# The convergence of the Central and Eastern European countries towards the European Union

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## Abstract

The Central and Eastern European countries had a long transition process that started in 1990. This paper investigates the speed of convergence of the Central and Easter European (CEE) countries towards the income level of the European Union after the fall of the communist regimes. A panel data is built using 4 non overlapping intervals applied on the European Union countries from 1996 to 2011. The unconditional convergence is around 1.8%, while adding fixed effects, the unconditional convergence is 8.4% per year. On an array of explanatory variables for economic growth, the speed of convergence jumps up to 17% per year. Considering potential biases from these approaches, the real convergence speed is expected to be around the mid-point of these outcomes. The most important drivers of economic growth and convergence are the ones related to macroeconomic, stability, development, external sector, competitiveness, and financial sector.



Key words: convergence, CEE, economic growth, post-communist countries

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## Introduction

After the fall of the Iron Curtain in 1989, the Central and Eastern European (CEE) countries (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia) embarked on a process of transition from planned economies to market economies and income convergence towards the income level of the European Union. The first 10 years were marked by painful reforms and crises. Price and trade liberalization were the first transformations to be done. Other changes as privatization and institutional reforms faced different levels of resistance from one country to another. These years were described by high inflation, output decline and general dissatisfaction. Everything seemed to pay off after 2000 when the economic growth in the region was not matched by many. With an average real growth of 4.8% per year, only India and China grew with higher annual rates (see Figure 1). But the achievement is even more important because the region has a 2 to 4 times higher GDP per capita[1] than these two large countries. In this period all the CEE countries, with the exception of Croatia, joined the European Union in 2004 or 2007 which encouraged the investments and consumption using foreign capital. To some extent, this caused the growth to be unsustainable over the long term and these economies to be much more vulnerable to any negative shocks.

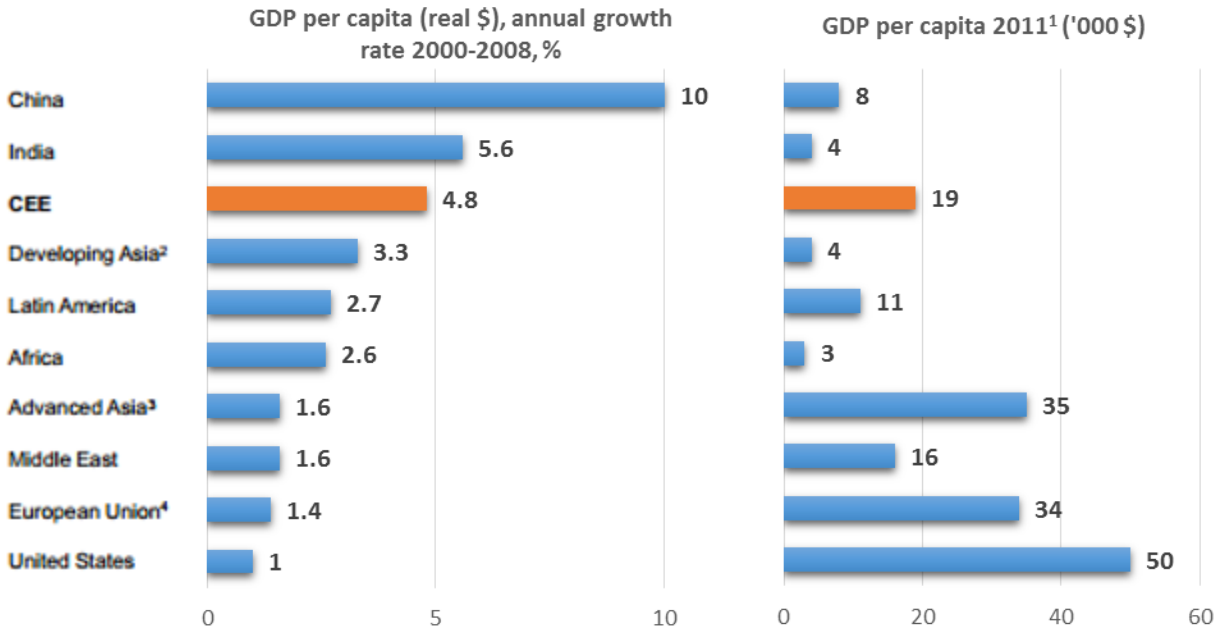
After the successful period of 2000 to 2008, with the exception of Poland, everyone suffered once the recent crisis started. The external shock that came from Western Europe and the United States engaged the previously created imbalances and in some cases the output losses were significant, while the recovery is either inexistent or very slow. Many reached agreements with the International Monetary Fund in order to reach fiscal sustainability.



[1] In PPP – Purchasing Power Parity

Restoring of competitiveness became an important topic for everyone, but the tools used are different from one country to another.

**Figure 1 Economic growth in the world (2000-2008)**




1. In purchasing power parity terms
2. Not including China and India
3. Japan, Hong Kong, South Korea, Singapore, and Taiwan
4. Not including CEE

Source: International Monetary Fund and McKinsey Global Institute analysis

In such a tough economic environment, the speed of convergence slowed down significantly, while the high expectations regarding the catch up with the Western European countries vanished. In this paper, this convergence process is analyzed. The aim of this research is to find the possible factors that increase convergence. The motivation resides in identifying areas where the policy makers have to focus in order to help the CEE economies to narrow the gap with the western economies. This study is significant for the literature related to the topic because it tests the influence of a wide number of variables over the speed of convergence. Data from 1996 to 2011 from the European Union countries is used by building a panel of the available data, using equal non overlapping intervals.

Results show that the most important drivers of economic growth that increases the convergence speed are the ones related to external sector, competitiveness, financial sector, macroeconomic, stability and development variables. These outcomes should be used with caution since the structure of the economy can change in the future, especially after a crisis, and, as a consequence, other factors can drive the economic growth.

# Chapter 1 Literature review

Barro and Sala-i-Martin (Barro and Sala-i-Martin 1992) define convergence as the situation when poorer countries tend to grow faster than rich ones - known as beta (β) convergence. Specifically, there is evidence of beta convergence in a cross-section sample of countries if a negative relation between annual economic growth per capita and initial GDP per capita is identified. They find evidence of convergence among the US states from 1840 to 1988 and for 98 countries from 1960 to 1985. For long term samples, there is evidence of convergence even without controlling for any other variables, called unconditional convergence (e.g. 2% for the US states for personal income per capita), while for short term samples, the evidence of convergence is shown only after controlling for school enrolment rate and government consumption to GDP, called conditional convergence because it is conditional on having equal rates of school enrolment, government consumption to GDP, etc.

This pioneer approach was revised and augmented by the former authors, as well as by a number of followers. Therefore, new econometric techniques focus on different groups of countries, or regions, allowed for a development of a relatively large range of literature on this topic.

