Erasmus University Rotterdam
Erasmus School of Economics
Bachelor Thesis Economie & Bedrijfseconomie

The Effect of Financial Integration on Economic Convergence in Europe

This research aims to identify the effect of financial integration on economic convergence. In the first part of this research a theoretical framework is constructed to analyze the developments of both concepts in the euro area over the research period 1990-2017. Classical economic theory predicts that high factor mobility within an area leads to convergence. On the other hand, theories are discussed which explain the possible negative effects of financial integration on convergence.

In the empirical part of the research it is observed that until approximately 2009 the countries in the sample both converged and became more financially integrated. From 2009 onwards, which coincides with the beginning of the Great Recession, both trends get reversed.

The direct effect of financial integration on β- and σ-convergence is measured by linear equations that measures convergence complemented with variables for financial integration and an interaction term. In the case of σ-convergence financial integration seems to have a positive effect on convergence. Regarding β-convergence the most remarkable outcome of the linear regression model is that financial integration has an inhibitory effect on economic growth, but this effect dampens when the initial level of wealth is already high. This implies that financial integration has a counteracting effect on convergence since it hurts weaker economies disproportionally. This effect is however only observed over the whole sample period 1990-2017 and is not observed when the sample period is divided into smaller sub-samples. Much caution is therefore needed when making claims about this effect, but the result admits cause to further research.

Emiel van der Geest, 437281
Supervisor: Albert-Jan Hummel
8-9-2019

Contents

1. Introduction

Organized European cooperation has been a matter of interest since 1957 when the European Economic Community (EEC) was founded. Since then, the collaboration of the countries within this community intensified while over the years some new countries joined the community as well. The partnership of the EEC eventually resulted in the European Union and alongside also the creation of a monetary union. Globalization has led to a world that is way more economically integrated and this is eminently the case for the countries within the European Union. Differences in the structure and strength of the economies undermine a proper functioning of the single European economy. There is evidence that north-south disparities in Europe have increased in the early 1980's. As a result, the Single European Act of 1987 implied that the European Community has the explicit objective to reduce these regional disparities. (Neven & Gouymete, 1995)

To accomplish this objective, it is essential that the European countries will become more similar over time rather than growing apart. This particular phenomenon is called economic convergence and is a topic which has been studied intensively in the past. When poor countries have the opportunity to 'catch-up' with the richer economies the market as a whole becomes more competitive which will result in higher overall GDP per capita. If convergence does not occur and the poor countries stay poor, the richer countries can take advantage of the poor countries since the poor countries are not able to compete properly. This is of course undesirable and therefore convergence within the European Union, and more specifically the monetary union, is of high importance.

Besides an increase in economic integration, the world economy has also seen itself develop in terms of financial integration. Lane & Milessi-Feretti (2007) have shown that the extent to which countries are financially intertwined with each other has seen an impressive increase over the course of their research period 1970-2004. Additionally, they found that developed countries became relatively more financially integrated than developing countries.

Classical economic theory predicts that income per capita increases when capital has the opportunity to flow towards places where capital per worker, and with that marginal productivity of capital, is relatively low. Resources can get allocated in a more efficient manner. One would therefore expect that high financial integration within the European monetary union induces economic convergence. On the other disparities are still observed in the euro area

Given these developments and mechanisms the following research question comes forward:

'What is the effect of financial integration on economic convergence in the euro area over the research period 1990-2017?"

In this research a framework will be constructed which aim is to facilitate answering this question. An overview will be presented of the developments in convergence and financial integration. Also, the theoretical link between the two concepts will be made by analyzing the possible effects and why they occur.

In the second part, an empirical research will be executed in order to test the exact effect of financial integration on economic convergence in the euro area over the research period 1990-2017. This research period has been chosen for different reasons. This period consists of some very interesting events like the introduction of the monetary union in 2002 and the period of financial crises starting from 2008 onwards. A lot of research on the topic of economic convergence comes from the 1990's, and often cover periods up until 1990. Therefore, 1990 is an interesting starting date since it covers a relatively unresolved period. The sample of countries used in this research consists of the 12 countries that initially formed the euro area. Those countries are relatively similar and experienced the same monetary policy from 2002 onwards.

Also in the empirical part of this research the concepts of convergence and financial integration will be tested separately at first. Thereafter, the concepts will get tested together and the results of this can be analyzed by using the theoretical links constructed in the theoretical framework.

2. Theoretical framework

In the theoretical part of this research the concepts of economic convergence and financial integration will be explained. In the first part of the theoretical framework economic convergence and financial integration will be treated separately. The theoretical base of both concepts will be explained firstly after which empirical evidence will be discussed. Thereafter, theory on both concepts will be linked to each other to construct the framework that will help in answering the research question.

2.1 Economic convergence

2.1.1. Classic theoretical concepts of β- and σ-convergence

Economic convergence has been a topic of interest for several researchers over the years. The convergence hypothesis states that, over time, per capita income of economies will converge under the assumption that the circumstances are similar. The reason for this to occur is the assumption that marginal returns on capital are decreasing, as described in the neoclassical models of growth. This gives poorer economies the opportunity to 'catch up' with the richer ones. In the existing literature there are two concepts of convergence introduced, β-convergence and σ-convergence. Both are linked to each other but capture a different part of economic convergence. Where β-convergence tells something about the movement of an economy within the sample distribution, σ-convergence is about the spread of the distribution itself. Furthermore, both β- and σ-convergence use GDP per capita as measuring unit. (Sala-i-Martin, 1995)

Absolute β-convergence occurs if initially poor economies (low GDP per capita) have a stronger growth rate than rich economies. To measure β-convergence the following regression is used:

$$(1)\ \frac{log\left(y_{i,t+T}/y_{i,t}\right)}{T} = \alpha - \beta * \log\left(y_{i,t}\right) + \varepsilon_{i,t}$$

Where the left-hand side of the formula denotes economy *i's* average GDP growth rate between *t* and *t + T*. and $\log\left(y_{i,t}\right)$ is the logarithm of economy *i*'s initial per capita income at point *t*. If β>0 then there is absolute β-convergence.

σ-convergence is measured as the standard deviation of the logarithm of GDP per capita in a group of economies. If this standard deviation, and with that disparity, is decreasing over time we can speak of σ-convergence. This phenomenon is captured by the following equation:

$$(2)\ \sigma_{t+T} < \sigma_t$$

Where σ_{t+T} and σ_t are the standard deviations of the natural logarithms of output per capita across the sample at time *t+T* and *t*.

β-convergence is a necessary, but by itself not sufficient, condition for σ-convergence. When the initially poorer economies in a subset of countries grow faster than the rich ones, in most cases the distribution becomes more equal. However, when the poor economies outgrow the rich ones, it's theoretically possible that β-convergence occurs, but the dispersion between economies did not decrease and therefore σ-convergence is not observed.

Besides absolute β-convergence, we can also find the concept of conditional β-convergence in the literature. Conditional β-convergence controls for differences in other variables, besides initial GDP per capita level, that influence the steady-state GDP per capita level of an economy. Human capital and propensity to save are examples of variables that may differ in steady-state levels. However, when the assumption can be made that economies within in the subset of countries that are compared are similar, absolute β-convergence is an adequate measure. (Sala-i-Martin, 1995)

2.1.2. Empirical evidence on convergence

Especially from the 1980's onwards, al lot of empirical research has been done on economic convergence. The vast majority of these study convergence on a worldwide scale where they look whether the economically weakest countries are able to catch up with the wealthiest part of the world. Since this research will focus on the euro-area, an area that is in its entirety relatively economically developed, the empirical evidence that has been found in those worldwide studies cannot be simply applied on this research. Studies which use samples that are economically comparable, for example OECD countries or the states of the United States, are of higher relevance.

In the working paper of Barro & Sala-i-Martin (1990) they describe economic growth and convergence across the United States. From a neo-classical point of view, they examine from the United States from 1840 onwards. Their main finding is that convergence occurs evidently, but only when the assumption is made that diminishing returns to capital set in at a very low pace. Different regressions over different sub-periods are performed in order to estimate β-convergence across the United States. The regression performed on the longest interval, 1880-1988, results in a β of 0.0175. This corresponds to a half-life for the log of output per capita of approximately 40 years. In the extend of their research Barro & Sala-i-Martin add a great variety of explanatory variables to their models, like sectorial composition and migration of labor, which have varying effects on the outcome.

