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EURO MEMBERSHIP AND GDP GROWTH FORECAST

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Abstract

A simple panel data growth regression is estimated in order to determine if euro area membership permits GDP growth and if it promotes conditional convergence. Furthermore, the model is also used to determine if a high level of government expenditure helps to further growth. The study is carried out with a sample of OECD and European economies, conditional on a number of control variables and tested in different scenarios. Results show us that the euro area membership does not help forecast growth in any scenario except when restricted for non-founding members.

Keywords: economic growth, Euro area, panel data, fixed effects, convergence

1. Introduction

In principle, belonging to the Euro area should enhance GDP growth and convergence. As a result it has been subject to a lot of studies attempting to test whether the effect is as expected. According to the theory the benefits of belonging to the same monetary union are several and include among others: increase of intra-trade as barriers and tariffs almost disappear with the creation of a single and integrated market, stabilize exchange rate volatility, higher price transparency, and inflation stabilisation. All this should improve the macroeconomic environment that then reflects in higher and more stable growth rates. However, the 2008 financial crisis has tested these principles. The model includes two restricted versions to determine if the crisis had any different effect on GDP growth for euro countries.

Since the financial crisis, economic data does not seem to support the theory. Differences in gross domestic product per capita and wealth between developed countries, looks like it is stretching rather than shrinking. Some economies (like the US and Canada, or northern Europe) are getting richer and increasing their GDP per capita well above its 2008 level, while other countries (like southern Europe or Japan) took longer to achieve its 2008 GDP per capita levels, or what is worse, have not yet achieved it. Furthermore, the Covid-19 pandemic looks like is aggravating the situation, with some countries being more affected than others.

The purpose of this study is to determine if belonging to the Euro area helps forecast GDP growth on the long run. To do so a fixed effects growth model with OECD and European Union countries will be used and will later be augmented to introduce dummy variables that will try to capture the effect on the steady state growth and on the speed of convergence. From the growth model it will also be possible to see to the impact of Euro area on beta convergence and the net effect of government consumption. Has the euro area membership been growth enhancing ex post its implementation? Will it enhance GDP per capita growth in the future?

Given the conflicting empirical findings in a world sample, it is rather difficult to see the scope of the euro membership on GDP growth per capita. By restricting the analysis to OECD and European Union countries the complexity of the analysis is substantially reduced by decreasing heterogeneity, and hence there is no need to discriminate in aspects like latitude, language or culture.

The work is organized as follows: section two reviews the literature on growth models, convergence and European membership effect on growth. Section three looks into the model, the methodology and the variables. Section four looks into the data. Section five presents the results of the restricted and augmented models, robustness checks and forecasts. Finally, section six considers some limitations of the study and concluding remarks.

The main finding is that the euro membership does not help forecast GDP per capita growth in any scenario except when restricted for non-founding Euro area members.

2. Literature review

The neo-classical growth model developed by Solow (1959) is used as a starting point. Although the amount of papers analysing growth is rather big, the one developed by Solow it is the main foundation and it is often used as a standpoint for any growth study.

Solow’s model is also referred as exogenous growth model as it only contains two variables affecting growth: capital and labour (or effective labour as it is multiplied by technology or knowledge). In the Solow model, growth is achieved by the accumulation of capital.

Countries achieve a steady state level of capital that equals depreciation, and at the same time they achieved a steady state level of output. Furthermore, countries cannot grow anymore unless there is a technological improvement (which needs to be exogenous).

Ever since, cross country growth studies have tried to capture sources of growth. Mankiw et al. (1992) proposed the famous endogenous growth model, extending the Solow model by introducing human capital, physical capital (or investment) and labour, which was able to capture much better the growth disparities among countries.

Absolute convergence can distinguish between two forms: beta convergence and sigma convergence (see Sala-i-Martin, 1995). Beta convergence (or catch-up process), happens when countries with a lower GDP per capita grow at higher rates than those with higher GDP per capita by capitalising on technology transfer, inward investment, and relatively lower labour costs, reducing the difference in GDP per capita gap, with beta itself being the speed of convergence. Furthermore they take advantage from rich countries as they can avoid mistakes or replicate successes. Sigma convergence on the other hand is when GDP per capita difference diminishes between countries over time (i.e. reduction of income disparities). Sigma convergences imply that beta convergence is taking place and other factors affecting GDP per capita growth, do not affect negatively on growth. Mankiw et. Al (1992) also introduced the concept of conditional convergence which can be defined as a process in which convergence is observed within countries conditional on one or more factors like savings or population growth, rather than unconditional or absolute convergence. This type of convergence tends to happen with sets of countries with similar parameters or institutions.

Barro (1991) introduced much more variables to his growth model that ended up being significant. These include initial human capital level, which is positively related to the initial GDP per capita (there seems to be a catch up process with the rich countries if the poor countries invest in human capital) or government spending which is negatively related to GDP growth and could harm it by negatively affecting investment.

Working with a panel data model, Bassanini and Scorpetta (2001) find out that the accumulations of physical and human capital explain most of the economic growth in OECD countries between 1960 and 1999 and that growth disparities seem to come from differences in investment rates, human capital, R&D and trade exposure among others. More recently, and working with an EU and OECD growth equation, Veiga (2020), concludes that the quality of institutions areas for improving future economic growth and make Portugal converge with its EU peers are regulation, legal system and corruption fighting.

Most empirical papers on GDP growth that assess membership significance after controlling for other aspects focus on convergence or European Union membership, rather than on growth or Eurozone membership. Working with a European Union sample and a panel data growth model, Crespo-Cuaresma et al. (2002), found that EU membership had a positive impact on growth on the long run, and that this positive impact increased the longer the country was a member and the least developed it was, promoting convergence. However, a dummy variable for Euro area was not included. In addition, Varblane and Vahter (2005) worked with transition European economies panel data growth model and concluded that these countries had a rapid process with reducing the per capita GDP disparities with the EU average level, suggesting that being a European Union member help them grow, promoting a very dynamic convergence process.

