Is the European Union growing closer or apart?

A quantitative study examining the EU and its growth characteristics

Jonathan Rosenkvist, Victor Johandahl
Abstract

In the aftermath of the Brexit referendum, a public debate both whether membership in the European Union and the implementation of the euro, by joining the European Monetary Union provide economic benefits, is heating up and is a popular topic within the political scene. This has resulted in member states starting to doubt if it makes fiscal sense to stay in the union. However, the existing studies unanimously point towards the EU has a positive effect on growth. Our study analyzes and attempts to conclude if there is economic convergence within the European Union. We also differentiate between countries adopting the euro in addition to EU memberships in order to see if they provide additional growth effects. The time frame of the model is between 1995 and 2017. During these 22 years, the study concludes economic convergence within the EU, which is especially desirable for developing countries. However, we found no supporting evidence of joining the EMU to have neither lower nor higher growth. By returning to the public debate, we would favor joining the European Union but be hesitant to adopt the euro by joining the common currency area.

Keywords: Growth, EMU, Eurozone, Currency union, Economic integration, Convergence
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1. Introduction

In this chapter, we will begin by presenting a background of the research and of our thesis. This will be followed by a brief history of the EMU, its goals and its functions and how EMU correlates to growth. The chapter continues by defining our research question, followed by the structure as well as the scope of the thesis.

1.1 Background

Over the last century, the global economy has significantly increased, where both trade and travel have been more readily available not only for firms worldwide but for the countries citizens as well. Within Europe, the European Union has since its beginning envisioned making the member states more economically integrated by allowing free movement of goods, services, capital, and labor. In addition, the proposal of creating a common currency within the EU, the European Monetary Union. According to the European Commission, EMU’s main objective is joint stability, more sustainable and more inclusive growth with a single market. A single currency within the EU could offer multiple advantages in comparison to countries having their own currency. It would stimulate trade across borders, traveling would be less of a hassle, and would provide increased price transparency. Lastly, it would arguably produce a higher, more stable growth rate. The European Commission states the key objectives of the EMU besides economic stability are to provide economic inclusive growth. Intuitively, the objective of focusing EMU on inclusive economic growth, i.e. convergence within the eurozone, begs the question if EMU entrance might be more beneficial for less-developed countries currently in the process of considering implementing a common currency. Several existing studies have investigated the economic growth effect by EMU membership, yet with contradictive conclusions. Much uncertainty still exists regarding the direct impact on economic growth by joining the EMU, more specifically, how the growth converges within EMU in comparison to non-EMU members. Therefore, this study contributes to whether there is economic convergence within the European Union and if there is any significant difference in economic growth between European countries who have joined the EMU and the ones who haven’t.
1.2 Research Question
Is there economic convergence within the European Union? Does an EMU membership promote economic growth?

1.3 Structure of the study
The thesis is divided into several parts. The second part lays out the theoretical framework regarding economic growth and convergence. In addition, previous findings and literature review will be examined. The third part consists of data. Both how the data will be collected and what relevant sources that will be used. The fourth section demonstrates the methodology used and the econometric procedure used to produce our result. The results will be presented in the fifth part, followed by a discussion in chapter six. Lastly, the conclusion and our final remarks are found in the last chapter of the study.

1.4 Scope of the study
This study is restricted to studying economic growth within the European Union while categorizing the Union into two distinguishable groups. Member states of the European Monetary Union and member states outside the eurozone. Our analysis is limited to the time period between 1995 and 2017. The time period is derived from when the first reliable data can be gathered and spanning to the last available data.
2. Theoretical framework and previous studies

The second chapter will start by explaining growth theory, both exogenous and endogenous. This is followed by convergence theory. The second part of the chapter will review previous literature.

2.1 Growth theory

Economic growth theory explains the change in countries Gross Domestic Product. In the long run, these theories have shown to also determine how living standards change as well as income levels. GDP-levels across the world economies has been rising steadily since the 1970s. The same is true for the average income level of individuals but this does not equal that living standards necessarily follow the same trend (Barro & Sala-i-Martin, 2004)

Living standards have been in focus since the dawn of time and as a result, growth theory has become one of the most significant studied subjects in macroeconomics. Examining the divergence in long term economic growth between countries can give us a deeper understanding as to why living standards differ from country to country (Barro & Sala-i-Martin, 2004).

2.1.1. Exogenous growth theory

To answer the question of what effect the EU and EMU have upon its respective member's economic growth rates depends on the underlying theoretical framework in which we examine them. The neoclassical growth theory established by Solow (1956) and later built upon by Mankiw, Romer, & Weil (1992) revolves around the assumption of diminishing returns to investment in capital. Assuming a constant rate of depreciation leads us to a distinctive capital-labor-ratio that the economy will reach in the long run, referred to as the economy’s steady state. The size of the capital stock will determine the economy’s steady-state level while per capita long-run growth will be determined solely by an exogenous rate of technological change (including factors like efficiency gains in the usage of capital and knowledge accumulation).

In the long run, this means that any economic policy, including economic integration which both the EU and EMU are examples of, cannot affect the growth rate of an economy. However, it might lead to more efficient factor employment in the production process which would alter the economy's equilibrium capital-labor ratio and in the medium run, generate higher growth rates until a new steady state is reached. Neoclassical growth theory acknowledges that
economic integration may have an effect but that of a level effect and not a scale effect on economic growth (Carlin & Soskice, 2005).

2.1.2 Endogenous growth theory

At this point, different implications can be found in endogenous growth theory developed since the mid-1980s (Romer, 1990). These theories dismiss the assumption of a diminishing marginal product of capital by arguing that knowledge is a public good and that accumulation of knowledge through innovation produces positive externalities. This, in turn, means that capital accumulation faces no limits and that the capital stock will increase without a boundary at ever faster rates. This would make the long-term growth rates endogenous and economic integration could then produce constantly higher growth rates.

