New empirical insights into the growth effects of economic integration within EU

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Abstract:

This paper investigates the existence of medium and long-run growth effects of economic integration within the European Union. We apply the system GMM methodology to estimate a number of dynamic panel data models. The study is undertaken for a panel sample consisting of 27 advanced economies and covering eight time periods between 1960 and 1999. We propose a number of new economic integration variables which presumably better reflect the complex nature of the economic integration process within the EU characterized by gradual widening and deepening. Our results point to an existence of a positive long-term relationship between economic integration and growth rates of real GDP per capita. At the same time we identify a negative medium-run effect on growth of accession into the EU. Both deepening and widening of the economic integration are found to be beneficial to long-term growth performance of Member States. The benefits associated with accession and membership in the EU are found to be asymmetrical.

Keywords: economic growth, European economic integration, dynamic panel data models, system GMM estimator

JEL codes: F15, O53, C23

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Introduction

The existence of a long-term growth effect of regional economic integration understood as a permanent increase in the long-term average rate of growth of GDP per capita cannot be accommodated within the neoclassical growth framework model and its extensions (for instance Solow 1956; Mankiw et al. 1992). Similarly to the influence of economic policy the neoclassical growth theory allows only for temporary increase in the growth rate as the economy moves to a new steady-state. At the same time the advocates of the new endogenous growth theory postulate that regional economic integration can lead to permanent changes in the rate of growth of integrating economies through various transmission channels. This for instance could be due to scale effects or increased diffusion of knowledge or technology. It is worth to point out that certain models (e.g. Baldwin and Forslid 2000) allow for both positive and negative impact on growth rates at the same time (asymmetrical effects in a core-periphery setting). Depending on specific characteristics of a given regional integration arrangement as well as given national or regional economy within its area, economic integration could have negative, positive or neutral effect both on the long-term as well as medium-term growth rates. Furthermore, taking into account the asymmetric character of most large regional integration arrangements (this applies in particular to the case of economic integration within the European Union) one could expect the potential growth effects to be asymmetric to a larger or lesser extent. To sum up there are many competing theoretical models with frequently conflicting consequences not only on the significance or direction but as well on the mere existence of accumulative effects of economic integration[1]. As is usually the case making a choice between conflicting theories necessitates elaborate and laborious empirical analysis.

Preceding empirical studies and the background of the present analysis

A significant number of empirical studies on the impact of economic integration on growth in general and of integration within the EU in particular has been conducted so far. The studies have utilized various econometric approaches. These have included: time-series analysis (e.g. Landau 1995, Vanhoudt 1999), standard growth regression analysis (e.g. Henrekson et al. 1996), static panel data models (e.g. Torstensson 1999) as well as dynamic panel data models

[1] A number of theoretical studies have been carried out on the growth effects of economic integration. These include for instance Baldwin (1989 and 1992), Bretscheger and Steger (2004), Deardorff and Stern (2002), Devreux and Lapham (1994), Haveman et al. (2001), Krugman and Venables (1993), Mazumdar (1996), Rivera-Batiz and Romer (1991, 1994), Waltz (1997a, 1997b, 1998), Willenbockel (1998 and 2001), Zielińska-Głębocka (2001).

(e.g. Badinger 2001). Potential growth effects have been analyzed both directly or indirectly through investigation of potential channels. As in the case of theoretical modeling, results of empirical studies conducted to date are rather inconclusive. Some studies point to existence of positive and statistically significant long-term effects of membership in the European Union. The study by Henrekson et al. (1996) estimated cross-sectional growth regressions for a sample of 115 countries and various specifications (they also constructed panel data models for 22 OECD countries). Authors identified positive and statistically significant effects of the membership in the EC and EFTA on economic growth (using EC/EFTA dummies). It showed furthermore that there was no significant difference between the membership in either of the regional integration arrangements.

In a study for the EEC-6 countries in the period 1961-1992 Italianer (1994) utilized integration-depicting variables based on trade flows. He identified important growth effects of both regional economic integration as well as of general levels of openness.

Torstensson (1999) conducted an analysis on a panel consisting of 20 OECD countries and covering three time periods between 1976 and 1990. The author empirically identified two channels linking economic integration to growth through investment and knowledge transfers. Torstensson interpreted it as an indirect argument for existence of growth effects of the EU. Baldwin and Seghezza (1996) in turn found proof of technology diffusion channel but rejected the integration-investment linkage. Brada and Mendez (1988) using an OLS estimation of a pooled data set found the membership of EEC to positively affect investment rates of its member states but provided no proof of integration – growth linkage. It is worth to point out that alongside standard economic integration dummy variables they introduced an interesting variable reflecting transitory effects related to EEC accession.

Results of other studies as well speak against existence of significant growth effects related to the membership in the EU whatsoever. For example, the study by Landau (1995) found that there had been no statistically significant difference between the growth of EEC member and non-member countries in a sample of 17 OECD countries in the period of 1950-1990. This would suggest that the there were no long-term growth effects associated with the membership in the EC.

Badinger (2001) through time-series analysis as well as static and dynamic data models (comparison between LSDV and GMM approach) for EU member states found no permanent increase in growth rates related to economic integration within the EU. Badinger constructed an interesting integration index that took into account both regional economic integration

within EU as well as liberalization at the multilateral level (broad liberalization). Badinger identified, however, important level effects – without economic integration real GDP per capita for the EU Member State would be on average 20 per cent lower than it was – economic integration within EU played marginal role – increase in productivity and multilateral integration dominated.

Utilizing panel data analysis for 23 OECD countries Vanhoudt (1999) found no positive or negative growth effects for the EC members in comparison to non-member OECD states. The analysis of the time-series data for EU member states showed the time series for economic growth to be stationary around two trend lines before and after the structural break of 1973. It is worth to note that Vanhoudt based his specification on an augmented neoclassical growth model of Mankiw, Romer and Weil (1992).

In an interesting study utilizing various specification of unbalanced data panel models with fixed effects and simple integration dummies for large samples of countries within a period 1950-1992 Vamvakidis (1999) showed that participation in regional integration arrangements (RTAs) was on average associated with slower growth rates than following a policy of broad liberalization. Broad liberalization dummies were statistically significant, it wasn't the case for regional integration dummies. Within a similar context of a large panel data set Haveman et al. (2001) found both being a free trade area or customs union member as well as being open in general to be growth-enhancing. Furthermore, the study found the scale of an integrated area not to affect growth in contrast to the scale of income dispersion within its borders.

For a balanced data panel of 20 countries in the period 1960-1999 and using LSDV approach Brodzicki (2003) found no statistically significant effect related to the EU membership (EU membership given by a simple dummy variable). In contrast, the length of membership in the EU and the scale of the EU economy were found to have positive impact on growth performance of its Member States. Similarly, Crespo-Cuaresma et al. (....) in a specification of a panel data model with fixed effects (for EU Member States – excluding Luxembourg and four subperiods of uneven length within 1960-1998) and using threshold panel data approach found the length of membership to positively affect growth rates of the Member States. The authors claim furthermore that economic integration within the EU led to asymmetric, convergence-stimulating effects.

The general conclusion to be drawn from the aforementioned empirical research is that the results obtained are very sensitive and that they do not provide clear-cut answers to existing questions. The results seem to depend largely on:

- the selection of sample (countries) and the period of analysis
- methodological approach followed or adopted (cross-section analysis – standard growth regressions, time series analysis, data panel) as well as to selection of explanatory variables and relations between them
- the way in which the integration enters the specification (from simple dummy variables to more complex indices based for instance on intensity of trade flows)
- respecting the principles and limits of econometric methodology – taking account of potential problems with econometric estimation.