Moreover Da Silva (2018), includes a dummy variable for Economic Monetary Union (EMU) for an OECD sample to determine if the euro itself had an impact on growth, suggesting that it does have a significant impact and that this impact had a negative effect, harming GDP growth to its members. Lastly Kaitila (2004) also finds beta and sigma convergence taking place in the EU15 countries during the 1960-2001 period, with EU post-membership growth being more favourable.

Literature leaves us with mixed feelings and with the sensation that there is a gap when it comes to the impact of being a member of the Euro area. This paper differs from the previous ones as the impact on growth and Euro Area membership is addressed.

3. Empirical approach

The aim of this study is to see the effect of the euro membership on GDP growth and determine if it helps forecast growth on the long run. Furthermore, the model will also try to capture if the effect is happening on the steady state growth, on the speed of convergence or on both. The model is built with panel data as it deals with heterogeneity and is useful to control for variables across entities and over time. The hypothesis to be tested here is if the euro membership has an effect on the steady state GDP per capita growth or in other words: determine if being part of the Eurozone will help forecast GDP growth in the future after controlling for other variables, as well as determining if it affects the speed of convergence. From the growth regression, it will also be possible to see the net effect of government consumption on growth and determine if there has been beta convergence or not.

Equation for the baseline model

The baseline growth regression is given by:

$$LnY_{i,t} = \alpha + \gamma \boldsymbol{X}_{i,t} + \beta lnY_{i,0t} + \varepsilon_{i,t} \quad (1)$$

Where $Ln\, Y_{i,t}$ is the growth GDP per capita, $\boldsymbol{X}_{i,t}$ is a vector of explanatory variables capturing growth, γ is a vector of coefficients for each one of those variables, $\beta lnY_{i,0t}$ captures speed of convergence, and $\varepsilon_{i,t}$ is the regression error term. Country is denoted by subscript $_i$ and sub-periods are denoted by subscript $_t$.

Augmented model for euro dummies

The augmented formula for growth is given by:

$$LnY_{i,t} = \alpha + \gamma\boldsymbol{X}_{i,t} + \beta lnY_{i,0t} + Deur_{i,t} + \beta DeurlnY_{i,0t} + \varepsilon_{i,t} \text{ (2)}$$

Where $Deur_{i,t}$ is a dummy variable that takes the value of one if the country is a member of the Euro area and zero otherwise and it measures the impact of the euro area on the steady state growth. On the other hand, $\beta DeurlnY_{i,0t}$ is the variable that will capture the effect of the euro area dummy on the speed of convergence.

Variables

The explanatory variables included in $\boldsymbol{X}_{i,t}$ to build the growth model are the ones based on the model from Mankiw, Romer and Weil (1992) and include physical capital, human capital and population growth. Additionally other variables were also included. These are variables to control for government participation in the economy, freedom of trade and economic freedom, as well as inflation, all widely used in growth models (see Crespo-Cuaresma 2002 or Varblane 2005).

Model built to predict growth

Equation (3) is an adapted version from Crespo-Cuaresma et al. (2002) growth formula:

$$[ln(Y_{i,Tt}) - ln(Y_{i,0t})]/n_t = \alpha + \beta_1 ln(Y_{i,0t}) + \beta_2 Inv_{i,t} + \beta_3 Educ_{i,t} + \beta_4 Infl_{i,t} +$$
$$\beta_5 Efreedom_{i,t} + \beta_6 FTrade_{i,t} + \beta_7 Pop_{i,t} + \beta_8 Government_{i,t} + u_{i,t} \quad \text{(1.a)}$$

The left hand side of the equation is GDP per capita growth, where *n* represents the number of years for each sub-period $_t$. The right hand side is composed by $ln(Y_{i,0t})$ which is the logarithm of GDP per capita for the first year of the subsample, $Inv_{i,t}$ refers to investment (subsample average), $Educ_{i,t}$ refers to education for the first year of the subsample, $Infl_{i,t}$

refers to inflation index (subsample average), $Efreedom_{i,t}$ refers to economic freedom of institutions for the first year of the subsample, $FTrade_{i,t}$ controls for freedom of trade (subsample average), $Pop_{i,t}$ captures annual population growth (subsample average) and lastly $Government_{i,t}$ controls for government participation in the economy (subsample average).

4. Data

The sample covers 30 years of data, starts in 1990 and goes until 2019. It is then divided in six intervals of five years each to capture possible business cycles: 1990-94, 1995-99, 2000-04, 2005-09, 2010-14 and 2015-19.

The sample includes 39 countries and is strongly balanced (with gaps). The countries comprise all the ones from the European Union[1] and OECD[2] except for the countries that have a population close to or below one million, which are Luxembourg, Cyprus, Malta and Iceland. This is done to avoid unnecessary noise or possible outliers. As previously mentioned the sample is quite homogeneous and there is no need to control for variables like religion or conflicts which facilitates the study. The model includes all European countries, including new eastern European countries to make it more complete. Old data for these countries is extremely scarce and to go further back in time than 1990 was unfortunately not possible. Furthermore, a sample containing fewer countries (26) but covering more years (50) was tested to see if it had a better result, but the results were weaker.

GDP per capita is expressed in real GDP purchasing power parity and it was decided to use this variable because it is more comparable across space and time than market exchange rates

[1] European Union comprises the following countries: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Lithuania, Latvia, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia and Sweden

[2] OECD comprises the following countries (excluding aforementioned countries): Australia, Canada, Switzerland, Chile, Colombia, Costa Rica, United Kingdom, Israel, Japan, Korea, Mexico, New Zealand, Norway, Turkey and the United States

measures (Durlauf et al. 2005). Real GDP per capita is sourced from the Penn World Table database. Gross fixed capital formation as a percentage of GDP proxy's investment and it is sourced from the OECD database.

Years of education is used to proxy education, as it displays stronger result than other estimated variables that were tested like percentage of people with attained secondary or tertiary education. Due to the nature of the sample countries and the homogeneity $Educ_{i,t}$ will not be statistically significant in most regressions. Education data is sourced from Barro-Lee's educational attainment dataset. Consumer price index (CPI) proxy's inflation level and it is sourced from the IMF database.

