Bachelor Thesis

Economics & Business Economics

Asymmetry in EU & EMU:

What impact did the financial crisis have?

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Abstract

This paper aims to show what effect the financial crisis in the period 2008-2009 has had on the existing asymmetry between the northern and southern countries in the EU and the EMU. By using macroeconomic indicators of twenty-seven EU and seventeen EMU countries over the period 1995-2011 we test for an increased asymmetry due to the financial crisis, using the endogenous growth model. Results show that there is a significant difference between the northern and southern groups, therefore asymmetry is evident. The financial crisis 2008-2009 had a negative impact on the GDP per capita in both groups in the EU and EMU, although not significant. We reject the hypothesis of increased asymmetry due to the financial crisis.

Keywords: asymmetry, EU, EMU, global financial crisis, endogenous growth model.

Table of Contents

1. Introduction

The EU has integration as its main aim, whether it is concerning the internal market or policies of trade and agriculture. The Economic and Monetary Union of Europe (EMU) has convergence of economies of the European Union as its aim. A single currency and one monetary policy are the key words of the EMU. Currently from the twenty-seven EU members seventeen are members of the EMU and two countries opted-out for the euro. All the eight other members have the obligation to sooner or later join the EMU. The EMU has the Maastricht criteria as the set of conditions which each member has to fulfill within a time framework for entry in the EMU. These conditions were set to assure a certain amount of uniformity and stability of the economic and fiscal situation in the Euro zone, as these are important for using a single currency and applying one monetary policy for all the members. Despite of the EMU-convergence criteria, the monetary union had a lot of members who did not comply with the criteria after their entrance.

Countries like Greece, Italy, Portugal, Ireland and Spain also known as the PIIGS are examples of countries that are constantly violating the Maastricht criteria and the Stability and Growth Pact without any action of the EU. These nations are unable to refinance their government debt without the help of their fellow EMU-members.
The Maastricht Criteria are:

- Government debt to GDP must not exceed three percent at the end of the preceding fiscal year and government deficit to GDP ratio should be no more than sixty percent at the end of the preceding fiscal year.
- Rate of inflation should not exceed 1.5 percentage points than in the three best performing member for the sake of price stability.
- Members should join the exchange rate mechanism (ERM II) for two years without devaluating their currency.
- The long-term average nominal interest rates should be not more than two percentage points higher than in the three best performing members.

It is a matter of fact that the southern countries already had higher deficits on their trade balances and current accounts than the northern EU and EMU countries before entering the EU and the single currency in 1999, therefore asymmetry between these groups was evident (Christodoulakis, 2010).

This paper aims to show that the financial crisis beginning from the year 2008 has led to an increased asymmetry in GDP between the northern and southern countries in the EU and the EMU. We will examine key macroeconomic indicators in the EU before and during the financial crisis in order to assess how the economic fluctuations in income per capita and external

balances have been effected by the financial crisis. The data will be gained for the period 1995-2011. The main question we are going to answer in this paper is:

What effect did the financial crisis have on the asymmetry in the EU and the EMU?

This paper will test the following hypothesis:

H_0: Asymmetry between the EU countries has increased due to the financial crisis.

H_1: Asymmetry between the EU countries has not increased due to the financial crisis.

In order to test the hypothesis we will classify the EU countries into two groups, namely the most affluent areas in the EU which includes most of the northern countries and the least affluent areas including mostly southern countries.

Northern group: Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, The Netherlands, Sweden, United Kingdom.

Southern group: Italy, Spain, Greece, Portugal, Ireland, Bulgaria, Cyprus, Slovakia, Slovenia, Estonia, Malta, Hungary, Latvia, Czech Republic, Lithuania, Poland, Romania, Malta, Slovak Republic and Slovenia.

We will use E-views to test for any trend breaks over the 15 years in the period from 1995 till 2011. The time starting from 1995 till 2007 is the period before the financial crisis and the period from the year 2008 till 2009 is the period during the crisis. The data we will use will be from the World Data Bank. To compare the two periods we will look at the GDP per capita and other macro economic variables. After looking at the asymmetry in the EU we will do the same for the EMU.

The second chapter will give an overview of several important studies about the asymmetry, the financial crisis and the convergence effects of the EU and EMU. Chapter three will provide the theoretical framework in which this research will be done, namely the endogenous growth theory and the optimum currency area. In chapter four the empirical research will be done, this is an important part because the main question will be answered on this basis. The conclusion includes a summary of the most important findings and a reciprocation of the main question, namely what the actual effect has been on the asymmetry of the output.

2. Literature Review

During the last two decades lots of research has been done on European integration and its consequences regarding economic factors varying from growth to macro economic variables like government debts and balances of payments. In the recent past also lots studies have been done about the global financial crisis and the euro crisis and its effects on the existence of the Euro Area. This chapter will illustrate the most important studies on European integration, the Economic and Monetary Union and the consequences of the crises on this integration.

2.1 European Integration

Since 1950 Europe started integrating with its fellow continent members with the European Coal and Steel Community. Hereafter this integration grew to the four freedoms of movement of, people, goods, services and money in 1993, making the single market a reality. The question that arises as a result of this integration is what effect this process of integration has had on economic growth. A few studies have answered this question, but not with similar results. Some say integration is good for growth while others suggest that international integration impedes growth (Grossman and Helpman, 1997).

Landau (1995) finds no relationship between growth and the EU membership. Badinger (2005) in contrast has found a positive effect on growth as the GDP per capita would have been one-fifth lower if integration had taken place since year 1950. This research indicates that European integration has led to economic growth, but has no a permanent effect on the growth rate. Henrekson et al. (1997) however found a permanent effect of approximately one percent while Vanhoudt (1999) could not proof any permanent effect. This question about the permanent effect on the growth rate has no unambiguous answer.

2.2 Economic and Monetary Union (EMU)

The benefits and costs of monetary union will be discussed in the second chapter. In this section we will identify the main arguments for establishing an Economic and Monetarion Union in the EU. The most important reason that the CPB study recognized was to empower the internal market by a stable monetary and budgetary policy (Bovenberg and de Jong, 1996). Furthermore this study indicated that elimination of foreign exchange costs and uncertainty would be positive for financial markets. The convergence criteria are necessary for entering, as accedence of countries with weaker discipline of monetary policy could lead to risks for the existence of the single currency.

Few studies have shown positive effects of the EMU on different firms and markets. A research of Ottaviano, Taglioni and Mauro (2009) shows that the euro has increased the competitiveness of European firms. Barrell, Gottschalk, Holland, Khoman, Liadze en Pomerantz (2008) studied the effects of the euro on productivity and employment. Their results indicated an increase of approximately two percent of the GDP of a few EMU members. Furthermore a

research about the effect of the euro on trade and foreign direct investments showed an positive effect of five percent (Baldwin, DiNino, Fontagné, De Santis and Taglioni, 2008).

2.3 Financial Crises

The most important studies regarding this paper will be discussed in this section. These studies explained the effects of the financial crises on the existence of the euro and the EMU.

There are a few crises which occurred in the last few years from 2007 till 2012. The recession which started in December 2007 and ended in June 2009 was known as the financial crisis. The second crisis is the Eurozone crisis which is also known as the European sovereign debt-crisis, with an emphasis on countries like Greece and Portugal. The Eurozone crisis started late 2009 (Shambaugh, 2012). Another crisis is the banking crisis in countries like Ireland and Spain. At last there is an ongoing growth crisis which implicates a constant low growth in the Eurozone (Hellwig, 2011).

Most of the studies suggest that a breakup of the Eurozone would not be very favorable. Eichengreen (2007) claims that a breakup of the EMU is unlikely to happen in the coming ten years and this also applies to a single member state that wants to leave the EMU. He states that long-term political costs would overshadow any immediate economic benefits. A study of the Rabobank (2010) on the other hand has the same conclusion with opposite reasoning that a break-up would lead to negative wealth-effects on the short run offsetting any long-run benefits. Anthanassiou (2009) furthermore argues that an EMU-exit of a member state would not be possible without a withdrawal from the EU. According to Buiter (2009) there are three solutions to the future of the Eurozone: a fiscal union, a break-up and the third is a creation of the author himself which concedes a minimum policy of the EMU. In a research of UBS (2011) the same conclusion came into view that the EMU is here to stay, because the costs of this break-up would exceed its benefits. They opt for greater fiscal transfer mechanism to smoothen the asymmetric shocks.

2.4 Asymmetry

Before the existence of the EMU lots of researchers warned for asymmetric shocks in a monetary union. Mundell (1961) discussed that asymmetric shocks are not suitable for an optimal currency area. In a working paper of the European Commission (Figueira and Hussain, 2006) came forward that asymmetry in the EU is increasing in absolute and relative terms. This asymmetry concerns the balance of payments of all EU members. In a study by Demyanyk and Volosovych (2004) about the degree of output asymmetry came forward that the EU acceding countries had higher gaining potential than existing EU members in terms of growth. Asymmetric shocks will be discussed further in chapter three. The research of Zsibok (2010) concentrated on the OCA hypothesis about the adjustment mechanism after an asymmetric shock in the EMU. Adjustments take place in prices, inflation rates, employment or by fiscal policies. They found a huge increase in inflation differentials within the EU during the financial crisis but spatial differences in the

balances of payments remained fairly stable. Differences were thus more found in non-EMU countries.

3. Model

To study whether asymmetry between the northern and southern EU and EMU countries has increased the endogenous growth theory will be used. This will show whether there was any convergence between both groups and if there has been an increased asymmetry during the financial crisis. The endogenous growth model will be our framework to answer the main question: What effect did the financial crisis have on the asymmetry in the EU and the EMU? The optimum currency areas theory will explain how asymmetry affects the conduction of economic policies. In this chapter both models the endogenous growth model and the optimum currency areas model will be explained and will help applying these models in this research.

3.1 Endogenous Growth Model

In contrast to the exogenous growth model, which explains sustainable growth by exogenous factors like technological advances, the endogenous growth model detects sources of growth in factors of production with a huge emphasis on knowledge. Hence, the long-run rate of economic growth can be influenced by economic factors. In this theoretical model the emphasis is on human capital, knowledge and innovation. The first version of the endogenous growth theory was the AK theory:

$$Y = AK \tag{3.1}$$

In this function output Y is exactly proportional to the aggregate stock of capital K, which implies both physical and human capital.

3.1.1 Human Capital

Human capital is a very important factor of growth in the endogenous growth theory. Individuals expend time and money to acquire knowledge. This knowledge acquisition starts from going to school, doing courses or learning skills. Knowledge is a non-excludable and non-rivalrous good. Non-excludable indicates that consumers cannot prevent others from consuming knowledge at the same time. Knowledge is non-rivalrous because consumption by one does not affect others' ability to enjoy it. This implies that knowledge actually is a public good. Its non-excludability obstructs producers from sufficient compensation for their production. Therefore governments and non-profit institutions play an important role in financing education and research and development.

Gaining knowledge is also known as an investment in human capital. Investment in human capital induces skilled and better trained workers, which lead to more productivity. So the endogenous growth model adds human capital H as a factor in the economy's production function:

$$Y = A\,F(K, L, H) \tag{3.2}$$

where Y is a function of a constant A and a function of the factors K, L and H. Y stands for the country's total output (GDP). A is the state of technology a positive constant, K shows the physical capital, L shows the worked hours and H is the factor of human capital.

