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Alternative Monetary Policy Tools of the ECB

Impact on Financial Markets

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Executive Summary

This thesis investigates the four firstly applied alternative monetary policy measures that the ECB announced in order to deal with the financial crises: fixed rate full allotment procedure (FRFA), longer-term refinancing operations (LTROs), foreign exchange liquidity provision (FEL), and easing of collateral (EOC). The aim of the paper was to answer two research questions: 1) Why did the ECB find it necessary to use alternative monetary policy measures? 2) Did these measures manage to achieve their purpose?

The ECB started using non-traditional measures as increasing tensions in the money markets did not allow normal monetary policy transmission mechanisms to work. Before the crises, the ECB conducted open-market operations at a specified minimum bid rate (MBR), which together with the reserve requirements and standing facilities allowed achieving balanced liquidity conditions. In the middle of 2007, this became impossible due to the following reasons: a) the ECB lost control of steering the Euro Overnight Index Average rate (Eonia), which became increasingly volatile. In order for the transmission to work, the ECB needs Eonia to be quite close to the MBR. b) The spread between key money market indices increased significantly. Namely, the spread between the Euribor different maturities and between Euribor and Eoniaswap increased significantly. c) The spread between the marginal rate (the lowest successful bid rate) and the minimum bid rate became unpredictable. The ECB needs it to be stable in order to make qualified decisions about liquidity needs.

The purpose of the empirical analysis was to estimate if the alternative policy tools managed to ease some of the money market tensions, by focusing on the spreads mentioned under point b). That was achieved by measuring financial market reaction on the days when the ECB made key announcements about the four alternative policy tools. The expected results were decreasing money market spreads and increasing stock market indices. The latter would show the market's approval of the use of these measures. Impact on exchange rates was also tested, since changes in the latter may influence investments and economic growth.

Using the GARCH (1,1) and Least Squares models, the estimation results were the following: First, majority of the announcements managed to decrease the Euribor-Eoniaswap spreads. Thus, the news of these measures decreased liquidity and/or credit risk premium on the money markets. At the same time, the spreads between Euribor shorter and longer maturities

mostly increased. The latter result is contrary to the expected, since despite the unlimited liquidity provision measures for shorter and longer term maturities, the Eurosystem Panel Banks demanded increased risk premium on the interbank lending markets. Second, stock markets experienced large drops on majority of the key announcements days. This may indicate disapproval on the use of these measures, or instead, increasing fears about further deepening of the crises.

Introduction

It is difficult to determine when the latest financial crises started, as the circumstances that caused it include a longer process of deregulations and other developments which started years before the drastic consequences reached the wider public. However, over the course of 2007, when the collapse of the US housing bubble and the abrupt shutdown of subprime lending led to losses for many financial institutions, the seriousness of the situation became apparent as it gained massive media coverage world-wide.

The crises intensified substantially after the failure of Lehman Brothers and the collapse of American International Group (AIG) in September 2008. Market activity declined drastically, interest rate spreads increased, stock markets plummeted and interbank lending activities seized up. Numerous financial and insurance companies from around the world have written down billions of euros of losses, many have gone bankrupt and many have been bailed out by the governments. Millions of people have lost their jobs and their homes in Europe, USA and elsewhere, where the real estate markets have experienced great losses, and many people have lost their pension and other savings. The decline of consumer wealth can be estimated to trillions of euros.

It is November 2011, and the world is still struggling with the financial crises. To address the implied challenges, central banks around the world introduced a set of nonstandard policy measures in addition to easing monetary policy through conventional means. Today, after around 4 years since the start, it is still difficult to find signs of recovery. The methods that have been applied to improve the world economies are therefore of extreme relevance at current times and deserve extended analysis with a critical mind. This is the motivation of this research paper, which investigates the four firstly-applied non-traditional policy tools that the European Central Bank (ECB) implemented since 2007. This paper will look into why there was a need for non-traditional policy tools and what the financial market reaction was on the alternative monetary policy announcements.

1. Research design

The main goal of this paper is to answer the following research questions:

Research question (1):

- *Why did the ECB find it necessary to use alternative monetary policy measures?*

Research question (2)

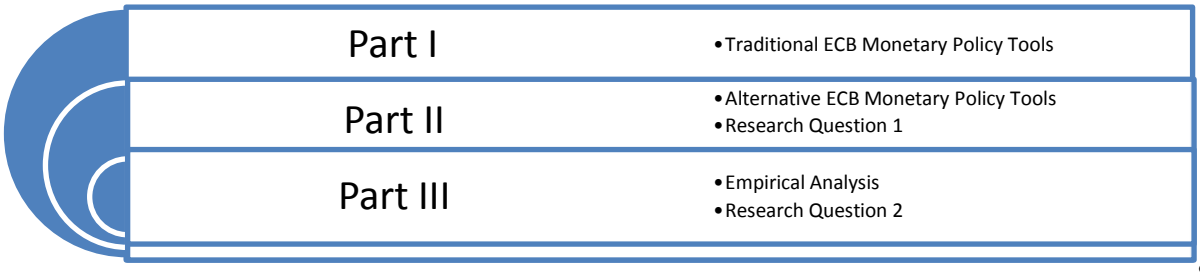
- *Did these measures manage to achieve their purpose?*

To achieve this, the paper has been divided into three parts:

Part I starts with a short discussion about the key monetary policy transmission theories. This is necessary in order to understand why and how the ECB conducts its monetary policy. Thereafter, the traditional monetary policy tools of the ECB will be outlined. The purpose of this is to set a theme for the use of the alternative measures and more specifically, to try to understand why the traditional monetary policy instruments were not sufficient.