Economic freedom of institutions proxy is Economic Freedom Index (EFI) developed by Fraser Institute in the Economic Freedom of the World report. Other variables like rule of law were tested but results were weaker and not significant. Freedom of trade proxy is trade, which has been widely used in growth studies. It is built by adding up export and imports as a percentage of GDP. Trade data is sourced from the World Bank Database.

Finally, to proxy the participation of the government in the economy and the dimension of those participations, it was decided to use the indicator of government expenditure as a percentage of GDP (which is sourced from the World Bank Database).

On a side note, the decision for choosing the above variables should not be seen as must go variables, as variables identification is very challenging and studies have used over 140 different variables to predict growth that have been found to be statistically significant (Durlauf et al. 2005).

Table 1 shows the means, number of observations, maximums, minimums and standard deviations of the dependent and all explanatory variables.

Variable	Number of observations	Mean	Standard deviation	Maximum	Minimum
Ln GDP growth	234	0.015	0.023	0.082	-0.11
Initial ln GDP	234	10.16	0.53	11.33	8.94
Investment	234	0.19	0.042	0.32	0.063
Education	234	10.68	1.62	13.25	5.22
Inflation	234	0.13	0.51	5.71	-0.0051
EFI	234	7.38	0.90	8.76	3.81
Trade	234	0.79	0.36	2.23	0.17
Population	234	0.0048	0.0078	0.033	-0.015
Government	234	0.19	0.039	0.27	0.085

Table 1. Variables descriptive statistics

5.1 Results with baseline model

In a first step, growth is regressed following a restricted version of equation (1). The model is run with three different panel data estimators: pooled OLS, fixed effects and random effects. A Hausman test is carried to determine if fixed effects or random effects should be used. The null hypothesis says that the unique error terms, α_i, are not correlated with the regressors, $\boldsymbol{X}_{i,t}$, or in other words, the covariance between the unique error terms and the regressors is zero. The null hypothesis is rejected (Prob>chi2 = 0.00) and fixed effects is chosen above random effects, as it is the only consistent estimator. Lastly, the F-test for the fixed effects estimator tell us that the results are better than those of pooled OLS estimation (Prob>F = 0.00) and that all the coefficients in the fixed effects model are different from zero. Because of all this, the fixed effects estimator is chosen. Furthermore, robust standard errors is used to avoid possible heteroscedasticity and autocorrelation.

As expected, growth depends negatively on the initial natural logarithm of GDP per capita, showing the model has evidence of beta convergence (Crespo-Cuaresma et al., 2002). Investment has the expected positive sign (see Barro, 1991) and education also has the expected positive sign. All coefficients are statistically significant at the 1% level.

Model	1	2	3
Initial ln GDP	-0.068*** (0.0091)	-0.065*** (0.0086)	-0.065*** (0.0086)
Investment	0.44*** (0.053)	0.25*** (0.038)	0.25*** (0.039)
Education	0.0061*** (0.0025)	0.0027 (0.0017)	0.0027 (0.0017)
Inflation		-0.018*** (0.0037)	-0.018*** (0.0038)
EFI		0.0048 (0.0037)	0.0049 (0.0036)
Trade		0.02* (0.01)	0.02* (0.01)
Population		-0.77* (0.4)	-0.79** (0.39)
Government		-0.38*** (0.098)	-0.46 (0.46)
$Government^2$			0.2 (1.13)
Observations	234	234	234
R^2	36.53%	63.71%	63.72%

Table 2. Restricted baseline model, linear model and quadratic model. Robust standard errors in parenthesis. ***[**] (*) stands for 1%, [5%] and (10%) significance.

In a second step, growth is regressed with all the additional variables capturing growth from equation 1.a. It can be observed that all three coefficients from the first regression maintain the same sign. Furthermore, inflation has a negative sign, which is in line with Barro, 1996 or Andrés and Hernando, 1997 as they found out that there is a significant negative correlation between inflation and income growth on the long run. Economic freedom index has the expected positive sign (see Veiga, 2020) and population the expected negative sign. Furthermore, all coefficients are significant at the 10% level except for education and economic freedom index.

Model two also shows that government expenditure is significant at the 1% level and has an expected negative relationship with growth. The argument is that government consumption does not enhance productivity but lowers savings and growth through distorting effects of taxes and investment decrease (see Barro, 1991 or Barro, 1996). To see the net effect of government consumption on growth, figure 1 plots GDP per capita growth net of the value predicted by all explanatory variables except for government consumption, against government consumption. It shows that holding everything else constant, ceteris paribus, if government consumption increases, it will have a negative effect on growth. This partial association appears to be strongly negative, with a correlation of -0.73.