Human capital and output per capita are known to be positively related. Furthermore human capital also increases the marginal productivity of other factors in the production function. If the production function is subject to constant returns to scale the marginal product of human capital is decreasing, which means that an increase in human capital will lead to a decrease in its reward. However if we take the externalities of investing in human capital on a collective level there will be no diminishing marginal productivity. Comparing human capital to other investments it can be said that human capital similarly pays off later. The difference however is that human capital has no collateral for repayment of a loan.

3.1.2 Public infrastructure

Public infrastructure is a factor that directly contributes to the production of a country. Public infrastructure includes roads, public transport, airports, telecommunication, sewage treatment and much more. These public services are as much important for firms as their machines. Public infrastructure can be written as K^G which stands for the stock of public capital. Adding the public infrastructure into the production function, the function will be:

$$Y = A\ F\ (K, L, H, K^G, I) \tag{3.3}$$

3.1.3 Innovation

Innovations are also part of the factor knowledge in many forms, like new techniques or new processes (Romer, 1990). Innovations can be measured by the investment in R&D, see equation (3.3). Technological innovations come in long waves, which means the effect of innovations on economic growth can only be seen on the long term. Take for example a firm, when growth slows down its profits decline as well. Managers will decide to invest in risky research and development projects. These projects will need a few decades to get profits. When these innovations become successful other companies tend to imitate or improve these innovations. This situation will not be appreciated by the original innovators leading to lesser investments in R&D. As result profits and growth will decline and managers will again invest in R&D.

3.1.4 Openness to trade

Openness to international trade stimulates growth. Nations with large trade exposure have faster growth rates (Burda and Yplosz, 2005). Take for example the Asian Tigers, in the last decades these countries had higher and faster economic growths. This can be explained by the openness as it allows knowledge to flow across countries and high level of competition makes producers watchful on new developments.

3.1.5 Health

Health is an important factor of growth which is inherent to human capital. When life expectancy in a country is low, investing in human capital will become less attractive. The other way around wealthy citizens would immigrate to countries with more health services.

3.2 Optimum Currency Areas

The optimal currency areas theory developed by Mundell (1961) concentrates on the costs associated with introducing one currency and the effects due to differences between countries. An optimum currency area can also be defined as a single currency zone or a monetary union where a group of countries use a single currency or two or more currencies with a fixed exchange rate.

The theory of the optimal currency areas have the following criteria to check if there is a possibility to introduce one currency: wage flexibility, labor mobility, product diversification, openness, fiscal transfers, homogenous preferences and solidarity.

In Mundell's theory of optimal currency areas countries can benefit from a common currency if three conditions are fulfilled:

1. The group of countries should not have asymmetric shocks; a shock should lead to similar effects on countries.
2. Labor mobility and wage flexibility within the group of countries.
3. There should be a fiscal policy that transfers money from one country to another.

We are going to discuss the advantages and disadvantages of a monetary union.

3.2.1 Benefits of a Monetary Union

The benefits of an optimal currency area are (Copeland, 2008):

Foreign exchange transaction costs

A currency union reduces transaction costs between countries. For example traders and travelers do not have to exchange their currency for a foreign currency when traveling outside the country. Having a single currency is also convenient for tourists who travel within the currency union. These transaction costs are not a very large sum, around a quarter or a half of 1% of the EU income, but still enough to consider a monetary union.

Less costs of uncertainty

Exchange rate uncertainty causes damage to the real flows of investment and trade. Traders generally prefer certainty over uncertainty, which means no risk of currency fluctuations and enhancement of trade and investment flows. Foreign companies will be more willing to invest in Europe.

International unit of account

One common unit of account enhances price convergence and price transparency. Consumers will shop more as they can compare prices more easily due to the same unit of account. As a result competition in the internal market will increase and lead to efficiency and more price convergence.

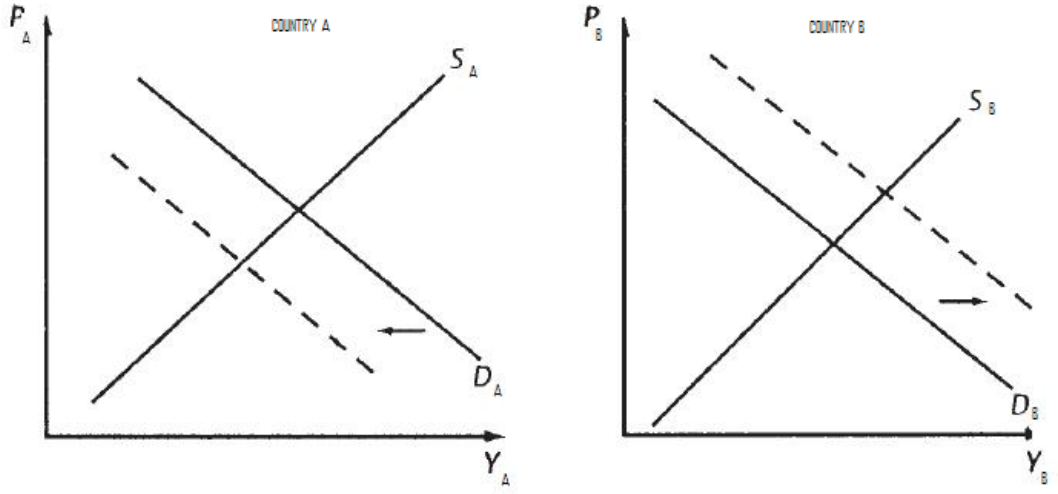
3.2.2 Costs of a Monetary Union

Kenen (1969) concentrated on the costs side of costs and benefits analysis of the optimum currency areas theory. The costs of a monetary union are more macroeconomic in nature and the benefits are more microeconomic in nature. A country that joins a monetary union cannot conduct an independent monetary policy. As a result a country cannot revaluate or devaluate its currency, determine the quantity of money in circulation and furthermore changing short-term interest rates is also not possible. Independent monetary policies can be very useful for countries that differ from other countries in a few important aspects.

Asymmetric shocks

When countries are hit by asymmetric shocks high labour mobility, wage flexibility and openness are important to reach equilibrium (de Grauwe, 2007). For example take countries A and B, both part of a monetary union, which means that they use the same currency managed by a central bank. If an asymmetric shock occurs in the aggregate demand in both countries, it will look like this:

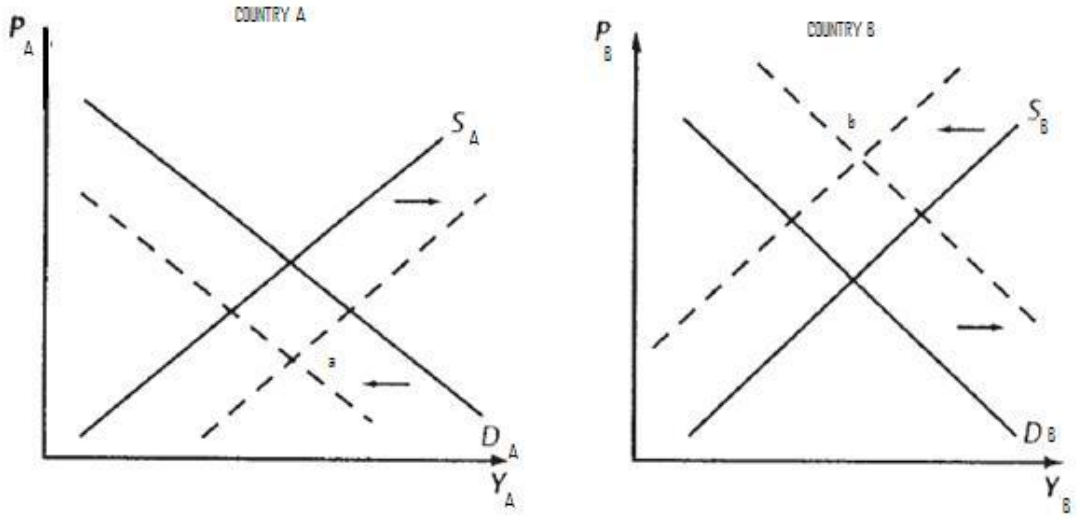
Figure 3.1 Asymmetric shock in aggregate demand in country A and B



In figure 3.1 D_x stands for the aggregate demand of the country which is downward sloping. This indicates that demand falls when prices go up. Aggregate supply is the upward sloping line S_x which indicates an increase in domestic output and more supply as prices tend to rise. Inherent to the supply line are labour wages and other input prices like material and energy, when these factors change the supply curve will also move consequently.

To analyze this asymmetric shock we will look at the figure above (3.1). In country A the demand curve has shifted to the left, which shows that demand in country A has decreased due to more demand for B made products. The demand curve of country B has shifted upwards due to increase in demand for their goods. As a result output will fall in country A and rise in country B. This will lead to more unemployment in country A and less unemployment in country B. This inequality can be adjusted by wage flexibility and labour mobility bringing both countries back to equilibrium.

Figure 3.2 Adjustment to equilibrium



1. Wage flexibility

Unemployed workers in country A will reduce their wages in order to get more work. On the other hand in country B workers will increase their wages due to the excess demand. Due to the reduction of wages in country A the supply curve moves downwards getting into a new equilibrium in point *a*, see figure 3.2. In country B higher wages will lead to an upward shift of the supply curve to the left. As a result country B ends up with less competitiveness and country A with higher competitiveness and lower prices. Slowly the competitiveness of country A will lead to an upward shift of the demand curve and consequently a downward shift of the demand curve in country B.

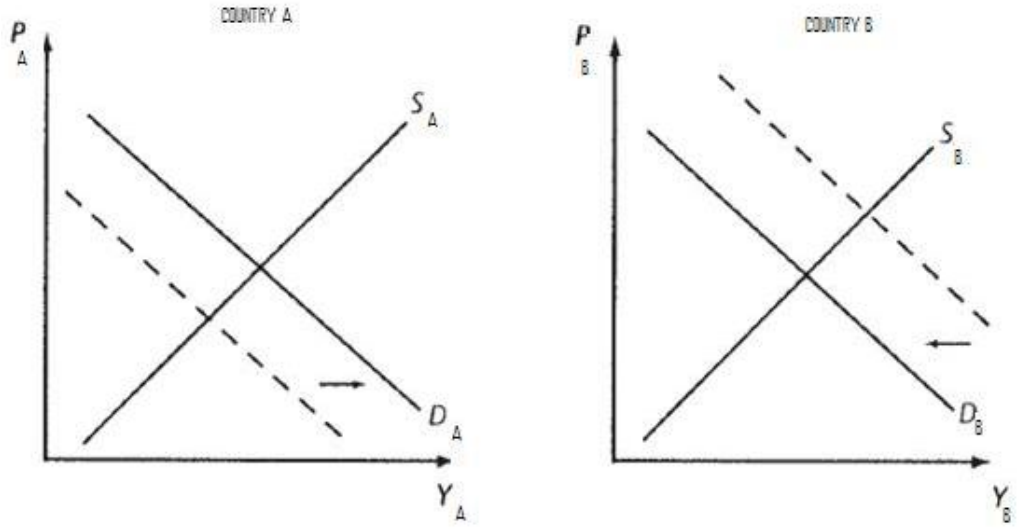
2. Labour flexibility

Now we will look at the mechanism caused by labour mobility. In this scenario unemployed workers of country A will move to country B in search of work. In this case there will be no

changes in wage rates of neither country. Country A will have no unemployment anymore and country B will not face any inflation due to wages. So the supply curve in country A will again shift downwards and in country B upwards to the left. This will bring both countries in equilibrium *a* and *b*, figure 3.2.