Besides β-convergence they also analyzed σ-convergence. Over the whole period 1840-1988 σ-convergence occurs since σ_t falls from 0.30 in 1840 to 0.19 in 1988. When studying smaller intervals, they also observe periods when σ_t which can be explained by events causing an external shock to the economy like the civil war in the 1800's. The interval 1975-1988 is also characterized by a rise in σ_t. The explanation given for this are the fluctuations in oil and other commodities that occurred in this period.

At last, Barro & Sala-i-Martin make a comparison of findings on convergence across countries. When studying β-convergence on a sample of 98 countries from 1960 till 1985, they only find evidence when holding constant additional variables, such as government consumption spending and school-enrollment. Otherwise the sign of β is negative, this in contrary to what is found in the United States.

Neven & Gouymte (1995) study the regional economic convergence in the European Community in the period 1975-1990. They study the pattern in convergence in Europe on a regional NUTS II level, which is more zoomed in since this research will be constructed on country level. However, some of their findings are still interesting regarding the economic convergence on a bigger scale. Figure 1 shows their findings on σ-convergence across the European regions. We observe a slight increase in the standard deviation of the total sample in the first part of the 1980's after which this trend reverses to a decrease in the second part. Also interesting are the separate trends of σ-convergence for the northern and southern regions. The southern regions seem to display a contrary trend where σ_t increases in the second part of 1980's. Neven & Gouymete suggest that the trade liberalization that occurred in 1985 with the implementation of the internal market program, can be associated with this change in the pattern of convergence given the view that the northern European countries were better in adjusting to

this new policy regime. In the southern countries only part of the economy profited from the measures, which may be an explanation of growing disparities.

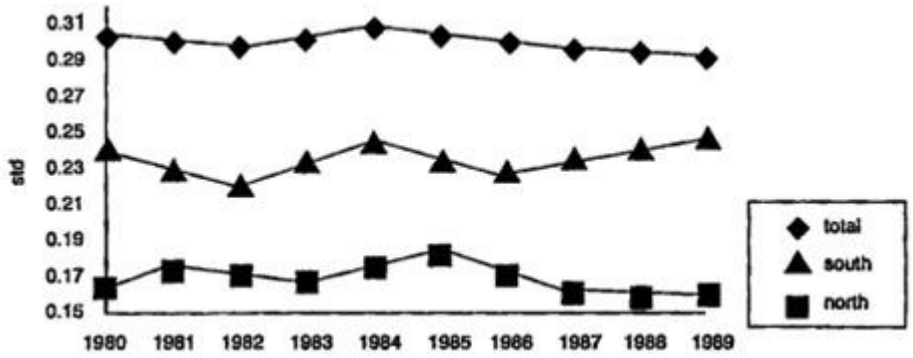


Figure 1, Standard Deviation across European Regions (Neven & Gouymete, 1995)

Further, Neven & Gouymete also tested (un)conditional β-convergence using a modified version of equation (1), being:

$$(3)\ \frac{log\left(y_{i,t}/y_{i,t-T}\right)}{T} = \alpha - \left(\frac{1-e^{-\beta*T}}{T}\right) * \log\left(y_{i,t-T}\right) + \varepsilon_{i,t}$$

When testing conditional convergence, they add country dummies to the model. They use this non-linear equation, which is also generally used in other literature concerning convergence, in order to avoid the β-coefficient being inversely related to the length of the period T. If convergence occurs, the growth rate falls over time since the predicted growth rate of a richer economy is lower. By using the non-linear equation, they are able to compare the speed of convergence across datasets with different time lengths. However, when the length of the period becomes small, the linear and non-linear equation coincide. (Sala-i-Martin, 1995)

Neven & Gouymete find that, over their total sample and sample period 1980-1989, β-convergence occurs at a rate of 0.53% in the unconditional model without country dummies and 1.11% when the model includes country dummies. The rate of 0.53% in the unconditional model corresponds to a half-life of about 130 years. The parameters are significant at the 5% level. Given their results, Neven & Gouymete state that the convergence that is observed in the whole sample can be associated with southern regions catching up with the north.

The implementation of the internal market program, which is also associated with the break in trend for σ-convergence shown in figure 1, can be linked to differences in β-convergence observed in the sample period. Table 1 and 2 show that convergence stagnates for southern

regions after 1985, in contrast to the northern regions. The expectation that a shock like the implementation of the internal market program increases convergence in general is not fulfilled. When looking at β-convergence it can even be suggested that the southern regions may be hurt by the liberalization policies. An important ending note of Neven & Gouymete is that evidence on, among other things, capital flows and investment, would be useful in further research.

Neven & Gouymete expanded their research by adding several variables controlling for differences in, for instance, human capital and industrial composition. Adding those variables ensures that differences in steady states are included in the model. Another method for holding the steady state constant is making sure that the analyzed set of economies can be assumed to have similar steady state values. Sala-i-Martin (1995) applied this method in search of absolute β-convergence. For this he uses several samples of countries that he assumes to have similar steady state values. Among which the OECD countries, a subset of, at the time, 24 economically developed and relatively wealthy countries. He finds that OECD countries display σ-convergence in the sense that the dispersion in GDP fell from $\sigma=0.60$ in 1950 to $\sigma=0.36$ in 1990. Between 1975 and 1985 convergence stagnated and disparity even slightly increased. Absolute β-convergence, again measured with equation (3), occurs at a rate of around 2 percent per year.

2.2 Financial integration

Over the years, the world's economy has made a great development regarding financial globalization. An important part in this financial globalization is the increasing extent to which capital is mobile and how financially intertwined countries are with each other. Restrictions on capital flows in the form capital controls have been reduced significantly for most countries in the last decades. A region where capital controls have been particularly renounced is the euro-area. A common credit market for this subset of, initially 12, European countries was created with the introduction of the euro in 2002. This potentially increased capital mobility between these countries and made them more financially integrated with each other.

Lane (2006) states that the creation of the euro area led to deeper and more liquid financial markets. Without exceptions, the euro-zone partners international portfolio holdings allocated to other euro-zone partners have increased from 1997, before the euro, to 2003. Table 3 shows this development.

The International Monetary Fund has made great contributions by regularly describing the current trend and new findings in their papers regarding international financial integration. They present a measurement method to quantify the extent of integration which will be discussed in the following paragraph.

Table 3

Proportion of Each Country's International Portfolio Holdings Allocated to Euro-zone Partners

	Portfolio share					
	Total		*Equity*		*Bonds*	
	1997	*2003*	*1997*	*2003*	*1997*	*2003*
Austria	47.5	65.1	50.2	54.8	46.7	68.1
Belgium	67.0	79.8	84.1	79.0	59.8	80.9
Finland	29.9	60.9	34.9	35.9	28.7	75.6
France	43.2	64.3	39.3	55.8	45.2	68.5
Germany	52.4	59.8	55.2	57.2	48.9	61.8
Greece	n.a.	40.5	n.a.	35.1	n.a.	42.1
Ireland	31.6	35.0	13.9	20.1	42.6	52.0
Italy	31.1	64.4	55.6	70.7	19.7	59.6
Luxembourg	n.a.	49.6	n.a.	32.4	n.a.	60.9
Netherlands	44.5	47.2	22.7	21.1	68.5	66.4
Portugal	45.2	64.4	54.0	66.7	43.2	60.8
Spain	36.2	63.2	45.8	62.8	27.6	64.2
	Ratio to GDP					
	Total		*Equity*		*Bonds*	
	1997	*2003*	*1997*	*2003*	*1997*	*2003*
Austria	11.7	53.2	2.8	9.5	8.9	43.7
Belgium	44.3	108.6	22.2	36.6	22.1	72.0
Finland	2.8	40.3	0.9	8.1	1.9	32.3
France	9.4	50.1	2.8	10.7	6.6	39.3
Germany	41.8	55.8	20.1	23.6	21.7	32.2
Greece	n.a.	7.9	n.a.	0.8	n.a.	7.1
Ireland	37.7	190.4	6.3	28.5	31.4	161.9
Italy	6.9	34.6	3.6	15.9	3.3	18.7
Luxembourg	n.a.	2447.3	n.a.	575.8	n.a.	1871.4
Netherlands	28.6	72.0	7.6	13.4	21.0	58.6
Portugal	8.2	42.7	2.4	5.2	5.8	37.5