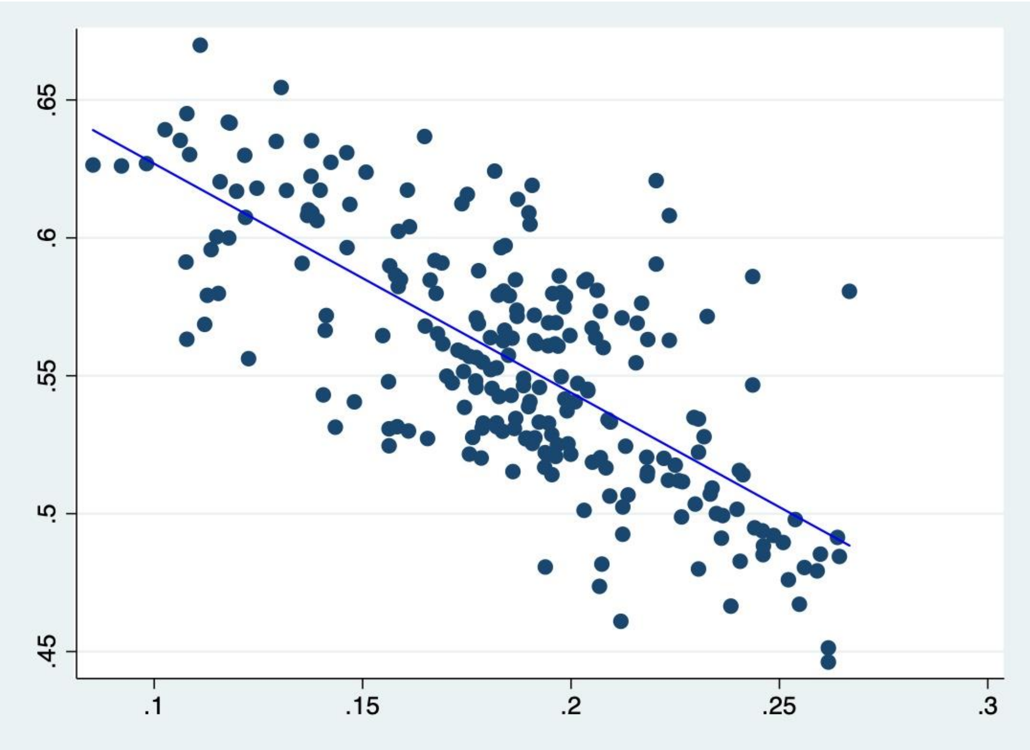

Figure 1. Partial association between GDP per capita growth rate and average government consumption.

In order to obtain a deeper understanding of government consumption, model three adds the square of government consumption to test the quadratic relationship between GDP per capita growth and government consumption. The results show however that the estimated coefficient is positive but not significant at the 10% level, indicating that the model only shows a linear relationship and not a quadratic relationship, while the linear coefficient is no longer significant. This makes sense as the sample contains mostly developed and rich countries that are placed on the right hand side of the Laffer curve and hence they do not profit from growth by increasing government expenditure (see Fölster and Henrekson, 2000).

Other models including additional variables for government consumption and intervention like size of the government developed by Fraser Institute were also estimated but all had weaker results than government consumption as a percentage of GDP so were not included in table 2.

5.2 Results with augmented model

In a fourth step a restricted version of the augmented model is regressed, including the Euro area dummy variable to see the effect on the steady state growth rate; surprisingly the coefficient is not significant at the 10% level. This shows that being a member of the euro area does not help predict growth on the long run and that it does not affect the steady state GDP per capita growth. All other coefficients maintain the sign from the previous model and are significant at the 10% level except for education and EFI. The model explains now 63% of the variation in growth.

Model five regresses the augmented model with both dummy variables to see the effect of Euro area on the speed of convergence and the steady state. However, the euro dummy is not able to capture this nor the steady state GDP per capita growth as both coefficients are not significant at the 10% level, in line with model four. All other coefficients maintain the significance and sign, as well as R^2.

Model	4	5 (Baseline)	6	7	8
Initial ln GDP	-0.065*** (0.0094)	-0.065*** (0.0093)	-0.066*** (0.0092)	-0.065*** (0.0092)	-0.065*** (0.01)
Investment	0.25*** (0.042)	0.26*** (0.045)	0.25*** (0.039)	0.26*** (0.039)	0.26*** (0.046)
Education	0.0026 (0.0018)	0.0026 (0.0019)	0.0027 (0.0017)	0.0027 (0.0017)	0.003 (0.0019)
Inflation	-0.018*** (0.0038)	-0.018*** (0.0038)	-0.018*** (0.0037)	-0.018*** (0.0038)	-0.018*** (0.0039)
EFI	0.0049 (0.004)	0.0044 (0.0038)	0.0049 (0.0037)	0.0044 (0.0038)	0.0045 (0.0039)
Trade	0.02* (0.011)	0.021* (0.011)	0.02* (0.01)	0.021* (0.01)	0.018 (0.011)
Population	-0.78* (0.42)	-0.74* (0.43)	-0.79* (0.42)	-0.79* (0.43)	-0.76 (0.47)
Government	-0.38*** (0.1)	-0.38*** (0.096)	-0.38*** (0.099)	-0.38*** (0.1)	-0.36*** (0.1)
Deur	0.00033 (0.005)	0.11 (0.133)	0.00022 (0.005)	0.1 (0.18)	0.1 (0.18)
βDeur		-0.01 (0.013)		-0.01 (0.017)	-0.01 (0.017)
DIrl			0.0038 (0.006)	0.26 (0.2)	
βDIrl				-0.023 (0.019)	
Observations	234	234	234	234	228
R^2	63.72%	63.85%	63.73%	64.01%	63.55%

Table 3. Augmented model and Ireland robustness checks.

Model five also shows that initial natural logarithm of GDP per capita is still significant at the 1% level and has the expected negative sign, indicating beta convergence as mentioned before. Figure 2 depicts beta convergence restricted to the Eurozone founding members[3], and it shows that indeed poorer countries have grown faster than richer countries, in line with model five and the principle of conditional convergence.

[3] Eurozone founding members include the following: Austria, Belgium, Germany, Spain, Finland, France, Italy, Ireland, Netherlands and Portugal

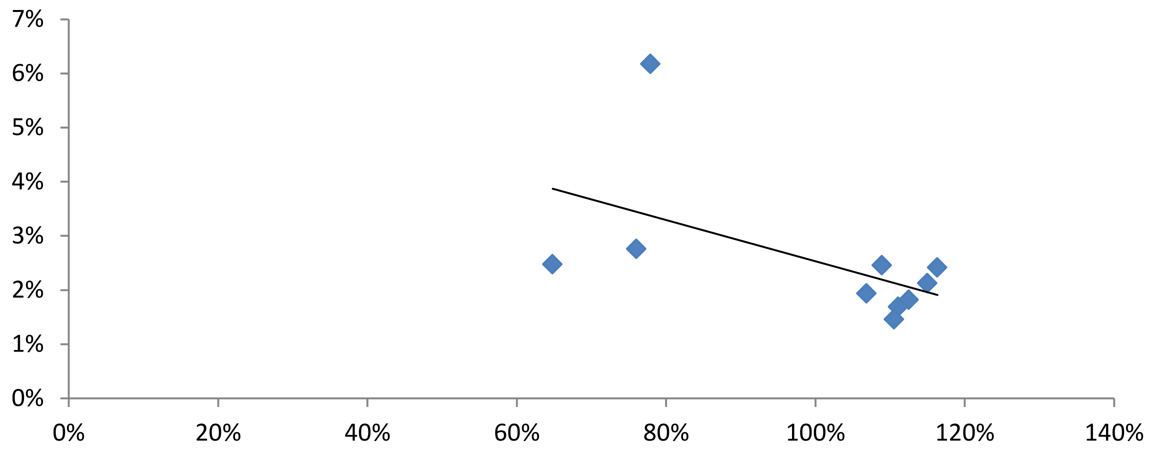

Figure 2. EU founding members initial real GDP per capita levels in 1990 vis-a-vis the EU founding member's level and their average annual growth, 1990 – 2019. Source: own with PWT data.

