

Department of Economics
Bachelor thesis - NEKH01 15 Credits
Autumn 2019



LUNDS
UNIVERSITET

Is the Eurozone an Optimal Currency Area?

An investigation from a financial market's perspective

Authors:

Carl Sandström

Niclas Stafsing

Supervisor:

Thomas Fischer

Abstract

The purpose of this study is to examine if the Eurozone is an Optimal Currency Area (OCA) or not. To do this we have examined if the European Central Banks monetary policy announcements have a significant impact on the equity markets and on the 10-year government bond yields in the Eurozone. We examine this by looking at eleven different countries in the Eurozone. These are: Germany, France, Belgium, Austria, Finland, The Netherlands, Italy, Spain, Greece, Portugal and Ireland. The study spans from the 28th of December 2010 until 25th of October 2019. During this time the ECB has made 86 announcements but on only ten of these occasions have they announced that there will be a change in the deposit facility rate. From this, we can conclude that there have been no significant price-reactions to the announcements, regardless if the interest rates have stayed the same, been increased, or decreased. From this we connected the results to the theories of Optimal Currency Areas (OCA) and the Efficient Market Hypothesis (EMH). We concluded that the Eurozone is an Optimal Currency Area since these securities all showed similar reactions to the monetary policy announcements and that the insignificant results is credited to a high efficiency on the equity and government bond markets in the Eurozone.

Keywords:

Optimal Currency Area, European central bank, Eurozone, Event study, Equity indices, 10-year government bond yield, Monetary policy, Efficient Market Hypothesis

Table of contents

1.	INTRODUCTION	4
2.	EARLIER RESEARCH	5
3.	CENTRAL BANKS AND FINANCIAL MARKETS	7
3.1	THE ECB AND THE MAASTRICHT TREATY	7
3.2	THE EQUITY AND BOND MARKET	9
3.3	THE EFFICIENT MARKET HYPOTHESIS	11
3.4	CONNECTION BETWEEN LONG-TERM AND SHORT-TERM INTEREST RATES.....	12
4.	MONETARY UNIONS	14
4.1	THE THEORY OF OPTIMAL CURRENCY AREAS	14
4.2	THE TRANSMISSION PROCESS	17
5.	DATA	19
5.1	LIMITATIONS	19
5.2	SELECTION OF EQUITY INDICES AND GOVERNMENT BONDS.....	19
5.3	KEY ECB INTEREST RATES	20
5.4	HISTORIC VALUES OF THE EQUITY INDICES AND THE 10-YEAR GOVERNMENT BOND YIELDS	21
6.	METHOD	24
6.1	EVENT STUDY	24
6.2	PROCEDURE OF THE EVENT STUDY	24
7.	RESULTS	29
8.	ANALYSIS	32
9.	CONCLUSION AND FURTHER RESEARCH	35
10.	LITERATURE	36

1. Introduction

Ever since the formation of the European Coal and Steel Community, the idea of a highly integrated Europe has been called into questioning. These doubts reached their all-time highs during the European debt crisis when sovereign defaults looked inevitable. But after some extraordinary monetary policy decisions by the ECB, interest rates within the Eurozone once again started to converge. And the doubts about further European integration started to bleach. This thesis is aiming to find an answer to the question whether the European Monetary Union actually is an Optimal Currency Area or not. We are examining this through the lenses of the European Central Banks monetary policy announcements and how it affects the equity and bond markets of these countries. To find an answer to this issue we are looking at how a few of the member states major equity indices and 10-year government bond yields react to monetary policy announcements from the ECB, and from this determine if they all belong to the same Optimal Currency Area or not. Our reasoning is that these countries assets should react in a similar manner to each other if they belong to the same Optimal Currency Area. This is because the monetary policy in a currency area needs to have an impact on all the members to be able to maintain balance and steer the economy in the right direction. The assets in question are the 10-year government bond yields of each of the countries and the main large cap equity index of each of the countries.

The different chapters of our thesis are the following. In chapter 2, we present a variety of earlier research on Optimal Currency Areas. In chapter 3 the interconnection between central banks and financial markets is presented. Moving on to chapter 4, we present the theory of Optimal Currency Areas and how monetary policy eventually affect real economic variables. Chapter 5 contains information about the data that we used for this thesis and chapter 6 presents the event study method that we used. In chapter 7 we present the results of our work and in chapter 8 these results are analyzed. Finally, chapter 9 concludes our thesis and proposes ideas for further research.

2. Earlier Research

In this chapter the earlier research on Optimal Currency Areas that is relevant to our work is presented. First the two Mundell models are presented, followed by different approaches to examine whether the Eurozone is an Optimal Currency Area or not.

There are a number of different papers examining whether the Eurozone is an Optimal Currency Area or not. The theory of Optimal Currency Areas started with Robert Mundell's work in 1961 in which assumptions of stationary expectations on exchange rates among economic agents were assumed (Mundell, 1961). Furthermore, he argued that Optimal Currency Areas had to contain member states with a common output composition to make a common monetary policy work for stabilizing the business cycle of the area. In the 1970s, Mundell expanded his own work through a series of papers that contained what would be called the second Mundell model (Mundell, 1973). In this model the stationary expectation assumption was scrapped, and Mundell argued that Optimal Currency Areas should contain member states with a variety of different output compositions. This, he argued, would lead to risk sharing and international portfolio diversification among the member states, and thus more effectively suppress asymmetric shocks in the area. Artis (2003) examines whether the Optimal Currency Area criteria are of relevance when policy makers decide whether to join a monetary union or not. He applied this to the EMU, and he concluded that these criteria are in fact reasonable arguments for a country in their decision to join or not. However, he concluded that he could not draw the conclusion that the EMU is an Optimal Currency Area due to its relatively new creation. Castañeda and Schwartz (2017) made an empirical assessment of the optimality of the EMU as an Optimal Currency Area. Their findings were carried out through an index they created based on deviations of different macroeconomic variables among the member states. Their conclusions were mixed and showed that the trend for integration returned after the great recession and the Eurozone crisis. They concluded that the signs of disintegration during the crisis years were not evidence of a failed monetary union, but rather evidence of a self-healing mechanism. Much as Artis (2003) argued, they reasoned that the EMU is too short-lived to draw any conclusions regarding if it will become an Optimal Currency Area in the future (Castañeda & Schwartz, 2017). A different examination regarding the EMU as an Optimal Currency Area is conducted by Costantinia et al. (2014). They looked at sovereign bond yield spreads across the Eurozone to determine if all the countries in their sample, Germany, France, The Netherlands, Austria, Finland, Belgium, Italy, Spain, Portugal and Greece belonged to the

same Optimal Currency Area. Aside from their findings regarding the origin of sovereign yield spreads, they reasoned that since significant differentials in cumulated inflation unveil differences in competitiveness, this would imply further appreciation of the real exchange rate. This does not cohere to economic integration and by systematically subtracting countries with high cumulated inflation differentials, they would eventually through statistical inference get a significant answer to which countries belonged to the same Optimal Currency Area. Their results were that the countries they named the “core” belonged to the Optimal Currency Area and those countries were Germany, France, The Netherlands, Austria and Finland. While the “periphery” countries Belgium, Italy, Spain, Portugal and Greece did not belong to the Optimal Currency Area (Costantinia, Fragetta & Melinad, 2014).

From more of a financial market’s perspective, other findings have been retrieved regarding the monetary synchronization of the Eurozone. Horvath (2018) found that the pass-through of policy rates to interest rates offered to individuals by banks has become less efficient. He blames this on both increased mark-ups, but also on a lower responsiveness by banks to alter their interest rates. Furthermore, he argues that the effectiveness of the interest rate pass-through has become diverse within the Eurozone, which is not optimal for making a common monetary policy work. Increased fiscal stability within the Eurozone is essential for making the monetary transmission process more efficient he argues (Horvath, 2018). Other findings regarding the ECB’s monetary policy affecting financial markets were found by Pacicco et al. (2019). They combined an event study with a panel regression to see whether the monetary policy announcements had a heterogeneously effect on different Eurozone equity indices. They found that conventional methods had an uneven effect on equity markets and unconventional methods, depending on intensities, had a homogeneous effect. This, they argued, is most likely to create asymmetries that will be reflected in the real economy through the equity channel of the transmission process of monetary policy. Furthermore, their evidence could have useful future application since they found that unconventional methods regarding monetary policy could be applicable to non-crisis times as well (Pacicco, Vena & Venegoni, 2019).

3. Central banks and financial markets

In this chapter the ECB's history and policy implementation is introduced, followed by how the equity and bond markets are affected by the ECB. After this, the Efficient Market Hypothesis is introduced and lastly, we take a look at the connection between short-term and long-term interest rates.

3.1 The ECB and the Maastricht treaty

The Maastricht treaty is officially known as the Treaty on the European Union and was signed in 1992. The treaty was an important milestone when transitioning from the European community into the European Union, EU, signalling the commitment to a deeper cooperation within the EU in a number of areas. The treaty also gave the European union broader authority to pass laws on a union level. This meant that every member state gave up a bit of their sovereignty and entrusted it to the EU (European Parliament, n.d). Among the areas of deepened cooperation, the treaty laid the foundation for the European Monetary Union, (EMU), and the implementation of a single currency, the Euro. At the same time the European Central Bank, ECB, and the European system of central banks, ESCB, was established. Their objectives are to maintain price stability and to safeguard the value of the Euro (European Central Bank, 2017b). But with the implementation of the Euro and a single shared currency the Maastricht treaty also defined a number of criteria that a country would have to live up to in order to be qualified to join. These criteria are often referred to as the Maastricht criteria or the convergence criteria. The purpose of these criteria is to ensure that price stability is maintained even as a new country join the monetary union. The criteria works to make sure that a country that is about to join the Euro is stable enough in a number of areas. In the area of economics there are four convergence criteria:

1. Price stability - The inflation rate cannot be higher than 1.5 percentage points above the rate of the 3 best-performing member states.
2. Sound and sustainable public finances - Government deficit cannot be higher than 3% of GDP. Government debt cannot be higher than 60% of GDP.
3. Exchange-rate stability - The candidate has to participate in the exchange rate mechanism (ERM II) for at least 2 years without strong deviations from the ERM II central rate and without devaluing its currency's bilateral central rate against the Euro in the same period.