Part II provides an overview of the financial market turmoil which started in the middle of 2007. By using the analysis of the theoretical background and traditional monetary policy tools of the ECB under Part I, Part II will explain why there was a need for an alternative approach. It will also describe the four alternative monetary policy tools: Fixed rate full allotment (FRFA), long-term repurchase operations (LTROs), foreign exchange liquidity provision (FEL) and easing/expansion of collateral (EOC). Part II answers Research question 1.

Part III provides the results from the empirical analysis. The purpose of this is to check if these measures managed to achieve the expected results. The analysis focuses on the reaction of the money markets by looking at the change in key money market spreads on the days of the key announcements of the use of non-traditional monetary policy measures. Part III starts with description of the model set-up and the use of financial data. After that, the actual results are provided and measured against the expected.



Empirical analysis

The empirical analysis measures the impact of key alternative monetary policy announcements on selected financial asset prices. The empirical analysis is conducted by comparing the end-of-day market prices of the announcements compared to the day before. The assets under analysis are divided into three categories: interest rate spreads, market indices and exchange rates. The GARCH (1,1) model is used to measure the effects on the market indices and exchange rates, and the Least Squares (LS) method with White corrected standard errors on the interest rate spreads. The results will show if and how markets reacted to the alternative monetary policy announcements, measured by daily changes on the selected asset prices. Part III answers Research question 2, and in addition, provides insight into the pitfalls of econometric modelling by using daily financial asset prices, calling for extreme care when interpreting the estimation results.

The reason for looking at the announcement effects is connected to the transmission mechanism of central bank monetary policy. The process through which monetary policy decisions affect the economy in general, and the price level in particular, is known as the transmission mechanism of monetary policy. In short, the central bank uses several monetary instruments in order to influence financial asset prices, since they cannot directly influence the real economy. These are liquidity management tools such as the reserve requirements and interest rate setting. The true goal of these measures is to influence the real economy, via the savings and investment decisions of households and firms. Unfortunately these changes take time and since there is only a few years of data since the implementation of the alternative policy measures, this is not sufficient for analyzing the real effects. Tradable asset prices (interest rate spreads, market indices etc.) on the other hand react immediately and can therefore provide an important signal about their expected future impact on the real economy. The change in the asset prices gives an idea of the effectiveness of the measures and the how the market participants perceive them.

2. Delimitations

This paper does not look into the reasons for why the financial crises started and does not elaborate on whether the measures applied by the ECB were the most optimal ones. However, it is the viewpoint of the author that these measures mostly deal with the symptoms of the crises, while almost no action is taken to eliminate the circumstances and market structures that have led to the financial breakdown. In addition, the paper focuses only on the first four

alternative policy measures, while analysis of the last two programs, Covered Bond Purchase Program (CBPP) and Securities Market Program (SMP), which were started in 2009 and 2010 respectively, are not included due to page and time limitations.

The announcements under analysis are only first-time announcements of the alternative monetary policy measures. Announcements about prolonging or modifying a measure are not included. Furthermore, the analysis does not look at the days when the specific policy tools were actually implemented, stopped or announced to be phased out.

A major issue when measuring the announcement effects is that it is impossible to eliminate the impact of all other global communications from that of the ECB announcements that were made on the same day. Furthermore, on some days the ECB made several announcements about different types of policy measures. Therefore, when estimating an impact on financial asset prices, it is not possible to differentiate the influence of one announcement from another.

Lastly, the study does not provide a comprehensive evaluation of the effectiveness of the non-traditional methods. Such an assessment requires measuring the objectives and outcomes of the measures over the entire policy application period, which requires a longer-term approach than the current study is able to capture.

3. Methodology

3.1 Duration and research process

Research on the topic "Alternative monetary policy tools of the ECB" started on April, 2011 and ended on November, 2011. During that period, the author spent six weeks at the Bank of Estonia, gathering the necessary data, talking to specialists and receiving guidance on the use econometric programs, econometric models, data inference and the topic in general. The whole research process was guided by Jesper Rangvid, an advisor from Copenhagen Business School.

3.2 Deductive, inductive approach and theory

The empirical part of current research paper has a slightly deductive approach, although the analysis is not based on any single theory which is tested for its accuracy. Theory is brought in as a tool to help explain the mechanisms of central bank monetary policy transmission

during normal times as well as times of financial crises. This helps in understanding how the ECB conducts its monetary policy and why it needed an alternative approach. The key theories in this paper are: interest rate channel, credit channel, asset price channel and exchange rate channel.

3.3 Data

Data sources

The data for current research stems mostly from primary sources. These are the ECB's press releases and publications, which are used for analysing the traditional and alternative monetary policy tools of the ECB. Primary data is furthermore used for conducting the empirical analysis (Part III), including all the raw data about the financial asset prices and interviews with specialists in the field. Secondary data sources are used as well, mostly in the form of research papers, which have been written by academics and economists.

Data types

The empirical part of the thesis takes mostly use of quantitative data. These include announcement dates and daily values of the European stock market indices, exchange rates and money market spreads. Qualitative data is used for gathering information about the announcement contents. Reuters EcoWin and the ECB Statistical Warehouse databases were used for extracting the data.