The principal aim of this paper is to use more elaborate econometric methodology in order to identify potential medium-term and long-term growth effects due to economic integration within the EU. A further contribution is to construct and test a set of new economic integration related variables which could allow for more robust verification of the following working hypotheses:

- regional economic integration can lead to accumulative effects understood as permanent changes in the average growth rate of real GDP per capita in the long-run (new growth theories) or to medium-term effects (neoclassical growth framework) – temporary effects on the transition path to a new steady-state,
- direction of the accumulative effect is not conclusive – depending on particular circumstances it could be positive, neutral or negative
- structural heterogeneity of economies leads to asymmetrical growth effects
- consecutive stages of regional economic integration (from the FTA till EMU) could be accompanied by new growth-stimulating developments; integration deepening could be conductive to growth by further liberalizing trade and factors of production flows, stimulating diffusion of knowledge; different stages could be associated with the dominance of different growth-enhancing transmission channels
- widening of regional integration agreement brings about significant benefits in terms of increased medium-term/long-term growth rates of real GDP per capita

We begin with analysis of stylized facts concerning growth performance of the EU Member States. As a next step simple statistical methods are utilized in order to identify medium-term effects of accession into the EU and of consecutive enlargements of the EU[2]. The principal part of the analysis is focused on an econometric estimation of panel data models. According to Ciecieląg and Tomaszewski (2003) panel data models bring a number of benefits in an econometric estimation of a model in comparison to standard growth regressions approach. Among others they:

- simplify identification of existing economic relations between variables and make easier choosing between competing hypotheses,
- allow for estimation of dynamic processes,
- existence of sequential observation for a given entity in a number of consecutive subperiods allows for identification of individual effects and having control over them,
- the estimation bias caused by omission of variables or inadequate specification of a model is significantly lowered in comparison to cross-sectional models,
- more observations lead to an increase in a number of degrees of freedom,
- reduce problems with collinearity of explanatory variables.

The nature of both economic growth and of economic integration – characterized by functional spillovers and gradual deepening, suggest use of dynamic models as preferred tools of analysis. As Greene (2004) points out panel data are well suited for examining dynamic effects. It is worth to point out, however, that in contrast to standard growth regressions the current level of GDP per capita and not the growth rate of real GDP per capita is the dependent variable in a dynamic setting. In turn we find its lagged value among the explanatory variables. This leads to severe complications in estimation. In some studies researchers utilize a popular GMM estimator of Arellano and Bond (1991) which was supposed to deal with potential bias in the estimation of dynamic panel data models. However, as Bond, Hoeffler and Temple (Bond et al. 2001) point out that when time series are persistent, and this is in particular the case with dynamic analysis of economic growth, the first-differenced GMM estimator can be poorly behaved and estimates are seriously biased. As a solution Bond, Hoeffler and Temple proposed to use more informative set of instruments provided within the framework of the system GMM estimator developed by Arellano and

[2] In order to simplify the discussion we refer to the EU to all developments related to regional economic integration within Western Europe since the creation of EEC-6 in 1958.

Bover (1995) and Blundell and Bond (1998). Following their recommendations we have decided to utilize this estimation technique in the current analysis (system GMM estimator is available in STATA's xtabond2 module).

Some stylized facts and statistical analysis

The point of departure in the present empirical analysis is the statistical analysis of growth of real GDP per capita (in constant prices)[3] in the period 1955 – 1999 for a group of 27 economies. The group consists of all EU-15 Member States[4] and a reference group of 12 other advanced economies – members of the OECD. The principal source of data is the Heston, Summers and Aten (2002) data set - Penn World Table PWT mark 6.1.

The average rate of growth of real GDP per capita for the whole group of 27 economies in the period 1955-1999 amounted to 2,8 per cent and was higher by only 0,1 per cent in comparison to the average for the period 1960-1999[5] (please refer to Table 1). An average growth rate for the EU-15 was higher in both periods in comparison to the reference group of twelve economies by 0,1 per cent as well. In the period 1960-1999 among the EU-15 MS the United Kingdom and Sweden had the slowest pace of growth (2.01 and 2.05 per cent on average) followed by Denmark (2.13 per cent) and the Netherlands (2.35 per cent). The group of fast growing economies consisted of Ireland (3.85 per cent on average) and Portugal (3.76 per cent), Spain (3.32 per cent) and Luxembourg (3.16 per cent)[6]. In the reference group only South Korea (5.73 per cent) and Japan (4.13 per cent) experienced on average higher rates of growth of real GDP per capita within the same period. Three economies from the reference group had growth rates not acceding on average 2 per cent – Mexico (1.74 per cent), Switzerland (1.35 per cent) and New Zealand (1.17 per cent).

Both in general as well as in a group limited to the EU-15 Member States we observe a steady decline in rates of growth of real GDP per capita throughout four analyzed decades. In the case of EU-15 the rate fell from an average of 3.9 per cent in the 1960s to only 1.9 per cent in the 1990s. It is worth to point out, however, that the situation varied considerably between Member States. The declining trend is particularly evident for Belgium, France, Italy,

[3] The growth rate is calculated as a natural logarithm of a ratio of final to initial value of a variable divided by the length of a period in growth rate=ln(yk/yP))/n. If n is long enough this allows for reduction of disturbance caused by cyclical factors.

[4] In the specific case of Germany for the period 1955-1990 we took into account only Federal Republic of Germany. Within the period 1991-1999 the data are for unified Germany.

[5] Due to the lack of data for human capital in the panel data analysis the data set had to be limited to the period of 40 years spanning from 1960 to 1999.

[6] For several reasons Luxembourg should be treated as an outlier – it had the highest initial level of GDP per capita and had one of the highest average rates of subsequent growth in real GDP per capita.

Germany, Spain, Portugal and Austria. The crises of the 1970s affected the EU economy to a greater extent that the economies of the reference group. Moreover, we can identify three major growth take-offs (understood as significant increase in average growth rates between successive decades) in the case of Luxembourg in the 1980s and Ireland and Greece in the 1990s. The Irish case is particularly appealing to new accession countries from Central and Eastern Europe – this cohesion country with GDP per capita not acceding 75 per cent of EU average managed to become the second most prosperous economy in the EU within a relatively short period of time.

If the analyzed period is divided into 5-years long subperiods the general declining trend in growth rates is still evident for both groups of countries with two major structural breaks in the second half of the 1980s and 1990s (the structural brakes were more evident in the case of the later group).

It is worth to finish the analysis of long-term tendencies in growth with a short look at the issue of absolute convergence and the related catch-up effect as postulated by neoclassical growth theory. As Figure 1 clearly indicates we could speak of absolute beta-convergence among the economies of EU-15 in the period of 1960-1999. The negative relation between the log of initial real GDP per capita and the average growth rate in the subsequent period is evident. A major issue off course is whether the rate of observed convergence was affected by the economic integration process (positively or negatively) or would it happen either way and thus economic integration was neutral. This is an important issue as a negative answer could speak against equalization-oriented structural policies of the European Union[7]. Figure 1 clearly points to an outlier-nature of Luxembourg (its omission would increase R square of a linear trend from 63 to 85 per cent).

The stylized data do not show clear benefits related to EU membership in terms of higher growth rates in comparison to the benchmark group. At the same time we could speculate that the potential growth-stimulating effects could be offset by a general decline of growth rates among advanced industrialized economies and by existence of general cycles as well as of global demand/supply shocks. Their impact seems to be increasing with continued progress of globalization characterized by greater openness and thus mutual interdependence.

It is thus important to empirically verify whether accession into the EU or consecutive enlargements (increases in the scale of the integrated area) led to medium-term growth effects

[7] At the regional level the extent of dispersion among the EU-25 in 2002 is striking; according to EUROSTAT – the least wealthy NUTS-2 region in Europe – Lubelskie in Poland had only 32 per cent of EU-25 average of PPS adjusted real GDP per capita and the wealthiest – Greater London 315 per cent.

for its Member States? A relatively simple statistical analysis should provide an initial insight into the problem (please refer to Table 2). While interpreting the results of such an exercise we should remember that the analysis is biased by the fact that we pool together observations from different subperiods. First two columns compare average growth rates of real GDP per capita between pre- and post-EU-accession subperiods (both 5 years long). The third column shows an absolute difference between the two subperiods (green shading depicts an increase, red shading - a decline). Despite of an observed increase of 0.9 per cent in the EU-15 average growth rate for the post-accession period the situation varies greatly between individual Member States. Only in the case of the Iberian and northern enlargements all acceding economies experienced significantly higher growth rates in the post-accession phases. When one takes into account the values of standard deviation for the pre- and post-accession periods – which has been proven by adequate statistical test, one has to conclude that there is no statistically significant difference between the averages. Furthermore, we have to take into account that an accession to the EU is preceded by an adjustment period within which the growth effects can already take place. It constitutes a further bias.