4. Long-term interest rates - The long-term interest rate should not be higher than 2 percentage points above the rate of the 3 best-performing member states in terms of price stability.

(Council of the European union, 2019).

As previously stated, these criteria are there to make sure that a country is qualified to adopt the Euro, but they were also an important tool used to prepare the European countries to become ready for an introduction of a single currency. But although these criteria were set for a reason, many countries that had failed to meet these criteria were still accepted by the European commission to join.

The countries that have adopted the Euro as their currency make up the Euro area or the Eurozone. Today the Eurozone consists of 19 countries with the ECB as their central bank and monetary policy authority. As mentioned earlier, the ECB's most important task is to maintain price stability in order to preserve the Euro's purchasing power and to promote economic growth and job creation within the union. This is controlled by the governing council whose aim is to keep the inflation just under 2 % over the medium term. Although the ECB is the Eurozone's common central bank and is tasked with managing the monetary policy of the region, a large responsibility still lies with the member states and their national central banks to coordinate their respective economic policies, in order to achieve their common goals of stability, growth and employment. The ECB and every Euro country's own central bank make up the ESCB (European commission, n.d).

The ECB has three main interest rates at their disposal when implementing monetary policy. There are two facilities for Euro area banks to borrow and lend at a daily basis, and they are called the deposit facility and the marginal lending facility (European Central Bank, n.da).

- The rate on the deposit facility is the rate at which Euro area banks can make deposits overnight within the Euro system.
- The rate on the marginal lending facility is the rate at which Euro area banks can borrow overnight from the Euro system.

When the ECB wants to affect liquidity on a longer horizon, they change the third rate at their disposal, called the main refinancing operation rate. This rate is the rate banks pay to borrow on a weekly basis from the Euro system, and it requires the bank to post collateral. The deposit

rate and the marginal lending rate define an interest rate corridor for the overnight interest rates in the Euro area. The deposit facility acts as the floor of this corridor and the marginal lending facility acts as the ceiling (European Central Bank, n.da). This has an intuitive explanation since banks offer lower rates for deposits than for borrowing. Inside this corridor we find the main refinancing operation rate.

3.2 The equity and bond market

The reasoning for how equities can be affected by central banks monetary policy decisions is through the risk-free interest rate. Since central bank's policy rates are often used as a proxy for the risk-free rate in a country, central banks affect the value of equities through changing their policy rate (Bernanke & Kuttner, 2004). A common model to value equities is called the dividend discount model (1).

$$V_0 = \frac{D_1}{1+k} + \frac{D_2}{(1+k)^2} + \frac{D_3}{(1+k)^3} + \dots + \frac{D_n}{(1+k)^n} \quad (1)$$

In this equation, V_0 is the value of the equity today, D stands for dividend and n for number of years. This model says that the value of the equity is the value of the future cash flows. In this case future dividend values are discounted back to what they would be worth today (Bodie, Kane & Marcus, 2018). The discount rate, k , is the required rate of return that investors expect. This rate, also called the market capitalization rate (2), is found by using the following formula (Bodie, Kane & Marcus, 2018).

$$k = r_f + \beta[E(r_m) - r_f] \quad (2)$$

Where r_f is the risk-free rate and $E(r_m)$ is the expected return of the market. $[E(r_m) - r_f]$ is called the risk premium. The β coefficient is a measure of the volatility, or systematic risk, of an individual stock in comparison to the unsystematic risk of the entire market (Bodie, Kane & Marcus, 2018). Since the risk-free rate is indirectly controlled by the central bank, the market capitalization rate is affected by the central bank's policies which in turn influences the valuation of equities within that central bank's monetary area. A lower discount rate leads to higher equity valuations for a given market return, since a lower discount rate makes future cash flows more valuable. But that lower rates lead to higher equity prices has another intuitive answer. Since the policy rate reduction affects all other rates within the monetary area, the

possibility for cheaper financing for companies occur. This leads to more leveraged businesses that hopefully can take advantage of economies of scale and increase their output significantly. This should eventually lead to increased equity prices.

The same argument holds for how the central bank affect the yield of bonds within the monetary union. Below we have the formula for calculating the price of a zero-coupon bond (3) (Asgharian & Nordén, 2007).

$$P_0 = \frac{N}{(1+R_n)^n} \quad (3)$$

Where P_0 is the price today, N is the nominal value and R is the market interest rate of the zero-coupon bond. Because the risk-free rate, that the central bank sets, affects all other rates in the monetary union, the market rate in the formula above will be affected. If the central bank cuts its main policy rate, the market rate for the zero-coupon bond should in theory also fall, and the price of the zero-coupon bond will rise since the price and the yield of a bond have an inverse relationship. The same theoretical reasoning applies to equities as well, namely that we discount the value of future cashflows back to today's value to be able to price the bond accurately.

When investigating the impact interest rates has on equities in a more complex way, we can see that depending on which industry and to which country the company belongs, different levels of interest rate sensitivity occurs. In a paper, Ferrando, Ferrer and Jareno (2017) examined the impact interest rates has on different sectors of the Spanish equity market. They conclude that sectors like financial, industrial and utilities are more sensitive to changes in interest rates than for example equities in telecommunications- and oil & gas sectors. Since different sectors face different levels of interest rate sensitivity, equity indices will be affected differently based on which sectors it is overweighed compared to other indices.

Furthermore, empirical evidence is found by Piazzesi and Swanson (2008) that futures contracts on short-term interest rates are significantly good at indicating future monetary policy, both in the near future and in the medium term. The future contract they examined was the Eurodollar future but as in most empirical findings, the Eurodollar was not a perfect estimator of future price movements for short-term interest rates. They did however look at ex-post excess returns, which was defined as the difference between short-term interest rates implied in the price of

the Eurodollar futures and the ex-post realized spot rates. These excess returns were on average positive and significant. Piazzesi and Swanson (2008) reasoned that due to a number of different biases, central banks should examine adjusted versions of futures rates in order to more accurately predict the impact that their announcements will have on short-term interest rates.

3.3 The Efficient Market Hypothesis

The Efficient Market Hypothesis or the EMH was developed by economist Eugene Fama in the 1970 (Fama, 1970). The hypothesis states that there should be no anomalies on the market and an investor cannot outperform it since all the public information should already be reflected in the price of a stock. In the EMH there are three different versions, the weak, the semi-strong and the strong form of the hypothesis. The varying factor in these different stages is the availability of information on the market (Bodie, Kane & Marcus, 2018). The weak form of the hypothesis implies that stock prices already reflect all the information that is available on the market through studying past price movements and trading data. This means that trend analysis is deemed useless in this form since the data on past stock price is available for the public. So even if such data would deliver reliable signals about future behavior of the stock all investors would already have been able to read them and exploit them. So, the signals would in turn become obsolete (Bodie, Kane & Marcus, 2018). The semi-strong form of the hypothesis means that the stock prices also depend on all publicly available information on a firm. In addition to past prices and trading data as is included in the weak form, the semi-strong form also includes quality of management, information on the firm's line of products, balance sheet composition, any held patents and earnings forecasts etc. Ergo, if all this information is already public then the stock prices should reflect this as well. Lastly the strong form, which is somewhat extreme, entails that stock prices not only reflect the previously stated information that is relevant to the firm but also information that is only accessible to insiders of the company. Meaning that every investor on the market would have access to the exact same amount of information as the insiders do, making it impossible to beat the market and make any profits. With all this in mind this theory does not say that the market cannot sometimes be wrong and that some stocks might be over- or undervalued at times. But what it says is that that the stock price should reflect the current available information on the market and the degree of available information on a market should give us an indication on how effective it is (Bodie, Kane & Marcus, 2018).

A lot of research regarding the Efficient Market Hypothesis on international financial markets find that they are often not efficient markets. Uctum and El Ouadghiris (2016) findings regarding the efficiency of the foreign exchange market when it comes to macroeconomic announcements says that the foreign exchange market is not a semi-strong efficient market since their models find a significant change in exchange rate volatility on announcement days (Uctum & Ouadghiris, 2016). Furthermore, Shostak (1997) concludes that the main shortcomings of the Efficient Market Hypothesis are that it gives an illusion of a difference between investing in the stock market and investing in a business model. He goes one step further with this statement and says that stock markets does not have a life of its own and that the Efficient Market Hypothesis is based on flawed statistical methods. He means that the cause of instability on financial markets are due to monetary policy announcements from central banks (Shostak, 1997).

3.4 Connection between long-term and short-term interest rates

There are a variety of different factors affecting the creation of long-term rates, for example inflation expectations, foreign long-term rates and risk premiums to name a few. Since one of the main factors that affect long-term rates is inflation expectations, we are going to give more attention to that part. The central bank has a lot of influence over the long-term rates even though they only change short-term rates. Inflation expectations go hand in hand with the business cycles and in times of economic expansion, the inflation expectations increase. This is because in the expansion phase economic activity increases, so economic agents are more willing to spend money, which puts an upward pressure on prices, which leads to a demand for higher wages for workers. Even though increased wages for workers is delayed due to bottleneck issues, the long-term interest rates tend to increase because of the higher inflation expectations. Since the central bank has an inflation target that they try to steer the inflation towards, the central bank must enjoy some trust from the public that it can achieve this goal. Empirical findings show that the markets trust in the central bank to achieve its price stability goal is a function of how independent the central bank is. To illustrate how the short-term policy rate, inflation expectations and the market pricing of long-term rates are connected we can say that the long-term rate is an inflation thermometer. If the inflation thermometer is increasing in temperature, the central bank needs to step on the break and increase the short-term policy rate to not let the inflation temperature get too high. If the central bank enjoys a high degree of trust from the general public, and especially the market, long-term rates will fall due to the new low

inflation expectation. The long-term rates will fall despite an increase in short-term financing cost (Hässel, Norman & Andersson, 2001). This is validated since if the trust in the central banks' ability to create stable price development in the future is high, the short-term rate will eventually fall as well (European Central Bank, 2017a).