When choosing to go with an exogenous or endogenous theory, the empirical literature lacks any clear evidence of which the better-suited alternative would be. The Solow model’s assumption of decreasing returns to input factors have mostly been confirmed (de la Fuente, 1997; Islam, 2003). However, more importantly, Solow’s model has been extended to explain economic integration and its inherent growth effects. This variant of the model would be what is known as the Augmented Solow model. As a result of the model’s proven validity in the field of macroeconomics and its adaptability to this study, we have chosen this model to explain growth while examining the effects of EU and EMU.

2.1.3 Convergence

The Solow model explains that the growth rate will be higher in economies currently residing further away from their steady state, i.e. they have lower levels of capital and output. Thus, developing countries that are further from their steady state will, according to Solow (1956), converge with the developed countries over time. In other words, lower levels of per capita income should have a higher growth rate in per capita terms. In contrast, the developed countries will experience lower levels of growth as a result of their economies being closer to their steady state. Based on historical evidence alone, this part of Solow’s theory could be heavily disputed when many developing countries have experienced low or negative growth rates during a long period of time (Carlin & Soskice, 2005).

According to Carlin & Soskice (2005), convergence is mainly looked at as either absolute convergence or conditional convergence. For absolute convergence to occur, all the determinants of the steady state must be identical across all economies, i.e. developing and
developed countries share the same steady-state position. The only difference is the countries saving ratios. Under absolute convergence, developing economies will catch up to the developed economies precisely as Solow stated in his theory. However, this is where historical evidence is contradictive, sub-Saharan African countries for example. In contrast, by allowing heterogeneity across different economies, or by discarding the assumption of having the same steady-state and the same parameters across the different economies, we get the concept of conditional convergence. In the Solow-Swan model, the convergence is conditional because the steady-state levels of both capital and output per capita are based on the growth rate of population, the saving rate, and the point of the production function. Conditional convergence accounts for country-specific steady states in accordance with countries having economies that differ greatly. In other words, according to conditional convergence, an economy grows faster the greater the distance is from its own steady-state value.

Under conditional convergence, as shown in figure 1 above, a developed economy could possibly be proportionately further away from its steady state than a developing economy by having a higher savings rate. On the other hand, if a developing and a developed economy would have the same saving rate, the growth rate per capita would be greater for the developing economy. The rationale behind developing economies having a slower growth rate than a developed one is because their low savings rate interferes with their higher average product of capital (Barro & Sala-i-Martin, 2004).

As written by Barro & Sala-i-Martin (1992), they coined the term beta convergence which is the negative correlation between an economy’s GDP per capita and its growth rate. This
relationship is the foundation for convergence and is the main component examined when studying economic convergence. The coefficient, furtherly in the text referred to as beta-convergence, is central throughout the paper.

2.2 Previous studies

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

In this study, the authors analyze whether the European Union (EU) and the Euro-zone (EZ) enhances economic growth. The results of this study contribute to the growing body of evidence that found a positive impact of EU economies and economic growth. The EZ had no impact on economic growth during the time series, which ranges from 1999 to 2013. They did, however, discover a negative impact for EZ during the financial crisis (Kabderian Dreyer & Schmid, 2017).

The authors argue the absence of accordance in economic theory whether economic integration has lasting long-term effects on growth. Solow (1956) explains that changes in economic integration, according to the standard neoclassical growth theory, is incapable of having lasting effects. According to Solow (1956), the driving factor in the long run for economic growth is exogenous technical progress. Explaining how exogenous technological progress is a public good and therefore not affected by economic integration. The author points out the effects generated by a currency union may only be transitional, not permanent.

In contrast, according to Romer (1990) and the endogenous growth theory, economic integration results in a scale effect, which in its turn increases economic growth permanently. By analyzing the European Union, Baldwin (1992) discovers trade is one of the channels which increasing growth due to economic integration. According to his founding, escalating trade and competition possibly affects productivity factors. Baldwin argues that the optimum steady-state levels are determined by endogeneity. He suggests a deeper economic integration, i.e. EMU membership, would result in even higher levels of trade and therefore permanently increase member states economy growth rate.
The European Commission conducted a study in 2008, *The impact of EMU on growth and employment*, where Barrell et al (2008) argues the reason existing literature researching the correlation between EMU and growth is negative or inconclusive, is because they only use a single driver factor of economic growth or one of the proximate determinants of growth.

The authors counter existing empirical findings by referring to multiple factors regarding the positive effects on a currency union. The authors argue that in order to estimate the potential effects of output effects on EMU, multiple growth factors need to be taken into consideration. He reasons this is the only study so far fulfilling that criteria. He argues multiple factors whereas the introduction of the euro impact growth. The first channel being price transparency, and how the euro affects competitiveness and the single markets effectiveness. Secondly, he examines the effect on financial integration and how it may affect productivity, due to a more stable microeconomic economy, which could have an impact on a country's’ investments and risk decisions. These channels are then analyzed of how they affect growth, in the aftermath of factoring in relevant variables, being labor skill, research level, openness, and demographic developments.

The analysis suggests a positive relationship between EMU and growth in the core EZ countries. The paper also suggested that openness had no significant effect on growth. Examining the long-term effects of growth, and the reasoning behind the lacking growth rate in the Euro area is due to the productivity per person hour. This means, according to the author, that the rate of skill accommodation between countries vary.

