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The EU, a Growth Engine? The Impact of European Integration on Economic Growth in Central Eastern Europe

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This paper investigates how the European integration process of central eastern European countries, which has been taking place since the 1990's, affects their GDP growth. Based on an augmented Solow model, I estimate a convergence equation for a panel of ten countries over 16 years (1995-2010). In the regression, trade with the other European Union member states as a share of total trade serves as a measure of European integration. I find a small, but significant medium-run growth bonus from integration, which is robust to alternative specifications of the regression equation and of the variables of interest. The results are confirmed by a supplementary analysis at the industry level using a difference-in-difference type of estimation strategy. The paper thus provides an argument in favour of European integration.

JEL : C23, F43, O47, R11
Keywords: European integration, central eastern Europe, economic growth, growth convergence

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This paper investigates how the European integration process of central eastern European countries, which has been taking place since the 1990's, affects their GDP growth. Based on an augmented Solow model, I estimate a convergence equation for a panel of ten countries over 16 years (1995-2010). In the regression, trade with the other European Union member states as a share of total trade serves as a measure of European integration. I find a small, but significant medium-run growth bonus from integration, which is robust to alternative specifications of the regression equation and of the variables of interest. The results are confirmed by a supplementary analysis at the industry level using a difference-in-difference type of estimation strategy. The paper thus provides an argument in favour of European integration.

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Introduction

The current financial and economic crisis has been accompanied by a wave of euroscepticism calling into question the benefits of the European Union (EU): While support for the EU among its citizens has fallen from 52% in 2007 to only 35% in 2014 (EC 2014: 6), Great Britain is even debating about leaving the EU, arguing that the economic costs of membership surmount its benefits. The question of whether the EU has a positive or a negative effect on its member states' economies is of particular

importance to those countries that have only recently joined the EU. In the countries of central eastern Europe (CEE)[1], politicians find themselves increasingly under pressure to justify EU accession and to defend it against those political and economic actors that argue that the region would have been better off outside of the crisis-shaken EU. At the same time, candidate and potential candidate countries closely follow the fate of CEE in order to determine whether they should aspire to join the EU themselves. Therefore, the question of economic costs and benefits of membership may also influence the enlargement dynamics of the EU.

One way of quantifying the effect that being an EU member has on a country's economy is to estimate the impact of a variable that measures European integration on GDP growth, through either a Solow or an endogenous growth regression. There exist some empirical studies, mostly dating back to the 1990's, that use simple integration measures to study the early EU members or the effect of the introduction of the common market in 1992. De Melo et al. (1992) and Landau (1995), by including a dummy for EU membership in their growth regressions, find that there is no significant effect of European integration, a result confirmed by Vanhoudt (1999) who tests the significance of both a membership dummy and a variable capturing years of membership. In contrast, Henrekson et al. (1997) find that EU members enjoy a bonus on annual GDP growth of 0.6 to 0.8 percentage points. More recently, Badinger (2005), by constructing a differentiated measure of integration based on a country's level of trade protection, finds a temporary growth effect of 0.5 percentage points per year, but no permanent growth dividend. Crespo-Cuaresma et al. (2008) also detect a temporary growth effect. While there is thus some empirical evidence on the growth effects of integration for the EU15 countries, so far there have been hardly any attempts made to estimate these effects in the new EU members[2], mostly because until recently, the time period that passed since their EU accession in 2004 and 2007 was judged not long enough to allow for a meaningful econometric analysis. However, over 20 years after the first integration measures between the EU15 and the CEE countries, there is now

[1] These are Poland, the Czech Republic, Slovakia, Hungary, Latvia, Lithuania, Estonia, Slovenia, Bulgaria and Romania. The youngest EU member country, Croatia, is not considered here since its accession took place outside of my sample period, in July 2013.

[2] One exception is Rapacki and Próchniak (2009a), but their analysis is less detailed than this paper.

enough data available to make a first attempt. Analysing CEE is interesting not only for its novelty: These countries provide an excellent testing ground for economic integration effects because, contrary to Western European countries that were the object of prior enlargement processes, CEE countries virtually had to build up economic relations with the European Union from scratch after the downfall of communism.

This paper quantifies the effect of European integration on economic growth in CEE based on the Solow growth model by carrying out a panel data analysis. The share of trade with the other EU countries serves as a proxy for common market effects. I find a small but significant medium-run growth bonus from European integration for CEE, which is robust to alternative specifications of the regression equation and of the variables of interest. The results are confirmed by a complementary analysis at the industry level, which employs the Rajan-Zingales difference-in-difference methodology. At the same time, I argue that some benefits from European integration cannot be captured by quantitative analysis, which is why the real growth effect is likely to be higher.

In what follows, I first provide some background on different growth theories and explain how regional integration can be incorporated in the Solow model. Then, I describe the estimation technique. In the third part, I develop the estimation equation and explain the construction of the variables. Part four, the regression analysis, is the main part, which will be followed by several robustness checks, including the Rajan-Zingales analysis.