A more detailed example from September 2019 of how the ECB used accommodative monetary policy to affect long-term rates is illustrated below. Aside from changing their key policy rates, the ECB used forward guidance to steer rates, assets and inflation expectations to name a few in the direction they want. Forward guidance is when a central bank, based on current economic outlook, provides information about its future intentions regarding monetary policy (European Central Bank, 2017a). Aside from cutting the deposit facility rate to -0.5 % on the 12th of September 2019, the ECB relaunched their asset purchase program. Furthermore, they signaled with forward guidance that future rate cuts are inevitable if inflation does not increase. This relaunch reinforced the accommodative stance of the ECB in several ways. First, term premia were affected downwards by the combination of net asset purchases and forward guidance by the ECB. Term premia is essentially the difference in yield-to-maturity between short-term bonds and long-term bonds. Since long-term bonds have a longer duration, they have time to collect more coupons and therefore has a higher yield-to maturity than a short-term bond, hence the name term premium (Cohen, Hordahl & Xia, 2018). Because of the increased demand in the marketplace for long-term bonds, the price of these bonds increased, i.e. the yield decreased, and the term premiums were affected. ECB's motive behind this was to spur economic activity for businesses and households by lowering the funding costs for these economic agents (European Central Bank, 2019a).

Secondly, the relaunch of net asset purchases sends a signal to the public that the ECB is willing to use all their available tools to achieve the inflation target. Aside from changing the expectations on short-term policy rates, and indirectly the expectations on long-term interest rates, this signal can have a significant effect on how the expectations on future inflation is perceived. A third reason for why the relaunch of asset purchases reinforced the ECB's accommodative stance is that these purchases have a wealth effect on the balance sheets of Eurozone banks. Because these banks hold a lot of European government debt, the downward pressure on rates, i.e. upward pressure on prices of these bonds, creates larger balance sheets for the banks, which hopefully can lead to increased lending activity, which should lead to increased consumption and investments in the Eurozone (European Central Bank, 2019a).

4. Monetary unions

In this chapter the theory of Optimal Currency Areas is examined further, as well as its founding father, Robert Mundell. Following this we look at how the transmission process of monetary shocks works its way through the economy.

4.1 The theory of Optimal Currency Areas

Robert Mundell is an economist and sometimes referred to as the “intellectual father of the European Monetary Union”. He was awarded the Nobel Prize in economics in 1999 for his groundbreaking contributions published in the 1960s on the ways monetary and fiscal policies work in open economies. Ever since 1970, Mundell has enthusiastically promoted a European monetary unification across the continent (McKinnon, 2000).

The discussion whether a one-size-fits-all monetary policy framework was going to work for Europe, containing economies with large structural differences, had two distinct factions of opinion. The ones in favor were mostly European politicians, whereas the doubters were mostly educated economists. The opposers of a European Monetary Union actually based their arguments for the most part on the classic article “The Theory of Optimum Currency Areas” from 1961, written by none other than Robert Mundell himself. This article seems to be reaching a conclusion that currency areas should become smaller, not larger (McKinnon, 2000). The contradiction of Mundell apparently being on both sides of the debate regarding monetary unification in Europe and around the world can be resolved by noting that there are two Mundell models. The earlier one from 1961 contains the base for the opposers of a European Monetary Union. The later model that was published in 1973 presents another view on the topic. In the second article Mundell concludes that “If a common money can be managed so that its general purchasing power remains stable, then the larger the currency area—even one encompassing diverse regions or nations subject to “asymmetric shocks”—the better.” (McKinnon, 2000, p.1).

The first Mundell model:

In the first Mundell model, his outlook was that both demand and supply shocks from the private sector could be cancelled out by fine tuning aggregate demand through implementing monetary and fiscal policies. To be able to turn this into a model, Mundell assumed that economic agents took the level of inflation, interest rate and exchange rate as constant and that they did not try to estimate these levels in the future. This assumption is essential to the first

Mundell model and is called stationary expectations (Mundell, 1961). Furthermore, Mundell argued that when the mobility of labour in a region is restricted, as in western Europe, these countries would react asymmetrically to macroeconomic shocks. Mundell's findings quickly became common knowledge in the field of economics, and two conditions were set for a one-size-fits-all monetary policy that would determine if a region was not an Optimal Currency Area. The first condition was that a region cannot be an Optimal Currency Area if the labor markets are segmented. The second condition was that when parts of a region have different compositions of output relative to each other, they will face terms-of-trade shocks differently. So according to this model, we need to have a region with high mobility on the labor market and a similar output composition for the monetary policy to be effective against asymmetric shocks (Mundell, 1961).

The second Mundell model:

In the second Mundell model, which was first presented in 1970, a revision of the stationary expectation condition has been made. Instead of taking the exchange rate as constant through time, future exchange rate uncertainty is acknowledged and how it could rattle financial markets by inhibiting international portfolio diversification and risk sharing (McKinnon, 2000). In this model, Mundell showed that asymmetric shocks to a region, due to a different composition of output, could be diminished by creating a monetary union for these different countries. The reason for this was that a large monetary union has greater possibilities for portfolio diversification. Further, Mundell explained that a negative shock to one country can be subdued by the international portfolio diversification possibilities within the monetary union. This is possible because trading partners within a monetary union holds claims on each other's output (Mundell, 1973). If we look at it from the opposite case, where there are two countries with two separate currencies, the total damage would be borne solely by the country facing the negative shock. This is because with two flexible exchange rates regimes, the country facing the negative shock would see a depreciation of its currency, effectively making foreign products and assets more expensive (Mundell, 1973). If government bonds were to be included in this model, currency risk premiums between the countries within the monetary union would arise. For example, the so called "periphery" countries in the monetary union would face increasing interest rates because of increased risk premiums on their government debt. Since these are the countries that before the unification would have devalued their currency to offset negative shocks to its economy, investors now demand a higher premium compared to the "core" countries since the periphery countries no longer can devalue their way through a downturn in

economic activity (McKinnon, 2000). The creation of the European Monetary Union exemplifies this well since countries like Italy and Greece had much higher interest rates than for example Germany before the creation of the Euro. After the Euro was launched, interest rates across the area converged and showed a reduction of risk premiums for the system as a whole. According to theory this is due to the fact that country specific risk premiums demanded by investors reduce when risk sharing through the new monetary union began. Even though a net reduction in interest rates across the area occurred, there are still interest rate differentials between countries due to the fact that investors demand different levels of risk premiums (McKinnon, 2000). Since the Eurozone has a highly diverse output composition between member states (European Central Bank, n.db). The second Mundell model will likely fit the European Monetary Union the best since the second model promotes larger monetary unions unlike the first model.

The criteria for identifying an Optimal Currency Area is often divided into two categories, country- and union specific. There are two common criteria in the country specific category. The first one is a high degree of product diversification within a country's output. This is because when a negative shock occurs, different industries are affected differently, and the aggregate affect diminishes. The second criteria is a high degree of price- and wage flexibility. This flexibility is important because when a country leaves its own floating currency for the fixed union currency, they lose the possibility of having the exchange rate absorb the negative shock to its economy. But price- and wage flexibility can compensate for the loss of the flexible exchange rate and absorb the negative shock hitting the country (Fregert & Jonung, 2014).

For the union specific category, there are many different criteria. One of them is a high degree of production factor mobility, meaning that both labor and capital needs to be able to move easily between member states. Another criterion is a high similarity of production structure between member states. This is important because then member states output reacts in a similar way to negative shocks. This specific criterion plays in the hand of the first Mundell model, whereas the second Mundell model sees a highly different and diversified output composition as favorable. Furthermore, the business cycles of the different member states should have a high correlation with each other. These criteria connect well with two other union specific criteria, namely a high similarity in each member states monetary- and fiscal policy. These two policy criteria make up the foundation of what is necessary for an Optimal Currency Area to function well. Why this is so important is because when policymakers try to stabilize the

economy through monetary- and fiscal policy, the member states need to react in a similar fashion to these policy decisions for it to work (Fregert & Jonung, 2014).

Furthermore, empirical findings regarding the correlation of business cycles is found by Frankel and Rose (1996). They concluded that increased trading between member states, within an Optimal Currency Area, had a positive impact on the correlation of their business cycles. Their empirical findings differed a bit from the theoretical viewpoint of Eichengreen (1992) and Krugman (1993) though. Both Eichengreen (1992) and Krugman (1993) found that increased trading could result in a higher geographical concentration of industrial specialization, i.e. comparative advantages when countries joined the same monetary union. This leads to a lower correlation between business cycles because external shocks to the union will impact member states differently according to them. However, they also note that if demand shocks to the monetary union are the dominant shocks, or if a lot of the member states trading with each other is intra-industry, then business cycles should become more correlated.

4.2 The transmission process

As early as 1933, Ragnar Frisch separated dynamic analysis of how the economy fluctuates into what he called impulses and propagations. These so-called impulses can be seen as a shock to the economic system. The propagation can be seen as the transmission of these shocks out to the economic system. So, the transmission describes how the economy responds to the specific shock that it experienced. The transmission process starts in the asset markets because, compared to the output market, information- and transaction costs are lower than in the output market. An example of a shock that transmits to the asset market is an open market operation by a central bank. Because when the central bank purchases assets it reduces the quantity of assets and increases the monetary base in the economy. A bid up on financial assets begins, with rising stock prices and lower bond yields as the typical outcome. The shock to the economy must be one of more permanent nature for the transmission process to take it from the asset market to the output market. If the shocks are more transitory in nature, the asset market will quickly adjust back to its previous price level, and the output market is rarely affected. If these shocks are of a permanent nature, the price changes on financial assets affect the output market because now the price on production relative to financial assets has decreased. Not only has the relative price on production decreased, interest rates have also decreased, which makes investment in the new cheap production factors even more attractive (Meltzer, A.H, 1995).