*Has the Euro Promoted Eurozone’s Growth?*

In this study, Ioannatos (2018) conducts an empirical analysis based on a natural experiment where they study whether the Euro as a currency union, promoted Eurozone economic growth. Difference-in-Differences (DiD)-method was used as a methodology where the EMU’s growth was compared to that of nine non-EMU economies used as a control group. The basic DiD-method was augmented with supply-side covariates consistent with the neoclassical theory of growth. The major findings of Ioannatos (2018) found were that there are no significant growth effects for the Eurozone emerging from the introduction of the Euro, hence no systematic growth was found in correlation with the introduction of the Euro. The literature review added even more credibility by mainly highlighting studies that are all focused on the advantages of the Euro, which this study then goes on to disprove with raw data. However, this study lacks
in one aspect. Ioannatos (2018) concludes that the Euro didn’t promote Eurozone growth but fails to analyze why they got this result or how this might be a possibility.

Is the Euro Beneficial for All Countries?

The authors argue that in contrast to financial and political integration, monetary integration alone has a dual and indirect impact on growth. The study is focusing on the interaction between financial and economic growth. According to the authors, this can be explained by the increased level of financing by joining the eurozone, which has a positive impact on economic growth. The second effect of the euro is the possibility of over-borrowing, which is a microeconomic risk. The authors argue the risk of over-borrowing by adopting the euro reverses the positive spiral link between financing and economic growth. The study proposes the suitability of adopting the euro is dependent on a country's ability to balance the two effects mentioned above (Kalaitzoglou & Durgeu, 2016).

Re-Evaluating Swedish Membership in EMU: Evidence from an Estimated Model

Söderström (2008), on behalf of the Swedish central bank Riksbanken, prepared a paper for the NBER conference on “Europe and the Euro” in October 2008. He, where he examined the potential costs and benefits for Sweden of joining EMU. The report focuses primarily on the business cycles of Sweden and the Euro area. The data shows that the Swedish business cycles are closely related to the business cycles within the eurozone. In addition, the author puts emphasis on the effects of both common and country-specific shocks. The evidence suggests that since the mid-1990s, the Swedish business cycle has been closely correlated with the other EU economies, suggesting that common shocks have been an important driving force of business cycles in Europe. However, the estimation model conducted in the study suggests that the fluctuations of the Swedish economy are heavily due to country-specific shocks. He argues that this could have been costly for Sweden by implementing the euro.
3. Data

In this chapter, we present how and where the data is collected. This is followed by a brief introduction of the database by which the data is collected. Chapter three ends by demonstrating how the data is being processed.

3.1 Data collection

The data is extracted from the World Bank Group. The data will be examined as panel data, with 23 annual observations ranging from 1995 to 2017 for each variable and country. The time period was chosen from the last available data in order to get a result as significant and time relevant as possible while still including a proportionately time frame before and after the introduction of the Euro. We chose to stay with annual data only when our scope is the economic long run and more specifically, to study growth rates a longer time period is needed.

3.2 Data sources

The World Bank Group consists of 189 countries, and function as shareholders. These shareholder countries are the policymakers at the World Bank. Besides providing economic data for the member countries, the World Bank Group are committed to achieving two primary goals by 2030. First, the goal to end extreme poverty by reducing the number of people living below $1.90 per day to less than 3% of the world population. Secondly, their goal is to promote shared prosperity, by cultivating the income growth of the bottom 40% for all countries. Unlike other banks, they describe themselves as a unique partnership with the main function to support the development and to reduce poverty around the world.

3.3 The Processing of Data

To allow our variables to account for occasional fluctuations in growth and still show the growth trend, we must create moving averages for our dependent growth variable (lnY) and our GDP per capita (lny0) variable. By doing this, we control for the variance that occurs from year to year in economies. These averages are calculated on the growth of the upcoming five years which also allows each observation to affect growth during a longer time frame. The reasoning behind calculating our averages based on upcoming years is that a change in year t cannot be expected to influence the growth of previous years.
Additionally, applying a moving averages filter on our growth_t and initial GDP_t-variables are essential to account for business cycles that ordinarily are assumed to be 5 years (Schumpeter, 1939). If not accounted for, these cycles could create an additional variance in our model that we would not be able to explain through any of our explanatory variables. The smoothing effect of our moving average application is illustrated down below in Figure 2:

Figure 2. Moving average effects
4. Method

This chapter describes the method and methodology that will be used for constructing the regression models. This will be followed by presenting our empirical models and the construction steps along the way. The following part contains the rationale of our methodology, ending with potential caveats and biases with our final model.

4.1 Identifying the model and methodology

In order to conduct an empirical analysis, a suitable methodology is vital. A quantitative approach is more suitable than a qualitative methodology since a requirement in order to produce optimal results from our estimations, is to have data that is easily interpreted and as precise as possible. Unlike a qualitative study, by which the research is built upon interpretations and own subjective experiences by the researchers, our model contains measurable variables. In order to estimate and analyze those elements, a quantitative approach is required (Collis & Hussey, 1942). The quantitative process covers the extraction of data, which later is compiled and analyzed using statistical regressions. Similarly, as Mann (2015) for us to be able to study the growth effects within the EU and EMU, we will implement an augmented Solow growth model. The models will be analyzed using a convergence analysis.