In the next columns an analogous analysis has been carried out for four consecutive cases of EU enlargement in 1973, 1981, 1986 and 1995. We could argue that potential growth effects at least in the medium-run and/or in the long-run should be larger the higher the scale and economic potential of acceding states (both in relative and absolute terms), the more significant are the structural differences between the two groups of economies (greater possibility for efficiency-boosting reallocation effects) and the more advanced is the economic integration process itself (both in terms of negative and positive integration in Tinbergen's terminology). The actual enlargements brought about significant increases in the scale of the EU economy both measured by total population or total GDP (please refer to Table 3). This in accordance with new growth theories should at least lead to changes in medium-term growth rates of member states not mentioning permanent impact[8]. It is thus important to note that only in the case of the first and the last enlargement (1973 and 1995) the differences between averages for Member States are statistically significant at least at the 10 per cent level of statistical significance. In the cases of the second and the third enlargement the differences between pre- and post-enlargement average growth rates are statistically insignificant.

[8] We intentionally omit the word "increase" because despite a dominating expectation of positive growth effects of economic integration some more advanced theoretical models allow negative effects to occur or the process to by asymmetrical for instance lead to positive effects for core-economies and negative effects for the peripheries.

The potential positive benefits of enlargement in 1973 were clearly off-set by the first oil crises constituting a severe supply shock to a global economy as well as effects of dissolution of the Bretton Woods system. The accession of Greece, taking into account the relative and absolute size of the Greek economy in comparison to EEC-9, should not have made a large impact. The actual outcome – a fall in average growth rates could once again be attributed to general developments in the global economy at the outset of the 1980s. The observed positive outcomes of the next two enlargements – Iberian and northern could be at least partially attributed two developments in the global economy in the second halves of 1980s and 90s (positive disturbance). However, we should note that the advancement in the economic integration process since the second half of the 1980s (internal market program, EMU) could have boosted the positive effects related to increases in the scale of the integrated area through enlargement. This should be taken into account in the subsequent – more elaborate analysis. Simple statistical analysis cannot therefore disclose positive growth effects of integration deepening or widening. In order to exclude the effects/disturbances we should employ more elaborate methods of econometric estimation.

Econometric analysis of dynamic data panel models

As has been already explained in the introduction we chose estimation of panel data models as a principal tool of empirical analysis in the paper. This required building a significant data set and than adjusting it to a dynamic setting. Baring in mind the importance of human capital accumulation for economic growth of advanced economies and due to limited access to human capital data (observations in the Barro-Lee data set are provided at 5yr-long intervals) the period of analysis was divided into eight consecutive subperiods of 5 years each (1960-1964, 1965-1969, 1970-1974, 1975-1979, 1980-1984, 1985-1989, 1990-1994 and finally 1995-1999). A major benefit of such an approach is an elimination of part of disturbance caused by economic cycles. The sample is identical to that investigated above – it includes 27 advanced countries – 15 member states of the European Union and 12 advanced economies constituting a reference group. It gives in total a balanced data set of 216 observations. As we have already mentioned above the use of a system GMM estimator required making necessary modifications to the basic panel data set. This limits the total number of observations for each economy to 7 and thus gives the total data set of 189 observations. A significant problem in the estimation of dynamic panel data models is accurate identification of the character of the explanatory variables in the model. The variable could be endogenous, exogenous or predetermined. In the case of majority of variables in this study it was relatively simple to

identify the character. In some cases, however, making a right decision required use of appropriate procedures (Hausman test).

The results of estimation of dynamic panel data models with a two-step system GMM estimator are given in Table 5. In columns S1 to S5 the basic specification is gradually extended through addition of consecutive explanatory variables. We have chosen a standard set of explanatory variables (please refer to Table 4 for information on variables) utilized in empirical literature on growth: lagged value of GDP per capita, investment rate, government spending in relation to GDP, the openness ratio (total trade to GDP – broad liberalization proxy), rate of growth of population and a human capital proxy – log of the average years of schooling. In the choice of variables for basic specification we tried to accommodate both theoretical postulates as well as results of empirical studies - including these variables that are not sensitive to changes in the set of explanatory variables (Levine and Renelt 1992). Taking 1 or 5 percent level of significance, all explanatory variables, apart from the rate of growth of population (N), have statistically significant influence on the dependent variable although some coefficients display unexpected signs. This applies in particular to a human capital proxy – (LNAYS). This could be due to the fact we have limited the sample only to relatively advanced economies with similar levels of relative human capital stocks. A rather imperfect character of proxies for human capital accumulation in general could be blamed as well. Despite the above remark we have decided to use LNAYS as a human capital proxy as it is commonly used in empirical literature on growth.

It is worth to note that consecutive extensions to the basic specification lower the coefficient on lagged GDP per capita level – this in turn could be attributed to a higher rate of conditional convergence when more structural variables are included. Coefficient on lagged GDP per capita is statistically significant at 1 per cent level and the variable seems not to be sensitive to changes in the set of explanatory variables. In all cases the impact of the investment rate on growth is statistically significant at the 1 per cent and the coefficient is estimated at 0.9. The impact of government spending as share of GDP (GOV) on growth in models S2 do S4 is statistically significant and as expected the coefficient has a negative sign. Greater openness of an economy as measured by the openness ratio (OPEN – value of trade to country's GDP) seems to improve the long term rate of growth.

From column S6 onwards we modify the basic specification by adding variables related to regional economic integration within the EU. This should allow for verification of proposed working hypotheses. In columns S6 to S6''' the basic specification is augmented with dummy

variables reflecting membership in the European Union (EU and EUW). Only in one out of four specifications the impact of the integration variable EUW is statistically significant at the 1 per cent level and the value and sign of the coefficient point to a positive growth effect of economic integration within the EU. This result is however sensitive to the presence of the openness variable (OPEN) – its inclusion causes lack of statistical significance.

Following Vanhoudt (1999) and Brodzicki (2003) in columns S7 to S7'' we verify whether duration of membership in the EU has an impact on growth rates of the Member States. We would expect a positive and relatively strong effect. The basic specification is augmented with EUT_INI – variable showing the length of membership in the EU (in years) at the beginning of each of analyzed subperiods. The impact of the variable is statistically significant at 1 per cent level and does not seem to be sensitive to changes in the basic specification – inclusion or exclusion of OPEN and LNAYS. The longer a given economy is a member of the EU the greater is the impact on its growth. This in turn, at least partially, could be attributed to the dynamics of economic integration in the EU as such – it picked up the pace only in the second half of the 1990s after an era of eurosclerosis.

In the next step, similarly to Brada and Mendez (1988), we try to identify potential mid-term growth effects of accession into the European Union (please refer to column S8). The basic specification is augmented through inclusion of EUACC_LINI – the initial value of EUACC at the beginning of each subperiod. EUACC takes a value of zero for non-members, 1 for an acceding country in the first year of membership and for the following years of membership the value of EUACC is given as 1 divided by a given year minus year of accession. It thus drops to 0.2 level 5 years from accession and to 0.1 a decade after accession. This should allow for identification of potential medium-term effects related to the accession itself. We have to remember, however, that it is at least partially biased because the effects of accession, as it is frequently postulated in the literature, materialize within the pre-accession adjustment period. In the case presented in the Table 5 as well as in other tested specifications the sign of the coefficient is negative but it is not statistically significant – this does not allow us to draw any conclusions.

In order to eliminate the problem of collinearity with integration variables in the models S9 to S14' the variable OPEN has been dropped out – it would otherwise significantly bias the estimates. In models S9 and S10 the basic specification has been extended by inclusion of variables depicting the scale of an integrated area as measured by the ratio of total EU population to the population of a given country (EUSC_POP1 and EUSC_POP2). In the latter

case the impact of a size of a home economy has been eliminated. Both variables take a value of zero for non-EU members. Results of estimation suggest that the expansion of the scale of integrated area affect growth rates of the Member States. This is in accordance with the postulates of new growth theories. It is worth to note that expansion encompasses both the growth of population as such as well as the consequences of consecutive enlargements. The impact of both scale variables is statistically significant at the 1 per cent level and the estimated coefficients are positive and have the same value. Further expansion of the EU could be growth-stimulating as it allows among others for utilization of potential scale effects, increases the absolute and relative stocks of resources and increases their variety. With more liberalized factor flows this could significantly improve the overall allocation of resources and thus allow for productivity-stimulating specialization to occur.

In the next group of models we ask whether integration deepening understood as a process of gradual movement towards more advanced stages of economic integration (in the Balassa style from a free trade area, customs union, common market to EMU) could lead to medium- or long-term growth effects. On theoretical grounds we could expect the impact of deepening to be positive but we cannot exclude also a possibility of a negative effect for certain regions within the integrated area. In the analysis we take into account the potential impact of EU relations with third countries – for instance FTA with Israel, customs union with Turkey or a common market within the European Economic Area (EEA). We thus augment the basic specification with a set of simple dummy variables for economic integration stages taken on individual basis as well as with composite or aggregated indices.