To further exemplify this there is a simplified and theoretical example below (figure 1) of the way an open market operation from the central bank finds its way to affect the production of output in the economy. On September 16th 2019 in a press release from the ECB, they described how they thought the transmission process would affect the economy by cutting the deposit facility rate by 10 basis points. This cut would reduce the Euro Overnight Index Average, EONIA, which is a market interest rate that is a reference rate to a lot of the lending process in the Eurozone and underlies the pricing of many financial assets (European Central Bank, 2019a). If the EONIA rate is reduced, lending activity should increase and with the lower discount rate there should be more inflated asset prices in the Eurozone. Thus, the shock of a reduced deposit facility rate is transmitted to the asset market. Since the deposit facility rate is the anchor for the EONIA market interest rate, lowering the deposit facility reduces the funding costs for businesses and households (European Central Bank, 2019a), which shows how their decision of lowering the deposit facility rate will affect the output market positively. Aside from this, the increased asset prices create not only larger consumption possibilities for households, but it also reduces the relative price of production factors relative to financial assets, making it more attractive for investments (European Central Bank, 2019a).

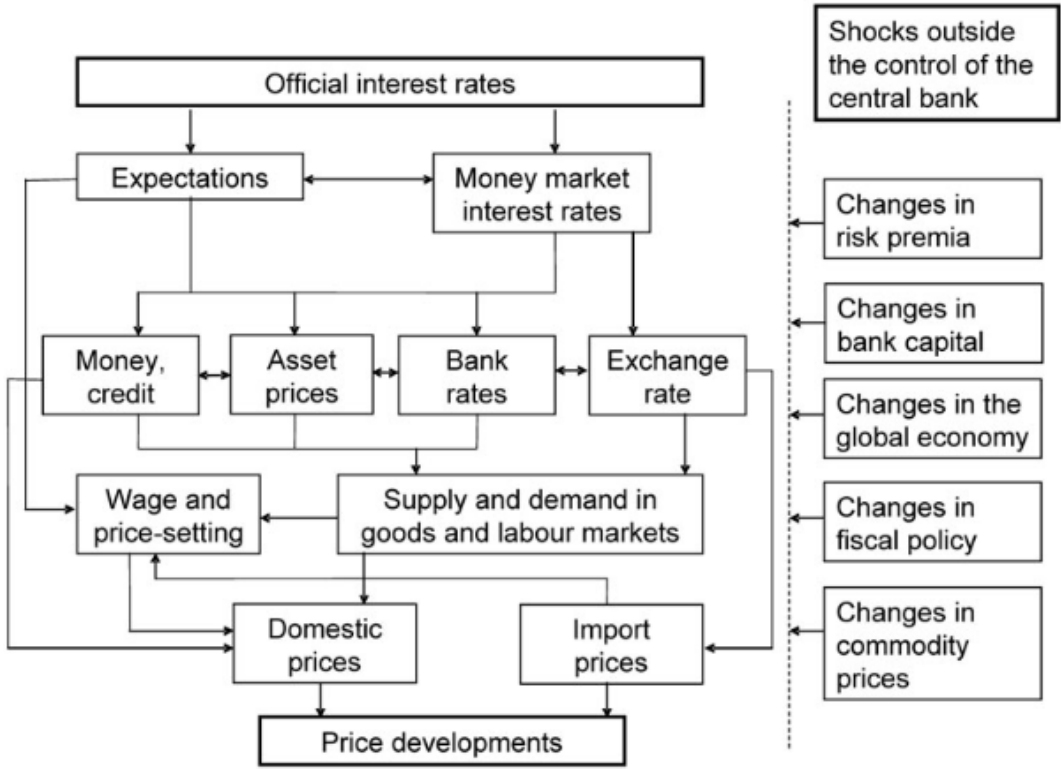


Figure 1 (European Central Bank, (n.dc)) shows what the transmission process looks like when a central bank alters their monetary policy.

5. Data

5.1 Limitations

We have limited ourselves to only look at the founding members of the European Monetary Union, except for Luxembourg due to a lack in available data. Instead we added Greece, who is not a founding member, but who joined the union in 2001, right after its inception. We choose these countries since they have all been members in the monetary union for a long time. This was important because the theory of Optimal Currency Areas states that an interest rate convergence will happen among the countries and we wanted to be sure that this had occurred. Furthermore, we have limited ourselves with regards to the timeframe of our thesis. We choose to only look at announcement days between January of 2011 until October of 2019. This was partly because we wanted enough time to have passed since the inception of the monetary union, so that interest rate convergence had occurred, and partly because we did not want to include the price movements from the recession in 2008.

5.2 Selection of equity indices and government bonds

In this study we analyse the returns from equity indices and the yield from 10-year government bonds for each country. The equity indices we have used have been selected because they are the indices with the largest companies in their respective country and should therefor serve as the best representation. For the government bond yields we have looked at the 10-year government bonds. For each of them we have looked at the daily closing prices and the returns from the equity indices have been calculated using the daily closing prices. The data spans from the 28th of December 2010 until 25th of October 2019. The data on equity indices and bonds was downloaded from Datastream (Datastream, 2019). The equity indices and government bonds that we have looked at for each country are presented in the two tables below (Table 1 and Table 2) where the countries have been divided into two groups, core and periphery. We have divided the countries into these two groups, core and periphery, to make it easier to present the statistics in our graphs and tables.

	Germany	France	Belgium	Austria	Finland	The Netherlands
Equity Index	DAX 30	CAC 40	BEL 20	ATX	OMX Helsinki 25	AEX
Government bonds	10-year yield	10-year yield	10-year yield	10-year yield	10-year yield	10-year yield







Table 1. Equity indices and government bonds that we used for the countries in the group “core countries”.

	Italy	Spain	Greece	Portugal	Ireland
Equity Index	FTSE/MIB	IBEX 35	FTSE/Athex Large cap	PSI 20	ISEQ 20
Government bonds	10-year yield	10-year yield	10-year yield	10-year yield	10-year yield

Table 2. Equity indices and government bonds that we used for the countries in the group “periphery countries”.

5.3 Key ECB interest rates

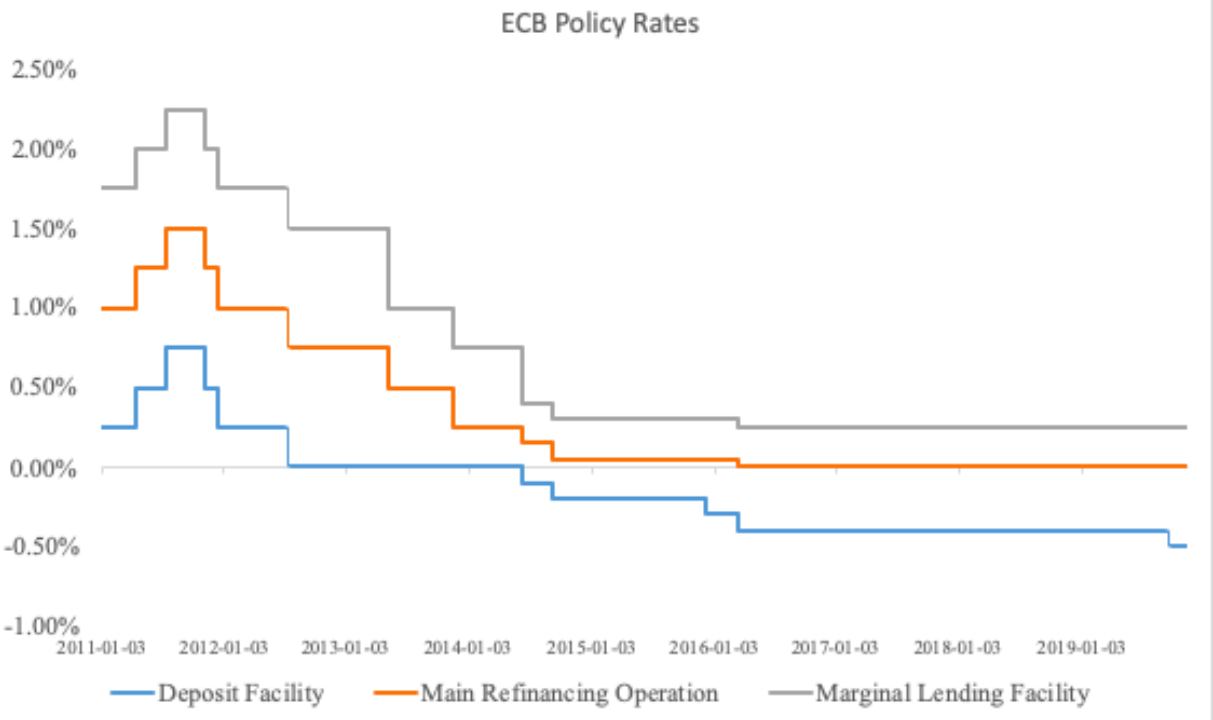
During the time span of our study, the ECB has made 86 announcements but on only ten of these occasions have they made a change in the deposit facility rate. The first two times ECB increased the rate but since then the rate has only been decreased. This data was collected from the ECBs website (European Central Bank, 2019b).

Date	The interest rate on the deposit facility
2011-04-07	 increased by 25 basis points to 0.50%
2011-07-07	 increased by 25 basis points to 0.75%,
2011-11-03	 decreased by 25 basis points to 0.50%
2011-12-08	 decreased by 25 basis points to 0.25%
2012-07-05	 decreased by 25 basis points to 0.00%
2014-06-05	 decreased by 10 basis points to -0.10%

2014-09-04	↓ decreased by 10 basis points to -0.20%
2015-12-03	↓ decreased by 10 basis points to -0.30%
2016-03-10	↓ decreased by 10 basis points to -0.40%
2019-09-12	↓ decreased by 10 basis points to -0.50%

Table 2. Showing the dates where the ECB announced that they would increase or decrease the deposit facility rate

The graph below (Graph 1) depicts the development of key ECB interest rates. The deposit facility rate, main refinancing operations rate and the marginal lending facility rate during the time of our study, from 28th of December 2010 until 25th of Oktober 2019.

