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EU and EZ Growth Effects following the Introduction of the Euro

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Published in:
Proceedings of the 15th International Conference on Finance and Banking

Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Dreyer, J. K., & A. Schmid, P. (2016). Does the Euro enhance Economic Growth? EU and EZ Growth Effects following the Introduction of the Euro. In I. PALEČKOVÁ, & I. SZAROWSKÁ (Eds.), *Proceedings of the 15th International Conference on Finance and Banking* (pp. 72-83). Silesian University.

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Download date: 12. Jul. 2025

Does the Euro enhance Economic Growth? EU and EZ Growth Effects following the Introduction of the Euro

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Abstract
One of the major economic reasons for the creation of the European Union (EU) and of the Euro-zone (EZ) was an expected bonus of economic growth associated to member states. While several studies exist on the growth bonus of the EU membership, there are none for the EZ, the latest and deepest step of economic integration in Europe. The aim of this article is to investigate whether the EU and EZ memberships enhance growth of their members. In order to perform our empirical analysis, we apply an augmented Solow growth model using convergence analysis and the panel Generalized Method of Moments (GMM) to estimate its coefficients. We restrict the time frame of our research on the first 14 years of the Euro - from 1999 to 2012. In line with economic intuition we find a positive and neutral impact of EU and EZ memberships on economic growth respectively. These economic results can be considered especially interesting to new potential EZ members, such as some of the Central Eastern European Countries (CEE), who are about or in the process to join the common currency club.

Keywords: economic integration, EU and EZ memberships, neoclassical growth model, endogenous growth theory, growth bonus
JEL codes: F15, F33, F43, O52

1. Introduction

The common European currency, agreed upon in 1992 in the Maastricht treaty and introduced in 11 countries in 1999, and in further nine afterwards, is commonly seen as a step to further economic integration in the European Union (EU). The Euro was officially motivated as the foundation for a prosperous economic development, expressed in microeconomic efficiency, macroeconomic stability and equal living standards across regions and countries (European Commission, 1990).

But did economic integration spur growth in the EU overall and/or in the EZ? Has economic convergence taken place with poorer countries catching up with the richer ones? The aim of this article is to reflect upon these questions, giving special attention to the analysis of the influence of integration caused by EU and EZ memberships on economic growth during the first 14 years of the Euro. In order to perform our empirical investigation, we analyse different versions of a growth model and estimate their coefficients.

There is no accordance in the literature on whether economic integration has lasting effects on economic growth. According to the standard neoclassical growth theory (Solow, 1956), changes in economic policy, including economic integration, may only have short-term

level effects. The long-term driving force for economic growth is the exogenous technical progress, which is a public good and is not affected by e.g. economic integration. Thus, only transitional rather than permanent effects may be generated by membership in a currency union like the EZ.

However, according to the endogenous growth theory (Romer, 1990), economic integration implies additional scale effects, which enhance economic growth on a permanent basis[1]. Analysing the EU, Baldwin (1992) shows that trade is one of the channels through which integration enhances growth. For him the bigger market size and the consequent intensification of trade and competition can affect productive factors of an economy such as physical and human capital, because the steady-state level of these factors is determined endogenously. In this case, trade liberalization indeed affects permanent growth rates and welfare even in the Solow growth model.

Given these different views on the consequences of integration and in light of the EU and the EZ as the most far-reaching projects of economic integration in modern history we implement an augmented Solow growth model using convergence analysis to study the growth effects associated to EU and EZ memberships.

We estimate different versions of our model using a panel GMM technique according to Arellano and Bond (1991). We restrict our data on the 28 EU members and on the EFTA countries Iceland, Norway and Switzerland from 1999 to 2012. In order to avoid problems of representativeness, we use only European countries for the analyses, but we do not restrict ourselves to EU or EZ members[2].

Our results indicate that EU membership implied a growth bonus compared to non-members. Besides, EZ membership implied a negative effect on growth during the years of the financial crisis (from 2007 to 2012). This means that members of the currency union performed worse during the crisis than other EU members. Furthermore, our results indicate that beta convergence existed among countries during the period analysed and thus poorer countries were catching up with richer ones.

The outline of the paper is as follows: in section 2 we discuss the literature on trade and growth effects of integration of the EU and EZ. Afterwards, in section 3 we formulate our models and estimate their coefficients in section 4. Section 5 concludes.