Theoretical framework

The answer to the question of what effect regional integration has on growth depends on the underlying theoretical framework. The neoclassical or Solow growth theory, constituted by Solow (1956) and extended by Mankiw et al. (1992) builds crucially on the assumption of diminishing returns to investment in capital. Under a constant rate of depreciation, this means that there is a distinctive capital-labour ratio which the economy will reach in the long run. While the size of the capital stock determines the economy's steady state income level, per-capita long-run growth

dynamics are determined solely by an exogenous rate of technological change (comprehending elements like knowledge accumulation, efficiency gains in the use of capital etc.). This means that any kind of economic policy, including integration, cannot affect the growth rate of an economy in the long-run. However, if it leads to more efficient factor employment in the production process, it will alter the economy's equilibrium capital-labour ratio and generate temporarily higher growth rates until a new steady state is reached. Thus, neoclassical growth theory predicts that economic integration will have a level effect, but not a scale effect on economic growth. Different implications are provided by the endogenous growth literature developed since the mid-1980's (e.g. Romer 1990). It revokes the assumption of a diminishing marginal product of capital, arguing that knowledge is a public good and that the creation of knowledge through innovation produces positive externalities. Hence, capital accumulation faces no limits, and the capital stock will increase without bound and at an ever faster speed, making the long-term growth rate endogenous. According to this growth theory, economic integration can therefore produce constantly higher growth rates.

Empirical literature has provided no clear evidence over which of the models conforms more to reality, but the Solow assumption of decreasing returns to input factors has mostly been confirmed (de la Fuente 1997, Islam 2003). This is one reason for choosing the Solow model as the theoretical framework for my analysis; the second one is that the model has been extended to explain economic integration, and has proven able to explain the inherent growth effects. European integration was formally incorporated into the Solow growth model in a work of Baldwin (1989), who postulates that it produces two kinds of growth effects. EU integration measures like the establishment of the common market lead firstly to the de-fragmentation of national European markets and in consequence to more market participants competing with each other. As a result of enhanced competition, mark-ups fall and an industrial restructuring takes place that leads to a more efficient resource allocation. Secondly, more favourable investment conditions in the EU stimulate the formation of new capital, shifting the capital-labour ratio and leading to a new equilibrium with higher per capita output, a medium-run growth bonus of integration.

Estimation technique

An easy way to estimate a Solow model draws on the convergence literature (e.g. Barro and Sala-i-Martin 1992, 2003). The Solow model implies that because of diminishing returns to capital, those countries with lower values of initial capital and income per capita will experience higher growth rates so that in the long run, they will catch up with richer economies. Allowing country characteristics like technology, preferences and population growth to differ, which means that each country has an individual steady state, it can still be assumed that an economy grows faster the further it is from its own steady state. This 'conditional convergence' (Barro and Sala-i-Martin 1992: 226) can be tested by regression analysis, estimating a simple equation of type

$$growth = \alpha + \beta(initial\ GDP) + \varepsilon \quad (1)$$

If poor countries grow faster than rich ones, the beta-coefficient in the equation should have a negative sign in the regression – which is why this type of convergence is also called *beta-convergence*[3]. By including investment in physical and human capital as explanatory variables, the simple convergence equation can be extended to test for the Solow model assumptions. It then becomes

$$growth = \alpha + \beta(initial\ GDP) + \gamma_1 CAP + \gamma_2 EDUC + \varepsilon \quad (2)$$

where *CAP* is investment in physical capital and *EDUC* is investment in human capital. The Solow model predicts that both gamma-coefficients should be positive: the higher the investment in physical and human capital in a country, the faster its growth. (The second derivative should be negative in accordance with the assumption of diminishing returns to investment.) Economies that are further away from the steady state will make higher investments in capital because the returns on it are higher, while in the steady state the investment rate will just equal capital depreciation so that no new capital is accumulated.

[3] In contrast to *sigma-convergence* which implies that the dispersion of income within a group of countries declines over time (Barro and Sala-i-Martin 1992).

Other variables of interest can be included in the equation. Indeed, the estimation framework as such puts no limits on what explanatory variables can be tested, which is a virtue as well as a problem. As has been shown by Levine and Renelt (1992), regression results are very sensitive to the exact specification of the estimation equation and might become insignificant in a different setting – so that causal relationships can be constructed in empirical testing where in reality they do not exist. It is therefore beneficial that the empirical analysis of growth effects of European integration is based on sound theoretical underpinnings.

Different estimation techniques can be employed to test for beta-convergence, among them cross-sectional, time series or panel data analyses (see Islam 2003: 312). The advantage of panel data vis-à-vis cross-sectional or time series analysis is that –next to providing a higher number of observations –, it can account for country heterogeneity. Fixed effects should be chosen since country characteristics are likely to be correlated with some explanatory variables. This is indeed what has been done by the vast majority of panel data growth studies (Durlauf et al. 2005: 629). Country fixed effects will control for time-invariant differences in technology that are unobserved but determine the steady state towards which the economies are converging; this allows the researcher to pool countries with different steady states into one sample.