Barro (Barro 2012) analyzes a large panel of 80 countries, it does not include any of the CEE countries, for the period between 1960 and 2009, divided in 5 years non overlapping intervals. Without country fixed effects, he finds a conditional convergence rate of 1.7% per year, the quality of institutions being an important explanatory variable. Using the same time interval and specification, but with country fixed effects, the convergence rate is 4.5% per year. He argues that this value might be overestimated because of the use of the country fixed effects in a relatively small time dimension of the panel. Using a panel of a limited number of countries starting from 1870 and using country fixed effects he finds an unconditional convergence rate of 2.4% per year.

Cuaresma, Ritzberger-Grünwald and Silgoner (Crespo-Cuaresma, Ritzberger-Grunwald and Maria Antoinette 2008) use a panel data from 1960 to 1998, divided in 8 years non overlapping sub-periods, to investigate the conditional β convergence in the EU-15 countries. Controlling for investment, education, inflation, government consumption, openness and number of years as a member of the European Union and using fixed effects they obtained an average 4% to 6% β convergence rate per year, depending on the model, towards the country specific steady state. They consider that investment, education and openness might be endogenous variables.

Rapacki and Mariusz (Rapacki and Mariusz 2008) examine a cross-sectional framework to study the unconditional β convergence of the CEE-10 towards the EU-15 using data from 1996 to 2007. For the period they obtained an average 2.8% β convergence rate per year towards the steady state.

De la Fuente (de la Fuente 2003) studies panel data of OECD countries to find the sources of β convergence between 1970 and 1995. He splits the data in sub periods of 5 years and finds that different factors lie behind each country growth rate, with technological diffusion being the main one. Labor market and investment rates played a negative role for convergence.

Morgese, Borys, Polgár and Zlate (Morgese Borys, Polgár and Zlate 2008) use OLS on panel data (1993-2005) with 4 years non overlapping sub-periods and 2SLS and GMM techniques on traditional panel data, for 15 Eastern European countries to study the factors that influence convergence. They find evidence of convergence after controlling for a number of variables. Institutions play an important, but indirect role – better institutions do not support growth, but increase the importance of traditional macroeconomic and financial variables. They also conclude that investment is possibly endogenous.

Recent authors (Hausmann, et al. 2014) concluded that convergence might be explained using other variables than the traditional ones. By developing an index of economic complexity using export data they analyzed how many products a country exports and how many countries export the same product. The more products a country exports and the less the number of countries exporting the same product, the higher the economic complexity index of that particular country. They find that this kind of specialization helps to better explain β convergence of 128 world economies and they confirm their findings using both cross-section and panel data regressions for different time periods.

Available literature confirms that in long-run economic convergence is predominately determined by the country's initial income, but institutional or other country specific factors significantly shape the final speed of convergence. Contrary to general expectations, a limited number of studies focus on the European Union countries and more specifically on new European Union member states, for whom the catching up process is assumed to be very relevant. This might be the result of poor data availability, given that for many former communist countries there is no data prior to 1990 and if there is, the quality of this data is questionable. An additional cause might lie in the potential econometric problems arising from working with small samples.

## Chapter 2 Methodology

The classic approach for testing β convergence is the cross section method (Barro and Sala-i-Martin 1992), which was widely used by other authors after they published their seminal paper. The folowing equation is used for estimation:

$$\frac{1}{T} * \log\left(\frac{y_{i,t_0+T}}{y_{i,t_0}}\right) = B - \left(\frac{1-e^{-\beta T}}{T}\right) * \log\left(y_{i,t_0}\right) + \left(u_{it_0,t_0+T}\right) \quad (1)$$

Where $t_0$ is the initial year of the database, $T$ is the number of years considered in the analysis, $y_i$ is the income per capita in country $i$, $B$ is the constant term, $u_{i,t_0,t_0+T}$ is the distributed lag of the error terms $u_{it}$ between $t_0$ and $t_0+T$ and $\beta$ is the average convergence rate.

This method needs a large number of countries to be included in the analysis in order to generate robust results. In the paper of Barro and Sala-i-Martin (Barro and Sala-i-Martin 1992) they analyze the convergence process using a sample of 98 countries from around the world and another one of 48 US states. The European Union has 28 members. Using a similar approach for these countries has the disadvantage of working with a small number of observations, at most 28 if data is available for all countries.

Given these limitations, the proposed model uses a panel that is built using equal non overlapping intervals, instead of a cross-section database (Barro 2012). This method increases the number of observations by n times, where n is the number of intervals that can be built using the existing database. The equation is the following:

$$\frac{y_{i,t+n}+y_{i,t+(n-1)}+\cdots+y_{i,t}}{n} = \alpha + \beta\, Log\left(y_{i,t-1}\right) + \frac{\lambda\left(Z_{i,t+n}+Z_{i,t+(n-1)}+\cdots+Z_{i,t}\right)}{n} + \eta_i + \mu_{i,t}\,^{2} \quad (2)$$

[2] Depending on the nature of the variable and how it can influence economic growth, in case of some control variables the equation is $\lambda\left(Z_{i,t}\right)$ instead of $\frac{\lambda\left(Z_{i,t+n}+Z_{i,t+(n-1)}+\cdots+Z_{i,t}\right)}{n}$. It takes into the account the value of the variable at the beginning of the period instead of considering the average value over the period.

Where $i$ – country, $t$ – time in years, $n$ – number of years in one non overlapping interval; $y$ - real GDP per capita, $Z$ - control variables, $\eta$ - dummy for each country, $\beta$ - the average annual speed of convergence, $\lambda$ – the coefficient for control variable, and $\mu$ - the error term.

In this form, the real average annual growth per capita over a period of $n$ years is regressed against the real GDP per capita in the last year before the interval starts and other control variables. If there is a negative correlation between the left hand side variable and real GDP per capita in the last year before the interval starts, there is evidence of β convergence. It means that countries that were having higher GDP per capita in the last year before the interval starts grew at a slower pace than the ones with smaller GDP per capita. Besides the advantage of increasing the number of observations, this method has also the advantage that the results are not influenced, or influence is smaller than in a panel sample, by "idiosyncratic economic dynamics at business cycle frequency" (Morgese Borys, Polgár and Zlate 2008). This influence is reduced by using the average value of variables, while preferably the length of a non-overlapping interval is equal with the average duration of the business cycle.

In an analysis without country fixed effects, the omitted variable is exactly the country fixed effect that is positively correlated with the dependent variable. The estimated effect of lagged GDP on current GDP tends to bias upward (Barro 2012), a result of the omitted variable bias. As a consequence, the estimated convergence rate might be downward biased. This effect is more important as the number of countries increases. In this case, where this number is small, the estimation produces nearly unbiased estimators.