Data collection methods

All the ECB press-releases and official communications were examined and sorted in order to find relevant communications relating to the use of the alternative monetary policy measures. The announcement dates were gathered for the following four alternative monetary policy announcements: FRFA, LTRO, FEL and EOC. These are days when the ECB (mostly via press-releases) announced the first time use of a specific measure. There are up to 7 announcements under each category. For example under LTRO, there are 3 key announcement dates: these are the days when the ECB, for the first time, communicated the application of 3-month, 6-month and 12-month supplementary LTROs.

3.4 Models and calculations

Financial estimations are conducted by using the GARCH (1,1) and LS models. GARCH is used to measure the effect on market indices and exchange rates. Under GARCH estimations,

Berndt-Hall-Hall-Hausman (BHHH) is used as the optimization algorithm (Berndt, Hall, Hall & Hausman, 1974) and in rare cases the Levenberg-Marquardt algorithm (Levenberg, 1944; Marquardt, 1963). [1] Student's t distribution is used for the error distribution. LS estimation is used to measure the effect on the interest rate spreads. For LS, White Heteroskedasticity-Consistent Standard Errors and Covariance is used. The chosen significance level for testing for the type I error is 5% (α=0,05).

A dummy variable is created for each announcement day and its {+1} and {-1,+1} window days. These are used in the estimations to see if the announcements have any significant effect on the average daily changes of the respective assets. Calculations and model estimations were made by using Eviews 7.

3.5 Definition of key concepts

Definition of key concepts is provided under Appendix 1.

4. Existing research

There is a vast amount of research papers written on the topic of current financial crises. Firstly, numerous economists have presented their view on what the causes of the crises were. The largest and most thorough research has been conducted in the USA by the Financial Crises Inquiry Commission (FCIC, 2011). The FCIC was created to examine the collapse of major financial institutions that failed or would have failed if not for the assistance from the government. As known to the author, no investigation equal to that of the FCIC report has been conducted by the European governments.

The ECB has published several papers relating to the monetary policy tools used during the crises (Lenza, Pill & Reichlin, 2010; Cassola & Huetl, 2010; Giannone, Lenza, Pill & Reichling, 2011), and about the effectiveness of steering the market rates during the crises (Abbassi & Linzert, 2011). There are publications about the monetary transmission mechanisms, for example, a paper by Weber, Gerke and Worms (2008) and Gambacorta and Marques-Ibanez (2011), who write about the bank lending channel during the crises. A more econometric viewpoint is taken by researchers who use econometric models to analyse the

[1] Levenberg-Marquardt algorithm was used when BHHH algorithm did not converge. Levenberg-Marquardt modifies the BHHH algorithm by adding a correction matrix to the sum of the outer product of the gradient vectors.

transmission mechanism, i.e. Chudic and Fratzscher (2011), who look at the global transmission by using the GVAR model.

There is significant amount of literature about central bank communications and how it influences market expectations and asset prices. However, most of them deal with the press releases and other communications related to the interest rate setting (see for example Rosa & Verga, 2008). There has been much less research conducted about the announcement effects of non-traditional monetary measures. Most of them have been undertaken in the USA and they deal with FED announcements and their effect on asset prices. Glick and Leduc (2011) look at how Large-Scale Asset Purchases (LSAPs) have affected commodity prices; Gagnon, Raskin, Remache and Sack (2011) and Krishnamurthy and Vissing-Jorgensen (2011) measure the effects of LSAPs on various financial asset yields, including treasury and agency debt yields; Neely (2010) uses the event-study methodology and shows that Federal Reserve announcements concerning LSAPs had significant effects on the American and foreign bond yields as well as on exchange rates.

In regards to research about ECB announcements, AÏt-Sahalia, Andritzky, Jobst, Nowak and Tamirisa (2010) have examined the impact of macroeconomic and financial sector policy announcements on interbank credit and liquidity risk premiums in the euro area during the recent crisis. Hussain (2010) measures the monetary policy announcements on international stock markets using high frequency data. The ECB has published a working paper (Afonso, Furceri & Gomes, 2011) where they have conducted an event study analysis on the reaction of government yield spreads before and after announcements from rating agencies. There have been no studies that are known to the author, which would measure the effect of FRFA, FEL, EOC and LTRO announcements on market indices, exchange rates and money market spreads.

Part I Traditional ECB Monetary Policy Tools

The following section starts by explaining the transmission mechanism of central bank monetary policy by looking at some key theories. Next, the traditional monetary policy tools of the ECB are examined in order to understand how the ECB in, "normal times", conducts its monetary policy. This will serve as the basis for Part II, which examines the alternative monetary policy tools that the ECB has used in response to the financial crises, and especially, why there was a need for a non-traditional approach.

1. Monetary policy transmission theories

The monetary policy transmission mechanism is the process how central bank activities may influence the economy in general, and the price level in particular. Because of the impact monetary policy has on financing conditions in the economy and market expectations about economic activity and inflation, monetary policy can affect the prices of goods, asset prices, exchange rates as well as consumption and investment. What makes monetary policy transmission a complex topic, is that there is no single linear way how central bank monetary policy is transferred through the financial markets to the economy, but instead, there are many channels through which monetary policy may work. The main theories which discuss these channels are the interest rate channel, credit channel, exchange rate channel and asset price channel. These channels are non-exclusive, and should be used as complements in order to understand the many ways the transmission may take place.[2]

1.1 Interest rate channel

The interest rate channel theory represents the most traditional thinking about how the central bank can influence the economy by increasing or decreasing the interest rate. The basic idea is that interest rates influence the economy by affecting the relative prices in the economy. Interest rate channel theory focuses on the relative prices of capital, future consumption, in terms of current consumption, and the price of domestic goods in terms of foreign goods (Bean, Larsen & Nikolov, 2002). An increase in nominal interest rates by a central bank will

[2] However, due to changes in the financial markets and bank funding patterns, it will be explained later under Part II, why some of these theories can be used more for informational purposes, while a need for up-dated models, reflecting the changed market circumstances is called for.

increase the real rate of interest and the cost of capital, given some degree of price stickiness.[3] Higher real rates can cause households and firms to invest less, due to the increased cost of lending, and postpone consumption today in favour of consumption in the future. The decreasing spending and investment lowers the aggregate demand and final production. This is a typical situation of economic recession, where growth is impeded since private and public consumption and investment are the main drivers behind the GDP.

