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The EU Enlargement and Economic Growth In the CEE New Member Countries

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The EU Enlargement and Economic Growth In the CEE New Member Countries

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Abstract

In this paper, we aim to check whether the EU enlargement contributed to economic growth of ten new member countries from Central and Eastern Europe (CEE-10), including their real convergence towards the EU-15 development level. To this end, we econometrically test the relationships between selected macroeconomic variables linked to the EU enlargement and the rate of economic growth of the CEE-10 countries over the period 1996-2007. The variables comprise: (i) the progress of market or structural reforms, (ii) economic freedom, (iii) foreign aid, and (iv) the FDI inflow.

In the first part of the study, we test the convergence hypothesis (both beta and sigma) for the CEE-10 group towards the EU-15 countries. In the subsequent parts, we build an econometric model and carry out the correlation and regression analyses, with a view to find out the possible effect of the EU membership on economic growth of the CEE countries. The last part of the paper develops possible scenarios of the real convergence of the CEE countries towards the EU-15.

Our results indicate that the EU enlargement significantly contributed to economic growth of the CEE-10 countries and their catching up with the EU-15 development level. This conclusion has been supported by both the convergence analysis and the econometric test of economic growth determinants. According to our projections, the actual process of real convergence between individual CEE-10 economies and the EU-15 may take between 8 and 33 years.

Disclaimer: The views and opinions expressed here are the authors' only and should not be attributed to the European Commission.

The EU Enlargement and Economic Growth In the CEE New Member Countries

1. Introduction

While the traditional trade theory (Viner, 1950) implied that economic integration would lead to a real convergence in development levels between countries involved, some more recent theories (Krugman, 1991) recognized that integration might also result in rising development asymmetries. A similar conclusion can be derived from new models of economic growth (Romer, 1986, 1990; Lucas, 1988), which do not confirm the convergence hypothesis. Recent empirical studies suggest that the trend towards income-level convergence tends to occur within homogeneous groups of countries, whereas heterogeneous groups are more likely to experience real divergence tendencies.

Thus, the debate on economic convergence and the effects of integration is in no way closed. This leaves much room for discussion about the factors conducive to economic convergence or divergence, and calls for empirical research covering different groups of countries.

In this paper, we aim to check whether the EU enlargement contributed to economic growth of ten new member countries from Central and Eastern European (CEE-10), including its effect on their real convergence towards the EU-15 development level. To this end, we test the relationships between selected macroeconomic variables linked to the EU enlargement and the rate of economic growth of the CEE countries over the period 1996-2007.

Our exercise is anchored in both neoclassical and endogenous economic growth models. The former imply that development asymmetries between countries tend to decrease over time. However, they do not satisfactorily explain the long-run determinants of economic growth. Hence, our analysis also draws from endogenous growth models that provide a better explanation of growth drivers.

The layout of the paper is as follows. In Section 2 below, we test the convergence hypothesis (both β and σ) for the CEE-10 group towards the EU-15 countries. In Section 3 we carry out the correlation and regression analyses, based on cross-section data, aimed to econometrically test the possible effect of the EU membership on economic growth of the CEE countries. Section 4 in turn develops tentative projections of real convergence of the CEE countries towards the EU-15. Section 5 concludes.

2. Income-level convergence between the CEE-10 and the EU-15 countries

2.1. Methodology

For the purpose of the present study, we will interpret the notion of real economic convergence as a trend towards the equalisation of income or development levels between countries; further on it is referred to as income-level or growth convergence.

In this section, we conduct an empirical test of income-level convergence between ten CEE new EU member countries (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia) and the EU ‘core’ (EU-15).¹

Our approach is based on neoclassical growth models (Solow, 1956; Mankiw *et al.*, 1992), which assume the feasibility of income-level convergence (or more precisely, conditional β -convergence). This implies that a less developed economy tends to grow faster than a more developed one. The convergence is conditional since it occurs when both economies move to the same steady-state. If a less developed economy always grew faster, we would deal with the absolute convergence.

Since the CEE-10 countries are quite homogenous and follow similar paths of economic and social policies, they probably tend to the same steady-state. Thus, they should exhibit convergence tendencies as indicated by neoclassical models of economic growth.

Another possible gauge of catching up is σ -convergence. It takes place if income differences between the economies concerned decrease over time. Income differentiation can be measured by the variance or standard deviation of GDP per capita. β -convergence is a necessary but not sufficient condition for the σ -convergence.

In order to test the β -convergence hypothesis, we estimate the following regression equation:

$$\frac{1}{T} \ln \frac{y_T}{y_0} = \alpha_0 + \alpha_1 \ln y_0. \quad (1)$$

The explained variable is the average annual growth rate of GDP per capita between period T and 0 while the explanatory variable is GDP per capita level in period 0. If α_1 is negative, this proves the β -convergence. In such a case, we can calculate the value of β coefficient that measures the speed of convergence:

$$\beta = -\frac{1}{T} \ln(1 + \alpha_1 T). \quad (2)$$

¹ This part of the exercise, based on IMF data (IMF, 2008), is a follow-up of our earlier research on the subject (e.g. Matkowski, Próchniak, 2007abc; Próchniak, 2008ab; Rapacki, Próchniak, 2007; Rapacki, 2008 and 2009).

With a view to test the σ -convergence, we estimate the trend line of dispersion in income levels between countries:

$$sd(\ln y_t) = \alpha_0 + \alpha_1 t. \quad (3)$$

The explained variable is the standard deviation of log GDP per capita levels between the economies while the explanatory variable is the time ($t = 1, \dots, 12$ for the period 1996-2007). The σ -convergence is corroborated if α_1 is negative.

2.2. Convergence towards the EU-15

In this part we embark on the empirical test of β and σ -convergence between the CEE-10 countries and the EU-15.

Beta convergence

Our analysis corroborates the β -convergence of the CEE-10 countries towards the EU-15 - it has been found both at individual country and at regional levels (the average for fifteen old EU members and the average for ten EU entrants). The results of our calculations are shown in Table 1 and Figure 1.