2. Membership and Economic Growth

If one studies the EZ as a second step of economic integration in the EU, it would be natural to ask if higher integration would further enhance trade and consequently permanent growth rates of EZ members as shown for the EU by Baldwin (1992). Some authors argue that with the elimination of exchange rate risk and of foreign exchange transaction costs, trade profits would become less risky and increase, laying the foundation for augmented trade within members of the EZ (Bun and Klaassen, 2002). According to the seminal paper of Rose (2000) the trade creating effects of the common currency could be as big as 300%. However, Baldwin and Taglioni (2006) and Bun and Klaassen (2007) argue that prior studies could have overestimated the trade creating effects of the Euro. They show some econometrical

[1] One could also argue for negative growth effects if initial GDPs of EZ members are strongly differing. This could especially happen when a period of strong growth appreciates the real effective exchange rate via the Balassa-Samuelson effect (Balassa, 1964 and Samuelson, 1964). In the case of a common currency, countries are not able to depreciate their currencies. As showed by Knedlik and Schweinitz (2012), these countries would then lose competitiveness, causing problems of deficits in current account and consequently imbalances in the common currency area. These macroeconomic imbalances may have led five different countries (Greece, Ireland, Italy, Portugal and Spain) to their debt crisis.

[2] Contrary to many empirical papers (among others, Sala-i-Martin, 1996 and Magrini, 1999), we are careful to select countries that are directly connected to the regional integration in Europe. As Crespo Cuaresma et al. (2008) discuss, we do not want to measure a global benefit of being part of the EU or of the EZ, but a regional one.

inaccuracies of these studies, which are related to endogeneity of variables and to country specific time trends in trade integration. When these inaccuracies are corrected, the positive effects of the EZ membership on trade are still significant, but not as large as thought before. In line with these authors, Berger and Nitsch (2008) show that when controlling for the trend in trade integration, the effect of EZ membership on trade simply disappears.

The conflicting views related to the effects of integration on economic growth inspired further studies during the nineties. For example, Landau (1995) was not able to detect a growth bonus in a cross-country study with 17 OECD members from 1950 to 1990. However, Henrekson et al. (1997), who used a panel data sample with 22 OECD countries from 1975 to 1990, found an annual growth bonus of about 0.8% for EU or EFTA members. Finally, Vanhoudt (1999) disagreed with the former authors. Using the same time frame of Landau (1995) for his analysis and data on 23 OECD countries he found a negative effect of EU membership on economic growth.

These contradicting results provoked Badinger (2005) to construct another measure for economic integration apart from EU membership or its length. Accounting for a weighted sum of tariffs and trade costs he considers the EU integration as a dynamic process with different speeds of integration and which is also influenced by complex global tendencies that cannot just be captured by a dummy or another similar measurement. Using panel data of exclusively 15 EU countries from 1950 to 2000 he rejects the hypothesis of permanent growth effects, but verifies level effects. He concludes that the EU's GDP would be one-fifth lower in case of no integration.

Crespo Cuaresma et al. (2008) return to the more traditional regression equation of an augmented Solow model using the average length of EU membership as an extra independent variable. For a data sample of 15 EU countries from 1961 to 1998 they find a significant positive effect of EU membership on economic growth which increases with the membership's length. Moreover, by constructing subgroups of countries, they are able to show that the growth bonus is higher for initially poorer countries meaning that EU membership enhances beta convergence[3].

Mann (2015) also uses an augmented Solow model to test if the European integration enhanced economic growth in CEE (Central Eastern European) countries. The author finds a small, but significant effect of integration on economic growth. A similar analysis that confirms Mann's results was made by Rapacki and Próchniak (2009). The authors investigate the possible effects of EU membership on the growth of CEE countries from 1996 to 2007. They conclude that the enlargement of the EU contributed to the growth of these countries and to their convergence with the development level of the EU-15 countries. This convergence process, which accelerated with the approximation of the EU enlargement after 2000, should take up to 33 years.

3. Defining Membership's Growth Effects

From the augmented Solow growth model and using convergence analysis we can assume that the following variables determine economic growth[4]:

$$AGr_{t,i} = \beta_1 \ln\left(y_{0t.i}\right) + \beta_2 INV_{t,i} + \beta_3 EDU_{t,i} + \beta_4 INF_{t,i}, \\ + \beta_5 GOV_{t,i} + \beta_6 OP_{t,i} + u_{t,i} \quad (1)$$

[3] Beta convergence is a term created by Barro and Sala-i-Martin (1992). It refers to the negative correlation between the economic power of a country per capita and its growth rate. The survey of Durlauf and Danny (1998) shows its empirical evidence.