Now we can conclude that automatic adjustment to equilibrium is possible if there is high wage flexibility or labour mobility in the monetary union. One of these two conditions should at least be fulfilled. When this is not the case country A will stay in a disequilibrium and country B will have to face high inflation. Thus, to adjust asymmetric shocks the condition of high wage flexibility and labour mobility are very important. If both countries were not in a monetary union country A would devaluate its currency to become more competitive and in country B a revaluation of its currency would decrease the demand, see figure 3.3.

Figure 3.3 Devaluation currency A & revaluation of currency B



Insurance systems

Besides labour mobility and wage flexibility insurance systems also alleviate negative asymmetric shocks. An example of an insurance system is when country A gives money to country B as the latter is facing a negative demand shock while country A is having a positive one. There are public insurance systems and private insurance systems.

1. Public insurance system

In a public insurance system countries centralize a large part of their government budgets at say for example a European level. Here we assume European organizations have certain taxes imposed on citizens of the monetary union members. When country A suffers from a negative demand shock the European government will reduce its taxes for A´s citizens and increase its taxes in country B to realise more output. The problem which arises is moral hazard. Countries

that constantly have negative demand shock might take advantage of their situation and would not take the effort to make things better.

2. Private insurance system

Asymmetric shocks can also be smoothened by a private insurance system. This system can only be realised when bond markets, equity markets and banking sectors are fully integrated. For example country A's firms make losses due to a negative shock. As a result of the integrated equity markets this negative shock will also be felt by country B as its citizens own stocks of A's firms. In this way a positive shock in country B will also lead to positive effects in country A with the same reasoning. This scheme also applies for the bond markets and bond holders. Asymmetric shocks will be equally spread on both countries making these shocks neutral. Moral hazard will also be a problem in this scenario.

Economic policy in a monetary union

In a monetary union one policy is conducted by the central bank of the union. To simulate the effects of different economic policies we will use a model (Viaene, 2012). The assumptions in this model are as following:

1. There is a single currency within the monetary Union and a flexible exchange rate with the rest of the world (*k*)
2. A union of two countries, *A* and *B*
3. Perfect capital mobility in and outside the monetary union
4. Exchange rate expectations are static: $r=r_w$
5. Prices and wages are exogenous, fixed price model
6. No effect of union policies on rest of the world
7. Foreign interest rate is r_w

Behavioral equations of the goods market:

(3.4) $Y_A = C_A(T_A,Y_A) + I_A(r) + G_A + N_A(Y_A, Y_B, Y_w, k)$

(3.5) $Y_B = C_B(T_B,Y_B) + I_B(r) + G_B + N_B(Y_B, Y_A, Y_w, k)$

where C stands for consumption, I for investments, G for government expenditures and N for the net exports.

Behavioral equations of the money market:

(3.6) $M = (Y_A+Y_B)\,L(r)$ or $Y_2 = (M/L(r)) - Y_A$

where Y_A, Y_B and k are endogenous variables and T_A, T_B, G_A, G_B, Y_w, M, r_w exogenous.

Example:

(3.4.a) $Y_A = A_A + c_A Y_A - i_A r - m_A Y_A + d_A Y_B + e_A Y_W + f_A k$

(3.5.a) $Y_B = A_B + c_B Y_B - i_B r - m_B Y_B + d_B Y_A + eB Y_W + f_B k$

(3.6.a) $M = g(Y_A + Y_B) r^{-h}$

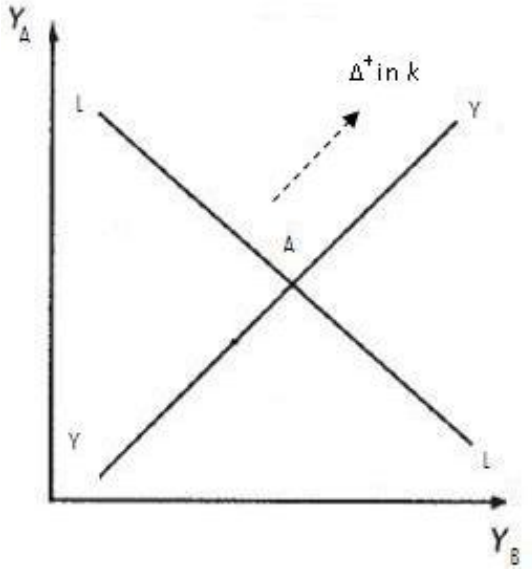
All these equations together imply:

$Y_B = \alpha Y_A + \beta r + \gamma Y_w + \delta$

$Y_B = (1/g)(M/r-h) - Y_A$

And $N_A(Y_A, Y_B, Y_w, k) + N_A(Y_A, Y_B, Y_w, k) = 0$

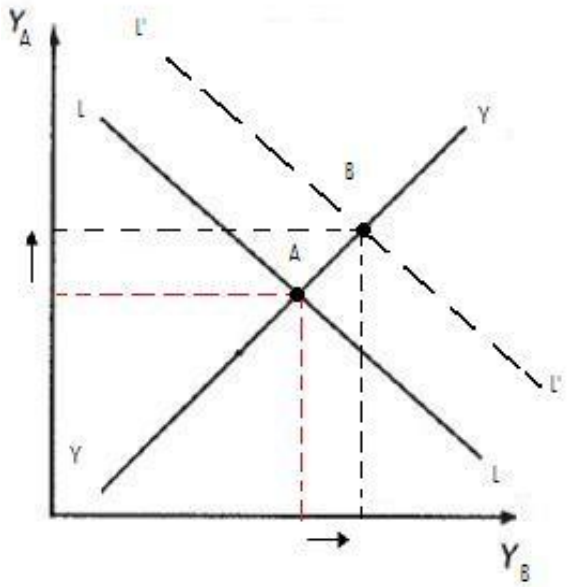
Figure 3.4 Macroeconomic equilibrium



At point A in figure 3.4 we can see a macroeconomic equilibrium. An increase in k results into a depreciation of the currency and a higher equilibrium.

1. Monetary Policy

Figure 3.5 Expansionary monetary policy

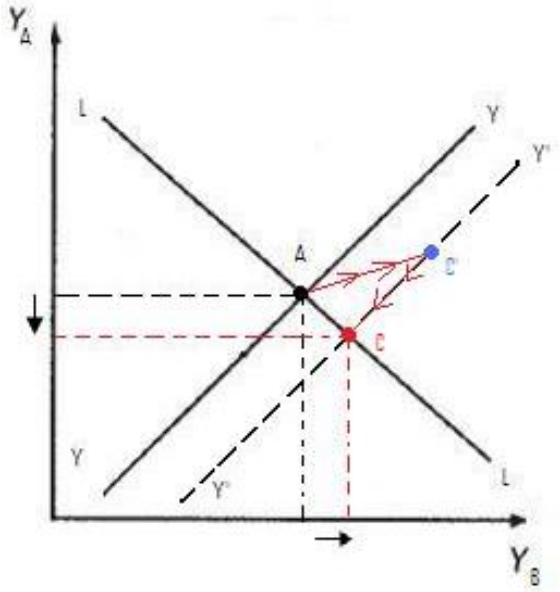


When the central bank decides to conduct an expansionary monetary policy the effect on both countries will be an increase in income Y_A and Y_B leading to point B, figure 3.5. The LL curve shifts to the right L'L' due to an increase in M, which means a capital outflow and a downward pressure on r. As a result more money will be available and the central bank reduces the interest rate making it more attractive for people to keep cash. This shows that a monetary policy is effective in a currency union, because $\Delta Y_A + \Delta Y_B > 0$.

2. Fiscal expansion

A fiscal expasion on the other hand leads to a shift of the YY curve to the right, beacause governments spend money, $\Delta G>0$. There will be a multiplier effect in both countries leading us to a short term equilibrium in point C', figure 3.6. An increase in government spending leads to an uppward pressure on r. This upward pressure will increase the demand for money and as a result inflow of capital, $\Delta^{-} k$. The currency will appreciate, hence exports and economic activity will decrease bringing us to point C. The net effect is diversion of economic activity as M, r^{-h} and $(Y_A + Y_B)$ are fixed. As a result Y_B looses what Y_A gets. Therefore a fiscal policy can be seen as charity and is not effective because $\Delta Y_A = \Delta Y_B$.

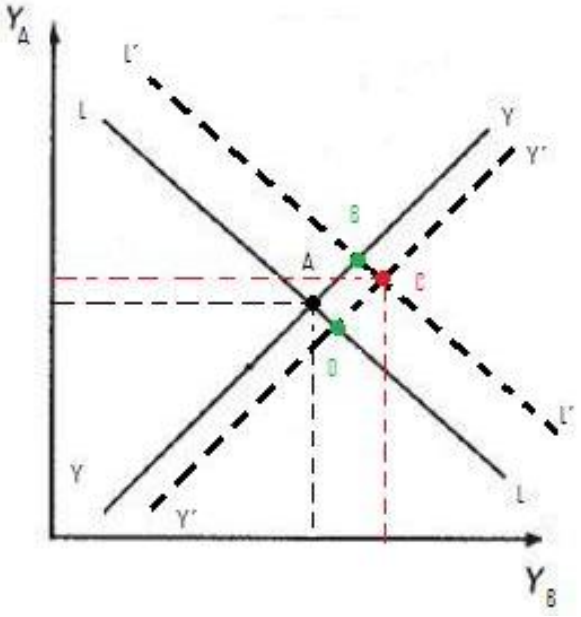
Figure 3.6 Expansionary fiscal policy



3. Policy coordination

The optimal economic policy is when both expansionary monetary and fiscal policies are conducted. The result will be full employment in both countries. As we can see in figure 3.7 with the monetary policy we will arrive in point B where both countries have an increase in Y. When adding a fiscal policy we will reach the red dot C of full employment, otherwise only a fiscal policy would bring us to point D. Therefore a combination of both policies has full employment as a result.

Figure 3.7 Policy coordination



4. Empirical Study

The endogenous growth theory showed how growth can be explained by human and physical capital, innovation and public infrastructure in chapter 3. This theory will provide us a theoretical framework to test our hypothesis. In this chapter we will compare the GDP per capita for both northern and southern EU group in the period from 1995 till 2011. With the help of Eviews 7 we study the relationship by regressing GDP per capita on being a northern or a southern EU member and the factors given in the endogenous growth theory. We will test whether it is significant to be a northern or a southern EU member and whether the asymmetry has increased in this period by looking for trend breaks. Moreover we will also test whether periphery EMU countries and other EMU-members have diverged from each other due to the global financial crisis.

4.1 Background

To make two groups we have divided the European Union in relation to the EU average volume index of GDP per capita in purchasing power standards (PPS) of year 2011. The European Union's average is an index of 100. Group one consists countries that have a GDP per capita higher than the EU average (>100) and group two has a GDP per capita lower than the EU average (<100). In figure 7.1 in the appendix we can find the volume index of GDP per capita of all EU countries expressed in relation to the EU average equal to 100 from Eurostat. We kept this criterion for the division with two exemptions of Ireland and Italy. These two countries on basis of this criterion strictly belong to group one, but due to their status in the financial crisis and the government debts they are classified as group two.