Table 1
Regression results for β -convergence (CEE-10 & EU-15)

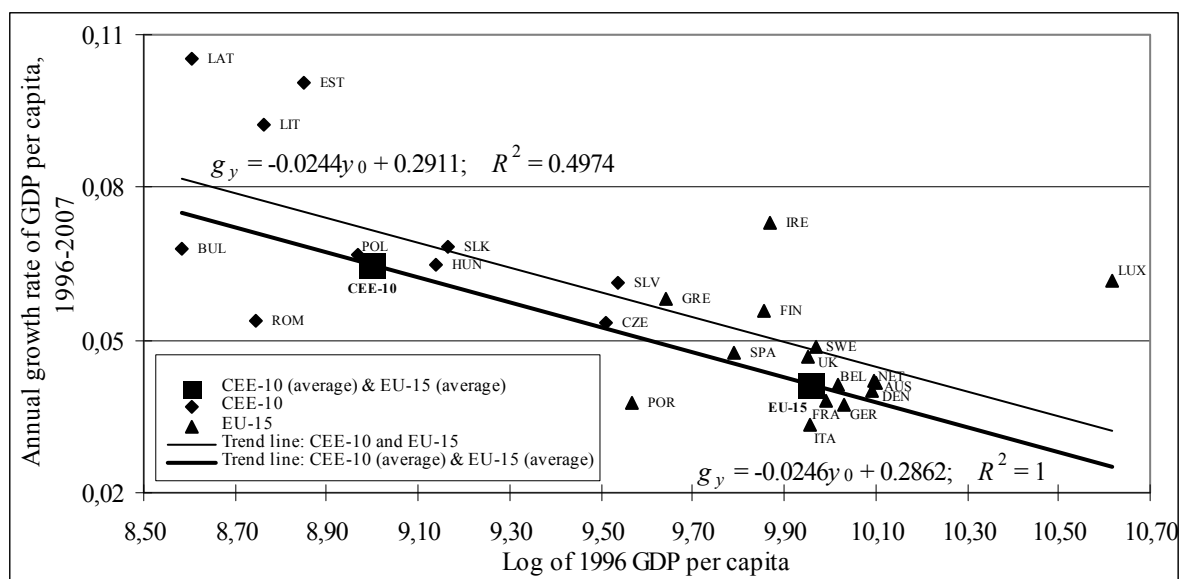
Period	α_0	α_1	<i>t</i> -stat. (α_0)	<i>t</i> -stat. (α_1)	<i>p</i> -value (α_0)	<i>p</i> -value (α_1)	R^2	β - convergence	β
<i>25 countries of the enlarged EU</i>									
1996-2007	0.2911	-0.0244	5.94	-4.77	0.000	0.000	0.4974	yes	0.0284
1996-2001	0.1262	-0.0077	1.93	-1.12	0.067	0.273	0.0521	yes	0.0078
2001-2007	0.4228	-0.0367	7.00	-5.99	0.000	0.000	0.6091	yes	0.0415
<i>2 regions (CEE-10 and EU-15)</i>									
1996-2007	0.2862	-0.0246	.	.	.	.	1.0000	yes	0.0287
1996-2001	0.1132	-0.0071	.	.	.	.	1.0000	yes	0.0072
2001-2007	0.4534	-0.0406	.	.	.	.	1.0000	yes	0.0466

Source: Own calculations.

As can be seen in Table 1, less-developed member countries of the enlarged EU (excluding Malta and Cyprus) recorded faster economic growth than those more developed.² Similarly, Figure 1 demonstrates that the average annual growth rate of the 25 present EU members during 1996-2007 was inversely related to their initial GDP per capita level. The estimated trend line for the 25 countries has a slope -0.0244 , which implies that β coefficient totals 2.84%. The value of R^2 has been depressed mainly due to the behaviour of Ireland, Luxembourg, Romania, and the Baltic states that markedly diverge from the trend line.

² The only deviations from this general pattern are Ireland and Luxembourg, which exhibited remarkably fast growth (7.3% and 6.2% respectively) as for their initial income levels.

Figure 1
GDP per capita growth rate over the period 1996-2007
and the initial GDP per capita level (CEE-10 & EU-15)



Source: Own calculations.

The convergence trend can be also traced at a more aggregate or regional level. Data in both Table 1 and Figure 1 unequivocally show that the average growth rate in the CEE-10 was much higher than in the EU-15 while the initial GDP per capita was lower. The slope of the trend line for these two regions is -0.0246 with the β coefficient equal to 2.87%.

As a consequence, while in 1996 the average GDP per capita in the CEE-10 (\$ 8,097) represented slightly more than one-third of the EU-15 average (\$ 21,119) by 2007 the relative development level of the former group increased to nearly 50% of the latter (\$ 16,516 and \$ 33,234, respectively).

The catching-up process accelerated in the second part of the period as the EU enlargement approached. Between 1996-2001 and 2001-2007, the β coefficient rose from 0.78% to 4.15% for 25 countries whereas for the two regions involved it went up from 0.72% to 4.66%.

It should be stressed however that our findings imply a relatively slow income-level convergence between the recent EU entrants and the old EU members. The β coefficient of 2.84-2.87% suggests that, if the average economic growth patterns prevailing in 1996-2007 continue, the EU-25 countries would need about 25 years to decrease by half the distance to their common hypothetical steady state. The same holds in particular true for CEE-10 economies and the pace of their catching up vis-à-vis the EU-15 group.

Sigma convergence

The major finding of our empirical test under this heading is that the CEE-10 countries reveal a σ -convergence towards the EU-15, both in the country-by-country and sub-group examination. The results are reported in Table 2 and Figure 2.

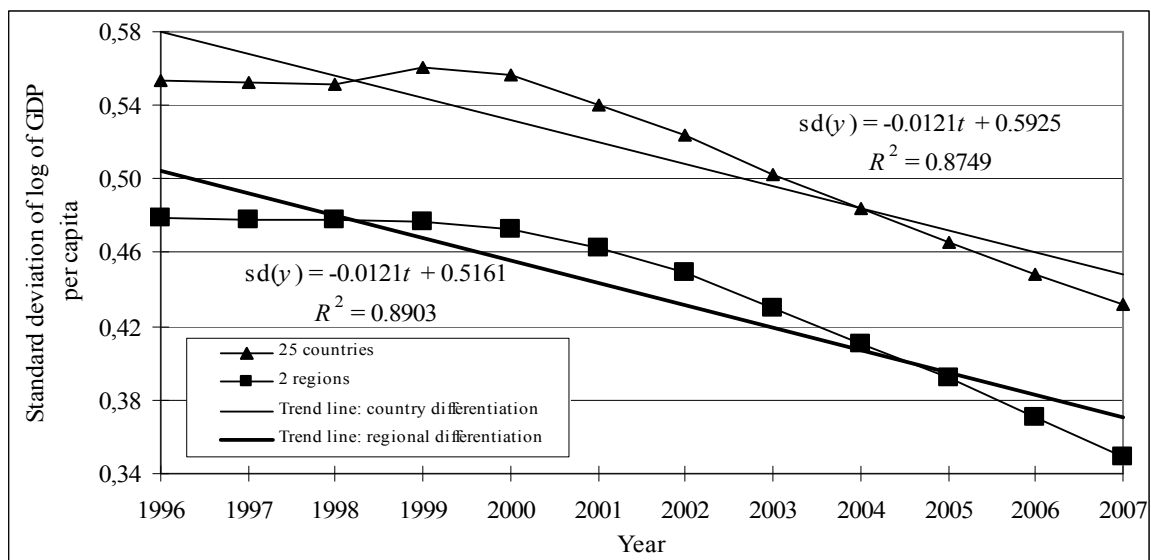
Table 2
Regression results for σ -convergence (CEE-10 & EU-15)

