NORGES HANDELSHØYSKOLE
Bergen, spring 2012

The Financial and Economic Situation in the Eurozone

Is the Eurozone an Optimal Currency Area?

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MASTER THESIS

Master of Science in Economics and Business Administration

major in Financial Economics

NORGES HANDELSHØYSKOLE

Executive summary

This thesis examines whether the Eurozone forms an optimal currency area by analyzing each of the 17 member countries' contribution to increased wealth for the Eurozone. Furthermore, how the member countries have been affected by losing their national monetary policy when entering the Eurozone, in form of increased volatility in inflation and output, unemployment and fiscal situation.

The results of the analysis suggest that without Greece, the remaining member countries would have formed a better currency area, and that Ireland is the only country that tends to have net costs from the introduction of the euro and the loss of its national monetary policy. The analysis is followed by a brief discussion of different scenarios for the Eurozone; a break-up, no-change and an adapt-to-succeed view, which includes suggestions of measures of structural improvements for the Eurozone, e.g. centralized budgets with Eurobonds or restructuring the Eurozone into a complete political union.

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Preface

This thesis is conducted as a finishing part of my Master of Science in Economics and Business Administration, with major in Financial Economics at the Norwegian School of Economics (NHH).

The main purpose of this thesis will be to answer the following problem; does the Eurozone form an optimal currency area. I intend have a broad perspective at the different aspects of this matter, and to gather information to get a full view of the situation and what is up for discussion as possible measures. The Eurozone was created on basis of political reasons, and economic matters were de-emphasized, I want to look at economic consequences of the creation of the Eurozone and the introduction of the euro.

The motivation behind my choice of topic is that I wanted to write my master thesis about a subject with high degree of actuality, and use macroeconomic theories to answer some of the problems that are up for discussion. The problems that have aroused from the loss of national monetary policy have been severe, and the Eurozone is now at a cross-road which got me thinking; what happens if the Eurozone breaks up, or what are the costs if there are not any major changes in the system. It must be a middle way, some obvious measures to stabilize the national economies in crisis.

I wish to thank my advisor, Karl Rolf Pedersen, for his feedback.

Bergen, 18 June 2012

Siri Olset Øvrebø

1. Introduction

The recent years have been turbulent for the Eurozone as a monetary union, and its whole structure is in danger of a break-down. The global financial crisis in 2008 led to eruptions of more crises in the Eurozone; a fiscal crisis in Greece, a banking crisis that originated from Ireland and spread to the Eurozone, a competitive crisis and a major sovereign debt crisis (Bergsteen and Kirkegaard, 2012).

In the first years after introducing the common currency, the euro, positive effects can be located in employment, inflation, financial stability etc. Candidate countries noticed all these positive effects, and assumed that their economy would become more stable if they also joined. It became so important for some countries to join the European Monetary Union that even though they did not meet the criteria, they forged their budgets to get accepted (part 2.1). That was when the problems started to get serious.

1.1 Presentation of the problem

The years after the introduction of the euro can be characterized by that fact that the euro was a success, the effects from a common currency was positive until financial markets became unstable and consequences of the loss of national monetary policy were proved to be severe. There have been many discussions lately about the Eurozone, if some countries are better off seceding from the union, in addition to discussions about many the measures that can be conducted to improve the structure and dynamics of the union. I chose my master thesis topic after reading some of these articles, and I have formulated the following problem:

Does the Eurozone, as it is today, form an optimal currency area?

I do not intend to answer this problem explicitly, but to sum up the most important pointers in the thesis which leaves an open interpretation to the reader.

To be able to answer this problem, it is important to know what characterizes an optimal currency area. Paul de Grauwe states that the Eurozone form an optimal currency area when all member countries increase wealth, and the benefits from being in a currency union exceeds the costs (2009). A country should only join the currency union if both the country and the union as a whole will gain from its membership.

There are a lot of definitions of wealth, and they usually consist of the same factors such as; financial wealth associated with profits, welfare in which legal institutions lead to the feeling of being secure, health organs, happiness and prosperity; standard of living (Dictionary.com, 2012).

If the Eurozone forms an optimal currency area, where all countries benefit from their memberships, a break-up of the Eurozone would be out of the question, and measures should be made to improve the structure of the heavily debated monetary union. On the other hand, if the Eurozone does not form an optimal currency area, it is important to locate the country/countries in question, and whether or not it/they affect the currency area in a way that its costs exceed the benefits to be able to find the best possible solution.

1.2 The angle of the thesis

I intend to address the problems in the Eurozone by width and not depth because I believe that getting an impression of the bigger picture leads to finding the best possible solutions.

1.3 The motivation behind the creation of the Eurozone

The European Union was created with the vision of free flow of capital goods, services, labor and capital. The founders of EU tried to create a single market in Europe, but due to the monetary turmoil in Europe, the exchange rates went in different directions, which is contradictable to a single market. The only way to create a single market in Europe was to create a common currency, and furthermore the ECU was created which turned out to be a success (ECB, 2009). The main idea behind the euro was to take the ECU to a further level, and create a currency which would be used by all the EU members.

1.4 Members of the European Union

There are 27 member countries in the EU (European Union, n.d.). Belgium, France, Germany, Italy, Luxembourg and Netherlands formed the EU in 1952. Denmark, Ireland and United Kingdom became members in 1973. Greece became an EU member in 1981, and Portugal and Spain in 1986. In 1995 Austria, Finland and Sweden joined the EU. Furthermore, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia became members in 2004, and Bulgaria and Romania in 2007. Candidate countries in 2012 are Croatia, FYR of Macedonia, Iceland, Montenegro, Serbia, and Turkey.

1.5 Members of the European Monetary Union

There are 17 countries that are members of the European Monetary Union, also called the Eurozone. There were originally 11 member countries when the Maastricht Treaty was signed in 1991 (EC Commission, 2012); Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, Netherlands, Austria, Portugal and Finland. Other countries has later fulfilled the criteria and joined the union; Greece (2001), Slovenia (2007), Cyprus (2008), Malta (2008), Slovakia (2009) and Estonia (2011).

1.6 Structure of the thesis

Part 2 will present important characteristics, facts and developments in the European Monetary Union that will be important for the rest of the thesis. Part 3 will present the theory of optimal currency areas. Part 4 will analyze the problem and starts by an evaluation of the management of the monetary and fiscal policy by the ECB for the Eurozone as a whole. Furthermore, the individual countries are analyzed in relation to net benefits from the theory of optimal currency areas, and also the effects for each member country from being in a monetary union and losing its national monetary policy is analyzed. Part 5 presents the results which sum up the analysis. There will be a discussion of possible measures in part 6, and part 7 concludes.

2. Characteristics and developments in the Eurozone

In this section, I am going to write about characteristics and developments that are relevant for the rest of my thesis; criteria to join EMU, the Euro and the European Central Bank (ECB) and monetary and fiscal policy in the Eurozone. This section will partly be based on Paul de Grauwe's; economics of monetary union (2009).

2.1 Criteria to join EMU

The criteria to join the monetary union in Europe are stated in the Maastricht Treaty, which was signed by the leaders of the EU, in the Dutch city Maastricht, in December 1991. The purpose of the treaty was to prepare for a monetary union by deciding on criteria that had to be fulfilled before a country could obtain membership, and to implement elements that would eventually facilitate for a political union (citizenship and common foreign and internal affairs policy) (European Union, n.d.). There are two principals that were stated in the treaty (Euro Treaties, 1992); (1) a gradual transition into a monetary union and (2) the candidate countries have to satisfy the following convergence criteria;

- Inflation; no higher than 1,5% more than the average of the three lowest inflation rates among the EU countries
- Long term interest rate; no higher than 2% more than the average in three low-inflation countries
- Exchange rate; no devaluation of national currency two years prior to membership, membership in the Exchange Rate Mechanism (ERM)
- Government budget deficit; must not exceed 3% of GDP
- Government debt; must not exceed 60% of GDP

In May 1998, the 11 countries stated above more or less satisfied these criteria; Greece did not at that time, but did so in 2001 and introduced the euro in January 1, 2002. Denmark, Sweden and United Kingdom decided to stay out of the monetary union even though they fulfilled the criteria (De Grauwe, 2009). UK has the right to opt out, and Denmark decided to let the entry decision be the case of a national referendum. Sweden deliberately refused to enter the exchange rate mechanism, and thereby failed to satisfy one of the entry conditions.

The convergence requirements are subject to ensure common goals, e.g. low inflation, and for countries to prove their worthiness, of a membership in the union, everyone waited 10 years. High debt and budget deficits can cause risk of high inflation, which will increase costs for the union as a whole. To prevent countries from manipulating their exchange rate, they could not change it within two years prior to a potential membership in the union.

Some of the Eurozone candidates did not satisfy one or more of the criteria, e.g. the debt levels were over 100% in Italy and Greece. Even Germany did not satisfy the budget rules; the debt level was over 60% and increasing. The Treaty was ignored due to strong political will to proceed with the implementation of a common currency.

2.2 Euro and the financial markets

The monetary union started functioning from January 1, 1999, when the European Central bank took over control of monetary decisions from the national central banks, and the term euro came to its existence. The national currencies were still in use in its respective country, and the exchange rates to the euro were irrevocably fixed. The euro in form of banknotes and coins was introduced January 1, 2002, and the national currencies were taken out of circulation.

A common currency is most advantageous when there is full integration in different markets between countries. For the euro to function as an insurance mechanism in the presence of asymmetric shocks, it is important that the financial markets between countries are integrated. When the financial markets are fully integrated, the effects of asymmetric shocks will be less severe due to the fact that investors from one country invest in financial assets in other countries, and there will be a risk-sharing mechanism due to diversified investors and markets. On the road to fully integrated financial markets, an important obstacle has been eliminated; the exchange risk, but more are still in the way, e.g. differences in legal systems and country associated risk.

Some markets are virtually fully integrated; the interbank markets and the government bond markets. Other markets integrate slowly; the corporate bond market, equity markets and the banking sector. The main obstacles for integration in these markets are differences in legal and regulatory systems like accounting and taxation rules, corporate governance practices and the fact that banks are regulated differently between national territories.

One goal when creating the euro was for it to become an international currency, and now the euro reserve holdings by central banks make up more than 25%. For the euro to become international, the equity and bond markets need to grow. The financial size matters because it influences the liquidity of financial assets, and it gives a competitive advantage when the diversity and choice of investment opportunities are increased. Another factor for the euro to become an international currency is monetary and financial stability at home.

2.3 The European Central Bank

With a common currency in place, the Eurozone also needed a common central bank, and the European Central Bank (ECB) was introduced with the euro in 1999. The role as a decision maker of monetary and exchange rate policy shifted from the national central banks to the European Central Bank (Scheller, 2004). The national central banks most important responsibilities are to implement decisions taken by ECB, reassure financial stability in its country, and banking supervision.

ECB follows a central banking model called "the German model" (De Grauwe, 2009), another such model is the Anglo-French model. The main features of the German model are that price stability is the primary objective and the central bank is politically independent. Objectives like output and employment can only be pursued when not interfering with price stability.

2.3.1 The institutional framework of ECB

The national central banks and the ECB are part of the Eurosystem. ECB is often used as a synonym for the Eurosystem, and it is important to know the difference.

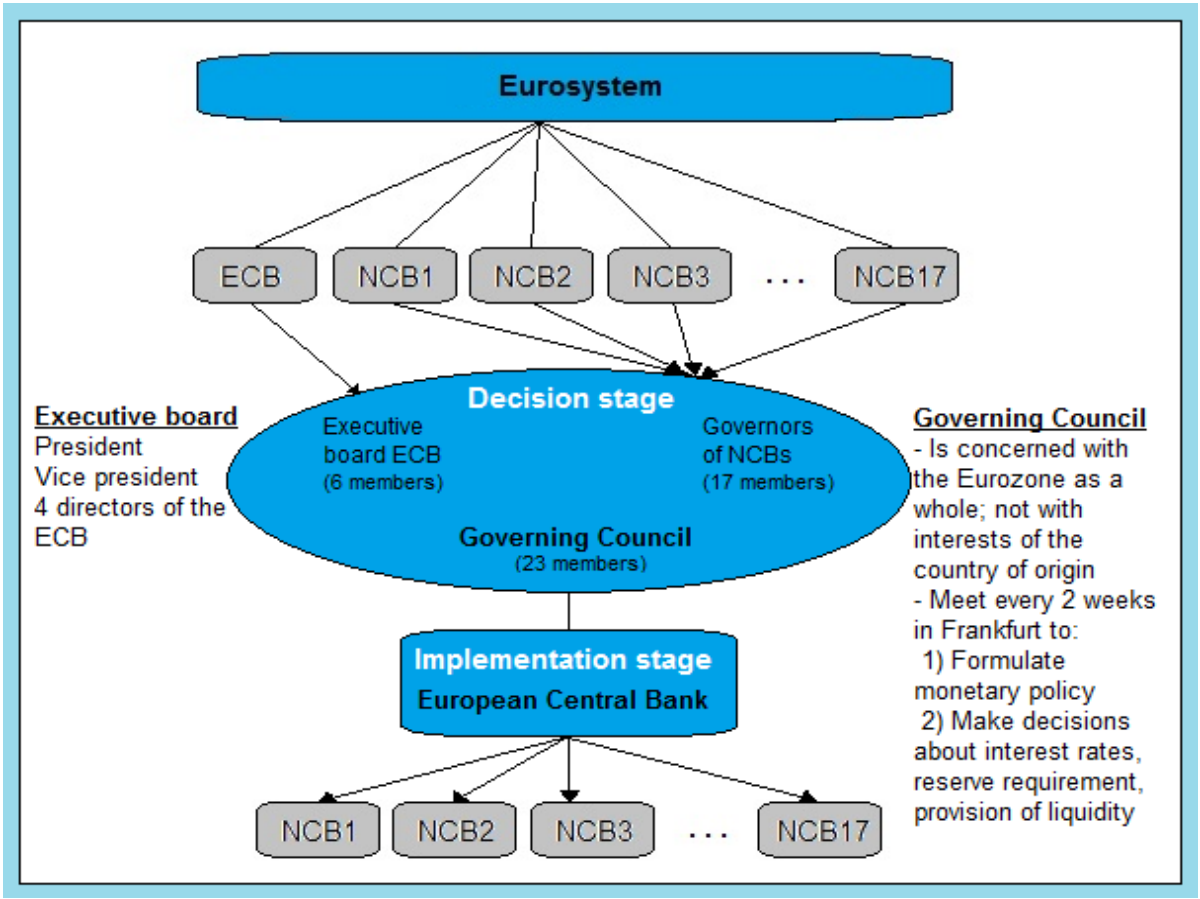

Figure 1: The Eurosystem (Gerdesmeier et al., 2009)

Figure 1 illustrates how the Eurosystem consists of ECB and all the national central banks in the member countries. The representatives, one from each national central bank and the executive board of 6, make the Governing Council. The Governing Council formulates monetary policy and makes decisions about interest rates, reserve requirement and provision of liquidity based on the concerns of the Eurozone as a whole. The European Central Bank delegates the implementation of the monetary policy to each national bank. Further in this thesis, ECB will be used as a synonym for the Eurosystem.

2.3.2 ECB as independent, accountable and transparent

The ECB is designed to be *independent* and protected by political interference, which is important to maintain price stability. The Eurosystem (ECB and NCB's) are not allowed to be influenced by any government of an EU member state, and are prohibited to lend money to any public sector entity (ECB, n.d.). If the ECB was to be political dependent, politicians may have used the monetary policy to win elections by promising stable budgets by printing money, but when printing money, prices will increase and lead to price instability.

An independent institution like the ECB should be *accountable* for the conduct of its policies to citizens and representatives. The ECB sees itself as accountable due to the fact that the representatives go beyond their obligations of reporting, they have monthly reports in the "Monthly Bulletin" instead of quarterly reports (ECB, n.d.). However, there is no one to exert control over the central banks performance due to the absence of a political union. The objectives in the Maastricht Treaty are vague when it comes to responsibilities next to price stability, and there is a lack of effective supervision of banks (De Grauwe, 2009).

Transparency is achieved by effective communication and is considered crucial by most central banks. The definition of transparency stated by the ECB is; "the central bank provides the general public and the markets with all relevant information on its strategy, assessments and policy decisions as well as its procedures in an open, clear and timely manner" (ECB, n.d.). With a transparent monetary policy, the central bank can obtain credibility among the public to exert the policy more effectively by making consequences more predictable. When publishing information which is credible and consistent, market participants create expectations about the future, and expectations have a tendency to become self-fulfilling, which is intended by the central bank.

2.4 Monetary policy in the Eurozone

From the Maastricht Treaty it has been interpreted that price stability is the main objective for policymaking. The definition of price stability in the Eurozone is stated in the ECB Monthly Bulletin, January 1999; "an annual increase in the Harmonized Index of Consumer Prices (HICP) of below 2% can be considered as being compatible with this primary objective of monetary policy" (ECB, 1999, p.9). Later, in May 2003, this definition was redefined at to include the terms "below, but close to 2%" and "medium term" (ECB, 2003, p.5). The strategy to achieve this target is proposed in a "two-pillar" approach; (a) the monetary approach and (b) the identification of numbers of variables that provide important information to forecast future inflation. In 2003, this first-pillar was de-emphasized, and the role of money became less prominent in the monetary decisions, it has since then been used as a cross-check. This decision was made due to the fact that money growth had almost no power predicting inflation; M3 exceeded the target of 4,5% every year, but inflation remained stable.

Price stability was emphasized to financial stability because it was seen as a way to minimize the risk of financial instability. In addition, the supervisors and regulators are seen as responsible for maintaining financial stability.

(a) The monetary approach based on the quantity theory equation;

Equation 2.1 $m + v = p + y$

where m is the money stock, v is the velocity of money, p is the price level, and y is real GDP, all terms are in logarithms. If we transform this equation into first difference, the numbers can approximately be interpreted as growth rates (the change from one year to another);

Equation 2.2 $\Delta m = \Delta p + \Delta y - \Delta v$

The ECB made forecasts for the future trend growth of GDP and velocity of respectively 2% and –0.5% per annum (ECB, 1999, p.9). With an inflation target of close to 2%, the money stock (broad monetary aggregate, M3) should not increase by more than 4.5% per annum. This can be seen as a 'reference value' of the money stock growth. Note that this value can change if GDP and/or velocity changes.

ECB use money stock as an intermediate target to reach the ultimate target of inflation, below, but close to 2%. In comparison, inflation forecast is used by some countries as intermediate

target to achieve the ultimate target of inflation. In both approaches, the interest rate is used as an instrument to control the intermediate target.

(b) Forecasting future inflation

A number of variables have an influence on future inflation, these are carefully watched by the ECB so that measures can be taken at an early stage to steer actual inflation towards the inflation target of 2%; wages, exchange rate, bond prices, yield curve, measures of real activity, fiscal policy indicators, price and cost indices and business and consumer surveys (ECB, 1999). When one of these indicators signals a threat to future price stability, ECB can use short-term interest rates and/or reduce liquidity in the system to prevent the inflation from deviating from the target.

Criticism to this approach is that ECB narrows its responsibilities by having only one target; price stability. It is not always a trade-off between output and price level stabilization when shocks occur as illustrated in the figure 2.

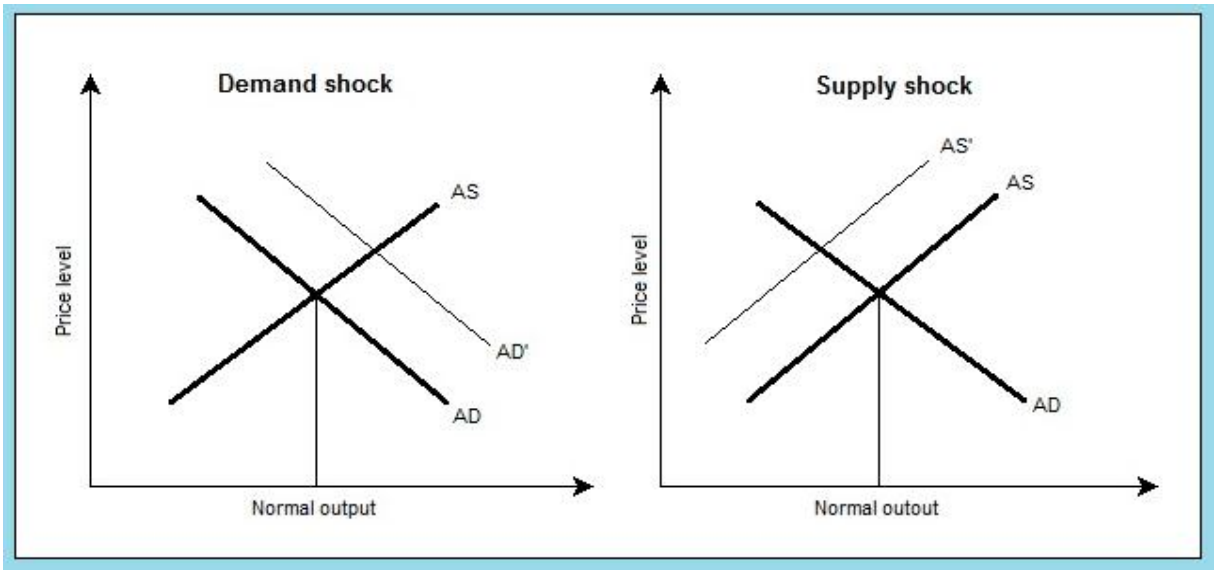

Figure 2: Effects of demand and supply shocks (De Grauwe, 2009)

When there is a demand shock in the economy, both output and price level will increase, and when taking measures to correct the increasing price level, output will also be corrected. There is no trade-off between price and output stabilization when shocks in aggregate demand occur. A demand shock is in most cases temporary. On the other hand, when there is a supply shock, the situation will be handled differently. There will be a trade-off between output level and price level, and due to the fact that ECB only have one target; inflation, monetary policy

will always be set to correct the price level, which will lead to an even lower level of output after correcting for the negative supply shock. A supply shock often tends to be permanent, and can be the case of technological developments.

The ECB monetary policy can be characterized as strict inflation targeting and is illustrated in figure 3. The ECB has opened up for some output stabilization after the definition of monetary policy was revised to include the medium run term, it does not have to react to change in inflation immediately.

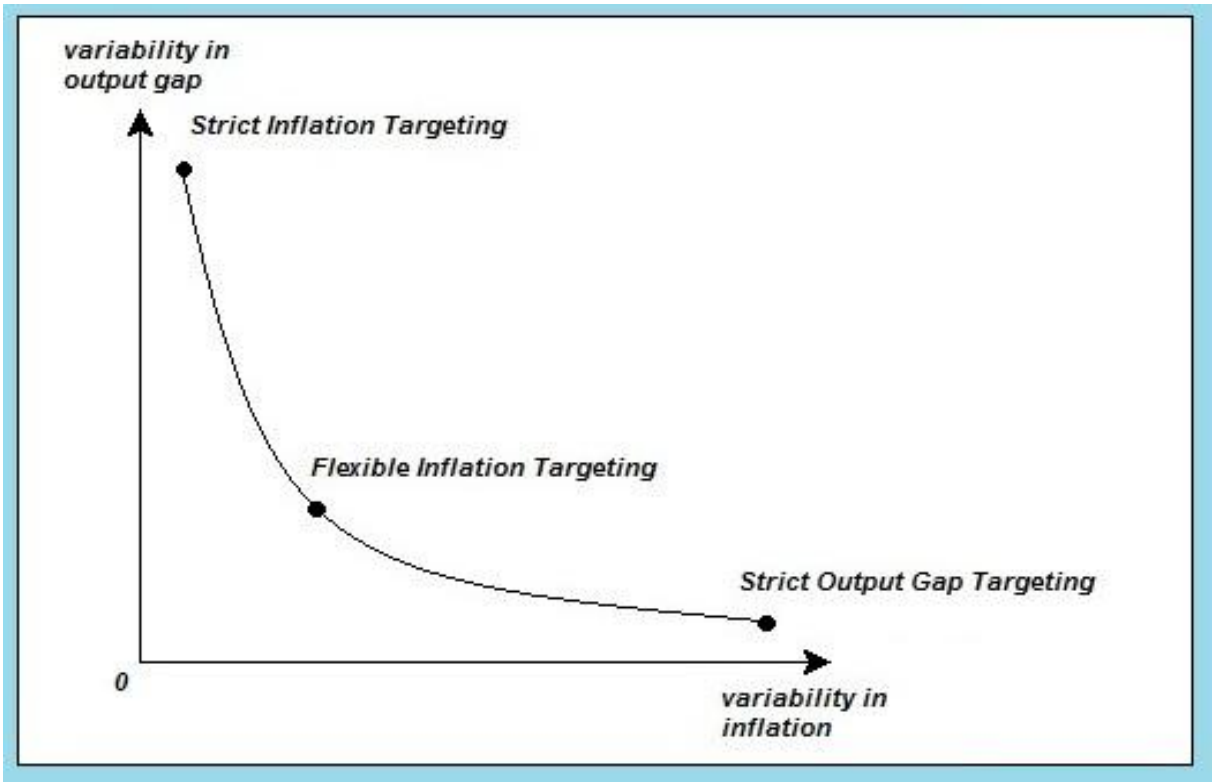

Figure 3: Trade-off between inflation and output gap (Steigum, 2004)

A strict inflation target involves low variability in inflation traded with high variability in output, in the case of a supply shock. Only considering price stability, monetary policy can contribute to fuel a boom created by technological developments, or fail to see ominous developments in asset markets created by 'animal spirit'[1] (Keynes, 1936), in this case they do nothing. Strict inflation targeting cannot be maintained because it can conflict with financial stability.

[1] human emotion that drives consumer confidence and trust, e.g. hope and fear

2.4.1 Monitoring financial instability instead of price stability?

In macroeconomic models, developed with assumptions of perfect capital markets, informed and rational agents and no transfer costs, price stability implies financial stability. These models, along with the fact that financial stability is difficult to monitor, makes the decision to focus solely on price stability easy for policymakers.

In fact, when monitoring financial instability instead of financial stability, the monetary authorities can obtain important information about developments that can threaten financial stability by two variables; asset prices and credit growth. "Financial instability is a situation in which: a) some important set of financial asset prices seem to have diverged sharply from fundamentals; and/or b) market functioning and credit availability, domestically and perhaps internationally, have been significantly distorted; with the result that c) aggregate spending deviates (or is likely to deviate) significantly from the economy's ability to produce" (Ferguson, 2002).

2.4.2 Monetary policy instruments in the Eurozone

The Eurosystem has three sets of instruments in the operational framework to control monetary policy in the Eurozone; open market operations, standing facilities and minimum reserves (ECB, n.d).

Open market operations increase or reduce money market liquidity by selling and buying securities by transactions using tenders. This illustrates the role of the interest rate as an instrument, which is set to be applied on the main refinancing operations, the repo rate. The rate currently used is a fixed-rate set by the Governing Council. The purposes of the open market operations are to signal the ECB's policy stance, manage the liquidity situation in the Eurozone and control interest rates (ECB, n.d). The developments in variable and fixed repo rates from 1999 to 2011 are shown in figure 4.

Standing facilities provide and absorb overnight liquidity to banks and are managed by the NCB's through (1) the *marginal lending facility,* where the marginal lending rate is typically 1% higher than the repo rate, and (2) the marginal deposit facility, where the marginal deposit rate is typically 1% lower than the repo rate. The lending and deposit rates are fixed by the Governing Council, and the developments in these rates are also shown in figure 4.

The developments in fixed/variable repo-rates, marginal lending rate and marginal deposit rate from January 1999 to December 2011;

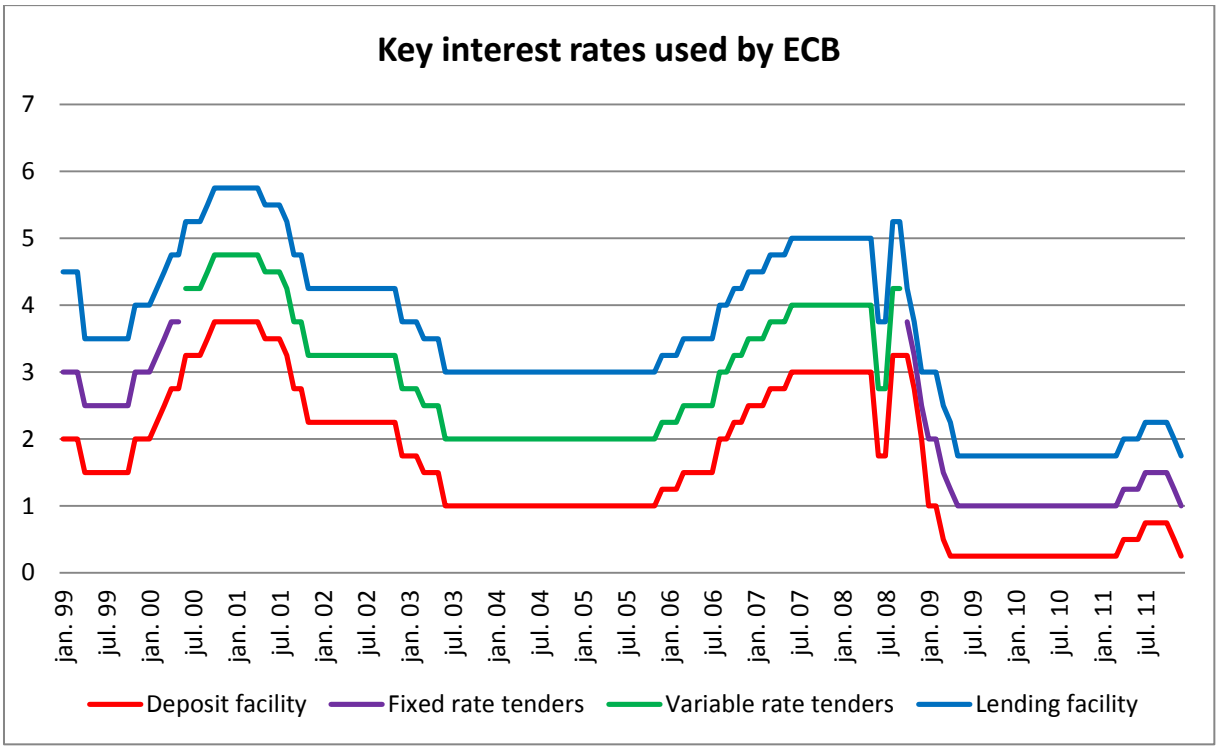

Figure 4: Key interest rates used by ECB (ECB, n.d.)

Minimum reserves affect money market conditions by changing reserve requirements, which create shortage/increase liquidity and control the money stock. This instrument is not used in monetary policy, but to smooth short-term interest rates. It can be a useful instrument to control bank credit when it is expanding too quickly.