According to Kuttner and Mosser (2002), the above described mechanism is "embodied in conventional specifications of the "IS" curve[4]—whether of the "Old Keynesian" variety, or the forward looking equations at the heart of the "New Keynesian" macro models developed by Rotemberg and Woodford (1997) and Clarida, Galí and Gertler (1999), among others" (p.434). The IS-LM model does not however underpin the assumptions of the transmission mechanisms and it pays little attention to financial frictions. Economists also started finding other problems with the model, more specifically that the macroeconomic response on interest rate changes is much larger than the interest elasticities of consumption and investment (Bernanke & Getler, 1995). That led economists' focus to switch to other transmission channels, among others, to the credit channel.

1.2 Credit channel

The credit channel works when the central bank changes the amount of credit firms and households have access to in equilibrium. Monetary policy which decreases the availability of credit via bank loan supply restrictions reduces agents' spending and investment, which leads to a reduction in output. Thus, the difference between the interest rate channel and the credit channel mechanism is the way spending and investment decisions change due to changes in monetary policy.

The credit channel of monetary policy has traditionally been broken down into two types: the bank-lending channel (also called the narrow credit channel) and the broad credit channel (Bean, Larsen & Nikolov, 2002). The broad credit channel focuses on the external finance

[3] Price stickiness means that there is some resistance for the prices to change, despite changes in demand or input costs. Price stickiness must be present for the change in the nominal rate to influence the real rate, since if the prices (π) change accordingly to the changes in the nominal rates (i), the real rate (r) will stay the same: $r = i - \pi$

[4] IS curve is part of the IS-LM model (Investment Saving/Liquidity preference Money supply), which depicts the relationship between interest rates and real output in the goods and services market and the money market. The intersection point of both lines is where the economy is in equilibrium in both markets.

premium in credit markets, and the narrow bank lending channel is measured in terms of supply of bank loans.

Broad credit channel

According to the broad credit channel view, monetary policy adjustments that affect the short-term interest rate are amplified by endogenous changes in the external finance premium (De Graeve, 2007). That term is used to show the differences in the cost of capital when borrowing internally or externally. External financing is more expensive and includes an external finance premium, which exists due to market frictions, i.e. problems with asymmetric information in the form of adverse selection and moral hazard.

Contractionary monetary policy in the form of rising interest rates enhances these market frictions. The adverse selection problem arises when, in the case of high interest rates, the more risky borrowers (also having the highest probability of default) are the only ones willing to take credit. Adverse selection problems may increase when low-risk investment projects with associated lower returns are crowded out of the credit markets, since there are more profitable investment opportunities (although the latter might also carry higher risk). Moral hazard problems can intensify because some borrowers have limited liability and may take riskier investment positions, since they are not personally liable for the repayments. As an example, several financial institutions, which took much more risk than some other companies in the same industry, have been bailed out during the financial crises. At the same time, almost none of the persons involved have been made accountable for their highly risk-taking behaviour.

Bank-lending channel

The main feature of the bank-lending channel is that a central bank can influence the supply of credit that financial institutions provide to companies and households, which influences the real economy. Central banks may do so by changing the quantity of base money and thereby altering the cost of capital to bank-dependent borrowers (Bean et al., 2002). Furthermore, changes in policy rates can affect banks' marginal cost for obtaining external finance differently, depending on the level of a bank's own resources, or bank capital. According to the ECB (1), this channel is particularly relevant in bad times such as a financial crisis, when capital is scarcer and banks find it more difficult to raise capital.

For the bank lending channel to work properly, two key assumptions have to be fulfilled: First, banks should not be able to fully shield their loan portfolios from monetary policy changes. Thus, when the central bank decreases the availability of liquid funds to the banking sector, banks cannot get funding from alternative sources without incurring costs. The second assumption is that a significant proportion of borrowers must be bank-dependent. That would imply that in case of loan supply contraction, they decrease consumption and/or investments, since they do not have easy access to non-bank sources of funding (Bernanke & Gertler, 1995; Farinha & Marques, 2001). This would in turn depress aggregate demand and GDP.

According to Gambacorta and Marques-Ibanez (2011), empirical results on the traditional bank lending channel of monetary policy transmission prior to the crisis have given mixed results as to the strength of the channel, whereas recent evidence shows that bank-specific characteristics can have a large impact on the provision of credit. They state that "the role of the quantity and the quality of bank capital in influencing loan supply shifts has been largely downplayed, especially in Europe" (p.1).