Period	α_0	α_1	<i>t</i> -stat. (α_0)	<i>t</i> -stat. (α_1)	<i>p</i> -value (α_0)	<i>p</i> -value (α_1)	R^2	σ - convergence
<i>25 countries of the enlarged EU</i>								
1996-2007	0.5925	-0.0121	55.85	-8.36	0.000	0.000	0.8749	yes
1996-2001	0.5571	-0.0013	81.76	-0.76	0.000	0.491	0.1253	yes
2001-2007	0.5581	-0.0183	495.26	-72.57	0.000	0.000	0.9991	yes
<i>2 regions (CEE-10 and EU-15)</i>								
1996-2007	0.5161	-0.0121	52.09	-9.01	0.000	0.000	0.8903	yes
1996-2001	0.4845	-0.0029	142.06	-3.30	0.000	0.030	0.7320	yes
2001-2007	0.4853	-0.0191	231.60	-40.68	0.000	0.000	0.9970	yes

Source: Own calculations.

Table 2 shows that GDP differentials tended to diminish among the EU-25 members and between the CEE-10 region and the EU-15 area in the whole period 1996-2007 and in both sub-periods. For the whole period, the slope of estimated regression equations has been negative (-0.0121 for both the 25 countries and the two regions).

Figure 2
Standard deviation of GDP per capita, 1996-2007 (CEE-10 & EU-15)



Source: Own calculations.

Figure 2 illustrates the behaviour of the standard deviation of log GDP per capita levels. It decreased from 0.55 in 1996 to 0.43 by 2007 among the 25 countries and from 0.48 to 0.35 between CEE-10 and EU-15, which is equivalent to claim that income differences between

the CEE-10 countries and the EU-15 followed a downward trend. The most pronounced fall in income differentiation took place after 2000.

Wrapping up, our analysis confirmed that the CEE-10 countries exhibited a strong economic convergence towards the EU-15 development levels. Moreover, the catching up process accelerated in the second half of the period as the EU enlargement approached.

3. Economic growth determinants in the CEE-10

3.1. Methodology

In the preceding section, we showed that during 1996-2007 the CEE economies displayed on average a faster economic growth compared to EU-15 countries. Hence, we can raise the following question: was this fast economic growth caused only by the convergence mechanism (resulting from the differences in the marginal product of capital) or was it also driven by other factors? One of such potential factors was the accession of the CEE countries to the European Union. The effect of EU enlargement on economic growth could take place via two channels. The first channel entails the EU actions aimed at speeding up the progress of structural reforms in the CEE countries, changing their institutional environment, and facilitating the flows of goods, services, capital, and labour. The second channel involves the EU policies aimed at direct reduction of income differences between countries and regions.

In this part of the study, we test empirically the hypothesis that the EU enlargement significantly contributed to economic growth of the CEE countries. To this end, we embark on correlation and regression analyses. To start with, we build an empirical model of economic growth (the multiple regression equation) that relates the GDP growth rate to its main determinants. The selection of explanatory variables is based on the correlation analysis. Once the model is built, it will be extended to include variables that measure the EU enlargement directly. If these variables are significant, we may assume that EU enlargement contributed to economic growth of the CEE countries. We will test many variants of the model to make our results more credible.

The explained variable is the total real GDP growth rate. The explanatory variables were divided into two groups.

The first group comprises those economic growth determinants that will serve as control variables in our regression equations. We test 21 variables grouped into 8 categories (see Table 3): (a) investments (in physical capital), (b) human capital, (c) consumption, (d) international trade, (e) government, (f) structure of the economy, (g) financial sector, (h)

prices. The choice of control variables was based on our earlier review of empirical studies on economic growth determinants (Próchniak, 2006).

Table 3
Correlation of control variables with the GDP growth rate
(EU-10 countries, 1996-2007)

Variable		Correlation		
Name	Description	<i>n</i>	<i>r</i>	<i>p</i>
<i>Investments (in physical capital)</i>				
gcf	Gross capital formation (% of GDP)	40	0.54	0.000
gfcf	Gross fixed capital formation (% of GDP)	40	0.46	0.003
<i>Human capital</i>				
life	Life expectancy at birth, total (years)	40	-0.05	0.740
mort	Mortality rate, infant (per 1,000 live births)	40	-0.30	0.063
lfpri	Labour force with primary education (% of total)	40	-0.46	0.003
lfsec	Labour force with secondary education (% of total)	40	-0.04	0.804
lfter	Labour force with tertiary education (% of total)	40	0.36	0.022
<i>Consumption</i>				
con	Final consumption expenditure (% of GDP)	40	-0.06	0.723
houcon	Household final consumption expenditure (% of GDP)	40	-0.20	0.212
govcon	General government final consumption expenditure (% of GDP)	40	0.27	0.093
<i>International trade</i>				
exp	Exports of goods and services (% of GDP)	40	0.24	0.135
imp	Imports of goods and services (% of GDP)	40	0.40	0.011
expimp	Exports plus imports of goods and services (% of GDP)	40	0.32	0.043
netexp	External balance on goods and services (% of GDP)	40	-0.50	0.001
cab	Current account balance (% of GDP)	40	-0.60	0.000
<i>Government</i>				
gov	General government balance (% of GDP)	39	0.53	0.000
<i>Structure of the economy</i>				
agr	Agriculture, value added (% of GDP)	40	-0.47	0.002
ind	Industry, value added (% of GDP)	40	-0.49	0.001
ser	Services, value added (% of GDP)	40	0.64	0.000
<i>Financial sector</i>				
cred	Domestic credit to private sector (% of GDP)	40	0.23	0.150
<i>Prices</i>				
inf	Inflation (%)	40	-0.56	0.000

n – number of observations, *r* – correlation coefficient, *p* – *p*-value.