2.5 Fiscal policy in the Eurozone

Fiscal policy can be used to achieve financial stability when the government uses the tools of tax change, change in government spending, and introduction to new legislations that can change the reaction of participants in the economy, but these are not flexible instruments. It takes time to achieve results when using fiscal policy, and when it is used once, it will take many years until it can be used again. When using fiscal policy, a decline in public spending tends to be more effective in terms of generating surplus, in oppose to a rise in the tax rates (Semmler et al., 2005).

In the Eurozone, monetary policy is centralized to be managed by the Eurosystem and fiscal policy is decentralized to be managed by each member state. Fiscal policy does not have that direct effect that monetary policy has, and is less effective when it comes to stabilization, and in particular for countries with high levels of government debt and large budget deficits. The efficiency of the monetary policy can be affected by the fiscal policy's long-term conditions for economic growth. When fiscal policy is in the hands of the government in each country, there is a possibility that this power may be used for political benefits, and not economic benefits, by politicians to win elections.

The Maastricht Treaty gives explicit quantitative guidelines for management of national budgets; government debt cannot exceed 60% of GDP and budget deficit over 3% can get a country fined (up to 0,5% of GDP), and whether or not these strict rule generates more or less discipline is discussed in part 6 of this thesis.

2.5.1 The Stability and Growth Pact

The purpose of the stability and growth pact is to ensure stability in government debt and budgets. It consists of a surveillance part; a warning system, and a dissuasive part, when surveillance does not give results. The main features of the Stability and Growth Pact can be summarized the following way (De Grauwe, 2009);

Surveillance: Members of the Eurozone have to submit Stability Programs which focuses on public finance and aims at bringing about a budgetary position close to balance or surplus; this program is examined and monitored by the Council.

Dissuasive: A budget deficit is excessive if it exceeds the reference value of 3% of GDP. When a country has a budget deficit over 3%, they can get fined by 0,5% of GDP. There are

two exceptions to this rule; "(i) it results from an unusual event outside the control of the member state (natural disaster), (ii) it results from a severe economic downturn (decline in GDP over 2% annual)" (Cabral, 2001). The Council decides whether it is an excessive deficit or not. The member country has 6 months to correct this before it gets fined. If the Council decides to impose a sanction, the country involved will have to make a non-interest bearing deposit, and if the excessive deficit is not corrected within two years, the deposit turns into a fine.

The reason for these direct and strict guidelines is that when a country has increasing debt and deficit, the Eurozone as a whole has to pay higher interest rates. It is fair that the country gets punished and has to pay a fine.

SGP has gained a lot of criticism due to the lack of flexibility of national budgetary policies, and was later reformed into being more flexible and give more emphasis to debt levels in evaluating the member countries' fiscal position.

2.5.2 Debt dynamics

An increase in real government debt is a common characteristic after a severe financial crisis (Reinhart and Rogoff, 2008). The increase in debt is caused by a collapse in tax revenues, in addition to an increase in government spending to ease the downturn in a deep and long recession. This increase in debt can be observed among many of the Eurozone countries after the financial crisis, and it has been discussed whether the debt levels are sustainable or not. The debt dynamic theory presented in this paragraph is based on Helmut Gärtner (2006) and lecture notes from NHH by Rolf Jens Brunstad (2012).

b: government debt ratio in percent of GDP
g: government spending in percent of GDP
t: tax income in percent of GDP
μm: money financed deficit in percent of GDP
y: growth in real GDP
r: government real interest rate on debt

The nominal increase in government debt can be written as (see appendix A for full derivation);

Equation 2.4 $\Delta b = g - t - \mu m - (y - r)b$

When looking at the equation graphically, the first part of the equation (g – t – μm) is the constant and the latter (y – r) is the slope, and debt dynamics can look like this if the budget deficit is positive and growth in real GDP is higher than the long term interest rate on debt;

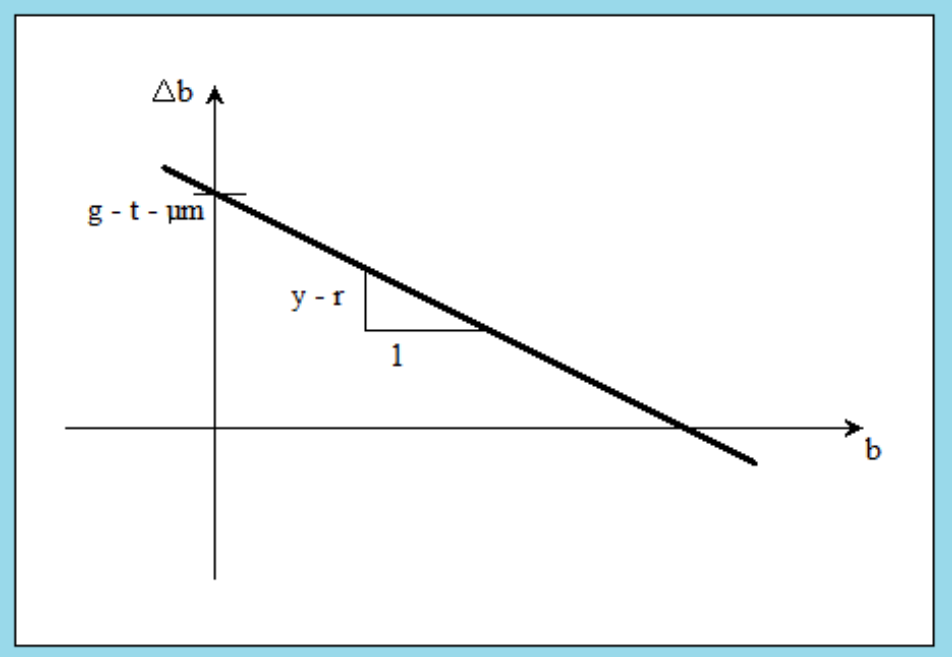

Figure 5: Effects on changes in debt level (Gärtner, 2006)

In equilibrium, the growth rate of debt is constant (Δb = 0), and can be calculated by the following equation;

Equation 2.5 $b^* = \frac{g-t-\mu m}{y-r}$

Furthermore, μm is assumed to be 0, and the equilibrium can be characterized by;

1. **High growth and budget deficit (r < y and g > t)**

In the long run, the debt ratio will be b* for any given debt ratio today, as long as the deficit is given (figure 6). The debt ratio will converge to zero with a balanced budget and a GDP growth larger than the real interest rate on debt.

2. **High growth and budget surplus (r < y and g < t)**

In this case there is a budget surplus, which makes the government a creditor in equilibrium, b*. The equilibrium is stable due to GDP growth being larger than real interest rate on debt.

3. **Low growth and budget deficit (r > y and g > t)**

When real interest rate on debt exceeds real growth in GDP, there are two consequences; the government is a creditor in equilibrium, b*, and the debt ratio equilibrium is fragile. In oppose to the cases mentioned above, there are endogenous processes that will move the debt ratio away from equilibrium with any small displacements. Stabilization is difficult, but possible.

4. **Low growth and budget surplus (r > y and g < t)**

This equilibrium is also characterized by instability. The government is running a budget surplus, but the equilibrium requires debt.

There four cases are illustrated in this figure;

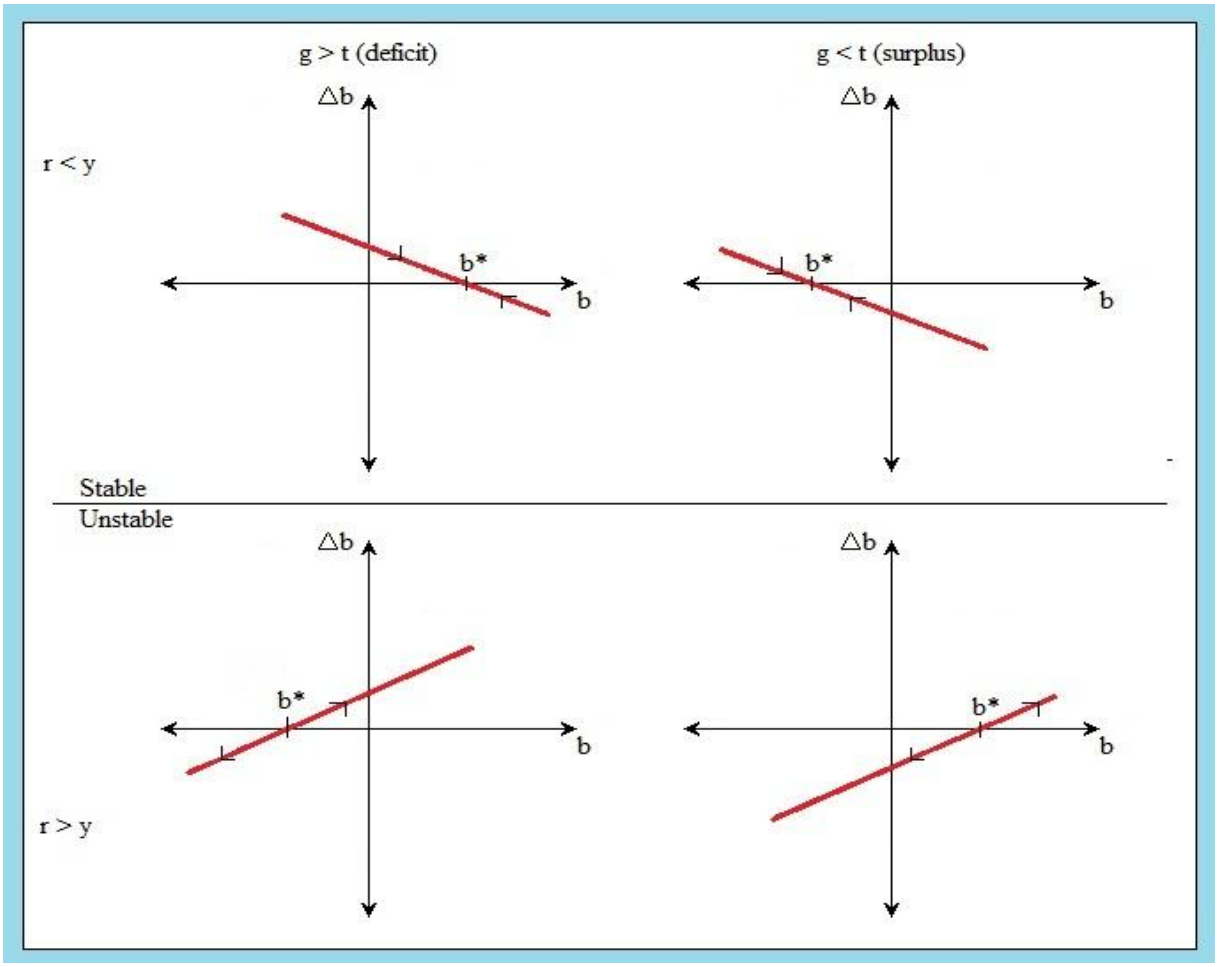

Figure 6: Debt dynamics (Gärtner, 2006)

Macroeconomic theory states that when a country is in recession, the government should increase spending and/or reduce tax to trigger actions among market participants that will boost the economy and lead to growth in GDP. This is not always true, because the only

situation an increase in government spending is throughout positive is when the increase in government spending is due to government investment, which produces benefits in the future (Gartner, 2006). The future returns should exceed the interest rate on debt.

If the budget deficit is increasing, the budget deficit is larger than the difference between GDP growth and real interest on debt rate plus money financed deficit in percent of GDP ((g-t) > (y-r)b+μm), the real debt ratio in percent of GDP will increase. The country's creditworthiness will fall which will lead to an increase in interest rate on debt. The country will lose its ability to manage debt and with no financial help, they can go bankrupt.

Countries with increasing debt and budget deficit can reduce their debt ratios by increase tax rates or reduce government spending. The consequence of e.g. a tax reduction is that a restricted fiscal policy will reduce household's disposable income, and the demand will decrease. Decreased demand will lower sales of durable goods and services, and postpone investments. When the demand decreases, companies tend to reduce prices to increase sale, and a decrease in prices will affect price levels negatively. Lower inflation and unchanged nominal interest rates will increase the real interest rate, and together with the reduced growth in GDP, the country will have more debt problems.

Another measure to reduce debt ratios can be to increase inflation. This can be done by financing debt or by 'debt erosion'; an unforeseen increase in inflation will reduce the debt's real value. The latter only works for domestic creditors or debt in domestic currency. Debt can be financed by printing money or by private loans. There has been discussed whether the positive effects (government revenue) of printing money exceeds the negative effects (inflation tax), printing money does not seem to be a profitable option. If debt is financed by private loans, it will eat up private savings, which will reduce capital stock and lead to a steady state, and potential income (when investing).

2.5.3 Fiscal devaluation as an instrument for national authorities

Conditions for an optimal currency union are high labor mobility and wage and price flexibility, to make up for the loss of the exchange rate instrument as a stabilization mechanism. When the exchange rate cannot be devalued when a country loses competitiveness, as for all the members of the Eurozone, other measures must be considered. After the financial crisis, the term 'fiscal devaluation' has been mentioned as such an instrument; a shift in tax from employers to consumers (De Mooij and Keen, 2012). A fiscal

devaluation can have positive effects e.g. reduced wage costs from lower tax rates on labor, increased incentives to work, and export becomes cheaper which increases competitiveness. Fiscal devaluation will only have these effects if employees do not bargain for higher nominal wages, and firms use lower tax rates to cut export prices (Pettinger, 2011).

This fiscal devaluation will work in the short run when nominal wages are fixed. A cut in social contribution will result in lower labor costs and a reduction in export prices. Increased VAT applies to import and demand tiles towards domestic products.

There are some practical issues with fiscal devaluation, there is a question concerning the size of the shift, endogeneity in terms the increased export demand also would lead to increased employment and revenue from social contributors, what about the losers of the VAT being increased who does not gain from the contribution cut, like pensioners.

The effect becomes insignificant, but after 10 years (De Mooij and Keen, 2012).

2.5.4 Financial stability mechanisms

In the aftermath of the financial crisis, debt problems in many Eurozone countries aroused. Countries were in desperate need for liquidity, but more debt was neither an option nor a possibility. The high debt levels led to downgrades in creditworthiness, which led to higher risk premium, made the debt unsustainable and threatened countries with bankruptcy.

Two temporary money funds were established;

- EFSM: European Financial Stabilization Mechanism; administrated by the Commission and guaranteed by EU (60 billion euro) (EC Commission, 2012)
- EFSF: European Financial Stability Facility; entity in Luxembourg, guaranteed by the members of the Eurozone (440 billion euro) (ESFS, 2012)

A more permanent scheme is to be introduced in July 2012 and will function next to EFSM and EFSF for a given period in time until it replaces them; the European Stability Mechanism (ESM) (500 billion euro) (The Economist, 2012). ESM is an intergovernmental organization which goes hand in hand with a fiscal compact designed to ensure budgetary discipline among Eurozone members (ECB, 2011). ECB has the role to provide loans and purchase bonds in the primary market. It is called Europe's version of the International Monetary Fund, and is an international finance institution, guaranteed by the members of the Eurozone, where the capital responsibility is weighted by GDP.

3. The theory of optimal currency areas (OCA)

In this section I am going to present an outline of a cost benefit analysis based on the theory from Paul De Grauwe's; economics of monetary union (2009). After I have stated theoretical costs, benefits and net benefits of a currency area, the net benefits will be applied to the Eurozone's member countries in part 4.2.

3.1 Costs

The main cost for a country when joining a common currency area, is the loss of the ability to conduct national monetary policy. A country cannot use interest rate to control for price pressures and instabilities in the economy, and cannot use the exchange rate to increase competitiveness or reduce the cost of foreign debt. These are a country's most important and most effective instruments to maintain financial and price stability. Most costs of a monetary union are related to the loss of interest rate and exchange rate as tools, and it will be explained how asymmetric shocks and structural differences between member countries can be costly without the right tools.

3.1.1. Asymmetric shocks

When asymmetric shocks occur in a monetary union, it is important that each member country have the right mechanisms to correct for such shocks. It has also been a discussion on whether or not a membership in a monetary union will increase or decrease the frequency of asymmetric shocks, these aspects will be presented below.

3.1.1.1 Mechanisms to control for asymmetric shocks

When interest rate and exchange rate cannot be used to correct for asymmetric shocks because a country is in a monetary union, it is important to have flexible mechanisms in labor markets and/or the ability for budget transfers. If not, asymmetric shocks can be very costly.

The theory on how to respond to asymmetric shocks is based on Mundell (Mundell, 1961). It is important to know if the asymmetric shock is temporary or permanent, shocks in demand are often temporary, and shocks in supply are often permanent (Balke, 1991). Shocks in demand can be changes in consumption or investment driven by expectations, policy

measures to regulate demand, and shocks in income and wealth, demand shocks can be permanent in terms of changes in preferences among consumers. Shocks in supply typically comes from an increase in productivity due to the introduction of new technology, policy changes in the labor market and other aspects of the economy, and "cheap import" from China. If the shock is temporary, the consequences are not severe and the country will not suffer much from the loss of its instruments to the currency union. If the shock is permanent, the consequences may be severe without the right correction mechanisms.

There are three mechanisms that can correct for a permanent asymmetric shock;

i) Wage flexibility
ii) Labor force mobility
iii) Public or private insurance mechanisms

To illustrate how these mechanisms work to correct for the shock, I will use an example with an asymmetric shock in demand where consumer preferences changes from a good in country A to a good in country B in a monetary union. The consequences for country A will be a loss in output due to the decrease in demand, and increased unemployment due to loss in income. Country A will experience a bust; a downward pressure in prices. Country B will have the opposite effects; an increase in output due to an increase in demand, and when the output and income increases, they will hire more and reduce unemployment. Country B will experience a boom; an upward pressure in prices. The costs of a monetary union can be severe if there are no correction mechanisms in the markets to correct for the effects of the shock in this example if the shock is permanent.

Flexibility in wages is one important mechanism that is of great advantage in a monetary union. If wages are flexible, country A can correct for the increase in unemployment due to the fact that workers will reduce their wage claims, the price on products can be lowered and products become more competitive; the demand will increase. A demand increase in country B will put an upward pressure on wages, and with an increase in wages, prices tend to increase. The products become less competitive and the demand will be reduced.

If the *labor force is mobile*, the shock will be corrected in the following manner; the unemployed from country A will move to country B to work, the wage claims will not be reduced as above, and the unemployment problem is corrected in country A. The increase of labor force in country B will not put a pressure on wages, and the pressure on prices is gone.

These mechanisms are most favorable because the labor market will automatically adjust to eliminate negative effects of such a shock. If these mechanisms are not in place for a country in a currency union there is a third, but less favorable, alternative; insurance mechanisms.

An *insurance mechanism* can be characterized as an income transfer between involved countries. The problem with this alternative is when asymmetric shocks are permanent, and the income transfer prevents the adjustment mechanisms from operating; the receiving country will obtain a permanent disequilibrium in terms of the transfers becoming permanent, and the insurance scheme unsustainable. If the transfers lead to country A not adjusting wages, the insurance mechanism will lead to moral hazard. A *public insurance system* is when there is a redistribution of the government budget; country A pays less tax due to an increase in unemployment, and country B pays more tax due to increases in wages. Government spending is increased in country A and lowered in country B. For this to be possible, the monetary union is in need of a centralized budget. A *private insurance scheme* functions through financial markets. As explained in part 2.2, if the monetary union have fully integrated financial markets, and there will be a risk-sharing mechanism when stocks are held both by citizens of country A and B. Moral hazard will in this case be lower/not existent compared to a public insurance system. The main problem with a private insurance system is the fact that most households do not operate in the stock market, and the 'smoothing effect' will be limited.

If none of these three mechanisms are present in member countries of a monetary union, the loss of interest rate and exchange rate as correction tools can be very costly.

3.1.1.2 The frequency of asymmetric shocks in a monetary union

Based on theory presented by Mundell, the discussion whether asymmetric shocks occur more or less frequently has aroused. There are two main views on this aspect; the view of the European Commission, and the Krugman view.

The *European Commission view* states that in a monetary union, asymmetric shocks will occur less frequently (EC Commission, 1990). A monetary union will make trade within the union easier which implies more trade, more similarities in demand and make shocks more symmetric. Industrial goods are the most traded goods within the union, and the trade is based on economies of scale and product differentiation. This structure of trade will make shocks more symmetric, and will be reinforced by the removal of barriers in the single market.

The *Krugman view* states the opposite; in a monetary union, asymmetric shocks will occur more frequently (Krugman, 1991). This statement is based on the theory and analysis made by Krugman that with more trade follows regional concentration of industrial activities to exploit economies of scale, and to be closer to the final market. Shocks will then be sector specific and affect the relevant region. This implication supports the statement that shocks become more asymmetric in a monetary union and the costs of a monetary union will increase with increased trade.

These views are illustrated in the following figure, where the European Commission view draw a positive relationship between trade integration and symmetry in shocks, and the Krugman view a negative relationship between trade integration and symmetry in shocks.

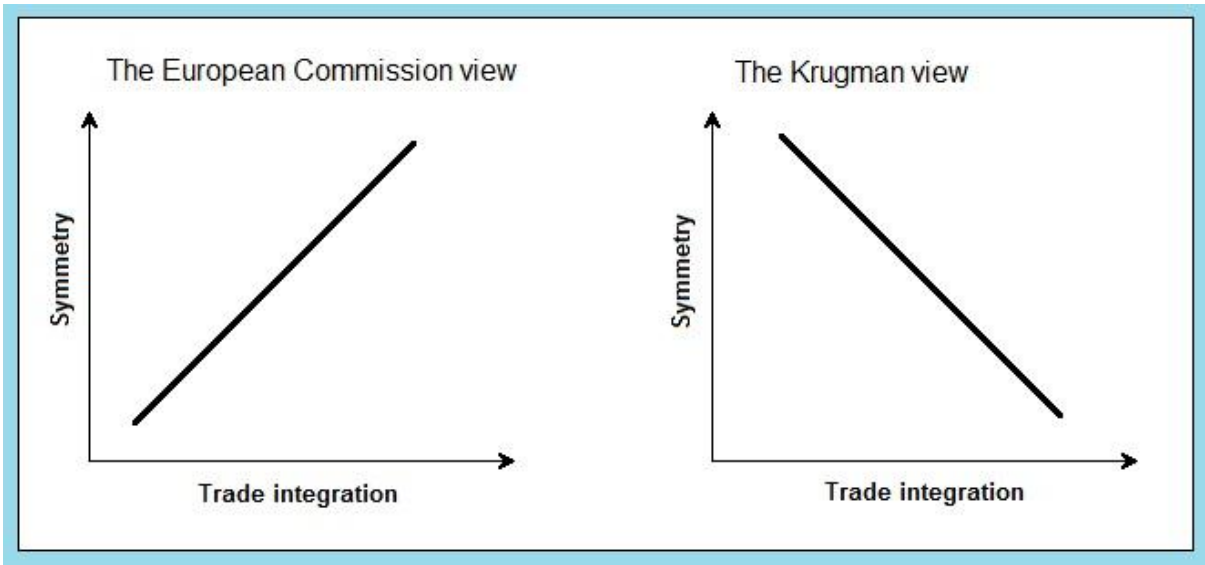

Figure 7: Two views of trade effects to symmetry in shocks (De Grauwe, 2009)

The European Commission view implies a benefit from more integrated markets, and the Krugman view implies costs of trade for a monetary union in the form or more asymmetric shocks. A presumption exists in favor for The European Commission view, but the Krugman view cannot be disputed due to the fact that borders become less important for production.

3.1.2 Costs of differences

Countries that are members of a monetary union need to have the same preferences of inflation and unemployment, same degree of centralization in labor market institutions, same legal systems and preferably the same growth rates to minimize the costs of countries losing their national monetary policy. The relevance of differences in these matters has been argued to what extent they are important, and they will be mentioned briefly.

3.1.2.1 Different preferences of inflation and unemployment

In a monetary union, all countries have the same currency, and the exchange rate instrument is lost within the union. Countries within a union cannot devaluate the currency relative to one and other and the inflation rates has to be equal, this can be explained by the following equations (De Grauwe, 1975);

Equation 3.1 $\pi_1 = w_1 - q_1$

Equation 3.2 $\pi_2 = w_2 - q_2$

Equation 3.3 $e = \pi_1 - \pi_2$

In these equations π is inflation rate, w is wage increase, q is growth in productivity and e is the rate of depreciation. Since the countries have the same currency, e is equal to 0 and cannot be changed and $\pi_1 = \pi_2$. These preferences have to be equal in order for the monetary union to function, when there are differences in these preferences, one country has to accept more inflation and less unemployment than it normally would have, and the other has to accept less inflation and more unemployment than it normally would have, and these are is the costs of different preferences in a monetary union.

3.1.2.2 Differences in labor market institutions

There can be divergent wage and price developments if there are both countries with centralized and decentralized institutions in the same monetary union, even with the same disturbances (Bruno and Sachs, 1985).

Say there is a positive supply shock, with an increased price level, wages are expected to increase, but the size of the increase is different in countries with centralized labor unions than in countries with decentralized labor unions. The nominal wage increases more in decentralized labor unions because there are many unions, and they do not want their members to suffer from a lower increase, and they bargain for a higher nominal wage. In a centralized labor union, the nominal wage tends to increase with the inflation rate, and the real wage level will stay the same. Nominal wages in countries with decentralized unions tend to increase more than in countries with centralized unions when a positive supply shock occurs.

3.1.2.3 Differences in legal systems

Difference in legal systems can be in form of different protection mechanisms of banks, and mortgage can be different products across countries if some countries offer fixed rates to

maturity and others floating rates; the risk will be different. Different legal systems may also lead to differences in financial markets and risk of financial shocks is transmitted differently. There can also be differences in access to capital markets, in some countries, companies may have full access and can finance investment projects in capital markets, and these become more liquid than companies in countries where they only fund themselves through banks. When a company fund themselves through the capital market, an increase in interest rate will increase the price of financial products and lead to negative wealth effects. In countries where companies fund themselves through banks, an increase in interest rate will have an income effect and lead to less demand for consumption.

3.1.2.4 Differences in growth rates

When a country has a larger growth rate than another, the import in this country will be larger than the import in the other country, the net export will decrease and the country will lose competitiveness. The country with high growth rates can adjust by lowering the prices and make goods more competitive. Differences in growth rate are not a big problem.

3.1.3 Sum of costs

- In a monetary union, the individual countries loses their national monetary policy
- Individual countries loses exchange rate mechanisms to correct for shocks
- The loss of these instruments creates costs when asymmetric shocks occur, and when correcting for differences across countries
- A common currency can create costs when/if the member countries find it difficult to adjust for disturbances
- There are costs associated with the partial loss of independence in fiscal policy

3.2 Benefits

There can be a lot of costs related to a common currency, but there can also be a lot of benefits. Such benefits can be increased economic efficiency in terms of no transaction costs, wealth gains from less uncertainty, elimination of exchange rate risk, increased trade and benefits related to the fact that the currency can become an international currency.

3.2.1 No transaction costs

There are both direct and indirect benefits associated with the elimination of transaction costs. Direct benefits are direct savings when transferring money. For the specific monetary union like the Eurozone, these direct benefits are estimated by the EU Commission to be between 13 and 20 billion euros per year (EC Commission, 1990), the counterpart being the banking sector. Bank transfers between member countries are more expensive than within a country as the payment systems are not fully integrated. This is due to the fact that national systems are still in use, and transfers between countries follow a more expensive route, even though national payments are linked to the TARGET system.

An indirect effect from no transaction costs of a common currency is that a common currency leads to more price transparency. This price transparency will benefit consumers in the way that price of similar products can be more easily compared, the competition between companies with similar products increases and may lead to reduced prices, which again benefits the consumer. Price differences between countries are significant due to the fact that borders have a tendency to define markets. Studies conducted in the US found evidence of higher price differentials between US and Canada than within the US (Engel and Rogers, 1995). The case of the US illustrates the benefits of having states relative to countries in a union. The euro contributes to economic integration and leads to financial integration and price convergence.

3.2.2 Wealth gains due to less uncertainty

When the risk of exchange rate changes is eliminated, there are opportunities for wealth gains. Such gains can result from the fact that there is less uncertainty about future revenue; a risk will be eliminated for risk adverse individuals who will seek more opportunities, and increases wealth. The exchange rate is not normally distributed, which represents a risk of large changes with low probability. There are situations where exchange rate can lead to increased wealth, e.g. for exporting companies that profit from changes in exchange rate.

3.2.3 Elimination of exchange rate risk related to growth

It is assumed that the elimination of the exchange rate risk may reduce systematic risk, and the real interest rate is temporary lowered. With lower systematic risk, a lowered risk premium is required by investors on the same investment. Agents will use a lower discount rate on investment and more investments will be profitable, which again leads to increase in growth. Testing shows no effect in the real interest rate in the Eurozone after introducing the monetary union, and as follows, no change in growth (De Grauwe, 2009).

3.2.4 Trade and openness of countries

No transaction costs and no exchange rate uncertainty will increase trade, and according to the European Commission view introduced in 3.1.1.2, asymmetric shocks will be reduced. In addition to the benefits from the common currency, monetary unions also have benefits from more integrated financial markets and banking systems, which tend to increase trade further due to the fact that these mechanisms reduce cost of trading and facilities trade.

No transaction costs in trade between countries using the same currency will reduce the probability of decision errors, these errors are based on the difficulties of trading with a country in another currency. The elimination of this type of decision error risk will make countries, which sell a lot of goods and services in the foreign market, more open and again lead to wealth gains.

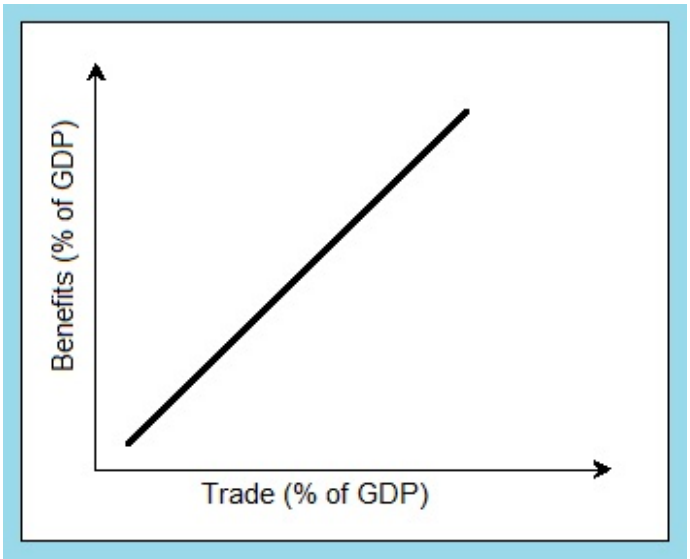

Figure 8: The relationship between trade and benefits in a monetary union (De Grauwe, 2009)

Figure 8 represents the relationship between openness (trade) and benefits.

Openness is measured by the bilateral trade in percent of GDP of the country in focus, relative to other trading partners within the monetary union.

More openness increases benefits from being in a monetary union.