In growth analysis, panel data studies usually work with data averaged over five- to ten-year periods (see Durlauf et al. 2005: 628; Islam 1995 opts for five-year periods), the reason being that annual variation in growth rates is caused largely by business cycle fluctuations that disguise the underlying growth trend. Since business cycles span about five years, this is the minimum length of averaging that should be chosen – and due to the shortness of my sample, going beyond it would unnecessarily reduce my observations. Still, the sample size makes it necessary to work with overlapping time periods instead of the usually chosen non-overlapping scheme. The advantage is that I do not have to cut the sample period into arbitrary time blocks. As a disadvantage, overlapping periods introduce serial correlation to the error terms, which means that the OLS estimator is still unbiased, but no longer efficient (Wooldridge 2003: 376f.). Therefore, the estimates for standard errors need to be corrected. In a macroeconomic sample of countries that lie in vicinity to each other, it is likely that in addition to serial correlation, there will also be spatial correlation in errors. A post-estimation test

applied to my sample confirms that there is spatial correlation, which is why I employ the Driscoll and Kraay (1998) estimator in the regression, which takes both types of correlation into account.

Specification of the estimation equation

The dataset contains observations for the ten CEE countries from 1995 to 2010, the choice of the time period being determined by the availability of reliable data. The estimation equation is formulated as

$$growth_{it,t+4} = \alpha_i + \beta_1 log(y_{it}) + \beta_2 CAP_{it} + \beta_3 EDUC_{it} + \beta_4 OPEN_{it} + \beta_5 TRANS_{it} + \beta_6 EI_{it} + \beta_7 world\_growth_{t,t+4} + \varepsilon_{it,t+4} \quad (3)$$

For the dependent variable, average growth over an n-year period is measured as

$$\frac{\log(y_{i,t+n}) - \log(y_{i,t})}{n}$$

I employ data from the Penn World Tables; the variable is multiplied by 100 to derive growth rates in the regression.

As explanatory variables, the equation contains firstly the convergence and Solow variables initial GDP (*y0*), physical capital (*CAP*) and human capital (*EDUC*). While it is safe to follow the body of empirical growth literature in the definition of the human capital variable (as educational attainment of the over 25-year old, obtained from the Barro-Lee educational attainment dataset), the specificities of the region under analysis make it necessary to employ a different measure of physical capital than usually chosen. While the Solow model equation contains capital stock, most papers use gross fixed capital formation as a proxy (e.g. Mankiw et al. 1992, Barro 2003, de Melo et al. 1992, Crespo-Cuaresma et al. 2008). This is legitimate as long as the rate of depreciation of capital can be assumed to be constant, which does not apply in the case of CEE. The centrally planned economies of the eastern bloc were heavily industrialized and probably suffered from dynamic inefficiency (Burda and Wyplosz 2012: 68), which is why after the end of communism, large parts of their capital stock

became obsolete. The restructuring of the economy that took place in the 1990's and beyond resulted in a rate of capital depreciation that is time-varying over the sample period. A measure that refers to the overall amount of capital in the economy is net returns on net capital stock, for which data is provided by the AMECO database of the European Commission.

The main variable of interest in the regression equation is the indicator of European integration *(EI)*. Quantifying the impact of regional integration is a complicated task because what researchers would like to measure – the allocation effects of integration and the resulting reduction in transaction costs – is impossible to measure. Instead, two possible proxies can and have been used in the literature: The *driving forces* of integration, in the case of the EU the formation of institutions like the customs union, the common market and the economic and monetary union, and the *consequences* of integration, i.e. the impact on economic variables like trade, investment or macroeconomic variables such as prices and interest rates (see Krieger-Boden and Soltwedel 2010). A small number of researchers have constructed an institutional index of regional integration (e.g. Hufbauer and Schott 1994, Dorucci et al. 2002), taking as a point of departure Balassa's (1961) five stages of regional integration and assigning scores to the levels of integration achieved. What is problematic about this procedure is that scores are always to a certain extent arbitrary and that institutional indices cannot take into account to what extent the measures adopted by political actors have actually been implemented. The latter is a caveat especially for CEE because, although these countries have accepted the *acquis communautaire*, European institutions in that region are not yet as established as in countries that have been EU members for a longer time period. Therefore, I refrain from using institutional indices. There have also been attempts to develop (for the EU15) concise indicators of the economic outcome of integration (e.g. Dorrucci et al. 2002 and König and Ohr 2012, both making use of Optimum Currency Area theory), but these are highly complex and a lack of data for the 1990's makes it impossible to construct them for CEE.

Instead, I have opted for an output measure based on the common market, more concretely on the four freedoms that have been established in CEE during the accession process: the free movement of goods, services, labour and capital. Ideally, I would take all four freedoms into account, using a separate measure for each, but measurement problems (in labour) and data constraints (in services and

capital) restrict my analysis to the free movement of goods. In my regression, I therefore define European integration as

$$\frac{\text{trade with EU27}}{\text{total trade}}$$

The measure is constructed using trade data from the IMF's Direction of Trade Statistics (DOTS). Summary statistics are displayed in the appendix. The chosen integration measure represents a necessary compromise between complexity and feasibility, easier to construct than the above mentioned indices, but more sophisticated than the rather simple techniques that have been employed by most of the existing literature on growth effects of European integration, such as including a dummy for EU membership in the estimation equation (de Melo et al. 1992, Landau 1995, Henrekson et al. 1997, Vanhoudt 1999) or using the number of years of EU membership as a proxy for integration (Vanhoudt 1999, Crespo-Cuaresma et al. 2008). Contrary to those techniques that imply that integration would be either a one-shot event (membership dummy) or a linear process (years of membership), my trade integration measure will take into account the uneven and evolutionary nature of the European integration process in CEE.