Significant correlations (*p*-value not greater than 0.1) with corrected (expected) sign are dark-shadowed.

Not significant correlations with corrected (expected) sign are light-shadowed.

All the data are 3-year averages.

Source: Own calculations.

The second group of explanatory variables encompasses those that measure the impact of EU enlargement on economic growth. We test 24 variables grouped into 4 categories (see Table 4): (a) foreign direct investments (FDI), (b) economic freedom, (c) progress in transition (or structural reforms), (d) aid. FDI, economic freedom, and the progress in systemic transformation represent the first transmission channel of the effects of EU enlargement on CEE countries. Aid, on the other hand, reflects the second transmission channel, related to EU funds transferred to less developed CEE countries and regions with a view to eliminate development asymmetries.

Obviously, our set of variables that measure the influence of EU enlargement is far from perfect. We do not know exactly, to what extent FDI, economic freedom, and the progress in systemic transformation are the effect of the “EU factor”, and to what extent they result from broader economic changes in the world economy. In our view, however, the ‘external anchor’ due to (the prospects of) EU membership was an important driver of FDI inflow, increased economic freedom, and accelerated structural reforms in the CEE countries. This view has recently gained increased support among economists.³

Given the limited availability of data on EU structural and aid funds transferred to the CEE countries we decided to use a more comprehensive variable: aid as a proxy for the inflow of EU funds.⁴

The study covers 10 CEE countries (CEE-10 or EU-10) and the period 1996-2007. All calculations have been run for four 3-year averages: 1996-1998, 1999-2001, 2002-2004, and 2005-2007 (however, for many variables the data for 2007 was not available and the average entails shorter period). Thus, we have 4 observations for each country and the maximum number of observations is 40 (10 countries × 4 observations). Since we analyse 3-year averages, we eliminate the influence of business cycles as well as supply- and demand-side shocks, both internal and external, on the rate of economic growth.

The data used in the analysis come from the following sources: EBRD (2008), Eurostat (2008), Heritage Foundation (2008), IMF (2008), and World Bank (2008).

3.2. Correlation

The correlation analysis involved 21 control variables and 24 variables that measure the growth effects of EU enlargement. The results of the former are shown in Table 3 in the Appendix. Dark-shadowed cells in the table indicate the correlations that have correct (expected) sign and are statistically significant (with p -value below 0.1), whereas the light-shadowed cells show the correlations that have expected sign, but are insignificant.

Both variables representing investments: gross capital formation (gcf) and gross fixed capital formation (gfcf) reveal positive and significant correlations with the GDP growth rate. The values of correlation coefficients for gcf and gfcf are similar since both variables have almost the same coverage (the only difference being changes in stocks included in gcf).

As regards human capital, the closest correlation with economic growth exhibit two categories of labour force: with tertiary education and with primary education (for the former the correlation coefficient is positive at the level of 0.36 whereas for the latter it is negative

³ See e.g. IMF, *World Economic Outlook 2002*, Washington D.C. 2002, p. 102.

⁴ Aid includes both official development assistance (ODA) and official aid.

and amounts to -0.46). Life expectancy and labour force with secondary education turned out to be uncorrelated with the GDP growth rate (correlation coefficients close to zero). In turn, mortality rate displayed an expected negative relationship with economic growth. Hence, we can claim that education was a crucial factor of economic growth in the CEE-10 countries.

In contrast, consumption (% of GDP) was uncorrelated with economic growth. This was not the case of international trade, which proved to be an important growth driver. Both exports and imports rates featured positive and significant correlations with the GDP growth rate. However, the external balance on goods and services and current account balance were not positively correlated with economic growth. This means that high volume of international trade is a much more crucial economic growth determinant than good external balance.

Similarly, sound fiscal policy aimed at reducing budget deficit was an important economic growth determinant. General government balance exhibits a significantly positive correlation with the GDP growth rate in the CEE-10 economies.

Our results point also to a clear-cut relationship between the sectoral structure of the economy and economic growth. Higher GDP growth rates in the CEE-10 countries were associated with lower shares of agriculture and industry in their GDP, and with correspondingly higher share of the service sector.

Our analysis also shows that a variable describing the financial sector, i.e. domestic credit to private sector displayed – as expected – a moderate positive correlation with economic growth in those countries.

On the other hand, inflation rate was significantly and negatively correlated with the GDP growth rate (the correlation coefficient -0.56 is highly significant with p -value of 0.000).

To wrap up, our findings point to a pretty good correlation between the GDP growth rate and the explanatory variables. Hence, our empirical models of economic growth appear to be credible and should have good statistical properties.

Before selecting the control variables for the econometric model, we will first present the results of the correlation analysis for the second group of variables that measure the effect of EU enlargement. This is shown in Table 4.

The data in Table 4 indicate that almost all the variables display an expected and – in most cases – significant correlation with economic growth.

Table 4
Correlation of EU-enlargement-related variables with the GDP growth rate
(EU-10 countries, 1996-2007)