4.2 Methodology description

When determining which variables to include in our model, we look for those which are assumed to have a high correlation with the growth rate. We start off by assuming that developing countries have a larger potential to grow than the developed countries. For our model, this means to include a GDP per capita statistic at the start of every period. This illustrates the higher a country’s GDP per capita is at the start, the less it is expected to grow relative to the developing country. As a result, we end up with the simple equation for convergence (Barro & Sala-i-Martin, 1992):

\[
Growth_{t,i} = \beta_0 + \beta_1 \text{initial GDP}_{t,i} + \epsilon_{t,i}
\]  

(1)

For this assumption to be mathematically valid, we also expect the coefficient \( \beta_1 \) to be negative. As stated in the theory chapter, by finding a negative relation between the initial level of GDP per capita and the growth rate, we attain beta convergence.
In our study, we have chosen variables very similar to the ones used by Mann (2015). By adding explanatory variables, in this instance investment in physical capital and human capital in the form of education, our initial convergence analysis equation is extended.

\[ \text{Growth}_{t,i} = \beta_0 + \beta_1 \text{initial GDP}_{t,i} + \gamma_1 \text{CAP}_{t,i} + \gamma_2 \text{EDUC}_{t,i} + \epsilon_{t,i} \]  (2)

In equation (2) physical capital \( \text{CAP} \) and human capital \( \text{EDUC} \) is included. \( \text{CAP} \) will be the investment made into physical capital as the share of GDP. \( \text{EDUC} \) will represent the percentage of the total population above the age of 15 with any tertiary education. Investment into physical capital will have a direct effect on a country’s output and hence we expect that the coefficient for \( \text{CAP} \) will be positive. We expect the same to be true for the variable \( \text{EDUC} \), as higher education would have a positive effect on growth. Although the variable \( \text{EDUC} \) possess the risk of suffering from reverse causality because a higher growth rate could mean the country could put more resources into education. Solow predicts the gamma-coefficients, \( \gamma_1 \) and \( \gamma_2 \), to be positive. Additionally, accounting for the assumption of diminishing returns to investments means that the second derivative should be negative. This assumption builds upon economies further away from their steady states investing more into capital since the returns are higher. However, economies in their steady states will experience an investment rate that equals capital depreciation leading to a halt in capital accumulation.

The framework of our current equation allows us to test any independent variables and include all of the significant ones which have shown to be both a virtue and a problem. Levine & Renelt (1992) show us that we must specify our equation very precise since the regression results are highly sensitive and might emerge insignificant in a different environment.

Government spending also has a significant effect on growth since governments are assumed to be less efficient than the private sector. While this might not hold true for short term effects, high government spending is ultimately expected to cause capital flight in the long run which in turn will affect growth negatively (Fölster & Henrekson, 2001). Therefore, government spending (\( \text{GOV} \)) is included in our model and we will assume that the coefficient of government spending to be negative.

Lastly, we add an explanatory variable for openness. A higher intensity of trade with foreign countries enhances competition and growth in most cases. Hence, the more open a country is in terms of trade, the more its economy is expected to grow (Harrison, 1996). This variable will measure a country’s total exports and imports relative to its total GDP and we expect the coefficient to be positive.
In our current equation, the *initial GDP per capita* variable is not evenly distributed. The explanation for this is because different economies possess different GDP per capita values, where a low GDP per capita value is common whereas a high GDP per capita value is uncommon. In order to get a normal distribution, the variable needs to be presented in a perzental change form instead of absolute terms. This is obtained by applying the natural logarithm. In order to maintain a consistent relationship between the *Growth* and *BNP per capita* variables, the natural logarithm of *Growth* variable is applied as well.

\[
\ln \text{Growth}_{t,i} = \beta_0 + \beta_1 \ln( y_{0t,i}) + \beta_2 \text{CAP}_{t,i} + \beta_3 \text{EDUC}_{t,i} + \beta_4 \text{GOV}_{t,i} + \beta_5 \text{OP}_{t,i} + \epsilon_{t,i} \quad (3)
\]

The *GDP per capita*, or \( y_{0t,i} \), is presented in *current terms* ($) of economy \( i \) at the start of period \( t \). Just like previous growth analysis studies, the variables are shown in average terms. The time frame differs anywhere from three to ten years. The reasoning behind using average terms instead of the absolute values is due to fluctuations in business cycles. Business cycles are closely correlated to the growth rate of an economy, where a complete business cycle is at least three years (Schumpeter, 1939).

The final adjustments in order to get our model complete in which we can measure the direct effects of EMU memberships regarding economic growth is the process of adding dummy variables. The dummy variable *EMU* is added to the model, where 1 indicate an EMU membership and 0 indicate a non-member country. Lastly, by including a time dummy, *CRI\( t \)*, the overall growth effect of the euro-crisis is accounted for in every country. CRI equals 0 prior to the euro crisis of 2008, and 1 during and after the euro-crisis. By adding an interaction variable, i.e. the interaction between the membership dummy and the time dummy, it allows us to examine if the euro-crisis of 2008 inhibited the growth rate for EMU members by a higher degree than for non-EMU members. The euro-crisis can both be an endogenous or exogenous phenomenon. By interpreting the crisis as an endogenous phenomenon, the crisis variable will not be included in the regression model, unlike the exogenous viewpoint of the matter. This results in two different regression models, equation (4) and (5). These final models are thereby:

\[
\ln \text{Growth}_{t,i} = \beta_0 + \beta_1 \ln( y_{0t,i}) + \beta_2 \text{CAP}_{t,i} + \beta_3 \text{EDUC}_{t,i} + \beta_4 \text{GOV}_{t,i} + \beta_5 \text{OP}_{t,i} + \\
\beta_6 \text{EMU}_{t,i} + \beta_7 \text{EMU}_{t,i} \text{CRI} \_t + \epsilon_{t,i} \quad (4)
\]

and

\[
\ln \text{Growth}_{t,i} = \beta_0 + \beta_1 \ln( y_{0t,i}) + \beta_2 \text{CAP}_{t,i} + \beta_3 \text{EDUC}_{t,i} + \beta_4 \text{GOV}_{t,i} + \beta_5 \text{OP}_{t,i} + \\
\beta_6 \text{EMU}_{t,i} + \epsilon_{t,i} \quad (5)
\]
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real GDP Growth</td>
<td>Real GDP Growth, current US$</td>
<td>World bank</td>
</tr>
<tr>
<td>Initial Real GDP per capita</td>
<td>Real GDP per capita, current US$</td>
<td>World bank</td>
</tr>
<tr>
<td>Education</td>
<td>Barro-Lee: Percentage of population age 15+ with tertiary schooling</td>
<td>World bank</td>
</tr>
<tr>
<td>Government expenditure</td>
<td>Government final consumption expenditure (% of GDP)</td>
<td>World bank</td>
</tr>
<tr>
<td>Openness</td>
<td>Trade (% of GDP)</td>
<td>World bank</td>
</tr>
<tr>
<td>EMU membership</td>
<td>Indicator variable: 1 for EMU member, 0 otherwise</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Description of data