3.2.5 The euro as an international currency

As mentioned in part 2.2, the euro is on its way to become an international currency. A benefit from the euro being an international currency is that is creates additional revenue to the issuer of the euro when it is used all over the world. Profit associated with this revenue goes to the government, and citizens will benefit in terms of reduced taxes, and a government spending remaining at the same level. A second benefit is when the international currency is held as international reserve, it can be used to finance the gap when government spending exceeds tax income, and the exchange rate risk is in the hands of foreign holders. A third benefit is increased activity in financial markets, banks and bond and equity market will attract business and create jobs.

3.2.6 Symmetric shocks

In part 3.1.1, asymmetric shocks are associated with more costs for two countries in a monetary union than two countries outside a monetary union. However, in the case of a symmetric shock, countries within a monetary union have more to gain than countries outside the union.

Say there is a positive shock in aggregate demand, the central bank in a monetary union can increase the interest rate to control the shock in both countries, but it may be difficult for countries outside the union to coordinate such measures. If one country uses the exchange rate mechanism to correct the shock, it will be in expense of the other country, and if the other country responds by the same exchange rate change, there is a danger of a negative spiral, and the effect of the exchange rate changes will be reduced (De Grauwe, 2009).

3.2.7 Sum of benefits

- Decreased transaction costs and stimulated economic integration
- Improved price stability
- Increased trade
- Wealth improvements by elimination of exchange rates risk
- Increased competition due to price transparency
- Financial, institutional and political integration
- Benefits from the euro becoming an international currency

3.3 Net benefits

The net benefits are found when costs and benefits of a monetary union are compared. Some factors are critical to produce net benefits, and are discussed in this section. These factors are the degree of openness of countries related to trade, degree of price and wage rigidities and labor mobility. Another aspect that is relevant is to look at the relationship between flexibility in labor markets and symmetry in shocks.

3.3.1 Openness of countries and flexibility in labor markets

There are both costs and benefits related to the openness of countries. Costs are discussed in 3.1.1.1 and are the results of low ability to correct for asymmetric shocks with labor mobility and wage and price flexibility. Benefits related to more open economies in a monetary union is discussed in part 3.2.4 and can be partly related to the European Commission view that more trade will lead to asymmetric shocks being less frequent, and partly to increased profit and wealth from elimination of transaction shocks and price transparency.

Figure 9 represents costs and benefits related to the openness of countries.

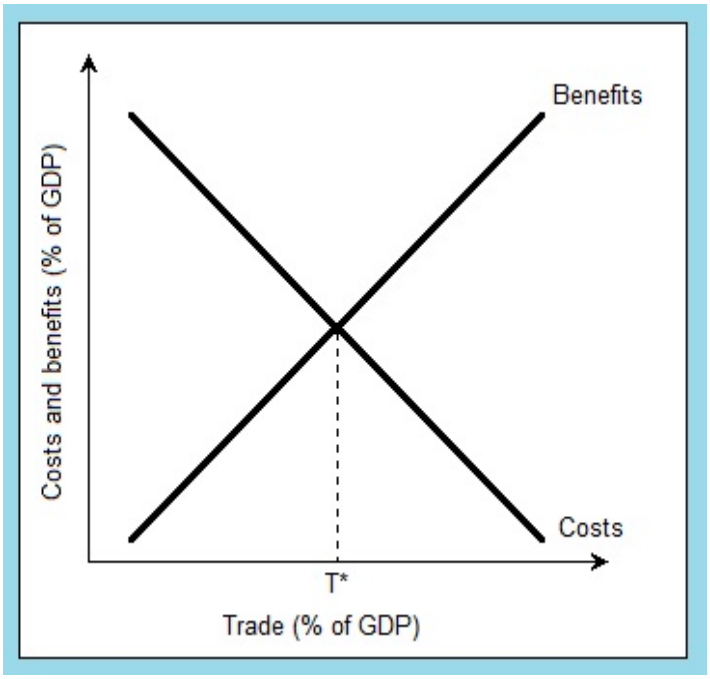

Figure 9: Benefits and costs in form of trade in a monetary union (De Grauwe, 2009)

The intersection between costs and benefits are the critical level of whether or not a country should join a monetary union with its trading partners.

Countries with a large percent of trade are located to the right of the intersection; the benefits exceed the costs of joining a monetary union. Countries with low degree of trade are located to the left of the intersection, and have less to gain from joining a monetary union.

The intersect point in this figures has been debated, and there are two extreme views; the monetarist view and the Keynesian view, in addition to the degree of flexibility.

The monetarist view states that national monetary policy is ineffective when it comes to correct for an asymmetric shock, whether the shock is permanent or temporary. The cost curve in this case is closer to the origin, and often steeper than the cost curve in the figure. More countries would benefit from joining a monetary union.

In the Keynesian view, there are a lot of price and labor rigidities, and national monetary policy instruments are crucial to correct for asymmetric shocks. The cost curve is located further away from the origin in relation to the figure above, and fewer countries will gain from joining a monetary union.

There is also the aspect of how flexible labor market and prices are. For countries with more flexibility in these markets, the costs of asymmetric shocks are lower due to the fact that these mechanisms make the adjustment process smoother and faster, the cost curve would shift to a level closer to the origin, and make a monetary union more beneficial. In the opposite case, costs of an asymmetric shock may be severe, and the cost curve will shift out, making monetary union less attractive to possible member countries. These effects are discussed in part 3.1.1.1.

These factors together can be summed up in a figure illustrating the symmetry in shocks on the vertical axis and the degree of flexibility in labor market and prices on the horizontal axis and an optimal currency area can be located where benefits exceed costs.

3.3.2 Symmetry in shocks and labor market flexibility

The net benefits can be summed up in figure 10 that illustrates the relationship between the size and frequency of symmetric shocks and the degree of flexibility in the labor market. If the shocks are mostly asymmetric, there is great need for flexible wages and labor mobility to correct for the shock, if these mechanisms are not in place; the costs of joining a monetary union are substantial. When there are a lot of rigidities in wages and the labor force is not mobile, asymmetric shocks can be costly, and it is important that when joining a monetary union that shocks tend to affect countries symmetrically.

Figure 10 illustrates the border between an optimal currency area, and a currency area which is not optimized. The vertical axis represents the degree of symmetry in demand and supply shocks, given by the correlation between growth rates of output and employment. The horizontal axis represents the degree of flexibility in the labor market; mobile labor force and flexible wages. The optimal currency area line (OCA-line) is where costs of joining a

monetary union equal the benefits. When having less degree of symmetric shock and low degree of flexibility, a country should not join a monetary union, on the other hand, if a country has the same types of shocks as the union, and/or large degree of flexibility in the labor market, a country should join a monetary union that both the union and the country can benefit from.

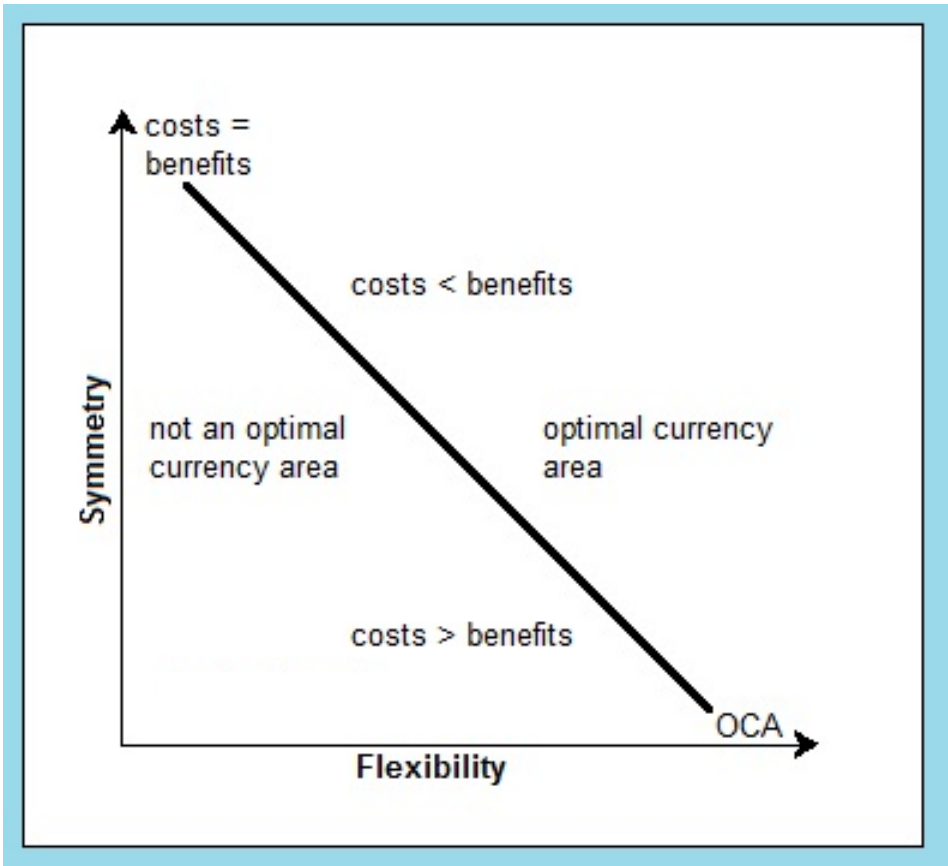

Figure 10: Optimal currency area (De Grauwe, 2009)

3.3.3 Sum of net benefits

There are net benefits when;

- When the countries are open/there are a lot of intra-EU trade
- When monetary policy have little effect in the single country
- When there is low degree of rigidities in prices and labor market
- When the labor force is mobile
- When there are few asymmetric shocks
- When being in a monetary union increases wealth; for individual countries and for the Eurozone as a whole

4. Analysis

The analysis will start with a presentation and evaluation of the management of the monetary and fiscal policy for the Eurozone as a whole after the introduction of the euro in 1999. Secondly, theory of optimal currency areas will be applied to the members of the Eurozone, and it will be analyzed if the monetary union has led to net benefits. Third, the effects to member countries of losing their national monetary policy will be examined. Finally, the budget situation for each country will be evaluated.

When analyzing the Eurozone as a whole, monthly data for the changing composition of the Eurozone will be used, due to the fact that ECB is in charge of the monetary policy of the countries that are members at a given point in time. However, when analyzing the individual countries, yearly data for the Eurozone consisting of 17 members throughout the period will be used, this is due to better comparison. Most of the data material is gathered from Eurostat, which is the European Commission's release of statistical development concerning the Eurozone.

4.1 The management of the monetary and fiscal policy in the Eurozone as a whole

The primary objective of the monetary policy in the Eurozone is to keep **inflation** below but close to 2% in the medium term. Secondary objectives are output and employment. This section will be used to evaluate the management of the monetary policy in relation to the characteristics and developments addressed in part 2.4 of this thesis.

The Maastricht Treaty (part 2.1) and the Stability and Growth pact (part 2.5) states criteria of fiscal situation to be eligible for a membership in the Eurozone and regulations of fiscal policy after joining the monetary union, respectively, that every member country has to follow. This section, in addition to an evaluation of the monetary policy, also evaluates the fiscal situation of the Eurozone as a whole in relation to these criteria and regulations.

There are a lot of factors that play a role in the interest rate decision and to the economic development within and between countries; only the most important factors will be included in the following discussions.

4.1.1 Monetary policy in the Eurozone: the real economy

It was decided, when planning and creating the Eurozone, that it should follow the German model of central banking. Practically, this means that the primary target of monetary policy is price stability as mentioned in part 2.3. Growth in prices was believed to be reflected in growth in money supply, and as a result, money supply was monitored and was prominent in monetary decisions until 2003. The following analysis will start by presenting inflation[2] (HICP), the target interest rate (the repo rate) and the growth in money supply[3] (M3).

Figure 11 presents the development of monthly changes in HICP (12 month average) and the changes in the target interest rate, from the start of ECBs reign.

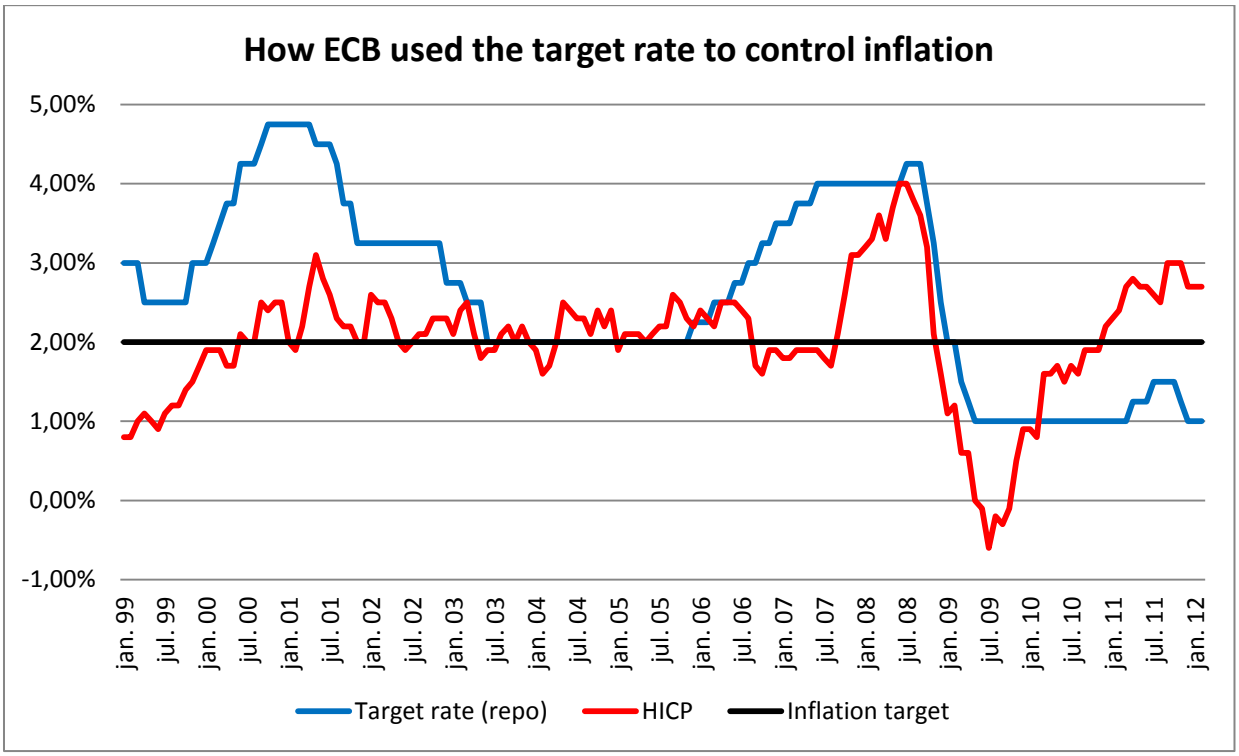

Figure 11: HICP and target rate (Eurostat, 2012 and ECB, n.d.)

From the introduction of the euro in 1999, the inflation was close to the 2%-target until mid-2007. Under and after the turmoil from the end of 2007 until today, inflation has deviated substantially from target relative to previous periods.

[2] HICP is the "Harmonized Indices of Consumer Prices" and is similar to Consumer Price Indices (CPI) when it comes to the definition; measuring inflation faced by consumers, but the indices measure inflation with different aims and use different concepts or methods (appendix B). Source: Eurostat

[3] Money supply, M3, is seasonally adjusted and is the sum of currency in circulation, overnight deposits, deposits with an agreed maturity of up to two years, deposits redeemable at notice of up to three months, repurchase agreements, money market fund shares/units and money market paper and debt securities issued up to 2 years. Source: European Central Bank.

Even though inflation was close to target, and relatively stable, from 1999 to mid-2003, the target rate was raised 7 times from November 1999 to October 2000 (ECB, n.d.). The fact that the target rate was raised, even though inflation was stable during this period, can be interpreted as (1) the target rate was raised to keep inflation low and/or (2) the target rate was raised to stabilize for other factors in the economy. Before 2001, the global economy was in a high activity period with increased productivity due to new technology. Inflation is a lagging indicator, and to prevent future increase in inflation, the interest rate was raised in response to the increased activity in the economy.

In March 2001, the "dotcom" bubble busted which resulted in an 8 month long recession in the US (NBER, 2012). This had an effect in most countries, and ECB responded, like most central banks, with lowering the target rate to correct for the negative effects of the bust. The target rate was lowered 7 times until it was set to 2%, followed by over two years of no change. During this 7 year period, the inflation remained close to 2% for the Eurozone as a whole, and effects of changes in economic activity was corrected before it made an effect to the inflation. ECB managed the monetary policy in a way that the primary objective of price stability was satisfied, and the monetary policy can be characterized as a success in the eyes of the ECB up until this point.

In 2006 and 2007, the target rate was again raised despite low and stable inflation in the Eurozone. This was due to the positive prospects of the economy of increased growth in output, and employment as an effect of increased job creation (ECB, 2007). Although the target rate was raised, inflation exceeded target substantially from mid-2007 and grew until the financial crisis took the world economy by surprise in mid-2008. Both target rate and inflation fell dramatically as the asset bubble busted.

In the aftermath of the global financial crisis, the target rate has remained low despite high inflation relative to target. Financial and fiscal imbalances are factors that have contributed to the decision of keeping the target rate low (ECB, 2012), together with slow recovery of the economic activity, debt and credit conditions and unemployment considerations.

Money supply is mentioned in part 2.4 as an intermediate target to reach the ultimate target of inflation below but close to 2%. ECB projected that a yearly growth of money supply of 4,5% implied a 2% increase in price level.

The following graph illustrates the growth in money supply in relation to changes in target interest rate and projected target of growth in money supply of 4,5%.

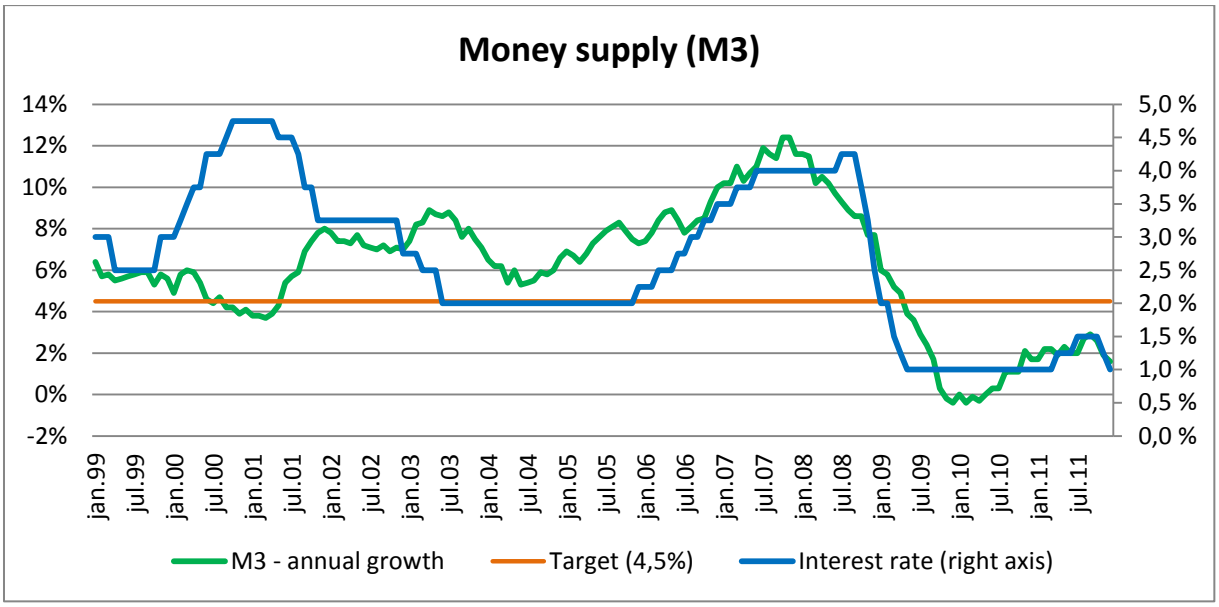

Figure 12: Money supply and target rate (ECB, 2012 and ECB, n.d.)

Due to the scope of explaining the reactions of target interest rate changes mentioned above, the discussion of the reactions in the target rate related to growth in money supply will be brief. An increase in the interest rate implies an increase in the cost of money.

During the years 1999-2000, the growth in money supply was high relative to the target projected of 4,5%. As the target rate was raised, money became more expensive, and as a result, the demand for money went down and the growth of money supply slowed down. After the dotcom bust in 2001, target rate went down and money supply increased to stimulate the economy in the recession.

This low level of interest rate during the mid-2000s is the main factor that drove the increasing growth in money supply from 2005 (ECB, 2006), the increasing money supply was seen as a risk of future inflation increase and as a respond to the high increase in money supply, the target rate was increased. The increase in the target rate was not sufficient, and the growth in M3 was stimulated by a flat yield curve; low/no difference between short-term and long-term interest rates for bonds of the same credit quality, and an increasing interest in financial assets in the Eurozone by non-EU residents (ECB, 2007) The high increase in money growth continued despite the continuous increase in the target interest rate, and they both peaked in 2007/2008. After the financial crisis, both interest rate and growth in money

supply have been low, even a decline in money supply can be seen in 2009/2010, which is mainly due to downward impact of a steep yield curve (ECB, 2010). The most recent observations of a slight increase in growth of money supply is due to an easing of deleveraging pressure on banks, the risk of sudden deleveraging has declined (ECB, 2012).

In relation to the first-pillar of the monetary policy, the growth in money supply was projected to be close to 4,5%, but the actual average growth has been 6,1% from 1999 to 2011. In 2003, the role of money growth was de-emphasized due to its failure to predict inflation. Before 2003, growth in money supply and target rate went in different directions; a negative relationship, and after 2003 movements in target rate and growth of money supply have been similar; a positive relationship. The graphical results cannot be used to make assumptions of causality, and they most likely have an effect on each other or they are both endogenous and affected by other factors in the economy. They can be affected by each other in the following ways; an increase in growth of money supply can be seen as a threat to price stability and the target rate can be increased to stimulate stability in price, on the other hand, an increase in target rate increases the cost of money, and the demand for money declines, which in terms reduces money supply in the economy. It must also be mentioned that an increase in the target rate is not the only way to dampen growth in money supply, the central bank can also reduce the supply of liquidity by using other instruments such as standing facilities and minimum reserves mentioned in part 2.4.2. The decision of de-emphasizing M3 when making monetary decisions is not reflected in the graph.

The only time period where growth in money supply have had a clear effect on target rate decisions is in 2006/2007, when growth in money supply had increased for over a year, and was seen as a risk of growth in price levels.

If not interfering with price stability, secondary targets like **output and employment**[4] (sometimes **unemployment**[5]) can be emphasized in an interest rate decision. These real

[4] The employment rate is calculated by dividing the number of persons aged 15 to 64 in employment by the total population of the same age group. The indicator is based on the EU Labor Force Survey. Employed population consists of those persons who during the reference week did any work for pay or profit for at least one hour, or were not working but had jobs from which they were temporarily absent. Source: Eurostat

[5] The unemployment rate is the number of unemployed persons as a percent of the labor force based on International Labor Office (ILO) definition. The labor force is the total number of people employed or unemployed. Unemployed persons comprise persons aged 15 to 74 who are without work during the reference week, are available to start work within the next two weeks and have been actively seeking work in the past four weeks or had already found a job to start within the next three months. Source: Eurostat

economic indicators can only be affected by monetary policy in the short-run, in the long run they are fixed and can only be affected by structural changes e.g. changes in legislation and regulation, and/or changes in productivity by e.g. new technology (the monetarist view).

The output gap tells us about the activity in the economy. When GDP (total output) is larger than trend, there is a high economic activity period (a positive output gap) and when GDP is lower than trend, the country experience a low economic activity period (a negative output gap). When the output gap increases (trough to peak in GDP), the economy is in expansion; a boom, and when GDP declines (peak to trough in GDP), the economy is in recession; a bust.

Equation 4.1: $output\ gap = y = \frac{Y - Y^*}{Y^*}$

Figure 13 illustrates the relationship between yearly target interest rate (the level of December of the respective year), unemployment and output gap.

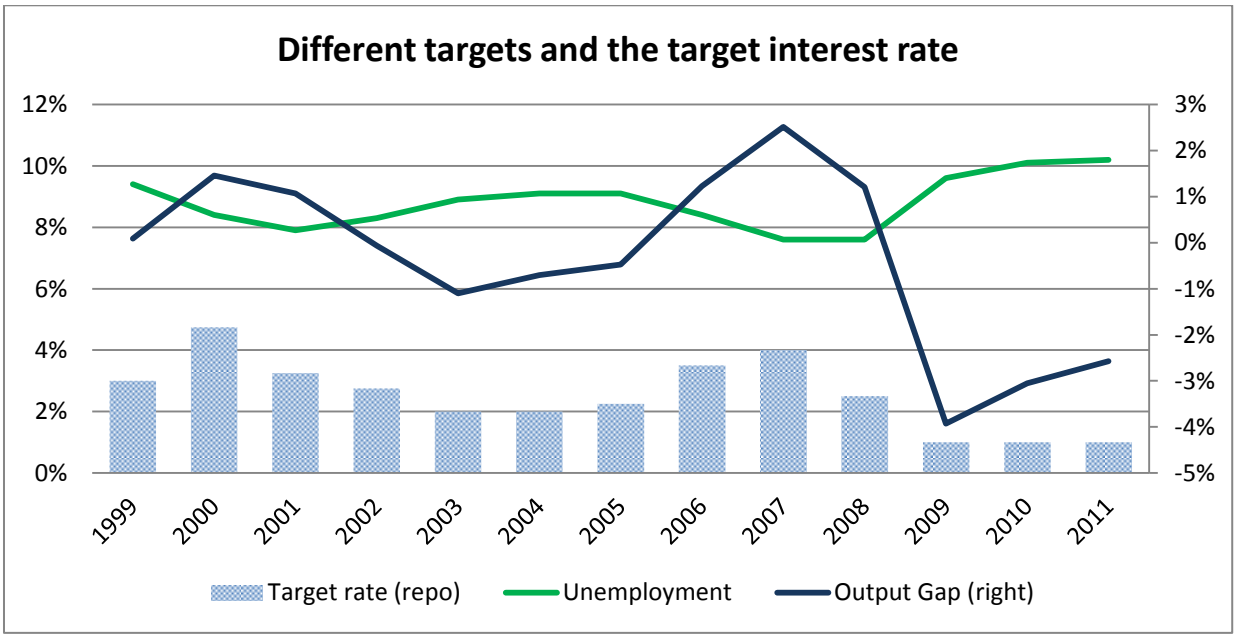

Figure 13: The relationship between target rate, unemployment and output gap (ECB, n.d., Eurostat, 2012 and OECD, 2011)

As indicated above, the interest rate was set as a result of the activity in the economy, and when looking at figure 13, this tends to be true. The output gap was positive from 1999 to 2001 mostly due to an increase in new technology, negative from 2002 to 2005 which was the recovery period after the dotcom bust in 2001, positive from 2006 to 2008 due to good future prospects and negative after 2009 due to the financial crisis. Unemployment has been moving in the opposite direction, slightly lagging, which is in line with economic theory.

It can also be interesting to look at correlation between the factors illustrated in figure 13, replacing unemployment with employment because unemployment tends to be lagging.

	Employment	Output gap	Target rate
Employment	1,00		
Output gap	-0,37	1,00	
Target rate	-0,55	0,91	1,00

Table 1: Correlation between employment, output gap and target rate

The interest rate changes are highly correlated with economic activity, given by the output gap, with a correlation coefficient of 0,91; in 91% of the periods, interest rate and output gap went in the same direction at the same time. This result must be interpreted with caution as the number of observations is relatively low due to the use of yearly data, there is also the endogeneity question, and as follows, causality. Employment seems to have a negative correlation with both output gap and target rate which does not make sense due to the fact that in periods of high economic activity, more jobs are created which tend to lead to higher employment.

Even though ECB has been successful in reaching their target in periods of relatively stable conditions, and even under the 2001-recession, some criticism is relevant. There were no threats to price stability in the two years of low and unchanged target rate in 2003-2005 in the eyes of ECB (ECB, 2005), but in the same report it is stated that money supply had been growing increasingly and could cause a risk of price pressure. If the target rate had been raised earlier in response to the increase in money supply, it could have dampened the high economic growth in the preceding years, and maybe also some of the effects from the crisis.

In times of stable prices, before 2007, ECB have been focusing on stabilizing output and unemployment. Under and after the financial crisis in 2008, inflation, growth in money supply and output gap all fell, and unemployment increased. Due to this symmetric effect, the interest rate was used to stimulate all these effects at the same time. The only period where ECB had a choice between price stability and output stabilization was 2011, where inflation exceeded the 2% target, and the output gap was negative. The low economic activity combined with high unemployment and fiscal instabilities have resulted in the decision of continuing to keep the target rate at a low level. Despite the low interest rates during the mid-2000s, the management of the monetary policy for the Eurozone as a whole has been satisfactory.

4.1.2 Fiscal policy: the budgetary situation for the Eurozone as a whole

The Maastricht Treaty states criteria to join the European Monetary Union, and among the criteria, there are two that related to the budgetary situation; government debt must be kept lower than 60% of GDP, and government budget deficit must not exceed 3% of GDP. The Stability and Growth Pact (SGP) is making sure that member countries follow these criteria even after becoming a member of the union by e.g. fining countries that have budget deficits higher than 3% of GDP. The following analysis will present budgetary statistics for the Eurozone as a whole and relate this situation to the criteria in the Maastricht Treaty. Government debt and budget deficit are nominal gross values in percent of nominal GDP.

The evaluation will start by looking at the relationship between growth in real GDP and budget deficit, due to the fact that the budget deficit tends to increase when GDP declines. This relationship was presented in appendix A, corresponding to part 2.5.2, by the equation;

Equation 4.2 $\frac{G-T}{Y} = (g - t)$

When GDP increases, the budget deficit will be reduced, given that government spending (G) and tax income (T) stay the same. If a country has a budget deficit (g > t), the reduction in tax rate will be lower than the reduction in government spending in percent of GDP.