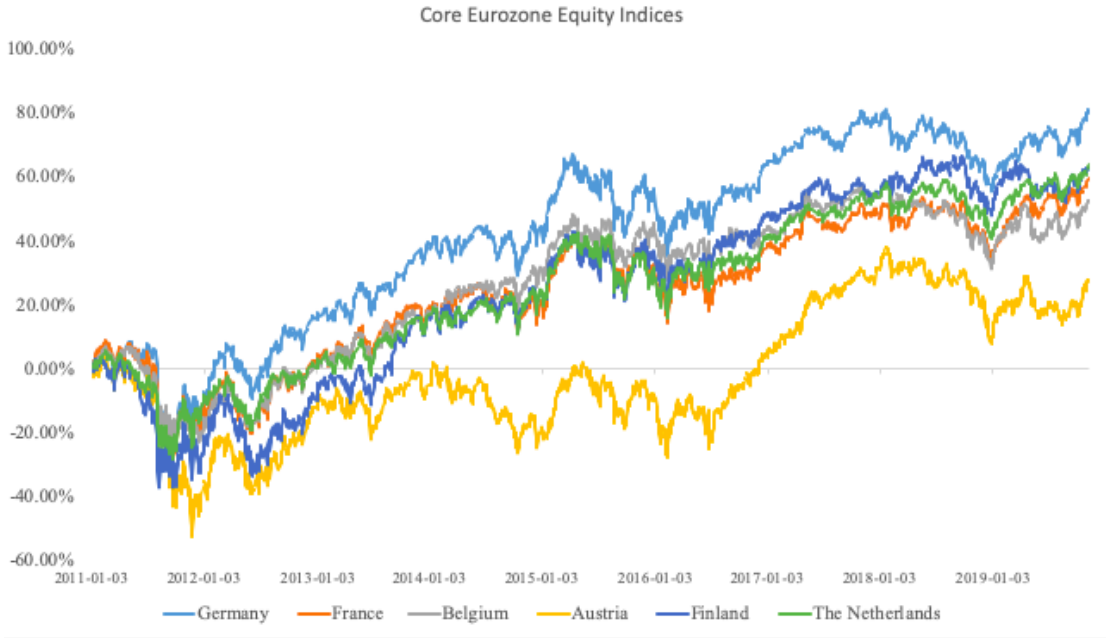


Graph 1. Key ECB policy rates (deposit facility rate, main refinancing operations rate and the marginal lending facility rate) from 2010-12-28 until 2019-10-25

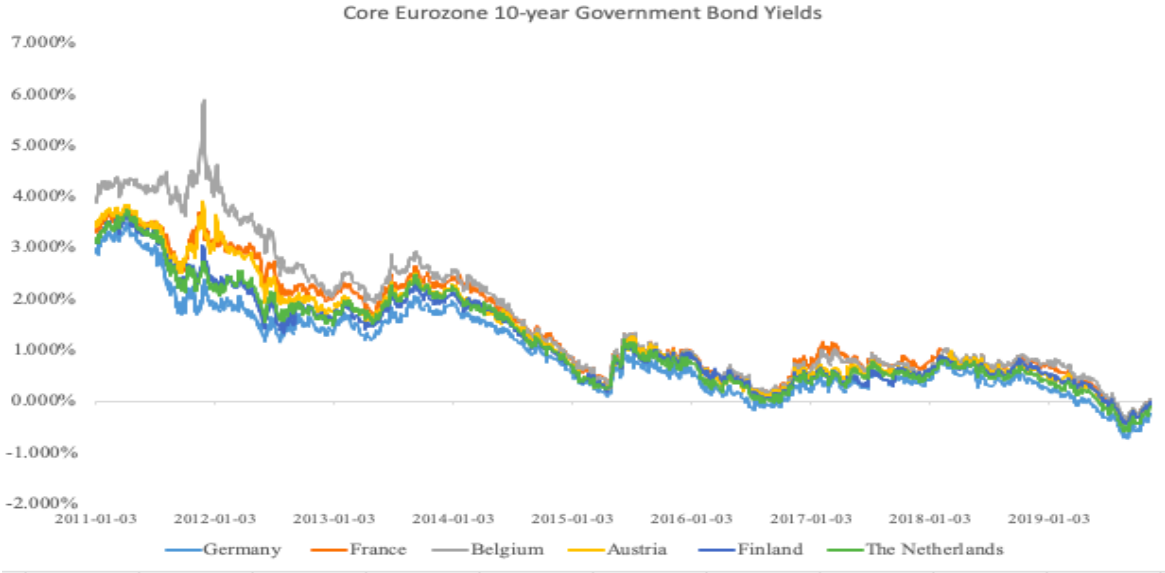
5.4 Historic values of the equity indices and the 10-year government bond yields

The following four graphs presented below depict the development of the Equity indices and government bond yields from each respective country in our study (Table 1) during the time

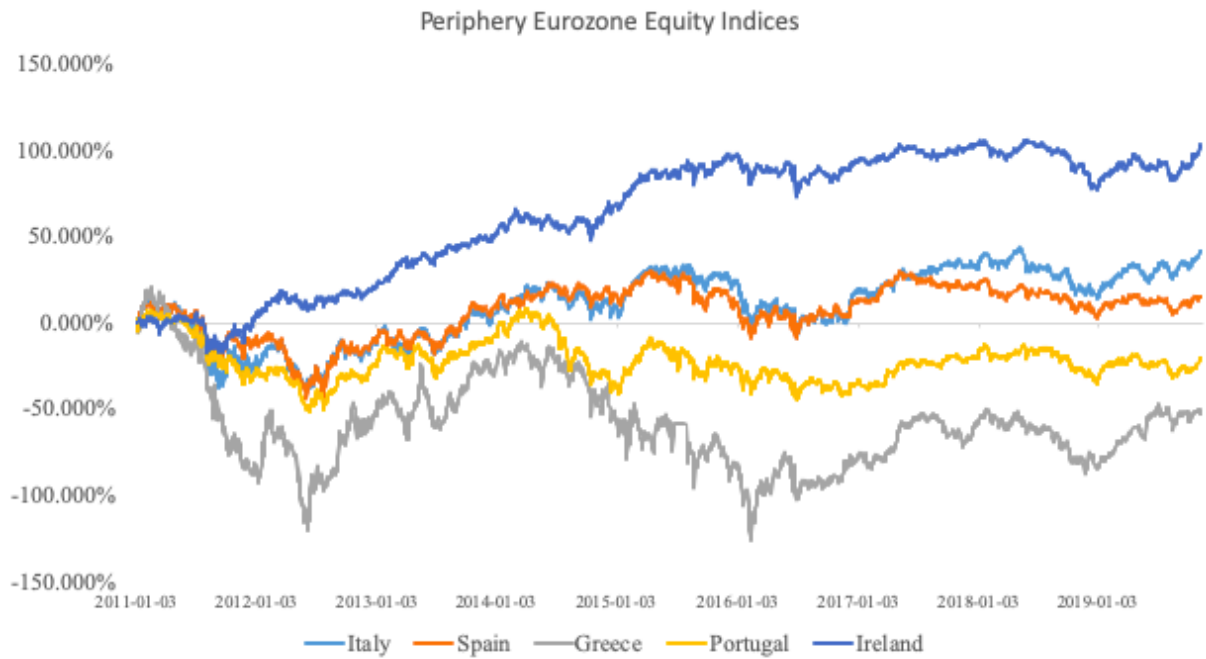
that we investigate them, from the 28th of Decemebr 2010 until the 25th of October 2019. For the equity indices it shows the development of the cumulative return and for the 10-year government bonds it shows the yield. We have again divided the countries in two groups, core and periphery.



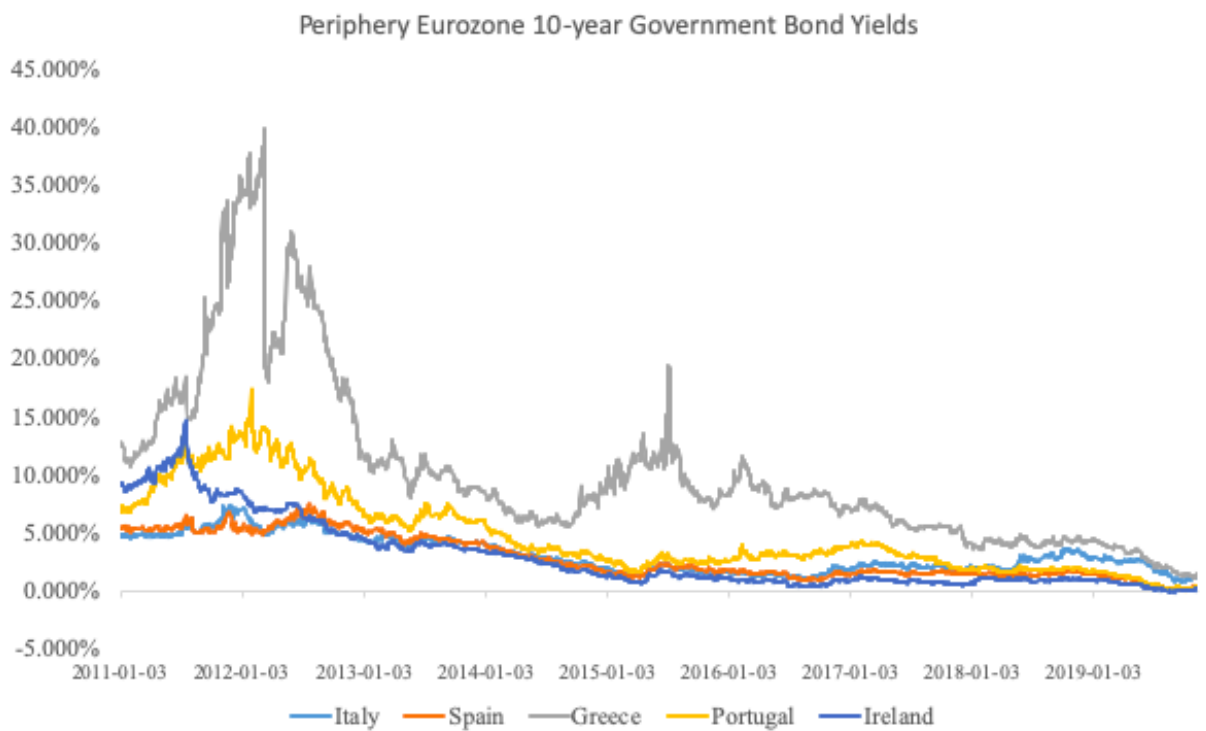
Graph 2. Cumulative return from each core country’s equity index from 2010-12-28 until 2019-10-25



Graph 3. Yield from each core country’s 10-year government bond from 2010-12-28 until 2019-10-25



Graph 4. Cumulative return from each periphery country's equity index from 2010-12-28 until 2019-10-25



Graph 5. Yield from each periphery country's 10-year government bond from 2010-12-28 until 2019-10-25

6. Method

In this chapter we present the general approach to how an event study is performed and how we eventually did our event study.