In regressions S11 and S12 we verify whether forming an FTA with the UE leads to growth effects (EU_FTA and EU_FTAW). The dominance of trade creation effects over trade diversion effects in the case of the European Union which has been proven for Member States in numerous studies would suggest that this stage of economic integration should lead to significant and positive dynamic effects in terms of increased growth rates. As expected in column S11 the impact of EU_FTA is statistically significant but only at the 10 per cent level and the coefficient has an expected sign and is high. However, coefficient on a simple dummy variable EU_FTAW is not statistically significant in S11'. This is also the case in the next three models – the coefficients on variables of interest to us (reflecting membership of a customs union - EU_CU and EU_CUW or a common market EU_CM and EU_CMW) are statistically insignificant. A dummy variable for common market within or with the EU – EU_CMW analyzed in two models (S13 and S13') indicates a positive impact of common

market membership on growth. In both specifications the impact is statistically significant (at 5 or 1 per cent level) and the coefficients are high and positive. In the next four models potential effects of fixing exchange rates with EU Member States or being a part of the eurozone are analyzed. It has been theoretically and empirically proven that the choice of exchange regime system is not neutral to growth (e.g. Bordo 2003). It is important to note that in a very specific case of the EU, developments leading to an introduction of a common currency encompassed a significant coordination and harmonization of major policy areas. A simple dummy variable is at least an imperfect measure of this advanced stage of integration.

In all analyzed cases the coefficients are positive and statistically significant at least at the 5 per cent level. In the case of variables which do not take into account the membership in the Bretton Woods system (EU_EMU1 and EMU_EMU1W) the values of an F test for statistical significance of specification is significantly higher than for EU_EMU2 and EMU_EMU2W which take the Bretton Woods system-membership into account. The coefficient next to EU_EMU1 has a value twice as high as the one next to EU_EMU2 while the value of coefficients next to both dummy variables are close to each other. Still they are positive and statistically significant at least at the 10 per cent level.

In the next four models we have tried to verify whether deepening of integration within the EU leads to growth effects through inclusion of aggregated indices of integration advancement within the EU (S16 to S17')[9]. The impact of all variables of interest to us is statistically significant at the 5 per cent level and the coefficients have about the same value and their sing is positive which would suggest that integration deepening is conductive to growth – leads to growth effects in the long-term. Or to put it in other words, the more integrated you get the higher are the related growth effects.

In models S18 to S18'' we have tried to verify the existence of potential medium and long term effects of EU membership through simultaneous introduction of a pair of economic variables. In model S18 a dummy variable EUW which is supposed to approximate long-term benefits of membership and EUACC_LINI which is supposed to approximate medium-run effects of accession have been introduced. The coefficient next to EUW is positive and is statistically significant at the 1 per cent level which could suggest existence of positive long-term effects of EU membership. Coefficient on EUACC_LINI is however statistically insignificant. This problem is resolved when one changes to a pair of variables EU and

[9] EU_COM1 is a sum of EU_FTAW, EU_CUW, EU_CMW and EU_EMU1W. It thus takes a value of 0 and from 1 to 4 if certain aspect of formalized economic integration with the EU took place. It enters the model as an average value within a given subperiod (EU_COM1AV) or as a value of EU_COM1 in the initial year of a given subperiod (EU_COM1LINI). The construction of EU_COM2 is analogous.

EUACC (models S18' and S18''). Both specifications differ only by inclusion or exclusion of general openness index. In both cases the coefficients are statistically significant at 1 per cent level and imply existence of a positive long term growth effect of membership in the European Union while at the same time they show that the accession to the EU itself leads to negative medium-term effects. It could reflect significant adjustment costs as a bulk of which is said to be concentrated around the time of accession. If unbiased, this result contradicts neoclassical models (e.g. a la Baldwin) which presuppose an accession-related rise in the general level of productivity and thus postulate positive medium-run growth effect. To sum up, the obtained results suggest that despite of negative impact of accession on growth performance in the medium-run the benefits associated with the EU membership dominate in the long run.

Following Henrekson at al. (1996) in the next models we have compared (columns S19 and S19') potential growth effects of economic integration within the European Union to potential growth effects within a second important RIA in Europe – the European Free Trade Area (EFTA). The impact of variables of interest to us is not statistically significant in S19. In S19' the coefficient on variable for EU (EUW) is positive, however, it is once again insignificant. The coefficient on a dummy variable for EFTA (EFTAW) is positive and statistically significant at the 5 per cent level. Still we have to interpret the above results as rather inconclusive.

Last but not least we have estimated models with variables reflecting the scale of an integrated area in relation to the scale of a domestic economy measured by real GDP per capita (EUSC_GDP1 and EUSC_GDP2) and variables reflecting the central-peripheral location in relation to the EU (EU_CP1AV and EU_CP2AV)[10]. The construction of the aforementioned

[10] EU_CP1AV and EU_CP2AV are average values of indices of relative centrality-peripheriality ICP1 and ICP(2) within a given 5yr long subperiod. In the construction of the indices we have utilized the following assumptions:

- geographic distance between two countries is calculated as the shortest distance between their capital cities measured in kilometers using with the „as the crow flies" approach (Cieślik and Ryan 2004),
- the actual distance is modified by an arbitrarily set index of economic integration $\psi_{x\_y,t}$ which decreases the distance by 25 per cent (approximation of transport costs) when the two countries form an FTA with or within the EU; $\psi_{x\_y,t}$ takes value of 1 if there is no FTA and 0,75 when there is an FTA between two countries,
- Relative centrality-peripheriality is measured as a geometric average of integration-adjusted distances from all analyzed countries ,
- Economic potential measured by real GDP ($GDP_{x,t}$) partially reduces the importance of central or peripheral location in relation to the EU

Two indices have been constructed ICP(1) and ICP (2).

$$\mathbf{ICP_{x,t}(1)} = \frac{\mathbf{GDP_{x,t}}}{\mathbf{(g \,.\, av(d_{x,y} \cdot \psi_{x\_y,t}))^4}} \quad \mathbf{ICP_{x,t}(2)} = \frac{\mathbf{GDP_{x,t}}}{\mathbf{(g \,.\, av(d_{x,y} \cdot \psi_{x\_y,t}))^2}}$$

ICP(1) to economic integration-adjusted distance and thus central or peripheral location in relation to the European Union while ICP(2) puts more emphasis on the scale of the local economy.

variables – inclusion of the level of GDP, has necessitated a number of tests in order to determine their character in the model. The results have showed that EUSC_GDP1/2 should be treated as endogenous and EU_CP1AV/2AV as predetermined.

In models S20 and S21 the basic specification (with or without human capital variable) has been augmented with variable EUSC_GDP1 – a ratio of a scale of an integrated area to a scale of domestic economy measured by real GDP. It is noteworthy that inclusion of LNAYS doubles the coefficient on EUSC_GDP1 and leads to increase in the level of statistical significance from the 5 to the1 per cent level. In models S21 and S21' analogously specified models with EUSC_GDP2 have been estimated. It is important to note that in the construction of the variable the impact of the domestic economy has been excluded (similarly to EUSC_POP2). In both cases we have obtained the same estimate of a coefficient on EUSC_GDP2 of 0.0001. The coefficient has been significant at the 1 per cent level. Moreover, in this cases we have obtained the highest level of statistical significance of specification as given by the value of the F test among all of the estimated dynamic panel data models. The scale of an integrated economy as measured by both population or real GDP seems to matter for growth – result we would expect on the basis of new growth theories.

In the last group of models we have tried to find out whether location within the European Union (relative centrality or peripheriality) impacts growth performance. The issue of location is getting more and more popular with the rise of new economic geography. This has become an issue as well in analysis of growth effects of economic integration (e.g. Baldwin and Forslid 2000). In order to look for potential effects we augmented the basic specification with the aforementioned variables EU_CP1AV and EU_CP2AV. We have to note that the relative location in relation to the EU changes significantly in time due to both economic integration as well as consecutive enlargements of the European Union itself. The results are rather inconclusive. Lack of statistical significance does not allow to formulate conclusions on the obtained results in the regression S22. Inclusion of the openness ratio (OPEN) has increased the statistical significance of the specification (F test), however, coefficients on variables OPEN and LNAYS are not statistically significant. The impact of the variable of interest to us (EU_CP1AV) is statistically significant at 1 per cent level and the coefficient points to a negative impact of central location within the EU on growth. In other words having a peripheral location within the EU is least growth-diminishing. This negative effects is highest for centrally located and/or large Member States: Germany, France, Great Britain, the

Netherlands, Italy and Belgium. With an exception of Switzerland, Norway, Turkey and the USA the effect of relative centrality – peripheriality is marginal for the rest of the economies. Among the EU economies it is the smallest for small economies located in the peripheries – Ireland, Greece and Portugal. The results seem to be biased by the fact that most cohesion economies (also at the regional level) in the EU are located in the peripheries – these in turn obtain most of structural funding.