Table 4.1 Division of EU countries according to their relation to the EU average GDP per capita in PPS (Appendix: figure 4.1)

Group 1	**Group 2**
Austria	Estonia
Belgium	Greece
Denmark	Hungary
Finland	*Ireland**
France	*Italy**
Germany	Latvia
Luxembourg	Portugal
The Netherlands	Spain
Sweden	Czech Republic
United Kingdom	Romania
	Slovak Republic
	Slovenia
	Poland
	Lithuania
	Bulgaria
	Cyprus
	Malta

** Countries have this classification due to their status in the financial crisis*

4.2 Hypotheses

To see if the financial crisis has had a more asymmetric effect on southern countries we will test the following central null-hypothesis (H_0):

1. H_0: Asymmetry between the EU countries has increased due to the financial crisis.

The alternative hypothesis will be (H_1):

1. H_1: Asymmetry between the EU countries has not increased due to the financial crisis.

To test this hypothesis we have test firstly whether the financial crisis in the period 2008-2009 had a negative effect on the GDP per capita and whether the divided groups in the EU are significantly different from each other. The hypotheses will be as following:

2. H_0: The financial crisis had a negative impact on the GDP per capita.
2. H_1: The financial crisis did not have a negative impact on the GDP per capita.

And:

3. H_0: GDP per capita of group one and two do differ from each other.
3. H_1: GDP per capita of group one and two do not differ from each other.

Furthermore it is interesting to see whether the GDP trend differs between EMU countries and non-EMU countries. Therefore we will also test the following hypothesis:

4. H_0: EMU members have a higher GDP per capita
4. H_1: EMU members do not have a higher GDP per capita

For the EMU countries the following hypothesis will be tested:

5. H_0: Asymmetry between the EMU countries has increased due to the financial crisis.
5. H_1: Asymmetry between the EMU countries has not increased due to the financial crisis.

4.3 Data

To empirically test whether asymmetry in the EU has increased in the period 1995 till 2011 due to the financial crisis, we have a dataset of twenty-seven countries of the European Union. We are using five independent variables and three dummies to explain the dependent variable GDP per capita. The independent variables are labor force with tertiary education, research and development, public spending on education, dummy EMU, dummy financial crisis and a dummy for the groups. There are no outliers in any of the variables.

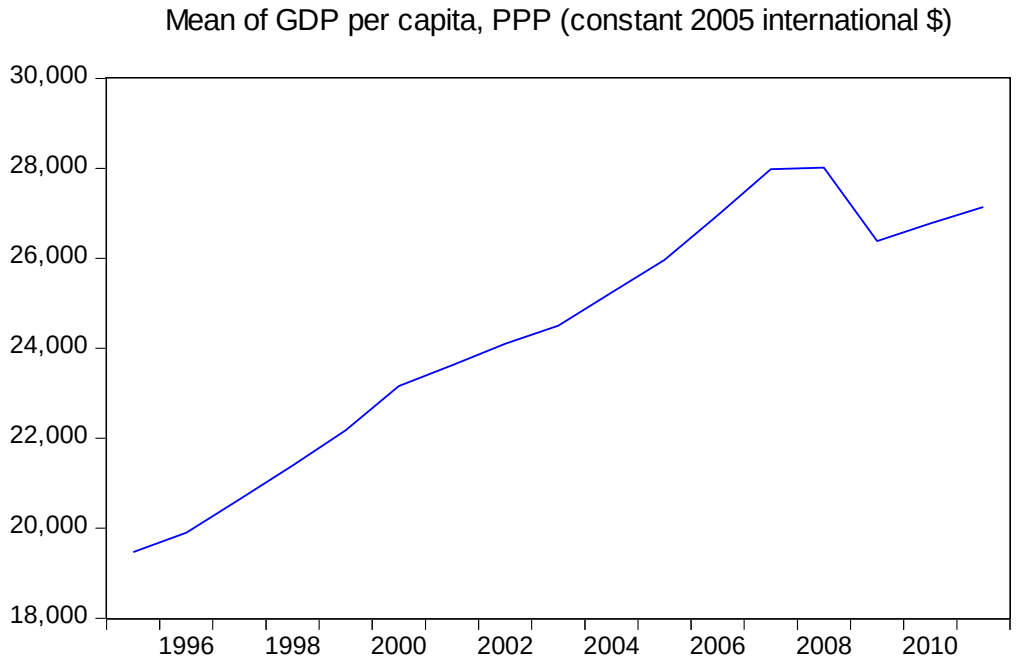
1. Gross Domestic Product (GDP) per capita (real)

The real Gross Domestic Product (GDP) per capita will be the dependent variable and has the year 2005 as its base year. The GDP per capita is expressed in constant (2005) U.S. dollar. This variable will be the Y (equation 3.3) in the endogenous growth model, measured by the endogenous factors known as the independent variables. The GDP per capita will be used to compare economic status between the EU countries in the period from 1995 till 2011. This period will be divided into two sub-periods. The first sub-period starts from 1995 and ends in 2007, which will be the period before the financial crisis. The second period is 2008-2011 known as the financial crisis and post financial crisis. By comparing these two sub-periods we will know whether there has been a trend break in the GDP per capita between the two groups of countries because of the financial crisis.

Figure 4.1 Mean of real GDP per capita of the EU

Source: Data from the World Databank, made in EViews

Note: This figure shows the development of the mean of the Gross Domestic Product of all EU countries for the period 1995-2011. The dip in the years 2008 till 2009 is caused by the financial crisis.

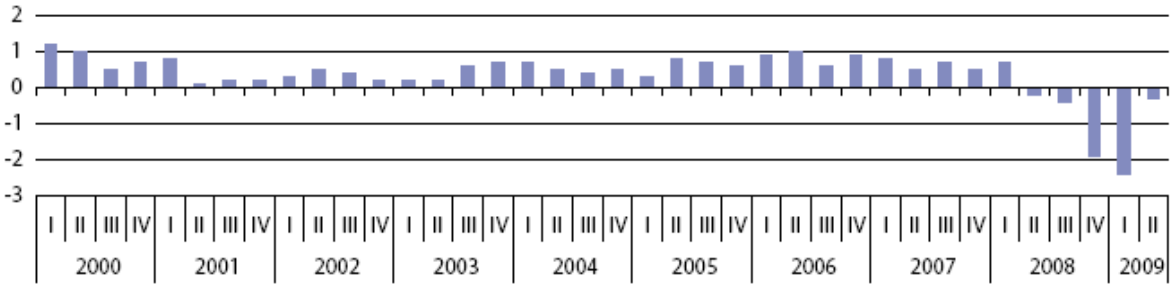


In figure 4.1 we can see the mean of all twenty-seven countries' GDP per capita in the European Union. There is an upward going trend till 2008, from that year a fall in GDP per capita can be seen. This fall in GDP per capita can be explained by the recession which started in year 2008 and ended in 2009. We can see a rise in GDP per capita since year 2009. The global financial crisis however is still going on since then in other forms of crises as we saw in chapter 2, section 2.4.

Figure 4.2 EU nominal GDP (at market prices) change on previous quarter

Source: Eurostat, Impact of the economic crisis on national accounts

Note: In the second quarter of 2008 the fall in GDP started in EU due to the economic crisis. The dip was the first quarter of 2009.

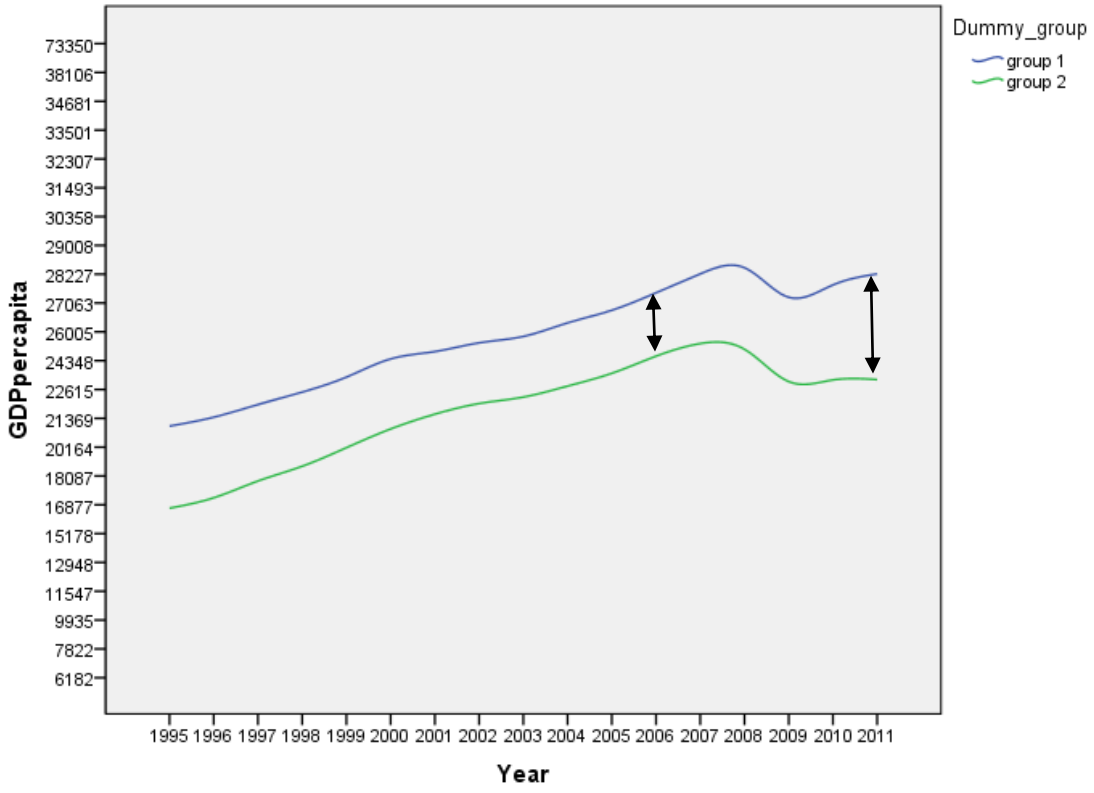


In figure 4.2 we see a histogram with the nominal quarterly change in GDP of the EU. From this figure we can conclude that the GDP started with a negative growth from the second quarter of 2008. Now looking at the difference in GDP per capita between group one and two we find the following graph:

Figure 4.3 Real GDP per capita, group 1 & 2

Source: Data from World Databank and conducted in SPSS.

Note: In this figure the development of the GDP per capita is shown starting from year 1995 till 2011. Group one indicates northern EU countries and group two represents southern EU countries. Group one has a systematic higher GDP per capita than group two. Till year mid-2007 there was increasing trend, this growth changed into a decay of the GDP per capita. From 2010 both groups are tending to return to their trend, however group one is returning faster to its trend than group two.



This figure is very important for our research, because we see a greater fall in group two's GDP per capita and the trend is not recovering as fast as group one's trend. We see that the gap in between both trends has increased after the fall in the recession (see gap between arrows, figure 4.3). The question is whether this increased difference between both groups of countries is significant. Data of GDP per capita was available till 2011 unlike all the independent variables which were only available till year 2010.

To study the differences between the EU members we will use the following independent variables.