Using country fixed effects has become very popular in studies about economic growth[3]. This is happening because of the ability to capture the effect of non-observable

[3] The first to use it was (Knight, Loayza and Villanueva 1993), while after that, it is widely use. See as example (Acemoglu, et al. 2005), (Morgese Borys, Polgár and Zlate 2008), (Crespo-Cuaresma, Ritzberger-Grunwald and Maria Antoinette 2008) and (Barro, Convergence and Modernization Revisited 2012)

variables that can influence the left hand side variable, the GDP per capita. One problem that can arise from using country fixed effects appears if the non-observable variables are not constant over time. If features like geography or preferences of the population do not change or can change only over a very long period of time, others like quality of institutions can change during the time span of the sample, increasing the errors. In this analysis I use a 16 years dataset. Given the relatively small length, the described problem is expected to be rather small because there is not enough time for the non-observable variables to change significantly.

Anther downward of using fixed effects is the Hurwicz – type bias on the coefficient of a lagged dependent variable (Hurwicz 1950). In the case of the lagged dependent variable, the fixed effect estimator is biased downward (Nerlove 2000). This bias becomes smaller when increasing the number of years of the sample but increasing the frequency of data does not help decreasing the bias (Barro 2012).

Considering the biases that can occur when using the model with or without fixed effects, the β convergence speed is underestimated in the models without country fixed effects and overestimated in the models with country fixed effects.

## Chapter 3 Data

Data from all members of the European Union countries are included, with the exception of Luxembourg that is an outlier regarding many variables and its economy is substantially different from the other countries in the European Union. Thus, a maximum of 27 countries are included in the regressions, depending on data availability.

Regarding the time span used, data starting with 1996 until 2011 is used. Year 1996 was chosen because for many countries, almost entirely CEE, data is not available before this year. Another reason is that during the first 5 years after the fall of communism, there were tremendous changes in the former planned economies, these years being for most of the countries the transition to market economies. Many structural changes took place and shocks hit the economy. Thus the economic growth data for these years is not relevant for the long term economic development. Moreover, including the period 2008-2011 the effect of the crisis will also be included.

Ideally the length of a non-overlapping period should be equal with the length of a business cycle in order to eliminate any variation that might be driven by the point of the business cycle a period captures. For example one period has only the downturn or the upturn part. Authors found that the median length of the downturn is 31 months, while downturn is only 15 months in the European Union and another few developed countries around the globe (Camacho, Perez-Quiros and Saiz 2005). Because of this, the 16 years of data are divided into 4 non-overlapping periods of 4 years each. In order to test if the choice of interval duration influences the results, I use the same models with 3 and 5 years intervals for robustness checks.

The variables used are divided into four categories. *Macro economy, stability and development* category includes Real GDP per capita which is used to calculate the average growth for left hand side variable but as a right hand side variable too by using the initial level

at the beginning of the first period. Investment rate is calculated as total investments, public and private, as percent of GDP. A higher investment rate generates a higher growth. Government consumption rate is the government consumption calculated as percent of GDP, a higher rate stimulates economic growth. Openness is the sum of exports and imports over GDP. A higher rate of openness can boost economic growth. A low and stable inflation rate is facilitating growth, while high rates can hurt it. On the other side, very low or negative inflation is not good for economic growth, but in the sample used it is not the case of prolonged very low or negative inflation. Proximity to technological frontier is calculated as total factor productivity of country x in year i, divided by the best country's total factor productivity in year i. The bigger the distance to technological frontier, the bigger is the room for improvement in productivity, thus the room for improvement in economic growth, hence economic convergence. For this explanation to be translated into the econometric model, for TFP proximity the value of the first year of each interval is used.

The second category is *External factors, competitiveness and financial sector.* Terms of trade is calculated as net barter terms of trade index. If terms of trades are worsening, more capital is going out in relative terms in order to buy the same products. This is equivalent to less capital disposable for investment in the domestic economy. World Competitiveness Index measures the competitiveness of countries by analyzing how they create a competitive business environment, a more competitive economy is expected to have a higher GDP. Real effective exchange rate (RERR) - deflated using Consumer Price Index /Unit Labor Cost - can stimulate economic growth if the domestic currency is undervalued by stimulating the tradable sector. High volatility of nominal effective exchange rates is calculated considering exchange rates vis-à-vis the European Union countries. It can slow economic growth because it induces uncertainty regarding the price of exports and imports, the exchange at what the foreign investments can be repatriated plus various interactions if prices of some goods are set in

foreign currency for example. Stock of domestic credit is measured as percent of GDP. Increasing credit stock can stimulate investments and consumption, both increasing GDP. Stock of foreign direct investments is measured as percent of GDP. More capital from abroad will stimulate the domestic economy. Economic complexity is calculated based on the diversity of countries, the number of distinct products a country produces, and the ubiquity, number of countries that make a product, of products using trade data (Hausmann, et al. 2014). Diversification of the products a country produces is equivalent with having a higher complexity index which should led to higher GDP and economic growth.

The third category is *Economic freedom, democracy and government effectiveness*. Most of them are represented by qualitative rather than quantitative indicators. All are influenced by the legislation that applies in the particular country for which the observation is pertaining. Understanding how they are built is important in order to understand their influence on economic growth and convergence. Rule of law is measured as freedom from corruption and how strong the property rights are. Democracy indicator is measured in terms of the level of political rights. Labor is the labor market flexibility given by the regulations in place in terms of how easy is to make a contract or to break one. Fiscal freedom is represented by the top marginal private/corporate income tax plus tax burden as percent of GDP, using with equal weights for the two. A higher level of fiscal freedom means lower top marginal taxes and tax burden. Government effectiveness is constructed using the perceptions of the quality of public services, civil service, the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to these policies. Business freedom is based on the complexity of starting/closing a business and obtaining a license. In all cases more freedom is considered to enhance economic growth.

The last category is represented by the *Social and education conditions*. Mortality rate is defined as inverse of life expectancy at birth. A lower mortality rate can increase the

population, thus influencing economic growth. But in the same time it can show an aging population that might not be active. In the case of countries where the pension system is pay-as-you-go, an aging population can crowd out the government consumption and investment, thus having a negative impact on economic growth. A higher fertility rate should be associated with a higher economic growth since on long term the working age population should increase. Tertiary Education is measured as total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. An increase in the number of higher educated population should increase GDP as productivity increases. Population ageing is the old age dependency ratio, calculated as the rate of 65+ people over the ones with age between 15 and 64. A lower old age dependency ratio should correspond to a higher GDP since the proportion of productive population is higher.

All available sources identified for potential institutional, technological, educational, and competitiveness factors are used if they have long enough samples of data. The list of variables and their sources can be seen in Appendix I.

# Chapter 4 Results

First, the results for unconditional convergence and simple conditional convergence, with only one control variable, are presented. In the second part, results for more complex models of conditional convergence are showed, using as a base model the one presented in Convergence and Modernization Revisited (Barro 2012). More control variables will be introduced in the second part in order to test their impact for growth and convergence.