2.2.1 IFIGDP

Lane & Milesi-Ferretti (2003) introduce the IFIGDP ratio as a volume-based measure of financial integration. The IFIGDP ratio can be obtained by the following formula:

$$(4)\ IFIGDP_{it} = \frac{(FA_{it}+FL_{it})}{GDP_{it}}$$

Where FA_{it} and FL_{it} respectively capture the stock of foreign assets and foreign liabilities and GDP_{it} is the gross domestic product for country *i* at time *t*. The IFIGDP ratio has seen a significant increase in the last decades. (Lane & Milesi-Ferretti, October 2003)
Until approximately 1990 both industrial and emerging economies worldwide followed the same trend towards an IFIGDP ratio of circa 100%. After this the trend in international financial integration diverged where the industrial countries grew to a ratio of about 300% in 2004 while the emerging economies continued the old trend which led to a ratio of 150% in the same year. This development is displayed in figure 3. (Lane & Milesi-Ferretti, 2007) Since the euro-area countries all fall in the industrial economy category we can expect them, in general, to also display this acceleration in international financial integration from 1990 onwards. However, it may be that within the group of euro-area economies there are significant differences in the extent to which countries are financially integrated.

2.3 Theoretic link between convergence and integration

Since the aim of this research is to explain the effect of international financial integration on economic convergence this section will be dedicated to finding the theoretical link between both concepts. The effect of international financial integration on economic convergence can either be positive, negative or ambiguous. A theoretic framework will be constructed to explain what the drivers of the different effects are.

2.3.1 Positive effect

In order to understand why a financially integrated country will benefit in terms of economic convergence we need to look at the drivers of economic growth in the neoclassical models. The underlying model for the economic convergence models that are used in this

research is a general Solow-model with a Cobb-Douglas production function in the following form:

$$(5)\ Y = AK^{\alpha}L^{(1-\alpha)}$$

Where Y is output, A is a fixed technology parameter, K the physical capital stock and L is labor. Assuming that prices are set competitively, α is a parameter that denotes the share of income that is paid to capital in the economy. Hence $(1-\alpha)$ is the share of income paid to labor. An important assumption is that the second derivative of output over capital is negative and therefore marginal returns to capital are decreasing. Capital accumulation over time occurs when saving exceeds effective depreciation, this is defined by:

$$(6)\ \frac{dK}{dt} = sY(t) - \delta K$$

s denotes the saving rate, *Y(t)* is output at time *t* and δ is the rate of depreciation. The capital stock will grow until saving and depreciation coincide and when this is the case an economy will find itself in steady state. (Sala-i-Martin, 1995) Since we're interested in output per capita we divide and (6) by *L* to obtain:

$$(7)\ y = Ak^{\alpha}$$

In a model like equation (7), the rate of convergence depends on two factors: propensity to save and productivity of capital. Capital has decreasing marginal returns and its productivity will therefore be maximized by accumulating capital until the point where the savings are equal to depreciation. Once this point is reached an economy finds itself in stead-state. If an economy is further below its steady-state level of capital, growth will be faster which tend to lead to a higher rate of convergence. (Barro, Sala-i-Martin, Blanchard, & Hall, 1991)

The most straightforward manner to accumulate capital is increasing the savings rate. Another possibility, and this is where financial integration comes in, is attracting capital from other economies. When an economy has the possibility to accumulate extra capital by lending from other economies, the growth rate of the capital stock will be higher and roughly defined by:

$$(8)\ \frac{dK}{dt} = sY(t) - \delta K + \gamma(fl - r)$$

Here the increase in capital stock over time ($\frac{dK}{dt}$) is not only defined by the saving rate and the output but also by foreign lending (*fl*) minus the costs of lending in the form of interest payments

(r). γ is a parameter which measures how fast differences in lending rates translate into capital flows.

If the rate of return of the lending economy exceeds the interest rate, lending capital from abroad contributes to accumulating capital. Because of the diminishing marginal returns to capital, additional capital returns can be higher than the interest rate in capital scarce countries and lower than the interest rate in capital abundant countries. Under perfect capital mobility, which is proxied by high financial integration, capital will move towards the economies with the highest marginal returns which results in equalization of return rates and instant convergence in output per capita.

An economy can have three different forms of openness towards international capital markets. It can be entirely closed, where foreign borrowing will be non-existent. The economy can also be entirely open which implies perfect capital mobility. A mixture of both forms will be an economy where capital is partly mobile. In the first case, the closed economy, firms are entirely dependent on the propensity to save of the households in the economy for obtaining capital. Their growth rate, and subsequently their convergence rate, is therefore also solely dependent on the rate at which capital accumulates by saving. If the saving rate is not sufficiently high, an economy will not be able to increase their return on capital and output enough to catch up and converge in the closed economy case. (Barro, Mankiw, & Sala-i-Martin, 1992)

In the open economy model with perfect capital mobility, and under the assumption that the economy is small, households and firms face a constant interest rate set on the world capital markets. Since the interest rate equals the rates of return on capital, values for capital, human capital and output will be constant at their steady-state levels. Once an economy opens up to the world capital market it jumps immediately towards its steady state, which implies an infinite rate of convergence. This conflicts highly with what is observed in empirical evidence. (Barro, Mankiw, & Sala-i-Martin, 1992)

The most realistic, and therefore most interesting, case is when capital is mobile to a certain extent. This gives an economy the opportunity to attract some external capital which subsequently leads to faster growth. Imperfect capital mobility causes the gradual path by which an economy converges towards it steady state to speed up. The classical-economic ideas result in the following first hypotheses:

Hypothesis 1.1: Increased capital mobility has a positive effect on the level of σ-convergence in the euro area."

Hypothesis 1.2: "Increased capital mobility has a positive effect on the rate of β-convergence of an economy." "

2.3.2 Negative effect

Since the prevailing neoclassical models of growth imply that high capital mobility leads to faster growth and convergence, it is necessary to also analyze the opposite point of view: a negative effect of financial integration on economic convergence.

Essential in the convergence models is the assumption that capital will flow from capital abundant countries, with low marginal rates of return on capital, towards capital scarce countries where the marginal returns on capital are high. This pattern of capital flows is not always observed in practice and this is known as the Lucas paradox. In his 1990 paper, Lucas firstly states that investment by wealthy countries in poor countries falls short of what is predicted by the neoclassical models. After this he gives four possible answers on the question why the assumptions made in the neoclassical models are wrong and how they should be replaced. One of his possible answers implies that capital market imperfections are the cause. (Lucas, 1990)

This direction is of relevance for this research since it involves capital markets into the discussion of convergence. Lucas his explanations focuses on a setting where one economy is significantly wealthier than the other. In this research the setting is different since all economies are relatively wealthy. Although there are clear differences between the euro area countries in terms of wealth, this does not compare to the differences in the setting presented by Lucas. Explanations that assume, for example, an imperial power against a (former) colony are therefore of less relevance.

Gertler & Rogoff (1990) give an alternative explanation on how capital market imperfections can lead to a negative effect of financial integration on growth. They state that capital market efficiency does not only stimulate growth but that this relation also works the other way around. An increase in wealth in a country tend to reduce agency problems in lending and investment. As a result, it will be easier to accumulate capital which facilitates further growth. It will be difficult for a poor economy to compete with a wealthier economy that has a more efficient capital market. In this way, an open capital market magnifies the positive effect of

starting with a higher endowment of capital. Gertler & Rogoff made some empirical observations that possibly support this theory. Both total and private external debt have a positive greater than unit-elastic relation with GDP per capita which implies that wealthier countries attract relatively more foreign capital. The presence of sovereign risk is a possible explanation since poor countries, with high default risk, may not be able to attract capital because of this risk. Either way capital flows from rich to poor get muted or even reversed. This indicates the possible negative effect of capital mobility on the growth of economically weaker countries and thus convergence.

3. Data

In the empirical part of this research we will study the 12 countries that initially formed the euro-area, also known as euro12, over the research period 1990-2017. The euro12 countries are choses as research group for several reasons. From 2002 onwards these countries experienced the same monetary policy imposed by the ECB. Countries who joined the euro area at a later moment can be in other stages in terms financial integration or their convergence path. Further, the data on this subset of countries is relatively complete which makes it suitable for the statistical tests that will be performed in later sections. The following paragraphs describe the sources of the data which will be used and the relevant statistics.