However it can also be seen that Ireland has a yearly average GDP per capita growth of over 6%, which looks like an outlier. A robustness check is performed to confirm this hypothesis. Equation (3) adds a country specific dummy for Ireland, which according to model six is not significant; equation (4) adds Ireland country specific dummy and this dummy times initial GDP, to see the effect on speed of convergence. Model seven shows that both coefficients are still not significant at the 10% level. The hypothesis that Ireland is an outlier cannot be confirmed.

$$LnY_{i,t} = \alpha + \gamma \boldsymbol{X}_{i,t} + \beta lnY_{i,0t} + DIrl_{i,t} + \varepsilon_{i,t} \text{ (3)}$$

$$LnY_{i,t} = \alpha + \gamma \boldsymbol{X}_{i,t} + \beta lnY_{i,0t} + DIrl_{i,t} + \beta DIrlY_{i,0t} + \varepsilon_{i,t} \text{ (4)}$$

As a final test, a regression without Ireland is run in model 8 from table 3. Results show however that both Deur dummy variables are still not significant at the 10% level and the R^2 is smaller than in the baseline model, with all other variables keeping its sign and significance, except for trade and population that lose significance. Because of the weaker results this model is discarded and Ireland is kept in the sample.

Nevertheless, as many studies point out (see Sala-i-Martin, 1995), beta convergence is not sufficient condition for sigma convergence to happen. In order to see if the data supports this, the coefficient of variation with standard deviations and averages is calculated. Figure three depicts the coefficient of variation for Euro founding members. In contrast with beta convergence, sigma convergence (or the dispersion in GDP per capita among Eurozone founding members) has not been happening since the early 2000's.

And what is more, it can be observed how the coefficient of variation explodes if Ireland is not removed from the sample. It is only when Ireland is removed from the sample that neither sigma convergence nor divergence is happening, with the coefficient of variation stalling around 0.15 and 0.2. This confirms that Ireland has a different steady state growth rate and speed of convergence than the group. Reasons could include that Ireland has the ability to attract high values of investment or has tax advantages that other European countries cannot offer because of debt burdens.

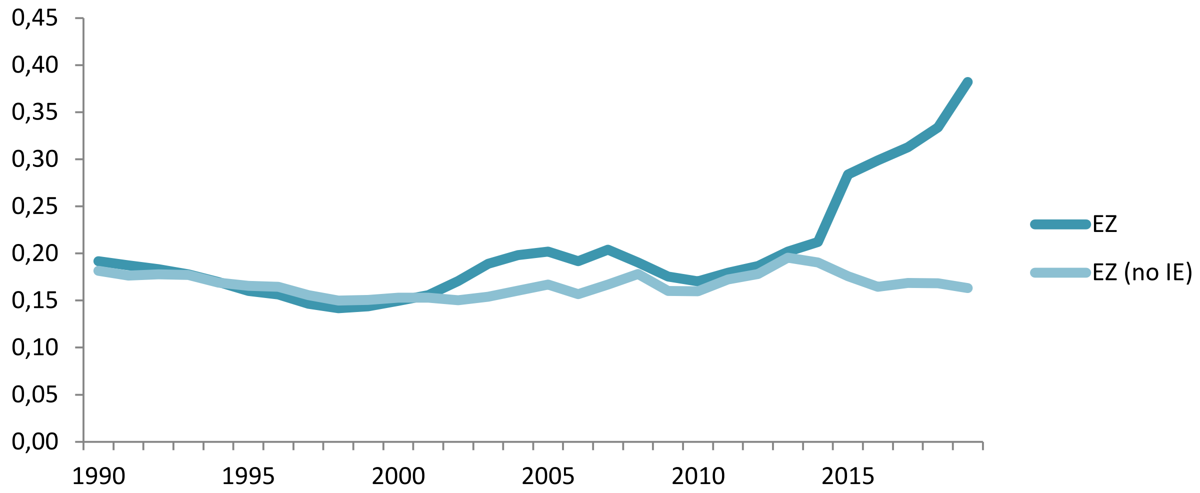

Figure 3. Sigma convergence by coefficient of variation (σ_t/μ) among EU founding members. Source: own with PWT data.

5.3 Robustness checks

In order to obtain a greater understating of the euro membership effect on growth, the euro area dummy variable is split into two. The first of this division shows the impact of the euro area membership in the GIIPS[4] countries and non-GIIPS countries that belong to the Eurozone and the second one with Eurozone founding members and non-founding members[5].

In column 10 from table 4 it can be seen that the euro dummy coefficients for GIIPS countries are not significant at the 10% level, and the same happens for the non-GIIPS coefficients. This suggests that euro area membership does not have any different effect on GIIPS or non-GIIPS countries, neither on the steady state GDP growth level nor on the speed of convergence. This is in line with the previous findings.

The results are different if the effect of the euro membership on Euro area founding members and the euro late adopters are compared. Model 12 from table 4 shows that the euro dummies coefficients for founding members are never significant. However, the coefficients for the non-founding members are significant at the 1% level. This suggests that the euro membership has a positive effect on the steady state GDP per capita growth for the euro late adopters. Furthermore, it also tells us that that the euro membership affects positively on the speed of convergence as βDNon-Found has a negative sign, promoting convergence. This model explains 64% of the variance in GDP growth.

A final robustness check includes a regression restricted to 2014 and another one until 2009, to control for the 2008 global financial and the consequent sovereign euro debt crisis that affected particularly European economies for several years.