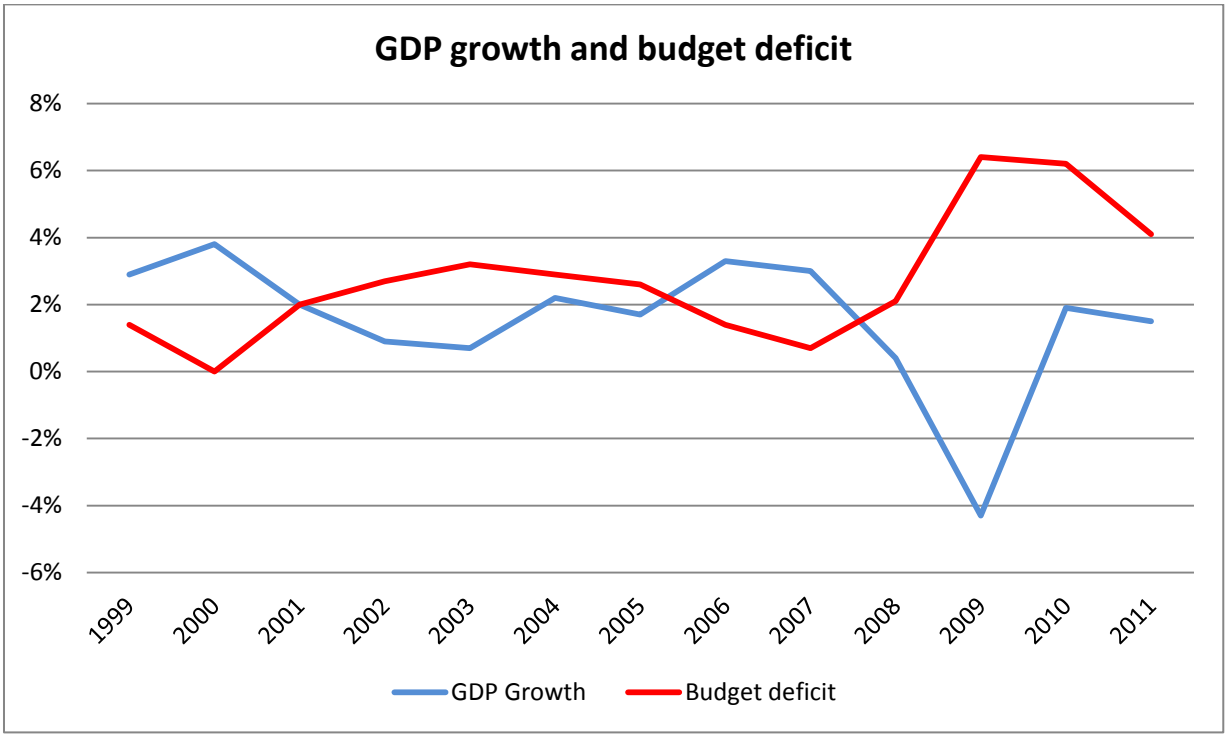

Figure 14: The development of growth in real GDP and budget deficit (Eurostat, 2012)

When looking at actual data of real GDP and the budget deficit for the Eurozone as a whole in figure 14, the relationship in equation 4.2 tends to be true. Budget deficit moves in the opposite direction of real GDP. This co-movement can be measured by correlation;

	Growth in real GDP	Budget deficit
Growth in real GDP	1	
Budget deficit	-0,72	1

Table 2: Correlation between growth of real GDP and budget deficit

In 72% of the cases, GDP growth and budget deficit moves in the opposite direction at the same time. This implies that, in most cases, when there is an increase in GDP growth, there is a decrease in budget deficit. These are both endogenous and affected by other factors, but to what extent they move in the opposite direction can be interesting to notice.

Figure 15 presents the development of budget deficit in % of GDP during the euro-period for the Eurozone as a whole, and the Maastricht criteria of a budget deficit limit of 3% of GDP.

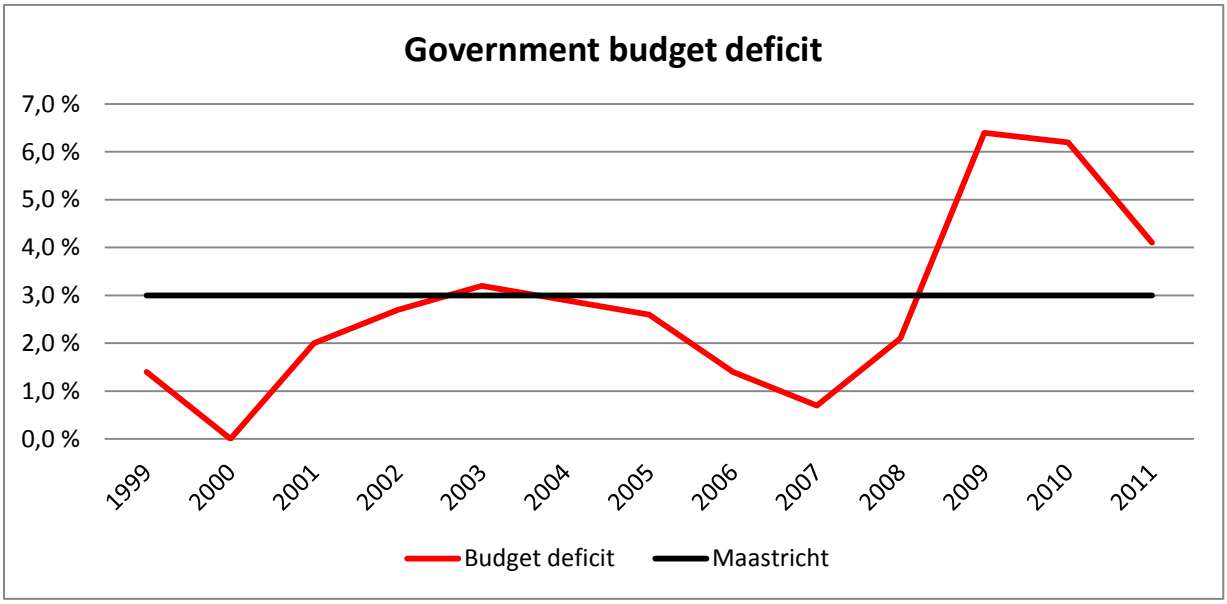

Figure 15: Government budget deficit in % of GDP in relation to the Maastricht Treaty

The budget deficit was under the critical limit for the Eurozone as a whole until the financial crisis in 2008 (except for 2003 when it just about exceeded the limit). After the financial crisis, the budget deficit has been over 3% of GDP, with a peak in 2009. In 2011, the budget deficit was falling, and is hopefully soon to be back under the 3% limit. Even though the budget deficit situation looks good for the Eurozone as a whole, this is far from the case of the individual member countries, which will be presented later.

Figure 16 presents the development of government debt in % of GDP during the euro-period for the Eurozone as a whole, and the Maastricht criteria of a government debt limit of 60%.

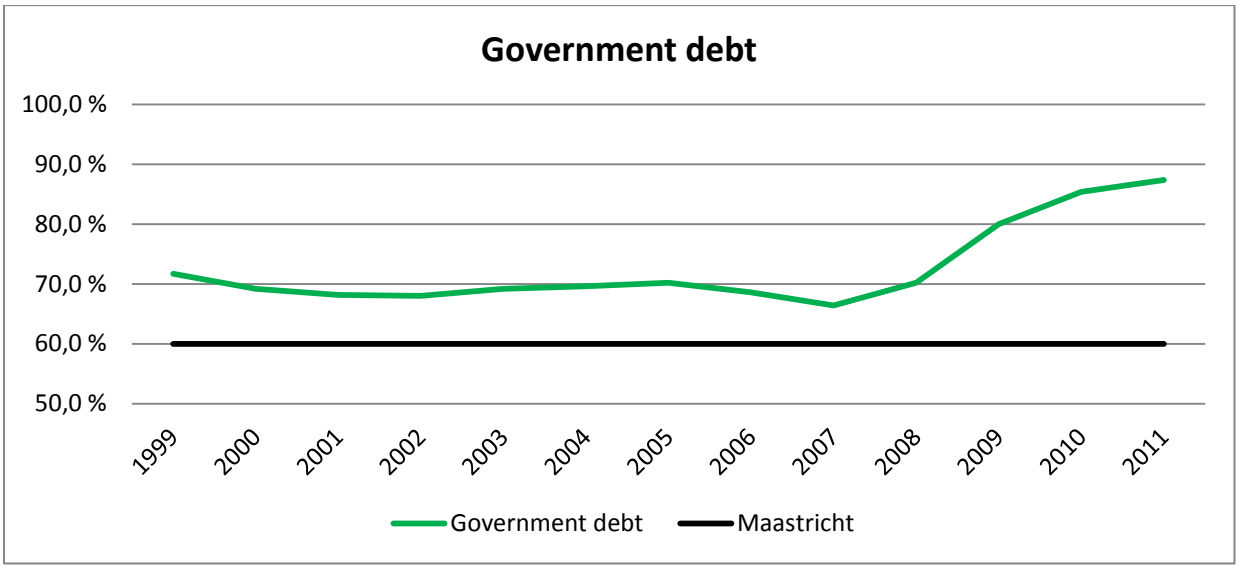

Figure 16: Government debt in % of GDP in relation to the Maastricht Treaty (Eurostat, 2012)

The government debt level has exceeded the 60% of GDP limit over the whole period, but it has been stable. From 1999 to 2008, the debt level has been close to, and mostly below, 70%, but increasing after 2008. In 2011, the debt ratio was close to 90%, which implies an increase of 20% in only three years. The increasing debt level can be due to the increasing budget deficit because countries are using debt to finance it, it can be due to increasing cost of debt (increasing nominal and real interest rates) and also lower inflation.

This increase in debt can become very costly for the Eurozone. Some member countries increased their debt to finance the budget deficit that resulted from the financial crisis, and with an increasing debt level, the credit worthiness of the country was lowered, followed by increasing interest rates due to increases in risk premiums and an increased risk of default. All Eurozone members must contribute to finance a bail-out so that countries with high debt and risk of default do not go bankrupt.

All in all, the Eurozone's aggregate budget deficit has been below 3%, except for under and after the financial crisis in 2008, which is understandable and accepted. However, the aggregate government debt level has never met the 60% debt ratio criterion, and this is debt that has the potential to become very costly. Measures to decrease the debt ratio must be made, e.g. a centralized government budget for the Eurozone or Eurobonds, both will be discussed in part 6.

4.2 Net benefits in relation to OCA theory

A monetary union forms an optimal currency area when benefits of being in a monetary union exceed the costs. Net benefits can be a result of (1) degree of openness/trade, (2) symmetry in shocks, (3) and flexible labor markets in terms of wage and labor force. Effects of the loss of national monetary policy to individual countries will be analyzed in 4.3.

4.2.1 Openness and trade

Since the 1980s, the monetarist view has gained adherents, and due to the belief that national monetary policy is ineffective when it comes to correct for asymmetric shocks, the degree of openness needed to benefit from the monetary union is at a lower level, which makes the union profitable for more countries. This contributed to the realization of EMU in the 1990s.

Country	Export	Import	Total activity
Belgium	67 %	61 %	128 %
Slovakia	70 %	58 %	128 %
Czech Republic	62 %	52 %	115 %
Estonia	50 %	62 %	112 %
Hungary	61 %	51 %	111 %
Slovenia	50 %	48 %	98 %
Netherlands	61 %	33 %	94 %
Lithuania	40 %	41 %	82 %
Latvia	31 %	45 %	76 %
Luxembourg	30 %	39 %	69 %
Bulgaria	33 %	36 %	69 %
Malta	17 %	50 %	67 %
Austria	30 %	35 %	65 %
Poland	28 %	28 %	56 %
Ireland	34 %	21 %	55 %
Romania	23 %	29 %	53 %
Germany	24 %	22 %	47 %
Denmark	22 %	21 %	43 %
Portugal	18 %	25 %	43 %
Sweden	19 %	22 %	42 %
Finland	16 %	19 %	36 %
France	13 %	17 %	30 %
Cyprus	5 %	24 %	29 %
Spain	14 %	14 %	28 %
Italy	13 %	14 %	27 %
United Kingdom	11 %	13 %	24 %
Greece	5 %	11 %	16 %

Table 3: Intra EU export and import in % of GDP (Eurostat, 2012)

Table 3 illustrates the openness given by intra-union export and import to EU countries (% of GDP) in 2011, and to illustrate total activity, these are summed up.

Export and import are summed into “total activity” to present a better picture of the trade integration. When looking at net export, the values are more similar, and are not representable for trade in total, and do not give any information about the degree of trade in the European Union; the net export of countries with low export and import are relatively similar to countries with both high export and import. The calculations are made by dividing nominal intra-EU export and import by nominal GDP, respectively.

The euro has generated new trade flows in the Eurozone, which has expanded the choice of goods and services, and increased consumer wealth. From table 3, the result of trade activity varies a lot among the EU countries.

The European Union and the euro were created with a vision of increased trade within Europe, to stimulate integration. Of the 11 countries that were first introduced to the euro, only 5 of these have total intra-EU trade of over 50% of GDP; the Benelux-countries (Belgium, Netherlands and Luxembourg), Ireland and Austria. The other 6 countries have total EU trade activity between 25% and 50% of GDP; Germany, Portugal, Finland, France, Spain and Italy. One would believe that these countries were the ones with most trade due to the fact that those were the main drivers behind the EU and the EMU. Other countries with total EU trade between 25% and 50% of GDP are Denmark, Sweden and Cyprus.

The countries with most intra trade in the European Union, along with the Benelux-countries, are actually the Eastern European countries and the new EMU members; Czech Republic, Hungary, Lithuania, Latvia, Romania, Poland and Bulgaria (outside the Eurozone), and Slovakia, Slovenia, Estonia and Malta (new EMU members).

United Kingdom and Greece are the countries with the lowest degree of trade, with less than 25% trade activity of GDP with other EU countries.

High level of trade in the Eastern European and new EMU members may be due to the fact that they are poorer, and costs of importing from/exporting to EU countries are lower than to import from/export to countries outside the EU. The location can also be a relevant factor; they trade with countries closer to one and other. Countries with a lower degree of trade within the European Union are mostly western countries, richer countries, and may be trading more with countries outside the EU (the US, Asia and Norway) to stimulate the demand for specific goods and to seek a broader range of products from all over the world.

When looking at export, the countries around the Mediterranean Sea tend to have less export than other countries in the European Union; Malta, Cyprus, Spain, Italy and Greece. These countries have limited national resources, and the main exports are fruits, vegetables, wines, textiles and clothing, machinery, and tobacco in Cyprus, (Trading Economics, 2012, and Encyclopedia of the Nations, 2012). The low degree of trade is mainly due to the limitations in national resources to export and long traditions of production and usage of local food. These factors must not be mistaken as low degree or will of integration. For Greece and Italy, the benefits of less inflation ware more important than the trade benefits when joining the monetary union (De Grauwe, 2009).

For open countries, like the Eastern European and the Benelux-countries, the trade benefits from a membership in EMU are grand. Less open countries like Greece and Italy had other incentives for joining the union, e.g. control over their large level of inflation. When it comes to total activity presented in table 3, it is not certain that 2011 is a representative year when it comes to trade, due effects from the financial crisis and the financial and fiscal instabilities present in the Eurozone. It is also difficult to determine how much trade it takes to generate net benefits in a monetary union.

4.2.2 Symmetry in shocks

Two views of the effect of an increase in trade to the symmetry in shocks were stated in part 3.1.1.2; The European Commission and the Krugman view. This thesis will not analyze the frequency of asymmetric shocks after joining a monetary union, but find the degree of symmetry in shocks between the member countries. This symmetry in shocks can be found by taking the correlation between each member country and the Eurozone of growth in real GDP, employment and demand.

The symmetry analysis consist of three correlation analyses, the correlation of growth in real total domestic demand for all Eurozone countries and the Eurozone aggregate for the years 1998-2011 (OECD, 2011), the correlation of growth in employment between all Eurozone countries and the Eurozone aggregate for the years 1998-2011 (Eurostat, 2012) and the correlation of growth in real GDP between all Eurozone countries and the Eurozone aggregate for the years 1996-2011 (Eurostat, 2012). Table 4 presents each country's correlation with the Eurozone aggregate, and not the correlation between single countries.

The degree of symmetry in shocks between member countries and the Eurozone;

Correlation with the Eurozone			
Growth of;	real GDP	Employment	Demand
Belgium	92 %	49 %	80 %
Germany	90 %	36 %	74 %
Estonia	81 %	54 %	68 %
Ireland	75 %	92 %	88 %
Greece	47 %	50 %	56 %
Spain	87 %	91 %	88 %
France	97 %	70 %	97 %
Italy	97 %	87 %	93 %
Cyprus	80 %	67 %	
Luxembourg	91 %	-40 %	81 %
Malta	55 %	24 %	
Netherlands	91 %	67 %	88 %
Austria	94 %	47 %	87 %
Portugal	75 %	81 %	66 %
Slovenia	88 %	45 %	80 %
Slovakia	57 %	44 %	36 %
Finland	96 %	88 %	83 %
Average	**82 %**	**56 %**	**78 %**

Table 4: Symmetry in shocks

Permanent shocks to the economy can be reflected in real GDP, and temporary shocks can be reflected in demand. Countries that are not in a monetary union have a higher probability of less correlation due to the fact that different monetary policies can be the cause of asymmetric shocks. In this case the countries are all in the same monetary union and are affected by the same monetary policy after they joined, which affect the countries in a similar way and makes shocks more symmetric. Even though the same monetary policy leads to the correlation factors being endogenous, there is more symmetry in a monetary union.

Each member country's growth in real GDP is highly correlated with the Eurozone aggregate. The Eurozone aggregate is growth in total real GDP for all members of the monetary union, and the biggest countries in terms of GDP will as follows have a large correlation. The sample consists of yearly data, which implies few observations. The results may be stronger in this case, and represent a larger correlation, compared to a larger data set. Disregarded the fact of a small sample, the matrix shows large correlation in growth of real GDP. The exceptions from very large correlation are Greece, Malta and Slovakia (the other countries have a

correlation coefficient over 0,75), but the correlation is still strong. When it comes to growth in real GDP, the correlation with the Eurozone can be characterized as relatively strong for all member countries, and shocks to real GDP can be said to be very symmetric.

When it comes to employment, the correlation is not as high as for real GDP, but still, it can be characterized as high correlations. The exception in this case is Luxembourg, where the correlation is negative and may be due to the extensive protection of employees (Lowtax, 2012). Germany, Malta, Austria, Slovakia and Slovenia have lower correlation than the other countries. Germany is the highest weighted country in the Eurozone aggregate, and the relatively low degree of correlation can be interpreted that other countries are moving in the opposite direction of Germany, and it can be difficult to make unambiguous conclusions about symmetry in employment. The correlation coefficients must be interpreted with caution due to the small sample size. Shocks in employment can be characterized as relatively symmetric.

The correlation of growth in demand between the member countries and the Eurozone are high for most countries, only Slovakia has low correlation. Data for Malta and Cyprus were unavailable. Shocks in real demand tend to be symmetric within the Eurozone.

All in all, shocks can be characterized as more symmetric than asymmetric, and symmetry in shocks to real GDP and real demand is higher than symmetry in shocks to employment. This can be due to the fact that Germany has more regulations of the labor market, and the ability to create new jobs independent from the market situation. The results must be interpreted with caution, and criticism can be raised to the small sample sizes.

4.2.3 Labor market flexibility; mobility of labor and wage rigidities

For countries where the mobility of labor is limited and the flexibility in wages is low, a membership in a monetary union can be very costly when asymmetric shocks occur. Due to separate policy regimes, institutional differences in labor markets have accumulated over the years. The reason for the limited mobility of labor may be due to language barriers, cultural differences and affiliation of own country and culture.

It is difficult to determine the degree of flexibility for the member countries in the Eurozone, the flexibility in labor markets is not easily quantified, and difficult to analyze. For countries that have a centralized wage bargaining, the wage tends to be less flexible when it comes to flexibility in the upward direction, but more flexible when it comes to downward flexibility.

Decentralized wage bargaining is more flexible when it comes to increasing wages due to a higher pressure from unions to increase wage as a result of higher productivity, but less flexible when it comes to decreasing the wage level.

My overall evaluation of the labor markets in the Eurozone is that there is a low degree of flexibility. This can be a result of several factors as stated above, such as cultural differences and language barriers. In comparison with the US, where the flexibility is much higher, language and cultures are not major obstacles, and in addition they have a different mentality when it comes to labor mobility; they live where they work, in oppose to the Eurozone; they work where they live.

4.2.4 Symmetry in shocks and flexibility in labor markets compared

Isolating all other effects, when placing the Eurozone in relation to the OCA line in figure 10, only considering symmetry in shocks and flexibility in labor markets, I would place the Eurozone just above the OCA line. The levels of symmetry among member countries are relatively high, but the flexibility in labor markets is relatively low.

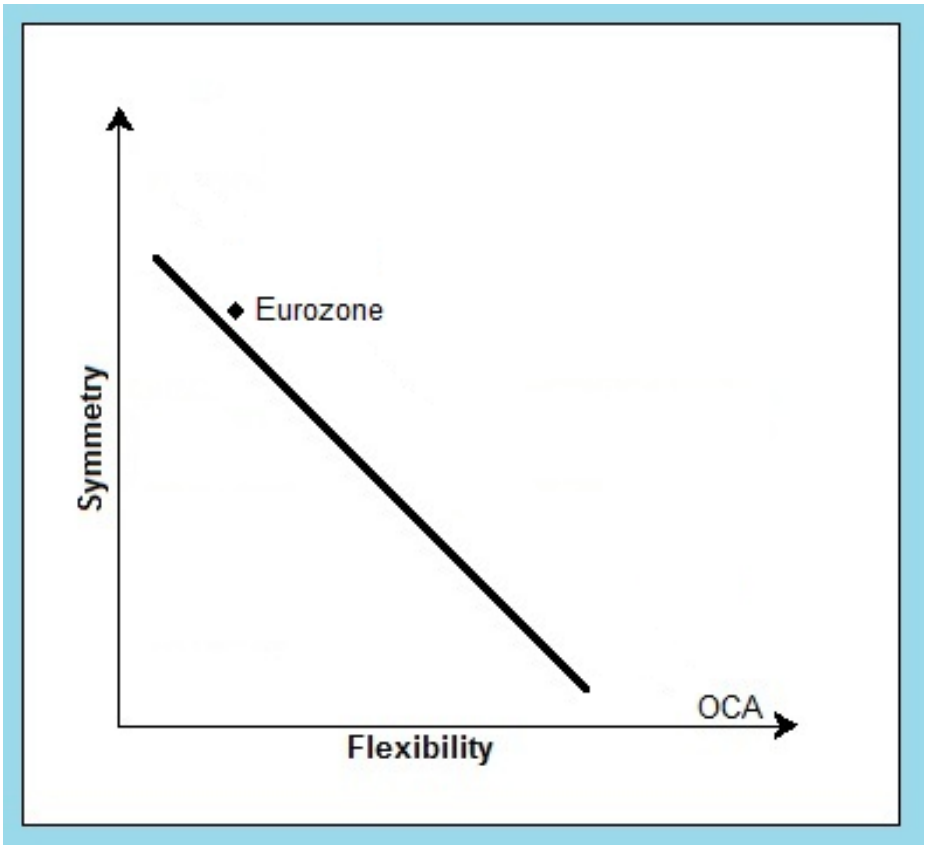

Figure 17: Eurozone in relation to the OCA line

4.3 Effects from the introduction of euro in the member countries

This section will address different effects of the introduction of euro and the loss of national monetary policy for the individual countries. In countries where the loss of monetary policy has not been relatively costly, the monetary policy had little effect on the economy in the country before joining the monetary union, and generates higher net benefits, which is in line with the monetarist view, mentioned in part 3.3.1 and 4.2.1. Even though it is still too early to determine whether the membership in the EMU and the loss of national monetary policy have had a significant impact on output, inflation and unemployment, this section will address the effects up until 2011. The results must be interpreted with caution, as the sample size is small and the monetary union is still young.

4.3.1 Desired interest rate

The two main costs and losses by joining a monetary union are the national interest rate and the exchange rate as instruments to stabilize the economy. This section will present a comparison of desired interest rates (target rates) between each member country calculated by the Taylor rule, to find the deviation between actual target rate and the optimal target rate for each country, theoretically.

Desired interest rates are calculated for the Eurozone countries, including the Eurozone as a whole, by using the simple Taylor rule stated in equation 4.3 (Taylor, 1993).

Equation 4.3 $$i_t = \bar{r} + \pi_t^* + \gamma_\pi(\pi_t - \pi_t^*) + \gamma_y(y_t - y_t^*)$$

The equation consists of the real equilibrium interest rate, $\bar{r}$ at full employment, inflation target, π^* and potential GDP, y^*. γ_π and γ_y are positive parameters. Taylor postulated that $\bar{r}$ = π_t^* = 2, and γ_π = γ_y = 0,5.

Taylor's inflation parameter has been discussed to be too low, and that it should be larger than 1 in order to lead to stable inflation (Alesina et al., 2001). It should be larger than 1 so that when inflation exceeds target, nominal interest rate should increase by more than inflation rate to increase the real interest rate. Only when increasing the real interest rate, inflation can be brought back to target. Alesina et al. found the parameters for the Eurozone to be γ_π = 1,5 and γ_y = 0,5. The central banks reaction function can be formulated as in equation 4.4.

Equation 4.4 $$i_t = 2 + 2 + 1{,}5(\pi_t - 2) + 0{,}5(y_t - y_t^*)$$

Table 5 includes each country's relative size, the inflation rate of each country in 2011 (Eurostat, 2012), the output gap for 2011 (OECD, 2011) and the calculated desired interest rate. The relative size is calculated by dividing the country's real GDP by the Eurozone real GDP for all members in 2011. The relative size of Malta and Cyprus are 0,1% and 0,2%, respectively, these two countries are not included as output gaps for these are not available.

Country	Relative size	Inflation	Output gap	Desired interest rate
Greece	2,1 %	3,10 %	-15,00 %	-1,85 %
Ireland	1,8 %	1,20 %	-7,79 %	-1,09 %
Slovenia	0,4 %	2,10 %	-3,53 %	2,38 %
France	21,5 %	2,30 %	-3,42 %	2,74 %
Spain	11,1 %	3,10 %	-4,94 %	3,18 %
Finland	2,0 %	3,30 %	-4,57 %	3,67 %
Eurozone		**2,70 %**	**-2,57 %**	**3,76 %**
Germany	27,7 %	2,50 %	-0,79 %	4,36 %
Italy	16,7 %	2,90 %	-1,74 %	4,48 %
Netherlands	6,6 %	2,50 %	-0,14 %	4,68 %
Portugal	1,8 %	3,60 %	-2,66 %	5,07 %
Luxembourg	0,4 %	3,70 %	-2,85 %	5,12 %
Austria	3,2 %	3,60 %	-1,82 %	5,49 %
Belgium	3,8 %	3,50 %	-1,50 %	5,50 %
Estonia	0,1 %	5,10 %	-3,89 %	6,70 %
Slovakia	0,7 %	4,10 %	1,10 %	7,70 %

Table 5: Desired interest rates for all Eurozone members in 2011

The desired interest rates are ranged from lowest to highest. Germany, France, Italy and Spain have the largest real GDP and furthermore larger weights; they have more influence on the theoretical interest rate decision.

For Greece and Ireland, the desired interest rates calculated from the Taylor rule are negative, which is mainly due to the high negative output gap. Countries in the other end of the table have the need for a relatively large interest rate due to their high inflation. Inflation has been well above target for almost every country, with the exception of Ireland, but at the same time the output gaps have been negative in 2011 for all Eurozone countries, except for Slovakia. There is currently a trade-off situation in the interest rate decision between inflation and output. As mentioned in 4.1.1, ECB have emphasized output in 2011, along with other factors like employment and the fiscal situation in the Eurozone, which has led to the target interest rate being held at a low level, and was between 1% and 1,5% throughout 2011 (compared to the calculated target interest rate of 3,76%). This deviation is an example of the fact that some

rules and models for the economy are simple, and should never be used for something other than a cross-reference, or to increase the understanding of reaction functions.

The gap between desired interest rates between Eurozone member countries is 9,55%. Countries in the high end and countries in the low end can be subject of unfortunate interest rate decisions. Countries in the low end need to be stimulated to increase price level or economic activity, and the high activity/high inflation in countries in the high end need to be dampened. The European Central Bank cannot do both at the same time, and there will always be losers when it comes to interest rate decisions.

In the long run, it is believed by monetarists and stated in macroeconomic theory that monetary policy does not have an effect on the real economy, which means that the loss of national monetary policy is not a severe cost. Consequences in the short term of e.g. low interest rate when there is a need for higher interest rate can help "fuel the fire" in the economy; the prospect for the future is good, expectations about the future by investors, increase investment and animal spirit; market values can exceed fundamental values in stocks, and create bubbles in house prices and other assets. These expectations and the increased demand cause pressure on prices, in can result in increased inflation. Also increase in output, and risk caused by bubbles.

The following sections will describe the situation of output, employment, growth in GDP and the fiscal situation for all 17 members of the Eurozone, and will be related to the desired interest rates in table 5.

4.3.2 The common currency's effect on inflation

The largest cost of joining a monetary union is the loss of national monetary policy; these costs are in terms of higher volatility in inflation and output. This section will locate effects from the loss of national monetary policy in terms of volatility, to the extent inflation and output deviates from inflation target and normal output, respectively. If the mean absolute deviation from inflation target/normal output is lower after, relative to before the introduction of the euro, these countries have had benefits of more stable inflation/output, and if the deviation from inflation target/normal output is higher after, relative to before the introduction of the euro, the loss of monetary policy can be interpreted to be costly in terms of increased volatility in inflation and output.

Instead of presenting the results graphically, they are presented in a table, which is illustrative when it comes to volatility. The results are presented by MAD: Mean Absolute Deviation;

Equation 4.5 $$\frac{\sum_{i=1}^{n}|x_i - \hat{x}|}{n}$$

Instead of deviation from the sample average, it can in this case be more illustrative to take the deviation from inflation target, 2%, to locate volatility effects of centralized monetary policy.

Equation 4.6 $$\frac{\sum_{i=1}^{n}|x_i - 2\%|}{n}$$

The analysis is based on monthly inflation given by annual rate of change (Eurostat, 2012). Although data were only available from 1997, which implies a relatively small sample size for the years before introducing the euro and uncertainties when it comes to whether or not these 24 months (for 11 countries) are representable for a period of "normal" inflation, the results are very interesting and can be seen as indicative.

Table 6 presents the mean absolute deviation from the inflation target;

Mean absolute deviation from the inflation target (2%)

Period/country	1997-2011	Before euro	After euro	Difference
Eurozone	0,56	0,55	0,56	-0,01
Belgium	0,92	0,80	0,94	-0,15
Germany	0,75	0,93	0,72	0,20
Estonia	3,34	3,97	2,94	0,43
Ireland	1,52	0,63	1,65	-1,02
Greece	1,58	1,86	1,49	0,37
Spain	1,11	0,32	1,23	-0,91
France	0,66	1,02	0,61	0,41
Italy	0,57	0,21	0,62	-0,41
Cyprus	1,23	1,09	1,56	-0,46
Luxembourg	1,20	0,82	1,26	-0,44
Malta	1,13	1,03	0,40	-0,37
Netherlands	0,79	0,43	0,84	-0,41
Austria	0,75	1,00	0,71	0,29
Portugal	1,08	0,43	1,18	-0,74
Slovenia	3,22	4,19	1,39	2,80
Slovakia	3,70	4,28	1,58	2,70
Finland	0,90	0,71	0,93	-0,22

Table 6: Inflation and mean absolute deviation from inflation target

The table is divided into two parts, and starts by presenting the MAD for the whole period, January 1997 – April 2012. Secondly, the mean absolute deviation from inflation target is divided into the period before and after the introduction of the euro for all member countries; 1997-1998 and 1999-2012 for Germany, France, Italy, Spain, Portugal, Finland, Ireland, Belgium, Netherlands, Luxembourg and Austria, 1997-2000 and 2001-2012 for Greece, 1997-2006 and 2007-2012 for Slovenia, 1997-2007 and 2008-2012 for Malta and Cyprus and 1997-2010 and 2011-2012 for Estonia. These definitions of "before euro" and "after euro" will apply in every table and analysis where "before euro" and "after euro" are mentioned.