The construction of the variable EU_CP2AV reduces the role of relative centrality-peripheriality in comparison to the scale of an economy as measured by the level of domestic real GDP. The variable puts dominant emphasis on the scale of domestic economy and marginalizes the role of location within or in relation to the EU. This impacts the results significantly (models S23 to S23''). Model S23 takes into consideration the impact of human capital and omits an impact of a general level of openness. The coefficient on EU_CP2AV is statistically significant and has a positive sign. In the case of modified models S23' and S23'' the coefficients on the variable are statistically significant at the 1 per cent level and the coefficients next to EU_CP2AV are on average 60 per cent higher than in the model S23. When one compares models S23' and S23'' it is worth to notice that inclusion of a proxy for human capital (LNAYS) doubles the value of F test while the coefficient on EU_CP2AV drops only slightly.

Conclusion

The objective of this paper was to assess whether the process of regional economic integration within the European Union affected growth rates of its Member States. The positive answer to that question would suggest that the results are consistent with the theories emphasizing the endogenous nature of economic growth.

Our results point to an existence of a positive long-term relationship between economic integration and growth rates of real GDP per capita. At the same time we have identified a negative medium-run effect on growth in the post-accession period. This could be related to significant costs associated with EU accession which are said to be particularly high in the pre- and post-accession phase.

Both deepening and widening of the economic integration are found to be beneficial to long-term growth performance of Member States. These are related to greater level of internal openness (more liberal trade flows and factor flows), certain amount of harmonization and coordination, grater potential of utilizing economies of scale and increases in the scale of the integrated area caused by consecutive enlargements.

The benefits associated with accession and membership in the EU are found to be asymmetrical. The benefits are more significant for small economies with lower initial level of GDP per capita which suggests that economic integration can potentially affect the rate of economic convergence. This is not without policy implications.

Results of our analysis provide support for greater extent of openness in general – extensions of free trade area or common market agreements to third countries stimulate general growth. It is worth to note that more advanced stages of economic integration characterized by greater internal openness and better coordination and/or harmonization seem to have greater impact on growth performance of the EU Member States.

In addition, although our analysis provides some support for endogenous growth and new economic geography theories in that location within the EU (relative centrality-peripheriality) could impact the growth performance of individual economies, the results are sensitive and thus should be treated with caution.

Future extensions of this study should incorporate a larger and more detailed sample as well as new measures of economic integration (economic integration variables) better depicting its dynamics and complexity. This could be based on intensity of trade flows or FDI flows. The major bottleneck in the analysis is still the unavailability and/or quality of data on human

capital stocks. It would be also beneficial to further test the sensitivity of the obtained results to changes in the set of explanatory variables as well as to the set of the benchmark group. The future studies should focus on identifying and quantifying the importance of various transmission channels between economic integration and growth performance of the Member States. It could also be beneficial to analyze the non-integration scenario which would allow for more precise quantification of the overall growth benefits related to integration within the EU (in a fashion similar to Badinger (2001)). Extended research should off course take into account potential improvements in the field of econometric estimation of dynamic panel data models, however, as Bond, Hoeffler and Temple (2001) rightly point out it should not become a means in itself.

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Table 1 Average growth rates of real GDP per capita

		Long term average		10-yr average				5-yr average								
		1955-1999	1960-1999	1960-1969	1970-1979	1980-1989	1990-1999	1955-1959	1960-1964	1965-1969	1970-1974	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999
EU-15 Member States	BEL	0.026	0.027	0.039	0.025	0.017	0.014	0.010	0.041	0.032	0.034	0.021	0.004	0.026	0.005	0.018
	FRA	0.027	0.026	0.041	0.026	0.019	0.008	0.030	0.038	0.037	0.030	0.026	0.011	0.025	-0.002	0.016
	ITA	0.031	0.029	0.044	0.026	0.022	0.011	0.033	0.039	0.047	0.028	0.032	0.009	0.029	0.004	0.013
	LUX	0.031	0.032	0.025	0.016	0.040	0.043	0.019	0.023	0.028	0.033	0.017	0.018	0.058	0.036	0.037
	NDL	0.023	0.023	0.032	0.019	0.015	0.019	0.007	0.027	0.030	0.024	0.018	0.002	0.023	0.009	0.025
	GER*	0.033	0.030	0.031	0.022	0.016	0.009	0.036	0.028	0.025	0.015	0.033	0.007	0.021	0.004	0.011
	DNK	0.024	0.021	0.036	0.015	0.017	0.017	0.034	0.038	0.027	0.013	0.022	0.012	0.014	0.011	0.017
	GBR	0.020	0.020	0.020	0.020	0.025	0.017	0.013	0.020	0.017	0.019	0.023	0.013	0.029	0.009	0.020
	IRL	0.036	0.038	0.033	0.030	0.025	0.053	0.004	0.029	0.035	0.025	0.030	0.013	0.033	0.021	0.065
	GRC	0.033	0.030	0.063	0.034	0.002	0.016	0.046	0.059	0.049	0.032	0.027	-0.011	0.009	0.003	0.024
	ESP	0.033	0.033	0.065	0.023	0.020	0.019	0.019	0.070	0.048	0.044	0.003	0.003	0.035	0.004	0.014
	PRT	0.038	0.038	0.053	0.033	0.027	0.023	0.028	0.043	0.048	0.051	0.032	-0.002	0.050	0.009	0.034
	AUT	0.032	0.029	0.035	0.032	0.019	0.015	0.031	0.031	0.034	0.036	0.030	0.008	0.026	0.009	0.018
	FIN	0.028	0.028	0.035	0.026	0.027	0.011	0.012	0.033	0.028	0.036	0.012	0.017	0.032	-0.022	0.036
	SWE	0.021	0.020	0.032	0.012	0.019	0.010	0.022	0.038	0.020	0.016	0.004	0.012	0.021	-0.007	0.022
Others	AUS	0.021	0.022	0.030	0.012	0.018	0.024	0.014	0.027	0.032	0.011	0.014	0.009	0.022	0.016	0.026
	CAN	0.021	0.023	0.030	0.030	0.018	0.015	0.009	0.027	0.024	0.033	0.027	0.009	0.020	0.001	0.024
	CHE	0.016	0.014	0.026	0.003	0.013	-0.002	0.017	0.032	0.019	0.016	0.008	0.002	0.017	-0.013	0.010
	ISL	0.025	0.027	0.023	0.046	0.014	0.013	0.010	0.042	-0.006	0.054	0.038	0.006	0.019	-0.005	0.031
	ISR	0.029	0.027	0.043	0.024	0.013	0.019	0.034	0.048	0.031	0.042	0.003	0.008	0.016	0.026	0.004
	JAP	0.045	0.042	0.083	0.029	0.030	0.008	0.049	0.073	0.084	0.025	0.030	0.018	0.035	0.007	0.007
	KOR	0.052	0.057	0.054	0.062	0.065	0.040	0.007	0.032	0.070	0.051	0.064	0.053	0.067	0.047	0.018
	MEX	0.019	0.017	0.030	0.028	-0.007	0.009	0.017	0.032	0.023	0.026	0.025	0.000	-0.015	0.008	0.022
	NOR	0.028	0.029	0.029	0.036	0.018	0.026	0.011	0.027	0.024	0.034	0.028	0.019	0.009	0.024	0.022
	NZL	0.014	0.012	0.019	0.004	0.014	0.013	0.004	0.021	0.005	0.032	-0.014	0.025	0.003	0.010	0.011
	TUR	0.022	0.022	0.028	0.023	0.023	0.013	0.031	0.023	0.032	0.026	0.009	0.022	0.020	0.003	0.013
	USA	0.022	0.024	0.030	0.028	0.021	0.019	0.003	0.025	0.024	0.025	0.035	0.016	0.021	0.010	0.025
Group-27 average*		**0.028**	**0.027**	**0.037**	**0.025**	**0.020**	**0.019**	**0.020**	**0.036**	**0.032**	**0.030**	**0.022**	**0.011**	**0.025**	**0.008**	**0.022**