[4] GIIPS countries include: Greece, Ireland, Italy, Portugal and Spain
[5] Euro late adopters include: Estonia, Greece, Lithuania, Latvia, Slovakia and Slovenia

Model	9	10	11	12
Initial ln GDP	-0.065*** (0.0093)	-0.067*** (0.01)	-0.066*** (0.0094)	-0.068*** (0.0098)
Investment	0.25*** (0.042)	0.25*** (0.044)	0.26*** (0.043)	0.26*** (0.045)
Education	0.003 (0.0019)	0.0034 (0.0038)	0.0032 (0.002)	0.0035* (0.002)
Inflation	-0.019*** (0.0037)	-0.018*** (0.0038)	-0.017*** (0.0038)	-0.018*** (0.0037)
EFI	0.005 (0.0038)	0.0047 (0.0038)	0.0044 (0.0036)	0.005 (0.0038)
Trade	0.019 (0.011)	0.02* (0.011)	0.018 (0.018)	0.016 (0.012)
Population	-0.74* (0.42)	-0.71 (0.43)	-0.7 (0.42)	-0.7 (0.43)
Government	-0.38*** (0.099)	-0.34*** (0.11)	-0.37*** (0.1)	-0.35*** (0.1)
GIIPS	-0.0059 (0.0051)	-0.081 (0.17)		
βDGIIPS		0.0072 (0.016)		
Non-GIIPS	0.003 (0.0057)	0.25 (0.2)		
βDNon-GIIPS		-0.024 (0.081)		
Founders			-0.0045 (0.004)	-0.18 (0.17)
βDFounders				0.017 (0.017)
Non-Found			0.0086 (0.0085)	1.1*** (0.22)
βDNon-Found				-0.1*** (0.022)
Observations	234	234	234	234
R^2	64.03%	64.46%	63.73%	63.92%

Table 4. GIIPS and Founders models.

Model 13 from table 5 is restricted to 2014. Results are robust with previous models as both the Euro area and the euro dummy times the initial GDP are still not significant. All other control variables maintain the expected sign and are significant at the 10% level except for EFI.

Same happens with model 14, which is restricted to 2009. The results are robust as dummies are still not significant at the 10% level and all other explanatory variables maintain the expected sign. The only notable change is that EFI is now significant at the 10% level. This suggests that even if the years that account for the worse GDP growth values are removed, the euro dummies are not significant and do not help forecast growth on the long run.

Model	5 (Baseline)	13	14
Initial ln GDP	-0.065*** (0.0093)	-0.076*** (0.013)	-0.1*** (0.017)
Investment	0.26*** (0.045)	0.28*** (0.06)	0.24*** (0.082)
Education	0.0026 (0.0019)	0.004* (0.0024)	0.006 (0.004)
Inflation	-0.018*** (0.0038)	-0.016*** (0.0037)	-0.017*** (0.0032)
EFI	0.0044 (0.0038)	0.0035 (0.0038)	0.008* (0.0041)
Trade	0.021* (0.011)	0.026* (0.014)	0.03 (0.02)
Population	-0.74* (0.43)	-0.8* (0.41)	-0.42 (0.41)
Government	-0.38*** (0.096)	-0.4*** (0.11)	-0.42*** (0.15)
Deur	0.11 (0.133)	0.074 (0.18)	-0.15 (0.2)
βDeur	-0.01 (0.013)	-0.0072 (0.017)	0.015 (0.02)
Observations	234	195	156
R^2	63.85%	66.98%	73.37%

Table 5. Augmented model and restricted models

5.4 Control for stability

Finally, to control for stability, a forecast is built in Stata for one variable (GDP growth per capita) across four periods of time (2000, 2005, 2010 and 2015) and 39 countries.

The results from the forecast do vary a lot depending on the country being studied. For instance, for countries like Spain, Poland, Portugal, Japan or Greece, the estimates forecast are very similar to the actual values of GDP growth for that period, with very low error.

However, in other countries like Bulgaria, Denmark, Mexico, USA or Norway the forecast values differ considerably from the actual values.

Surprisingly, it looks like the countries that have the euro as its main currency are forecasted slightly better than the ones that are not part of the Eurozone, even though the variable is almost never significant in the model. And indeed, the average residual sum of squares for the Euro Area countries (0.003) is smaller than the average residuals sum of squares for non-Euro Area countries (0.005). Graphs are included in the appendix for better visualization.

6. Concluding remarks and limitations of the study

Firstly, it was found that being a euro member does not help forecast GDP per capita growth in any scenario when controlling for growth factors except for when the dummy effect is restricted to non-founding members. This suggests that the only countries that benefited from becoming a Euro member were the ones that entered after its 1999 roll out, both on the speed of convergence and on its steady state level.

Would the result have been different if the sample was restricted to more countries? Would the significance of the euro membership dummy variables increase with a Euro area enlargement process?

Second, it was found that beta convergence is happening among Euro countries; however sigma convergence is not happening, and what is more, they are diverging. The study also finds that an increase in government spending for developed countries does not enhance further GDP per capita growth, supporting other studies and theory.

One could argue that the choosing of variables to capture growth are not the adequate ones or that some other could have been used. However they were chosen following other papers and tested several different ones. Furthermore, the R^2 present in the model was relatively high so it is believed that the conclusions remain valid. Could the effect of the euro membership in GDP per capita growth have been different if other variables would have been chosen?

One last interesting feature is that, when the forecast model was built, it seems like the countries that belong to the Eurozone were on average better forecasted than those countries that were not part of the Euro zone. Is this a consequence that the Euro area countries move in consonant as a single market while other countries move on their own, and this helps them get a better forecast?

Lastly, there is also the case of significance. Some studies point out that being statistically significant does not imply a real effect (Leppink et al., 2016). Could this happen the other way around? Can something that is not statistically significant in a model still be useful to forecast GDP per capita growth for instance?