2. Employment to population

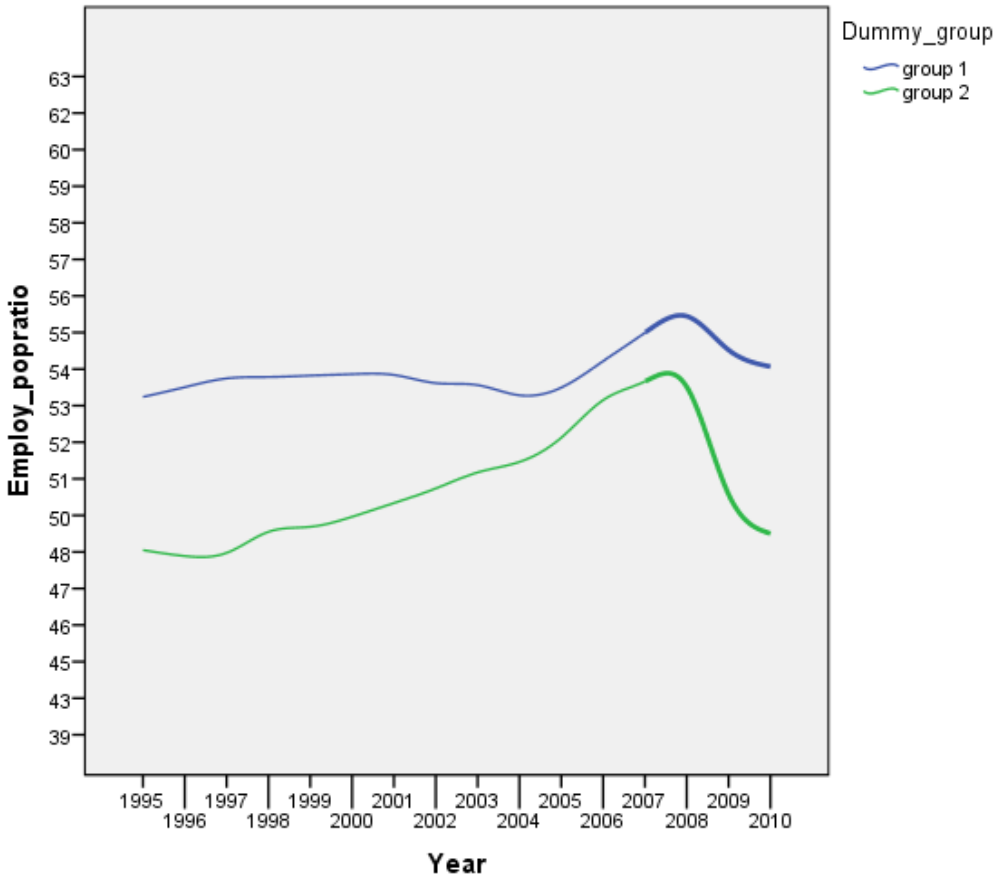
The Gross Domestic Product (GDP) is generated by citizens of a country so it is important to know what percentage of the population is contributing to the GDP. This variable is expressed in a percentage of the total workers above fifteen years. This is the independent variable L in

equation 3.3 of the endogenous growth model, which is known as the amount of employment. The employment ratio is given for the period 1995-2010 in the graph beneath, figure 4.3.

Figure 4.4 Employment to population ratio, 15+, total (%); Group 1 & 2

Source: Data from World Databank and conducted in SPSS.

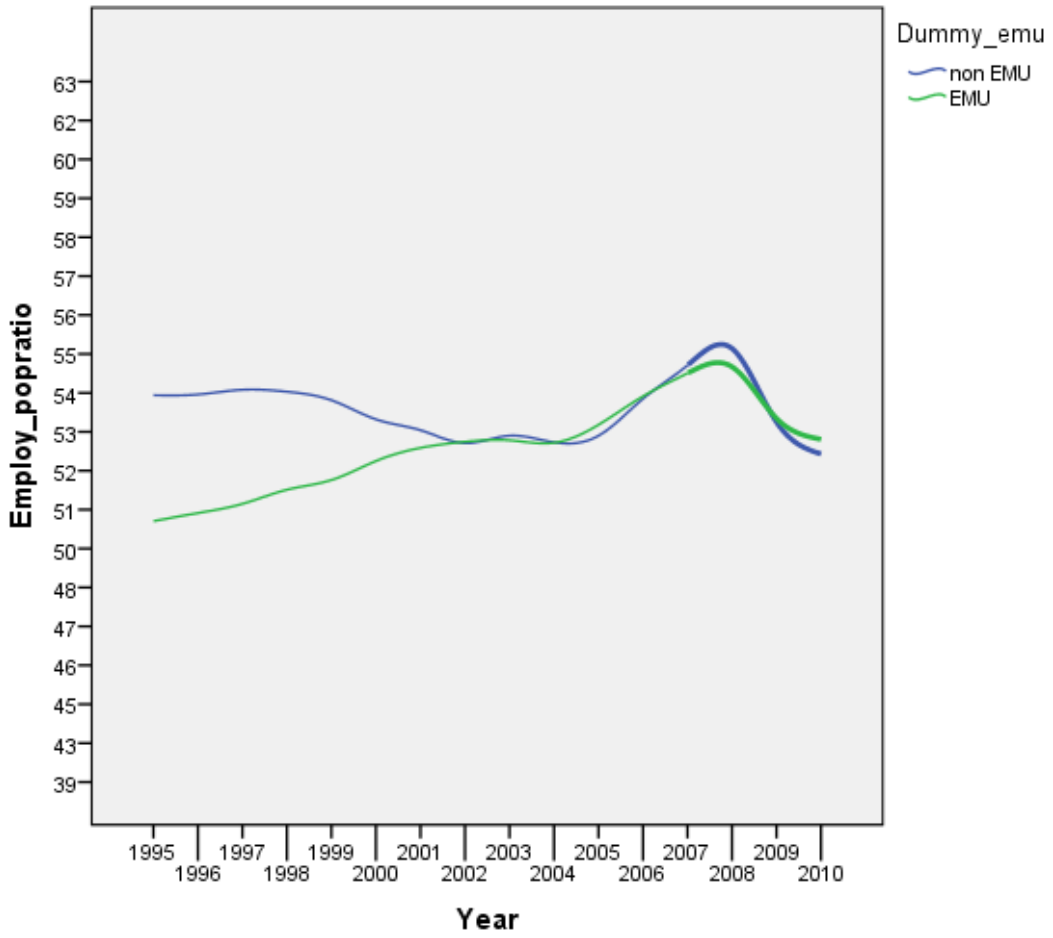
Note: This figure shows the employment to population ratio for workers above fifteen years, male and female in the period 1995 till 2010. From year 1995 till 2005 a convergence between both groups can be seen. The fall from the 2008 can be explained by the period of recession beginning in 2008 and ending 2009. After the recession in year 2010 the ratio is tending to go in an upward direction.



In the period 1995-2005 the employment ratio of both groups differed a lot. The rate of unemployment in the European Union was rising sharply since March 2008, this as a result of the global financial crisis. To name a few numbers, in the period from March 2008 till May 2009 the unemployment increased with 3.7 million making a total of 15.0 million in the EMU. Unemployment rose with 5.4 million people to a total of 21.5 million in the EU (Eurostat, 2012). In figure 4.4 a greater fall in employment can be observed in countries of group two in comparison to group one. This can be explained by the fact that Spain and the Baltic member states were hit most severely by unemployment. There is also a remarkable difference seen in the development of unemployment in the EMU and non EMU countries, figure 4.5. In this figure a convergence in the period 1995-2002 is seen between both EMU and non-EMU countries. Due

to the global financial crisis the non-EMU countries are hit harder by unemployment than the EMU countries. Data of year 2011 were not available.

Figure 4.5 Employment to population ratio, 15+, total (%); EMU & non-EMU countries
Source: Data from World Databank and conducted in SPSS.
Note: This figure shows the employment to population ratio for EMU and non EMU countries in the European Union in the period 1995-2010. A convergence between both groups can be seen from 1995 till 2002. From 2002 onwards a rise in the employment ratio is evident. From year 2008 a fall in the ratio is observable, this is again due to the global financial crisis. Remarkable is that the non EMU members have had a greater fall in employment than the EMU countries.



3. Labor force with tertiary education

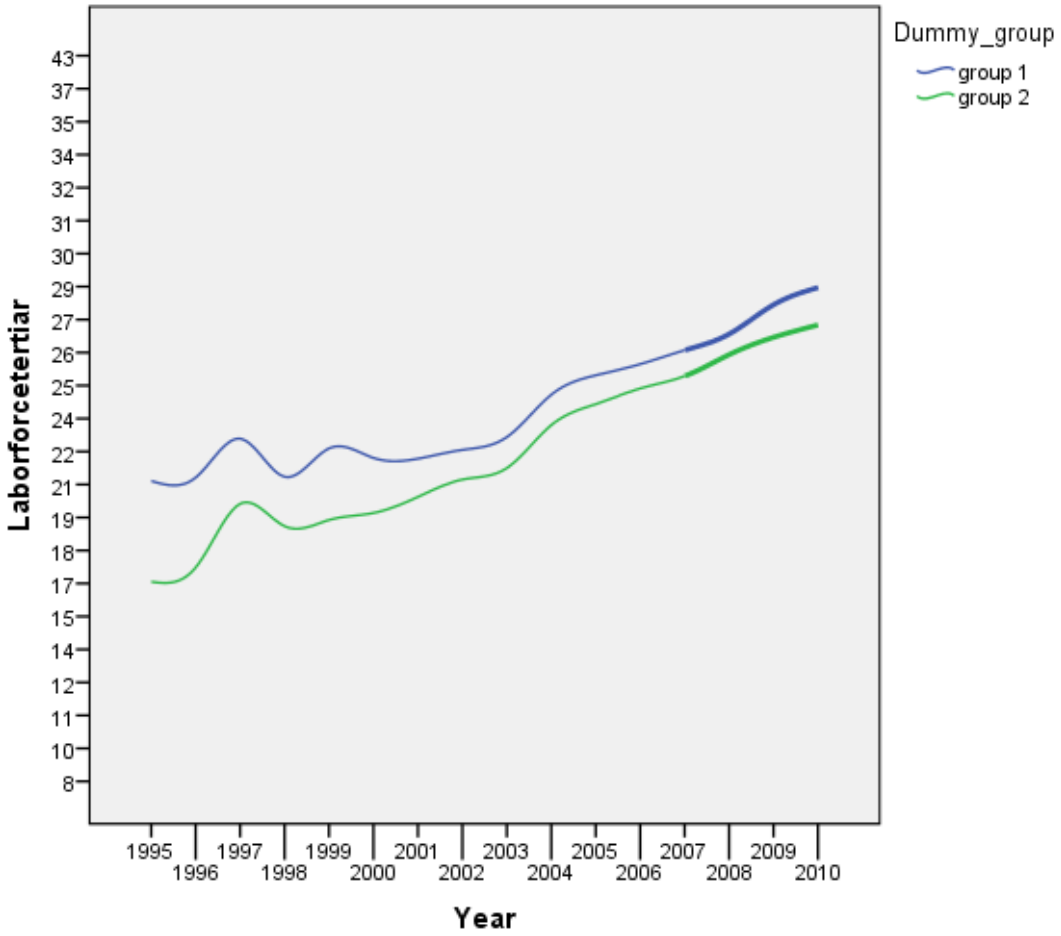
Labor force with tertiary education shows the human capital factor in an economy, which is variable H in the endogenous growth model equation 3.3. This variable is defined as a percentage of total workers in a country, see figure 4.6. Labor force with tertiary education indicates that workers have completed an academic study. Human capital is a very important factor to explain economic growth in the endogenous model. The variable is expressed as ´labor with tertiary education as percentage of total labor force'. Some observations of countries were

not available. For example the data of Bulgaria are missing in the years 1997 and 1998. However the missing observations are not influencing our data set. Furthermore data for year 2011 were not available.