3.1 Organization of Economic Cooperation and Development (OECD)

The database of the OECD is used primarily to obtain accurate data on GDP per capita. The dataset was complete did not miss any datapoints for the sample period. GDP is adjusted for purchasing power.

3.2 International Monetary Fund (IMF)

The IMF delivers the data that will be used in constructing the measure for international financial integration. For each economy, data on foreign assets, foreign liabilities and gross domestic product is obtained at the International Investment Position section. Foreign assets include all the assets an economy has outstanding in foreign economies. Foreign liabilities capture the opposite since this includes domestic assets that are owned by foreign economies. The dataset was unfortunately not complete as for some economies the data from the earlier years of the research period was not available.

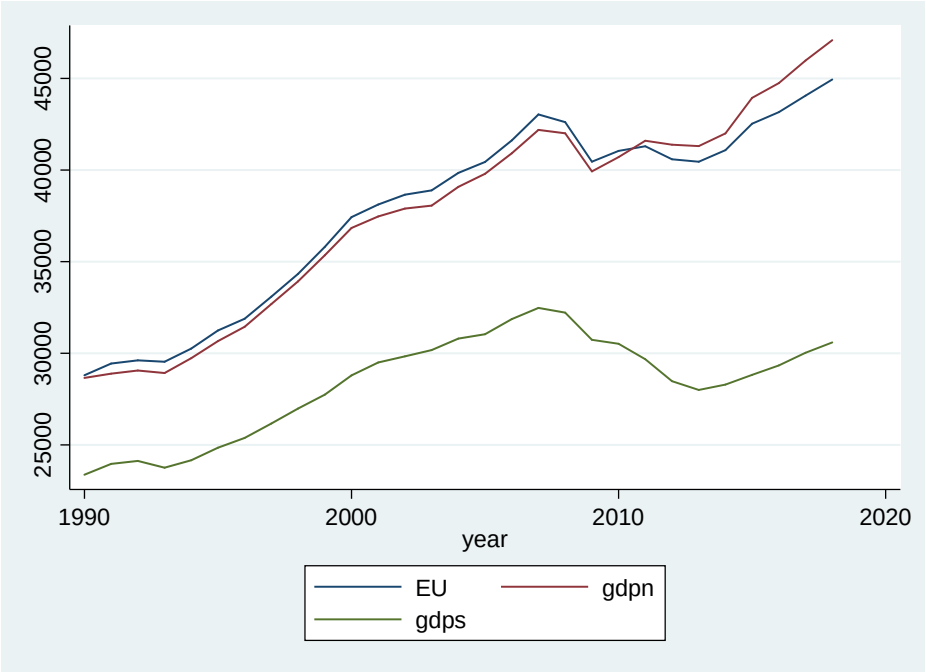
3.3 Descriptive statistics

In order to get an overview of the composition of the datasets that will be worked with some descriptive statistics are certainly useful. Data on GDP per capita is of primarily interest in measuring convergence. The average GDP per capita of the sample starts at just under €30.000, - in 1990 (converted to euros) and increases to almost €45.000, - in 2018. Figure(n) shows the development of average GDP per capita over time and also displays a separate trend-line for the northern countries (gdpn) and the southern countries (gdps) The distinction between north and south is based on what is generally used in previous literature but stays arbitrary. Austria, Belgium, Finland, France, Germany, the Netherlands and Ireland are counted among the northern countries while Greece, Italy, Spain and Portugal make up the southern group. Luxembourg is not included in the graphics since it is such an outlier in terms of GDP per capita and composition of the economy.

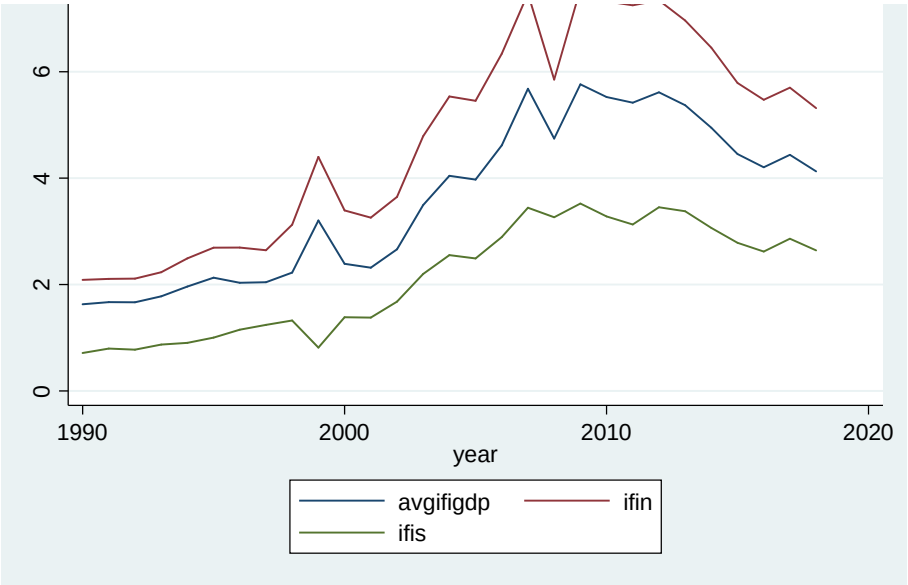
When taking a closer look at the trend lines displayed in figure 4 we observe that the trends are roughly comparable in their course until approximately 2009 when the Great Recession took off, given that the southern countries have a significantly lower average GDP per capita. Further, in the beginning of the 2000s, which coincide with the introduction of the euro, the trend for north and south seem to slightly differ as well. A remarkable observation is that the shock of the crises seems to hit the southern countries significantly harder, mainly in terms of absorbing the negative impact of the shock.

Besides the data on GDP, which is mainly used for measuring convergence, data regarding financial integration and capital mobility will also be analyzed. The IFIGDP ratio, calculated by equation (4), describes to what extent an economy is financially integrated in the international capital market. Figure 5 plots the trend of the average financial integration for the whole sample(avgifigdp), northern countries(ifin) and southern countries (ifis). Luxembourg, the Netherlands and Ireland are excluded from all samples since their economies are characterized as financial centers. (Lane & Milesi-Ferretti, International Financial Integration, October 2003) These countries are significant outliers in terms of financial integration. Luxembourg for example had an IFIGDP ratio of 400 in 2017 where the average ratio for the other countries is 4.

Figure 4



EU = average GDP per capita for the whole sample
gdpn= average GDP per capita for the northern countries,
gdps = average GDP per capita for the southern countries



avgifigdp = average IFIGDP-ratio whole sample
ifin= average IFIGDP-ratio for the northern countries
ifis = average IFIGDP-ratio for the southern countries

4 Methodology

In the theoretical framework several equations were introduced for measuring economic convergence, financial integration and capital mobility. In this section the use and possible transformations of these equations will be discussed.

The general linear regression model that will be used for measuring β-convergence is equation (1). Because of the scope of this particular research I will use modifications of the linear equation, instead of the non-linear equation that is generally used in the literature, to estimate the β-convergence coefficient. The variables that measure financial integration need to be integrated into the equation and the interpretation of the coefficients and the composition of the equation itself would be more complex when the non-linear equation is used. Since the linear equation will be used in this research it will not be possible to compare my β-convergence estimates one to one with those found in previous literature. In order to control for country specific differences, country- and time-dummies will be added to the model as well.

The cross-section standard deviation of the logarithm of GDP per capita will be computed to display the developments in σ-convergence. σ-convergence occurs when a downward sloping pattern is observed in the standard deviations over time.

Besides the measures of economic convergence, different measurement methods for financial integration and capital mobility also have been introduced. I will compute the IFIGDP ratio using equation (4).