[4] The definition of variables that impact economic growth in our study are similar to, among others, Henrekson et al. (1997), Crespo Cuaresma et al. (2008), Rapacki and Próchniak (2009) and Mann (2015).

where $AGr_{t,i} = \left[\ln\left(y_{Tt,i}\right) - \ln\left(y_{0t.i}\right)\right]/n$, $y_{0t,i}$ is GDP per capita in PPP terms of country *i* in the beginning of period *t*. The following variables are all presented in average terms for country *i* and period *t*: *INV* is the investment share as proportion of the GDP, *EDU* is the expected number of years of schooling, *INF* is the inflation rate, *GOV* is the share of government's consumption as proportion of the GDP, *OP* is openness of the economy defined as $\frac{exports + imports}{GDP}$.

Now, as in Henrekson et al. (1997), we measure the direct benefits of EU and EZ membership to economic growth by using a dummy variable *EU* (*EZ*) where 1 indicates an EU (EZ) member and 0 the contrary. With these variables Equation (1) can be rewritten as:

$$\begin{aligned} AGr_{t,i} &= \beta_1 \ln\left(y_{0t.i}\right) + \beta_2 INV_{t,i} + \beta_3 EDU_{t,i} + \beta_4 INF_{t,i} + \beta_5 GOV_{t,i} \\ &+ \beta_6 OP_{t,i} + \beta_7 EU_{t,i} + \beta_8 EZ_{t,i} + \beta_9 EU_{t,i} CRI_t + \beta_{10} EZ_{t,i} CRI_t + u_{t,i} \end{aligned}, \quad (2)$$

where $EU_{i,t}CRI_t$ and $EZ_{i,t}CRI_t$ are interactions of the dummy variables *EU* and *EZ* with another dummy variable that accounts for the financial crisis, which equals 1 in a year of crisis and 0 otherwise. This interaction variable is used to measure the relative performance of an EU (EZ) member compared to non-members during the financial crisis. Notice that because we use averages of the variables for period *t*, these dummy variables and their interactions are also expressed in average terms.

In order to correct for the possible autoregressive effects of the dependent variable, we add its lag of order 1 to equation (2). This should control for "inertial" growth that cannot be explained by the other controlling variables. We further add lags of order 1 for the variables investment share and inflation because they impact current growth[5]. Thus, equation (3) can be seen as the focus of our investigation.

$$\begin{aligned} AGr_{t,i} &= \beta_1 \ln\left(y_{0t.i}\right) + \beta_2 INV_{t,i} + \beta_3 EDU_{t,i} + \beta_4 INF_{t,i} + \beta_5 GOV_{t,i} \\ &+ \beta_6 OP_{t,i} + \beta_7 EU_{t,i} + \beta_8 EZ_{t,i} + \beta_9 EU_{t,i} CRI_t + \beta_{10} EZ_{t,i} CRI_t \\ &+ \beta_{11} AGr_{t-1,i} + \beta_{12} INV_{t-1,i} + \beta_{13} INF_{t-1,i} + u_{t,i} \end{aligned}, \quad (3)$$

Notice that these variables or combinations of them are used by almost every study that regress economic growth. However, our study differs from others in some ways. For example, our data series is only 14 years long, because of the Euro's short life span. Usually economic growth studies use longer data series. This is the case for example of Landau (1995), Vanhoudt (1999), Badinger (2005) and Crespo Cuaresma et al. (2008), who use more than 30 years of data in their studies. However, in line with our study, other authors such as Henrekson et al. (1997), Rapacki and Próchniak (2009) and Mann (2015) use periods of less than 15 years.

Besides, studies of growth analysis usually use variables in average terms for periods ranging from 3 to 10 years. For example, Crespo Cuaresma et al. (2008) use averages of 10 years, Islam (1995) and Mann (2015) use averages of 5 years and Rapacki and Próchniak (2009) use averages of 3 years. The reason to use averages is that growth rates are typically influenced by business cycle fluctuations, which may differ from the "correct" growth trend. Business cycles span at a minimum of 3 years, thus we cannot select periods of less than 3 years for our averages. On the other hand, our sample is short and thus selecting longer periods than 3 years would reduce the observations of our sample significantly. Thus, we choose to use periods of 3 years as in Rapacki and Próchniak (2009). For the same reason it is necessary to use

[5] In order to choose the lags to be included in our estimations, we first tested the model using only one of the variables INV, INF, GOV, and OP in equation (3) including its lags of order one. Only investment share and inflation proved to have significant lags. Likely, the lags of other variables lack significance, because we use our variables in average terms. These estimations are available upon request.

overlapping periods as in Mann (2015). Using overlapping time periods for our estimations has the advantage of not having to choose time blocks arbitrarily. On the other hand, overlapping periods may add autocorrelation to the residuals of our estimations. Thus, it is important to use a robust HAC (Heteroskedasticity Autocorrelation Consistent) method to correct the variance of our estimates.