The first column gives the mean absolute deviation from target over the whole period analyzed. The Eurozone as a whole has a relatively low deviation from inflation target with an average deviation of 0,56%, which is consistent with the conclusion in 4.1.1 that in terms of main target of the monetary policy for the Eurozone (inflation below, but close to 2%), the ECB's management of the monetary policy has been satisfactory.

Countries with relatively low degree of deviation from target are Germany, France, Italy, Netherlands and Austria with average deviation from target of less than 0,8%, these are also the countries with the largest weights in the Eurozone aggregate in terms of real GDP.

The countries with most volatile inflation, in terms of deviation from the Eurozone inflation target of 2%, are the newer Eurozone members; Estonia, Slovakia and Slovenia. The average deviation from target is over 3%, and this result is not surprising due to the fact that they are relatively new to the Eurozone and the volatility might have been very high before they joined the Eurozone due to facts like e.g. no inflation regulations or another inflation target. Other countries with relatively high deviation from the inflation target are Ireland and Greece with a deviation close to 1,5%, and also Spain, Cyprus, Luxembourg, Malta and Portugal with over 1% deviation from target in average. Ireland's high degree of deviation from target is due to high inflation in the first half of 2000s and deflation in 2009 and 2010, and Greece's deviation from the inflation target is due to overall high inflation over the whole period.

The fact that the average deviation in the Eurozone is the lowest deviation from target, implies that some countries exceed the inflation target and some countries have inflation below, but the Eurozone inflation makes the situation look better than it actually is; the actual deviation from target in individual countries are higher, but the Eurozone aggregate is close to 2% with the highest weighted countries Germany and France contributing to the downward pressure of Eurozone aggregate inflation and the other countries to an upward pressure.

To find out whether the membership in the monetary union has been costly or beneficial in terms of inflation, the time series can be divided into two parts; before euro and after euro. When taking the mean absolute deviation from target before euro and compare it to the deviation after euro, it is possible to make indicative feedback on the effect of the loss of monetary policy.

For some countries, the effects of being in a monetary union has been positive; the average deviation from inflation has been reduced; Slovakia and Slovenia are countries with the highest positive effects (respectively 2,7% and 2,8% closer to target in average over the years in the Eurozone). Other countries with positive inflation effects after introducing euro have been Greece and France, and a small positive effect in Austria. Estonia also has a positive effect, but due to facts of its recent membership and the global financial crisis, it is impossible to draw any conclusions about whether or not this positive effect is due to the membership in the Eurozone or not.

Some countries have had no substantial change in the average deviation from target, such as Belgium, Finland and Germany (2% ± 0,2% in average).

A country that experiences more volatility in inflation after joining the Eurozone, and where the membership has been costly because it cannot use effective instruments to control inflation e.g. the interest rate, is Ireland (over 1% increase in deviation from target after its membership). Spain, Portugal, Cyprus, Luxembourg, Italy, Netherlands and Malta have experienced an increase in deviation from inflation target of between 0,3 and 1%.

A test to find if there has been an overall positive or negative effect of the euro to all member countries is a t-test. This is a paired sample t-test for the average deviation before and after the introduction of euro. The null hypothesis, H_0, and the alternative hypothesis, H_1, can be formulated as follows, where $\overline{d\pi}$ is the average deviation from inflation target;

Equation 4.7 $H_0: \overline{d\pi}_{\text{before euro}} = \overline{d\pi}_{\text{after euro}}$

Equation 4.8 $H_1: \overline{d\pi}_{\text{before euro}} \neq \overline{d\pi}_{\text{after euro}}$

When performing a paired two sample t-test (appendix C) of the average deviation from inflation target before and after the introduction of euro, the result is that I fail to reject the null hypothesis at the 10% significance level and there is no difference in deviation from inflation target before and after the introduction of the euro. Due to the small sample size, a 10% significance level is appropriate, (p-value = 0,6507) (appendix C (a)).

The result, of no significant difference in inflation before and after the introduction of euro in the respective countries, must be interpreted with caution. The result of this analysis can only lead to the conclusion that there is no difference in inflation for all Eurozone members as a group, but it does not say anything about the situation for the individual countries. Due to the fact that the Eurozone does not have mechanisms to smooth inflation differences between single countries, the countries that have experienced an increase in inflation also have more costs associated with the membership in the monetary union; the loss of national monetary policy for these countries are costly. Ireland, Spain and Portugal have had the largest increases in average inflation after joining the monetary union, if this increase is significant is not possible to test, but a deviation from target of close to 1% every month (annual rate of change) can be discussed to be severe.

The desired interest rates calculated in table 5 for Ireland, Spain and Portugal are -1,09%, 3,18% and 5,07%, respectively. The actual target rate has been between 1% and 1,5% in 2011, which is high for Ireland, and low for Spain and Portugal (based on the calculations of desired interest rate). This degree of deviation in the level of interest rate required and the actual interest rate can lead to costs in terms of higher volatility in inflation (higher inflation for countries in need of higher interest rate, and lower inflation for countries in need of lower interest rate), higher volatility in output gap (same logic as for inflation) and an unfavorable high level of unemployment in countries where the target rate should have been lower.

4.3.3 The common currency's effect on output

An effect from the loss of the national monetary policy is the ability to use the interest rate to stimulate output. The MAD analysis and t-tests used to analyze volatility in inflation will be applied to output gap in this section. The mean absolute deviation from "normal" output, when the output gap is zero, is calculated in appendix D for the whole period; 1994-2011 (OECD, 2011) and is divided into before and after the introduction of the euro in the respective countries. This analysis is based on yearly data for 14 Eurozone members gathered from OECD; data for Malta, Cyprus and Slovenia are not available. The MAD from normal output is calculated using the formula;

Equation 4.9 $$\frac{\sum_{i=1}^{n} |x_i - 0|}{n}$$

Due to the fact that the time series are available from 1994, gives a more correct estimate for the volatility in output before the euro compared to the volatility in inflation, on the other

hand, due to the small sample size from the time series being yearly, results must be interpreted with caution.

When analyzing the whole period, the average deviation from normal output for the Eurozone is 1,34% (appendix D). The introduction of euro has stabilized output in Slovakia and Estonia, even though these are the countries that desire the highest interest rates when only considering inflation and output. The effects of the introduction of the euro to these countries can be further discussed to be uncertain due to their new membership status. When taking a t-test for the paired sample mean, I failed to reject the null hypothesis of no difference between before and after the euro (appendix C (b)).

It is more reasonable to analyze the effects in output gap from the membership in the Eurozone when excluding the financial crisis in 2008. This is due to an abnormal increase in output before the crisis and an abnormal decline during the crisis. To analyze the effects before and after the euro, the years 1994-2006 are used. Estonia and Slovakia joined the Eurozone after 2006 and are therefore excluded from the table; this is due to the fact that the results are most likely to be biased due to the effects from the financial crisis.

Table 7 presents the mean absolute deviation from "normal" output;

Mean absolute deviation from "normal" output

Period / Country	1994-2006	Before euro	After euro	Difference
Eurozone	0,83	0,93	0,77	-0,15
Austria	1,16	1,00	1,26	0,26
Belgium	0,74	0,96	0,61	-0,36
Finland	1,81	3,06	1,04	-2,02
France	0,77	0,80	0,76	-0,04
Germany	1,06	0,71	1,29	0,58
Greece	1,22	1,27	1,15	-0,12
Ireland	3,57	2,20	4,43	2,23
Italy	1,10	1,37	0,94	-0,43
Luxembourg	2,15	3,09	1,56	-1,53
Netherlands	1,31	0,90	1,57	0,67
Portugal	1,47	1,55	1,43	-0,12
Spain	1,56	1,56	1,55	-0,01

Table 7: Output gap and mean absolute deviation from normal output

When looking at the period 1994-2006, the average deviation from trend in the Eurozone as a whole is 0,83% when the financial crisis is excluded, compared to a deviation of 1,34% when the financial crisis was included. If the time series had been longer, the financial crisis would have been more relevant, but due to the small sample size, and the fact of no severe expansion

or recession in the years 1994-1998 in Europe, the best way to analyze the impact of the euro to the output is to exclude the financial crisis, due to its large negative impact.

Countries with largest deviation from trend during the whole period in the sample are Ireland, Finland, Luxembourg, Portugal and Spain. France, Belgium and Germany are the countries with the lowest degree of deviation from trend. Ireland and Spain had positive output gap in the mid-2000s when the other countries had negative output gaps. The economic activity in Ireland can be characterized as very strong in the years 1995-2007 (growth in relation to output gaps will be analyzed in the next section). Germany had the largest negative deviation between GDP and trend under the low economic activity period in the mid-2000s (OECD, 2011), and can be a possible explanation for the low target rate level.

The difference between deviation from trend before and after the introduction of the euro has been positive for some countries, positive in the meaning of output being closer to trend and lower volatility in output; Finland and Luxembourg are such countries. They tend to have had benefits of more stable output from being members of the Eurozone.

For some countries, the introduction of the euro has showed no effect in terms of deviation from normal output in France, Greece, Portugal and Spain. Even though they have lost the most effective instrument to stimulate short term output and financial stability, they have not been suffering in terms of more volatile output.

The countries with more volatile output after joining the Eurozone are Ireland, Germany and Netherlands. The extent of the effects in Germany and Netherlands can be discussed to be negative or insignificant, other factors than the introduction of the euro can be more explanatory in the matter of these countries. When it comes to Ireland, the deviation from trend before 1999 was 2,20% compared to 4,43% after 1999. This high level of output can be due to a too low interest rate level for too long. Furthermore, bubbles arose in prices and output, and when the financial crisis hit, the bubble busted and a banking crisis hit the Irish economy. Ireland has costs in terms of volatility in output associated with the loss of national monetary policy, in addition to inflation as seen in table 6. This result can be interpreted as the fact that Ireland needs its national monetary policy to stimulate the economy and the loss of national monetary policy is very costly. Monetary policy in Ireland does have an effect on price and financial stability. The European Central Bank has to consider the Eurozone as a whole when deciding upon monetary policy, Ireland need to use other instruments to stimulate price and financial stability.

It can be interesting to do a paired sample t-test to find out if the introduction of the euro had a significant positive or negative effect on volatility in output, 1994-1998 being the "before euro" and 1999-2006 being the "after euro". The null hypothesis, H_0, and the alternative hypothesis, H_1, can be formulated as follows, $\overline{dy}$ is the average deviation from normal output;

Equation 4.10 H_0: $\overline{dy}_{\text{before euro}} = \overline{dy}_{\text{after euro}}$

Equation 4.11 H_1: $\overline{dy}_{\text{before euro}} \neq \overline{dy}_{\text{after euro}}$

From the paired sample t-test I fail to reject the null hypothesis at the 10% significance level and there is no difference in deviation from "normal" output before and after the introduction of the euro. Due to the small sample size, a 10% significance level is appropriate, (p-value = 0,7803) (appendix C (c)).

The result, of no significant difference in deviation from "normal" output before and after the introduction of euro in the respective countries, must be interpreted with caution. The result of this analysis can only lead to the conclusion that there is no difference in the size of the output gap for the Eurozone as a whole, but it does not say anything about the situation for the individual countries.

The development in output gap for some selected countries;

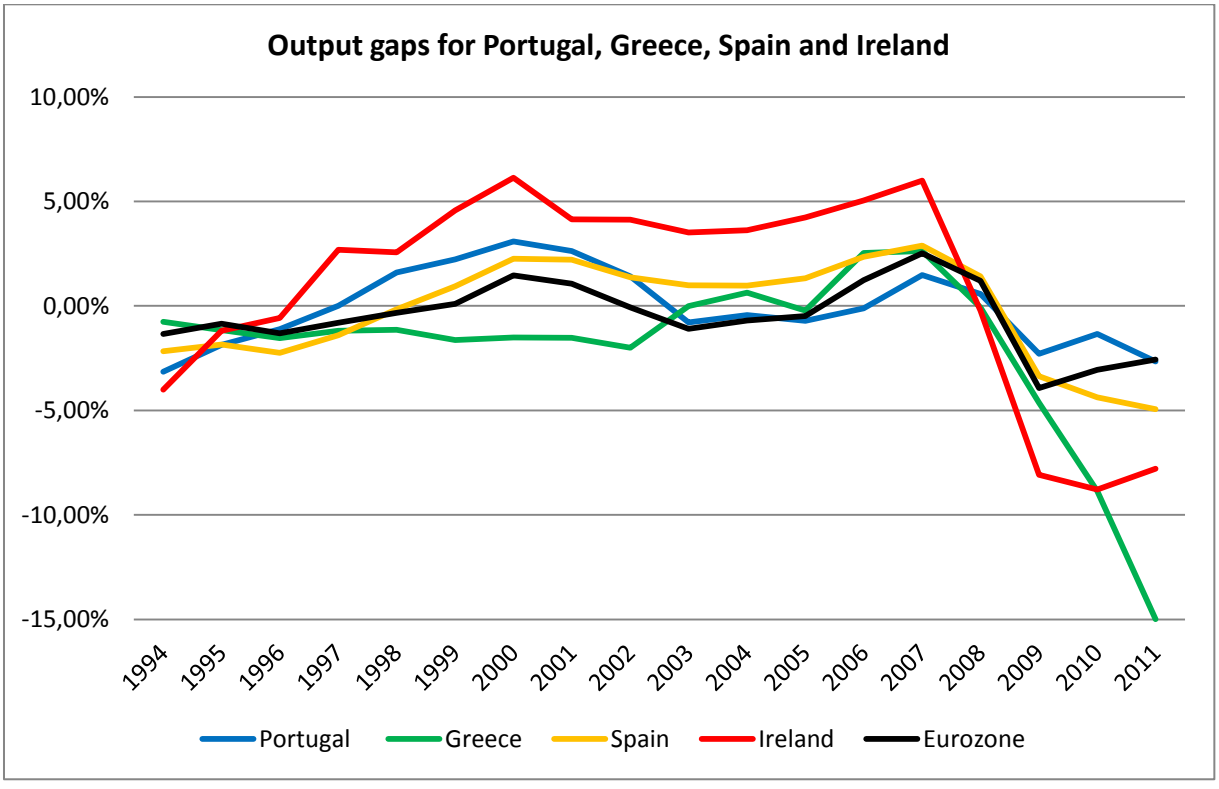

Figure 18: Output gaps for selected countries

The reason why I have chosen to look at these four countries; Portugal, Greece, Spain and Ireland, is due to the development in output gap differs from the trends in the other countries, (with exception of the new Eurozone countries which had their own monetary policy in the beginning and the mid-2000s and become irrelevant in this context). The output gap is being used to measure economic activity, and when the output gap is negative the country experience a low economic activity period and when it is positive, the country experience a high economic activity period.

The country which stands out the most is Ireland, which is also the country with the highest absolute deviation from trend. Ireland had a substantial expansion from 1996 until 2007. The membership in the Eurozone seems to have kept the activity in Ireland at a high level, until Ireland was the country with the fastest and largest decline in 2007-2008. The economic activity in Ireland is still below trend, but has recovered from 2010 to 2011.

When looking at Spain and Portugal, their output gaps tend to be similar, with the exception of the fact that Spain did not experience the negative output gap in the mid-2000s, as almost every other member of the Eurozone did. They both have declined further from 2010 to 2011, which can be interpreted as them being in a recession.

In Greece's case, the output gap was negative for the first 10 years in the figure above. What separates Greece's economic activity compared to other countries is the massive decline in output under and after the financial crisis in 2008. For the other countries, the output gap somewhat stabilized in 2009-2011, but Greece's dropped, leading it into a deep recession.

4.3.4 The common currency's effect on growth in real GDP

The problem when fast-growing countries form a monetary union with slow-growing countries is the risk of trade imbalances if the income elasticity between these countries is equal to one and the import tend to grow faster than export. To keep up competitiveness, the fast-growing countries would have to decrease prices, which would make the monetary union costly for fast-growing countries. Fast-growing countries are often the ones with more new products or old products with new features, which lead to the fact that income elasticity for export is higher and there are no trade imbalances (Krugman, 1989). De Grauwe (2009) concluded that the growth rates of fast-growing countries are sustainable after joining a monetary union.

I have presented the growth in real GDP for some countries, before and after the introduction of euro, that can be characterized as fast-growers before joining the monetary union;

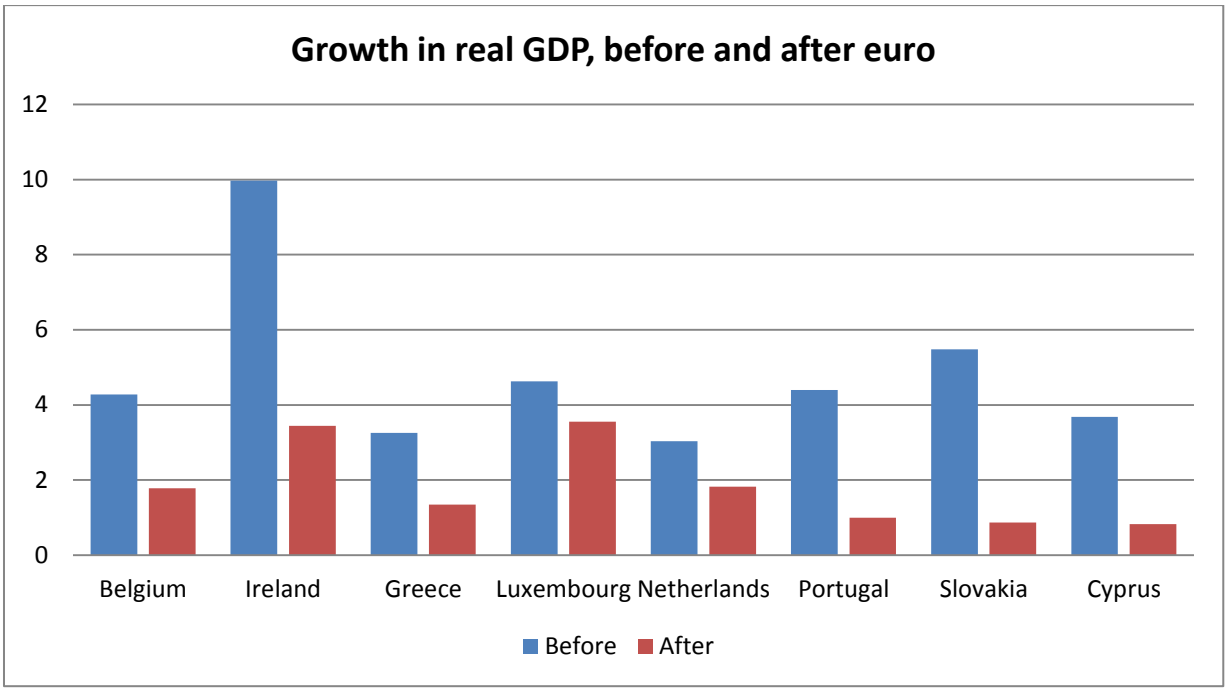

Figure 19: Growth in real GDP, before and after euro, for fast growing countries

The fast-growing countries included in figure 19 are countries with average yearly growth in real GDP over 3% before becoming a member of the Eurozone (appendix E). The null hypothesis is that growth is sustainable; average growth in real GDP ($\overline{\Delta y}$) before joining a monetary union will be equal to average growth in real GDP after joining the union for fast-growing countries;

Equation 4.12 H_0: $\overline{\Delta y}_{\text{before euro}} = \overline{\Delta y}_{\text{after euro}}$

Equation 4.13 H_1: $\overline{\Delta y}_{\text{before euro}} \neq \overline{\Delta y}_{\text{after euro}}$

When conducting a paired sample t-test for fast growing countries, the result is to reject the null hypothesis at the 1% significance level (p-value = 0,0024, appendix C (d)). The growth in real GDP significantly declined when joining the monetary union for fast growing countries. Due to a small sample size, the validity of the results can be questioned, even though the p-value is very small, and the results can seem strong. The results can also be affected by the financial crisis in 2008, which led to negative growth for all member countries, and slow growth in the aftermath of the crisis.

It can also be interesting to look at the effects in GDP growth when joining a monetary union when the negative effects from the financial crisis are eliminated. Table 20 illustrates average yearly growth in real GDP before, after and after the introduction of the euro until 2006. Slovakia and Cyprus are not relevant in this analysis due to their membership in the union becoming a reality after the test period.

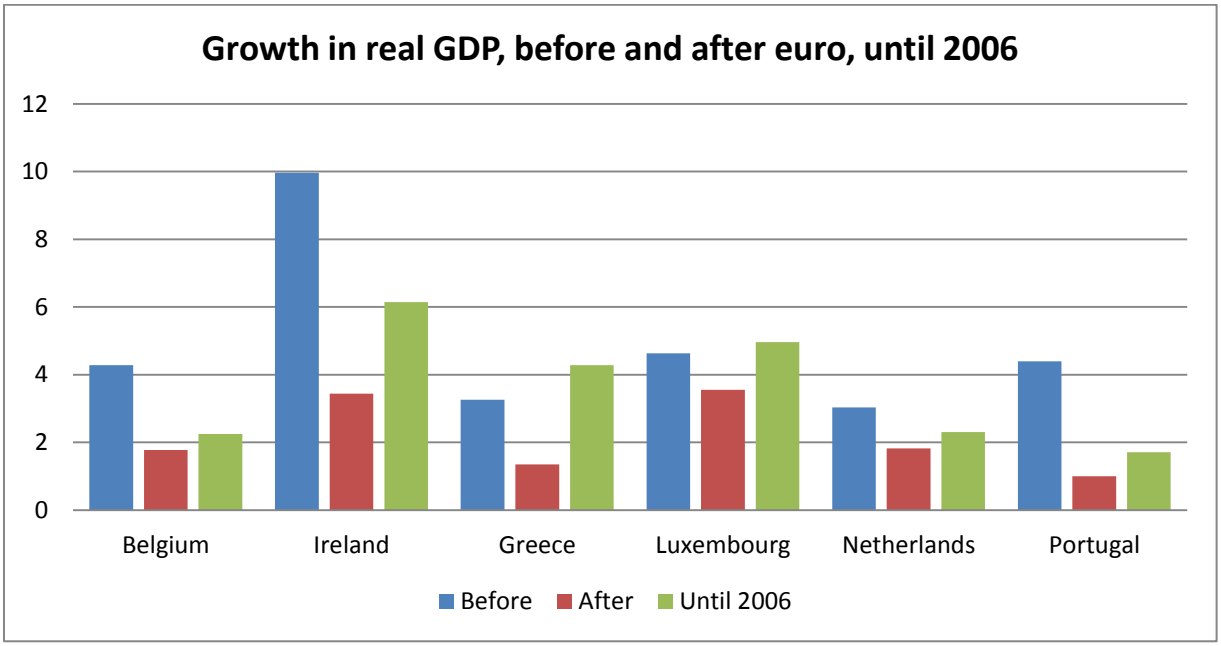

Figure 20: Growth in real GDP, before and after euro (until 2006) for fast-growing countries

When looking at the graphical results in figure 20, the growth in real GDP seems to have increased after joining the monetary union for Greece and Luxembourg, when not including the financial crisis. For Belgium, Ireland, Netherlands and Portugal, the growth has been reduced. The new hypotheses for testing if the monetary union has a significant effect on growth can be stated as follows;

Equation 4.14 H_0: $\overline{\Delta y}_{\text{before euro}} = \overline{\Delta y}_{\text{after euro-2006}}$

Equation 4.15 H_1: $\overline{\Delta y}_{\text{before euro}} \neq \overline{\Delta y}_{\text{after euro-2006}}$

The result from the t-test after eliminating the effects from the financial crisis is that I fail to reject the null hypothesis at the 10% significance level (p-value = 0,1420, appendix C (e)), and the introduction of the euro and the membership in the monetary union does not have a significant effect in growth for fast-growing countries. This is in line with the conclusion of De Grauwe (2009), of sustainable growth in a monetary union. Only when including the financial crisis, the growth in real GDP significantly declines, which gives an indication of the impact of the crisis in many countries' production.

The ECB forecasted the average annual growth in real GDP to be 2%, (section 2.4 a). Table 8 presents the average yearly growth in real GDP for all Eurozone members from 1999-2011.

Eurozone	Belgium	Germany	Estonia	Ireland	Greece
1,54%	1,78%	1,36%	4,22%	3,44%	1,67%
Spain	France	Italy	Cyprus	Luxembourg	Austria
2,42%	1,53%	0,74%	2,95%	3,55%	1,82%
Netherlands	Malta	Portugal	Slovenia	Slovakia	Finland
2,01%	1,60%	1,00%	2,85%	4,10%	2,35%

Table 8: Average growth in real GDP (Eurostat, 2012)

The growth in real GDP for the Eurozone as a whole has been moderate, and 1,54% in average, which is somewhat relatively lower than predicted.

Fast-growing countries, the countries with highest average growth have been Estonia, Ireland, Luxembourg and Slovakia with an annual average growth of over 3%. Slovenia and Cyprus also tend to have had strong growth (close to 3%). Despite the fact that the financial crisis made a relatively huge cut in real GDP for Ireland, Estonia and Slovenia, they are still characterized as fast-growers. When looking at table 6 and the average absolute deviation from inflation target, all these 6 countries were among those with highest deviation from inflation target over the whole period 1997-2011, fast growing countries can be characterized by high volatility in inflation. The effect of the monetary union has been positive for Estonia, Slovenia and Slovakia in terms of less volatile inflation. For Ireland, the membership in the monetary union tends to have led to more volatile inflation. In terms of volatility in output, presented in table 7, the fast-growing countries; Luxembourg and Ireland, have the highest deviation from "normal" output in average over the whole period, and when looking at effects of the monetary union, the introduction of the euro have had strong effects on both; to Luxembourg in terms of less volatility, and to Ireland in terms of higher volatility.

When moderate growth is defined as close to 2% (2±0,5), moderate growing countries in terms of average growth in real GDP from 1999-2011, in the Eurozone have been; Belgium, Greece, France, Austria, Malta, Netherlands, Spain, and Finland. All these countries have had an average deviation from inflation target close to 1%, over the whole period, and the effect of the introduction of the euro was insignificant to volatility in inflation (except for Spain).

When it comes to deviation from normal output, the moderate-growing countries are divided; Spain, Finland, Netherlands and Greece have had moderate to high deviation from normal output over the whole period, and the others have relatively low deviation from trend. The introduction of euro has not had any substantial effect to volatility in output, with the exception of Finland which has gained from the monetary union in terms of more stable output.

Germany, Italy and Portugal can be characterized as slow-growing countries. Portugal used to have more growth, but after the introduction of the euro, and especially after the financial crisis, the average growth in Portugal has been low. Portugal has had more volatility in inflation compared to the other slow-growing countries, and the effect of the euro has been more negative, in terms of more volatile inflation. The average deviation from output has been higher for Portugal, and the introduction of the euro has not had a significant effect to the deviation from normal output. Portugal is more similar to the moderate-growing countries, due to these characteristics, compared to the slow-growing countries; Germany and Italy. Germany and Italy have low deviation from inflation target during the period, and the introduction of euro had no effect to the extent of the deviation. Output deviation is moderate, and the euro has led to increased deviation from trend for these two countries.

Some concluding remarks from this analysis is that the fast-growing countries are characterized as volatile when it comes to inflation and output, in terms of absolute average deviation from target/normal. These are also the countries where the introduction of euro has had most effect. The moderate-growing countries have moderate volatility in inflation and output, and the introduction of the euro has had no significant effect. The slow-growing countries are characterized by low volatility in inflation, but somewhat higher volatility in output. The introduction of the euro has led to negative effects in output in terms of higher volatility in output, the output tend to deviate more from trend after 1999. The fact that the introduction of the euro has led to more deviation from inflation target/normal output for fast-growing and slow-growing countries can be explained by the centralization of the monetary policy; the economic activity in fast-growing countries, which should have had higher interest rates, was fueled by the low level of interest rates. Slow-growing countries are less affected by the target rate level.

4.3.5 The common currency's effect on unemployment

It can also be interesting to locate effects of the introduction of the monetary union in unemployment. Table 9 presents the average yearly unemployment rate over the period 1995-2011 (Eurostat, 2012), for all Eurozone members. The period is divided into "before" and "after" euro, and is given by the average unemployment rate over these periods.

Period/Country	Average 1995 - 2011	Before euro	After euro	Differance
Eurozone	9,3	10,7	8,9	-1,7
Belgium	8,1	9,4	7,8	-1,7
Germany	8,7	9,1	8,6	-0,5
Estonia	10,3	10,1	12,5	2,4
Ireland	7,6	10,4	6,7	-3,7
Greece	10,7	11,3	10,5	-0,7
Spain	14,1	18,2	12,8	-5,4
France	9,5	10,8	9,1	-1,8
Italy	8,9	11,2	8,2	-3,0
Cyprus	4,8	4,3	5,8	1,4
Luxembourg	3,6	2,8	3,9	1,1
Malta	7,0	7,2	6,6	-0,6
Netherlands	4,3	5,8	3,9	-1,9
Austria	4,3	4,3	4,3	0,0
Portugal	7,7	6,7	8,0	1,4
Slovenia	6,5	6,7	6,1	-0,5
Slovakia	15,1	15,6	13,3	-2,3
Finland	9,6	13,5	8,4	-5,1

Table 9: Unemployment

The average unemployment for the Eurozone as a whole is 9,3%, and is relatively high. This high unemployment rate can be caused by structural issues and legislation. The countries contributing most to this high unemployment are the highest weighted countries in the Eurozone aggregate; Germany, France and Italy. Spain also contributes to the high unemployment by its average of 14,1%.

It looks like most countries have decreased unemployment rates after joining the monetary union, with exceptions of Estonia, Cyprus, Luxembourg and Portugal. The decrease in unemployment can be tested whether or not it is significant.

Equation 4.16 H_0: $\bar{u}_{\text{before euro}} = \bar{u}_{\text{after euro}}$

Equation 4.17 H_1: $\bar{u}_{\text{before euro}} \neq \bar{u}_{\text{after euro}}$

When taking a paired sample t-test for the average unemployment rate for these two periods, the result is to reject the null hypothesis at the 5% significant level (p-value = 0,0245, appendix C (f)), and conclude that the membership in the European Monetary Union has led to an overall decrease in unemployment for the members. Again, the result must be interpreted with caution. The financial crisis is included in this period, and even though the financial crisis led to relatively large increase in unemployment, the effect of the monetary union is still positive.