6.1 Event study

The method we are using for this thesis is called an event study. In an article from 1997 MacKinlay describes through econometric tools and economic theory how to estimate the effect news events have on the value of a certain company. He further explains that this method can be applied to changes in central bank policy rates, dividend announcements and more. The foundation of the event study is to examine if certain real-world events has a statistically significant impact on security prices (MacKinlay, 1997). An event study is applied on times series data, and this data is ideally a large time span to be able to observe as many events as possible. Furthermore, since the cornerstone of event studies is that the Efficient Market Hypothesis prevails (Xie, Munir & Yang, 2019), this method is ideal for examining the effects of the ECB's monetary policy decisions on financial markets in the Eurozone. Because of the large anticipation of these monetary policy announcements, a lot of assumptions can be made through the Efficient Market Hypothesis on the announcements impact on these markets. Given that these announcements are closely watched by a number of "central bank-watchers" in the investment community, the potential effect of these announcements may already be priced in.

6.2 Procedure of the event study

Choosing the event window and estimation period: When composing an event study, one has to identify the period of interest for the study. In other words, the period where the prices on the securities are of interest. This period is called the event window. The event window is often larger than the specific day of interest because there could be factors contributing to the effect from the days before or after the event. In our event study we have chosen an event window of four days: two days before every ECB monetary policy announcement, the actual day of the announcement (the event day), and the day after the announcement. Our reasoning is that there is a lot of anticipation in the marketplace regarding these announcements, which makes it possible for the change of the deposit rate to be priced in before the actual announcement. Our reasoning for looking at the day after the announcement is to capture any post-event reactions to the policy decision in the marketplace. The next step is to choose the estimation period for the event study. In general, the estimation period is a period happening before the event in

question and estimates should not include returns from the event window. This is because the event itself should not have an impact on the estimated parameters of the security (MacKinlay, 1997).

The estimation period we have chosen is ten days long and starts twelve days before the event day and ends three days before the event day. We chose this interval mostly because the period between the ECB’s announcements on monetary policy have sometimes been less than a month. Since we do not want the former announcement to affect the expected return of the next announcement, we had to choose a short estimation period compared to other studies.

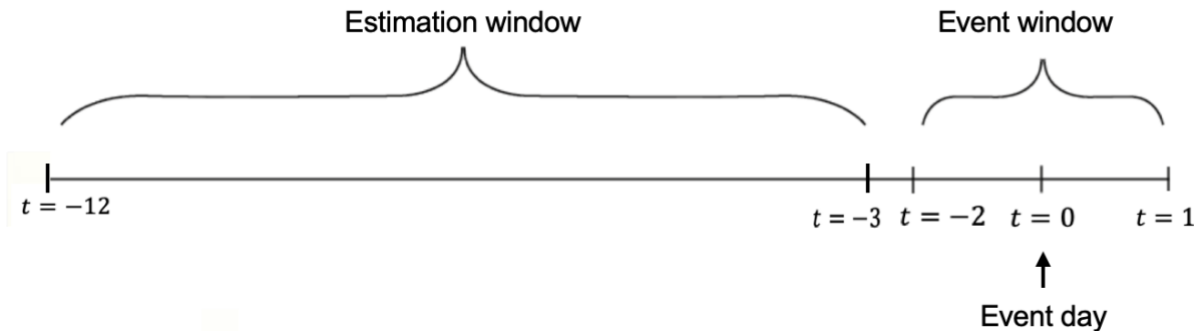


Figure 2. A timeline for the event study displaying the estimation window, event window and event day.

Selection of securities: After the event window is chosen, a selection of the securities that should be evaluated is the next step. This selection is often based on some criteria that could take geographical location of the firms or data availability of the different securities into consideration (MacKinlay, 1997). For our study we look at countries within the Eurozone to assess the impact of the policy announcements. But the criteria we chose is that we should only look at the founding members of the European Monetary Union, with exception for Greece who joined in 2001. Another complication occurred when we had some problems with finding relevant data for Luxembourg, which eventually led to us excluding them from this study. Our reasoning for only looking at the early members is that we want to look at countries whose economies have adjusted to the new currency and have reached some form of convergence with the rest of the Eurozone when it comes to interest rates. So, the selection of securities came down to the main equity index and the 10-year government bond for each of the initial members

of the European Monetary Union, plus Greece and minus Luxembourg. For the exact security selection, see Table 1 and Table 2.

Measurement of abnormal return and motivation for constant mean model: To measure the impact that the event in question has, the abnormal return is used. The abnormal return (4) is when the expected return is subtracted from the actual return during the event window. The expected return is calculated without including the event window, i.e. it is calculated from the estimation period.

$$AR_{it} = R_{it} - E(R_{it}|X_t) \quad (4)$$

When calculating the expected return, there are often two different methods to use. First, we have the “constant mean return model”, where the expected return is calculated as the average return of the security during the estimation period. The second method is called the “market return model”, and instead of taking an average of the security during the estimation period you look at how the market as a whole moved during this period. Often when looking at for example large American stocks you take the return of the S&P 500 as the market return (MacKinlay, 1997). For our event study we have chosen to use the “constant mean return model”. We chose this model because we are looking at the largest stock indices and 10-year yields of the largest Eurozone countries, and thus choosing the largest one of these and calling it “the market return” would not be appropriate. We could have looked at some kind of world index in order to apply the “market return model”, but this would include a lot of unnecessary noise from the rest of the world that would make this event study redundant. Furthermore, since the stock indices that we are looking at would be the market return in an event study that is looking at single stocks, we felt that using the “market return model” in our study would not be appropriate since the indices themselves are often used as the market return.

Statistical testing of the null hypothesis

The next step is to test the abnormal returns for significance. In order to do that, we first have to define the null hypothesis and then determine how and over what time periods we should aggregate these abnormal returns. For our event study the null hypothesis is that the announcement of monetary policy from the ECB has no significant impact on the securities we are looking at. Then the opposite of our null hypothesis is that ECB’s announcements has a

significant impact on the securities. Since the impact can be both positive and negative, our non-null hypothesis is two-sided.

$$H_0: V_0 = 0$$

$$H_1: V_0 \neq 0$$

Where V_0 is the change in return for the securities we are looking at. In order to find the t-statistic from our event study we first calculated a “cumulative abnormal return” or CAR (5) over the event window, i.e. stretching over four days.

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i\tau} \quad (5)$$

Where $AR_{i\tau}$ is the abnormal return of the security in question, τ_1 is the first day of the event window and τ_2 is the last day. After we calculated the CAR, we moved on to calculate the variance of the error term (6) of these securities over the estimation period.

$$\hat{\sigma}_{\varepsilon_i}^2 = \frac{1}{L_1 - 2} \sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \bar{R}_i)^2 \quad (6)$$

Where L_1 is the number of days of the estimation period, which in our case is ten. This measure is essential to the event study because we need to be able to adjust the variance of the securities during the event window with the variance of the error term from the estimation period in order to get sustainable results.

$$\sigma_i^2(\tau_1, \tau_2) = (\tau_2 - \tau_1 + 1) \sigma_{\varepsilon_i}^2 \quad (7)$$

The equation above measures the variance of the CAR (7), which is the variance of the returns during the event window. As we can see the variance of the CAR is adjusted to be able to be comparable with the results from the estimation period. These three steps are calculated for all the securities during all the events we are looking at, i.e. all announcement days from the ECB during the time period between January 2011 and October 2019. After this we had to make a decision of how to aggregate these results in order to connect it to theory. We chose to look at each security individually but to only focus at the days where the ECB actually changed the

deposit facility rate. So, this leads to ten events for each security across the time period. Then we used the following formula to calculate the average cumulative abnormal return (8).

$$\overline{CAR}(\tau_1, \tau_2) = \frac{1}{N} \sum_{i=1}^N CAR_i(\tau_1, \tau_2) \quad (8)$$

Where N is the number of events, which in our case is ten. After this we used the following formula to calculate the variance of the CAR (9) during the event window.

$$var(\overline{CAR}(\tau_1, \tau_2)) = \frac{1}{N^2} \sum_{i=1}^N \sigma_i^2(\tau_1, \tau_2) \quad (9)$$

And then finally we used this formula to calculate the t-statistic (10) for each security during the time period (MacKinlay, 1997).

$$t_1 = \frac{\overline{CAR}(\tau_1, \tau_2)}{var(\overline{CAR}(\tau_1, \tau_2))^{1/2}} \sim N(0,1) \quad (10)$$

Under the null hypothesis, V_0 is distributed as a t-distribution with $n-1$ degrees of freedom. Since our event study spans over several years, the critical t-value of 1,96 is used since n goes towards infinity. So, for a two-sided 95 % confidence interval the critical values become 1,96 and -1,96. This means that if the result is inside this interval it is insignificant. But if the result is outside of this interval, the t-statistic is significant, and the null hypothesis or the H_0 can be rejected (Körner & Wahlgren, 2015).