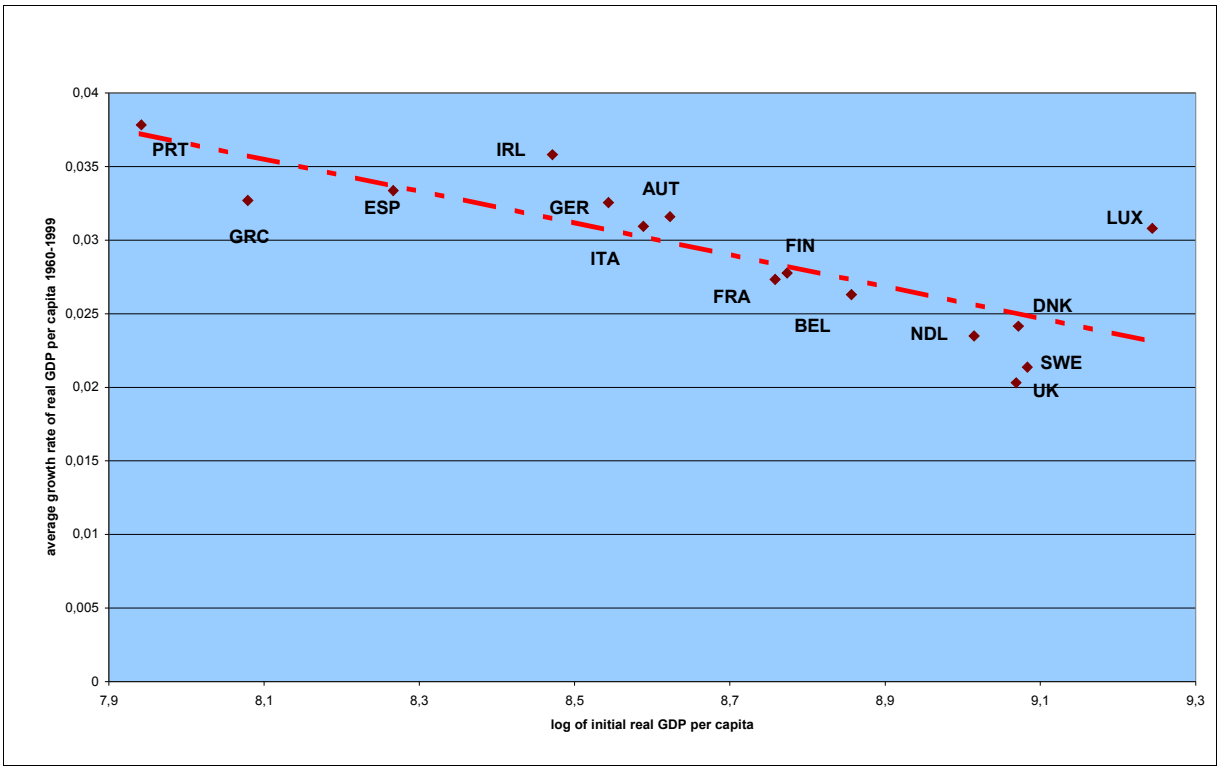
*Source: Own calculations based on the PWT mark 6.1 dataset. *Arithmetical average from averages for individual states.*

Table 2 Statistical identification of medium term growth effects of accession into EU and of its consecutive enlargements

	PRE-ACC	POSTACC	Change	PRE-ENL1 1968-1972	POST-ENL1 1973-1977	Change	PRE-ENL2 1976-1980	POST-ENL2 1981-1985	Change	PRE-ENL3 1981-1985	POST-ENL3 1986-1990	Change	PRE-ENL4 1990-1994	POST-ENL4 1995-1999	Change
BEL	0.025	0.038	0.013	0.039	0.015	-0.024	0.019	0.009	-0.010	0.009	0.029	0.019	0.005	0.018	0.013
FRA	0.036	0.036	0.000	0.036	0.014	-0.022	0.022	0.011	-0.010	0.011	0.028	0.016	-0.002	0.016	0.018
GER	0.055	0.040	-0.015	0.033	0.010	-0.023	0.020	0.012	-0.008	0.012	0.026	0.014	0.001	0.011	0.010
ITA	0.035	0.056	0.021	0.028	0.017	-0.011	0.027	0.014	-0.012	0.014	0.028	0.014	0.004	0.013	0.008
LUX	0.023	0.012	-0.011	0.034	-0.011	-0.045	0.015	0.025	0.010	0.025	0.043	0.018	0.036	0.037	0.001
NDL	0.040	0.034	-0.006	0.028	0.015	-0.013	0.010	0.010	0.000	0.010	0.025	0.015	0.009	0.025	0.016
DNK	0.027	0.003	-0.024				0.006	0.026	0.020	0.026	0.007	-0.019	0.011	0.017	0.006
GBR	0.017	0.006	-0.011				0.011	0.023	0.013	0.023	0.023	-0.001	0.009	0.020	0.011
IRL	0.026	0.025	-0.001				0.032	0.013	-0.019	0.013	0.054	0.041	0.021	0.065	0.044
GRC	0.015	-0.002	-0.017							0.000	0.007	0.008	0.003	0.024	0.021
ESP	0.007	0.039	0.032										0.004	0.014	0.010
PRT	0.002	0.059	0.057										0.009	0.034	0.025
AUT	0.009	0.018	0.009												
FIN	-0.022	0.036	0.058												
SWE	-0.007	0.022	0.029												
Average	**0.019**	**0.028**	**0.009**	**0.033**	**0.010**	**-0.023**	**0.018**	**0.016**	**-0.002**	**0.014**	**0.027**	**0.012**	**0.009**	**0.024**	**0.015**
Standard deviation	0.0195	0.0184	0.0260	0.0045	0.0105	0.0122	0.0084	0.0067	0.0133	0.0082	0.0141	0.0152	0.0104	0.0152	0.0112

Source: Own calculations.

Figure 1 Absolute convergence within the EU-15 in the period 1960-1999



Source: Own calculations based on PWT mark 6.1.

Table 3 Economic effects of consecutive enlargements of the EU

		I enlargement (1973)	II enlargement (1981)	III enlargement (1986)	IV enlargement (1995)
Population (in mln)	before	193.7	263.1	274.9	351.3
	after	258.0	272.8	323.4	400.5
	change (per cent)	+ 33.2%	+ 3.7%	+ 17.7%	+14.0%
Real GDP (in billions of USD)	before	2 703	4 134	4 701	6 088
	after	3 577	4 246	5 264	6 857
	change (per cent)	+ 32.4%	+ 2.7%	+12.0%	+ 12. 6%
Average real GDP per capita (pre accession =100)	before	100	100	100	100
	after	99.4	99.0	95.2	98.8
	change (per cent)	- 0.6%	- 1.0%	- 4.8%	-1.2%

Source: Own calculations based on PWT 6.1 and PWT 5.2.

Table 4 Description of variables in the data panel - 216 observations (1960-1999)

Name	Definition	Average	Min	Max	Standard deviation	SE
N	growth rate of population; 5yr average	0.0094	-0.0034	0.0383	0.0079	0.0005
LNGDP	natural logarithm of the initial real GDP per capita	9.456	7.378	10.537	0.513	0.035
GROWTH	growth rate of real GDP per capita - 5yr average	0.028	-0.024	0.097	0.0195	0.0013
KI	Investment rate; 5yr average	23.926	10.203	39.706	5.245	0.357
KG	Government expenditures to GDP; 5yr average	13.735	4.274	43.147	6.717	0.457
OPENK	Openness ratio; 5yr average	51.521	5.580	239.987	40.051	2.725