Since my European integration variable is sensitive to the evolution of world trade, I include as an additional control variable trade openness *(OPEN)*, measured by total exports plus imports of merchandize goods as per cent of GDP (data from the World Bank's World Development Indicators). This variable can be seen as an indicator of globalization.

Economic transition from plan to market not only affected the capital stock in CEE countries but produced various other effects as well. Major economic reforms were concerned with enterprise restructuring and privatization, price and interest rate liberalization, current account convertibility and the introduction of competition rules (Roland 2000: 11). These measures can be expected to have had a positive impact on growth, which might be erroneously captured by the European integration variable if not accounted for separately.[4] This is why I have introduced *TRANS* as an additional control

[4] Transition and integration effects are, however, not completely separable since, on the one hand, trade and financial liberalization that formed part of economic transition were necessary requirements for CEE to develop closer

variable measuring progress in economic transition. I have chosen to use the European Bank of Reconstruction and Development (EBRD) transition index for this purpose because such a condensed index has the advantage of capturing various transition effects without introducing too many new explanatory variables. The transition index is composed of six sub-indices on small-scale privatization, large-scale privatization, governance and enterprise restructuring, price liberalization, trade and foreign exchange system, and competition policy. They are measured on a cardinal scale from 1 to 4.33, with 1 meaning little progress and 4.33 meaning that the country has achieved the performance of advanced industrial countries. Since the EBRD sub-index on trade and foreign exchange system takes into account import and export controls, it will be correlated with European trade integration. To judge the severity of this problem, I constructed a new transition index without the trade sub-index and compared it to the original EBRD index. Correlation between EU trade and either of the indices is almost the same; using the reduced index instead of the original index thus makes no significant difference to my regression results. Therefore, it is safe to use the EBRD transition index in its original form.

The variable *world_growth*, which captures average world GDP growth between t and t+4 (using data from the World Development Indicators), is included in the regression for two different reasons. On the one hand, it provides a measure of the financial and economic crisis of 2007 and consecutive years, which seriously affected economic growth not only in CEE but in most globally integrated economies. It is important to use a crisis measure that is constructed in the same way as the dependent variable since average growth between t and t+4 was not only impacted by a potential crisis in t – the year in which all other explanatory variables are measured –, but also by the economy entering a crisis within the following four years. World GDP growth as a global measure of the crisis will take the same value for all ten CEE countries, making the simplifying assumption that the financial crisis hit all countries equally, but local crisis measures that would provide a more nuanced picture suffer from data constraints. Including world GDP growth also serves a second purpose: It accounts for overall productivity growth over time, which in Solow terms would be the rate of technological change. This

economic ties with Western Europe, while on the other hand, the EU itself influenced the transition path of CEE countries in many ways.

could be captured as well by including time fixed effects, but these are a rather brute measure that absorbs most of the variability of relatively time-invariant explanatory variables, rendering them statistically insignificant even though they are of economic significance. Also, year dummies do not have a direct interpretation, which is another reason why they are only second-best. The necessary assumption in order to be able to use world GDP is that it is independent from GDP in Europe (and thus, from the *EI* variable). World GDP growth captures growth in the EU as well, but in my opinion it is safe to argue that the EU accounts for too small a share of world output to significantly influence world GDP.

Summary statistics for all variables are provided in the appendix.

Estimation results

Table 1 displays the main regression results. Before including my variable of interest, European integration, I first show that the convergence and Solow model implications hold for my dataset. Column (1) shows a regression with only initial GDP and investment in physical and human capital as explanatory variables, plus the necessary control variable world GDP growth. The negative and significant coefficients on initial GDP show that there is beta-convergence in my dataset: Poorer countries are growing faster than richer ones, the conditional rate of convergence being approximately 11 per cent per year – which is high compared to what has been found earlier in regional datasets (see e.g. Barro and Sala-i-Martin 2003; for transition countries, see Rapacki and Próchniak 2009b). This suggests that the CEE countries are far away from their respective steady states. Human and physical capital have a significant positive effect on growth, as predicts theory: Raising the net returns on capital by one unit would yield 0.03 percentage points more growth while one more year of education for each citizen would raise annual growth rates in the medium-run by 2.21 percentage points. World GDP growth also positively impacts growth rates in CEE as expected.