All the measures for financial integration and capital mobility contain cross-sectional and time-series elements and can therefore easily be linked to the regression model for β-convergence. The following equations will be used for this:

$$(9)\ \frac{\log\left(y_{i,t+T}/y_{i,t}\right)}{T} = \alpha - \beta^{*}\log\left(y_{i,t}\right) + \delta^{*}\log(IFIGDP_{i,t}) + \pi^{*}\log(y_{i,t})^{*}\log(IFIGDP_{i,t}) + \Omega^{*}CountryDummy_{i} + \gamma^{*}T_{t} + \varepsilon_{i,t}$$

Equation (9) will be used to for estimating the effect of IFIGDP on the β-convergence coefficient β. The regressions can be compared with the outcomes of regressions made with the basic convergence equation (1) to see whether the added variables have an amplifying or weakening effect on β or do not affect β at all. Again, country-dummies will be added to the equation to control for country specific differences.

Since all measures for financial integration and capital mobility contain a cross-sectional dimension they cannot as easily be linked to σ-convergence. σ-convergence is only measured in a time-series dimension and therefore it is necessary to use an adjusted version of equation (4). The average IFIGDP-ratio of all the countries will be used to capture the extent of financial integration in the whole area. The effect of financial integration on σ-convergence can then be measured with the following equations:

$$(10) \quad \sigma_t = \gamma + \rho * T_t + \Omega * AverageIFIGDP_t + \varepsilon_{i,t}$$

$$(11) \quad \sigma_t = \gamma + \Omega * AverageIFIGDP_t + \varsigma * RecessionDummy + \varepsilon_{i,t}$$

Where T_t is a variable that captures time with $T_{1990} = 0$ when the period starts in 1990. ρ captures the effect of time on σ_t. A negative coefficient implies that $\sigma_t > \sigma_{t+T}$ and σ-convergence occurs. The recession dummy is equal to zero in the years before 2009 and becomes 1 from 2009 onwards.

5 Results

In this section the results of the empirical research will be presented. Firstly, the developments in convergence and financial integration will be displayed separately. Subsequently the both concepts will be linked using the framework that has been set up in the theoretical and methodological section

5.1 Convergence empirics

5.1.1 σ-convergence

Convergence will be measured by the aforementioned concepts of σ- and β-convergence. σ-convergence is measured in only the cross-sectional dimension and gives a broad overview on the economic developments for our sample of countries. Figure 6 displays the course of σ-convergence from 1990 till 2017 for the whole sample. We observe that the standard deviation within the sample starts of at roughly 0.25 in 1990 and gradually increases to just below 0.3 in 2009. In the last part of the period, disparities firmly increased resulting in a σ of 0.35. Figure 7 also displays the developments in σ-convergence but uses a sample without Luxembourg. Luxembourg's economy significantly differs from the other economies in the sample. In terms of GDP per capita and composition of the economy Luxembourg is a real outlier and it may therefore not be relevant to include them in the sample. Figure 2 shows a graduate decrease of the standard deviation but also a firm increase from 2009 onwards. Independent of the sample this increase in disparities is present. It is almost inevitable to connect this with the start of the Great Recession, which hit Europe around this time, and the successive euro crisis. It is however remarkable that after these economic crises the level of disparity does not fall again but stays at the new higher level.

5.1.2 β-convergence

As mentioned in the theoretical framework, σ-convergence tells us something about the distribution of the sample itself where β-convergence captures the extent to which an economy moves within the distribution. Under the assumption that the economies in the sample have similar steady-state output per capita values to which they all converge, we can test for absolute β-convergence. Conditional β-convergence is measured when explanatory variables are added to the model. The addition cross-sectional fixed effects to the model, in the form of country-

dummies, accounts for differences in steady state values of variables that potentially influence GDP and convergence levels. In this case the assumption need to be made that the differences in those values between the countries do not vary over time. Running a regression of equation (1) with length of each period T=1 for the whole time period 1990-2017 gives the following results presented by table 4.

Table 4:β-convergence 1990-2017

Model	**(1) Unconditional**	**(2) Time Fixed Effects**	**(3) Time- and Cross-sectional Fixed Effects**	**(4) Time- and Cross-sectional Fixed Effects, no FC**
β	-.001	-.006	-.033*	-.044*
	(-.21)	(1.19)	(-2.06)	(-2.05)
Constant	.026	-.039	.364*	.479*
	(.50)	(-.73)	(2.20)	(2.15)
R^2	.0001	.0367	.1435	.073
N	336	336	336	252

*t statistics of estimated parameter in parenthesis. * denotes a parameter significant at the 5% level*
no FC = Financial Centers excluded from the model

The regression containing the entire sample does not give a significant result. Controlling for time- and cross-sectional fixed effects alters the results from the regression. Table 4 shows that adding a time variable does not have an impact on the size or significance of the coefficient but does add some explanatory power to the regression given the higher R^2. The addition of country-specific dummies removes a lot of variation in the regression which results in a significant β and a β-convergence rate of 3.3%. Model (4) shows the results of a regression similar to model (3) only excluding the Netherlands, Ireland and Luxembourg, which can all be considered financial centers. (Lane & Milesi-Ferretti, International Financial Integration, October 2003) This results in a higher rate of convergence.

Given the statement of Quah (1996) that a broad range of researches find uniform β-convergence rates of around 2% per year, a β-convergence rate of 3.3% implies that convergence occurs relatively fast in this particular sample and time period. However, since this research

measures β using the linear equation (1) instead of the more generally used non-linear equation (3) much caution is needed when comparing the results with results from previous literature.

It may be more interesting and relevant to divide the sample period into sub-periods like Neven & Gouymette also did and compare β for the different sub-periods. By doing this the results of different periods can be compared to each other since the same equation is used in measuring convergence. It will be possible to find which time-periods are characterized by high mobility of the economies within the income distribution and if there is an observable trend. Afterwards this may be connected with certain policy implementations regarding financial integration and economic shocks. Essential is that the sub-periods are of the same length given the implication that β in equation (1) is inversely related to the length of the sample period. I choose to take sub-periods of each 11 years of length. The reason for this is twofold. On one side the used dataset simply does not contain enough observations to use shorter sample periods of for example 5 years which Neven & Gouymette did. The second reason is that the break year that is used by taking this sample period length, 2002, is the year of the official introduction of the euro in the 12 countries that the sample consists of. This is a major event in European economic policy and of high interest regarding the implications it entails concerning convergence and financial integration. In all the following models, time- and cross-sectional fixed effects will be controlled for. The results of the linear regression for the two periods can be found in table 5.

In the first period, ranging from 1990 till 2001, we find a β-coefficient of -.064 that is significant at the 10% level. In the second sample period, the coefficient for β is also significant at the 10% level and doubles in magnitude. This implies that countries are better able to move within the wealth distribution in the second period, after the formation of the euro-area. A higher initial level of GDP seems to have a stronger effect on the growth rate which implies stronger growth for the poorer countries.

Besides the introduction of the euro, the Great Recession followed by the Euro crisis can also be considered as major external shocks that undoubtedly had an impact on economic growth. By shortening the length of the sample periods, the introduction of the euro and the economic crises can be analyzed separately. In this regression the first period runs from 1995 till 2001, the second period from 2002 till 2008 and the third period runs from 2009 till 2015. Running the regression gives a significant coefficient for the first period resulting in a β-convergence rate of 12.8%. In the second period the observed coefficient is significant and translates to a

convergence level of 41.3%. regression of the last period does not give a significant coefficient. The convergence rates in the first two periods, and especially the rate that is displayed in the second period, are remarkably high. A rate of 41.3% would imply a half-life of approximately 2 years which is unrealistic. The results found in these regressions should be interpreted as an indication that convergence clearly increased after 2001 and clearly decreased after 2008. The results of the regression can be found in table 6.

When conditioning on time and cross-sectional fixed effects model (3) shows a significant and negative β-coefficient over the whole research period 1990-2017. When zooming in on the sub-periods significant and negative β-coefficients, at least at the 10% level, are observed for each period except the period ranging from 2009-2015.

5.2 Developments in financial integration

This section will give an overview of the developments regarding the financial integration using the different measurement methods introduced in the theoretical framework. The IFIGDP ratio will be treated first.