LNAYS	Log of average years of schooling (total population aged 16-65); data available for 1960-2000 at 5yr intervals	1.952	0.663	2.500	0.381	0.026
EUW	membership in the EU; dummy variable	0.338	0.000	1.000	0.474	0.032
EU	membership in the EU; duration of membership within a 5yr period measured in years divided by 5 (value from 0 to 1 in 0.2 intervals)	0.355	0.000	1.000	0.474	0.032
EUT_INI	Duration of EU membership in years; initial level	5.750	0.000	38.000	10.392	0.707
EUT	Duration of EU membership in years; 5yr average	6.462	0.000	40.000	11.126	0.757
EUACC	medium term effect of accession into the EU; 5yr average	0.044	0.000	0.417	0.090	0.006
EUACC_LINI	medium term effect of accession into the EU; value of EUACC at the beginning of 5yr period	0.043	0.000	0.500	0.106	0.007
EUSC_POP1	Common market scale index based on total population levels – 1st method; 5yr average	34.838	0.000	885.424	139.252	9.475
EUSC_POP2	Common market scale index based on total population levels– 2nd method; 5yr average	34.483	0.000	884.424	139.092	9.464
EUSC_GDP1	Common market scale index based on GDP levels – 1st method; 5yr average	28.888	0.000	645.098	103.675	7.054
EUSC_GDP2	Common market scale index based on GDP levels – 2nd method; 5yr average	28.533	0.000	644.098	103.498	7.042
EU_CP1AV	Centrality – peripheriality index - 1st method, 5yr average	0.027	0.000	0.355	0.061	0.004
EU_CP1LINI	Centrality – peripheriality index - 1st method; initial level	0.025	0.000	0.421	0.060	0.004
EU_CP2AV	Centrality – peripheriality index - 2nd method, 5yr average	0.075	0.000	0.730	0.135	0.009
EU_CP2LINI	Centrality – peripheriality index - 2nd method; initial level	0.070	0.000	0.746	0.129	0.009
EU_FTA	FTA within/with EU; duration of membership within a 5yr period measured in years divided by 5 (value from 0 to 1 in 0.2 intervals)	0.494	0.000	1.000	0.487	0.033
EU_FTAW	dummy variable for FTA within/with EU	0.523	0.000	1.000	0.501	0.034
EU_CU	Customs union within./with EU; duration of membership within a 5yr period measured in years divided by 5 (value from 0 to 1 in 0.2 intervals)	0.314	0.000	1.000	0.451	0.031
EU_CUW	dummy variable for customs union within/with the EU	0.343	0.000	1.000	0.476	0.032
EU_CM	Common market with the EU; duration of membership within a 5yr period measured in years divided by 5 (value from 0 to 1 in 0.2 intervals)	0.106	0.000	1.000	0.279	0.019
EU_CMW	dummy variable for common market with/within EU	0.157	0.000	1.000	0.365	0.025
EU_EMU1	membership in the EMS/ERMI/ERMII and euro zone; duration of membership within a 5yr period measured in years divided by 5 (value from 0 to 1 in 0.2 intervals)	0.181	0.000	1.000	0.366	0.025
EU_EMU1W	dummy variable for membership in the EMS/ERMI/ERMII and eurozone	0.227	0.000	1.000	0.420	0.029

EU_EMU2	membership in EMS/ERMI/ERMII eurozone + system Bretton Woods; duration of membership within a 5yr period measured in years divided by 5 (value from 0 to 1 in 0.2 intervals)	0.506	0.000	1.000	0.454	0.031
EU_EMU2W	dummy variable for membership in the EMS/ERMI/ERMII/eurozone and Bretton Woods	0.602	0.000	1.000	0.491	0.033
EU_COM1AV	aggregated integration index – 1 method; 5yr average	1.094	0.000	4.000	1.313	0.089
EU_COM1LINI	aggregated integration index – 1 method; initial level	0.981	0.000	4.000	1.272	0.087
EU_COM2AV	aggregated integration index – 2nd method; 5yr average	1.419	0.000	4.000	1.192	0.081
EU_COM2LINI	aggregated integration index – 2nd method; initial level	1.356	0.000	4.000	1.156	0.079
EFTA	membership in EFTA - EEA; duration of membership within a 5yr period measured in years divided by 5 (value from 0 to 1 in 0.2 intervals)	0.223	0.000	1.000	0.413	0.028

Source: Own calculations. GER - modified PWT 5.2 and 6.1.*

Table 5 Two-step system GMM estimation's results of various dynamic panel models

	S(1)	S(2)	S(3)	S(4)	S(5)	S(6)	S(6)'	S(6)"	S(6)"'	S(7)	S(7)'	S(7)"	S(8)
LNGDP0	0.9015 (49.04)***	0.9074 (40.69)***	0.9081 (46.65)***	0.8994 (47.79)***	0.888 (77.76)***	0.9097 (73.46)***	0.8925 (75.31)***	0.9107 (73.09)***	0.9142 (78.56)***	0.8998 (47.47)***	0.8835 (76.13)***	0.9094 (78.58)***	0.8973 (67.48)***
INV	0.0095 (6.03)***	0.0091 (4.90)***	0.0094 (6.15)***	0.0085 (5.90)***	0.0094 (11.28)***	0.0116 (10.84)***	0.0083 (6.35)***	0.0117 (11.29)***	0.0104 (10.23)***	0.0084 (5.57)***	0.0101 (10.38)***	0.0098 (8.19)***	0.0093 (8.98)***
GOV		-0.0042 (-2.29)**	-0.0031 (-2.76)***	-0.0017 (-1.99)**	-0.0005 (-0.71)	0.0012 (1.51)	-0.0007 (-0.87)	0.0011 (1.52)	0.0016 (2.23)**	-0.0021 (-1.97)**	-0.0008 (-1.04)	0.0008 (1.05)	
OPENK			0.0002 (1.65)*	0.0004 (-2.53)**	0.0005 (3.49)***	0.0009 (7.34)***		0.0009 (7.23)***		-0.0003 (-1.99)**	0.0002 (2.04)**		0.0006 (4.71)***
N				0.4418 (-0.49)	-0.2091 (-0.30)								
LNAYS					-0.0652 (-2.84)***	-0.0847 (-3.68)***	-0.0697 (-3.17)	-0.0872 (-3.81)***	-0.0883 (-4.33)***		-0.0731 (-3.25)	-0.0682 (-2.93)***	-0.0323 (-1.35)
EU						0.0095 (0.70)	-0.0061 (-0.44)						
EUW								0.0068 (0.51)	0.0453 (3.27)***				
EUT_INI										0.0022 (3.91)***	0.0016 (3.11)***	0.0022 (3.33)***	
EUACC_LINI													-0.0042 (-0.06)
F test	5189.4	6020.1	3494.6	965.7	3065.57	2219.89	6342.51	2223.7	2726.9	2700.54	6543.43	4917.82	1621.28
Hansen's test	26.42	26.53	26.11	24.54	24.82	19.98	19.35	19.60	21.88	21.98	24.94	16.05	24.79
AB test for AR(1)	0.007	0.007	0.007	0.004	0.006	0.005	0.005	0.005	0.005	0.006	0.005	0.005	0.006
AB test for AR(2)	0.234	0.300	0.282	0.262	0.237	0.209	0.244	0.213	0.219	0.282	0.248	0.237	0.236
Parameter next to LNGDP	-0.0985	-0.0926	-0.0919	-0.1006	-0.1120	-0.0903	-0.1075	-0.0893	-0.0858	-0.1002	-0.1165	-0.0906	-0.1027

Table 5 continued

	S(9)	S(10)	S(11)	S(11)'	S(12)	S(12)'	S(13)	S(13)'	S(13)"	S(14)	S(14)'
LNGDP0	0.8823 (79.66)***	0.8822 (79.67)***	0.883 (64.70)***	0.8838 (62.96)***	0.898 (72.34)***	0.8964 (68.97)***	0.8928 (74.23)***	0.8919 (82.65)***	0.9036 (81.61)***	0.9053 (78.88)***	0.9035 (77.13)***
INV	0.0086 (10.35)***	0.0086 (10.35)***	0.0081 (6.07)***	0.0074 (5.30)***	0.0092 (7.03)***	0.0085 (6.34)***	0.0094 (7.28)***	0.0095 (7.26)***	0.0103 (8.25)***	0.0104 (8.07)***	0.0098 (7.59)***
GOV	0.0008 (1.15)	0.0008 (1.16)	-0.0010 (-1.21)	-0.0007 (-0.73)	-0.0001 (-0.17)	-0.0015 (-1.77)*	-0.0009 (-0.82)	-0.0003 (-0.21)		-0.0017 (-2.50)**	-0.0009 (-1.37)
N	-0.7075 (-1.19)	-0.7135 (-1.20)									
LNAYS	-0.0932 (-4.34)***	-0.0933 (-4.35)***	-0.0781 (3.03)***	-0.0835 (-3.16)***	-0.0425 (-1.93)*	-0.0592 (-2.68)***	-0.0411 (-1.71)	-0.0444 (-1.90)*	-0.0533 (-2.31)**	-0.0648 (-2.82)***	-0.0605 (-2.60)***
EUSC_POP1	0.0001 (5.37)***										
EUSC_POP2		0.0001 (5.41)***									
EU_FTA			0.0368 (1.94)*								
EU_FTAW				0.0159 (0.79)							
EU_CU					0.0066 (0.50)						
EU_CUW						0.0116 (0.92)					
EU_CM							0.0496 (1.50)				
EU_CMW								0.0624 (2.54)**	0.0690 (2.98)***		
EU_EMU1										0.0801 (4.64)***	
EU_EMU1W											0.0307 (1.84)*
F test	5871.84	5846.07	41460.79	14061.06	11237.91	21881.59	17105.73	5124.35	3062.62	11169.91	16253.89
Hansen's test	15.56	15.55	20.77	18.33	22.66	21.55	24.43	25.11	26.54	21.90	21.05
AB test for AR(1)	0.004	0.004	0.007	0.006	0.006	0.006	0.005	0.006	0.005	0.006	0.005
AB test for AR(2)	0.229	0.229	0.256	0.262	0.238	0.260	0.231	0.265	0.259	0.278	0.223