### 4.1 Unconditional convergence

The unconditional convergence specification assumes that the only variable that matters for the evolution of GDP per capita is the initial real GDP per capita. Results confirm the presence of unconditional convergence in the European Union in the period from 1996 to 2011. In Table 1 the results of the equation without considering non-observable variables related to characteristics that are specific for each country can be seen. The speed of convergence is 1.9% per year and statistically significantly different from zero.

**Table 1 Unconditional convergence**

| LHS: Real GDP per capita growth | (1) Unconditional convergence | (2) Unconditional convergence |
|---|---|---|
| Constant | 0.206** | 0.825** |
| β - convergence rate | -0.0189** | -0.0841** |
| n | 105 | 105 |
| $R^2$ | 0.281 | 0.399 |
| Number of countries | 27 | 27 |
| Fixed effects | No | Yes |
| Robust standard errors<br>* indicates significance at the 5 percent level<br>** indicates significance at the 1 percent level | | |

The model with fixed effects takes into consideration non-observable variables that are specific for each country. A much higher speed of convergence can be seen in the European

Union, 8.4% per year. This is a much higher speed if it is compared with the 2-4% obtained by most of the authors when using similar methodology, but larger samples in terms of counties and number of years. Moreover, the explanatory power of the model (R-squared) with fixed effects is higher, suggesting that this one might be closer to reality than the other one.

### 4.2 Conditional convergence – one control variable

The assumption that the initial real GDP per capita is the only factor that matters for future economic growth is very strong and for sure it doesn't reflect reality. Certainly the convergence process was affected by other factors that influence economic growth. These factors are classified in four categories and their effect is tested separately.

Table 2 shows the variables that are related to macro economy, stability and development. $\beta$ – the convergence rate, is the coefficient of the real GDP per capita in the last year before the interval starts while the correlation between each factor and real GDP per capita growth is shown by $\lambda$.

Investments, Openness ratio, and Total Factor Productivity are all positively correlated with growth of real GDP per capita in the European Union countries. On the other side, a higher inflation rate, as well as proximity to technological frontier, has negative impact on economic growth. This is expected and shows that a higher inflation rate doesn't sustain growth. Regarding proximity to technological frontier, the negative sign shows that when a country is closer to having the best available technology at the beginning of the period, there is limited room for improvement in technology, thus not stimulating economic growth. This is the result of the fact that the closer one country is to the frontier, the closer it is to having the best available technology. Even though government consumption is part of the GDP from the accountancy perspective, if expenditure approach is considered, an increase in government consumption is negatively correlated with growth of real GDP per capita. This might happen because the

government consumption crowds out other funds that might be used more efficient in the economy by the private investors due to the fact that the government has to increase taxes or borrow in order to have a higher government consumption ratio which decreases the disposable amount of money for the private sector.

The conditional convergence rate varies from 8.4% to 15.7% per year, all rates being statistically significant. This proves that if key variables are considered, the convergence increases. Moreover, these models have higher explanatory power since R squared is higher if compared with the results obtained in the equations that tested unconditional convergence.

Table 2 Simple conditional convergence: Macro economy, stability and development

| Name of control variable (λ) | β - convergence rate | λ – coefficient of control variable | n | $R^2$ | Number of countries |
|---|---|---|---|---|---|
| Investments | -0.0765** | 0.391* | 97 | 0.532 | 26 |
| Government consumption ratio | -0.0868** | -0.627** | 105 | 0.495 | 27 |
| Openness ratio | -0.107** | 0.0771** | 105 | 0.452 | 27 |
| Inflation rate | -0.0891** | -0.0245** | 105 | 0.462 | 27 |
| TFP in constant 2005 prices | -0.157** | 0.316** | 105 | 0.782 | 27 |
| Proximity to technological frontier (first year of the period) | -0.0846** | -0.0793** | 105 | 0.473 | 27 |
| All regressions with fixed effects<br>Robust standard errors<br>* indicates significance at the 5 percent level<br>** indicates significance at the 1 percent level | | | | | |

In Table 3 the effect of external factors, competitiveness and financial sector on convergence can be seen. Terms of trade and economic complexity are not statistically different from zero while the convergence is the same or increases slightly in comparison with unconditional convergence model with fixed effects. One reason for which terms of trade is not significant might be the small variance this variable has within countries and years. Besides that, the number of observations is smaller since there is no data prior to 2000. Regarding economic complexity, the same applies: the variance is very small due to the fact that the

European Union countries are quite similar in how complex their economies are if compared with the rest of the world.

The competitiveness of these countries is positively correlated with economic growth and this equation returns a very high convergence rate of 20.1% per year. The coefficient of this variable is statistically different from zero and positive, thus the higher the competitiveness the higher the convergence rate. This shows that competitiveness is one of the key factors that help in the catching up process in the European Union and the argument is backed up by a strong explanatory power of the model. To be mentioned that in this case the number of observation is limited since the series doesn't start before 2001. The results might be biased because a smaller sample is used to estimate the model. Additionally, due to these data limitations, only the period after 2000 is considered. This might not be representative for long term growth since for most of the CEE countries this period was excellent from the perspective of economic growth (see Figure 1).

Real effective exchange rate is positively correlated with economic growth in both cases, calculated as yearly average or considering the value of the first year of the period. In other words, when the domestic currency is appreciating against a basket of foreign currencies economic growth is increasing. This doesn't have a straight forward economic explanation. But the reality might be that economic growth influences REER, not the other way. For CEE countries REER increased during this period probably drove by economic growth. Because of real convergence, nominal convergence was going on, so REER appreciated in CEE before the crisis. Since REER deflated by ULC is not statistically significant and REER deflated by CPI has an inverse correlation sign than expected these results are not solid. Volatility of Nominal Effective Exchange Rate (NEER) is negatively correlated with economic growth. In both cases, REER and NEER, the annual rate of convergence doesn't change significantly from the base model of unconditional convergence with fixed effects.

Change in stock of domestic credit as percent of GDP is positively correlated with economic growth, but the convergence rate doesn't change significantly. The same is available for stock of foreign direct investments, where the annual convergence rate is actually lower than in the model with unconditional convergence with fixed effects, 8.4% versus 7.7%. This is not an unexpected outcome since the CEE countries benefited from a lot of foreign direct investments, especially after they joined the European Union. Partialling out the effect of foreign direct investments shows that convergence rate would have been smaller without this amount of money coming from abroad.