7. Results

We have calculated two different sets of t-statistics for all of the country's equity indices and government bonds, the only thing that separates them from each other is the number of events we have acknowledged. In the first one, N=10, the t-stats have been calculated only with the data from the 10 events where the deposit facility rate was changed.

10 events –

t-stat (N=10)	Germany	France	Belgium	Austria	Finland	The Netherlands
Equity Index	-1,924884	-1,9517643	-1,8213405	-0,9002168	-1,794067313	-1,663497083
10 Y Yield	0,37984522	0,07737376	0,06018691	0,49831854	0,178429374	0,235096086

Table 3. t-stats for the core countries equity indices and 10-year government bond yields

t-stat (N=10)	Italy	Spain	Greece	Portugal	Ireland
Equity Index	-1,5644656	-1,6615293	-1,4113868	-1,1235305	-1,5727436
10 Y Yield	0,76816632	0,3755078	1,92771012	0,0681739	0,22274132

Table 4. t-stats for the periphery countries equity indices and 10-year government bond yields

As we can see in table 3 and 4, none of the countries equity indices nor the 10-year yields were significantly impacted by the changes in the deposit facility rate. Although when we examine the t-stats for the equity indices we can see that two or three of the t-stats are close to being significant on the 5 %-level, but that the majority of them are quite a long way from being significant, meaning that their t-value is larger than -1,96. This could be explained by the fact that we are looking at events that takes place between the year of 2011 all the way to 2019. Due to the fact that the economic outlook and market sentiment can change a lot during an nine-year time period it is not strange that we do not get as significant results as we had hoped for. If we take a look at the ten-year yields, we do not find any significant results here either. We can also see that all the equity indices have negative t-stats while the 10-year yields have positive ones. This goes against the theory of decreasing yields and increasing equity prices when a central bank cuts interest rates. This will be further examined in the analysis section. If we look at the different t-statistics of the equity indices we can see that some of them are closer to being significant than others. All the core countries equity indices, except Austria, are closer to the

critical value of -1,96 than the periphery countries. This tells us that the core countries equity markets react more strongly to monetary policy announcements than the periphery countries equity markets do. If we turn our attention to the government bond yields, there does not seem to be any coherent divide between core and periphery countries. All of them, except for the Greek yields, are highly insignificant. We believe that the reason that the Greek yields are such an outlier is due to the fact that it has been distinctively higher during the turbulent time of the European debt crisis. Most of the periphery yields skyrocketed during the European debt crisis, but the Greek yields went a lot higher and stayed there for a much longer time than any other yield. We think that this could have led to higher volatility of the Greek yields when policy rate changes from the ECB were announced, and thus led to a higher t-statistic compared to the other countries.

If we take it one step further to find significant results, we could look at a two-sided interval with a level of significance of 10 %. This gives us a critical t-value of 1,64. When looking at our results with this new critical value, we can see that Germany, France, The Netherlands, Belgium, Finland and Spain have a significant t-statistic on their equity indices. According to this new level of significance, these countries constitute an Optimal Currency Area with the ECB as the monetary authority. And if we take a look at the yields again, the results are still very insignificant, with the exception for Greek yields. If we take this new level of significance the ECB only affects Greek yields in a significant way, and we cannot draw any conclusions with regards to Optimal Currency Areas in the Eurozone. But because we did not get any similar results from the equity versus bond markets perspective, no conclusions based on this significance level is drawn. We choose to look at the 5 % significance level as our main result because it is the most commonly accepted and used level to look at, not too high or too low. If we increase the level of significance, the results become less precise, and it creates a trade-off between significant t-statistics and precision of our findings. Since we choose 5 % as our level of significance from the beginning and an increase in the level of significance to 10 % did not give us a solid foundation to draw conclusions from, with regards to Optimal Currency Areas, we chose to stick with our original significance level and not compromise the precision of our results.

In the second test, N=86, we have calculated the t-stats from all the 86 events, regardless if the deposit facility rate was changed or not.

86 events –

t-stat (N=86)	Germany	France	Belgium	Austria	Finland	The Netherlands
Equity Index	-0,2003231	0,061773	-0,1873575	0,044781	-0,13531611	-0,211897172
10 Y Yield	0,18025834	0,97642827	0,42881338	0,30058931	-0,277496966	0,038417094

Table 5. t-stats for the core countries equity indices and 10-year government bond yields

t-stat (N=86)	Italy	Spain	Greece	Portugal	Ireland
Equity Index	0,10886168	0,54979809	0,53869931	0,2712672	-0,7395096
10 Y Yield	-0,1775649	-0,7085385	-0,2879227	-0,6343446	-0,0029205

Table 6. t-stats for the periphery countries equity indices and 10-year government bond yields

Aside from the main results that we found, we applied the same procedure in this test, but on all the announcement days between January 2011 and October 2019, not only on the days that the ECB changed the deposit facility rate but every announcement day. The results from this procedure is depicted in table 5 and 6. In this case, the t-statistics are even more insignificant than in our main result, but these results are not as coherent as well. The reason for this is probably explained by the fact that on the majority of the events in this procedure, the deposit facility rate was not changed at all. We decided to proceed with the first test where N=10 not only because we found more coherent results, but also because the results could be motivated by the fact that in that test there was mostly rate cuts occurring. Since the second test looks at all the different rate decisions, we choose the first one due to the fact that that procedure should be better at explaining why these asset returns change as they do.

8. Analysis

As we can see none of the securities were impacted significantly by the ECB's change in the deposit facility rate. This has led us to draw the conclusion that the Eurozone is an Optimal Currency Area, at least when consulting the second Mundell model. We draw this conclusion based on the idea of European convergency of different macro variables, like inflation rate and stable levels of the exchange rate before a country can join the monetary union. So, we are basing our argument regarding whether the Eurozone is an Optimal Currency Area or not on the fact that the securities we are looking at needs to react similarly to monetary policy announcements. Since the level of interest rates in the economies we are looking at has already converged, it is highly reasonable that they should react similarly as well. We are connecting our results mainly to the second Mundell model because that model talks about risk sharing and international portfolio diversification. Since the European interest rates has converged so much during the past decades, risk premia within the Eurozone have diminished, which in our view could be proof of a successful implementation of an Optimal Currency Area and that the risk sharing and portfolio diversification effects work. If this theory holds, these securities should all move in the same direction as each other since the reaction to asymmetric shocks is spread between member states. Our results tell us that all the equity indices have moved in the same direction and that none of them had a significant reaction to the shocks we evaluated. The same goes for the ten-year yields we looked at, they all went in the same direction and none of them showed any significant impact. This makes us draw the conclusion that through the lenses of the second Mundell model, the Eurozone is an Optimal Currency Area due to the fact that securities move in the same direction and they are not significantly impacted by the monetary policy announcements.

Furthermore, since Franklin and Rose discuss that national business cycles could become more or less correlated within an Optimal Currency Area, our view on how the national transmission processes acts differ. Since a common international trade agreement can lead to comparative advantages for different areas of the Eurozone, idiosyncratic behavior of the different national business cycles could occur. On the other hand, Franklin and Rose (1996) reasons that for example if intra-industry trade is the majority of traded goods and services, then national business cycles could be more synchronized as trading within the Eurozone increases. Our view is that the on the one hand both equities and ten-year yields has moved in the same direction across the Eurozone, which could be a sign that the national transmission processes have

worked similarly within the Eurozone. But the countries that make up the Eurozone have different output compositions. Due to this we cannot draw the conclusion that the monetary policy decisions have affected their real economies in the exact same way just because these securities have moved in the same direction. Since our reasoning is that the second Mundell model is applicable to the Eurozone, and that it determines that it is an Optimal Currency Area, then the reasoning that the Optimal Currency Area should have member states with different output composition is applicable here. The second Mundell model also underlies our argument for the successful risk sharing and international portfolio diversification effects on the Eurozone. Furthermore, since interest rate sensitivity differs between industries and the fact that the member states of the Eurozone have different output compositions, the conclusion that the different national transmission processes acts the same way cannot be drawn. The definite answer to this question lies outside the scope of this thesis, and we will not investigate it further, but the assumption that these processes differ can be concluded. This does not, however, have an impact on our overall conclusion that the Eurozone is an Optimal Currency Area since the second Mundell model's foundation is that member states together create a diversified monetary union when it comes to output composition.

The results above shows, as mentioned, that none of the securities was significantly impacted during this time period. Our conclusion regarding this is that both the Eurozone equity markets and the market for the 10-year yields shows signs of belonging to the semi-strong version of the Efficient Market Hypothesis. Our reasoning behind this is that since monetary policy announcements from the ECB and other major central banks are such big macroeconomic events that there is simply too much coverage from different experts on the outcome of these events. There is published research from large banks and other institutions that estimate and analyze the impact these rate changes should have on the financial markets, and this information is very easy to obtain from different online sources. Since these are qualified experts that are making predictions on events that have three different outcomes, we argue that these monetary policy announcements almost become public knowledge before they are announced. We base this idea partly on the insignificant results we received and that these results can be explained by the fact that as Piazzesi and Swanson (2008) reasoned, the market for futures on interest rates "price in" these announcements before they occur. To prove this however is a difficult task and possibly an interesting topic for further research at a higher level. Since our event window is two days before the announcement until one day after we resonate that the change in monetary policy was almost already priced in and that a lot of what happened in our event

window could be a degradation of asset prices. Since a highly expected outcome was realized, and that outcome was already priced in, it is intuitive that this event would not have a significant impact on asset prices nor that it would have a lasting effect on them as well. We also find support for our reasoning in the literature of theoretical finance on how assets are priced. According to the literature equities can be valued with the dividend discount model and that the risk-free rate in this model is often based on some sort of major policy rate. This model tells us that if interest rates decline, equity valuations should increase based on the lower discount rate. Since equity prices in our event study was negatively impacted across the board, we find support for our theory here regarding that the market sort of price them back since the event was already priced in. Also, the fact that the literature states that when the risk-free rate decreases, longer-term interest rates on bonds should also decrease. In our event study the opposite has happened, i.e. interest rates on long-term bonds have been positively impacted. Once more the theory of a degradation of asset prices can be a possible assumption.