Looking at the development in unemployment rates (appendix F), not all countries have suffered in terms of increased unemployment under the financial crisis. The unemployment rates for the different countries which did not increase under or after the financial crisis can be grouped into degree of relative size and relative stability:

- Low and stable (under 5%): Netherlands, Luxembourg, Cyprus and Austria
- Moderate and stable (7-9%): Belgium, Malta and Slovenia
- High and stable (close to 10%): France
- Decreasing from high to relatively low: Italy, Finland, Germany and Slovakia
- High and very volatile: Estonia

The other countries are more volatile as seen graphically in figure 20, and these are also the countries where the financial crisis has affected unemployment negatively.

Development in unemployment for Ireland, Greece, Spain and Portugal;

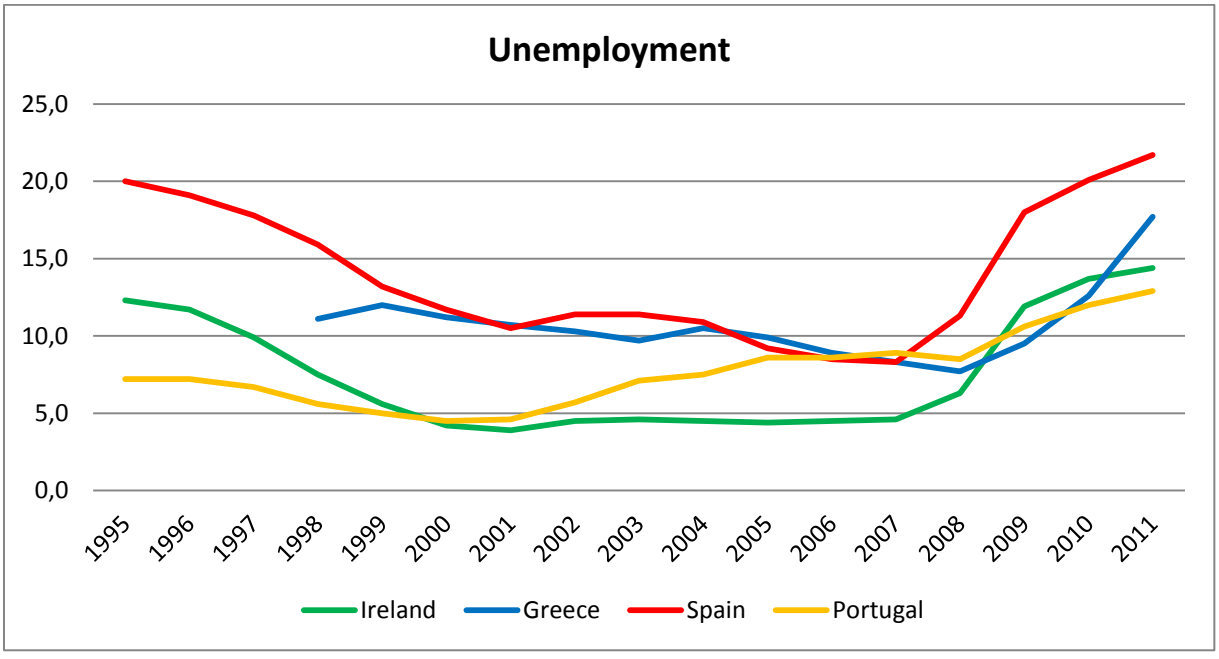

Figure 21: Unemployment

The unemployment rates for Spain, Ireland and Portugal were decreasing before they joined the monetary union, and the financial crisis triggered ripple effects which affected the unemployment rates in Ireland, Greece, Spain and Portugal negatively to great extent.

For Spain, the unemployment rate continued to decrease also after joining the monetary union. The overall high level of unemployment is due to structural issues in employment laws, reluctance to give full employment, few fixed jobs with full employment security, due to the gap between firing costs of workers with permanent and temporary contracts, and larger degree of regulation on use of temporary contracts (Bentolila et al., 2011). After the financial crisis, the unemployment rate has increased to over 20%.

In Ireland, the unemployment rate fell towards the introduction of the euro, and after the membership in the monetary union was a fact, the unemployment rate stayed relatively fixed at a low level until 2007. The relatively low interest rate level in the Eurozone could have been a driver for the low, maybe unsustainable, unemployment rate in Ireland, in addition to a high growth level in real GDP and a throughout positive output gap.

The membership in the monetary union seems to have had a negative effect to Portugal in terms of an increasing unemployment rate after the introduction of euro. Portugal experienced a loss of competitiveness after joining the monetary union.

Greece had positive development in unemployment after becoming a member of the Eurozone, the unemployment rate declined until 2008. The effects in unemployment rate from the financial crisis have dampened in the other countries, but the unemployment rate in Greece is increasing. Main problems for Greece are high debt levels, a tight budgetary situation, and a currency that is too expensive.

Spain and Ireland has suffered most in terms of increased unemployment after the financial crisis, these countries are characterized by more competitive labor markets (Acocella et al., 2010). Countries with higher degree of labor market imperfections have suffered less in terms of increased unemployment; Italy, France and Germany are such countries. The main result found by Acocella et al. (2010) is that in the case of a labor wedge, real wages are increased. This result can be explained by an example in the case of a negative financial shock; if the labor wedge is low, firms will substitute capital with labor, and a high labor wedge will lower the volatility in economy.

4.4 The budgetary situation for all Eurozone members

The reason for the recent discussions about the high debt levels in some Eurozone countries, and the negative associations, is the risk involved with high debt levels. An increased risk of default in one country implies a risk to the whole Eurozone in terms of higher interest rates on debt and costs in relation to a potential bailout. The government debt level and the budget deficits for all Eurozone members in 2011 are illustrated in figure 22;

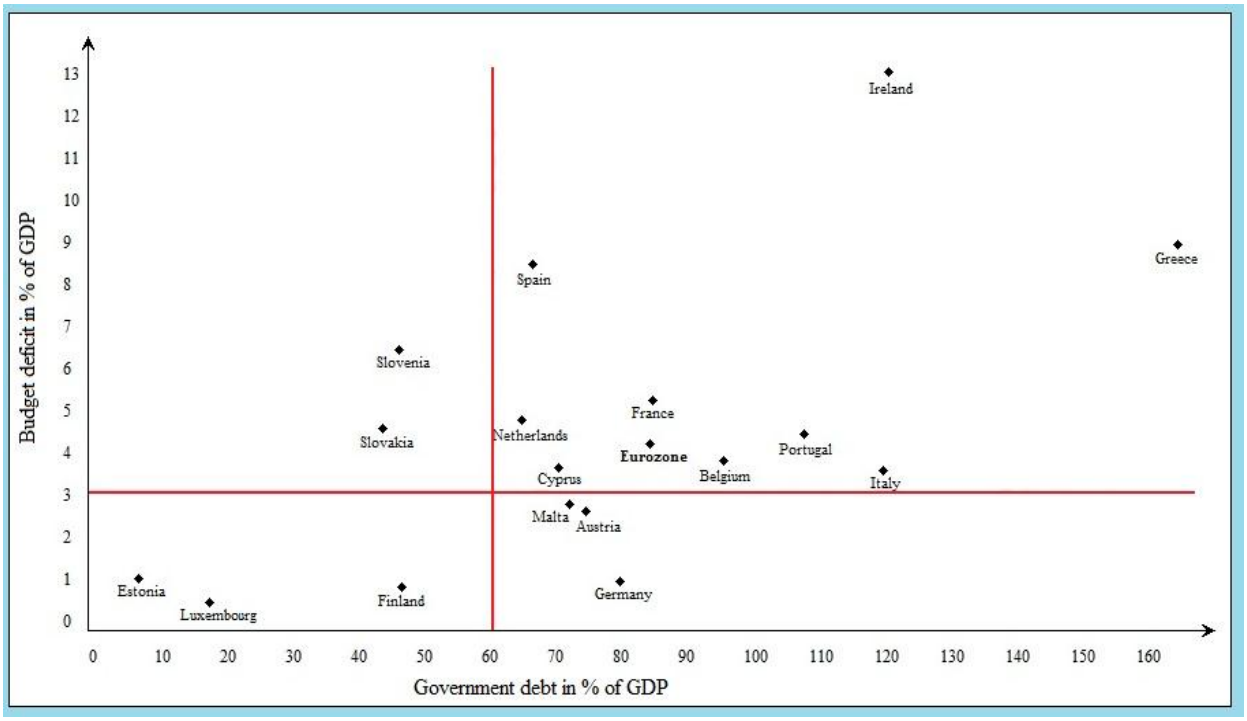

Figure 22: Debt and budget deficit for all Eurozone members in 2011 (Eurostat, 2012)

In 2011, only Estonia, Luxembourg and Finland fulfilled the Maastricht criteria of budget deficit less than 3% of GDP and a government debt level of less than 60% of GDP. The budget deficit rule was met by Malta, Austria and Germany, and the government debt rule was met by Slovenia and Slovakia. The total debt in the Eurozone was 87% of total GDP and the budget deficit 4% of total Eurozone GDP. Countries with the highest debt levels were Greece, Ireland, Italy and Portugal with a government debt level over 100%, and the countries with the highest budget deficits were Ireland, Greece and Spain. The 2011 situation may not be representative, in terms of relatively unusual high budget deficits due to the recent crisis. It can be interesting to look at the average debt and deficit levels over the recent years, and from this see how the individual countries have performed in relation to the criteria of Maastricht and the rules of the Stability and Growth pact.

The average level of government debt and budget deficits for the period 1999-2011 for the Eurozone member countries are stated in table 10.

Average level of government debt and budget deficit in percent of GDP, 1999-2011

Country	Eurozone	Belgium	Germany	Estonia	Ireland	Greece
Government debt	72,5	97,5	67,6	5,4	46,1	112,7
Budget deficit	-2,8	-1,4	-2,2	0,2	-3,9	-7,1

Country	Spain	France	Italy	Cyprus	Luxembourg	Malta
Government debt	51,4	66,9	109,0	63,0	9,5	64,5
Budget deficit	-2,4	-3,6	-3,3	-3,1	1,8	-4,8

Country	Netherlands	Austria	Portugal	Slovenia	Slovakia	Finland
Government debt	54,8	66,2	66,7	29,2	39,7	42,6
Budget deficit	-1,5	-2,2	-5,0	-3,2	-5,4	2,5

Table 10: Average government debt and budget deficit levels for all Eurozone countries (Eurostat, 2012)

In average over the period 1999-2011, Estonia, Spain, Luxembourg, Netherlands and Finland have fulfilled the Maastricht criteria of budget deficit less than 3% of GDP and a government debt level of less than 60% of GDP. The budget deficit rule has in average been met by the Eurozone aggregate, Belgium, Germany and Austria, and the government debt rule has in average been met by Ireland, Slovenia and Slovakia. The average debt in the Eurozone has been 72% of total GDP and the budget deficit 3% of Eurozone GDP, which means that in average, the Eurozone as a whole has performed well when it comes to budget deficit, but not government debt in relation to the Maastricht Treaty and the Stability and Growth Pact. The countries with overall high debt levels are Greece and Italy, with a government debt level over 100% of GDP, and the countries with overall high budget deficits are Greece, Portugal and Slovenia.

When comparing the budget situation for 2011 with the average budget situation, the financial crisis had a deep impact on Spain and Ireland, which have relatively good budget situations in average over the period. It should be mentioned that the comparison between 2011 and the average budget situation does not reveal growth in budget deficit and government debt, and the financial crisis cannot take the whole blame for the deteriorated budget situation in 2011.

Even though the debt levels and the budget deficits are high in some countries, one cannot draw any conclusions about the condition of the debts and deficits from the figures above. To

evaluate the condition of the Eurozone budgets, some factors next to debt and deficit are relevant, such as growth level and the real interest rate on the government debt. Theory of debt dynamics was presented in part 2.5.2, and when knowing the budget deficit, growth in GDP and the real interest rate on debt, the 10 year bond yield[6] (Eurostat, 2012), the Eurozone countries can be placed in figure 6. The calculations are shown in appendix G, in addition to the debt dynamics for the Eurozone countries in 2010.

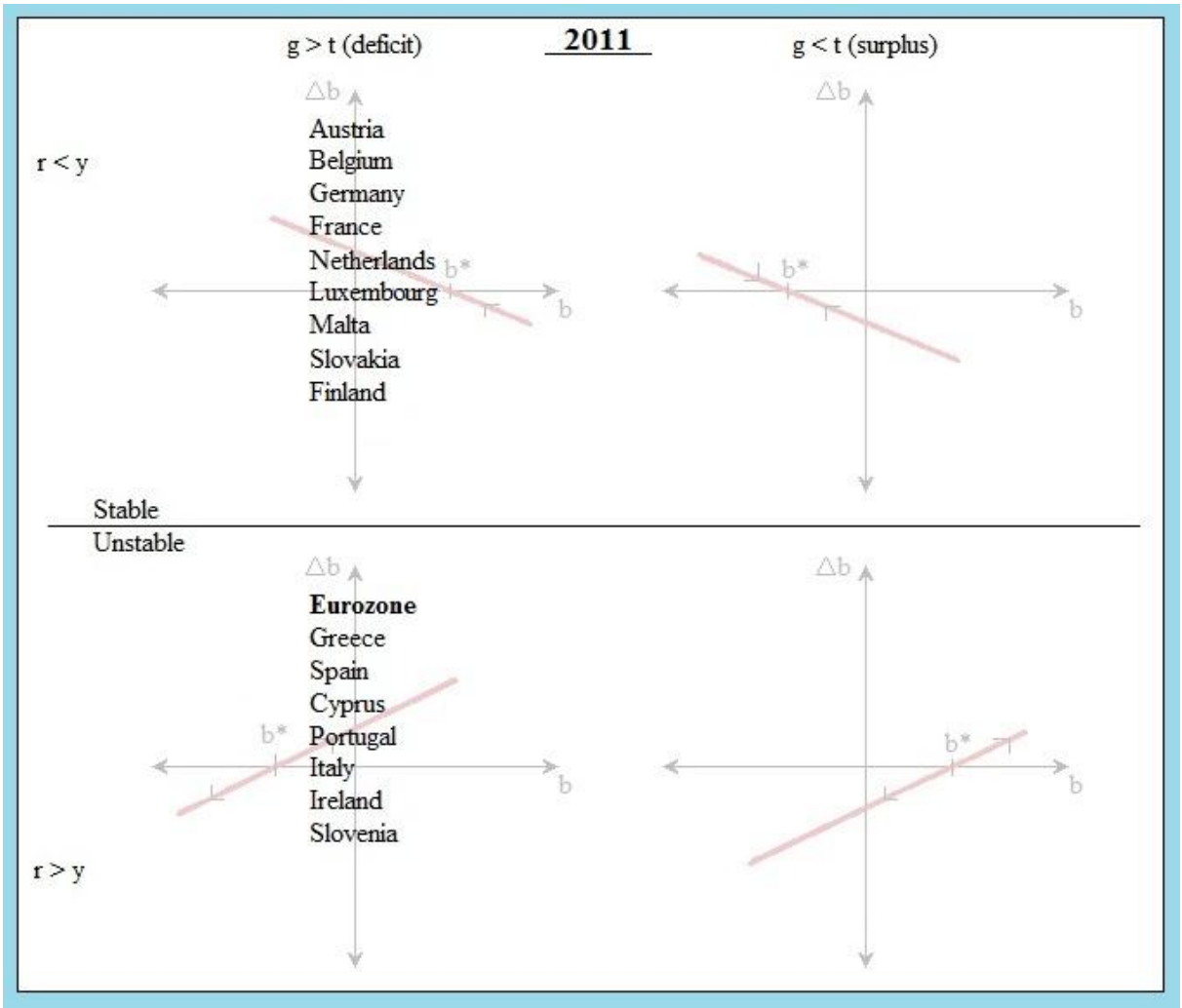

Figure 23: Debt dynamics in the Eurozone

All Eurozone countries have budget deficits in 2011, the countries above the line are debt borrowers in equilibrium, and can be characterized as having a stable equilibrium, and the countries under the line are debt creditors in equilibrium, which makes the debt dynamics unstable. The reason for the Eurozone as a whole being under the stability line is the low growth in GDP in 2011.

[6] Maastricht criterion bond yields: definition used for the convergence criterion for EMU for long-term interest rates (central government bond yields on the secondary market, gross of tax, with around 10 years' residual maturity). Source: Eurostat.

The fundamental reason for the debt crisis is the long term unsustainable increase in debt in private sector (De Grauwe, 2010). The increase in debt levels were driven by animal spirits; optimism due to decline in real interest rates, in Spain and Ireland, and pessimism in Germany. Animal spirits are self-fulfilling, and can lead to bubbles and booms/reverse.

The countries where the debt levels were unstable in 2011 were Greece, Spain, Cyprus, Portugal, Italy, Ireland and Slovenia. These countries have high budget deficits, an interest rate on debt that exceeds growth in the respective country, or both. Consequences of a high debt level can be illustrated by the situation of Greece; the country with the highest debt level in 2011. When Greece joined the Eurozone, the rules and ratings for the Eurozone applied. Greece automatically got better rated in terms of credit worthiness, and as a result, the interest rate on long term debt decreased. When the debt got cheaper, Greece lent more and spent it, taxes stayed the same. The debt level and budget deficit skyrocketed, and Greece suddenly became a more risky investment. Credit ratings fell and interest rate on long term debt increased. The debt Greece had managed to obtain in the short period of time was unsustainable and the risk of default increased; Greece became in risk of bankruptcy.

Many of the Eurozone member countries have not managed the fiscal situation well. Many countries exceed the 60% debt limit and the 3% budget deficit limit stated in the Maastricht Treaty and the Stability and Growth Pact. Reasons for the high budget deficits and debt levels may be due to political reasons. As the price of debt fell, and at the same time it became easier to borrow, the governments in some countries were tempted to increase their debt levels to increase spending. When the financial crisis hit, and as debt increased, creditworthiness was lowered, the investors raised the risk premium reflected in increased long term yields. The debt became difficult to manage, and the risk of default increased. Countries lined up to be saved by the EU and IMF from their unmanageable high interest rates on debt. In some countries, it can be close to impossible to lower the debt level once it is high due to the political opposition's promise of better conditions if they are elected, and so the debt trap continues.

When becoming a member of the European Monetary Union, a country loses the ability to conduct national monetary policy, and the remaining instrument is the fiscal policy. How can the member countries stimulate financial stability when there are restrictions on the use of fiscal policy in terms of 60% debt of GDP limit, and 3% of GDP limit for budget deficits?

5. Results

This part will follow the same structure as the analysis; it will start by summing up the results from the evaluation of the management of the monetary policy in the Eurozone, followed by a presentation of the results from the analysis related to whether or not the Eurozone form an optimal currency area, and is completed by presenting the results from the net effects that member countries have had from joining the monetary union in Europe.

5.1 The monetary policy in the Eurozone

The ECB has managed the monetary policy with success, when success only implies keeping inflation close to target. The Eurozone has had stable and relatively low inflation, but higher than the target (inflation below 2%). The output has been stable and not deviated much from trend, the interest rate has to some extent been used to correct for deviating output. When it comes to the fiscal situation of the Eurozone as a whole, the budget deficit has been below 3% (until the financial crisis), but the government debt has never been below 60%.

When it comes to price stability versus financial stability, ECB chose to have price stability as main target for the Eurozone's monetary policy; because it was believed that price stability led to financial stability. The financial crisis in 2008 proved that price stability does not necessarily imply financial stability, and without focus on financial stability next to price stability, the risk of an economic collapse increases. It was argued that financial stability can be difficult to monitor, but as mentioned in part 2.4.1, financial instabilities can easily be measured by monitoring asset prices and credit growth.

Have the emphasis of price stability to financial stability changed after the financial crisis? The president of the European Council, Herman Van Rompuy, stated that *"We are resolutely determined to guarantee the financial stability of the Eurozone"* (EU Business, 2011), and the president of ECB, Jean-Claude Trichet, stated that *"We remain firmly attached to the goal of price stability"* (Harrington, 2010). The debate on financial stability as a target for the monetary policy in the Eurozone has been brought back to light after the financial crisis (Agur and Demertzis, 2011). Financial stability as a target is supported by empirical research with the result that the policy rate affects risk taking. Opponents states that the bank regulator should take care of the bank risk.

As the situation is today, the national central bank is responsible for maintaining financial stability, and to monitor banks in its own country. The result of the delegated responsibility of financial stability has been lacking supervision of banks; they have expanded their balance sheets and taken excessive risk. The behavior of the banks can be explained by the fact that central banks and governments provide funding in the case of a crisis, and the banks keep investing in risky assets with the risk being held by the authorities. This development in the behavior of banks creates major risks and can provoke a future banking crisis. There is a great need for a centralization of the responsibility of maintaining financial stability and monitor banks.

5.2 Sum of main results from the analysis

The new member countries have the highest levels of trade, open countries contribute more to the Eurozone and they also gain more from their memberships. Shocks in real GDP, employment and real demand are relatively symmetric between the member countries and the Eurozone as a whole. The unemployment in the member countries has significantly declined after becoming a member of the monetary union.

Growth appears to be sustainable. Fast-growing countries have the highest volatility in inflation and output, in terms of absolute average deviation from target/normal, and losing their national monetary policy seems to have led to increased deviation from the 2% target. The moderate-growing countries have moderate volatility in inflation and output, and the introduction of the euro had no significant effect. Slow-growing countries have low volatility in inflation, but somewhat higher volatility in output and seem to be less effected by the target rate level, but the introduction of the euro has led to negative effects in output in terms of higher volatility in output, the outputs tend to deviate more from trend after 1999.

Almost every member country tends to violate at least one of the Maastricht criteria of government debt and budget deficit of 60% and 3% of GDP, respectively.

Even though the desired interest rates between member countries deviate by close to 10% in 2011, it does not seem to attract consequences in form of increased volatility in inflation and output gap. The cost of countries losing their national monetary policy does not seem to be severe for the Eurozone members, and most countries have net gains from their memberships.

5.3 The Eurozone in relation to theory of optimal currency areas

On the basis of openness, symmetry in shocks and the budgetary situation, I made a scorecard where I gave each country a score on their performance related to these three factors (appendix H (a)). The countries that contributes to net benefits in the Eurozone, and further converges it towards being an optimal currency area; generates trade benefits, have a high degree in symmetry of shocks and do not cause excessive risk in relation to the budget situation.

Countries with net contribution (a positive score) are green in figure 24 and countries who got a negative score are red. There are two shades of green, the darkest being the countries that contributes the most.

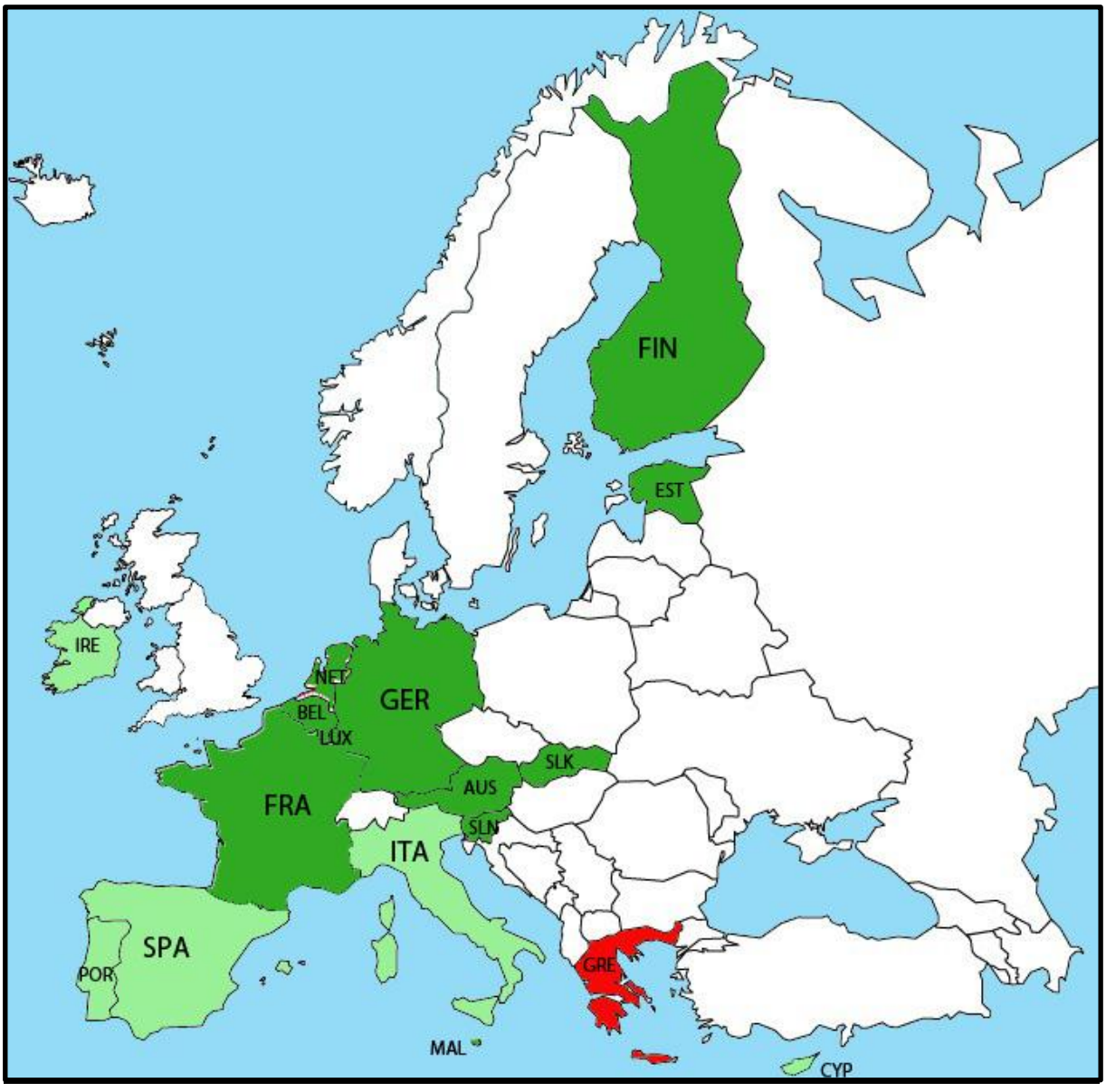

Figure 24: Countries that do/do not contribute to make the Eurozone an optimal currency area

The main result when the scores are given is that Greece is the only country that tends to be costly for the monetary union. Greece is relatively closed when it comes to trade, mostly due to the lack of natural resources to export, and low degree of import. Shocks have been symmetric to some extent, but not as much as for the other countries. The budgetary situation is the most important factor when it comes to Greece being a net cost for the Eurozone; the high level of government debt creates a risk, not only for Greece, but also for the Eurozone as a whole. If Greece defaults on paying its debt, the Eurozone has some responsibility for the debt. The risk of default, the high risk premium claimed by investors and the high long term bond yields can cause a risk of the Eurozone has to pay Greece's debt, with high interest rates.

If Greece secedes or is forced to leave the Eurozone, a critical consequence can be that Greece would not be able to borrow money due to its reputation of excessive risk of default and high debt level. To be able to manage its debt and budget deficits, Greece is most likely to print money, which may cause a risk of inflation problems, and even hyperinflation.

The Eurozone definitely has the ability to become an optimal currency area, with or without Greece. It is very difficult to determine if the Eurozone as it is today forms an optimal currency area, many factors suggest "yes" (symmetry in shocks and trade benefits), but many factors also suggest "no" (low flexibility in labor markets and as long as Greece is a member). If the Eurozone does not form an optimal currency area today, the Eurozone has potential to become an optimal currency area with the right measures and with time.

Concerning the question if the Eurozone is an optimal currency area;

- "The Eurozone has been a very successful currency area" (Feldstein, 2008)
- "The benefits exceed the costs. There is greater resilience of the euro area as a whole, low actual and expected inflation, low interest rates and greater macroeconomic stability. A benefit that has not yet emerged is the enhanced cross-country competition in several services" (Mongelli, 2008)

5.4 Net effects for individual countries by introducing euro

On the basis of openness, consequences from the introduction of euro in relation to inflation, output and unemployment, and the budgetary situation, I made a scorecard where each country was scored by how they were been affected in relation to these five factors (appendix H (b)). Countries that have gained from becoming a member of EMU have; trade benefits, lower volatility in inflation and output, lower unemployment and a good budget situation.

Countries that have net benefits (a positive score) are green in figure 25, countries that got a negative score are red, and countries with a score of zero are yellow. There are two shades of green, the darkest being the countries that have gained the most from a common currency.

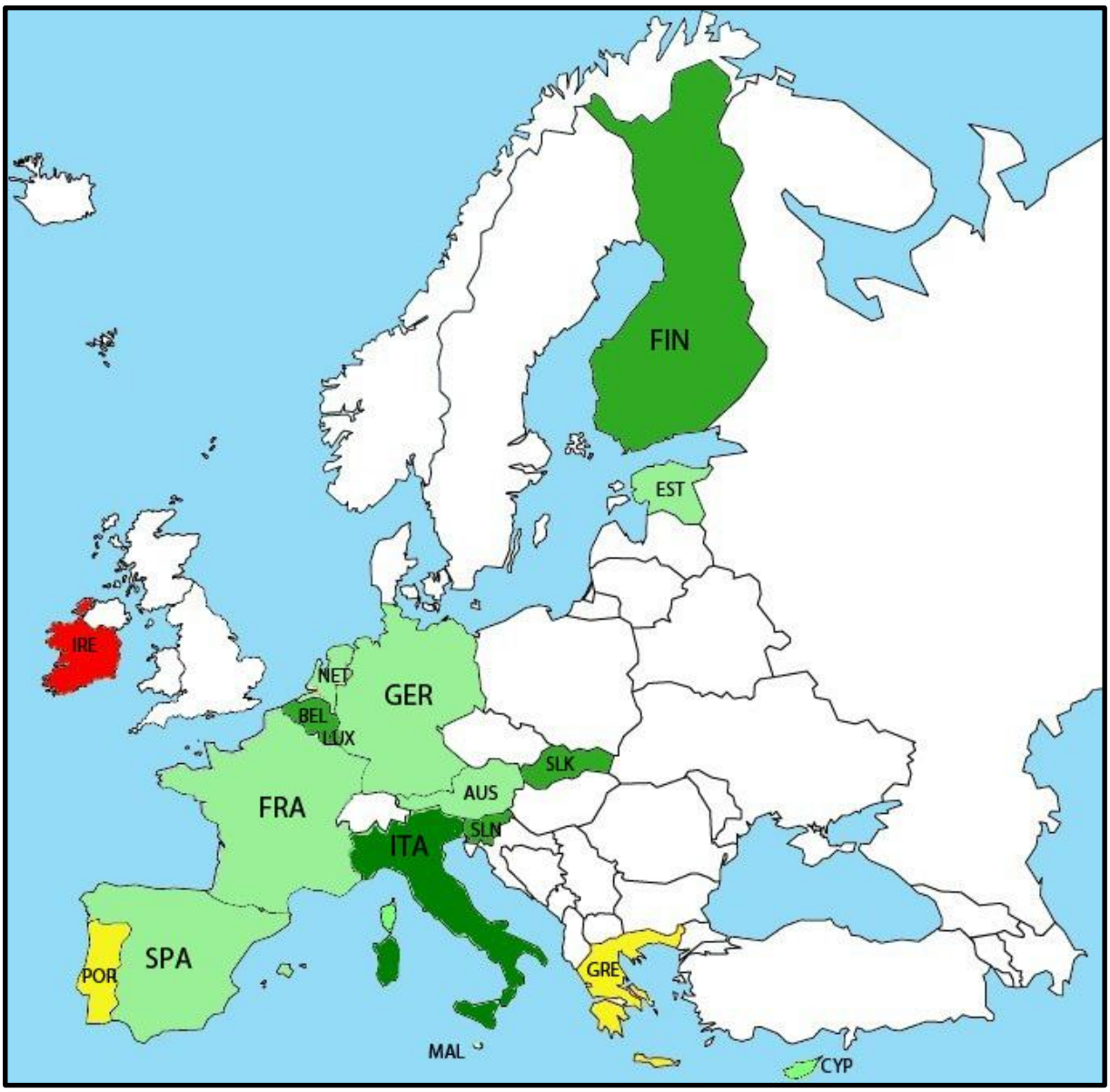

Figure 25: The net effect of the introduction of the euro to individual countries

The countries that are yellow on the map; Portugal and Greece, have both benefits and costs by being in a monetary union, and the costs cancel out the benefits. Ireland is the only country with clear net costs by being a part of the Eurozone. The loss of monetary policy has been severe, the economy in Ireland differs from the rest of the Eurozone, and Ireland does not seem to have effective instruments to stimulate financial, real economic and fiscal stability.