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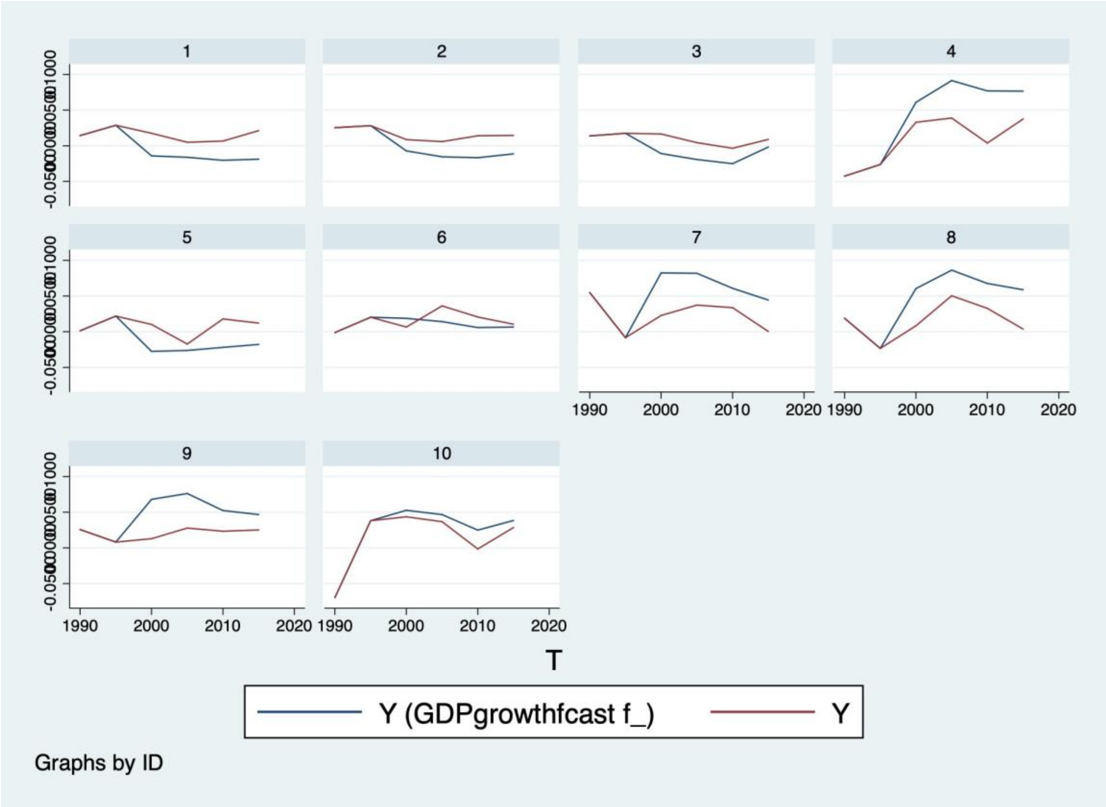
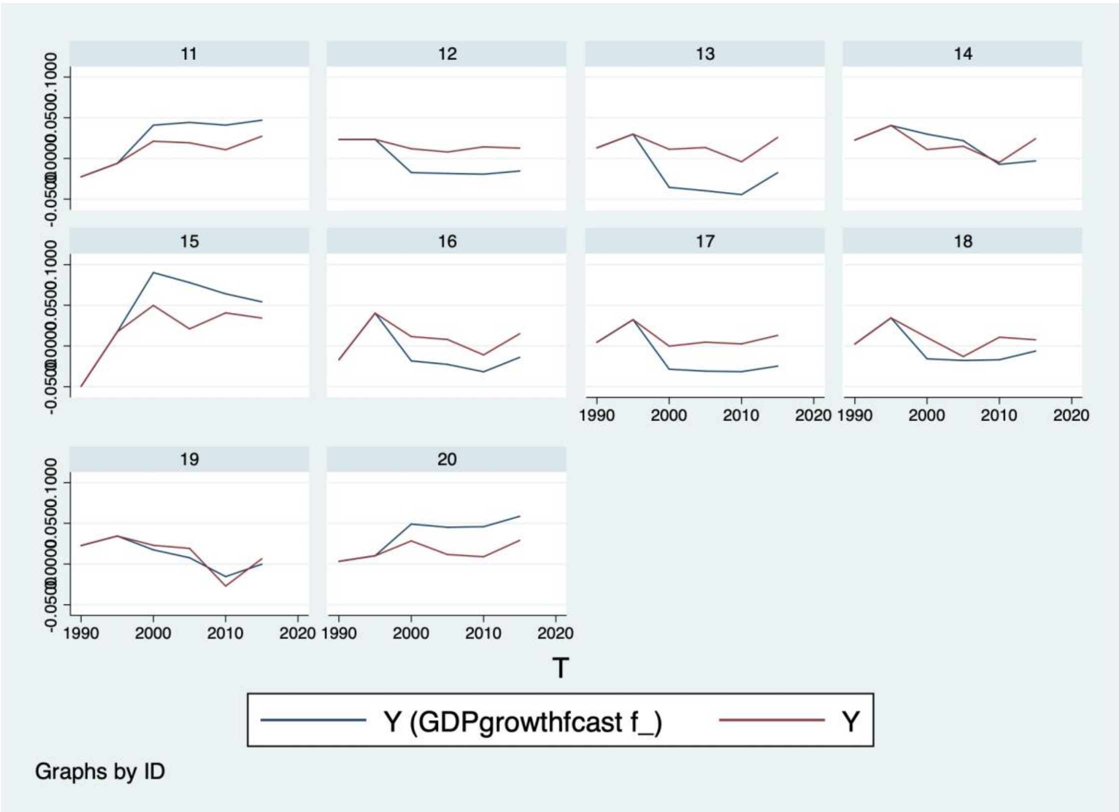
Appendix

Name	ID
Australia	1
Austria	2
Belgium	3
Bulgaria	4
Canada	5
Switzerland	6
Chile	7
Colombia	8
Costa Rica	9
Croatia	10
Czech Republic	11
Germany	12
Denmark	13
Spain	14
Estonia	15
Finland	16
France	17
United Kingdom	18
Greece	19
Hungary	20
Ireland	21
Israel	22
Italy	23
Japan	24
Korea, Rep.	25
Lithuania	26
Latvia	27
Mexico	28
Netherlands	29
Norway	30
New Zealand	31
Poland	32
Portugal	33
Romania	34
Slovak Republic	35
Slovenia	36
Sweden	37
Turkey	38
United States	39