Variable		Correlation		
Name	Description	<i>n</i>	<i>r</i>	<i>p</i>
<i>Foreign direct investments</i>				
fdi	Foreign direct investment, net inflows (% of GDP)	40	0.30	0.060
fdi_pc	Foreign direct investment per capita, net inflows (\$)	40	0.41	0.008
<i>Economic freedom</i>				
ief	Index of economic freedom	40	0.56	0.000
ief_bus	Index of economic freedom: business freedom	40	0.26	0.103
ief_tra	Index of economic freedom: trade freedom	40	0.42	0.007
ief_fis	Index of economic freedom: fiscal freedom	40	0.80	0.000
ief_gov	Index of economic freedom: government size	40	0.28	0.075
ief_mon	Index of economic freedom: monetary freedom	40	0.44	0.004
ief_inv	Index of economic freedom: investment freedom	40	0.26	0.099
ief_fin	Index of economic freedom: financial freedom	40	0.32	0.041
ief_pro	Index of economic freedom: property rights	40	0.07	0.657
ief_cor	Index of economic freedom: freedom from corruption	40	0.17	0.293
<i>Progress in transition (progress of structural reforms)</i>				
ti_all	Transition indicator	40	0.48	0.002
ti_privl	Transition indicator: large scale privatisation	40	0.37	0.020
ti_privs	Transition indicator: small scale privatisation	40	0.48	0.002
ti_ent	Transition indicator: enterprise restructuring	40	0.37	0.018
ti_price	Transition indicator: price liberalisation	40	0.50	0.001
ti_trade	Transition indicator: trade & forex system	40	0.37	0.019
ti_comp	Transition indicator: competition policy	40	0.37	0.019
ti_bank	Transition indicator: banking reform & interest rate liberalisation	40	0.50	0.001
ti_sec	Transition indicator: securities markets & non-bank financial institut.	40	0.28	0.079
ti_infr	Transition indicator: infrastructure reform	40	0.38	0.017
<i>Aid</i>				
aid	Aid (% of GNI)	30	0.07	0.723
aid_pc	Aid per capita (\$)	30	0.63	0.000

n – number of observations, *r* – correlation coefficient, *p* – *p*-value.

Significant correlations (*p*-value not greater than 0.1) with corrected (expected) sign are dark-shadowed.

Not significant correlations with corrected (expected) sign are light-shadowed.

All the data are 3-year averages.

Source: Own calculations.

FDI inflow was an important economic growth determinant for the CEE countries. FDI/GDP ratio and FDI per capita exhibit positive and significant correlations with the economic growth rate. Correlation coefficients equal 0.30 and 0.41 respectively.

Similarly, economic freedom turned out an important growth driver. Index of economic freedom displays a significantly positive correlation with the GDP growth rate (correlation coefficient of 0.56 with *p*-value 0.000). The positive correlation with the GDP growth rate has been also confirmed by all the component variables. However, for both property rights and freedom from corruption the correlation is insignificant.

Structural reforms much contributed to economic growth of the CEE countries. The transition indicator and its component variables all show positive and significant correlations with the GDP growth rate.

Aid (% of GNI) does not reveal any correlation with the economic growth (correlation coefficient equals 0.07 with p -value of 0.723). On the other hand, aid per capita shows a strong positive relationship with the GDP growth rate (correlation coefficient = 0.63 with p -value of 0.000).

Summing up, our findings indicate that the EU enlargement and the resulting higher FDI inflow, faster structural reforms, greater economic freedom, and increased transfer of EU funds can be deemed important determinants of economic growth of the CEE countries.

With a view to enhance the credibility of our findings, we additionally performed the regression analysis. The selection of control variables for the econometric model was based on the results of correlation analysis discussed above. We chose one variable from each category except consumption. Thus, we used 7 control variables: (a) gross fixed capital formation (% of GDP), (b) labour force with tertiary education (% of total), (c) exports of goods and services (% of GDP), (d) general government balance (% of GDP), (e) services, value added (% of GDP), (f) domestic credit to private sector (% of GDP), and (g) inflation (%).

The second group of variables in our model includes those that measure the impact of the EU enlargement on the CEE countries. Based on Table 4, we selected 6 variables: (a) FDI, net inflow (% of GDP), (b) FDI per capita, net inflow (\$), (c) index of economic freedom, (d) transition indicator, (e) aid (% of GNI), (f) aid per capita (\$). To avoid doubling of data we excluded only the components of the index of economic freedom and the transition indicator.

Prior to estimating various variants of the model, we conducted a multi-co-linearity test. About half of the correlations among our explanatory variables turned out statistically significant, indicating a possible multi-co-linearity. In such a case, the signs of the coefficients in the econometric model may be reversed. Nonetheless, seen from the economic angle, the multi-co-linearity does not violate the logical structure of the model because the explanatory variables represent different economic categories.

3.3. Regression

We estimated six empirical models of economic growth. Each model was tested in 7 variants. The basic variant comprises only control variables. Extended versions encompass both control variables and one variable measuring the effect of EU enlargement.

Table 5
Regression models for the GDP growth rate (EU-10 countries, 1996-2007)