Table 3 Simple conditional convergence: External factors, competitiveness, and financial sector

| Name of control variable (λ) | β - convergence rate | λ – coefficient of control variable | n | $R^2$ | Number of countries |
|---|---|---|---|---|---|
| Terms of trade | -0.129** | 0.0693 | 80 | 0.577 | 27 |
| Economic complexity index | -0.0898** | 0.0210 | 99 | 0.409 | 25 |
| World Competitiveness Index | -0.201** | 0.209** | 68 | 0.718 | 24 |
| REER (CPI deflated) | -0.110** | 0.000761** | 105 | 0.441 | 27 |
| NEER volatility | -0.0939** | -0.388** | 105 | 0.493 | 27 |
| Change in stock of domestic credit as % of GDP | -0.0862** | 0.245** | 104 | 0.471 | 27 |
| Stock of foreign direct investments | -0.0769** | 0.162** | 104 | 0.549 | 27 |
| All regressions with fixed effects<br>Robust standard errors<br>* indicates significance at the 5 percent level<br>** indicates significance at the 1 percent level<br>REER (ULC based) is not significant and is not reported | | | | | |

The effect of Economic freedom, democracy and government effectiveness on catching up and economic growth can be seen in Table 4**.** The coefficients for most of them are not statistically significant different from zero, thus they are not correlated with economic growth. In the case of Rule of law, Democracy indicator and Business freedom the β - convergence rate changes slightly, but in the regression where the control variable is Labor market flexibility it is almost double than in the unconditional convergence with fixed effects equation.

Fiscal freedom is positively correlated with economic growth and statistically significant. This is in line with the result obtained in the equation that contains Government consumption ratio (see Table 2). Higher top marginal taxes and higher tax burden is not exactly the same as higher government consumption. Income from it is not necessarily used for government consumption but it can go to government investments too, while the government consumption can be financed via borrowing not only through taxes. Even though the two, Fiscal freedom and Government consumption ratio, do not have an exactly opposite definition, the channels through they can influence economic growth and convergence process are roughly similar. The fact that both are statistically significant and have different signs suggests that the results are robust. The convergence ratio increases in this case to 11.3% per year from 8.4% per year in the unconditional convergence equation with fixed effects. In other words, in the European Union an economy that has lower taxes has a higher convergence rate and fiscal policy is relevant for economic growth.

Table 4 Simple conditional convergence: Economic freedom, democracy and government effectiveness

| Name of control variable (λ) | β - convergence rate | λ – coefficient of control variable | n | $R^2$ | Number of countries |
|---|---|---|---|---|---|
| Rule of law | -0.0812** | -0.0762 | 105 | 0.412 | 27 |
| Democracy indicator | -0.0856** | 0.0946 | 105 | 0.423 | 27 |
| Labor market regulation | -0.166** | 0.0977 | 80 | 0.600 | 27 |
| Fiscal freedom | -0.113** | 0.124* | 105 | 0.448 | 27 |
| Quality of institutions - government effectiveness | -0.0942** | 0.247** | 105 | 0.484 | 27 |
| Business freedom | -0.0787** | -0.0456 | 105 | 0.410 | 27 |
| All regressions with fixed effects<br>Robust standard errors<br>* indicates significance at the 5 percent level<br>** indicates significance at the 1 percent level | | | | | |

The quality of institutions is positively correlated with economic growth and the speed of convergence increases with about 1pp per year. In this equation measurement issues can

arise since the quality of institutions indicator measures the perceptions of how effective the government is. These perceptions are influenced by how effective the institutions are, but there are other factors that can impact them. One of them is international experience. If only a very small part of the population lived or traveled abroad they might consider a low efficient government to be the normality, thus considering it efficient. Culture can also play an important role, different cultures have different views on how the government should function.

How correlated are the social related variables with economic growth can be seen in Table 5. None of them is statistically different from zero, while the annual convergence speed changes slightly in both directions and varies from around 6% per year to approximately 12% per year. This outcome might be the result of the fact that the European Union countries are quite similar with respect to these variables, thus the variance within countries is limited. An equation with secondary education enrolment was tried too and the coefficient is not statistically significant from zero, not reported in the table below.

Table 5 Simple conditional convergence: Social and education preconditions

| Name of control variable (λ) | β - convergence rate | λ – coefficient of control variable | n | $R^2$ | Number of countries |
|---|---|---|---|---|---|
| Mortality rate | -0.0594** | 23.93 | 105 | 0.408 | 27 |
| Tertiary education enrolment | -0.117** | 0.0657 | 103 | 0.432 | 27 |
| Population ageing (rate of population aged 65+ over population aged 15-64 | -0.0947** | 0.200 | 105 | 0.405 | 27 |
| ln(Fertility rate) | -0.0786** | -0.0261 | 105 | 0.402 | 27 |
| All regressions with fixed effects<br>Robust standard errors<br>*indicates significance at the 5 percent level<br>** indicates significance at the 1 percent level | | | | | |



### 4.3 Conditional convergence – more control variables

These results are meaningful, but an economy is a complex system and all tested variables are part of the system. Given the limited number of observations it is not possible to

test them all in a single equation. For further testing the convergence process in the European Union the equation used by Robert Barro (Barro 2012) will represent the starting point. After this, a reduced form will be used and other control variables added.

There are several data issues with using the same model as the one used by Robert Barro (Barro 2012). Terms of trade are available only after 2000 and there is no data regarding male/female number of years in school, thus the choice to use tertiary education enrolment. This was chosen because the European Union countries are quite advanced in terms of education, in contrast with the sample of 80 worldwide countries (Barro 2012). Therefore using secondary education enrolment would not make much difference since all countries are on almost the same level. Moreover, it is likely that economic growth is driven rather by higher educated population since for secondary education there was no much room for improvement since 1990.

The results of these regressions can be seen in Appendix II and Appendix III. Models with unconditional convergence with and without fixed affects are the base models. Due to the issues with data availability, when adding different control variables, the number of observations decreases. As a result there are intermediate models, grey shade in appendix, to link two different specifications. In other words, the simpler model is run with both the initial higher number of observations and the reduced number of observations, the same observations like the more complex model. Hence, relevant comparison can be made while adding control variables and decreasing number of observations. If results differ it can be seen if it is the result of the added variable or the result of smaller number of observations.

Model (4) is a reduced form of Barro (Barro 2012) that includes only investments, education and government consumption. Croatia and Malta were dropped because there is no data regarding investments. The results are not much different from the simple conditional

convergence models. Sign for investments and government consumption are the same, while magnitude is roughly modified for government consumption. In the simpler complex convergence model the coefficient for investments is 0.39 while in the more complex one it drops to 0.27. Regarding education it was not significant in the first model and is only significant at the 10 percent level now. Education is not making a difference between countries of the European Union with respect to economic growth. Excluding the effect of education, investments, and government consumption, the speed of convergence increases to 12.9% per year from 8.4% in the base model (8.3% in model (3) with same number of observations).

Model (5) adds mortality rate, fertility rate, rule of law, openness ratio, democracy, and inflation. This model has the same control variables like Barro's model (Barro 2012), with the exception of terms of trade. This variable is not introduced here because the series starts only in 2000, using it would have limited the interval analyzed from 2000 to 2011, reducing it with 4 years.