9. Conclusion and further research

To conclude, we did not find any significant impact from the ECB on any of these asset's prices. As stated, this can very well depend on the forward-looking nature of financial markets. We reason that since the prices of the bonds and equity indices respectively moved in the same direction and magnitude, and since none of them were significantly impacted, we reason that the ECB is able to impact them in a similar manner. This is necessary for an Optimal Currency Area since the monetary authority of the area needs to be able to affect these securities in a consistent way, and we reason that this is an attribute the Eurozone displays. This makes us draw the conclusion that based on the reaction of the equity and government bond market in the Eurozone, the Eurozone actually is an Optimal Currency Area. There are still some unturned stones in this thesis, and some of those could be interesting for further research. The question to what degree the transmission process within the Eurozone differ, is, however of certain interest. Since these processes are different, one could model the monetary policy announcements effect on the countries respective equity- and bond market, and then move on to examine how this changed real economic variables like industrial production or housing prices in these countries. There might be some conclusions to draw as to for which countries the European Central Bank has the most effect on. Based on similarities of transmission processes, one might be able to determine which countries constitutes an Optimal Currency Area. Furthermore, an interesting area for further research could be to examine to what degree international risk sharing within the Eurozone has occurred. One might be able to draw more concrete conclusions regarding the convergence of interest rates in the Eurozone to international risk sharing. Another interesting topic for further research would be to examine to what degree the market has already priced in the ECBs monetary policy announcements in equity and bond prices. This would be of great interest for this thesis, but more generally it could be of interest for economics as a subject.

10. Literature

Artis, M. J. (2003), Reflections on the Optimal Currency Area (OCA) criteria in the light of EMU. *International Journal of Finance & Economics*. Vol. 8 Issue 4, p297-307. Available through LUBsearch: <https://www.lub.lu.se/en/find/lubsearch>. [Accessed on 12 December 2019]

Asgharian, H & Nordén, L. (2007), Räntebärande Instrument - Värdering och Riskhantering, Lund: Studentlitteratur

Bernanke, B & Kuttner, K, (2004), What Explains the Stock Market's Reaction to Federal Reserve Policy? NBER - National Bureau of Economic Research Working Papers. No. 10402

Bodie, Z., Kane, A. & Marcus, A.J, (2018), Investments, New York: McGraw-Hill Higher Education

Castañeda, J.E. and Schwartz, P., (2017) How Functional is the Eurozone? An Index of European Economic Integration Through the Single Currency. *Economic Affairs*. Vol. 37 Issue 3, p365-372. Available through LUBsearch: <https://www.lub.lu.se/en/find/lubsearch>. [Accessed on 12 December 2019]

Cohen, Benjamin H., Hordahl, P; Xia, D. (2018), Term Premia: Models and Some Stylised Facts. *BIS Quarterly Review*, September 2018, pp. 79-91.

Costantinia, M., Fragetta, M. and Melinad, G. (2014) Determinants of sovereign bond yield spreads in the EMU: An Optimal Currency Area perspective. *European Economic Review*, Vol.70, p337-349. Available through LUBsearch: <https://www.lub.lu.se/en/find/lubsearch>. [Accessed on 11 December 2019]

Council of the European union (2019). Conditions for joining the Euro area: convergence criteria. <https://www.consilium.europa.eu/en/policies/joining-the-Euro-area/convergence-criteria/#> [Accessed on 12 December 2019]

Datastream. (2019) Thomson Reuters Datastream. Available Online: Subscription Service
[Accessed on 4 November 2019]

Eichengreen, B.J. (1992). Should the Maastricht Treaty be saved? Princeton, N.J.:
International Finance Section, Department of Economics, Princeton University.

European Central Bank, (n.da), Available online,
<https://www.ecb.europa.eu/mopo/decisions/html/index.en.html>, [accessed 20 November
2019]

European Central Bank, (n.db), Available online,
<https://www.ecb.europa.eu/mopo/eaec/diversity/html/index.en.html>), [accessed 1 December
2019]

European Central Bank, (n.dc), Available online,
<https://www.ecb.europa.eu/mopo/intro/transmission/html/index.en.html>, [accessed 12
December 2019]

European Central Bank (2017a), What is forward guidance? Available online:
https://www.ecb.europa.eu/explainers/tell-me/html/what-is-forward_guidance.en.html.
[Accessed 17 November 2019]

European Central Bank (2017b), Five things you need to know about the Maastricht Treaty.
Available online: [https://www.ecb.europa.eu/explainers/tell-me-
more/html/25_years_maastricht.en.html](https://www.ecb.europa.eu/explainers/tell-me-more/html/25_years_maastricht.en.html) [Accessed on 11 December 2019]

European Central Bank (2019a), Reflections on Monetary Policy. Available online:
<https://www.ecb.europa.eu/press/key/date/2019/html/ecb.sp190916~ca77017a8e.en.html>.
[Accessed 5 December 2019]

European Central Bank (2019b), Press releases on Monetary Policy, Available online:
<https://www.ecb.europa.eu/press/pr/activities/mopo/html/index.en.html>
[Accessed 4 November 2019]

European Commission (n.d). What is the Euro area? Available online:
https://ec.europa.eu/info/business-economy-Euro/Euro-area/what-Euro-area_en
[Accessed on 12 December 2019]

European Parliament, (n.d), Available online: <https://www2.europarl.europa.eu/about-parliament/en/in-the-past/the-parliament-and-the-treaties/maastricht-treaty>
[Accessed 12 December 2019]

Ferrando, L., Ferrer, R. & Jareno, F., (2017), Interest Rate Sensitivity of Spanish Industries: A Quantile Regression Approach. *Manchester School* (1463-6786). Vol. 85 Issue 2, p212-242. Available through LUBsearch: <https://www.lub.lu.se/en/find/lubsearch>. [Accessed on 1 December 2019]

Frankel, Jeffrey A., & Rose, Andrew K., (1996), The endogeneity of the optimum currency area criteria, NBER- National Bureau of Economic Research. Working Paper. No. 5700

Fregert, Klas & Jonung, Lars. (2014), Makroekonomi- Teori, Politik och Institutioner, Lund: Studentlitteratur

Horvath, R. (2018), Financial market fragmentation and monetary transmission in the Euro area: what do we know? *Journal of Economic Policy Reform*, Vol. 21. p319-334. Available through LUBsearch: <https://www.lub.lu.se/en/find/lubsearch>. [Accessed on 13 December 2019]

Hässel, L., Norman, M. & Andersson, C. (2001), De Finansiella Marknaderna i ett Internationellt Perspektiv, Lund: Studentlitteratur

Krugman, P. (1993). 8 Lessons of Massachusetts for EMU, in Torres, F & Giavazzi, F. *Adjustment and growth in the European Monetary Union*, Cambridge: Cambridge University Press, pp.241-266

Körner, Svante and Wahlgren, Lars. (2015), Statistik dataanalys, Lund: Studentlitteratur

MacKinlay, A. Craig, (1997), Event Studies in Economics and Finance, *Journal of Economic Literature*, Vol. 35, p13-39. Available through LUBsearch:

<https://www.lub.lu.se/en/find/lubsearch>. [Accessed 3 November 2019]

Meltzer, A.H, (1995), Monetary, Credit and (Other) Transmission Processes: A Monetarist Perspective. *The Journal of Economic Perspectives*. 9(4):49-72. Available through

LUBsearch: <https://www.lub.lu.se/en/find/lubsearch>. [Accessed 30 November 2019]

Mundell, Robert A., “A Theory of Optimum Currency Areas”, *American Economic Review*, 51, Nov. 1961, pp. 509-17.

Mundell, Robert A., “Uncommon Arguments for Common Currencies”, in H.G. Johnson and A.K. Swoboda, *The Economics of Common Currencies*, Allen and Unwin, 1973. pp.114-32.

Pacicco, F., Vena, L & Venegoni, A. (2019), Market reactions to ECB policy innovations: A cross-country analysis. *Journal of International Money and Finance*. Vol. 91. p126-137.

Available through LUBsearch: <https://www.lub.lu.se/en/find/lubsearch>. [Accessed on 13 December 2019]

Piazzesi, M. & Swanson, E.T, (2008), Futures Prices as Risk-Adjusted Forecasts of Monetary Policy. *Journal of Monetary Economics*, vol. 55, pp. 677-91. Available through LUBsearch:

<https://www.lub.lu.se/en/find/lubsearch>. [Accessed on 3 December 2019]

Ronald McKinnon, 2000. "Mundell, the Euro, and Optimum Currency Areas," Working Papers 00009, Stanford University, Department of Economics.

Shostak, F, (1997), In defense of fundamental analysis: A critique of the Efficient Market Hypothesis, *Review of Austrian Economics*, Vol.10. Available through LUBsearch:

<https://www.lub.lu.se/en/find/lubsearch>. [Accessed 29 November 2019]

Uctum, R and El Ouadghiris, I, (2016), Jumps in equilibrium prices and asymmetric news in foreign exchange markets, *Economic Modelling*, Vol.54. Available through LUBsearch:

<https://www.lub.lu.se/en/find/lubsearch>. [Accessed 9 December 2019]

Xie, Y., Munir, F. and Yang, J, (2019), Overflow effect of credit rating announcements on stock exchange based on event study, *Applied Economics Letters*, Vol.26. Available through LUBsearch: <https://www.lub.lu.se/en/find/lubsearch>. [Accessed 9 December 2019]