An optimal currency area is characterized as an area which increases wealth for its members, this can be wealth in terms of profit, many profit from no transaction costs when trading with other countries, it can be in terms of more stable financial and economic markets. For consumers it can be price transparency, housing prices[7] etc.

Ireland experienced financial instability, a banking crisis, instabilities in prices, output, fiscal situation, an unsustainable low unemployment rate and a major bubble in house prices prior to the financial crisis, as a result of a too expansive monetary policy. The house price bubble busted and the real house prices fell dramatically, which led to great losses for consumers.

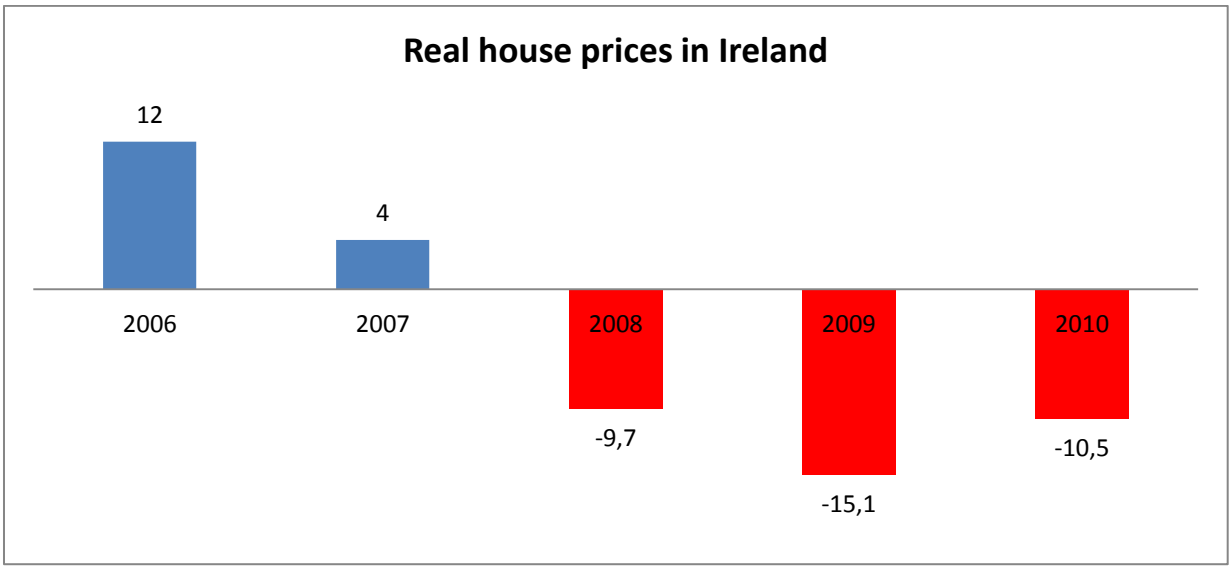

Figure 26: Real house prices in Ireland (Eurostat, 2012)

The monetary union has been a great cost for Ireland; for the government, businesses and for consumers, in terms of the losing the ability to conduct national monetary policy.

[7] The deflated house price index (or real house price index) is the ratio between the house price index (HPI) and the national accounts deflator for private final consumption expenditure (households and NPIs). This indicator therefore measures inflation in the house market relative to inflation in the final consumption expenditure of households and NPIs. Eurostat HPI captures price changes of all residential properties purchased by households (flats, detached houses, terraced houses, etc.), both new and existing, independently of their final use and their previous owners. Only market prices are considered, self-build dwellings are therefore excluded. The land component is included. Source: Eurostat.

6 Discussion

What measures can be made to transform the EMU into what we can with certainty call an optimal currency area? This question will be discussed in this part of the thesis, after a short discussion of what happens in a Eurozone break-up and what happens if there are no major structural changes in Eurozone.

The scenarios mentioned above were my initial thoughts of possible outcomes for the future of the Eurozone. The break-up and the no-change outcomes can be seen as extremities; break-up as the most expensive in terms of money, and no-change as the most expensive in terms of burden of the citizens and prosperity. I believe that there must be a middle way with a future outcome that is better than these extremities, and with the right measures, reforms, structural changes and long-term perspective, the Eurozone will eventually become a well functional monetary (and political) union, which increases wealth for all its members.

There is a strategy model which was initially made for companies, formed by Barbra Gibson, Adjunct Professor at Hult International Business School, which I find illustrative in my thesis, reflecting the outcomes above. Although the model was intended to describe various situations managers face when involved in a joint venture in different cultures, it explains possible outcomes of a strategy well.

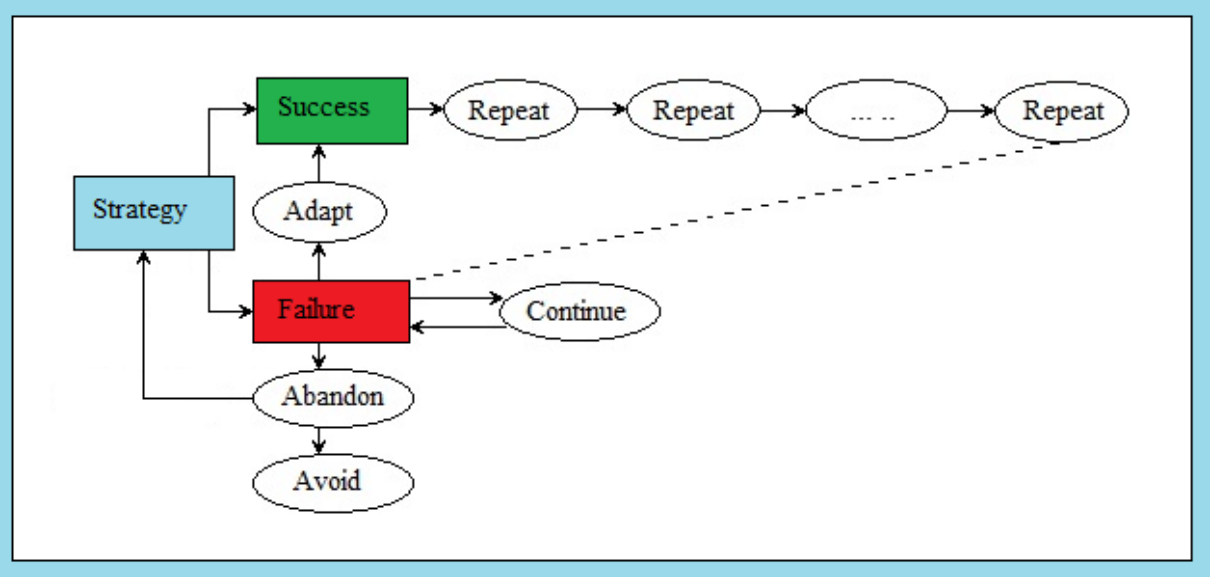

Figure 27: Strategy model (Gibson, 2012)

The model explains that you will start out with a strategy, and the strategy can either lead to success or failure. If the strategy leads to success, the strategy is usually repeated until it fails

(it will eventually fail due to dynamic environment, cultural differences, new laws, change in preferences etc.). Unless you know the market and continuously improve and adapt (not repeat), the strategy is most likely to fail at some point, and when it does, there are in this illustration three possible directions when experiencing a failure. Abandon strategy; either make a new strategy or avoid progress. Continue; when you fail and just continue with the same strategy, you will continue to fail over and over. Adapt; you can adapt the strategy to the market, culture, laws, products etc. until you succeed, and then repeat the strategy until failure. These are the dynamics of this model.

When applying this model to the Eurozone, the strategy was to create a monetary union with a common currency in the Eurozone, with a goal/vision of full integration in the European financial, banking, labor, capital and retail markets. The strategy was developed over many years, and was realized in 1999 theoretically (central bank), and in 2002 physically (the euro in coins and notes). It was a success. The strategy was repeated, and in 2008 it went wrong; it failed. The Eurozone members' national central banks had lost their most powerful instruments to correct economic and financial disturbances, the interest rate and the exchange rate, and were forced to follow the common strategies which led them into to more and deeper problems. The failure is a fact, and discussions and theories are many about what comes next; are countries going to secede from the euro and go back to their former currencies? This can be related to the abandon and avoid boxes in the model. What happens if they do nothing? They continue the strategy that has already failed, and fall into deeper problems. Or are they going to adapt to make the Eurozone a more optimal currency area and reach for success once again?

These different directions have been heavily discussed lately, and I will sum up these discussions in the following three paragraphs in my thesis. I am also going to sum up and discuss some measures on how to get back on track. This part is relatively brief and superficial, and is included in my thesis as an extension on what measures can be made to form an optimal currency area.

6.1 Scenario 1: A Eurozone break-up

Milton Friedman predicted in 2002 a collapse of the euro within 10 years due to disintegration from linguistic and cultural differences (Frydrych, 2002). Now, in 2012, it is 10 years after his prediction, which has yet to come true, a break-up of the euro is a hot topic.

The recent turmoil in the European markets has led to speculation in a break-up of the Eurozone. Some say it is too costly to fix the problems by structural changes, and some say the Eurozone is better off with their old currencies. If the members of the Eurozone choose to leave the euro and reinforce their national currencies, countries in need for a more expansionary monetary policy can devalue their national currencies and lower the national interest rates. These measures will lead to increased demand for national goods, investment, consumption and a better position when it comes to competitiveness. Furthermore, these effects will again lead to more employment and price and wage pressures. With the national monetary policy regained, countries decides their own monetary targets, which may be better suited for the economic and financial situation of the country, and debt will be priced correctly (when the euro was introduced, they could borrow at the same rate as the Eurozone).

If one country secedes, will the others follow? Germany and France will always stand up for the euro, and Belgium, Netherlands, Luxembourg and Austria will stand together with Germany and France (Klovland, 2012). Countries with large costs due to the loss of national monetary policy will probably follow the first seceding country.

There may be a lot of benefits from seceding from the Eurozone for some countries, but there will also be costs, costs in terms of losing the benefits associated with the membership in the European Monetary Union, and costs directly linked to the actual break-out. Barry Eichengreen (2010) wrote about different costs associated with a country seceding from the Eurozone. He starts his article by the statement that the decision to join the Eurozone is "effectively irreversible", before he lists up costs related to the potential break-out. First, there are *economic costs* such as the fact that wage inflation might neutralize potential benefits of increased competitiveness, and higher interests on public debt. To prevent the benefits by seceding to be cancelled out by the mentioned potential reactions, a labor market reform and a fiscal institution reform is needed when introducing the old currency. Second, there can be *political costs* associated with antagonizing the union/trading partners, and the stamp as a second class member of the EU. Third, there are major *procedural and planning costs* related to the reintroduction of the national currency such as the fact that all contracts need to be

renegotiated (wages, bank deposits, bonds, mortgages, taxes etc.). Computers will need reprogramming, vending and payment machines have to be renewed, labeling costs in stores etc. A devaluation of the national currency may lead to a *system-wide bank run* due to households and firms shifting deposits. Investors may escape, the fiscal situation may be exacerbated, the government would not be able to bail out banks; these factors may contribute to a *bond-market crisis*.

6.2 Scenario 2: No major structural changes

The scenario of no major structural changes relates to the "continue and fail" dynamic in figure 27. This can be argued to be the least favorable option due to the risk of triggering new crises and put all the Eurozone member countries in a risky position. It is not likely that countries with high debt and large budget deficits are able to solve their budget problems on their own, mostly due to political issues. If the reigning government cuts spending, increase tax, or increase the pension age, the opposition will take advantage of this and promise a more expansionary fiscal policy. With no major structural changes, more countries would need help from the ESM and IMF, and the economic and financial situation for the countries with budget problems and different preferences in monetary policy will worsen.

Countries with high unemployment rate and low economic activity (like Greece, Portugal, Spain and Ireland) should exert an expansionary fiscal policy by increasing spending and/or reduce taxes to encourage economic activity in the respective country, but they cannot do that due to the high debt levels, large budget deficits and the budget restrictions in the Stability and Growth Pact. ESM and IMF cannot bail them out indefinitely. To reduce debt problems, they have to tighten their budgets, which lead to education cuts and health cuts, or they can increase taxes, but if they do they will lose competitiveness and may be forced to cut back on employees. The results may be more unemployment, an economy in deep recession and poverty. Without major structural changes and without their national monetary policy, they are locked in a paradox.

6.3 Scenario 3: Measures and structural changes to improve EMU

"*Europe will emerge from its current turmoil, not only with the euro intact, but with far stronger institutions and economic prospects for the future*" (Bergsten & Kirkegaard, 2012).

"*Without EU-IMF aid, Greece could not pay salaries and pensions or run day-to-day government operations, a combustible addition to an already unstable political environment*" (Hope, 2012).This is a statement in relation to the Greek election in 2012, where only 2 of the 6 political parties support financial aid from EU and IMF.

The first statement gives hope to the future of the euro, and that the time for innovation is in times of crises. The other statement illustrates the need for major structural changes in the Eurozone design and its institutions.

There are many possible solutions and suggestions of structural changes and measures to improve the economic and financial situation in the Eurozone such as a reform to ensure growth, encourage confidence in the financial markets, supervision and stress tests of banks; recapitalize if needed, a need to establish crisis resolution procedures, labor market reforms to adjust wages to gain competitiveness, and tightening and cuts in countries with budget problems.

This part will start by presenting measures to improve the situation of the Eurozone suggested by the EU leaders in addition to targets for the future, followed by a presentation of hot topics and their content. Finally, structural changes and measures will be stated and consequences will be considered.

6.3.1 Measures and targets stated by EU-leaders

The EU-summit meeting, 26 October 2011, resulted in 7 measures to solve the Eurozone crisis (European Council, 2011). The main features of these measures can be summed up as follows;

- An agreement to secure a reduction of Greek debt to GDP ratio to 120% by 2020
- Optimize resources of the EFSF and allow it to be leveraged
- Raise confidence in the banking sector by facilitating access to term-funding and increase the capital position
- Ensure fiscal discipline and accelerate structural reforms for growth and employment
- Strengthening economic and fiscal coordination and surveillance
- 10 measures to improve the governance of the Eurozone
- Give a mandate to the President of the European Council to identify steps to strengthen the economic union and explore possible (limited) Treaty changes.

The German Chancellor, Angela Merkel, have stated that the construction of the Eurozone must be changed, and that Treaty changes are an immediate part of solving the crisis, which is the political response to a political derived confidence crisis (BBC, 2011).

The EU has decided upon 5 targets for the whole of EU within 2020;

- Employment: 75% between 20-64 years to be employed
- R&D: invest 3% of EU GDP
- Climate/energy: lower greenhouse gas emissions, more energy from renewable resources and an increase in energy efficiency.
- Education: reduce dropout rates and increase completion rate of 3rd level education
- Poverty: 20 mill fewer people in risk of poverty

6.3.2 Hot topics

A Eurozone 'holiday', Grexit, Eurobonds, austerity in relation to SGP and a growth pact are 'hot' topics these days. This section will give a brief introduction to these topics.

A Eurozone 'holiday'

The financial and economic situations in Greece after the financial crisis have been turbulent, Greece is on the edge of bankruptcy and an exit from the euro has been heavily debated. An alternative proposal to prevent a future break-up of the Eurozone is to give Greece a "*holiday*" (Feldstein, 2010). The proposal opens up to let Greece leave the euro, and come back with a stronger competitive position. The main features are that the bank balances and obligations would remain in euros, and wages and prices to be set in drachma, the drachma would devaluate against the euro, leaving Greek products more competitive both home and abroad. Conditions to let Greece have a holiday would to be tough fiscal measures against the high level of budget deficit and for it to stay at a lower level. Feldstein concludes with "it is better than having the country permanently leave the Eurozone". Cavallo and Cottani (2010) disagree upon giving Greece a holiday, and argue that "a better solution would be to adjust the Greek tax system", also called a *fiscal devaluation* (mentioned in part 2.5.3). Empirical testing shows that income and corporate taxes are associated with lower economic growth than taxes on consumption and property (Arnold, 2008), and that property tax is most growth friendly.

Grexit

"*If a member of a club does not respect the rules, it is better that it leaves the club*" was the statement of the president of the European Commission, José Manuel Barroso (The economist, 2012), when discussing Greece in relation to its political turmoil. The outcome of the Greek election is uncertain, and with only 2 of the 6 political parties supporting the EU-IMF financial support, there is a risk that Greece will not abide the terms of its bail-out. The term "*Grexit*" has aroused due to the fact that a Greek exit becomes more realistic. It has been estimated a 50% probability that Greece will leave the euro.

Eurobonds

Eurobonds (not Eurobond) is shorthand for the Eurozone sovereign debts that is jointly guaranteed by the 17 member countries. Eurobonds is a suggested measure against the high yields on countries government debt, and is believed to make the yield sustainable and the risk of debt default lower. Gros (2012) argues that Eurobonds only make sense in a political union, and that a country with a moderate debt level might be driven to insolvency due to

pressure of an increased government debt as a result of the low yields. A suggested measure to this problem is to divide the debt into "blue" and "red", e.g. debt up to 60% of GDP is guaranteed by the 17 members, and the single country has to manage the rest. Opponents of this dividing of debt argue that the yields on the red debt will explode due to lack of buyers.

Austerity

The matter of *austerity* in relation to budgets has also been discussed lately. The need for budget rules can both lead to more or less discipline. It can lead to less discipline because member states have an incentive of issuing unsustainable amount of debt due to the bailout guarantee; there is a moral hazard problem. It is also discussed that more rules lead to more discipline because countries that join the union cannot create money to finance budgets. It appears that the latter is the strongest, and the incentive not to run deficits is stronger (De Grauwe, 2009). A restraint on spending is most effective when it comes to reduce deficits and debt; cut social benefits and public wages. Also, a long-term real GDP increase has an effect of reducing debt (Nickel et al., 2010).

Fiscal policy in some countries tends to be driven by the motivation of political gains, and not economic gains. The governments in these countries use fiscal policy to win elections, not to stabilize the economy. More regulation can result in better management of fiscal policy and make it an economical matter, and not political, if governments have the correct guidelines, they cannot use fiscal policy for political gains.

A Eurozone growth pact

Recently, it has been brought to light that budget cutting in times of recession can be damaging in terms of high unemployment and slow growth, due to falling demand as consumers are concerned about job security and disposable income. The need for a Eurozone *growth pact* is favorable to austerity (Atkins, 2012).

6.3.3 Measures and structural changes

The central bank to regain control over financial stability

Give the responsibility of financial stability back to the central bank. The central bank can monitor financial instability as mentioned in part 2.4.1. One measure to increase growth for the member countries in the Eurozone may be to keep the interest rate at a low level, and let each country tighten the fiscal policy in relation to the state of the economic situation in each country, and at the same time improve their budget situation. The individual countries would by this get a lot of trust, and not all countries can be trusted to follow this policy.

The instruments of the government

As mentioned a few times already, fiscal devaluation can be an effective measure for countries to regain competitiveness and promote economic growth.

In the theory of debt dynamics, debt erosion was mentioned as an option to reduce the debts real value. Debt erosion only works for domestic creditors or debt in domestic currency, and since all Eurozone members have integrated credit markets and the same currency, debt erosion should be possible. There is one crucial obstacle; the Maastricht Treaty. The Treaty includes an inflation criterion which do not allow members to have higher inflation than 1,5% more than the average of the three countries in EU with lowest inflation.

Labor market flexibility and language

By introducing a common language in the Eurozone, e.g. English, in the early stage of school, this may lead to higher degree of mobility of labor in the long run, when it comes to move to another country to work. This increase in labor mobility is an important adjustment mechanism in a monetary union, to adjust for asymmetric shocks so that these shocks will have less impact on wages, unemployment etc. As it is today, many countries do have English in school, but the quality varies a lot.

A common identity

A political community needs a common set of values and references to ensure its coherence, and to guide its actions and endow these with legitimacy and meaning. A consequence of citizens of the Eurozone identifying themselves only with their country of origin and not the Eurozone as a whole, they may be reluctant to move when the economic and financial situation worsens, and prevent the adjustment mechanisms when an asymmetric shock occur to function properly. When citizens from one country have to move to another, they may feel

like they are losing their identity; their culture, language and religion. An important task for the leaders of the European Monetary Union and also the European Union is to create a common identity, with a common set of values. Defining the EU's borders and boosting the political legitimacy of the Union in the eyes of its citizens is the 'glue' that unites all Europeans and keeps the bloc together (Euractiv, 2011).

Laws and legislation

A monetary union and the potential political union need the same set of laws and legislation. The differences between countries need to be reduced, and this can be done by introducing common laws and legislation when it comes to the labor market. The Eurozone, and the EU, should facilitate for more jobs in the public sector, these are less affected by financial and economic situations, and may lead to the feeling of being secure for the employees.

A fiscal union with centralized budgets and Eurobonds

Centralizing a significant part of national budgets at the union level can lead to multiple benefits such as an insurance mechanism against asymmetric shocks, regulate the Eurozone debt level and budget deficit and facilitate for Eurobonds. Eurobonds will ease the budgetary pressure in many Eurozone countries, and may result in a solution of the debt crisis.

Differences in taxation, spending, social security and wage policies, which are decided at national level, can lead to asymmetric shocks, e.g. one country can better its competitive position. To enhance the sustainability of a monetary union it is important to have a central budget. National wage policies will have to be coordinated to avoid asymmetric developments in competitive positions of the member countries.

A political union; “The United States of Euro(pe)”

For the monetary union to function properly in the long run, a political union is needed. The Eurozone may benefit from becoming a political union, whit a federal state, a president, the same laws and legislations. This measure comes with a lot of implementation problems and a relatively long time-perspective.

The political union should be designed to have a certain degree of budgetary union, giving some discretionary power to spend and to tax to a European executive, backed by a full democratic accountability of those who are given the authority to spend and to tax. Too strong centralization of national budgets would lead to other problems, in particular moral hazard

problems. It also needs an increased institutionalized coordination of several economic policy instruments that have macroeconomic consequences; social policies and wage formation.

Fault lines in the Eurozone (De Grauwe, 2010) from becoming a political union are factors such as no mechanisms to ensure convergence of members' competitive positions, and thus prevent major trade imbalances. There is no mechanism to resolve crisis caused by these imbalances and divergent competitive positions. A full political union seems unrealistic; it would imply a significant transfer of spending and taxing powers to a central EU government and parliament. The political union must be able to; prevent massive divergences in competitive positions and trade imbalances within the Eurozone.

Complications

Complications in the Eurozone today, which make it difficult to adapt, are corruption in some countries (mostly the southern European), people's opinions and culture. If a political union were to be implemented, it would require a relatively long-term perspective and excessive planning, at least 20 years.

When having a long-term perspective, such structural measures as mentioned in this section have the potential to become more beneficial than a break-up of the Eurozone today.

7 Conclusion

The global financial crisis triggered several local crises in the Eurozone, a fiscal crisis, a banking crisis, a competitive crisis and a debt crisis. Based on the turbulence in many of the Eurozone's member countries' financial situation, real economy and government budgets, I formulated the problem:

Does the Eurozone, as it is today, form an optimal currency area?

The analysis started with an evaluation of the management of the monetary and fiscal policy in the Eurozone as a whole. The ECB has managed the monetary policy with success, when success only implies keeping inflation close to target. The output has been stable and not deviated much from trend, and the interest rate has to some extent been used to correct for deviating output. Despite the low interest rates during the mid-2000s, the management of the monetary policy for the Eurozone as a whole has been satisfactory. When it comes to the fiscal situation of the Eurozone, the budget deficit has been below 3% (until the financial crisis), but the government debt has exceeded 60% throughout the existence of the euro. A centralized budget with associated Eurobonds can be the answer to the fiscal instabilities in the Eurozone.

This thesis have examined whether the Eurozone forms an optimal currency area by analyzing each of the 17 member countries' contribution to increased wealth for the Eurozone in relation to theory of optimal currency areas. Furthermore, how the member countries have been affected by losing their national monetary policy when entering the Eurozone in form of increased volatility in inflation and output, unemployment and in relation to the fiscal situation.

There are a lot of interesting results when analyzing the individual member countries, and their effect on the Eurozone and the Eurozone's effects on the individual countries. Such results are that the new member countries have the highest level of trade, shocks in real GDP, employment and real demand are relatively symmetric between the member countries and the Eurozone as a whole, and even though the desired interest rates between member countries deviate by close to 10% in 2011, it does not seem to attract consequences in form of increased volatility in inflation and output gap. The unemployment in the member countries has significantly declined after becoming a member of the union, and growth appears to be sustainable. Fast-growing countries have the highest volatility in inflation, and losing their

national monetary policy seems to have led to increased deviation from the 2% target. Slow-growing countries seem to be less effected by the target rate level.

The results of the analysis suggest that without Greece, the remaining member countries would have formed a better currency area in terms of trade, symmetry in shocks and the budget situation. Ireland is the only country that tends to have net costs from the introduction of the euro and the loss of its national monetary policy; the costs are in terms of higher volatility in inflation and output and budget situation. Ireland has experienced decreased wealth in terms of a banking crisis and declining house prices. Greece and Ireland are the two countries with the highest level of government debt and budget deficits.

The analysis is followed by a brief discussion of different scenarios for the Eurozone; a break-up, no-change and an adapt-to-succeed view, which includes suggestions of measures of structural improvements for the Eurozone, e.g. centralized budgets with Eurobonds or restructuring the Eurozone into a complete political union.

In relation to the net benefits stated in the optimal currency area theory, I chose to place the Eurozone as it is today just above the OCA line due to the relatively high level of symmetry in shocks. Main obstacles for flexibility in labor markets are rigidities in prices and wages and mobility of labor. One relatively simple measure to increase the degree of mobility of labor is to introduce a common language, I suggest English, which will help the Eurozone to become a more optimal currency area.

To answer the problem explicitly; it is very difficult to determine if the Eurozone as it is today forms an optimal currency area, many factors suggest “yes”, but many factors also suggest “no”. If the Eurozone does not form an optimal currency area today, the Eurozone has potential to become an optimal currency area with the right measures and with time.

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Appendix

Appendix A: Debt dynamics

B: government debt

P: price level

G: government spending

T: government tax

i: government interest rate on debt

M0: monetary base

The nominal increase in government debt can be written as;

$$\Delta B = P(G - T) + iB - \Delta M0$$

Where P(G-T) (nominal value of primary budget deficit) + iB (nominal interest rate on public debt) is the nominal budget deficit, and ΔM0 is the change in monetary base.

This equation gives more meaning when written in percent of GDP, it opens for comparisons between countries.

$$\frac{\Delta B}{PY} = \frac{(G - T)}{Y} + i\frac{B}{PY} - \frac{\Delta M0}{PY}$$

This equation can be written in an easier way when substituting the value sizes with percentage sizes; g is government spending in percent of GDP, t is tax income in percent of GDP, b is the debt ratio which is debt in percent of GDP, μ is the growth in money supply and μm is money financed deficit in percent of GDP.

Equation 1:

$$\frac{\Delta B}{PY} = g - t + ib - \mu m$$

The debt ratio can be written as

$$b = \frac{B}{PY}$$

$$B = bPY$$

$$\Delta B \approx PY\Delta b + bP\Delta Y + bY\Delta P$$

$$\Delta B \approx PY\Delta b + bPYy + bPY\pi$$

$$\Delta B \approx PY\,[\Delta b + (y + \pi)b]$$

$$\frac{\Delta B}{PY} \approx \Delta b + (y + \pi)b$$

$$\Delta b = \frac{\Delta B}{PY} - (y + \pi)b$$

$$\frac{\Delta B}{PY} \approx \Delta b + (y + \pi)b$$

Where y is growth in GDP and π is inflation (growth in price level).

The equation can be rewritten as;

Equation 2:

$$\Delta b = \frac{\Delta B}{PY} - (y + \pi)b$$

We can substitute the debt ratio in equation 2 with the formula for debt ratio in equation 1;

$$\Delta b = g - t + ib - \mu m - (y + \pi)b$$

$$\Delta b = g - t - \mu m - (y - i + \pi)b$$

Fisher; $i + \pi = r$

$$\Delta b = g - t - \mu m - (y - r)b$$

In equilibrium, growth rate is constant (Δb = 0);

$$b^* = \frac{g - t - \mu m}{y - r}$$

For countries with increasing debt and budget deficit;

Reduction of debt ratio:

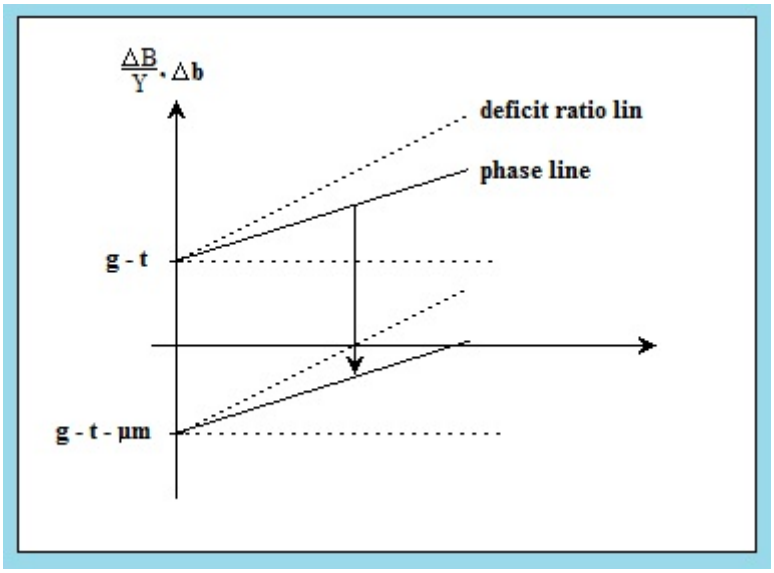
- $\frac{G-T}{Y}$ will be reduced if g decreases or t increases, but this can have the unfortunate effect of reducing growth and/or inflation
- Increase inflation;

a) increase $\frac{\Delta M0}{PY}$ by printing more money

b) Debt erosion; an unforeseen increase in inflation will reduce debt real value $((\pi b) \uparrow \rightarrow \Delta b \downarrow)$

Debt erosion only works for domestic creditors or debt in domestic currency.