As before, coefficients for mortality, fertility, rule of law, and tertiary education are not significantly different from zero, so it can be inferred these variables do not influence economic growth. Investments, government consumption and openness ratio are statistically significant and have the same sign as before. Comparing with model (4), as the coefficient is now 0.42 (compared with 0.27) the importance of investments increases in the model when more variables are considered as explanatory variables. The negative impact of government consumption decreases, but is still significant. Correlation between openness ratio and economic growth is as before, compared with the simple conditional convergence model (0.0771 versus 0.0770). Since investments, government consumption and openness ratio are all measured as percent of GDP, the coefficients can be directly compared. One percentage point increase in government consumption ratio (as percent of GDP) has approximately the same impact on economic growth, but in the other direction, as one percentage points increase

in investment ration (as percent of GDP). Also, the correlation between investments and increase of real GDP per capita is 5 times higher than correlation between openness ratio and growth of real GDP per capita (coefficients are 0.422 and 0.077). Democracy is the only variable that has a considerably different coefficient. If in the model where it was the only control variable it was not statistically significant, now there is a positive correlation between the level of democracy and economic growth. After introducing the new control variable the convergence speed decreases to 10.8% per year from 12.9% in model (4).

When introducing terms of trade, only data after 2000 are used. In order to compare the model (5) with the model with terms of trade (7), model (6) can be seen as a transitory model between the two. It has the same variables as model without terms of trade and the same observations as the model with terms of trade included. In this transitory model convergence speed increases, while government consumption and democracy indicator are no longer statistically different from zero. The same can be seen in model (7) that includes terms of trade. Convergence speed is even higher, while government consumption and democracy are not significant. Terms of trade are positively correlated with economic growth. In other words, an increase in price of exports increases relative to price of imports is associated with an increase in real GDP growth per capita.

Comparing the results of the model for the European Union countries and the one for 98 countries (Barro 2012) (8), there are some significant differences. Convergence rate is 4 times higher in the European Union. Also, coefficients for fertility rate and tertiary education are not significant for the European Union, but significant for Barro's sample (Barro 2012). Not enough variance in these 2 variables within countries and time might be the reason as the European Union countries are very similar in these respects, but the 98 worldwide countries (Barro 2012) are not. On the other side, investments and openness ratio are significant explanatory variables for growth equation in the European Union.

Testing for drivers of euro area catching up is greatly influenced by Total Factor Productivity (Balta and Mohl 2014). They test jointly the impact of employment protection legislation, effective average tax rates, government effectiveness, old age dependency ratio, and product market regulations. The result is that every variable is correlated with TFP growth, but product market regulator coefficient is not significant. If they impact TFP in Eurozone, it might be the case that economic growth and convergence speed can be influenced in the European Union. Due to the impossibility to access the same databases, proxies are used in case of some of these variables. They can be consulted in Appendix III. Model (9) shows the results of these variables applied for the European Union countries from 1996 to 2011 using the equation (4), as before. Only fiscal freedom is significantly different from zero and it has a positive correlation with real GDP per capita growth.

The results of testing jointly the variables in the reduced Barro (Barro 2012) model and Balta and Mohl (Balta and Mohl 2014) model can be seen in model (10). Sign of coefficients do not change when compared with the separated models, while coefficient for fiscal freedom is smaller and the one for investments is higher. Government consumption ratio is no longer significant, while all other control variables are not statistically significant. Speed of convergence is 16.8% per year, which is in the middle of the interval set by speed of convergence in the two individual models (12.9% and 19.6%).

Using the reduced form of Barro model (Barro 2012), the effect of financial indicators (foreign direct investment and stock of domestic credit), proximity to technological frontier, exchange rate (NEER and REER), and competitiveness (World Competitiveness Index) on economic growth and convergence speed is tested (models (11) to (14)). Change in domestic credit stock is not statistically significant, as well as domestic credit stock, which is not reported, while foreign direct investments are positively correlated with growth of real GDP per capita. Proximity to technological frontier is significant, has a negative sign and magnitude

is almost the same like in the simple conditional convergence model. These results are quite robust given that they are almost the same in different setups. Same happens in case of NEER volatility and competitiveness. The result for NEER proves that its volatility might negatively influence economic growth. In these models convergence varies from 10% to 17% per year. The model with competitiveness shows the highest convergence speed proving that competitiveness is an important driver for both growth and convergence.

# Chapter 5 Robustness checks

## 5.1 Initial year for GDP per capita as RHS variable

In literature there are two different ways of selecting the year for initial GDP per capita, the right hand variable. The first one is to use the value of the last year before each non-overlapping period starts, as used in the equations above. The second is to use the value of GDP per capita of the first year of each non-overlapping period. In order to check if this choice can influence the results regressions in Appendix II were used with initial GDP per capita level in first year of the interval instead of using the last year before the interval starts. The resulted models are in Table 6. In most of the cases (line $GDP_{t-1}$ compared with $GDP_t$) the speed of convergence is slightly higher in the case when real GDP per capita in the year before the period starts is considered. This is expected as the income level is most probably smaller in that year than in the first year of the period. Results show that the overall outcome doesn't differ significantly based on what year is chosen for GDP per capita as RHS variable.

Table 6 Comparison between income level in the year before the period starts and the first year of the period

| Name of control variable/ Model | Unconditional OLS (1) | Unconditional Fixed Effects (2) | Balta model (3) | Barro2012 reduced +financial indicators (4) | Barro 2012 reduced + proximity (5) | Barro 2012 reduced +NEER (6) | Barro 2012 reduced +WCI (7) |
|---|---|---|---|---|---|---|---|
| $GDP_{t-1}$ | -0.0189** | -0.0841** | -0.0834** | -0.129** | -0.108** | -0.159** | -0.167** |
| Observations | 105 | 105 | 95 | 95 | 95 | 75 | 75 |
| R-squared | 0.281 | 0.399 | 0.401 | 0.663 | 0.775 | 0.838 | 0.847 |
| $GDP_t$ | -0.0165** | -0.0700** | -0.0709** | -0.136** | -0.0997** | -0.136** | -0.155** |
| Observations | 107 | 107 | 96 | 96 | 96 | 75 | 75 |
| R-squared | 0.209 | 0.243 | 0.251 | 0.600 | 0.773 | 0.809 | 0.825 |
| Country FE | NO | YES | YES | YES | YES | YES | YES |

The other control variables are not reported
Robust standard errors
* indicates significance at the 5 percent level
** indicates significance at the 1 percent level

### 5.2 Starting year of the sample

Another source of debate might be the starting year of the dataset. In order to check what is the influence of choosing one period or another shifted by one year, models from Appendix II are run using 1997 as first year of dataset and 2012 as last one, instead of 1996 and 2011, respectively. The results can be compared in Table 7.