4.3 Rationale behind the methodology

Testing for beta convergence can be made with different estimation techniques, such as time series, cross-sectional, and panel data. (Islam 2003). The reasoning behind choosing panel data format is that panel data estimations test the values for heterogeneity. In addition, when estimating panel data, the two most commonly used models are fixed effects models and random effects models. In a random effects model, the unobserved variables are assumed to be uncorrelated with (or, more strongly, statistically independent of) all the observed variables whereas, in a fixed effects model, it is allowed for the unobserved variables to have an association with the observed variables. Since the characteristics of a country could correlate with some of the explanatory variables, we will conduct a fixed effects model for this study. In addition, countries with different steady states will be pooled into one sample using country fixed effects by controlling for unobserved time-invariant changes in technology. Previously conducted growth studies using panel data, a vast majority estimate with the fixed time effect model (R.W.Temple, 2005).
4.4 Caveats and biases

Since a large portion of the data is averaged over a five-year period, in order to correct for business cycle fluctuations, averaged data will, in addition, include disadvantages. For instance, serial correlation to the error terms could be a problem when using overlapping time periods. As a result, the OLS estimator will no longer be efficient, even though it is still unbiased.

The estimation approach for convergence analysis has been criticized by Quah (1996), even though previous studies have been conducted successfully. He argues that the methodology explained by Sala-i-Martin (1996) could be misleading and in fact produce a result far from the real picture.

Another caveat with the model presented is the risk of reverse causality. A few of our included variables will inevitably have a risk of reverse causality. This means that instead of the desirable association between our dependent and independent variable, which is the independent variable causing a change in the dependent variable, it is the other way around. Ergo, the growth rate of a country could consequently affect a country's education level because it a higher growth rate allows a country to invest more into the education system.

The risk for multicollinearity needs to be tested for. By constructing a correlation matrix (appendix), we can examine if we have independent variables with a strong correlation with each other. The table shows relatively low numbers, which is an indication that there is no multicollinearity present.

Testing for serial correlation (autocorrelation) will also be conducted which is defined as the correlation between the residuals of the observations. To ensure the regression model is not suffering from serial correlation, a Wooldridge test for autocorrelation will be run. In order to check for panel-level heteroskedasticity, the post-estimator likelihood-ratio test will be run. Graphical plotting of residuals can be found in the appendix.
5. Results

By revisiting our initial research question, which is: Is there economic convergence within the European Union? Does an EMU membership promote economic growth? We will present the results of our regression analysis and answer the research question given the values presented below.

5.1 Euro-crisis as an endogenous phenomenon

The result of the regression analysis is presented in table 2, where the euro-crisis is treated endogenously.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficients</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant***</td>
<td>3.675262</td>
<td>0.00</td>
</tr>
<tr>
<td>ln Initial GDP (per capita)***</td>
<td>-.1731291</td>
<td>0.002</td>
</tr>
<tr>
<td>CAP***</td>
<td>.044727</td>
<td>0.00</td>
</tr>
<tr>
<td>EDUC***</td>
<td>-.0558694</td>
<td>0.00</td>
</tr>
<tr>
<td>GOV***</td>
<td>-.0867828</td>
<td>0.00</td>
</tr>
<tr>
<td>OP***</td>
<td>.007991</td>
<td>0.00</td>
</tr>
<tr>
<td>EMU</td>
<td>-.1580205</td>
<td>0.087</td>
</tr>
</tbody>
</table>

*Table 2: Linear regression with fixed effects: Assuming euro-crisis as an endogenous phenomenon*

As can be found in Table 2, the coefficient of our first independent variable, ln(y0), is estimated to be negative with a value of -0.173. This supports our initial prediction and the original assumption of beta-convergence according to Barro & Sala-i-Martin (1992) where the coefficient \( \beta_1 \) for our variable \( \ln(y_{0t}) \) is shown to be negative. The implication of this result is that a one percent increase in real GDP per capita will result in a decrease in real GDP growth by .173 percent. Initial GDP per capita is also estimated to be the independent variable that has the largest impact on a country’s growth. By the p-value of the beta convergence coefficient, it is significant on a 1% significance level. This means that the probability of rejecting the null hypothesis when it is true is less than 0.2%. The value of this coefficient answers the first part of our research question, *is there economic convergence within the European Union*, which is true.
In our initial prediction, we predicted the relationship between growth and capital investment share to be positive. Our previous rationale is consistent with the regression, which has a value of 0.045. Even though it is marginally positive, the $\beta_2$ coefficient indicates the higher a country’s investment is, the countries are expected to have higher economic growth. As our previous coefficient, the p-value is significant at a 1% significance level.