In the next step, *EI* is added to the regression. Column (2) and (3) show the effect of European integration on growth under simplified model specifications while column (4) is the main estimation. The coefficient on *EI* is positive and significant throughout all three specifications, implying that

European integration has a growth-enhancing effect. All control variables are significant (*OPEN* only at the 10 per cent level) with notably *TRANS* being an important explanatory factor of growth in CEE: The further countries have advanced in their transition towards capitalism, the more they grow. The coefficient on European integration in specification (4), 0.12, means that an increase of EU trade over total trade by one percentage point will boost the annual GDP growth rate by 0.12 percentage points. Considering that from 1995 to 2010, the average share of trade with EU27 in total trade grew from 64 to 71 per cent, the accumulated growth effect during this period is 0.84 percentage points, which is quite considerable. Assuming that growth benefits of European integration will persist for some more years – the exact period depending on how long is the medium-run, which will end once a new steady state is reached –, the total effect of European integration will be even higher.

Table 1: Baseline Regression

dependent variable: growth

VARIABLES	(1)	(2)	(3)	(4)
y0	-10.7681***	-6.0983***	-11.7036***	-15.0954***
	(1.0828)	(0.4070)	(1.3732)	(1.9847)
cap	0.0318***		0.0336**	0.0301**
	(0.0086)		(0.0133)	(0.0111)
educ	2.2063***		1.7712***	1.2076**
	(0.4663)		(0.4753)	(0.4196)
open				0.0262*
				(0.0123)
trans				4.6180***
				(0.8494)
ei		0.2227***	0.1727***	0.1174***
		(0.0563)	(0.0388)	(0.0296)
world_growth	2.1445***	2.2358***	2.0201***	1.9927***
	(0.1581)	(0.0686)	(0.0955)	(0.1051)
Constant	71.3856***	41.8192***	74.8850***	96.0204***
	(10.4440)	(4.6552)	(12.2616)	(16.5486)
Observations	117	120	117	117
R-squared	0.6836	0.6930	0.7526	0.8191
Number of groups	10	10	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

I also tested whether the effect of *EI* takes a non-linear form, but a quadratic *EI*-term introduced into the equation turned out not to be significant. Furthermore, to find out whether the effect of European

integration varies according to the level of economic development or transition success, interaction terms between *EI* and *y0* and between *EI* and *TRANS*, respectively, were introduced. Coefficients on both terms were insignificant, so apparently the effect of European integration does not depend on how rich a country is or how well it managed transition while at the same time, European integration does not slow down or speed up convergence and transition dynamics.

In order to find out whether it is mainly trade with the old EU member countries or with the other new EU entrants that boosts growth, the analysis is repeated using trade with the EU15 relative to total trade as a specification of the EI variable. As Table 2 shows, the coefficient on the main linear specification, column (2), is significant and only marginally higher, which means that integration with old and new member states had a similar growth effect. This result is surprising since intra-CEE trade and trade between CEE and EU15 countries differs in terms of commodity composition[5] as well as in terms of the intensity of trade links that existed prior to the start of the integration process. It seems that these structural differences do not have any significant effects on the trade-growth channel.

Interestingly, when a quadratic term is included in addition to the linear term in column (3), both coefficients are significant. So integration with EU15 as such has a positive effect (and a higher one than before), but the higher the level of integration already achieved, the more this effect is mitigated. In consequence, the total effect will become negative once the share of EU trade over total trade exceeds 71.7 per cent, which in 2010 already applied to five CEE countries out of ten.

[5] See Crespo and Fontoura 2007 for a detailed analysis. It should be stressed, as shown by the authors, that the commodity composition of CEE countries' trade has also undergone significant changes since the 1990's.

Table 2: Regression with EU15 Trade.

dependent variable: growth			
VARIABLES	(1)	(2)	(3)
y0	-10.4191***	-13.9485***	-14.2481***
	(0.5467)	(1.2961)	(1.0211)
cap	0.0395***	0.0340***	0.0332***
	(0.0104)	(0.0086)	(0.0074)
educ	1.7611***	1.3756**	1.6495***
	(0.3722)	(0.4612)	(0.5042)
open		0.0173	0.0172
		(0.0140)	(0.0128)
trans		4.4667***	3.9783***
		(0.5391)	(0.5161)
ei_15	0.1770***	0.1232***	0.4300***
	(0.0178)	(0.0160)	(0.0784)
ei_15*ei_15			-0.0030***
			(0.0006)
world_growth	1.7876***	1.8028***	1.7960***
	(0.1078)	(0.0773)	(0.0821)
Constant	64.5457***	86.1681***	80.2315***
	(5.7847)	(11.6126)	(8.8981)
Observations	117	117	117
R-squared	0.7885	0.8398	0.8442
Number of groups	10	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Another question that I analysed is whether EU integration has had the same growth effect in all CEE countries. Bulgaria and Romania entered the EU three years later than the other CEE countries, and these two countries were also laggards in economic transition, so it seems possible that their speed of convergence is slower than that of the other countries. This would not be captured in the standard convergence model since it is a fundamental assumption of neoclassical growth theory that the speed of convergence is the same for all countries, even though their starting points are allowed to differ. A test of parameter heterogeneity brought however the result that Bulgaria and Romania did not behave structurally different with respect to their speed of convergence or the growth effect of integration.