The intuition of the coefficients of equation (3) is as follows:

- β_1 should be negative, since the wealthier a country, the less it is expected to grow. This effect is known in the literature by the term beta convergence.
- β_2 should be positive, since the higher the investment share of GDP, the more the country is expected to grow (Levine and Renelt, 1992).
- β_3 should be positive, since the higher the expected education of a country, the more human capital is expected to be used in its economy and thus the more the country is expected to grow.
- β_4 should be negative as the higher the inflation, the more volatile the expectations related to the economy and therefore the lower the expected growth (Barro, 1995).
- β_5 is expected to be negative, since the higher the government spending and its deficit, the higher one expects capital flight. Governments are usually criticized to be less efficient on the administration of their resources than the private sector. Thus, higher government spending tends to lower economic growth. One could however contest this negative relation for the short term.
- β_6 should be positive, since the more opened an economy, the more it is expected to grow (Harrison, 1995).
- β_7 and β_8 should be positive if EU and EZ membership enhance economic growth.
- If we use time dummies in our estimations, the overall effects of the financial crisis on the growth of all countries are indirectly accounted for. Thus β_9 and β_{10} are expected to be negative, if one believes that the financial crisis has hit EU and EZ members stronger than non-members.
- β_{11} is expected to be positive if one expects past growth to influence current growth positively. The same is valid for β_{12}, which is associated to past investment.
- β_{13} is expected to be negative, if past inflation influences current growth negatively.

Henrekson et al. (1997) and Crespo Cuaresma et al. (2008) give empirical evidence for the positive significance of EU membership on growth. As the authors explain, this growth bonus may be related to the economic stability resulting from inflation control and reduction of exchange rate volatilities between members. Another potential explanation for the growth bonus is the gain of efficiency of members associated to the reduction of size of their governments. This enhances economic growth according to Folster and Henrekson (2001).

But, if we regress growth according to their models and control for investment, education, government spending and openness of the economy, we will end up controlling many channels by which memberships can enhance growth. For example, government spending could be seen as a function of the membership because part of the GDP may go to the membership. The same is valid for investments, because the membership may provide several funds to different countries. Besides, membership may also partially determine openness through trade legislation. Given that all these variables are valid channels by which membership can influence GDP, why should they be controlled for? What do the dummies actually measure? In this case, the dummies EU and EZ should measure only differences in the access and dissemination of technology caused by the integration, as well as other possible channels to economic growth not used in the model. Henrekson et al. (1997) provide a lucid discussion on this issue. But is the channel of government spending not important when we want to measure the effects of membership on economic growth more generally? Thus, one could question if these channels should not be accounted for as part of the membership's benefits.

In order to cope with this problem we decided to first control for these channels, consequently using a more restricted approach towards the definition of the membership's effect

on economic growth. Afterwards, we use a more general approach where we do not control for these channels.

Thus, we start by the analysis of *Model 1*, where all different variables of Equation (3) are controlled for. In this case, the membership's effects on growth are restricted to those not coming through the channels of the controlled variables. In a first step, we estimate *Model 1a*, where we assume that the crisis is an endogenous phenomenon of the Euro and of the EU and thus should not be controlled for. Thus, we set β_9 and β_{10} to equal zero. So, the effects of the crisis are taken as part of the membership dummies and should be reflected in the estimation of their related coefficients β_7 and β_8. Afterwards, we run estimations for *Model 1b*, where the effects of the crisis on growth are controlled for EU and EZ members. Thus the equations for *Models 1a* and *1b* can be written as:

$$\begin{aligned} AGr_{t,i} &= \beta_1 \ln\left(y_{0t.i}\right) + \beta_2 INV_{t,i} + \beta_3 EDU_{t,i} + \beta_4 INF_{t,i} + \beta_5 GOV_{t,i} \\ &+ \beta_6 OP_{t,i} + \beta_7 EU_{t,i} + \beta_8 EZ_{t,i} \\ &+ \beta_{11} AGr_{t-1,i} + \beta_{12} INV_{t-1,i} + \beta_{13} INF_{t-1,i} + u_{t,i} \end{aligned} \tag{4}$$

and

$$\begin{aligned} AGr_{t,i} &= \beta_1 \ln\left(y_{0t.i}\right) + \beta_2 INV_{t,i} + \beta_3 EDU_{t,i} + \beta_4 INF_{t,i} + \beta_5 GOV_{t,i} \\ &+ \beta_6 OP_{t,i} + \beta_7 EU_{t,i} + \beta_8 EZ_{t,i} + \beta_9 EU_{t,i} CRI_t + \beta_{10} EZ_{t,i} CRI_t \\ &+ \beta_{11} AGr_{t-1,i} + \beta_{12} INV_{t-1,i} + \beta_{13} INF_{t-1,i} + u_{t,i} \end{aligned} \tag{5}$$