Table 7 Results using period 1997-2012

| Name of control variable/ Model | Unconditional OLS (1) | Unconditional Fixed Effects (2) | Balta model (3) | Barro2012 reduced +financial indicators (4) | Barro 2012 reduced + proximity (5) | Barro 2012 reduced +NEER (6) | Barro 2012 reduced +WCI (7) |
|---|---|---|---|---|---|---|---|
| 1996 to 2011 – base model | | | | | | | |
| $GDP_{t-1}$ | -0.0189** | -0.0841** | -0.0834** | -0.129** | -0.108** | -0.159** | -0.167** |
| Observations | 105 | 105 | 95 | 95 | 95 | 75 | 75 |
| R-squared | 0.281 | 0.399 | 0.401 | 0.663 | 0.775 | 0.838 | 0.847 |
| 1997 to 2012 | | | | | | | |
| $GDP_{t-1}$ | -0.0188** | -0.0912** | -0.0899** | -0.116** | -0.0891** | -0.0891** | -0.0950** |
| Observations | 107 | 107 | 98 | 98 | 98 | 98 | 98 |
| R-squared | 0.268 | 0.421 | 0.421 | 0.667 | 0.802 | 0.802 | 0.808 |
| Country FE | NO | YES | YES | YES | YES | YES | YES |
| The other control variables are not reported<br>Robust standard errors<br>* indicates significance at the 5 percent level<br>** indicates significance at the 1 percent level | | | | | | | |

The speed of convergence is roughly the same, with the exception of the last two models where it decreases from around 16% per year to approximately 9%. The last two models include NEER volatility and World Competitiveness Index. In 2012, the added year, the values of these indicators in CEE countries were much closer to their values in Western European countries than in 1996, the removed year. In 1996 inflation was high and the domestic currencies were depreciating fast, inducing high volatility on the market. In the same time structural reforms were still taken in many CEE countries, the competitiveness of these countries being much lower than Western European countries. These are some reasons why NEER volatility and WCI

might have a higher influence on explaining real GDP per capita growth in 2012 than in 1996, thus the convergence speed is lower in the models that include 2012 than in the ones that include 1996. Overall the outcomes are not significantly different if the first year of the sample is 1996 or 1997.

### 5.3 Length of one non-overlapping interval

The length of one non-overlapping interval might be the third source of debate. Ideally the length of one interval is equal with the length of a business cycle in order to partial out, at least partially if not totally, the effect of the "idiosyncratic economic dynamics at business cycle frequency" (Morgese Borys, Polgár and Zlate 2008). In order to test if the results can be influenced by the choice of interval length, the models in Appendix II are redesigned to have 3 years intervals (1996-1998,1999-2001,2002-2004,2005-2007,2008-2010) and 5 years intervals (1996-2000,2001-2005,2006-2010). The results of these equations are in Table 8.

Table 8 Results using different length of non-overlapping intervals

| Name of control variable/ Model | Unconditional OLS (1) | Unconditional Fixed Effects (2) | Balta model (3) | Barro2012 reduced +financial indicators (4) | Barro 2012 reduced + proximity (5) | Barro 2012 reduced +NEER (6) | Barro 2012 reduced +WCI (7) |
|---|---|---|---|---|---|---|---|
| 4 years intervals – base model | | | | | | | |
| $GDP_{t-1}$ | -0.0189** | -0.0841** | - | -0.129** | -0.108** | -0.159** | -0.167** |
| Observations | 105 | 105 | 95 | 95 | 95 | 75 | 75 |
| R-squared | 0.281 | 0.399 | 0.401 | 0.663 | 0.775 | 0.838 | 0.847 |
| 3 years interval | | | | | | | |
| $GDP_{t-1}$ | -0.0183** | -0.0949** | -0.0945** | -0.189** | -0.167** | -0.184** | -0.191** |
| Observations | 132 | 132 | 115 | 115 | 115 | 95 | 95 |
| R-squared | 0.222 | 0.345 | 0.348 | 0.686 | 0.769 | 0.808 | 0.818 |
| 5 years interval | | | | | | | |
| $GDP_{t-1}$ | -0.0175** | -0.0839** | -0.0800** | -0.150** | -0.129** | -0.129** | -0.129** |
| Observations | 79 | 79 | 72 | 72 | 72 | 72 | 72 |
| R-squared | 0.358 | 0.514 | 0.529 | 0.741 | 0.802 | 0.802 | 0.825 |
| Country FE | NO | YES | YES | YES | YES | YES | YES |

The other control variables are not reported
Robust standard errors
* indicates significance at the 5 percent level
** indicates significance at the 1 percent level

The speed of convergence differs to some extent from one specification to the other in the case of some models (3,4,5 years), but generally it remains high, confirming strong convergence in the European Union.

The three types of checks show that the initial results are robust. Changing the timespan from 1996-2011 to 1997-2012, using real GDP per capita in the first year of the period instead of last year between the period starts, and using different length for non-overlapping periods show limited changes in the speed of convergence for most setups.

## Conclusion

This research is studying the possible factors that can influence growth and convergence of the Central and Eastern European economies towards the European Union level. It analyses the influence of a wide number of variables related to macro economy, stability, development, external factors, competitiveness, financial sector, economic freedom, democracy, and social and education preconditions by using a panel data from the European Union countries, spanning from 1996 to 2011.

For these countries the annual speed of β convergence between 1996 and 2011 is much higher than in other sets of countries. Most of it is driven by the CEE countries since in 1996 these were the countries with the lowest real GDP per capita among the members of the European Union. The estimated unconditional convergence rate without using fixed effects is 1.9% per year, while when fixed effects are used it increases to 8.4% per year. Furthermore, when conditional convergence rate is estimated it varies between 9% and 17% per year depending on the explanatory variables used. Considering the biases induced by using or not using fixed effects, the results of regressions without fixed effects are understated while the ones where fixed effects are used are overstated, thus the real convergence being around the midpoint of these outcomes.

Macroeconomic, stability and development indicators are all significant, thus relevant for growth. Investments, TFP, and openness ratio are always significant and positively correlated with economic growth, explaining a large amount of the variation in real GDP growth. On the other side, government consumption proves to be negatively correlated with economic growth, while inflation rate is not significant. Concerning external factors, competitiveness and financial sector, most of the variables prove to be significant in different setups. Domestic credit, foreign direct investments, and competitiveness are positively correlated with growth. Regarding the exchange rate, volatility of nominal effective exchange

rate is negatively correlated with growth while a depreciation of real effective exchange rate promotes growth. Terms of trade are significant only in some models, thus results are not robust and this variable doesn't prove to be a key one. Economic freedom, democracy, government effectiveness, social and education preconditions are significant for economic growth in limited cases only. Fiscal freedom is the only variable that is significant in more models, being positively correlated with economic growth. The limitations of this research and results is given by the fact that it uses data from the past. If the structure and mechanisms of economy is changing, which is probable after a crisis, some results might not be relevant for the future performance and the way one economy works.

Drivers of income growth and convergence are important for policy makers as the decisions to focus on one or another proves to be critical in the development of these countries. The analysis suggests that policy makers should focus on improving the overall macroeconomic development, stability, competitiveness, and factors related to external and financial sectors.