1.3 Exchange rate channel

The exchange rate channel theory describes how monetary policy may affect the value of the currency. Namely, the theory of uncovered interest-rate parity theory (UIP) is often used for describing how, in case of open capital markets, the exchange rate is influenced by changes in central bank interest rates. Rising interest rates (other things being equal) would lead to exchange rate appreciation as investors start adjusting their investment positions by buying domestic assets, which are now offering higher returns. Lower interest rates do the opposite, leading to a weaker currency, which supports exports, since domestic prices have become more competitive on foreign markets. This can result in increased wealth higher and economic growth.

The exchange rate channel has however not found enough proof empirically. One explanation is to do with market expectations in respect to the expected outcome of the central bank monetary policy. Expectations have indeed been found to be a strong enough force which could explain some of the movements in the exchange rates. For example, if interest rate reduction is believed to increase economic growth, investors might start buying into the country's equities, which might increase the value of its currency.

1.4 Asset price channel

The asset price channel describes how monetary policy changes can have an impact on different asset prices, including housing. According to the HM Treasury (2003), if the central bank cuts interest rates, and if the cuts are passed on to retail mortgage rates, borrowing to fund housing will become cheaper, which increases the demand and subsequently prices. At the same time equity prices are also expected to increase after a fall in interest rates. That is to do with market expectations about the present value of the equity, which is calculated as a future stream of income from the equity (i.e. Discounted Cash Flow Model). Present value increases when interest rates fall, since the future income is discounted at a lower cost of capital. Equities' prices can also increase when interest rates decline, because the interest rate differential between investing in more risky equities have higher return prospects than investing in more stable and lower risk bonds. That may cause investors to switch from bonds to equities, increasing their demand, which puts upward pressure on prices. Higher equity prices also increase the market value of firms, thus making it more worthwhile to invest, which can ultimately lead to higher economic growth.

1.5 Other theories

There are several other channels of monetary policy transmission which have interested economists, including the wealth channel, balance sheet channel and risk-taking channel. That is because no single theory has been fully able to explain the actual response to the changes in monetary policy. The real transmission mechanism is probably closer to some mixture of the different transmission theories, whereas the interconnections are too complex to depict by using popular econometric models. According to Gambacorta and Marques-Ibanez (2011), "It is technically difficult to model the role of financial intermediaries in "state-of-the-art" macroeconomic models. It is not easy to incorporate a fully fledged banking sector into Dynamic Stochastic General Equilibrium (DSGE) models in particular" (p.1).

In addition to the mentioned theories, there is one additional concept, which is worth mentioning. Namely, central bank communication, which has received increasing interest among researchers, while no clear cut theory such as "communication channel" has been agreed upon. The impact of communication on monetary transmission is an interesting and controversial topic, especially since credible communication is built on trust, which may be difficult to maintain during economic shocks and financial crises. However, the key focus has

been on the way central bank communication manages expectations, influences financial markets and helps to increase the transparency of central bank macroeconomic objectives (see for example Blinder, Ehrmann, Fratzscher, De Haan & Jansen, 2008). Also the ECB acknowledges the importance of efficient communication (ECB, 2010) "The ECB's communication policy forms an essential element of the transmission of monetary policy" (p.66).

2. ECB objectives

The European System of Central Banks (ESCB) consists of the ECB and the national central banks (NCBs) of the European Union (EU) Member States.[5] The activities of the ESCB are carried out in accordance with the Treaty establishing the European Community and the Statute of the ESCBs and the ECB.

According to the Treaty on European Union (Maastricht Treaty), there is a specified hierarchy of objectives for the Eurosystem, where the overriding goal is price stability. In the long run, monetary policy can only influence the price level in the economy, since it cannot exert a lasting impact on the real economy. That is the reason for the clear allocation of responsibilities of the Treaty, with monetary policy being assigned the primary objective of maintaining price stability. Without sacrificing the objective of price stability, the Eurosystem has to support the general economic policies in the European Community, acting "in accordance with the principle of an open market economy with free competition, favouring an efficient allocation of resources" (ECB, 2006, p. 7).

The importance of price stability is based on economic theory and unambiguous historical evidence. The proponents of the price stability goal emphasise that maintaining price stability will contribute to general welfare, including high levels of economic activity and employment (see Appendix 2 for a short discussion about the importance of stable prices). This view emerged during the 1960s, where Milton Friedman and other emerging monetary economists (i.e. Friedman & Meiselman, 1963; Friedman & Schwartz, 1963) blamed the depth of the economic downfall of the Great Depression in poor monetary decisions. Furthermore, according to them, money supply was the key determinant of economic activity and inflation. Since that period, there arose a general agreement among the economists that inflation is

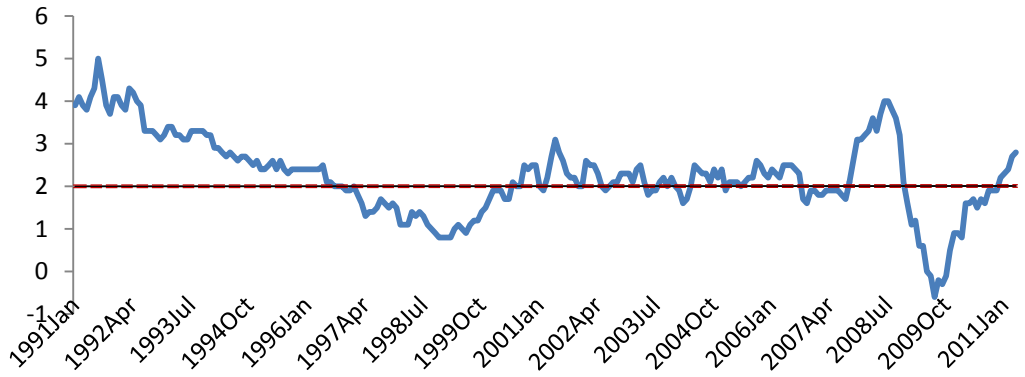
[5] In this paper, the term "national central banks" and "member states" will be used to refer to the national central banks and member states which have adopted the euro.

always a monetary phenomenon and that the ultimate source of inflation is overly expansionary monetary policy (Mishikin, 2011).