Robustness checks

In order to address a possible omitted variable bias, I include additional control variables in the regression which are suspect to influence growth while at the same time being correlated with *EI*. In the regressions reported in Table 3, I check some variables that are frequently found to have explanatory power for economic growth (see Durlauf et al. 2005: 652 ff): a monetary variable (the inflation rate, World Development Indicators), a fiscal variable (government consumption as per cent of GDP, Penn World Tables), a variable capturing population dynamics (population growth, World Development Indicators), and a proxy for the quality of political institutions (the control of corruption index of the World Bank's Worldwide Governance Indicators). Furthermore, economic growth of the CEE countries' European trading partners might influence both growth rates in CEE and trade integration with the EU countries. This is why I also included trade-weighted growth of the EU27 countries in the regression, which is the sum of GDP growth in European trading partners weighted by their shares in EU trade (Penn World Tables and DOTS).

None of the control variables changes the coefficient on European integration much, so there has not been an omitted variable bias caused by any of these variables before. However, when all control variables are included jointly, the EI coefficient becomes insignificant[6]. Only inflation and population growth are significant when included separately; inflation has a negative effect on growth (which however disappears in a regression including all control variables jointly), the growth rate of the population has a positive effect on economic development in CEE[7].

[6] Under alternative specifications of the AR process of errors, it is still significant at the 10 per cent level.

[7] This result stands in contrast with the negative effect of population growth that is mostly found in growth studies (e.g. Mankiw et al. 1992, for an overview see Durlauf et al. 2005: 657). However, contrary to studies using a global sample, there is a positive correlation between population growth and initial GDP in my sample.

Table 3: Additional Control Variables.

dependent variable: growth

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
y0	-15.0954***	-14.5205***	-15.3132***	-15.2990***	-16.9274***	-14.4748***	-14.4319***
	(1.9847)	(1.7176)	(1.8630)	(2.1603)	(2.4219)	(1.2067)	(0.8679)
cap	0.0301**	0.0333**	0.0306**	0.0276**	0.0433***	0.0286***	0.0582***
	(0.0111)	(0.0150)	(0.0107)	(0.0106)	(0.0120)	(0.0083)	(0.0143)
educ	1.2076**	1.2805***	1.2667***	0.9241*	1.3777***	1.2253**	1.6405***
	(0.4196)	(0.3541)	(0.4047)	(0.4648)	(0.2643)	(0.4171)	(0.2419)
open	0.0262*	0.0257**	0.0269**	0.0305**	0.0366***	0.0265*	0.0284***
	(0.0123)	(0.0093)	(0.0122)	(0.0133)	(0.0104)	(0.0124)	(0.0030)
trans	4.6180***	4.5646***	4.6084***	4.8801***	4.7181***	4.7389***	4.5493***
	(0.8494)	(0.8804)	(0.7657)	(0.9574)	(0.9932)	(1.1337)	(1.2514)
ei	0.1174***	0.1168***	0.1132***	0.1270***	0.1099**	0.1188***	0.1053
	(0.0296)	(0.0297)	(0.0282)	(0.0289)	(0.0387)	(0.0305)	(0.0632)
gov		0.2008					0.4979
		(0.1503)					(0.2752)
infl			-0.0010**				0.0103
			(0.0004)				(0.0093)
pop				0.5288**			0.3220*
				(0.2332)			(0.1468)
corr_control					0.1016		0.1816
					(0.1891)		(0.3310)
partner_growth						0.0022	0.0052
						(0.0040)	(0.0036)
world_growth	1.9927***	1.9438***	1.9774***	2.0601***	1.9828***	1.7646***	1.3043**
	(0.1051)	(0.1028)	(0.1001)	(0.1093)	(0.0895)	(0.4112)	(0.4481)
Constant	96.0204***	87.5099***	97.6766***	99.2599***	108.8309***	90.0626***	78.0654***
	(16.5486)	(11.1166)	(15.9122)	(18.0762)	(18.9905)	(9.1896)	(7.3566)
Observations	117	117	117	117	79	117	79
R-squared	0.8191	0.8274	0.8212	0.8237	0.8307	0.8201	0.8581
Number of groups	10	10	10	10	10	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Another possible endogeneity problem is reverse causality, which poses a problem for the vast majority of explanatory variables used in growth regressions[8] and could intuitively also apply to European integration: Not only might integration boost economic growth but growth might also lead to more integration. The fact that the European integration variable is pre-determined does not refute endogeneity since economic growth could be anticipated. One way of addressing reverse causality is

[8] Reverse causality between trade openness and growth is one of the most obvious cases. The well-known argument that next to openness leading to growth, growth also leads to openness (see e.g. Frankel and Romer 1999) does however not apply to European integration since it is measured as share of total trade and not as share of GDP.

to find a suitable instrument for European integration. A simple instrument would be a dummy for EU membership, but such a binary variable is only weakly correlated with *EI* since, as argued above, integration was not a one-off event. Indeed, using a membership dummy as an instrument for *EI* in the regression does not yield any significant results. A more convincing check for reverse causality is provided below.