# Appendix

Appendix I

| Variable name | Description | Source |
|---|---|---|
| GDP | Real GDP per capita | Eurostat |
| Investment rate | As % of total GDP | World Bank Databank |
| Government consumption rate | As % of total GDP | World Bank Databank |
| Openness | Imports + Exports as % of total GDP | World Bank Databank |
| Inflation rate | Annual Consumer Price Index | World Bank Databank |
| Proximity to technological frontier | Proximity to the TFP frontier (TFP of country x in year i, divided by the best TFP in year i) | Penn World Table - Groningen Growth and Development Centre |
| Terms of Trade | Net barter terms of trade index | World Bank Databank |
| Economic complexity | Based on the diversity of countries and the ubiquity of products | The Observatory of Economic Complexity |
| World Competitiveness Index | WCI measures the competitiveness of nations by analyzing how they create a competitive business environment | IMD World Competitiveness Center |
| Real effective exchange rate (ULC) | REER deflated using Unit Labor Cost and using EU28 as trading partners | Eurostat |
| Real effective exchange rate (CPI) | REER deflated using Consumer Price Index and using EU28 as trading partners | Eurostat |
| Nominal effective exchange rates | Yearly volatility of NEER (using EU28 countries) using monthly data | Eurostat |
| Stock of domestic credit as %GDP | Gross credit provided by financial sector to private companies plus net credit provided to central government | World Bank Databank |
| Stock of foreign direct investments | Stock of FDI as % of GDP | World Bank Databank |
| Rule of law | Freedom from corruption and property rights | Heritage Foundation |
| Democracy indicator | Level of political rights | Freedom House |
| Labor | Labor market flexibility | Fraser Institute |
| Fiscal freedom | Top marginal private/corporate income tax + tax burden as % of GDP | Heritage Foundation |
| Government effectiveness | Perceptions of the quality of public services, civil service , the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. | Worldwide Governance Indicators |
| Business freedom | Based on the complexity of starting/closing a business and obtaining a license | Fraser Institute |
| Mortality rate | Inverse of life expectancy at birth | World Bank Databank |
| Fertility | Fertility rate | World Bank Databank |
| Tertiary Education | Total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown | World Bank Databank |
| Population ageing | Old age dependency ratio. Rate of 65+ people over 15-64 | World Bank Databank |

Appendix II

| Name of control variable/ Model | Balta model (3) | Barro2012 reduced +financial indicators (4) | Barro 2012 reduced + proximity (5) | Barro 2012 reduced +NEER (6) | Barro 2012 reduced +WCI (7) | Barro 2012 original results (8) |
|---|---|---|---|---|---|---|
| Ln (GDP) | -0.0834** | -0.129** | -0.108** | -0.159** | -0.167** | -0.0447* |
| Mortality rate | | | 6.693 | -15.80 | -27.20 | -1.15 |
| ln(Fertility rate) | | | -0.0424 | -0.0233 | -0.0369 | -0.0351** |
| Rule of law | | | -0.00935 | 0.0267 | 0.0524 | 0.0045 |
| Investment as % of GDP | | 0.274** | 0.422** | 0.492** | 0.512** | 0.014 |
| Tertiary education enrolnment[1] | | 0.0929* | 0.0463 | 0.0425 | 0.0558 | 0.0062 / -0.0107* |
| Government consumption ratio | | -0.617** | -0.473* | -0.382 | -0.353 | -0.083 |
| Openness ratio | | | 0.0770** | 0.105** | 0.109** | 0.0129 |
| Terms of trade | | | | | 0.0948* | 0.092* |
| Democracy indicator | | | 0.195* | 0.103 | 0.127 | 0.021 |
| Inflation rate | | | -0.0439 | 0.00633 | 0.0458 | -0.0315 |
| Constant | 0.820** | 1.268** | 0.498 | 1.368* | 1.369* | not reported |
| Observations | 95 | 95 | 95 | 75 | 75 | 760 |
| R-squared | 0.401 | 0.663 | 0.775 | 0.838 | 0.847 | 0.511 |
| Adjusted R-squared | 0.395 | 0.648 | 0.748 | 0.812 | 0.820 | not reported |
| Country FE | YES | YES | YES | YES | YES | YES |
| Number of countries | 26 | 26 | 26 | 26 | 26 | 80 |

Absolute convergence for OLS model: -0.0189**
Absolute convergence for FE model: -0.0841**
1 – Barro (2012) uses female / male school years
Robust standard errors
* indicates significance at the 5 percent level
** indicates significance at the 1 percent level

Appendix III

| Name of control variable/ Model | Balta model (9) | Balta +Barro 2012 reduced (10) | Barro2012 reduced +financial indicators (11) | Barro 2012 reduced + proximity (12) | Barro 2012 reduced +NEER (13) | Barro 2012 reduced +WCI (14) |
|---|---|---|---|---|---|---|
| Ln (GDP) | -0.196** | -0.168** | -0.102** | -0.115** | -0.134** | -0.170** |
| Labor market regulation | 0.0684 | 0.0559 | | | | |
| Fiscal freedom | 0.238** | 0.156* | | | | |
| Government effectiveness | 0.164 | 0.0191 | | | | |
| Population ageing | -0.267 | 0.0972 | | | | |
| Business freedom | -0.0416 | -0.0758 | | | | |
| Investment as % of GDP | | 0.364** | 0.215 | 0.243* | 0.210 | 0.272* |
| Tertiary education enrolment | | -0.00766 | 0.0489 | 0.0636 | 0.0751 | 0.0214 |
| Government consumption ratio | | -0.330 | -0.571** | -0.683** | -0.612** | -0.361 |
| Change in stock of domestic credit as %GDP | | | 0.0883 | | | |
| Stock of foreign direct investments as %GDP | | | 0.139** | | | |
| Proximity to technological frontier | | | | -0.0765** | | |
| Average annual NEER volatility | | | | | -0.957* | |
| World competitiveness index | | | | | | 0.173** |
| Constant | 1.680** | 1.515** | 1.024** | 1.223** | 1.351** | 1.558** |
| Observations | 80 | 75 | 93 | 95 | 95 | 64 |
| R-squared | 0.710 | 0.819 | 0.718 | 0.724 | 0.702 | 0.809 |
| Adjusted R-squared | YES | YES | YES | YES | YES | YES |
| Country FE | 0.686 | 0.794 | 0.698 | 0.709 | 0.685 | 0.792 |
| Number of countries | 27 | 26 | 26 | 26 | 26 | 23 |

Absolute convergence for OLS model: -0.0189**
Absolute convergence for FE model: -0.0841**
Robust standard errors
* indicates significance at the 5 percent level
** indicates significance at the 1 percent level
REER is not significant in the Barro (2012) reduced form specification (with and without WCI included), regressions not reported.
Stock of domestic credit is not significant.

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