After estimating equations (4) and (5) we run *Model 2*, where we do not control for those variables that could be seen as channels by which membership affects economic growth. We assume that the following variables can be considered as good candidates for these channels: investment share, education, government spending and openness. Thus, *Model 2* has a broader approach towards the definition of the effects of membership on growth. Besides, we repeat the differentiation of the Euro crisis as endogenous or exogenous variable to EU and EZ memberships by running *Models 2a* and *2b* according to the following equations respectively:

$$\begin{aligned} AGr_{t,i} &= \beta_1 \ln\left(y_{0t.i}\right) + \beta_4 INF_{t,i} + \beta_7 EU_{t,i} + \beta_8 EZ_{t,i} \\ &+ \beta_{11} AGr_{t-1,i} + \beta_{12} INV_{t-1,i} + \beta_{13} INF_{t-1,i} + u_{t,i} \end{aligned} \tag{6}$$

and

$$\begin{aligned} AGr_{t,i} &= \beta_1 \ln\left(y_{0t.i}\right) + \beta_4 INF_{t,i} + \beta_7 EU_{t,i} + \beta_8 EZ_{t,i} \\ &+ \beta_9 EU_{t,i} CRI_t + \beta_{10} EZ_{t,i} CRI_t + \beta_{11} AGr_{t-1,i} + \beta_{13} INF_{t-1,i} + u_{t,i} \end{aligned} \tag{7}$$

4. Measuring the Membership's Growth Effects

This study wishes to analyse the effects on growth of EU and EZ memberships. But these memberships are not random events. Notice that several conditions must be met before a country can join them, where some relate directly to GDP. If that is the case, membership is an endogenous variable in the regressions which cannot be consistently estimated without using instrumental variables (Hayashi, 2000 and Bun and Klaassen 2007). One could also claim that other variables of Equation (3) could qualify as endogenous variable such as government spending, inflation, investment share, etc. For all these reasons, the more flexible GMM estimators are standard in regressions of economic growth.

We apply the panel Generalized Method of Moments (GMM) according to Arellano and Bond (1991), which is designed to panel models with a relatively short period of time and a large number of individuals and where a linear relationship is being studied. This linear relationship may be dynamic, where past realizations of the dependent variable influence its current ones. Moreover, individual fixed effects may be present and some regressors may be

endogenous. Furthermore, disturbances of the estimations may present heteroscedasticity and autocorrelation, even though uncorrelated across individuals. This GMM approach also assumes that all instruments are based on lags of the model's variables. The technique starts by transforming all regressors by differencing and that is why it is also called "difference GMM". By transforming the data, the difference GMM removes fixed effects, but the lagged dependent variable can still be endogenous (For more details, see Roodman, 2009).

Besides endogeneity, other problems of panel regressions could be mentioned. For example, our variables could have a unit root and be co-integrated. Furthermore, an individual time trend of growth could exist, what could bias the membership's effect upwards, since the longer the period, the more countries join the club. Baldwin and Taglioni (2006) and Bun and Klaassen (2007) discuss these issues and prove that those problems can significantly bias the calculated effects of membership on trade. However, because our panel has a more restricted time frame, accounting for a time trend on growth would not make sense and unit root tests for our panel data (Maddala and Wu, 1999, Im et al., 2003 and Levin et al., 2002) indicate that nonstationarity issues are not relevant to us, likely because of the small "T". A table with these unit root tests for our data is available under request.