The coefficient for our third independent variable (EDUC), that is a measure of a country’s level of education, was estimated to be negatively correlated to growth. This estimation contradicted our assumption about this variable and its effect on growth. According to Solow (1956) theory, investing in human capital would further increase a country’s growth. However, our estimations implicate that the higher percentage of a country’s population that has started any tertiary education will decrease growth by 0.056 per percent of the population with any tertiary education. The result is statistically significant when we observe a p-value of 0.00. Additionally, the negative effect of education is estimated to affect the growth of a country more than the effects of both CAP and OP. This contradictory finding in our estimation will be further discussed in our discussion chapter since there are a couple of likely explanations.

$\beta_4$, the coefficient for government consumption also has a p-value below 0.01, again indicating it to be valid by a 1% significance level. This coefficient indicated a negative correlation between growth and government consumption expenditure. This strengthens previous research and the intuitive argument that government spending is not as efficiently allocated as spending in the private sector.

Our independent variable for openness (OP) which is a measure of $\frac{\text{export} + \text{import}}{\text{GDP}}$ trade as a share of GDP, showed a positive coefficient as we predicted. At a significance level of less than 1%, OP’s effect on a country’s growth is estimated to be .008 percent per percentage trade relative GDP that is gained.

Unlike the other coefficients, the indicator variable EMU possess a p-value of 0.087, which means it is non-significant on both a 1%- and 5% significance level. It is however still significant on a 10% significance level. The coefficient of the EMU dummy is -0.158 which makes its impact on growth the second largest in our model. If a country is a member of the currency union, its growth would decrease by 0.158% relative to a non-member country. Both the lacking significance and value of this coefficient will be furtherly discussed in our discussion chapter below.
In addition, this coefficient provides the answer to the second part of our research question, being *Does an EMU membership promote economic growth?* Due to the relatively large p-value, it is hard to acquire a conclusive argument which suggests an EMU membership has a positive or negative effect on economic growth or any effect at all. However, on a 10% significance level, the model indicates the final step of European Integration, i.e. joining the common currency area, the eurozone, have a negative effect on growth. By connecting the second part of the research question with the first, *Is there economic convergence within the European Union?*

### 5.2 Euro crisis as an exogenous phenomenon

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<td>0.00</td>
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<td>EMU*CRI</td>
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<td>0.143</td>
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</table>

*Table 3: Linear regression with fixed effects: Assuming euro-crisis as an exogenous phenomenon*

In our second regression, we included an interaction term between the EMU dummy variable and the euro-crisis dummy variable with the assumption that the euro-crisis and its aftermath is exogenous. This means that the model needs to include the euro-crisis as an independent variable. The reasoning behind analyzing a second model was to see if the EMU growth rate could be explained by the euro-crisis and if countries within the euro-area are expected to recover at a different rate than for countries implementing their own monetary policy.

Both the EMU variable and the interaction term between EMU and CRI indicates little to no significance due to the p-value. The coefficients of the EMU p-value, 0.304, and the interaction term coefficient of 0.143, results are therefore inconclusive.
In Figure 3, we can examine a scatter plot of all countries included in our model. Most essential here is that we can observe a negative correlation between average real GDP growth (y-axis) and average GDP per capita (x-axis). This further confirms Barro’s theory about beta-convergence as shown by the red line that indicates the negative correlation. Other noteworthy observations include statistical outliers like Ireland that have experienced very high average growth rates and a relatively high average GDP per capita. Another statistical outlier is Luxembourg with a very high average GDP per capita and above average growth rate during the studied time period. A group of countries that can be observed in very close proximity to each other is the formation of Lithuania, Slovakia, Poland, Latvia and Malta who are all experiencing above-average growth while all also having lower average GDP per capita. This observation will be the base for further discussing found below in our discussion chapter.
6. Discussion

In this chapter, we will finish up our thesis by discussing our results with an analytical focus on what could be improved and/or changed. At the end of the chapter, we will give our suggestions on further research topics, all based upon our findings in this paper.

6.1 Discussion and analysis

6.1.1 Comparison to similar studies

Similar studies prior to our thesis have most commonly produced similar results as the results of this thesis. The first sub-question of our study aligned with previous studies. There is strong empirical support that there is convergence within the European Union. According to the European Commission, one of the main objectives of the European Union is to promote economic integration. The second part of the research question, which is to examine if there is any significant difference in growth rates by joining the eurozone in comparison to EU-members with their own central bank, have not had the same conclusive results in the existing literature. The results prior to this study are spread quite wide, with results ranging from EMU membership having both a positive and negative impact on growth, to being inconclusive. Our study would fall under the inconclusive category due to the high significance level. Although with the 10% significance level, our study suggests that EMU membership have a negative impact on economic growth.

There are multiple reasonings behind the ranging results. The first-factor being time. The common currency has only been implemented since 1999, with a vast number of countries joining the common currency area in the past ten years. The time frame for analyzing data, both comparisons between EMU and EU growth and convergence rates could have an insufficient time frame. This could lead to statistical difficulties.

The second justification is connected to the financial and euro-crisis of 2008-2009. Economies all over the world took a significant hit, not the least European countries. One of the consistent and conclusive remarks in other studies is that during the financial crisis of 2009, EMU member states suffered a more difficult time recovering back to their prior pre-crisis growth rate. By both joining EU and EMU, the growth effect bonus is partly neutralized by the negative effect EMU have of recovering from a financial crisis (Kabderian Dreyer & Schmid, 2017). As shown in our results, the interaction variable between EMU membership and the euro-crisis dummies
was insignificant. The reason for this could be to the selected time frame in our time dummy, where we generated the CRI variable by having a value of 0 prior to 2008 and having a value of 1 in 2008 and forward. This is because our initial question regarding the euro-crisis was to examine if EMU members had a more difficult time to recover its economic growth in comparison to non-EMU members in the aftermath of the crisis.