Debt can be financed by printing money or private loans.



- If the debt is financed by the private sector, it sucks up private savings. This reduces the capital stock which leads to steady state and potential income (when investing)
- There are two effects of printing money; 1) government revenue, seignorage, $\mu \times \frac{M}{P}$ and 2) real income is lost due to inflation, inflation tax, $\pi \times \frac{M}{P}$

Appendix B: HICP

HICP-CPI DIFFERENCES by the EUROPEAN COMMISSION

Both Harmonised Indices of Consumer Prices (HICPs) and Consumer Price Indices (CPIs) measure inflation faced by consumers, i.e. the changes in the prices over time of buying goods and services. HICPs and CPIs are for the most part based on the same data sources, but they measure inflation with different aims and therefore sometimes use different concepts or methods.

The main uses of the HICP are, first, for monetary policy purposes. The ECB defines price stability as a year-on-year increase of the HICP for the Euro area of below, but close to, 2% over the medium term. The change in consumer prices is one of the convergence criteria used to assess whether a Member State is ready to join the euro area. These uses require a harmonised conceptual framework and comparable results. In addition, HICPs are becoming increasingly used for economic analyses in general – and for indexation purposes.

CPIs play a role in some countries for monetary policy and for economic analysis in general, but also have a wide range of other uses, such as for the indexation of commercial contracts, wages, social protection benefits, financial instruments. The range of uses made of CPIs varies across countries. CPI calculation methods vary as a result, and national CPIs are usually not regarded as comparable for cross-country analyses. For the EU, only the HICPs provide comparable measures of consumer price inflation, and they are therefore used for cross-country analysis.

The differences between HICPs and CPIs may sometimes be significant in practice, although in general the differences have been diminishing as national statistical offices have adopted HICP standards also for their CPIs. The main differences are as follows:

- The treatment of *owner-occupied housing*: Price changes for the Owner-Occupied Housing are currently excluded from the HICP. In CPIs they may or may not be included, and, where they are included, the methods used differ substantially.

- The *coverage of households*: The HICP covers households' expenditures taking place within the country, whether those households actually live in the country or whether they are merely visiting the country and covers institutional households as well. On the other hand, CPIs usually record expenditures by resident households, whether that takes place within the country or abroad.
- The coverage and measurement of *taxes and fees, and services* – such as health, social protection, education and insurance services: The harmonised treatment of these expenditures is a major asset of the HICP. The HICPs measure the actual prices faced by consumers, so after taxes, duties and net of reimbursements, e.g. for medicines. CPIs may use different approaches, or exclude parts of such expenditures.

Some other differences between HICPs and CPIs, at least in some EU countries, concern: the methods used to estimate prices for goods when their quality is changing over time; the coverage of price reductions during winter and summer sales periods; the coverage of lotteries, games of chance and certain financial services and the basic calculation formulae used at the most detailed level to aggregate price data. There may be also differences between the national classifications used for the CPI and the harmonized classification of the HICP.

Appendix C: T-tests

T-test: One of the most common statistical test, a dependent samples *t*-test, or a paired samples *t*-test, is used to find significant mean differences between two groups on a particular measure. In the case of the dependent samples *t*-test or a paired sample *t*-test the two groups being compared are related somehow (Lani, 2008).

Appendix C (a): T-test for differences in inflation

More deviation before and after euro?

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	1,32	1,12
Variance	1,63	0,32
Observations	18	18
Pearson Correlation	0,58	
Hypothesized Mean Diff	0	
df	17	
t Stat	0,4609	
P(T<=t) one-tail	0,3254	
t Critical one-tail	1,7396	
P(T<=t) two-tail	0,6507	
t Critical two-tail	2,1098	

Appendix C (b) T-test for differences in output of times series including the financial crisis

Difference before and after euro

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	1,85	2,19
Variance	1,64	1,32
Observations	15	15
Pearson Correlation	0,49	
Hypothesized Mean Diff	0	
df	14	
t Stat	-1,0870	
P(T<=t) one-tail	0,1477	
t Critical one-tail	1,7613	
P(T<=t) two-tail	0,2954	
t Critical two-tail	2,1448	

Appendix C (c): T-test for differences in output of time series excluding the financial crisis

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	1,49	1,41
Variance	0,66	0,93
Observations	13	13
Pearson Correlation	0,35	
Hypothesized Mean Diff	0	
df	12	
t Stat	0,2853	
P(T<=t) one-tail	0,3902	
t Critical one-tail	1,7823	
P(T<=t) two-tail	0,7803	
t Critical two-tail	2,1788	

Appendix C (d): T-test for differences in growth

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	4,84	1,83
Variance	4,91	1,20
Observations	8	8
Pearson Correlation	0,57	
Hypothesized Mean Diff	0	
df	7	
t Stat	4,6422	
P(T<=t) one-tail	0,0012	
t Critical one-tail	1,8946	
P(T<=t) two-tail	0,0024	
t Critical two-tail	2,3646	

Appendix C (e): T-test for differences in growth for fast growing countries until 2006

t-Test: Paired Two Sample for Means

	Variable 1	*Variable 2*
Mean	4,93	3,61
Variance	6,52	3,17
Observations	6	6
Pearson Correlation	0,69	
Hypothesized Mean Diff	0	
df	5	
t Stat	1,7416	
P(T<=t) one-tail	0,0710	
t Critical one-tail	2,0150	
P(T<=t) two-tail	0,1420	
t Critical two-tail	2,5706	

Appendix C (f): T-test for differences in unemployment

	Variable 1	*Variable 2*
Mean	9,33	8,07
Variance	16,07	8,21
Observations	18	18
Pearson Correlation	0,85	
Hypothesized Mean Diff	0	
df	17	
t Stat	2,4680	
P(T<=t) one-tail	0,0123	
t Critical one-tail	1,7396	
P(T<=t) two-tail	0,0245	
t Critical two-tail	2,1098	

Appendix D: Output gap

Mean absolute deviation from "normal" output

Period / Country	1994 - 2011	Before euro	After euro	Difference
Eurozone	1,34	0,93	1,50	0,57
Austria	1,53	1,00	1,74	0,74
Belgium	1,04	0,96	1,06	0,10
Estonia	5,22	5,34	3,89	-1,45
Finland	2,65	3,06	2,49	-0,57
France	1,26	0,80	1,44	0,64
Germany	1,41	0,71	1,67	0,97
Greece	2,61	1,27	3,47	2,19
Ireland	4,29	2,20	5,10	2,90
Italy	1,48	1,37	1,53	0,16
Luxembourg	2,71	3,09	2,56	-0,53
Netherlands	1,44	0,90	1,65	0,75
Portugal	1,53	1,55	1,52	-0,03
Slovakia	2,61	2,98	1,02	-1,96
Spain	2,07	1,56	2,26	0,70

When looking at the deviation from normal output for the whole period, the Eurozone as a whole deviates in average 1,35%. The countries with most stable outputs, which are outputs closest to trends, are Belgium, Germany and France. In countries where outputs tend to deviate more from trend is Estonia, Greece, Finland, Ireland, Luxembourg, Slovakia and Spain.

It is more interesting to look at the difference between the average deviation from output before and after the introduction of the euro, to find if the loss of national monetary policy has had an impact on volatility in output to the individual country.

Most positive: Greece and Ireland (> 2%), also Austria, France, Germany, Netherlands and Spain. Most negative: Estonia, Finland, Luxembourg and Slovakia; the euro has had a positive effect for these countries in terms of volatility in output gap.

Appendix E: Growth in real GDP

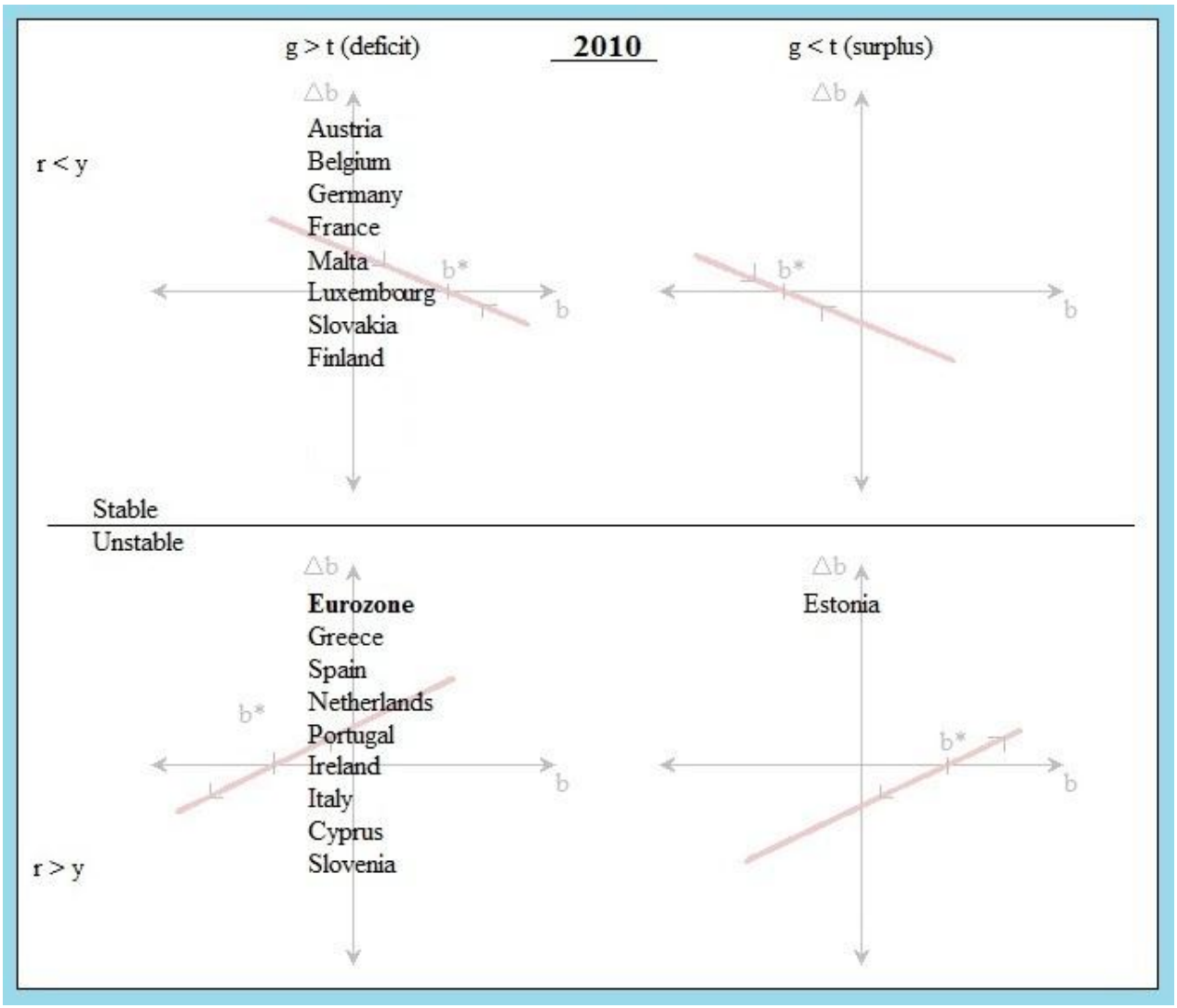
geo\time	Belgium	Germany	Estonia	Ireland	Greece	Spain	France	Italy	Cyprus	Luxembourg	Malta	Netherlands	Austria	Portugal	Slovenia	Slovakia	Finland
1990	3,1					3,8	2,6					4,2	4,3				0,5
1991	1,8					2,5	1	1,5				2,4	3,4		-8,9		-6
1992	1,5	1,9				0,9	1,5	0,8				1,7	2,1		-5,5		-3,5
1993	-1	-1				-1	-0,7	-0,9				1,3	0,5		2,8	7,2	-0,8
1994	3,2	2,5	-1,6			2,4	2,2	2,2				3	2,4		5,3	6,2	3,7
1995	22,9	1,7	6,5			5	2	2,9				3,1	2,7		7,4	7,9	4
1996	1,4	0,8	5,9	11,2	2,4	2,5	1,1	1,1	1,8	1,5		3,4	2,5	3,7	3,6	6,9	3,6
1997	3,7	1,7	11,7	10,9	3,6	3,9	2,2	1,9	2,3	5,9		4,3	2,3	4,4	5	4,4	6,2
1998	1,9	1,9	6,8	7,8	3,4	4,5	3,4	1,4	5	6,5		3,9	3,8	5,1	3,5	4,4	5
1999	3,5	1,9	-0,3	9,9	3,4	4,7	3,3	1,5	4,8	8,4		4,7	3,5	4,1	5,3	0	3,9
2000	3,7	3,1	9,7	9,3	3,5	5	3,7	3,7	5	8,4		3,9	3,7	3,9	4,3	1,4	5,3
2001	0,8	1,5	6,3	4,8	4,2	3,7	1,8	1,9	4	2,5	-1,5	1,9	0,9	2	2,9	3,5	2,3
2002	1,4	0	6,6	5,9	3,4	2,7	0,9	0,5	2,1	4,1	2,8	0,1	1,7	0,8	3,8	4,6	1,8
2003	0,8	-0,4	7,8	4,2	5,9	3,1	0,9	0	1,9	1,5	0,1	0,3	0,9	-0,9	2,9	4,8	2
2004	3,3	1,2	6,3	4,5	4,4	3,3	2,5	1,7	4,2	4,4	-0,5	2,2	2,6	1,6	4,4	5,1	4,1
2005	1,8	0,7	8,9	5,3	2,3	3,6	1,8	0,9	3,9	5,4	3,7	2	2,4	0,8	4	6,7	2,9
2006	2,7	3,7	10,1	5,3	5,5	4,1	2,5	2,2	4,1	5	2,9	3,4	3,7	1,4	5,8	8,3	4,4
2007	2,9	3,3	7,5	5,2	3	3,5	2,3	1,7	5,1	6,6	4,3	3,9	3,7	2,4	6,9	10,5	5,3
2008	1	1,1	-3,7	-3	-0,2	0,9	-0,1	-1,2	3,6	0,8	4,1	1,8	1,4	0	3,6	5,8	0,3
2009	-2,8	-5,1	-14,3	-7	-3,3	-3,7	-3,1	-5,5	-1,9	-5,3	-2,7	-3,5	-3,8	-2,9	-8	-4,9	-8,4
2010	2,2	3,7	2,3	-0,4	-3,5	-0,1	1,7	1,8	1,1	2,7	2,3	1,7	2,3	1,4	1,4	4,2	3,7
2011	1,9	3	7,6	0,7	-6,9	0,7	1,7	0,4	0,5	1,6	2,1	1,2	3,1	-1,6	-0,2	3,3	2,9
Avergage growth before EMU	**4,28**	1,36	**4,50**	**9,97**	**3,26**	2,72	1,70	1,36	**3,68**	**4,63**	1,69	**3,03**	2,67	**4,40**	2,91	**5,48**	1,41
Fast-growing after EMU	1,78			3,44	1,35				0,83	3,55		1,82		1,00		0,87	

Appendix F: Unemployment

GEO/TIME	Eurozone	Belgium	Germany	Estonia	Ireland	Greece	Spain	France	Italy	Cyprus	Luxembourg	Malta	Netherlands	Austria	Portugal	Slovenia	Slovakia	Finland
1995	10,7	9,7	8,3		12,3		20,0	10,5	11,2		2,9		7,1	3,9	7,2			15,4
1996	10,8	9,5	8,9		11,7		19,1	11,0	11,2		2,9		6,4	4,3	7,2	6,9		14,6
1997	10,8	9,2	9,7		9,9		17,8	11,1	11,2		2,7		5,5	4,4	6,7	6,9		12,7
1998	10,3	9,3	9,4		7,5	11,1	15,9	10,7	11,3		2,7		4,3	4,5	5,6	7,4	12,6	11,4
1999	9,6	8,5	8,6		5,6	12,0	13,2	10,4	10,9		2,4		3,5	3,9	5,0	7,3	16,4	10,2
2000	8,7	6,9	8,0	13,6	4,2	11,2	11,7	9,0	10,0	4,8	2,2	6,7	3,1	3,6	4,5	6,7	18,8	9,8
2001	8,1	6,6	7,9	12,6	3,9	10,7	10,5	8,2	9,0	3,9	1,9	7,6	2,5	3,6	4,6	6,2	19,3	9,1
2002	8,5	7,5	8,7	10,3	4,5	10,3	11,4	8,3	8,5	3,5	2,6	7,4	3,1	4,2	5,7	6,3	18,7	9,1
2003	9,0	8,2	9,8	10,0	4,6	9,7	11,4	8,9	8,4	4,1	3,8	7,7	4,2	4,3	7,1	6,7	17,6	9,0
2004	9,3	8,4	10,5	9,7	4,5	10,5	10,9	9,3	8,0	4,6	5,0	7,2	5,1	4,9	7,5	6,3	18,2	8,8
2005	9,2	8,5	11,3	7,9	4,4	9,9	9,2	9,3	7,7	5,3	4,6	7,3	5,3	5,2	8,6	6,5	16,3	8,4
2006	8,5	8,3	10,3	5,9	4,5	8,9	8,5	9,2	6,8	4,6	4,6	6,9	4,4	4,8	8,6	6,0	13,4	7,7
2007	7,6	7,5	8,7	4,7	4,6	8,3	8,3	8,4	6,1	3,9	4,2	6,5	3,6	4,4	8,9	4,9	11,1	6,9
2008	7,6	7,0	7,5	5,5	6,3	7,7	11,3	7,8	6,7	3,7	4,9	6,0	3,1	3,8	8,5	4,4	9,5	6,4
2009	9,6	7,9	7,8	13,8	11,9	9,5	18,0	9,5	7,8	5,3	5,1	6,9	3,7	4,8	10,6	5,9	12,0	8,2
2010	10,1	8,3	7,1	16,9	13,7	12,6	20,1	9,8	8,4	6,2	4,6	6,9	4,5	4,4	12,0	7,3	14,4	8,4
2011	10,2	7,2	5,9	12,5	14,4	17,7	21,7	9,7	8,4	7,8	4,8	6,5	4,4	4,2	12,9	8,2	13,5	7,8

Appendix G: Government debt and budget deficit

	Budget deficit (t-g) in % of GDP		Growth in real GDP		10y bond yield (i)		Inflation (HICP) (π)		Real interest rate (r) (i-π)		y-r	
GEO/TIME	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Eurozone	-6,2 %	-4,1 %	1,90 %	1,50 %	3,61 %	4,41 %	1,6 %	2,7 %	2,01 %	1,71 %	-0,11 %	-0,21 %
Belgium	-3,9 %	-3,9 %	2,20 %	1,90 %	3,46 %	4,23 %	2,3 %	3,5 %	1,16 %	0,73 %	1,04 %	1,17 %
Germany	-4,3 %	-1,0 %	3,70 %	3,00 %	2,74 %	2,61 %	1,2 %	2,5 %	1,54 %	0,11 %	2,16 %	2,89 %
Estonia	0,3 %	1,0 %	2,30 %	7,60 %	5,78 %	nn	2,7 %	5,1 %	3,08 %	nn	-0,78 %	nn
Ireland	-31,2 %	-13,0 %	-0,40 %	0,70 %	5,74 %	9,60 %	-1,6 %	1,2 %	7,34 %	8,40 %	-7,74 %	-7,70 %
Greece	-10,5 %	-9,2 %	-3,50 %	-6,90 %	9,09 %	15,75 %	4,7 %	3,1 %	4,39 %	12,65 %	-7,89 %	-19,55 %
Spain	-9,3 %	-8,5 %	-0,10 %	0,70 %	4,25 %	5,44 %	2,0 %	3,1 %	2,25 %	2,34 %	-2,35 %	-1,64 %
France	-7,1 %	-5,2 %	1,70 %	1,70 %	3,12 %	3,32 %	1,7 %	2,3 %	1,42 %	1,02 %	0,28 %	0,68 %
Italy	-4,5 %	-3,8 %	1,80 %	0,40 %	4,04 %	5,42 %	1,6 %	2,9 %	2,44 %	2,52 %	-0,64 %	-2,12 %
Cyprus	-5,3 %	-6,3 %	1,10 %	0,50 %	4,60 %	5,79 %	2,6 %	3,5 %	2,00 %	2,29 %	-0,90 %	-1,79 %
Luxembourg	-0,9 %	-0,6 %	2,70 %	1,60 %	3,17 %	2,92 %	2,8 %	3,7 %	0,37 %	-0,78 %	2,33 %	2,38 %
Malta	-3,7 %	-2,7 %	2,30 %	2,10 %	4,19 %	4,49 %	2,0 %	2,4 %	2,19 %	2,09 %	0,11 %	0,01 %
Netherlands	-5,0 %	-4,6 %	1,70 %	1,20 %	2,99 %	2,99 %	0,9 %	2,5 %	2,09 %	0,49 %	-0,39 %	0,71 %
Austria	-4,5 %	-2,6 %	2,30 %	3,10 %	3,23 %	3,32 %	1,7 %	3,6 %	1,53 %	-0,28 %	0,77 %	3,38 %
Portugal	-9,8 %	-4,2 %	1,40 %	-1,60 %	5,40 %	10,24 %	1,4 %	3,6 %	4,00 %	6,64 %	-2,60 %	-8,24 %
Slovenia	-6,0 %	-6,4 %	1,40 %	-0,20 %	3,83 %	4,97 %	2,1 %	2,1 %	1,73 %	2,87 %	-0,33 %	-3,07 %
Slovakia	-7,7 %	-4,8 %	4,20 %	3,30 %	3,87 %	4,45 %	0,7 %	4,1 %	3,17 %	0,35 %	1,03 %	2,95 %
Finland	-2,8 %	-0,9 %	3,70 %	2,90 %	3,01 %	3,01 %	1,7 %	3,3 %	1,31 %	-0,29 %	2,39 %	3,19 %


g > t (deficit)
2010
g < t (surplus)
r < y
Austria
Belgium
Germany
France
Malta
Luxembourg
Slovakia
Finland
Stable
Unstable
Eurozone
Greece
Spain
Netherlands
Portugal
Ireland
Italy
Cyprus
Slovenia
Estonia
r > y

Appendix H: Scorecard

To illustrate which countries that are contributing most to make the Eurozone an optimal currency area H(a), and which countries have had net benefits/costs from being in a monetary union (b), I have made scorecards where I sum up the results from the analysis.

For both scorecards; a total score over 5 points are in a dark shade of green, a score between 1 and 5 points are in a lighter shade of green, a score of 0 is in yellow, a negative score is red.

The purpose of the scorecard is to illustrate and present a simple overview of the results from the analysis. It can be argued that other factors not included in the scorecard also can have relevant effects. I chose not to weight the different factors in relation to each other, either way the result is based on subjective measures. Furthermore, it is difficult to determine which factor is most important; the scores are all ranged from -5 to 5 and summed up to illustrate a positive or negative effect.

Appendix H (a): Countries contributing to make the Eurozone an optimal currency area

	Openness	**Symmetry in shocks**	**Budget situation**	**Sum**
Austria	3	4	1	7,7
Belgium	5	4	-1	7,7
Cyprus	2	4	-1	4,5
Estonia	5	3	5	13,3
Finland	2	5	5	12,0
France	2	5	-1	5,7
Germany	2	4	1	6,7
Greece	1	3	-5	-1,3
Ireland	3	5	-5	3,0
Italy	2	5	-3	4,0
Luxembourg	3	3	5	10,7
Malta	3	3	1	6,5
Netherlands	4	4	-1	7,0
Portugal	2	4	-3	2,7
Slovakia	5	2	1	8,3
Slovenia	4	3	1	8,3
Spain	2	5	-3	4,0

Factors that I have chosen to include in what makes an optimal currency area in my thesis are the degree of openness, symmetry in shocks and the budget situation.

The first factor that is essential to determine whether or not there are net benefits from a monetary union is the degree of trade integration. When scoring **openness**, I made intervals of degree of total trade and gave points.

- Total intra EU trade over 100% of GDP: 5 points
- Total intra EU trade between 75% and 100% of GDP: 4 points
- Total intra EU trade between 50% and 75% of GDP: 3 points
- Total intra EU trade between 25% and 50% of GDP: 2 points
- Total intra EU trade between 0% and 25% of GDP: 1 point

I made the 25% intervals to set the trade for each country in perspective, and to make an easy comparison. The trade score cannot be negative, because all degrees of trade have positive impact.

I have also included the degree of **symmetry in shocks** in my scorecard. I have given the degree of symmetry in GDP, employment and demand a score each, and included the average score in the scorecard under symmetry.

- Correlation with the Eurozone over 90%: 5 points
- Correlation with the Eurozone between 75% and 90%: 4 points
- Correlation with the Eurozone between 50% and 75%: 3 points
- Correlation with the Eurozone between 25% and 50%: 2 points
- Negative correlation with the Eurozone: -1 point

These groups are based on my own judgment, each factor (real GDP, employment and demand) got an individual score, and the average is presented in the table. Only negative correlation can contribute negatively, and I chose to subtract only 1 point in the case of asymmetry, due to the fact that it was only one case. All countries have relatively high degree of symmetry in shocks (over 25%).

I chose to exclude **flexibility in labor markets** due to the difficulty of quantifying it, and due to fact that there is a relatively high degree of symmetry in shocks, the need for flexible labor markets is not critical.

I have also chosen to include the **budget situation**. The risk that one country brings to the Eurozone in form of high debt level, and possibility for increased interest rates for the whole monetary union, contributes negatively. The scores for each country when it comes to budget situation are represented by the level of debt in 2011, combined to the budget deficit in 2011.

- Countries that fulfilled both Maastricht criteria in 2011: 5 points
- Countries that violated one of the Maastricht criteria in 2011: 1 points
- Countries that just about violated both Maastricht criteria in 2011: -1 point
- Countries that violated both Maastricht criteria and has either a relatively high debt level or a high budget deficit in 2011: -3 points
- Countries that violated both Maastricht criteria by far in 2011: -5 points

A violation of the Maastricht budget criteria of maximum 60% debt of GDP and maximum 3% budget deficit of GDP is serious, which is why there is a gap of points between no violation and one violation. Countries that violated both criteria got negative scores, but also the extent of the violation affects score negatively. Ireland and Greece both got -5 points in the budgetary situation due to their high levels of debt and budget deficits.

Appendix H (b): Net effects for the single country of being in a monetary union

	Openness	Inflation	Output	Unemployment	Budget	Sum
Austria	3	0	0	0	0	3
Belgium	5	0	0	2	-1	6
Cyprus	2	0	-	-1	0	1
Estonia	5	0	-	-2	0	3
Finland	2	0	3	5	0	12
France	2	0	0	2	0	4
Germany	2	0	-1	0	0	1
Greece	1	0	0	-1	0	0
Ireland	3	-3	-3	4	-3	-4
Italy	2	0	0	3	0	5
Luxembourg	3	0	3	-1	0	5
Malta	3	0	-	1	0	4
Netherlands	4	0	-1	2	-2	3
Portugal	2	-1	0	-1	0	0
Slovakia	5	3	-	2	0	12
Slovenia	4	3	-	0	0	9
Spain	2	-1	0	5	-2	4

Factors that determines whether a country has gained from joining a monetary union (has experienced net benefits) can be the degree of openness, stable inflation, stable output, a decrease in unemployment and stable fiscal situation.

The scores of degree of **openness** are the same as in the scorecard for the optimal currency area. This represents an increase in wealth for the individual countries in terms of benefits from trade by no transaction costs, no uncertainty in exchange rate and price transparency.

Less volatility in **inflation** can lead to gains in form of price stability, and the volatility in inflation can be measured by absolute deviation from inflation target (2%) in average. Countries with less deviation from inflation target after becoming a member of a monetary union have had benefits from being in a monetary union. The score is determined as follows;

- Less volatility in inflation after joining the monetary union; over 2%: 5 points
- Less volatility in inflation after joining the monetary union; 1% - 2%: 3 points
- Less volatility in inflation after joining the monetary union; 0,5% - 1%: 1 point
- No change in the degree of inflation deviating from target; ± 0,5%: 0 points
- More volatility in inflation after joining the monetary union; -0,5% - 1%: -1 point
- More volatility in inflation after joining the monetary union; over -1% - -2%: -3 points
- More volatility in inflation after joining the monetary union; over -2%: -5 points

Less volatility in **output** can lead to gains in form of financial stability, and the volatility in output can be measured by absolute deviation from trend (output gap = 0) in average. Countries with less deviation from trend after becoming a member of a monetary union have had benefits from being in a monetary union. The score is determined as follows;

- Less volatility in output after joining the monetary union; over 2%: 5 points
- Less volatility in output after joining the monetary union; 1% - 2%: 3 points
- Less volatility in output after joining the monetary union; 0,5% - 1%: 1 point
- No change in the degree of output deviating from normal; ± 0,5%: 0 points
- More volatility in output after joining the monetary union; -0,5% - 1%: -1 point
- More volatility in output after joining the monetary union; -1% - 2%: -3 points
- More volatility in output after joining the monetary union; over -2%: -5 points

The scores for **unemployment** are given based on the increase/reduction in unemployment average after joining the monetary union. ± 0,5% gives 0 points, 0,6-1,5% gives 1 point, 1,6-2,5% gives 2 points etc. and the same grading criteria for negative effects (increased unemployment after joining the Eurozone).

The scores for the budget situation are bit more complex. The scores are given when comparing the budgetary situation for the member countries in 2011 to the average budget situation for the period 1999-2011.

- For countries where the budget situation for 2011 is relatively the same as the average budget situation; 0 points
- For countries which have violated one Maastricht criteria more in 2011 compared to the average budget situation; -1 point
- For countries which have violated both Maastricht criteria in 2011 and did fulfill both when looking at the average budget situation; -2 points
- For countries which to great extent have violated the Maastricht criteria in 2011 compared to the average budget situation; -3 points

Countries with negative scores have suffered from the membership in the Eurozone in terms of fiscal instability due to the lack of national monetary policy.