Table 1: GMM Estimation Results

		1a		**1b**		**2a**		**2b**	
		Coef.	**p-value**	**Coef.**	**p-value**	**Coef.**	**p-value**	**Coef.**	**p-value**
β_1	$\ln y_{0t,i}$	**-0.2807**	**< 0.001**	**-0.298**	**< 0.001**	**-0.2567**	**< 0.001**	**-0.2723**	**< 0.001**
β_2	$INV_{t,i}$	**0.0045**	**0.010**	**0.0050**	**0.005**	x	x	x	x
β_3	$EDU_{t,i}$	0.0036	0.441	0.0049	0.295	x	x	x	x
β_4	$INF_{t,i}$	0.0016	0.333	0.0011	0.467	0.0013	0.235	0.0010	0.444
β_5	$GOV_{t,i}$	**-0.0072**	**0.008**	**-0.0060**	**0.025**	x	x	x	x
β_6	$OP_{t,i}$	0.0001	0.465	0.0001	0.577	x	x	x	x
β_7	$EU_{t,i}$	**0.0137**	**0.043**	**0.0141**	**0.021**	**0.0244**	**0.035**	**0.0256**	**0.022**
β_8	$EZ_{t,i}$	0.0038	0.743	0.0166	0.146	0.0034	0.785	0.0127	0.331
β_9	$EU_{t,i}\ CRI_t$	x	x	-0.0092	0.519	x	x	0.0008	0.943
β_{10}	$EZ_{t,i}\ CRI_t$	x	x	**-0.0165**	**0.057**	x	x	**-0.0124**	**0.096**
β_{11}	$AGR_{t-1,i}$	-0.2183	0.395	-0.2138	0.375	-0.0158	0.864	-0.0084	0.936
β_{12}	$INV_{t-1,i}$	**-0.0020**	**0.075**	**-0.0022**	**0.005**	x	x	x	x
β_{13}	$INF_{t-1,i}$	**-0.0030**	**< 0.001**	**-0.0030**	**< 0.001**	**-0.0035**	**< 0.001**	**-0.0034**	**< 0.001**
Sargan Test		8.233	0.312	8.028	0.330	14.778	0.393	16.646	0.275
Autocor. Test (1)		1.331	0.091	1.298	0.097	2.006	0.022	1.858	0.031
Autocor. Test (2)		-0.740	0.229	-0.711	0.238	-0.592	0.276	-0.611	0.270
Wald Coef.		473.4	< 0.001	569.5	< 0.001	128.3	< 0.001	160.4	< 0.001
Wald Time Dum.		319.8	< 0.001	305.4	< 0.001	584.8	< 0.001	540.9	< 0.001
Confidence Intervals at 10% Significance of Selected Coefficients									
		1a		**1b**		**2a**		**2b**	
β_1	$\ln y_{0t,i}$	-0.3405	-0.2208	-0.3560	-0.2400	-0.3010	-0.2123	-0.3228	-0.2218
β_2	$INV_{t,i}$	0.0016	0.0074	0.0020	0.0079	x	x	x	x
β_5	$GOV_{t,i}$	-0.0118	-0.0026	-0.0104	-0.0015	x	x	x	x
β_7	$EU_{t,i}$	0.0025	0.0248	0.0040	0.0243	0.0053	0.0436	0.0071	0.0440
β_{10}	$EZ_{t,i}\ CRI_t$	x	x	-0.0309	-0.0022	x	x	-0.0247	-0.0001
β_{12}	$INV_{t-1,i}$	-0.0038	-0.0001	-0.0042	-0.0003	x	x	x	x
β_{13}	$INF_{t-1,i}$	-0.0043	-0.016	-0.0042	-0.0017	-0.0051	-0.0019	-0.0052	-0.0017

Models 1a and *1b* are estimated using lags of order 4 of the model's variables in the GMM vector of instruments. *Models 2a* and *2b* use lags of orders 4 and 5. Significant coefficients are marked in bold.

Source: author's calculations

Results for our GMM estimations of Models 1a, 1b, 2a and 2b are given in Table 1. The estimations perform well and autocorrelation tests of residuals indicate that the disturbance terms of the second order do not present autocorrelation. This allows us to select any instrument of lag 3 or higher. Besides, none of the GMM estimations are rejected by the Sargan test, showing that our GMM estimations meet the requirements of identification. Furthermore, all Wald tests support the use of both our variables and time dummies to regress economic growth.

In order to correct the variance of our estimates all p-values and confidence intervals in Table 1 are calculated using the robust HAC method according to White (1980) and Newey and West (1987). Unfortunately, when we use the HAC method, our confidence intervals get wider and we cannot be so precise on where the true values for our estimates are. Thus, we will be conservative and use as measurements of growth bonus and of effects of the financial crisis the lower and upper boundaries of the confidence intervals of their coefficients respectively.