Figure 6 plots the course of the course of the IFIGDP ratio, figure 7 does the same but excludes financial centers Luxembourg, the Netherlands and Ireland. In their researches, Lane and Milesi-Ferretti make a distinction between 'normal economies' and financial centers. Certain countries, like Luxembourg, the Netherlands and Ireland, are labeled as financial center since their international investment position relative to their GDP is significantly larger than those in other economies which can be linked to their special position in the global financial sector. As a result, financial centers cannot always be compared to the regular economies. Because of this, and the fact that a small measurement error in gross position can lead to a big measurement error in their net position, I will make special considerations in using the financial centers in my estimates. All countries display a constant growth until the end of the 2000s. When regressing IFIGDP over time, for different time periods and using country dummies, we observe a significant and positive time coefficients. A distinction is observed between the northern and southern countries where the northern countries display significantly more growth in their IFIGDP ratio. The results of the regressions can be found in table 7.

Table 7: Financial Integration

IFIGDP	***(5) 1990-2017***	***(6) 1990-2017, no FC***	***(7) 1990-2017, North***	***(8) 1990-2017, South***
T	.473*	.159*	.201*	.099*
	(4.27)	(16.90)	(13.93)	(13.95)
R^2	.959	.791	.745	.717

*t statistics of estimated parameter in parenthesis. * denotes a parameter significant at the 5% level. ** denotes a parameter significant at the !0% level*

Table 8: Financial Integration sub-periods

IFIGDP	***(9) 1990-2001***	***(10) 2002-2018***	***(11) 2002-2008***	***(12) 2009-2018***
T	.116*	.041*	.443*	-.196*
	(13.34)	(2.36)	(9.74)	(-10.42)
R^2	.964	.827	.931	.956

*All models exclude financial centers. t statistics of estimated parameter in parenthesis. * denotes a parameter significant at the 5% level. ** denotes a parameter significant at the !0% level*

The introduction of the Euro in 2002 and the beginning of the crises in 2008 can both be considered as possible break points in the development in international financial integration. Table 8 show the results of the regressions that confirm this presumption. In order to test this break, dummy variables for the periods before and after 2002 (period=0 for year<2002 and period=1 for 2001<year<2009) and 2008 (period1=0 for 2001<year<2009 period1=1 for year>2008) were made. The term that captures time interacted with the dummy is significant in both regressions which implies a structural break in the series. The coefficient of the interaction term given by the break in 2002 is positive and implies that after 2002 IFIGDP is significantly higher. The interaction term of the second break test in 2008 displays the opposite, here the coefficient is negative which corresponds with the stagnating or even decreasing trend in international financial integration after 2008.

The years before and after the break-years 2001 and 2008 display less strong coefficients for the interaction terms which confirms that the actual break takes place in these years. The results of the break-test can be found in table 9.

Table 9: Break-test Financial Integration

IFIGDP	*(13) 1990-2008*	*(14) 2002-2018*
T	.129*	.452*
	(5.84)	(10.18)
Period dummy	-3.79*	3.69*
	(-5.13)	(4.92)
Interaction term	.315*	-.521*
	(6.34)	(-6.22)
R^2	.910	.935

*All models exclude the financial centers. t statistics of estimated parameter in parenthesis. * denotes a parameter significant at the 5% level. ** denotes a parameter significant at the !0% level*

5.3 Interaction effects

The aim of this research is to estimate the effect of financial integration on convergence. It is therefore essential to connect these concepts. Before testing the relationship between the concepts by adding them together in a new model, the results of the previous sections will be analyzed simultaneously. Table 6 and table 8 show that there are several breaks in trends in both convergence and financial integration which take place at the same points. The introduction of the euro, break-year 2001, corresponds with an increase in both financial integration and convergence-rate. The second break-year, 2008, is characterized by a stop in the convergence trend and a negative development in financial integration. This is by no means evidence for a causal relation between both the concepts, but it suggests that they move in the same direction.

5.3.1 σ-convergence & average financial integration

Since σ-convergence is measured only in a time-series dimension, the general IFIGDP-ratio cannot be used in a regression. The average IFIGDP-ratio in the euro area is used in equation (10). Table 10 shows the results of the regressions based on this equation.

Table 10: β-convergence & financial integration 1990-2018

σ-convergence	***(15) Whole sample***	***(16) FC's excluded***	***(17) Whole sample***	***(18) FC's excluded***	***(19) Whole sample***	***(20) FC's excluded***
Time	.0029*	.0013*	.0035*	.0033*		
	(10.60)	(2.43)	(7.01)	(3.42)		
IFI			-.0003	-.0136*	.0004	-.0118*
			(-1.31)	(-2.41)	(1.40)	(-4.13)
Recession-dummy					.0402*	.0636*
					(4.64)	(7.34)
n	29	29	29	29	29	29

*t statistics of estimated parameter in parenthesis. * denotes a parameter significant at the 5% level. ** denotes a parameter significant at the !0% level*

Since IFIGDP values for the financial centers are considered outliers, the models excluding the financial centers are of most relevance. Firstly, we will look at the models covering the whole sample period. The magnitude of the time-coefficient becomes negative after adding the financial integration variable to the model excluding financial centers. This implies that, holding financial integration constant, disparitiy increases over the period 1990-2018. Financial integration itself has an enhancing effect on σ-convergence which is displayed by the negative sign of the coefficient. When comparing model (22) and model (23) we observe that in the model without financial centers the amplifying effect of financial integration on σ-convergence is stronger.

Since there is a clear break visible in the development in σ-convergence, and the period before the break displays a more gradual trend, the period before 2009 will be analyzed separately. This is done by adding a dummy variable which has a value of 0 before 2009 and 1 from 2009 onwards. As expected, in both model (24) and (25) the coefficient of the dummy variable is significant and positive which implies greater disparity after 2009. The financial integration coefficient shows differences in sign, significance and magnitude when comparing model (24) and (25). This implies that only in the model without financial centers financial integration has an amplifying effect on σ-convergence.

Based on the results presented in this paragraph hypothesis 1.1 can be examined. Financial integration seems to have an enhancing effect on σ-convergence given the coefficients found in the regression and therefore hypothesis 1.1 cannot be rejected. It is likely that the result is, at least partly, due to similar trends in both concepts and not necessarily the result of a causal relationship and therefore this result should be adopted with much caution.

5.3.2 β-convergence & financial integration

In the methodology section a transformed linear regression is presented which will estimate the interaction effect of the IFIGDP ratio, which captures financial integration, and initial GDP per capita, which is the driver of β-convergence. Equation (9) is used for this regression. Firstly, we will start with the models that cover the whole sample period, as done in section 5.1.1. Table 11 displays the results of the estimates found in these models. The comparison of model (29) and model (4) is the most interesting given that those models control for both cross-sectional and time fixed-effects and have therefore the highest credibility. Adding the financial integration decreases the significance of the convergence coefficient β but also slightly increases the magnitude. The financial integration coefficient is significant and has a negative sign, the interaction term is also significant and has a positive sign. The first implies that only having a high level of financial integration lowers the growth rate of an economy. However, the combination of a higher initial GDP level with a higher level of financial integration is correlated with a higher level of growth.

This last result can be interpreted as financial integration only having a positive outcome on growth when an economy is already rich. This result can possibly explain that on the one hand financial integration increases over the years and on the other side more disparity is observed within the euro-area. The result is consistent with the theory of Gertler & Rogoff about possible negative effects of financial integration on convergence as described in section 2.3.2. Based on this finding hypothesis 1.2 should be rejected. The convergence-coefficient slightly increases after adding the extra variables and the interaction term shows that financial integration amplifies disparity. The richer economies experience a relatively positive effect of financial integration on their growth rate in comparison to the poorer economies which counteracts convergence.

Table 11: Convergence & Financial Integration 1990-2018

Model	(21) Unconditional	(22) Conditional	(23) Unconditional, no FC	(24) Conditional, no FC
β-Time	-.012	-.039	-.030	-.049**
	(-1.14)	(1.63)	(-1.63)	(-1.74)
δ-IFI	.011**	.003	-.108**	-.156**
	(2.46)	(.38)	(-1.92)	(-2.39)
π-interaction term	-.001**	-.0002	.010**	.014**
	(-2.46)	(-.38)	(1.90)	(2.33)
Constant	.129	.426	.331**	.535**
	(1.22)	(1.70)	(1.73)	(1.83)
R^2	.023	.072	.039	.122
n	276	276	222	222

*t statistics of estimated parameter in parenthesis. * denotes a parameter significant at the 5% level. ** denotes a parameter significant at the !0% level*
the conditional models control for time and cross-sectional fixed effects, the unconditional models do not.