Figure 4.6 Labor force with tertiary education in % of total; Group 1 & 2

Source: Data from the World Databank and conducted in SPSS.

Note: This figure shows the percentage of labor force that had an academic education. In the period from 2003 till 2010 less volatility is seen in the upward going trend. Labor force with tertiary education is higher in group one than in group two. The global financial crisis did not yet have any impact on the labor force with tertiary education.



The effect of the global financial crisis cannot be seen in the graph as yet but will be observable on the long term as academic studies normally have a length of three to four years. A decrease in labor force with tertiary education will most probably be seen from 2012 and onwards as students who started their courses in 2008 will be graduating from this year onwards. Future students will not decide as easy as before to begin an academic study, as a lot of government policies regarding student financing are changed in the EU.

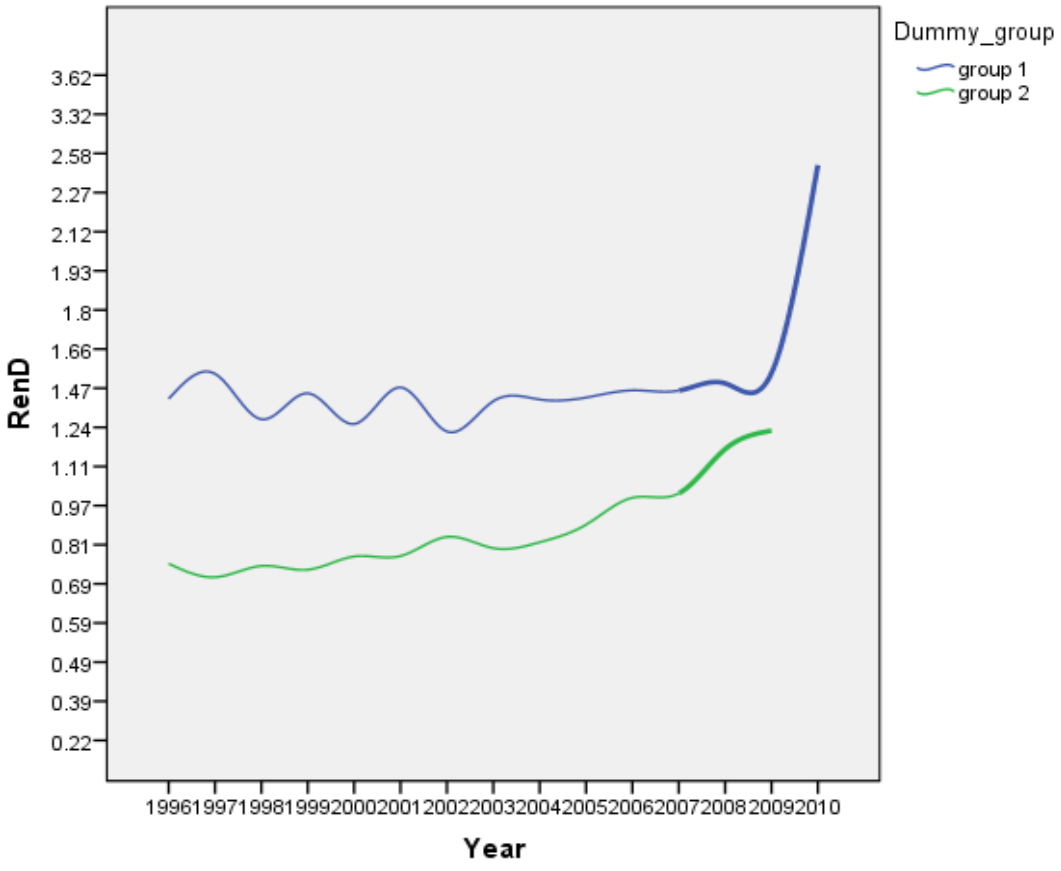
4. Research and Development

Research and development is also an important independent variable and is the innovation factor I in the endogenous model, equation 3.3. Data of R&D are given as percentage of the country's GDP, see figure 4.7. This variable shows the level of innovation which in is inherent to the economic growth of a country. From year 2009 there a sharp rising trend can be seen in group one countries. Data of group one are till year 2010, whereas group two's data was available till year 2009.

Figure 4.7 Research & Development expenditure (% of GDP); Group 1 & 2

Source: Data from the World Databank and conducted in SPSS.

Note: In this figure the expenditure on research & development is shown as percentage of the Gross Domestic Product. Group one's expenditure on R&D is consistently higher than the expenditure of group two. From year 2007 an increase in R&D expenditure can be observed for group two, from 2009 there is a fall in growth. Group one has a sharp rise in its expenditure on R&D from the year 2009.



5. Public spending on education

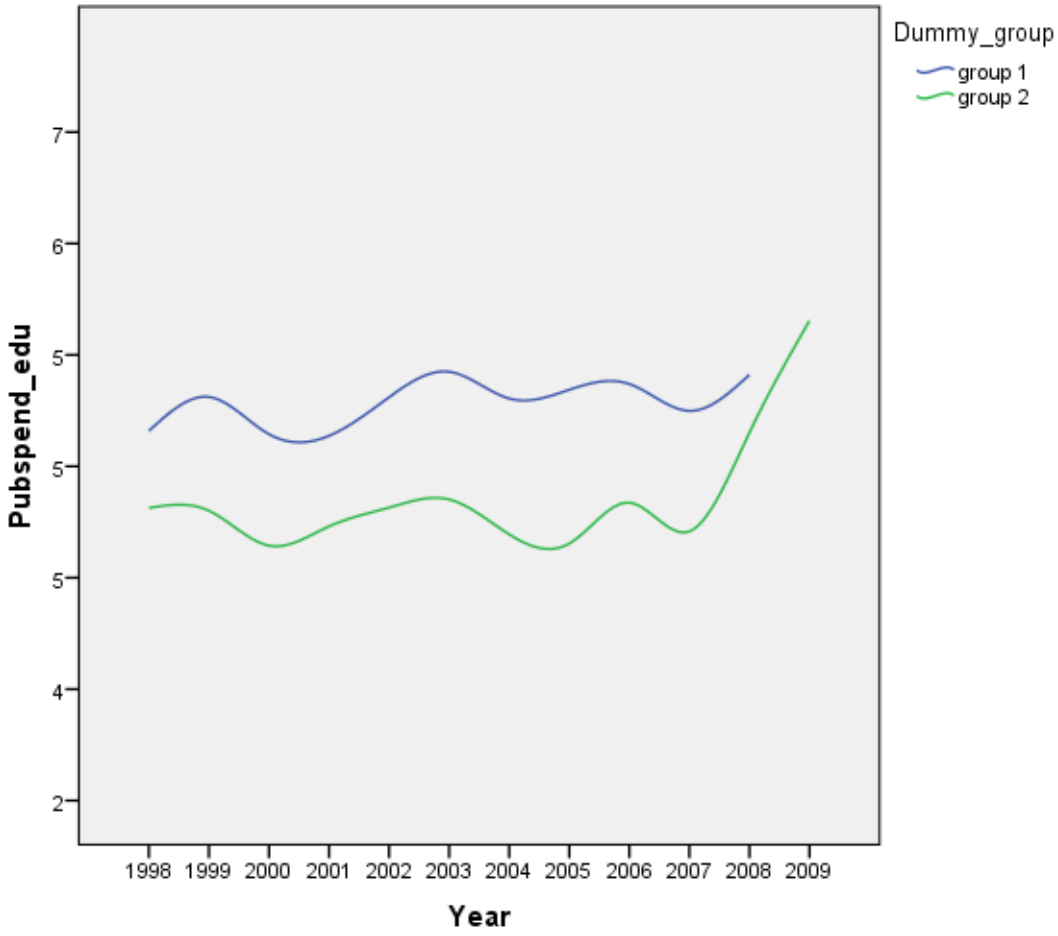
Public spending on education is also a factor that is important for economic growth. Public spending on education is annually expressed as a percentage of the GDP, see figure 4.8. Education is a public good and necessary for all citizens. In chapter 3 this factor is explained as

K^G. A few countries do not have data for each year, but this will not affect our data set. Group one's data is till 2008, while group two's data were available till 2009.

Figure 4.8 Public spending on education (% of GDP); Group 1 & 2

Source: Data from the World Databank and conducted in SPSS.

Note: This figure shows the development of public spending on education as a percentage of the Gross Domestic Product. As in all previous variables this variable also is consistently higher in group one. From the year 2007 an increase in expenditure can be observed in both groups. In group two this growth is much higher than group one.



6. Dummy EMU or not

To test whether members of the EMU more badly off than the other EU members it is important to add the dummy EMU. This will show whether this dummy is significant or not for the financial crisis and the decrease in economic growth in countries of group two. EMU members have dummy number one and non-EMU members have dummy number zero.

7. Dummy financial crisis

The dummy financial crisis is an important variable to see whether there has been a trend break during the period from 1995 till 2011 due to the financial crisis. Years with no financial crisis are indicated with a zero and the period of financial crisis with a one, the financial crisis years are years 2008 and 2009.

8. Dummy Group 1 or 2

This dummy will divide the countries in two parts (table 4.1), namely the northern (group one) and southern countries (group two). Group one is indicated with dummy number zero and group two have dummy number one.

4.4 Methodology

To analyze whether the financial crisis has had a more negative effect on the economic growth of group two we will use data which we described above. This dataset contains all annual figures from 1995 till 2011. The GDP per capita, which is the dependent variable, will be explained by four independent variables: labor force with tertiary education, research and development, public spending on education and employment to population. The dummy which we added are whether a country is a member of the EMU, whether it belongs to group one or two and a dummy to indicate the financial crisis. We will use a panel analysis because we have to look at the behavior of the variables during these fifteen years for all twenty-seven countries. The following regression will be estimated considering the endogenous growth model:

(4.1) GDP per capita = $\alpha + \beta_1$ labor force tertiary education + β_2 R&D + β_3 public spending on education + β_4 employment to population + β_5 Dummy EMU + β_6 Dummy group + β_6 Dummy financial crisis + ε

For the panel analysis we will use the Estimated General Least Squares (EGLS) method. This method minimizes the residuals of the dataset and takes cross-section weights into account to minimize the effect of heteroskedasticity. We use the assumptions of the Gauss-Markov theorem for a most optimal estimator of the regressor. The assumptions of this theorem are: 1. expectations of disturbances are zero ($E_{u\_i}=0$); 2. independent variables are non-random; 3. homoskedasticity; 4. independent variables are linearly independent, no multicollinearity; 5. disturbances are not autocorrelated.