We decided to leave all the non-significant coefficients in our estimations. Reducing the estimated models by setting non-significant coefficients to zero (deleting variables) based on inference tests could create two different problems. First, it could confuse the interpretation of the coefficients. A good example for that would be the problems with the interpretation of the membership dummies: What would they capture in each setting? Second, the result of setting coefficients to zero based on inference tests could strongly depend on the ordering in which we proceed. This is discussed by Hendry and Krolzig (2004).

4.1 Estimation Results of the Restrict Approach (Model 1)

Observing the results of the estimations of Model 1a, β_1 is negative implying beta convergence. The richer the state, the lower its potential to grow. β_2 is the coefficient associated to the investment share of the economy.

There is evidence that the higher the investment share, the more the country is expected to grow. However, the coefficient associated to past investment share β_{12} is significant, but appears to have the "wrong sign". This indicates that past investment has a negative influence on growth. Although it is hard to explain the exact cause for this contra intuitive result, it is not uncommon to find similar findings in the literature (inter alia Blomstrom et al., 1996, Attanasio et al., 2000, Loayza et al., 2005 and Roodman, 2008). For example, Blomstrom et al. (1996) and Attanasio et al. (2000) have 2 possible explanations for this problem: The first is that savings, which anticipate growth negatively limits investment. The second is that growth is a cyclical variable. Thus, periods of high growth and investment are preceded by periods of low growth and investment.

There is no evidence that β_3 and β_4 are significant in our sample. This implies that education and inflation are not relevant to explain growth. However, past inflation has a negative impact on current economic growth (β_{13} is negative and significant).

Besides, β_5 is significant and confirms that the higher the government consumption, the lower its potential growth. β_6 is related to the openness of the economy. In our estimations, there is no evidence that this variable is significant to measure economic growth.

The coefficients related to EU and EZ memberships are β_7 and β_8 respectively. The significance of the former coefficient evidences that EU membership contributes positively to economic growth, which goes in line with most of the literature discussed earlier. In our case, EU members have an expected bonus in growth of at least 0.25% per year. However, there is no evidence that EZ membership influences economic growth (β_8 is not significant).

Finally, β_{11} is not significant indicating that past growth does not influence current growth in our model setting.

Notice that our model considers the effects of the financial crisis equally for every country in the time dummies of the GMM. However, the financial crisis may have affected EU and EZ members stronger than other countries. Because we do not have access to longer time series for the Euro, our estimations are restricted to a period of only 14 years. If the financial crisis is an exogenous factor and we do not expect it to happen in the long term with the frequency observed in our data sample, our results for the coefficients of EU and EZ would be biased. They would be solely driven by the European Debt Crisis and should therefore not be

expected to hold in the future. To put it simple, one would expect just that lower growth in the end of our sample coincides with larger (and longer) membership in the EU and EZ.

In order to account for this possible effect, *Model 1b* controls for the extra effects of the crisis on EU and EZ members individually. Thus, the effects of the memberships on growth can be analysed more precisely.

The estimated coefficients of Model 1b have very similar characteristics of those of Model 1a. As in Model 1a, notice that when we control for the crisis in EZ countries, we observe a significant positive effect of EU membership on economic growth (β_7 is positive and significant). This positive effect is of at least 0.4% per year. On the other hand β_8 remains non-significant implying that EZ membership does not directly affect economic growth, unless during the time of the financial crisis (β_{10} is significant). We can say that EZ membership amplifies recession in EU countries that adopt the Euro in at least 0.2% per year, neutralizing at least part of the growth bonus associated to EU membership. We can further observe that the crisis did not affect EU members that are not part of the EZ more than non-EU members (β_9 is not significant).

So, what is the contribution of EZ membership to economic growth during the first 14 years of the Euro? If the crisis is consequence of the common currency, *Model 1a* should be taken into consideration and we could conclude that the Euro does not contribute to economic growth. On the other hand, if the crisis is exogenous, *Model 1b* shows that the EZ membership amplified the negative effects of the financial crisis from 2007 to 2012.

4.2 Estimation Results of the Broader Approach (Model 2)

Model 2 analyses a more general approach of the benefits of EU and EZ memberships to economic growth. Basically, this model re-estimates Model 1 without controlling for those variables that can be seen as possible channels by which membership can influence growth.

Notice that the significance and signals of our GMM estimates in Models 2a and 2b, where we do not control for investment, education, government spending and openness of the economy are very similar to those of Models 1a and 1b.