Another conjecture is that the Stability and Growth Pact is not working as intended. The Stability and Growth Act is an agreement, by which EU members are required to uphold fiscal policy criteria in order to join/maintain a membership to the European Union. The two criteria are to have a budget deficit of no more than 3% of GDP and to have a Debt-to-GDP ratio of 60% or less. Breaches of the deficit criterion since its implementation have been reported of all EU member states except Luxembourg and Sweden. Out of the 19 eurozone countries, 12 are currently beaching the Stability and Growth Pact debt criteria. This could mean that the monetary policy set within EMU could be undesirable for specific member states. This is more evident when country-specific shocks are a vital driving force of a country's business cycle, instead of common shocks. If this is the case, joining EMU could be costly (Söderström, 2008).

Another point of consideration is to examine the impact of political and financial integration. The interpretation being political integration an EU membership and financial integration an EMU membership. The previous study with the scope of investigating the impact of the different types of integration concluded their study by stating neither political nor monetary integration have a direct impact on growth but is revealed as an indirect impact through debt and financial growth. This would suggest why some countries manage to experience a positive effect of acquiring the euro, while other economies plummet and are experiencing problems upholding their growth rate prior to implementing the euro. One could say that implementing the euro is a two-edged sword, where it allows better access to financing for investments, which has a positive effect on growth. On the other hand, it could also trigger a country to over-borrow, drowning their economy in debt (Kalaitzoglou & Durgheu, 2016).

6.1.2 The negative coefficient for human capital (EDUC)

When initially constructing our thesis, our intuition and the literature seem to coincide on the effect of investments towards human capital producing almost exclusively positive effects on growth in the long run (Kabderian Dreyer & Schmid, 2017). However, due to a lack of data regarding investments into human capital or even education, we decided to use a statistic that
explains what percentage of a country’s population have any tertiary education. We still expected this independent variable to show a unanimous positive effect. Post regression we can state that we were wrong in our assumptions. However, a strong correlation was still found between education level and growth. The fact that a country with a higher share of tertiary education in its population correlates negatively with growth, is quite interesting from an economic perspective. When considering Solow’s growth theory about economies and their steady states, suddenly this correlation does not seem economically invalid. Consider a country with a low share of its population being tertiary educated, we would assume that the country is still developing its economy. Developed economies almost exclusively have high education levels combined with moderate growth rates. As illustrated in figure 4 below. From the two marked areas, we can clearly observe one group of developed economies and one group of developing economies, both near each other.

If we were to apply our growth theory assumptions to these two groups, one would quickly realize that instead of the green group being labeled “developed”, it would be referred to as economies closer to or at their respective steady states. The red group of economies would be
referred to as economies further away from their respective steady states. Hence, the high growth rates found in many of the red group’s countries would be expected, even though their high growth rates are directly contributing in producing a negative and contradictory coefficient for EDUC in our estimations.

In conclusion, this realization has led us to believe that if one were to include human capital in growth models it would have to be based on monetary investments and not on education levels. Quite possibly the countries in the red group might be investing in education while having their education levels still lagging. Supposedly, if Solow’s theory is correct, defining EDUC as monetary investments into education would then shift the coefficient for EDUC from negative to positive as we initially expected. Another possible solution would be to keep EDUC as explaining education levels, but rather have it measure the change in education levels which would better indicate an economy’s human capital accumulation.

6.1.3 Scatter plot findings

The outliers that can be observed above in figure 1 are quite controversial findings if we are to adhere to the Solow-Swan growth model. Namely, Ireland and Luxembourg, are outliers with Ireland possessing an extremely high average rate of growth and Luxembourg possessing an extremely high average GDP per capita. Ireland produces controversy when having an extremely high average growth rate alongside an above average GDP per capita. This cannot be explained using our current growth models. The same is true for Luxembourg with its extremely high average GDP per capita combined with its above-average growth rate. These outliers in our results might stem partly from the fixed effects that countries inhibit in our model, characteristics that differ between countries but are constant over time. For example, both differences in fiscal policy and a differing presence of labor unions might be producing these differences without our model being able to explain them.

6.1.4 Eurozone and the criteria of an OCA (optimal currency area)

It is commonly criticized that the eurozone does not fulfill the criteria for being an optimal currency area (OCA) (Krugman 2015). This is, according to the study, one of the leading reasons why the EMU countries handled the crisis worse than EU countries. The eurozone fulfills some of the criteria for an OCA, such as labor mobility across regions, capital mobility, price and wage mobility across the European Union, and the symmetry of shocks. In contrast, the remaining criteria are not attained by the eurozone. Firstly, for the eurozone to be considered an OCA, a risk sharing system would be required. This allows money redistribution
in the form of an automatic fiscal transfer mechanism to countries who have been suffering negatively from the criteria above. We would argue that in order to steer the European Union and the Eurozone towards an OCA with a fiscal transfer mechanism, the European Parliament and the policymakers would be required to further control the individual countries fiscal policies, resulting in deeper economic integration within the EMU.

In addition, because of the structure of the European Union, constructed by a set of nations with cultural differences, language barriers, with different customs, the EU will have difficulties to form an optimal currency area. One could argue that by having language barriers between two countries intuitively lowers labor mobility compared to a common currency area established within a single nation and language, such as the United States.

6.2 Suggestions on further research

6.2.1 Common-shocks vs country-specific shocks

An interesting potential study would be to see how important country-specific shocks have been for the economy, instead of assuming common shocks being the driving force of business cycles within the EU and EMU. By estimating and ranking countries by how important country-specific shocks have been for fluctuations in economies, this could further help countries considering joining the EMU of how costly it would become. Intuitively, if country-specific shocks of an economy have a larger impact on the economy’s fluctuations than common-shocks, those countries need to re-evaluate the benefits and costs of joining the eurozone. The increased costs of joining the EMU by looking at common- and country-specific shocks could be because EMU monetary policy is designed to tackle common-shocks, not on a country-specific level.