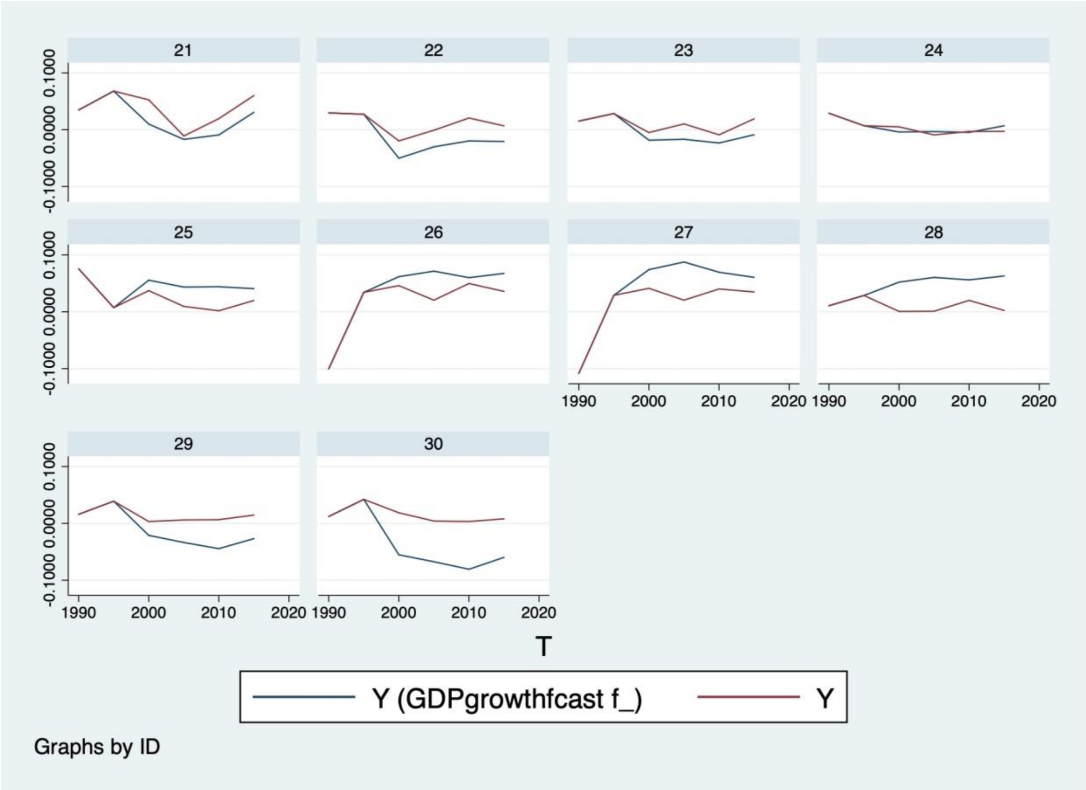
Countries summary and its corresponding ID.



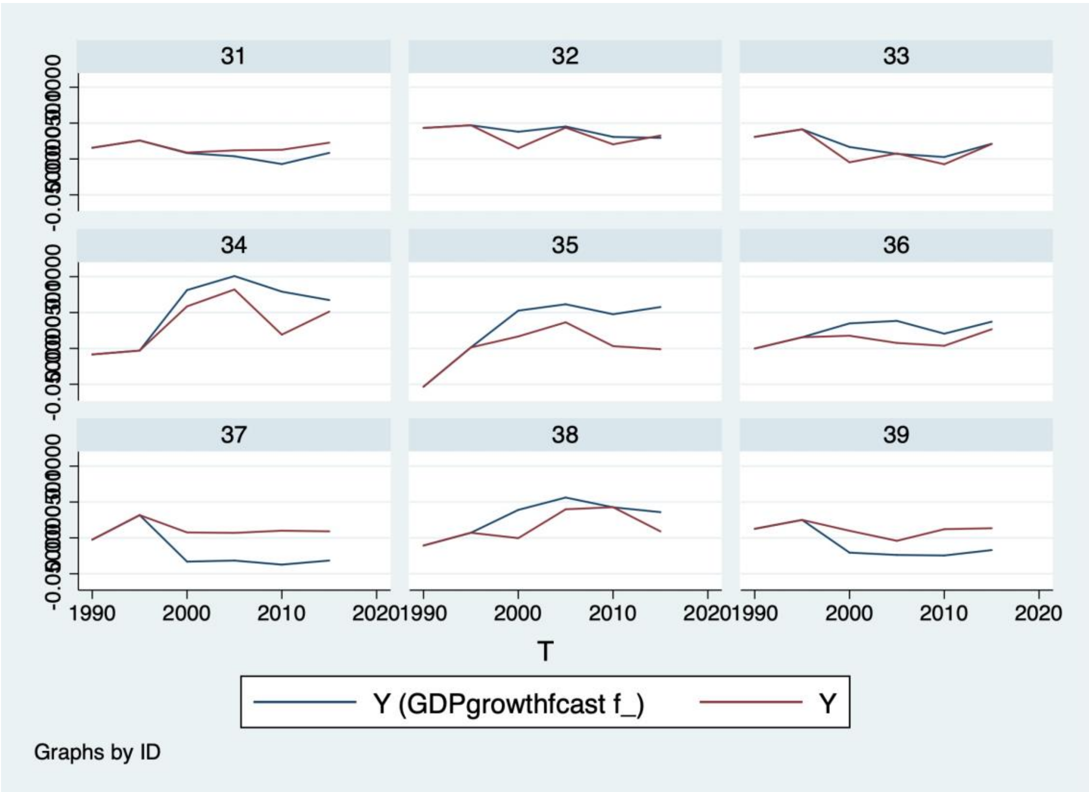
Forecast for countries 1-10.



Forecast for countries 11-20.



Forecast for countries 21-30.



Forecast for countries 31-39.