Today, a concept of "the long-run neutrality of money" underlies mainstream macroeconomic thinking. It states that in the long run – after all adjustments in the economy have worked through – a change in the quantity of money in the economy will be reflected in a change in the general level of prices (ECB (6)). This will however not induce permanent changes in real variables such as real output or unemployment. That is why the central bankers recognize that keeping inflation under control is their responsibility.

While the Treaty clearly identifies price stability as the primary objective of monetary policy, it does not give a precise, quantitative definition of this objective (ECB, 2008b). In 1998, the Governing Council adopted a quantitative definition of price stability, where the price stability is defined as a "year-on-year increase in the Harmonised Index of Consumer Prices (HICP) below 2% for the euro area over the medium term" (ECB Press Release (PR), 1998). Due to the lags in the transmission process of the monetary policy, the ECB is only able to affect the price level after some quarters or years, thus the monetary policy goal is medium term price stability. In addition, the Governing Council clarified in 2003 that, within this definition, it aims to keep HICP inflation close to 2% (ECB PR, 2003). By that the ECB is trying to avoid not only deflation but also very low inflation. Over the period of around 20 years, price stability has been rather close to the specified target, with HICP inflation rate being 2,24% on average since the launch of the euro in 1991 (Figure 1)

Figure 1: HICP Overall Index: Euro area: Changing composition: Annual rate of change: Neither seasonally nor working day adjusted.



Source: ECB Statistical Data Warehouse

3. Assessment of monetary policy stance

Assessing the monetary policy stance is challenging, since it has to take into account the uncertainty about current and future economic conditions and the functioning of the economy, including the transmission of monetary policy itself. Given the uncertainty surrounding any such judgements in real time, the assessment must encompass all the information relevant to the formation of a view on the risks to price stability in the medium term (González-Páramo, 2011, October 13). The Governing Council of the ECB assesses risks to price stability on the basis of economic and monetary analysis.

3.1 Economic and monetary analysis

According to the ECB (2008b), the two-pillared structure – comprising both an economic analysis and a monetary analysis – provides two complementary perspectives on the determination of price developments. The economic analysis aims to identify risks to price stability for short to medium-term horizons. To achieve this, it carries out business cycle analyses and tries to identify economic shocks relevant to understanding price developments and output trends over the short to medium-term horizon.

The monetary analysis aims at identifying risks to price stability at medium to longer term horizons. It draws on a broad set of monetary, financial and economic information which enables the assessment of the policy's implications for risks to price stability. In this context, monetary and credit developments, and their determinants, play a distinct role, given that monetary growth and inflation are closely related over the longer term (ECB (6)). This reflects the fundamental monetarist principle that, over the longer term, inflation is a monetary phenomenon, as mentioned above.[6]

Based on the monetary and economic analyses, the Governing Council of the ECB sets the key ECB interest rates for signalling its monetary policy stance. Under normal circumstances, these key rates are the minimum bid rate (MBR) on the main refinancing operations and the interest rates on the marginal lending facility and the deposit facility, which form a corridor around the MBR. The task of the Eurosystem is to steer the short-term market interest rates

[6] It is interesting to note that while central banks use this argument, Friedman, who became famous with the argument of inflation being a monetary phenomenon actually opposed the existence of the largest central bank in the world, the FED. "One unsolved economic problem of the day is how to get rid of the Federal Reserve" (Levy & Friedman, 1992).

within this corridor, and normally towards the minimum bid rate, by means of monetary policy operations described under the following paragraphs.

4. Monetary Policy Tools

The Eurosystem has a set of three policy instruments for conducting its monetary policy:

- Open market operations
- Standing facilities and
- Reserve requirements

4.1 Open market operations

Open market operations are central to the functioning of the ECB. They are used "for the purposes of steering interest rates, managing the liquidity situation in the market, and signalling the stance of monetary policy" (ECB, 2006, p. 7). Eurosystem open market operations can be divided into four main categories: main refinancing operations (MROs), longer-term refinancing operations (LTROs), fine-tuning operations and structural operations.

Open market operations can differ in terms of aim, regularity and procedure. They can be executed as standard tenders, quick tenders or bilateral procedures.[7] As for the instruments used, reverse transactions[8] are the main open market instrument of the Eurosystem and can be employed in all four categories of operations. MROs and LTROs and are only used for providing liquidity, while structural and fine-tuning operations can be used for both – liquidity increasing and absorption (Figure 2)

[7] Bilateral procedures" are those where the Eurosystem makes a transaction with one or a few counterparties without using tender procedures. These include operations executed through stock exchanges or market agents.

[8] Reverse transaction is an operation whereby the central bank buys or sells assets under a repurchase agreement or conducts credit operations against collateral. Repurchase agreement is made when the ownership of the asset is transferred to the creditor, while the parties agree to reverse the transaction through a re-transfer of the asset to the debtor on the next business day.