In regression 4.1 we expect variables employment to population, labor force tertiary education, R&D and public spending on education to have a positive effect on the GDP. In this regression public spending can have a negative relation with the GDP as the income of a country falls with government spending. Although on the long term public spending on education should have a positive effect on the GDP. To test whether public spending has a positive relationship with GDP on the long term we will add a lag to regression 4.1. For the optimal lag we have to

look for the lowest Akaike Information Criterion value by using an unrestricted VAR model, see appendix table 7.1.

(4.2) GDP per capita = $\alpha + \beta_1$ labor force tertiary education + β_2 R&D + β_3 public spending on education + β_4 employment to population + β_5 Dummy EMU + β_6 Dummy group + β_7 Dummy financial crisis + public spending on education(-lag) + ε

We also have to test whether there has been a trend break due to the financial crisis. To check for a structural break we will test our dataset with the Chow Test for Parameter Stability, also known as the Chow Break Test. We will have to divide our data into two sub-periods as we indicated earlier: 1995-2007 and 2008-2011, pre- and post- 2008 recession periods. Three following regression are possible:

Model of Chow Break Test

Time period 1995-2007: (4.3) $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon_{1t}$
Time period 2008-2009: (4.4) $Y = \gamma_0 + \gamma_1 X_1 + \gamma_2 X_2 + \gamma_3 X_3 + \gamma_4 X_4 + \varepsilon_{2t}$
Time period 1995-2011: (4.5) $Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \varepsilon_t$

Equation (4.3) and (4.4) shows that the parameters of both periods are different from each other, while equation (4.5) assumes that both periods have the same parameters including the intercept. Regression (4.5) has 241 observations and estimates the relationship between the endogenous independent variables X_x and Y which stands for the GDP per capita. The null hypothesis (H_0) and the alternative hypothesis (Ha) for the Chow Test are:

(4.6) H_0: $\beta_0 = \gamma_0, \beta_1 = \gamma_1, \beta_2 = \gamma_2, \beta_3 = \gamma_3, \beta_4 = \gamma_4$
(4.7) $H\alpha$: $\beta_0 \neq \gamma_0, \beta_1 \neq \gamma_1, \beta_2 \neq \gamma_2, \beta_3 \neq \gamma_3, \beta_4 \neq \gamma_4$

H_0 assumes that there is no difference in intercept or slope coefficients between the two periods which is the same as regression (4.5). H_a assumes that there is a certain difference in between the parameters of both periods and regression (4.5) will not be correct anymore. When H_0 is rejected, a significant structural break will be evident. This will show that the global financial crisis which started in the year 2008 caused a structural change in the trend of the GDP per capita.

When H_0 of the Chow test is rejected and a structural break is evident, we can add a dummy for the financial crisis, indicating whether the crisis had a significant effect on the GDP per capita or not. The dummy with value one indicates a financial crisis year and value zero a non-financial crisis year. When we add the dummy financial crisis we get regression 4.1.

The next step is to test whether the asymmetry in the EU has increased due to the financial crisis. To test this we will use the difference in differences estimation by multiplying the group dummy with the financial crisis dummy. This will allow for different severity of the

crisis on the two groups and the reaction of the endogenous variables to the sudden financial crisis. Our regression will change to:

(4.8) GDP per capita = $\alpha + \beta_1$ labor force tertiary education + β_2 R&D + β_3 public spending on education + β_4 employment to population + β_6Dummy group*Dummy financial crisis (interaction) + ε

The difference-in-differences estimate is

$$\beta_6 = (Y_{group1,t=1} - Y_{group1,t=0}) - (Y_{group\ 2,t=1} - Y_{group2,t=0})$$

where Y stands for the GDP per capita for group one or two and t=1 indicates the financial crisis and t=0 no financial crisis.

4.5 Empirical Results

European Union

After regressing our data in Eviews with the Estimated Generalized Least Squares method we got the following results in Table 4.2. The dependent variable is the GDP per capita explained by the independent variables employment to population, tertiary labor force, public spending on education, research and development, dummy EMU, dummy group and dummy financial crisis.

Table 4.2 Regression Results GDP per capita; EU

Notes: This table contains the results of the regression obtained by using the Estimated Generalized Least Squares Method including cross-section weights in EViews

***indicates a significance at 1% significance level; **at a 5% significance level; *at a 10% level

R^2: R-squared, S.D: Standard Deviation, SSR: Sum Sqaured Residuals, D-W: Durbin Watson Statistic

Variable	Coefficient	Standard Deviation	t-value
Intercept	-3692.64*	2115.73	-1.75
Employment to population	313.54***	32.64	9.60
Tertiary labor force	159.26***	27.88	5.71
Public spending on education	-551.06**	220.08	-2.50
Research & Development	5172.37***	208.79	24.77
Dummy EMU	6015.37***	427.49	14.07
Dummy Group	-1483.21***	548.30	-2.71
Dummy Financial Crisis	-1348.19	2775.31	-0.49

	Weighted	Unweighted		Weighted	Unweighted
R^2	0.896	0.694	**Mean**	42169.00	23635.00
Adjusted R^2	0.893		**S.D.**	29374.91	
S.D. regression	4827.136		**SSR**	5.43E+09	5.59E+09
F-value	287.366		**D-W stat**	0.073	0.027
P(F-statistic)	0.000				

By studying these results we can see that three independent variables have significant positive coefficients at a significance level of one percent. These variables are employment to population, tertiary labor force and research and development. Regarding the variable employment to population it can be said that it is quite predictable because when more people work the GDP per capita will grow as well. This indicates a positive relationship between employment to population and the GDP per capita. The second variable which is also positively related to the GDP per capita is the tertiary labor force. An explanation for this result is that the higher educated an employee is the higher its contribution will be to the GDP, and so also to the GDP per capita. The third independent variable is research and development with also a very high significance for having a positive relationship with the GDP per capita. Research and development contributes to the income of a country. Public spending on education however has a significant negative relationship with the dependent variable at a significance level of five percent. This relationship is negative because the public spending is seen as a cost on short term

which is deducted from the country's income. On the long term this public spending contributes to skilled and educated employees and therefore also to the GDP.

Now looking at the dummies we see that all of them are significant at a significance level of one percent, but not all positively. Dummy EMU is positively related to the GDP per capita, EMU countries had dummy one and non-EMU countries dummy zero. This indicates that countries that are EMU-members have a significant higher contribution to the GDP. This means we cannot reject our H_0 number four that EMU countries have higher GDP per capita.

Dummy Group has a significant negative relationship with the dependent variable. The negative relation can be explained by the numbers which were allocated to the two groups of countries. Group one: northern countries with higher GDP per capita than EU average had dummy number zero and group two: southern countries with a lower GDP per capita than EU average were dummy one. This result shows that countries of group two have a significant lower GDP per capita than the countries of group one and we cannot reject H_0 number three that the GDP per capita of both groups do differ from each other.

Dummy Financial Crisis is negative related with the GDP per capita, but not significantly. For the period 1995-2007 and 2010-2011 the countries had a zero, indicating no financial crisis and for 2008-2009 the dummy was one. This result is indicating that the financial crisis actually has a negative effect on the GDP per capita but not significantly. This result was also seen in graph 4.1, the GDP per capita during that period had a great fall. We reject H_0 number two that the financial crisis did have a significant negative effect on the GDP per capita in the EU.

Looking at the R-squared statistics it can be said that the independent variables are explaining almost (weighted) ninety-one percent of the GDP per capita. The unweighted R-square indicates that the variation in GDP per capita can be explained with our independent variables for almost seventy percent.

Now we will look at the results of regression 4.2 to see whether public spending on education has a positive relationship with the GPD per capita on the long term.

Table 4.3 Regression Results GDP per capita with lags of public spending on education

Notes: This table contains the results of the regression obtained by using the Estimated Generalized Least Squares Method including cross-section weights in EViews

**indicates a significance at 1% significance level; * at a 5% significance level

R^2: R-squared, S.D: Standard Deviation, SSR: Sum Sqaured Residuals, D-W: Durbin Watson Statistic

Variable	Coefficient	Standard Deviation	t-value
Intercept	-6021.25*	2899.54	-2.08
Employment to population	374.83**	38.78	9.67
Tertiary labor force	194.02**	35.11	5.52
Public spending on education	410.59	528.41	0.78
Research & Development	5067.57**	371.98	13.62
Dummy EMU	5615.92**	522.79	10.74
Dummy Group	-641.00	805.05	-0.79
Dummy Financial Crisis	-3011.29	2469.40	-1.22
Public spending education (-3)	-1235.24**	494.62	-2.50

	Weighted	Unweighted		Weighted	Unweighted
R^2	0.90	0.70	**Mean**	42789.27	24594.24
Adjusted R^2	0.90		**S.D.**	32362.37	
SD regression	4734.58		**SSR**	3.54E+09	3.65E+09
F-value	195.75		**D-W stat**	0.097	0.036
P(F-statistic)	0.00				

In table 4.3 we see that all the independent variables except public education has a significant relation with the GDP per capita after adding three lags in public spending on education to the regression. Public spending on education has become positive in relation to the GDP per capita but not significantly. Dummy group however is not significant anymore after adding the lags. Further all the results are the same as in table 4.2 in the sense of significant relationships and the explaining power of the independent variables, R squared.

Difference in differences - Interaction results

Table 4.4 Regression Results GDP per capita with interaction dummy group and financial crisis

Notes: This table contains the results of the regression obtained by using the Estimated Generalized Least Squares Method including cross-section weights in EViews

**indicates a significance at 1% significance level; * at a 5% significance level

R^2: R-squared, S.D: Standard Deviation, SSR: Sum Sqaured Residuals, D-W: Durbin Watson Statistic

Variable	Coefficient	Standard Deviation	t-value
Intercept	-9137.428**	1672.29	-5.46
Employment to population	450.8915**	40.00	11.27
Tertiary labor force	392.9923**	31.93	12.30
Public spending on education	-1373.977**	181.86	-7.55
Research & Development	5439.603**	278.80	19.51
Dummy Group*Dummy FC	-6065.295	5507.42	-1.101

	Weighted	Unweighted		Weighted	Unweighted
R^2	0.87	0.54	**Mean**	42956.86	23635.00
Adjusted R^2	0.87		**S.D.**	37715.57	
SD regression	5308.97		**SSR**	6.62E+09	8.35E+09
F-value	340.24		**D-W stat**	0.13	0.027
P(F-statistic)	0.00				

By studying these results (table 4.4) we can see that all the independent variables are significantly positive related to the GDP per capita except the public spending on education, which is negatively related. By adding the interaction between dummy group and dummy financial crisis we see a negative relationship with the GDP per capita. This means that an EU country that belongs to group two has had a more negative impact due to the financial crisis. This coefficient however is not significant at a significance level of 10%. Hence we have to reject our H_0 number one which assumed that group two countries were hit worse than group one due to the financial crisis.

Economic and Monetary Union

We could not find a significant negative effect for group two countries in the EU, so we will test whether we can find this effect within the EMU. We will test whether the financial crisis has had a more negative effect on the GDP per capita of the periphery EMU countries, including countries like Greece, Portugal and Spain. For this we will divide the EMU countries into two groups known as: periphery EMU and normal EMU. This division is made on the same basis like

the EU countries: the relation to the EU average GDP per capita in 2011 (figure 7.1, appendix). Periphery EMU countries have a GDP per capita below the EU average and the normal EMU are equal to or above the EU average of the GDP per capita.