Parameter next to LNGDP	-0.1177	-0.1178	-0.1170	-0.1162	-0.1020	-0.1036	-0.1072	-0.1081	-0.0964	-0.0947	-0.0965

Table 5 continued

	S(15)	S(15)'	S(16)	S(16)'	S(17)	S(17)'
LNGDP0	0.8964 (80.28)***	0.8994 (81.60)***	0.8945 (78.65)***	0.8835 (77.98)***	0.8945 (78.65)***	0.8835 (77.98)***
INV	0.0092 (10.08)***	0.0095 (10.38)***	0.0095 (7.85)***	0.0092 (7.38)***	0.0095 (7.85)***	0.0092 (7.38)***
GOV	-0.0009 (-1.32)	-0.0003 (-0.42)	0.0005 (0.77)	-0.0012 (-1.71)*	0.0005 (0.77)	-0.0012 (-1.71)*
OPENK	0.0006 (4.77)***	0.0006 (5.44)***				
N	0.3982 (0.48)	0.5641 (0.67)				
LNAYS	-0.0570 (-2.54)**	-0.0550 (-2.43)**	-0.0581 (-2.43)**	-0.0820 (-3.37)***	-0.0581 (-2.43)**	-0.0820 (-3.37)***
EU_EMU2	0.0412 (2.78)***					
EU_EMU2W		0.0286 (2.29)**				
EU_COM1LINI			0.0136 (2.54)**			
EU_COM1AV				0.0134 (2.26)**		
EU_COM2LINI					0.0136 (2.54)**	
EU_COM2AV						0.0134 (2.26)**
F test	3616.47	5576.34	1307.7	2831.11	1307.70	2831.11
Hansen's test	21.22	21.56	21.82	21.16	21.82	21.16
AB test for AR(1)	0.005	0.005	0.006	0.006	0.006	0.006
AB test for AR(2)	0.246	0.215	0.230	0.248	0.230	0.248
Parameter next to LNGDP	-0.1036	-0.1006	-0.1055	-0.1165	-0.1055	-0.1165

Table 5 continued

	S(18)	S(18)'	S(18)''	S(19)	S(19)'
LNGDP	0.8910 (71.82)***	0.8981 (66.17)***	0.8961 (63.30)***	0.9055 (64.09)***	0.9096 (65.68)***
INV	0.0091 (8.91)***	0.0093 (8.37)***	0.0091 (6.84)***	0.0116 (10.75)***	0.0117 (11.20)***
GOV	-0.0005 (-0.68)	0.0004 (0.49)	-0.0007 (-1.00)	0.0013 (1.64)	0.0009 (1.26)
OPENK	0.0001 (0.89)	-0.0001 (-0.69)		0.0009 (6.90)***	0.0007 (5.40)***
N					
LNAYS	-0.0830 (-3.53)***	-0.1099 (-4.66)***	-0.0693 (-3.03)***	-0.0938 (-3.71)***	-0.0706 (-2.91)***
EU		0.0884 (6.38)***	0.0491 (3.24)***	0.0114 (0.64)	
EUW	0.0553 (3.67)***				0.0297 (1.63)
EUACC		-0.3318 (-7.43)***	-0.2170 (-4.63)***		
EUACC_LINI	-0.0555 (-0.79)				
EFTA				0.0023 (0.11)	
EFTAW					0.0443 (2.34)**
F test	1369.1	2946.59	5714.5	1847.35	1911.6
Hansen's test	23.88	23.04	22.63	20.08	19.19
AB test for AR(1)	0.006	0.005	0.005	0.005	0.005
AB test for AR(2)	0.249	0.279	0.276	0.206	0.201
Parameter next to LNGDP	-0.1090	-0.1019	-0.1039	-0.0945	-0.0904

Table 5 continued

	S(20)	S(20)'	S(21)	S(21)'	S(22)	S(22)'	S(23)	S(23)'	S(23)"
LNGDP	0.8837 (64.09)***	0.8903 (66.31)***	0.881 (63.97)***	0.858 (63.90)***	0.8896 (71.72)***	0.9021 (57.77)***	0.8919 (71.96)***	0.9043 (62.07)***	0.8591 (65.92)***
INV	0.0088 (8.03)***	0.0105 (9.95)***	0.0092 (8.47)***	0.0091 (8.61)***	0.0084 (7.71)***	0.0083 (6.34)***	0.0088 (8.08)***	0.0089 (7.13)***	0.0079 (7.31)***
GOV	-0.0009 (-0.84)	0.0001 (0.06)	-0.0015 (-1.47)	-0.0004 (-0.50)	-0.0004 (-0.42)	-0.0015 (-1.07)	-0.0002 (-0.23)	-0.0011 (-0.77)	0.0008 (0.78)
OPENK						0.0002 (0.71)		0.0001 (0.35)	0.0008 (4.72)***
N	-1.0465 (-1.22)	-1.2993 (-1.67)*	-1.1166 (-1.30)	-1.932 (-2.48)**					
LNAYS		-0.0531 (-3.36)***		-0.0636 (-4.03)***	-0.0370 (-2.24)**	-0.0397 (-1.58)	-0.0414 (-2.59)***		-0.1373 (-8.01)***
EUSC_GDP1	0.0001 (2.12)**	0.0002 (3.52)***							
EUSC_GDP2			0.0001 (2.08)**	0.0001 (2.02)**					
EU_CP1AV					0.1079 (1.34)	-0.2598 (-3.04)***			
EU_CP2AV							0.0691 (1.90)*	0.1148 (3.04)***	0.1079 (2.93)***
F test	33448.0	39310.6	51477.4	61469.0	10907.5	28033.1	7272.2	10301.9	21215.6
Hansen's test	23.68	23.27	22.39	23.24	25.83	12.73	26.23	22.78	15.61
AB test for AR(1)	0.006	0.005	0.005	0.005	0.006	0.007	0.006	0.007	0.007
AB test for AR(2)	0.253	0.232	0.259	0.251	0.249	0.249	0.247	0.264	0.240
Parameter next to LNGDP	-0.1163	-0.1097	-0.1190	-0.1420	-0.1104	-0.0979	-0.1081	-0.0957	-0.1409

Source: Estimations carried out by Maria Blangiewicz in STATA with the use of xtabond2 module within of the research grant BW no. 3480-5-0296-4. Comments:

a) Value of t-statistic in brackets. In accordance with procedure proposed by Arellano and Bond t-statistics were calculated as a division of coefficients obtained from two-step system GMM estimation by mean errors of estimation of the same model estimated with one-step system GMM estimator.
b) Number of observations – 189; depending on model the number of degrees of freedom varies from 182 to 187.
c) Significant at *** - 1 per cent. ** - 5 per cent. * - 10 per cent level of significance.
d) In a dynamic setting the dependent variable is not the growth rate of real GDP per capita but the level of real GDP per capita. One of the explanatory variables is its lagged value. In order to obtain the convergence parameter we need to subtract one from the coefficient on lagged GDP per capita.
e) Test F for statistical significance of specification.
f) Hansen test of over-identifying restrictions.
g) Arellano-Bond test for first and second order autoregression; Prob values given.