	Model 1: basic (EU-10)	Model 1: with fdi (EU-10)	Model 1: with fdi_pc (EU-10)	Model 1: with ief (EU-10)	Model 1: with ti_all (EU-10)	Model 1: with aid (EU-10)	Model 1: with aid_pc (EU-10)	Model 2: basic (EU-10)	Model 2: with fdi (EU-10)	Model 2: with fdi_pc (EU-10)	Model 2: with ief (EU-10)	Model 2: with ti_all (EU-10)	Model 2: with aid (EU-10)	Model 2: with aid_pc (EU-10)
Constant	-3.8641 -0.96 0.346	-3.9126 -0.95 0.351	-3.6215 -0.91 0.369	-3.4095 -0.77 0.445	-9.1225 -1.67 0.104	-2.5683 -0.58 0.566	-2.8123 -0.64 0.528	-12.2512 -3.78 0.001	-12.2760 -3.82 0.001	-10.9698 -3.33 0.002	-13.1372 -3.81 0.001	-14.5212 -3.68 0.001	-13.5917 -3.36 0.002	-10.0633 -3.11 0.005
gfcf	0.1505 1.40 0.171	0.1502 1.37 0.180	0.1510 1.43 0.162	0.1603 1.40 0.172	0.1791 1.66 0.107	0.2306 1.77 0.093	0.2455 2.12 0.047	0.1240 1.41 0.167	0.0989 1.11 0.274	0.0683 0.73 0.472	0.0849 0.84 0.407	0.1052 1.17 0.249	0.0807 0.71 0.482	0.0468 0.54 0.595
lfter	0.0244 0.70 0.489	0.0249 0.70 0.491	0.0322 0.93 0.360	0.0251 0.71 0.485	0.0378 1.06 0.297	0.0085 0.22 0.831	-0.0103 -0.29 0.775	0.0496 1.28 0.210	0.0464 1.20 0.237	0.0531 1.39 0.174	0.0438 1.10 0.279	0.0606 1.50 0.142	0.0336 0.73 0.469	0.0218 0.56 0.583
exp	-0.0146 -0.67 0.508	-0.0157 -0.65 0.522	-0.0311 -1.29 0.207	-0.0128 -0.55 0.585	-0.0288 -1.21 0.234	-0.0158 -0.65 0.524	-0.0218 -0.95 0.354							
gov	0.3947 3.81 0.001	0.3888 3.28 0.003	0.3378 3.11 0.004	0.4040 3.66 0.001	0.4197 4.05 0.000	0.1734 1.20 0.243	0.0001 0.00 1.000							
ser	0.1289 2.03 0.051	0.1293 2.00 0.055	0.1298 2.08 0.046	0.1345 1.99 0.055	0.0993 1.51 0.143	0.1021 1.51 0.146	0.0673 1.04 0.312	0.2140 3.51 0.001	0.2124 3.52 0.001	0.2031 3.37 0.002	0.1898 2.77 0.009	0.1723 2.34 0.025	0.2374 3.81 0.001	0.1703 2.65 0.014
cred	-0.0219 -0.86 0.397	-0.0219 -0.84 0.405	-0.0336 -1.28 0.210	-0.0220 -0.85 0.403	-0.0311 -2.43 0.241	-0.0914 -2.43 0.025	-0.1015 -2.86 0.010							
inf	-0.0496 -1.82 0.078	-0.0496 -1.79 0.083	-0.0509 -1.90 0.067	-0.0505 -1.90 0.080	-0.0398 -1.81 0.162	-0.0728 -2.50 0.021	-0.0690 -2.54 0.020							
fdi		0.0118 0.11 0.913							0.1413 1.33 0.194					
fdi_pc			0.0019 1.49 0.146							0.0019 1.51 0.139				
ief				-0.0179 -0.28 0.780							0.0556 0.79 0.433			
ti_all					2.0729 1.41 0.168							1.4688 1.01 0.318		
aid						0.2378 0.29 0.775							0.8256 0.92 0.365	
aid_pc							0.0596 1.77 0.092							0.0673 2.19 0.038
<i>F</i> statistics	7.27	6.16	6.89	6.18	6.81	5.63	6.86	10.66	8.60	8.85	8.07	8.26	6.71	8.68
<i>p</i> -value for <i>F</i>	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
<i>R</i> ²	0.6213	0.6215	0.6475	0.6223	0.6450	0.6924	0.7330	0.4704	0.4958	0.5030	0.4798	0.4855	0.5178	0.5814
<i>R</i> ² adj.	0.5358	0.5205	0.5535	0.5216	0.5503	0.5693	0.6261	0.4263	0.4381	0.4462	0.4203	0.4267	0.4407	0.5144
No. of obs.	39	39	39	39	39	29	29	40	40	40	40	40	30	30

Table 5 (cont.)

	Model 3: basic (EU-10)	Model 3: with fdi (EU-10)	Model 3: with fdi_pc (EU-10)	Model 3: with ief (EU-10)	Model 3: with ti_all (EU-10)	Model 3: with aid (EU-10)	Model 3: with aid_pc (EU-10)	Model 4: basic (EU-10)	Model 4: with fdi (EU-10)	Model 4: with fdi_pc (EU-10)	Model 4: with ief (EU-10)	Model 4: with ti_all (EU-10)	Model 4: with aid (EU-10)	Model 4: with aid_pc (EU-10)
Constant	-7.0203 -2.03 0.049	-7.3887 -2.17 0.037	-6.2036 -1.85 0.073	-8.4335 -2.25 0.031	-8.5406 -1.90 0.066	-7.3695 -2.20 0.037	-4.5324 -1.43 0.164	-3.1200 -1.41 0.167	-3.2198 -1.46 0.152	-2.0863 -0.93 0.358	-8.0360 -2.53 0.016	-12.4119 -3.05 0.004	-2.6069 -0.75 0.462	-3.2917 -1.50 0.145
gfcf								0.2589 2.87 0.007	0.2314 2.50 0.017	0.1798 1.81 0.079	0.1197 1.10 0.280	0.1554 1.68 0.101	0.1959 1.46 0.157	0.1409 1.61 0.120
lfter	0.0598 1.64 0.110	0.0557 1.55 0.130	0.0620 1.76 0.087	0.0526 1.41 0.166	0.0648 1.71 0.097	0.0357 0.98 0.335	0.0311 0.94 0.358	0.0872 2.04 0.048	0.0835 1.96 0.057	0.0892 2.14 0.039	0.0613 1.43 0.160	0.0956 2.41 0.021	0.0835 1.54 0.135	0.0274 0.63 0.533
exp														
gov														
ser	0.1785 3.09 0.004	0.1725 3.02 0.005	0.1530 2.66 0.012	0.1472 2.22 0.033	0.1589 2.30 0.027	0.1679 3.02 0.006	0.1012 1.80 0.084							
cred														
inf	-0.0155 -2.73 0.010	-0.0147 -2.63 0.012	-0.0146 -2.66 0.012	-0.0144 -2.49 0.018	-0.0144 -2.40 0.022	-0.0173 -3.40 0.002	-0.0147 -3.20 0.004							
fdi		0.1440 1.48 0.147							0.1490 1.22 0.231					
fdi_pc			0.0021 1.90 0.066							0.0024 1.70 0.098				
ief				0.0562 0.97 0.340							0.1423 2.08 0.044			
ti_all					0.7568 0.54 0.595							3.3701 2.64 0.012		
aid						1.1107 1.74 0.094							0.5249 0.48 0.637	
aid_pc							0.0652 2.53 0.018							0.1032 3.37 0.002
<i>F</i> statistics	13.92	11.34	12.10	10.65	10.31	12.32	14.55	7.53	5.58	6.24	6.92	8.16	2.69	7.51
<i>p</i> -value for <i>F</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.002	0.001	0.000	0.067	0.001
<i>R</i> ²	0.5370	0.5644	0.5804	0.5491	0.5408	0.6635	0.6995	0.2893	0.3175	0.3421	0.3657	0.4049	0.2372	0.4642
<i>R</i> ² adj.	0.4985	0.5146	0.5324	0.4975	0.4883	0.6096	0.6515	0.2509	0.2606	0.2873	0.3129	0.3553	0.1491	0.4023
No. of obs.	40	40	40	40	40	30	30	40	40	40	40	40	30	30

Table 5 (cont.)