Complementary Analysis: Rajan-Zingales Estimation

In a seminal paper, Rajan and Zingales (1998) tried to identify the relationship between finance and growth by investigating whether industries that are more dependent on external financing grow relatively faster in countries that are more financially developed *a priori*. Known under the name of its inventors, this difference-in-difference type of estimation technique has since been applied to various other contexts, for the area of the European Union e.g. to analyse the growth effects of financial integration (Guiso et al. 2004) or the effect of foreign direct investments in CEE (Friedrich et al. 2013). The strong point of this technique is that thanks to the additional panel dimension introduced by industry data, it is able to address the reverse causality problem convincingly: If the explanatory variable of interest (in Rajan and Zingales (1998) financial development, in my case European integration) simply anticipated growth as reverse causality suggests, all sectors would be affected in the same way and no sectoral growth dividend should be discernible.

Transferring the underlying principle of Rajan and Zingales (1998) to my research question, it means analysing whether European integration disproportionally benefits industries that entertain closer ties with industries from other EU countries *a priori*. If European integration has a positive growth effect, the growth differential between these industries and non-EU dependent industries should be more in favour of EU-dependent industries in countries that are more integrated. As a proxy for EU dependency can serve export dependency since exporting industries are the ones that benefit the most from the establishment of the Single Market's freedom of trade in goods.

The estimation equation is then formulated as

$$growth_{i,k,t} = a_{i,k} + b_{k,t} + c_{i,t} + \alpha share_{i,k,t-1} + export\_dep_{i,k}(\beta EI_{k,t} + \gamma TRANS_{k,t}) + \varepsilon_{i,k,t} \quad (4)$$

where *a*, *b* and *c* are country-industry, country-time and industry-time fixed effects, *growth* is the (one period) growth in value added in industry i, country k and time t, *share* is the initial share of industry i in total manufacturing of country k at t-1, *export dep.* is my measure of export dependency of each country-industry pair and the variables *EI* and *TRANS* are the same as in the main analysis. The variable *TRANS* has to be included in the analysis again because it might influence industry growth in a way similar to European integration, i.e. a higher achieved level of economic transition might disproportionally benefit industries with a high export dependency, so that this effect might erroneously be captured by *EI* if *TRANS* is omitted.

The sample contains the same countries as the original sample, but the time period is restricted to 2000-09 due to the need to use out-of-sample data to construct the measure of export dependency (see below). Data for the industry-level variables are taken from the UNIDO's Indstat4 and IDSB (Industrial Demand-Supply Balance) datasets, which supply information at the level of 4-digit ISIC codes. The growth rates of value added are log-differences of deflated nominal values. Since industry data tends to be rather noisy, I drop the top and bottom 2% of the distribution. The initial share of an industry-country pair is the value added in that industry as a fraction of total value added in the manufacturing sector of the respective country at t-1. It accounts for the industry structure and should be included in the regression because it seems likely that growth rates are dependent on the size of the industry. Export dependency is computed as the share of exports in total output of each industry-country pair. In accordance with Rajan and Zingales (1998), I use data from a time period outside the sample period, the 1990's, to avoid endogeneity problems,. Because data coverage varies across countries, I take the median of the annual values from 1990 to 1999.[9] Additionally, I delete industry-country pairs with only one observation. Growth rates as well as initial share and export dependency

[9] Using the median instead of the mean serves to reduce the influence of outliers. In the years following the fall of the Iron Curtain, CEE countries first had to learn to exploit their comparative advantage vis-à-vis their new trading partners in the West, which is why the export pattern of some industries still underwent changes during that period.

are converted for the convenience of interpretation into percentage values by multiplication by 100. Summary statistics of all variables can be found in the appendix.

The estimation technique used is OLS with clustered standard errors, following the result of a Levene test for spacial correlation. Table 4 below shows the regression results, in column (1) with only an interaction term between export dependency and *EI*, in column (2) with an additional term containing *TRANS*.

Table 4: Regression results Rajan-Zingales analysis

dependent variable: growth		
	(1)	(2)
VARIABLES		
share	-7.6587***	-7.6633***
	(1.7651)	(1.7661)
export dep.*ei	0.0180***	0.0181***
	(0.0049)	(0.0047)
export dep.*trans		-0.0480
		(0.2931)
Constant	27.1794***	-115.0536
	(6.5366)	(106.7334)
Observations	4,512	4,512
R-squared	0.5095	0.5095

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The coefficient on the interaction term export dependency-European integration is positively significant at the 1% level, meaning that there is a growth bonus for the exporting industries relative to others when the country they are located in becomes more integrated. This effect is not mitigated when controlling for the impact of economic transition from plan to market economy. Thus, the industry-level analysis supports the results of the macroeconomic growth regression; it does not seem the case that the results presented in table 2 were suffered from reverse causality. Note that the coefficient on EI cannot be interpreted in terms of absolute growth effects, since the level effect of integration is absorbed by fixed effects in the regression. In general, Rajan and Zingales analysis only allows for relative statements, a comparison of the size of the growth effect to the estimate obtained in the macroeconomic analysis is thus not possible.