In this section we will again look at the different sub-periods, 1990-2001 and 2002-2012 to begin with. Table 12 displays the results of these regressions. Model (14) shows a slightly weaker β-coefficient than the coefficient from model (15) which is without the financial integration variables. This implies that holding financial integration constant, convergence occurs at a slower rate in the period 1991-2001. The second sample period does not give any significant coefficients so no statements can be made about this.

Given the non-significance of the additional variables in this paragraph, no strong additional statements can be made about hypothesis 1.2.

Lastly, table 13 displays the results following the set-up of table 6. The first two periods show significant β-coefficients, both with and without the inclusion of the financial integration variables. The financial integration variables are by no means significant. The third period shows the most remarkable results. Without the presence of the financial integration variables, this period displays a convergence rate of 27.4% which is significant at the 10% level. However, when including the financial integration variables, the sign of this coefficient becomes positive. This implies a positive correlation between GDP level and growth, though the coefficient is not significant. The financial integration coefficient and the interaction term are significant at the 10% level. A positive and significant coefficient for financial integration implies that growth increases when a country is more financially integrated. The negative significant interaction

coefficient implies that having both a high initial level of GDP and a high level of financial integration tempers growth in the period 2009-2015. This finding is consistent with the neo-classical theory which implies a positive effect of financial integration on convergence.

Again, no strong additional statements can be made regarding hypothesis 1.2 because of the insignificance of the coefficients.

6 Conclusion

The aim of this research was to investigate the effect of financial integration on economic convergence in Europe. In order to function in an efficient manner, it is essential that the countries within the European monetary union converge to each other rather than diverge. Since the founding of the EEC, and the different European forms of cooperation that followed the EEC, policy measures and acts have been introduced with the aim to reduce disparities within Europe. Besides this it has also became more convenient to move factors across countries. This applies especially for the factor capital. These concepts and the interaction between them have been the base of this research.

In this section conclusions will be drawn based on the results presented in the previous chapter and the hypotheses constructed in the theoretical framework. Hypotheses 1.1 and 1.2 where constructed to analyze the general trend in economic convergence. For both β- and σ-convergence applies that it occurs until the beginning of the last constructed sample period in 2009. After 2009 the countries in the sample diverge in such a way the hypothesis 1.1 must be rejected, σ-convergence does not occur over the whole sample period. Even despite the strong divergence after 2009, β-convergence does still occur over the whole sample period. The sample period consists of two break points in financial integration; the introduction of the euro area as a monetary union around 2001 and the beginning of the financial crisis around 2009. Following from the sections that analyzed convergence and financial integration separately, some notable presumably similar trends are observable.

The aim of this research is to investigate the direct effect of financial integration on convergence. Therefore, the most interesting results are found in the last section of this research where the concepts of convergence and financial integration are combined in a single regression. Convergence does occur over the whole sample period, also after controlling for financial integration with the added variables. Over the whole sample period, financial integration itself has a negative effect on the growth rate. Given that in general the poorer countries are less

financially integrated, which is displayed in the data section, one would expect that this implies a positive effect of financial integration on convergence. However, the evidence on this is quite mixed. In the case of σ-convergence there seems to be an enhancing effect of financial integration on convergence which is in line with the neoclassical theory. The evidence on β-convergence is mixed and often not significant. The conditional model covering the whole research period displays an interaction term which implies a negative effect. The combination of a high initial GDP and a high level of financial integration possibly counteract the initial negative effect of financial integration on growth. This implies that the poor economies experience possible negative effects of financial integration stronger than the richer economies in the distribution, which implies a negative effect of financial integration on divergence. When looking at the theoretic framework this finding is consistent with the theory of Gertler & Rogoff about relative capital market efficiencies.

7. Implications

The results found in this research are in some cases remarkable. The finding that financial integration has a negative effect on economic convergence is counterintuitive and goes against the neo-classical theory. However, much caution is needed when interpreting this result. The fact that a significant result that implies the effect is only found in one of the models indicates that additional research on this effect is desirable. With more resources it will be possible to construct a more precise model with more explanatory variables to isolate the effect and reduce omitted variable bias. The concept of financial integration should be deepened more. The construction of a network that makes clear bilateral capital flows can help in further explaining why capital moves from certain economies to others.

Besides all this it will also be interesting to investigate different areas, for example the states of the United States or the West African Economic and Monetary Union to control if the effects found in the euro area are also present in different parts of the world. It is desirable to construct follow-up research in areas that are, like the euro area, characterized by relatively similar economical composition and policy. Otherwise it becomes difficult to account for all the possible differences that influence economic growth.

7 References

Barro, R. J., & Sala-i-Martin, X. (1990). Economic Growth and Convergence Across the United States. *National Bureau of Economic Research*.

Barro, R. J., Mankiw, N. G., & Sala-i-Martin, X. (1992). Capital Mobility in Neoclassical Models of Growth. *Natuional Bureau of Economic Research*.

Barro, R. J., Sala-i-Martin, X., Blanchard, J. O., & Hall, R. E. (1991). Convergence Across States and Regions. *Brookings Papers on Economic Activity*, 107-182.

Gertler, M., & Rogoff, K. (1990). North-South lending and endogenous domestic capital market inefficiencies. *Journal of Monetary Economics*, 245-266.

Lane, & Lane, P. R. (2006). The Real Effects of European Monetary Union. *Journal of Economic Perspectives*, 47-66.

Lane, P. R., & Milesi-Ferretti, G. (2007). The external wealth of nations mark II: Revised and extended estimates of fereign assets and liabilities 1970-2004. *Journal of International Economics*, 223-250.

Lane, P. R., & Milesi-Ferretti, G. (October 2003). International Financial Integration. *IMF Economic Review*, 82-113.

Lucas, R. E. (1990). Why Doesn't Capital Flow from Rich to Poor Countries. *American Economic Review*, 92-96.

Neven, D., & Gouymete, C. (1995). Regional Convergence in the European Community. *Journal of Common Market Studies* , 48-65.

Quah, D. T. (June, 1996). Empirics for economic growth and convergence. *European Economic Review*, 1353-1375.

Quah, D. T. (March, 1996). Convergence Empirics Across Economies with (Some) Capital Mobility . *Journal of Economic Growth*, 95-124.

Sala-i-Martin, X. (1995). The Classical Approach to Convergence Analysis . *Journal of Economic Literature classification* .

8 Appendix

8.1 Theoretical framework

Table 1, β-convergence 1980-1985, (Neven & Gouymete, 1995)

Sample	*I*	*Is*	*In*
Unconditional model	*β=0.251*	β=2.55*	*β<0*
	(–1.519)	(–2.310)	(1.47)
	R^2=0.02	R^2=0.09	R^2=0.02
With country dummies	β=2.01*	β=4.44*	*β=0.26*
	(–3.99)	(–2.974)	(–0.537)
	R^2=0.27	R^2=0.15	R^2=0.35

Table 1, β-convergence 1985-1989, (Neven & Gouymete, 1995)

Sample	*I*	*Is*	*In*
Unconditional model	β=0.77*	*β=0*	β<1.08**
	(–2.22)	(1.44)	(–1.79)
	R^2=0.03	R^2=0.02	R^2=0.03
With country dummies	*β=0.42*	*β=0*	β=1.86*
	(–0.86)	(–0.084)	(–3.040)
	R^2=0.32	R^2=0.38	R^2=0.77

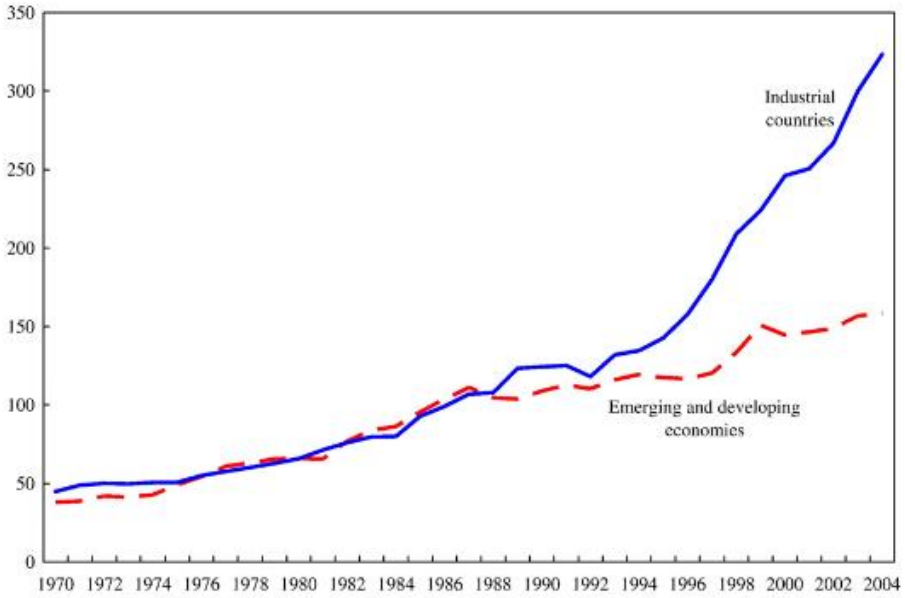


Figure 2 IFIGDP-ratio (Lane & Milesi-Ferretti, 2007)