Figure 2 ECB Monetary policy operations

Monetary policy operations	Types of transactions Liquidity provision	 Liquidity absorption	Maturity	Frequency	Procedure
Open market operations					
Main refinancing operations	Reverse transactions	-	One week	Weekly	Standard tenders
Long-term refinancing operations	Reverse transactions	-	Three months	Monthly	Standard tenders
Fine-tuning operations	Reverse transactions Foreign exchange swaps	Reverse transactions Collection of fixed-term deposits Foreign exchange swaps	Non-standardized	Non-regular	Quick tenders Bilateral procedures
Structural operations	Reverse transactions Outright purchases	Issuance of ECB debt certificates Outright sales	Standardized/non-standardized -	Regular and non-regular Non-regular	Standard tenders Bilateral procedures
Standing facilities					
Marginal lending facility	Reverse transactions		Overnight	Access at the discretion of counterparties	
Deposit facility		Deposits	Overnight	Access at the discretion of counterparties	

Source: ECB (2011, p.13)

Main refinancing operations (MROs)

The main refinancing operations are regular liquidity-providing reverse transactions with a frequency and maturity of one week.[9] They are executed by the NCBs on the basis of standard tenders and according to a pre-specified calendar. MROs play a pivotal role in fulfilling the aims of the Eurosystem's open market operations, steering interest rates, managing the liquidity situation in the market and signalling the stance of monetary policy (ECB, 2005).

Until May 2000, the ECB used fixed rate tender procedures for its MROs but due to severe overbidding, decided to turn to variable rate tender procedures instead (ECB PR, 2000). Therefore, since June 2000 and until October 2008, the main refinancing operations of the Eurosystem were conducted as variable rate tenders with a minimum bid rate. For each tender, the ECB announced a benchmark allotment amount at a pre-specified minimum bid rate. MBR is the minimum interest rate at which counterparties may place their bids when they want to borrow money from the ECB (ECB, 2004). The highest bids are satisfied first, up to when the total allotment amount is exhausted, whereas the lowest satisfied bid rate is called the marginal rate (MR). The liquidity allotment amount is that which allows the euro area credit institutions to fulfil their liquidity needs. Banks need liquidity for fulfilling the ECB's reserve requirements and due to changes in autonomous factors (banknotes in circulation and government deposits at central banks). The allotment amount takes into account the liquidity already supplied via other open market operations, the ECB's forecasts of autonomous factors and excess reserves (banks' current account holdings in excess of reserve requirements).

[9] In March 2004 the timing of reserve maintenance periods was amended and the maturity of the main refinancing operations was shortened from two weeks to one week (ECB, 2005).

Longer-term refinancing operations (LTROs)

Similarly to MROs, LTROs are liquidity-providing reverse operations and are executed as standard tenders, in a decentralised manner by the national central banks. They are aimed at providing longer-term refinancing to the financial sector. LTROs are normally conducted with a monthly frequency and a maturity of three months (ECB, 2004). As a rule, the Eurosystem does not intend to send signals to the market by means of these operations and therefore normally acts as a rate taker. Thus, LTROs are usually conducted with a variable rate and sometimes the ECB sets the allotment amount for the tender.

Fine-tuning operations

Fine-tuning operations are conducted irregularly when there is a need to absorb or supply liquidity. While MROs, and to a lesser extent LTROs, are used for the systematic provision of liquidity to the banking sector, fine-tuning operations are used for a different purpose, mainly to manage the liquidity situation in the market and to steer interest rates, particularly the overnight rate (Eonia). Eonia, the euro overnight index average rate, is the weighted average of all overnight unsecured lending transactions undertaken in the euro interbank market (European Banking Federation (EBFa)). With fine-tuning operations, the ECB tries to smooth the effects on interest rates caused by unexpected liquidity fluctuations.

Since October 2004, the ECB has normally conducted a fine-tuning operation on the last day of the reserve maintenance period to counter liquidity imbalances which may have accumulated since the allotment of the last main refinancing operation. The liquidity management purpose is to steer short-term money market interest rates to a level close to the minimum bid rate that signals Eurosystem's monetary policy stance. According to the ECB, 2008a), "This approach supports ex ante expectations in the market that the overnight rate will be at the midpoint of the corridor formed by the standing facility rates on the last day of the period, which, anchors Eonia close to the policy rate earlier in the period" (p.92).

Furthermore, there is also a strong response of interbank interest rates (i.e. Euribor) to changes in the ECB refinancing rate. That is why the ECB interest rate can be used as a tool to influence market rates. An important aspect here is that in order for monetary transmission to work properly, the ECB relies on the money market to distribute the liquidity among banks at market interest rates (ECB, 2009a).

Fine-tuning operations will normally be executed by the NCBs through quick tenders or bilateral procedures (ECB, 2004). The Eurosystem may select a limited number of counterparties to participate in fine-tuning operations. Fine-tuning operations are primarily executed as reverse transactions, but may also take the form of foreign exchange swaps and collection of fixed-term deposits.

Foreign exchange swaps

Foreign exchange swaps are mainly used for managing the liquidity situation in the market and for steering interest rates. Foreign exchange swaps are used when the Eurosystem buys (or sells) euro spot against a foreign currency and, at the same time, sells (or buys) it back in a forward transaction on a specified repurchase date (ECB, 2004). The Eurosystem and the counterparties agree on the swap points for the transaction, which represents the difference between the exchange rate of the forward transaction and the exchange rate of the spot transaction.

Fixed-term deposits

The Eurosystem may invite counterparties to place fixed-term deposits with the national central banks. The collection of fixed-term deposits is a liquidity absorbing operation. The deposits accepted from counterparties are for a fixed term and with a fixed rate of interest (ECB, 2004). No collateral is given by the national central banks in exchange for the deposits.