	Model 5: basic (EU-10)	Model 5: with fdi (EU-10)	Model 5: with fdi_pc (EU-10)	Model 5: with ief (EU-10)	Model 5: with ti_all (EU-10)	Model 5: with aid (EU-10)	Model 5: with aid_pc (EU-10)	Model 6: basic (EU-10)	Model 6: with fdi (EU-10)	Model 6: with fdi_pc (EU-10)	Model 6: with ief (EU-10)	Model 6: with ti_all (EU-10)	Model 6: with aid (EU-10)	Model 6: with aid_pc (EU-10)
Constant	3.3372 3.76 0.001	2.5172 2.46 0.019	2.4535 2.69 0.011	-3.5210 -1.11 0.276	-5.3953 -1.19 0.241	2.4740 2.83 0.009	0.9496 1.05 0.303	-7.6752 -2.19 0.035	-8.0248 -2.33 0.026	-6.9075 -2.01 0.052	-9.3988 -2.51 0.017	-8.0284 -1.74 0.090	-8.0057 -2.44 0.022	-4.5934 -1.46 0.157
gfcf														
lfter	0.0963 2.52 0.016	0.0902 2.39 0.022	0.0924 2.56 0.015	0.0675 1.75 0.088	0.0994 2.70 0.011	0.0726 1.86 0.075	0.0379 1.10 0.280							
exp														
gov														
ser								0.2094 3.74 0.001	0.2006 3.64 0.001	0.1857 3.32 0.002	0.1641 2.48 0.018	0.2055 3.16 0.003	0.1863 3.57 0.001	0.1072 1.93 0.065
cred														
inf	-0.0235 -4.23 0.000	-0.0224 -4.06 0.000	-0.0209 -3.90 0.000	-0.0182 -3.14 0.003	-0.0173 -2.77 0.009	-0.0240 -4.55 0.000	-0.0185 -4.37 0.000	-0.0147 -2.55 0.015	-0.0140 -2.46 0.019	-0.0138 -2.46 0.019	-0.0134 -2.31 0.027	-0.0145 -2.34 0.025	-0.0177 -3.48 0.002	-0.0144 -3.15 0.004
fdi		0.1649 1.54 0.133							0.1556 1.58 0.124					
fdi_pc			0.0027 2.40 0.022							0.0020 1.79 0.082				
ief				0.1192 2.23 0.032							0.0725 1.26 0.217			
ti_all					2.4849 1.96 0.057							0.1698 0.12 0.905		
aid						0.8481 1.17 0.253							1.3992 2.47 0.021	
aid_pc							0.0828 3.32 0.003							0.0749 3.17 0.004
<i>F</i> statistics	13.10	9.84	11.78	11.33	10.69	10.19	16.86	18.68	13.78	14.27	13.17	12.13	16.13	19.20
<i>p</i> -value for <i>F</i>	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
<i>R</i> ²	0.4146	0.4505	0.4954	0.4857	0.4712	0.5405	0.6605	0.5024	0.5345	0.5432	0.5233	0.5026	0.6505	0.6890
<i>R</i> ² adj.	0.3829	0.4048	0.4533	0.4429	0.4271	0.4874	0.6213	0.4755	0.4957	0.5051	0.4836	0.4612	0.6101	0.6531
No. of obs.	40	40	40	40	40	40	30	40	40	40	40	40	30	30

Regression coefficients, *t*-statistics, and *p*-values are given in the respective cells. Definitions of variables are given in Tables 5 and 6. All the data are 3-year averages.

Significant regression coefficients with the expected sign for the EU-enlargement-related variables are shadowed (light-shadowed cells correspond to a 20% significance level, dark-shadowed cells correspond to a 10% significance level).

Source: Own calculations.

Table 5 describes the estimated models. The explained variable is the growth rate of total real GDP. The explanatory variables are shown on the left-hand side of the table.

Model 1 incorporates all seven explanatory variables. However, due to its unsatisfactory economic and statistical properties, it fails to explain the impact of EU enlargement on economic growth of the CEE countries. Nevertheless, its extended versions are included in Table 5 to ensure the coherence of its logical structure.

The remaining models shown in Table 5 (models 2-6) explain correctly the economic growth determinants of the CEE countries. The explanatory variables have expected signs (as in the correlation analysis) and are – as a rule - significant. Models 2-6 were carefully chosen after a detailed screening of many other potential empirical growth models. The ones selected include 2 or 3 explanatory variables. The best properties feature the models with a relatively small number of variables due to two reasons. First, it is the outcome of multi-co-linearity of explanatory variables as indicated in Table 5. Second, the regression analysis based on a small number of observations (maximum 40) cannot accommodate too many explanatory variables; otherwise it would artificially overvalue the *R*-square coefficient.

Models 2-6 explain very well the impact of the EU enlargement on economic growth of the CEE-10 countries. We do not discuss particular models in detail; instead, we highlight only the results that are most relevant to the effects of the EU enlargement. The latter include in particular the following findings.

First, foreign investments (measured both as % of GDP or per capita) significantly contributed to economic growth of the CEE countries. This is confirmed by positive and highly significant regression coefficients (*p*-value for FDI/GDP ratio between 0.124 and 0.231, depending on the model, and for FDI per capita - between 0.022 and 0.139). Based on the regression equation, we may quantify the impact of FDI on economic growth. Given the range of regression coefficients for FDI/GDP ratio (0.1413 to 0.1649), an increase of FDI/GDP ratio by 1 percentage point implies, *ceteris paribus*, higher economic growth rates by about 0.1-0.2 percentage points. In turn, regression coefficients for FDI per capita range from 0.0019 to 0.0027. This indicates that a rise in FDI per capita by \$100 accelerates the economic growth by about 0.2-0.3 percentage points.

Second, economic freedom turned out an important economic growth driver in the CEE countries, too. In models 2-6, regression coefficients of the index of economic freedom are positive and – except models 2 and 3 – statistically significant. Economic freedom has the highest significance in models 4 and 5 (*p*-values amount to 0.044 and 0.032 respectively, and

the corresponding regression coefficients are 0.1423 and 0.1192). This suggests that an improvement in the index of economic freedom by 1 percentage point increases the GDP growth rate by roughly 0.1 percentage point. However, we have to emphasize that the index in question is a qualitative variable. Hence, when interpreting its quantitative contribution to economic growth one has to bear in mind the methodology of its calculation and the values it can assume (the range from 1 to 100).

Third, the transition indicator assumes the expected positive regression coefficients in models 2-6. Still, this variable is significant only in models 4 and 5. The corresponding *p*-values amount to 0.012 and 0.057, and the regression coefficients equal 3.3701 and 2.4849 respectively. This implies that the increase in the transition indicator by 1 point brings about an acceleration of economic growth by 2-3 percentage points, which may suggest a very strong effect. Given however the scale of this indicator (from 1 to 4.3), its growth impact is much weaker and comparable to that of other variables.