Table 4.5 Groups normal EMU & periphery EMU

Normal EMU	**Periphery EMU**
The Netherlands	Ireland
Belgium	Greece
Germany	Portugal
France	Italy
Finland	Spain
Luxembourg	Estonia
Austria	Slovak Republic
	Slovenia
	Malta
	Cyprus

Table 4.6 Regression Results GDP per capita for EMU with interaction Dummy financial crisis and EMU periphery

Notes: This table contains the results of the regression obtained by using the Estimated Generalized Least Squares Method including cross-section weights in EViews

**indicates a significance at 1% significance level; * at a 5% significance level

R^2: R-squared, S.D: Standard Deviation, SSR: Sum Sqaured Residuals, D-W: Durbin-Watson Statistics

Variable	**Coefficient**	**Standard Deviation**	**t-value**
Intercept	8759.41**	1753.25	4.99
Employment to population	244.314**	36.23	6.74
Public spending education	-1254.27**	230.40	-5.44
Tertiary labor force	241.06**	28.68	8.41
Research & Development	4071.75**	236.99	17.18
D Financial Crisis*D EMU Periphery	-612.05	549.10	-1.11

	Weighted	**Unweighted**		**Weighted**	**Unweighted**
R^2	0.76	0.40	**Mean**	61498.21	26735.48
Adjusted R^2	0.75		**S.D.**	63358.40	
SD regression	4781.64		**SSR**	3.18E+09	4.03E+09
F-value	89.28		**D-W stat**	0.098	0.019
P(F-statistic)	0.00				

Study of these results in table 4.6 shows just like the EU results (table 4.4) a significant relationship between the four independent variables and the GDP per capita. Employment to population, labor, tertiary labor force and research and development are positively related to the GDP per capita. Public spending on education however is negatively related to the GDP per capita. The interaction between dummy financial crisis and dummy EMU periphery is negative but not significant. This makes us reject hypothesis H_0 nr. 5, about a more negative impact due to the financial crisis on periphery EMU members.

4.6 Summary of the Results

After this empirical study we came to the following results about the relationship between the GDP per capita and northern or southern country in the EU and EMU during the financial crisis period 2008-2009.

- A significantly positive relationship between employment to population ratio is found in all the regressions we have done.
- A significantly positive relationship between labor force tertiary education is found in all the regressions we have done.
- Public spending on tertiary education has a significantly negative relationship with the GDP per capita without including a lag. When adding a lag of three years the variable public spending on tertiary education becomes positive but not significantly leaving this variable of no importance in explaining the GDP per capita.
- Research & Development are of significant positive relevance for the explanation of the GDP per capita in all the regressions.
- Dummy EMU has a significant positive relationship with the GDP per capita, hence we cannot reject H_0 nr. 4.
- Dummy Group has a significant negative effect on the GDP per capita. Hence, the difference in country hypothesis, H_0 nr. 3 cannot to be rejected.
- Dummy Financial Crisis has a negative effect on the GDP per capita, but not significantly hence we have to reject the financial crisis specific hypothesis, H_0 nr. 2.
- The difference in differences estimate for the EU was not significantly negative and is therefore of no importance in explaining the GDP per capita. Hence, the group and financial crisis specific hypothesis, H_0 nr. 1 has to be rejected.
- The difference in difference estimate for EMU was negative but not significant. The hypothesis about periphery EMU countries worse off than normal EMU countries, H_0 nr. 6 has to be rejected.

5. Conclusion

This paper explained the effect of the global financial crisis in the period 2008-2009 on the asymmetry in GDP output in the European Union. For this we first looked at previous studies about convergence and divergence in Europe. In the literature overview we found that convergence after entrance in the EMU was evident. Furthermore a convergence in income and a gradual rise in incomes can be explained after entering the EMU. Several policies have been conducted to realize real convergence between the two asymmetric groups in the EMU. The global financial crisis of 2008-2009 had a deterioration of several EMU countries' GDP as a result.

In this paper we zoomed in on this aspect of the financial crisis. This study tested several hypotheses where of the most important was whether the financial crisis in the period 2008-2009 resulted in an increased asymmetry in the EU and the Eurozone. To test this hypothesis we used the endogenous growth model, which are not the regular macroeconomic factors to explain economic growth. In this paper we used employment to population, tertiary labor force, research and development and public spending on education as explaining variables for the GDP per capita. We also added a few dummy variables to indicate different groups, whether a country is an EMU member and a dummy indicating the financial crisis. The GDP per capita was our dependent variable which we used to detect any convergence or divergence in the period 1995-2011. For these variables we used annual data from the World Databank and EViews 7 and SPSS to conduct all the regressions and graphs.

The first regression showed us that all the independent variables were significantly positive except variable public spending on education. This is explained by the indirect effect of variable on the GDP per capita. After adding three lags to this variable public spending on education turned positive in relation to the GDP per capita, but not significant. The dummies in the regression had several important results. The dummy EMU turned out to be significantly positive at a significance level of one percent. This means that EMU members have significantly higher income than non-EMU members and we cannot reject hypothesis, H_0 nr. 4. Dummy group turned out to be significantly negative. This result shows that northern EU countries have higher GDP per capita, hence we cannot reject hypothesis, H_0 nr. 3. The global financial crisis did not turn out to be significant, it indeed was negative but of no significance. We had to reject our hypothesis that assumed a negative impact on the GDP, H_0 nr. 2.

Our most important hypothesis was tested by doing a difference in differences estimate to see whether the financial crisis created an increased asymmetry between the two groups in the EU. For this estimate we multiplied dummy financial crisis with dummy group. After adding this interaction to the regression we got a not significant negative relationship with the GDP per capita. Concluding that the financial crisis did not resulted in an increased asymmetry between the two EU groups and rejecting hypothesis, H_0 nr. 1.

Now that we did not find any significant negative relationship between the financial crisis and the asymmetry in the EU, we tried to do the same for the EMU. After dividing the EMU on the same basis we added the interaction dummy financial crisis and dummy EMU periphery. However the result was the same as before, negative but no significant increased asymmetry in the EMU. Hence, we have to reject our hypothesis, H_0 nr. 5.

Our conclusion is that till now there has not been a significant increase in the asymmetry in output. This was a study to identify an increased asymmetry in the EU and the EMU due to the financial crisis. However the results for an increased asymmetry were not significant, our graph (figure 4.3) shows that the trend of both groups are diverging, indicating that an increased asymmetry is on its way.

Further research is necessary to measure the asymmetry in output due to the financial crisis, as the side effects of the financial crisis in 2008-2009 are still observable. Another reason is that other crises like the Eurozone crisis are also enhancing asymmetry in the EU and the EMU. What the total effect of all these financial crises will be on the asymmetry can only be measured effectively when the global financial crisis ends.

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7. Appendix

Figure 7.1 Volume index of GDP per capita in Purchasing Power Standards (PPS) is expressed in relation to the European Union (EU 27) average to equal 100.

Source: Eurostat

Note: A country with an index higher than 100 has a higher GDP per capita than the EU average (=group 1) and countries with a index below 100 have a lower GDP per capita than the EU average (=group 2).

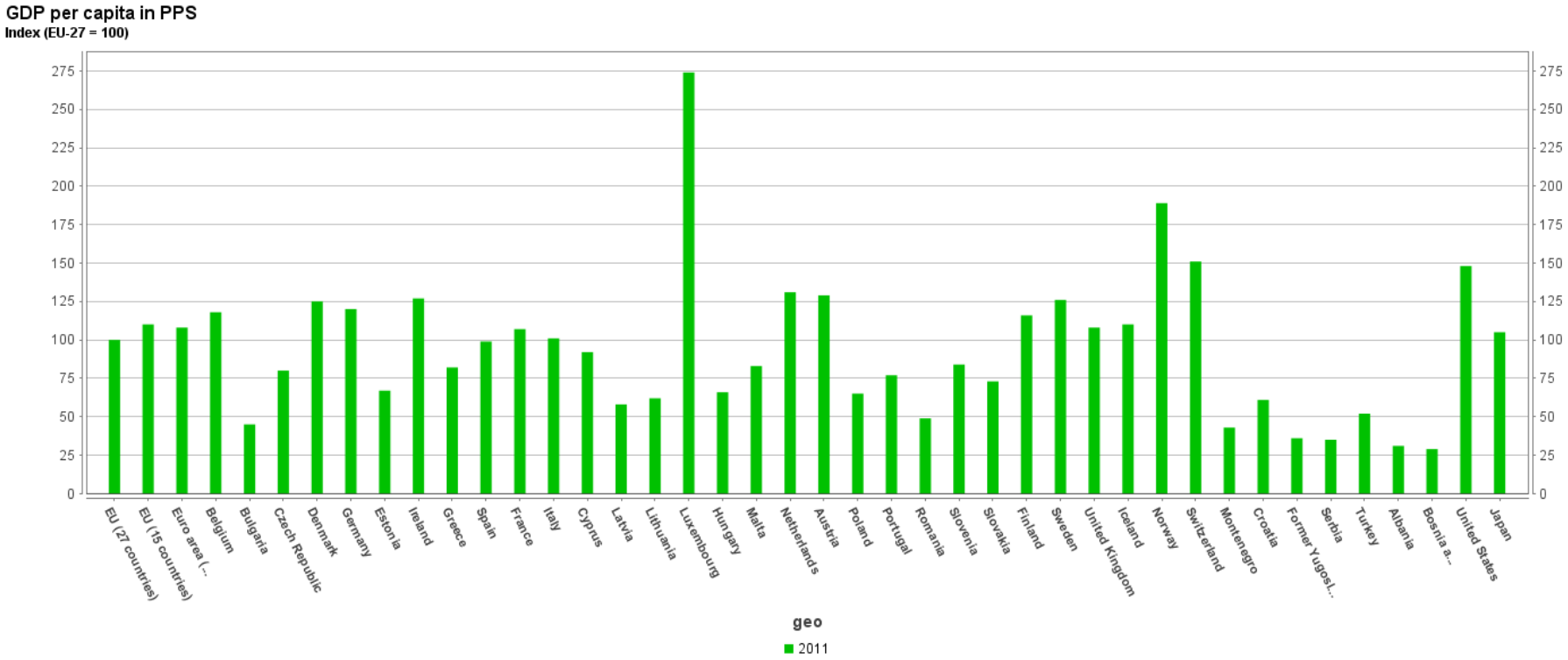

Table 7.1 Optimal Lags with Akaike Information Criterion; VAR

Note: The Akaike Information Criterion was the lowest after adding three lags. Therefore we added three lags in regression 4.2 with results in table 4.3.

Vector Autoregression Estimates (VAR)			
Lags	Public spending on education		
1	0.693		
Standard error	(0.074)		
T-statistics	[9.262]		
2	0.219		
Standard error	(0.088)		
T-statistics	[2.476]		
3	0.046		
Standard error	(0.073)		
T-statistics	[0.627]		
C	0.247		
Standard error	(0.112)		
T-statistics	[2.194]		
R^2	0.93	Log likelihood	-29.33
Adjusted R^2	0.93	Akaike (AIC)	**0.41**
SSR	13.57	Schwarz (SC)	0.49
S.E. equation	0.29	Mean dependent	5.34
F-value	714.17	S.D. dependent	1.11