Conclusion

This paper has attempted to answer the question whether the accession to the European Union of the ten CEE countries has had a positive effect on their economic growth. Building on the Solow growth theory, the empirical analysis confirmed that there is a significant medium-run growth effect of trade integration within the countries of the EU. Although the yearly growth benefit is relatively small, aggregated over a period of several years it becomes substantial. The analysis has further shown that the effect is similar whether integration with all EU members or with the EU15 is considered, that it is the same for the accession countries of 2004 and 2007 and that the results are robust to alternative specifications of the regression equation and variables of interest. An industry-level Rajan-Zingales analysis has confirmed the results. The paper thus makes an argument in favour of EU membership of CEE countries and in this way not only helps to justify the European integration process of existing members, but also provides a point of departure for discussions on EU membership in candidate or potential candidate countries.

At the same time, there are economic benefits from European integration that have not been captured in the analysis; taking them into account would make the growth effects of the EU's eastern enlargement even larger. In the following, I will give a short overview of these effects.

Firstly, this analysis has been limited to the new EU countries; it does not allow for any statement about the economic effects of EU enlargement on the incumbents. Several ex-ante studies (e.g. Baldwin et al. 1997, Neck et al. 2000, Breuss 2001, Sulamaa and Widgren 2003) have attempted to estimate the effect on the EU15 countries and came to the result that for this group, the 2004/07 enlargement would have a small positive effect of up to 0.2 per cent of real income.[10] Thus, enlargement benefits are not limited geographically to the countries I have analysed. Secondly, EU membership, and the prospect of accession, added to the economic attractiveness of CEE not only for other EU countries but also for the rest of the world, for example by lowering risk premiums. Joining a club of highly developed countries with stable institutions held a long-term promise for a safe

[10] Next to there being countries that benefit at a much larger scale, like Germany, Austria and Italy, there are however also countries that suffer long-term economic losses due to enlargement, like Spain and Portugal (see Breuss 2001).

investment climate and reliable trading partners in CEE. This is likely to have attracted the interest of firms from outside the EU as well and to have encouraged them to develop business relations within the region. Indeed, CEE combines the attractions of developing countries (high marginal returns on capital, cheap labour that is at the same time well trained thanks to the Soviet education system) with the institutional stability of advanced countries. The trade between CEE and the world in total has increased, which has been captured in my analysis by the openness variable; how much of this effect is due to European integration cannot be measured. Thirdly, CEE countries benefited from EU accession not only through joining the common market – which has been approximated by my trade integration variable – but also through direct financial transfers in the form of pre-accession assistance and, as EU members, access to structural funds and direct payments in agriculture. Taking this channel into account would further increase the CEE countries' growth benefits from European integration[11]. And finally, it is not clear how the CEE countries would have developed had they not been offered the possibility of becoming EU members in the 1990's. Would they have stayed on the economic transformation path that they subscribed to after the collapse of the Soviet bloc? Would privatization, enterprise transformation and price liberalization have been carried out to the same extent? Would executives in CEE have been as committed to establishing democracy and rule of law or would the countries have taken an authoritarian turn as some of their eastern neighbours? Maybe CEE countries would have been as successful in all these aspects without the prospect of EU accession, but it seems reasonable to assume that at least some part of the success can be attributed to European integration.

[11] Studies that have estimated the effect of structural funds transfers on economic growth are for example Beugelsdijk and Eijffinger 2005 and Becker et al. 2010.

Appendix: Summary statistics

Table A.1 Growth variables.

Variable	Mean	Std. Dev.	Min.	Max.	Obs.
growth	3.570	1.953	-1.63	8.020	120
y0	9.407	0.395	8.632	10.209	120
cap	85.159	19.389	14.675	126.086	117
educ	10.703	1.033	8.840	13.086	120
ei	69.004	8.307	41.467	82.262	120
open	93.657	27.672	37.354	156.506	120
trans	3.655	0.296	2.610	4.060	117
world_growth	1.868	0.482	1.410	2.890	120
gov	9.311	2.605	4.808	15.848	120
infl	17.005	84.748	-1.13	1058.374	120
pop	-0.291	0.471	-1.911	0.904	120
corr_control	0.297	0.425	-0.820	1.320	79
partner_growth	168.477	76.659	-5.379	328.596	120

Table A.2 European Integration variable by country.

Country	Mean	Std.Dev.	Min.	Max.	Obs.
Bulgaria	53.173	5.325	41.467	58.398	16
Czech Republic	77.110	2.189	71.372	80.033	16
Estonia	69.789	4.570	63.473	77.479	16
Hungary	72.185	1.798	68.992	76.146	16
Latvia	71.400	4.740	60.119	75.469	16
Lithuania	57.980	4.123	49.433	64.329	16
Poland	71.820	1.342	69.018	74.385	16
Romania	66.849	5.241	55.400	72.396	16
Slovakia	78.149	2.514	72.700	82.262	16
Slovenia	71.582	2.214	67.867	76.093	16

Table A3: Summary statistics Rajan and Zingales analysis

Variable	Mean	Std. Dev.	Min.	Max.	Obs.
variables measured at the country-industry-year level					
growth (2^{nd} to 98^{th} percentile)	2.496	28.748	-103.503	142.487	7,824
initial share	0.884	1.334	0	17.924	9,303
variables measured at the country-industry level					
export dependency	37.657	24.644	0	88.507	907
variables measured at the country-year level					
ei	70.130	7.275	51.757	82.262	100
trans	3.754	0.201	3.28	4.06	98

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