Fourth, aid was also an important economic growth determinant in the CEE countries, in particular in per capita terms. In models 2-6, this variable displays positive and highly significant regression coefficients (*p*-values from 0.002 to 0.038, and regression coefficients between 0.0652 and 0.1032), which suggests that a rise in the aid level by 10 \$ accelerates economic growth by ca. 1 percentage point. This effect seems very strong, which may be misleading, as the prevailing low levels of aid per capita in the CEE countries (\$ 12-73) might have overstated its differential growth impact. The second variable, aid/GNI ratio is significant only in models 3 and 6. The respective regression coefficients amount to 1.1107 and 1.3992. This implies that a rise of the aid/GNI ratio by 1 percentage point leads to a similar acceleration of the GDP growth rate. This relationship is very strong and probably true, the more so that the inflow of foreign funds directly increases aggregate demand, thus enhancing economic growth.

To conclude, our analysis has shown that the EU enlargement significantly contributed to economic growth of the CEE-10 countries. The major sources of this positive impact included: high FDI inflow, fast progress of structural reforms, economic freedom, and aid inflow. Good statistical properties of the regression equations confirm the robustness of our results.

4. Prospects of actual economic convergence between the CEE-10 and the EU-15

As a wrap of the foregoing discussion, below we embarked on a tentative projection of possible scenarios of a complete catching up between the CEE-10 and EU-15 countries.

Table 6. Possible scenarios of closing the development gap between the CEE-10 and the EU-15 countries (number of years)

Country	1996 development gap (GDP per capita in PPP, % of EU-15 average)	Average annual growth rate of real GDP per capita (1997-2008) ^a	2008 development gap (GDP per capita in PPP, % of EU-15 average)	Expected time to catch up by a CEE-10 country with the EU-15 average development level – base case	Revised average annual growth rate of real GDP per capita (1997-2008 and forecast for 2009-10)	Expected time to catch up by a CEE-10 country with the EU-15 average development level – revised scenario
Bulgaria	25	5.1	35.6	32.9	5.1	30.4
Czech Republic	65	3.1	73.9	23.4	3.2	18.8
Estonia	33	7.1	61.0	9.7	6.2	11.1
Hungary	44	4.0	56.4	26.5	3.6	28.1
Latvia	28	8.0	50.4	11.5	6.8	13.6
Lithuania	31	7.3	55.6	11.1	6.2	13.1
Poland	39	4.4	50.1	27.6	4.3	25.5
Romania	23 ¹	6.5 ²	38.5	20.2	6.2 ³	19.9
Slovak Republic	43	5.1	64.0	14.1	5.1	13.0
Slovenia	66	4.2	82.4	8.2	4.1	7.9
EU-15	100	1.8	100.0	x	1.6	x

a – data for 2008 are the most recent Eurostat forecasts (as of mid-December 2008).

1 – 1999, 2 – 2000-2008, 3 – 2000-2010.

Source: Eurostat database and authors' calculations.

Table 6 compiles the input data necessary for carrying out the pertinent projections. It also sheds some empirical light on the pace of actual convergence process to date. The projections (base case) were derived from a simple extrapolation of the economic growth paths (real GDP per capita) of individual CEE-10 countries between 1997 and 2008, assuming that the average growth trend over the same period in the EU-15 sub-group will continue. Under these assumptions, it may take between 8 and 33 years for individual CEE-10 economies - as data in the fifth column of Table 6 indicates - to close their 2008 development gaps towards the EU-15 average. The first transition economy that is likely to fully catch up is Slovenia (by 2016), followed by Estonia (2018), Lithuania (2019) and Latvia (2020). On the other end of the spectrum are Bulgaria, Poland and Hungary whose real convergence process may be completed between 2035 and 2041 respectively. According to this basic scenario, the remaining new EU members ought to close their income gaps between 2022 (Slovakia) and 2031 (Czech Republic).

Apart of the base case projection, in Table 6 we also developed a revised scenario that partly incorporates the possible effects of the current crisis in the world economy on future economic growth of both individual CEE-10 countries and the EU-15 (simple extrapolation combined with a growth forecast for 2009-10). According to this scenario, while some individual new EU member countries are likely to gain (in particular the Czech Republic, Bulgaria and Poland) and some may lose (especially the Baltic states) in terms of the length of catch up, the CEE-10 as a group would shorten the real convergence process.

Obviously, the scenarios outlined above are subject to many uncertainties and contingent upon a number of key factors that may hinder the real convergence process and make it much slower compared to our projections. Hence, they should be interpreted as a reference only and a starting point for more comprehensive exercises aimed at fine-tuning the forecasts of the future real convergence trajectories between the CEE-10 and the EU-15 countries to a turbulent economic reality.⁵

It is also worth stressing in this context that the EU membership does not offer a guarantee for the real income convergence of the CEE-10 countries towards the EU-15 level. As evidenced by the experience of Greece (until 1995) and Portugal (after 2000), regional integration may at times co-exist with real divergence trends (Rapacki, 2008). The challenge for the new CEE members therefore is to follow the patterns established by Ireland and Spain rather than those of Greece and Portugal.

⁵ One of the most interesting exercises of this kind can be found in a recent IMF study (Schadler et al., 2006).

5. Conclusions

The main findings of our study may be summarized in four points.

1. Our results indicate that the EU enlargement significantly contributed to economic growth of the CEE-10 countries. This claim is supported by both the convergence and economic growth determinants analyses.
2. There has been a clear-cut income-level convergence between the CEE-10 countries and the EU-15. The former grew on average faster than the latter during 1996-2007 while their initial income level was much lower. Moreover, the convergence process accelerated after 2000 as the EU enlargement approached.
3. The econometric test of economic growth determinants shows that four variables related to the EU enlargement: FDI inflow, economic freedom, progress of structural reforms, and aid inflow, are positively and significantly correlated with GDP growth rates in the CEE countries. The positive contribution of these factors to economic growth has been also corroborated by the regression equations. Good statistical properties of correlation coefficients and regression equations add to the robustness of our results.
4. According to our projections, the actual process of real convergence between individual CEE-10 economies and the EU-15 may take between 8 and 33 years.

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