As observed in Model 1, we observe a significant positive effect of EU membership on economic growth in both Models 2a and 2b (β_7 is positive and significant). Thus, EU membership is expected to influence economic growth in at least 0.53% (Model 2a) and 0.71% (Model 2b) positively per year. On the other hand β_8 is not significant. This means that EZ membership does not influence economic growth, unless during the financial crisis when it hinders growth with at least 0.01% per year (see Model 2b, where β_{10} is negative and significant). In this case, the positive effect of EU membership on growth is at least partly neutralized in Euro countries by an amplified negative effect of the financial crisis as discussed earlier. Besides, the crisis seems not to affect EU members that do not adopt the Euro more than non-EU countries, since in Model 2b β_{11} is not significant.

We can conclude again that the effects of EZ membership on economic growth depend on how we look at the crisis: if the crisis is consequence of the common currency, Model 2a should be taken into consideration and we would conclude that the Euro does not contribute to economic growth. On the other hand, if the crisis is exogenous, Model 2b shows that EZ hindered economic growth during the years of the financial crisis.

Even though the conclusions of Models 1 and 2 are very similar, one could observe in a first look a major difference between the estimated sizes of the growth bonus of EU membership. This coefficient seems to be higher in Model 2 than in Model 1. This should be expected because Model 2 does not control some of the channels through which membership can influence economic growth. For example, when investment share is controlled in Model 1, the EU variable does not capture the effect that membership exercises over investment share. Part of investment share may be enhanced because of the membership. Contrarily to Model 1, Model 2 accounts for this effect in the membership dummy. Thus, it would be natural to find higher values for the growth bonus of EU (β_7) in the estimations of Model 2. Notice that most of the literature discussed in this article uses restrict models such as our Models 1a and 1b. This is

likely the reason why they find a growth bonus closer to the ones we estimated in Models 1a and 1b.

However, given the wider confidence intervals for the estimated EU coefficients in Models 2a and 2b, there is no statistical evidence that they differ from those of Models 1a and 1b. Thus, we prefer to be conservative and use the lower boundaries of the models estimates to conclude that there is a significant positive effect of EU membership on growth of at least 0.25% to 0.71% per year. On the other hand, during the years of the financial crisis, this positive effect is neutralized by at least 0.01% per year in countries that adopt the Euro. Unfortunately, because of the HAC corrections for the standard deviations of our estimates, their confidence intervals become wider and we cannot be more precise on their measurements. Nevertheless, we can conclude that they are significant.

5. Conclusion

The aim of this study was to investigate if the integration caused by EU and EZ implied growth bonus for their members during the first 14 years of the Euro. We further analysed economic convergence in member countries as well as the relation of other variables to growth, according to different versions of an augmented Solow growth model.

In accordance with the literature our results show a negative relation between per capita income and growth, which can be seen as an evidence of beta convergence for the 14 years of our sample. During this period, poorer countries have been "catching up" with the wealthier ones.

Countries that are more opened to trade are expected to grow more because of scale effects. However, we could not find any significant effect of trade on economic growth. Likely, this result is a consequence of the economies included in our sample, which are all relatively opened to international trade. The same is valid to education, which was also not significant.

Besides, we found evidence that investment share has a positive and significant relation with growth. On the other hand, we verified that past inflation and government spending have a significant negative effect on economic growth.

We observe a positive relation between EU membership and growth during the first 14 years of the Euro, meaning that the EU countries analysed in our data grew stronger than non-EU members. This goes in line with most of the literature discussed in this study.

The gains in growth promoted by EU membership are evidence for the endogenous growth theory of Romer (1990) and for the study of Baldwin (1992) in which economic integration implies scale effects and consequently has positive effects on growth. Consequently, according to this theory, the more countries join the EU, the higher the scale effect of the economy and thus the higher the incentives for research and development activities. This results on technological progress and thus permanent growth effects are generated.

Finally, does EZ membership impact economic growth? The answer to this growth question is especially interesting to potential new entrants of the common currency, even though there may be other than economic reasons to join the Euro. Examples for new potential members are some of the CEE countries that are planning or are already in process to join the common European currency. We conclude that the impact of EZ membership on economic growth depends on the way we look at the crisis: If we think about it as an endogenous phenomenon of the EZ, we should run our estimations without controlling for it in Euro countries. That is what we did in a first step and found no evidence that EZ membership influenced growth. However, if we think about it as an exogenous variable and control for its effects in Euro countries, we can observe that EZ membership hindered economic growth during the period of the crisis compared to other EU members; while in other years it did not affect growth. Thus, we can say that for EZ members, the positive effects of EU membership on growth are partly neutralized during the years of the financial crisis. Since the history of the Euro is still short, the future will show us the right approach.

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