8.2 Convergence

Figure 6

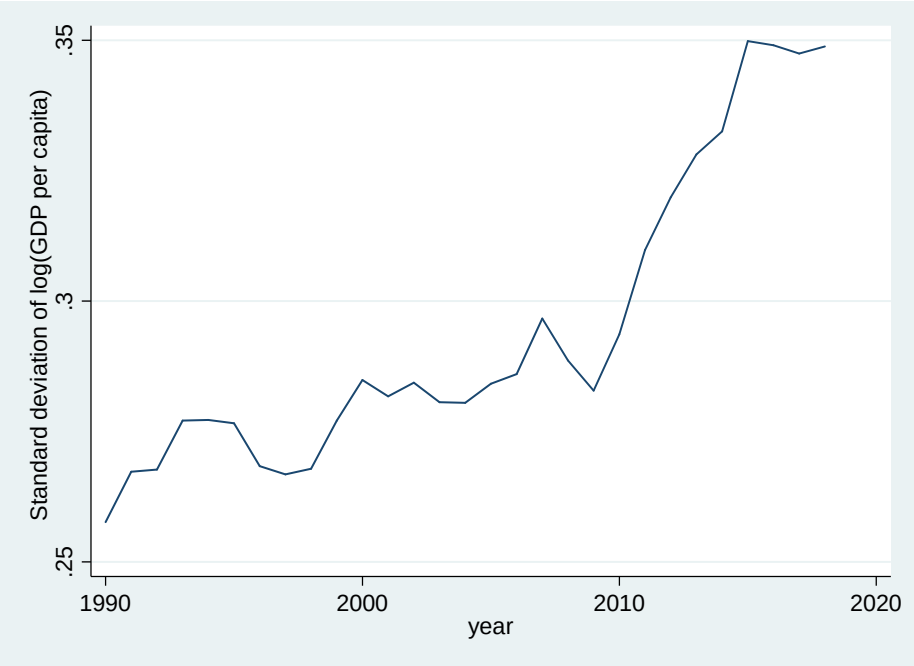
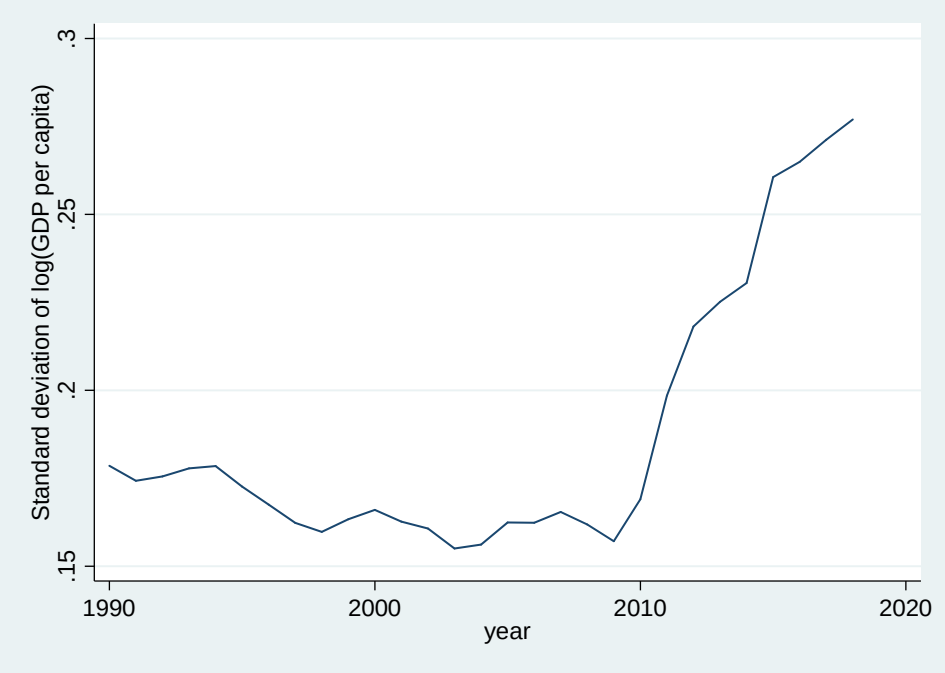


Figure 7



Luxembourg is excluded from the sample in the construction of this figure.

Table 5:β -convergence 1990-2001, 2002-2013

Model	(25) Conditional 1991-2001	(26) Conditional 2002-2012
β	-.064**	-.128**
	(-1.93)	(-1.93)
Constant	.654**	.1.415*
	(1.94)	(2.03)
R^2	.422	0.2102
n	132	132

t statistics of estimated parameter in parenthesis. denotes a parameter significant at the 5% level ** denotes a parameter significant at the 10%. Both models are conditional in the sense that cross-sectional and time fixed effects are controlled for.*

Table 6: β-convergence 1995-2001, 2002-2008, 2009-2015

Model	(27) Conditional 1995-2001	(28) Conditional 2002-2008	(29) Conditional 2009-2015
β	-.128*	-.413*	-.110
	(-3.36)	(-4.75)	(-1.21)
Constant	1.326*	4.277*	.996
	(3.42)	(4.78)	(1.01)
R^2	.670	.358	.4137

*Sample size: n=84 for all samples. t statistics of estimated parameter in parenthesis. * denotes a parameter significant at the 5% level. ** denotes a parameter significant at the !0% level*

8.3 Interaction effects

Table 12: Convergence & Financial Integration 1990-2001, 2002-2012

Model	(30) Conditional 1991-2001 – financial integration	(31) Conditional 1991-2002	(32) Conditional 2002-2012 – financial integration	(33) Conditional 2002-2012
β	-.187*	-.207*	-.136	-.061
	(-2.38)	(-3.55)	(-1.42)	(-.81)
δ	.365		.005	
	(1.60)		(.03)	
Π	-.034		.000	
	(-1.55)		(.01)	
Constant	1.853*	2.126*	.1.514*	.714
	(2.32)	(3.55)	(1.52)	(.91)
R^2	.414	.339	0.253	.214
Sample size	N=74	N=99	N=95	N=99

*All samples exclude financial centers. t statistics of estimated parameter in parenthesis. * denotes a parameter significant at the 5% level. ** denotes a parameter significant at the !0% level*

Table 13: Convergence & Financial integration 1995-2001, 2002-2008, 2009-2015

Model	**(34) IFI 1995-2001**	**(35) 1995-2001**	**(36) IFI 2002-2008**	**(37) 2002-2008**	**(38) IFI 2009-2015**	**(39) 2009-2015**
β-Time	-.133**	-.152*	-.311*	-.289*	0.193	-.274*
	(-1.72)	(-2.43)	(-3.54)	(3.83)	(1.19)	(-3.91)
δ-IFI	.256		-.080		1.233*	
	(1.33)		(-.56)		(2.97)	
π-Interaction term	-.0.24		.007		-.116*	
	(-1.31)		(.55)		(-2.95)	
Constant	1.350**	1.575*	3.219*	2.993*	-2.152	2.845*
	(1.73)	(2.46)	(3.57)	(3.85)	(-1.25)	(3.72)
R^2	.548	.490	.475	.452	.603	.513
Sample size	N=50	N=63	N=59	N=63	N=63	N=63

*All models exclude financial centers. t statistics of estimated parameter in parenthesis. * denotes a parameter significant at the 5% level. ** denotes a parameter significant at the !0% level*