This could be a research paper designed for some of the eastern European countries currently in the process of joining the EU and/or EMU. Even if previous literature has empirical support for beta convergence within the European Union, this might not be the case if the country does not share the same business cycle with the other European Union members. This could be true if most of the country’s export and import is conducted in Asia or other geographically close nations that also trade mostly to countries outside of Europe.
6.2.2 Education’s correlation to growth in developed and developing economies

Our estimation results produced a negative correlation between the share of a population with any tertiary education and real GDP growth rate. We argue that this result would be worthwhile researching furtherly. Most developed economies are currently service driven economies where education has a high significance. Still, developing countries manage not to compete, but to outcompete the already developed economies in terms of growth. This might not be considered very significant by many, but when acknowledging the fact that countries never have been this exposed to competition on a global scale we end up with some interesting questions. Building on this, countries in the European Union have even lower barriers between each other, i.e. their domestic markets face even more competition from within the union. Considering these circumstances, it would seem almost arrogant not to further investigate whether developing countries their high growths through economic measures and policies that developed economies have not considered or even left behind. One aspect would be to examine the developed countries tend to transform to welfare economies while still developing economies have not, specifically the developing economies with high growth rates seems to reject the welfare model.

The scatter plot findings in chapter 6.1.3 further add validity to this question. In outliers like Ireland and Luxembourg, we can clearly see that even highly developed economies are able to produce and sustain high growth rates while already experiencing a high GDP per capita. This adds to questioning the role that education currently plays in neoclassical growth theory. There could be a distinction we could define to transform education into being more relevant as an explanatory variable to growth. For example, one could hypothesize that including only the hard sciences, information technology, and artificial intelligence would produce a variable that is vastly more relevant to explain growth than the all including a variable that we used in this study.
7. Conclusion

The purpose of this study was to investigate whether there is economic convergence within the European Union and if an EMU membership promotes economic growth. By implementing augmented Solow models with data of EU countries, gathered from the World Bank on European countries, we conducted a convergence analysis. Our empirical analysis confirmed our research question of whether there is economic convergence within the EU. However, it does not confirm that EMU membership affects economic growth at a viable statistically significant level. Our results regarding economic convergence contribute to the growing body of already existing evidence. The result of our second regression model where we accounted for the euro-crisis as an exogenous phenomenon, was not sufficient enough to conclude whether or not the growth rate was affected differently in EMU countries.

If we were to conduct a similar study with the same research question, our findings could have been more significant by altering our growth model. Both by testing additional explanatory variables, which could allow us to explain the variance in growth by a higher degree. A meaningful variable to include could, for instance, be unemployment. By changing the variable of the euro-crisis to only account for the crisis years, instead of the period following the crisis. This could improve the statistical significance of the variable and could possibly give a more precise measure of how significant country-specific monetary policies are in managing a crisis.

As in any other study, our model could suffer from biases and caveats. In our case, the risk of reverse causality is always present in the education variable, which is close to impossible to adjust for, other than having that in mind.

By concluding the study in broader terms, developing countries considering joining the European Union would most likely converge with the existing EU members. However, developing countries should exercise caution when considering applying for EMU membership. Despite the weak statistical support, the coefficient for EMU membership did indicate a negative correlation for economic growth. This aligns with some of the previous studies. Finally, it is worth taking into consideration that EMU should be equally cautious in determining its new members, not just the other way around.
References


Collected Data

The World Bank

  - Barro-Lee: Percentage of population age 15+ with tertiary schooling. Total (Incomplete and Completed Tertiary)

  - Real GDP Growth (%)
  - GDP per capita (current US$)
  - Gross fixed capital formation (% of GDP)
  - General government final consumption expenditure (% of GDP)
  - Trade (% of GDP)

Data was collected 2019-05-24.
Appendix

Definitions

| Definition of terms          | 
|------------------------------|---------------------|
| Y                            | Real GDP            |
| y0                           | Initial Real GDP per capita |
| CAP                          | Capitals share of GDP |
| EDUC                         | Education           |
| GOV                          | Government expenditure |
| OP                           | Openness            |
| EMU                          | EMU membership      |
| CRI                          | Euro-crisis         |

List of EU countries included in the model

1. Austria (AUT)  15. Hungary (HUN)
2. Belgium (BEL)  16. Ireland (IRL)
3. Bulgaria (BGR) 17. Italy (ITA)
4. Cyprus (CYP)  18. Lithuania (LTU)
5. Czech Republic (CZE)  19. Luxembourg (LUX)
6. Germany (GER)  20. Latvia (LAT)
7. Denmark (DNK)  21. Malta (MLT)
8. Spain (ESP)  22. Netherlands (NLD)
9. Estonia (EST)  23. Poland (POL)
10. Finland (FIN)  24. Portugal (PRT)
11. France (FRA)  25. Romania (ROU)
12. Great Britain (GBR)  26. Slovak Republic (SVK)
13. Greece (GRC)  27. Slovenia (SVN)
Figures

Figure 5: Histogram Log of GDP per capita

Figure 6: Histogram GDP per capita
Controlling for serial correlation and heteroskedasticity

Figure 7: Residuals against time

Figure 8: Residuals against linear prediction

Figure 9: Residuals against Education

Figure 10: Residuals against Openness

Figure 11: Residuals against Initial GDPPC

Figure 12: Residuals vs Gov. spending
Figure 13: Residuals against Capital

Tables

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<th>Variable</th>
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Table 4: Descriptive statistics

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Table 5: Correlation matrix