Structural operations

Structural operations can be carried out by the Eurosystem through reverse transactions, outright transactions[10] and issuance of debt certificates (ECB, 2006). Outright transactions are conducted when the Eurosystem buys or sells assets outright on the market, in which case there is a full transfer of ownership from the seller to the buyer with no connected reverse transfer of ownership (ECB, 2006). ECB debt certificates may be issued in order to absorb liquidity from the market. They constitute a debt obligation of the ECB vis-à-vis the holder of the certificate.

[10] According to ECB's publications, it could until 2007 use outright purchases and sales for both – structural and fine-tuning operations (ECB, 2006). From 2008 on, they are only mentioned under structural operations (ECB, 2011) and the author has not been able to find an explanation for the elimination of this type of operations.

4.2 Reserve requirements

The second monetary policy tool besides the open market operations is reserve requirements. The ECB requires credit institutions established in the euro area to hold deposits on accounts with their national central bank. These are called "minimum" or "required" reserves. Reserve ratios may not exceed 10% of any relevant liabilities forming part of the basis for minimum reserves, while they may be as low as 0% (EC, 1998). Institutions' holdings of required reserves are remunerated at the rate of Eurosystem's main refinancing operations (ECB, 2006).

The aim of the minimum reserves is stabilizing money market interest rates and creating (or enlarging) a structural liquidity shortage in order to smooth out fluctuations in liquidity. The minimum reserve requirement needs to be complied with on average over each reserve maintenance period, which is usually one month. Therefore holding liquidity in a central bank on one day is a (quasi-) perfect substitute for holding liquidity on another day during the maintenance period (ECB, 2009a). This facilitates stabilisation of very short-term interest rates because day-to-day fluctuations of liquidity conditions can be smoothed out over the period.

4.3 Standing facilities

The third type of Eurosystem monetary policy tools is standing facilities. They are aimed at providing or absorbing overnight liquidity, signalling the general stance of monetary policy and bounding the overnight market interest rates (ECB, 2006). There are two types of standing facilities – deposit facility and marginal lending facility. Banks can deposit unlimited funds with the deposit facility overnight at their national central banks and in return receive interest (rate on deposit facility). They usually do so when they have liquidity surpluses. The deposit rate normally provides a floor for the overnight market interest rate. In case of liquidity shortages, banks can obtain overnight liquidity from the national central banks against eligible assets via the marginal lending facility. In return for their holdings, they are paid interest, which is slightly above the main refinancing rate. The interest rate on the marginal lending facility normally provides a ceiling for the overnight market interest rate.

Under normal circumstances the two standing facility rates constitute a corridor (standing facilities corridor) and thereby limit the volatility of the overnight rate (Appendix 3). The size of the standing facilities corridor has in normal circumstance been 200 basis points (bps).

5. Part I summary

Part I firstly underlined the main theories about central bank monetary transmission mechanisms, namely the interest rate channel, credit channel, asset price channel and exchange rate channel. Interest rate channel theory focuses on how domestic and firm consumption are influenced by changes in central bank interest rate. Credit channel theory looks at how the same actors change their investment and spending behaviour due to changes in the supply of funds. Asset price channel theory looks at adjustments in investor portfolios between interest-bearing and non-interest bearing assets, due to central bank monetary policy, which influence the aggregate demand, prices and the GDP. Exchange rate channel theory focuses on UIP and market expectations.

Secondly, Part I introduced the main goal of the ECB, which is medium-to long term price stability. Stable prices are among other things important for maintaining the real value of income and wealth, for increasing transparency of prices, costs and income, and for easing savings and investment decisions. The importance of price stability has been supported by monetarists, who believe that inflation is, in the long-run, only a monetary phenomenon. The ECB conducts monetary and economic analysis in order to understand the markets and decide on the necessary monetary policy methods. For carrying out its monetary policy stance, the ECB has three instruments: open market operations, standing facilities and reserve requirements.

Under open-market operations, the ECB may conduct main refinancing operations and longer-term refinancing operations for providing liquidity to the financial sector. In addition, it can conduct fine-tuning operations and structural operations, which can be liquidity absorbing or liquidity providing operations. The task of open-market operations together with the reserve requirements and standing facilities is to steer the over-night interest rate close to the main refinancing rate of the ECB. The main refinancing rate together with the standing facilities corridor and the benchmark allotment amount should steer the overnight rate so that balanced liquidity conditions are achieved. This is to ensure that there is an equal probability

of a shortage or a surplus of liquidity, which would need to be offset via standing facilities at the end of the maintenance period and therefore the probability of recourse to the marginal lending facility and the deposit facility are equal (ECB, 2009a).

PART II Alternative ECB Monetary Policy Tools

"Exceptional times have called for exceptional actions. Faced with the financial crisis, we have introduced a set of non-standard measures, which we call "enhanced credit support". These measures are intended to prevent the threat of a drastic loss of liquidity in the financial system as a whole and support the flow of credit to firms and households above and beyond what could be achieved through policy interest rate reductions alone." (Trichet, 2009, September 4)

Part II investigates the reasons for using non-traditional monetary policy measures, thus answering Research Question 1. This will be achieved by examining the indications of market tensions in the beginning of the financial crises and how they impacted the traditional monetary policy transmission mechanism. Subsequently, Part II provides an overview of the four firstly applied alternative monetary policy measures and furthermore, will examine the rationale behind their implementation:

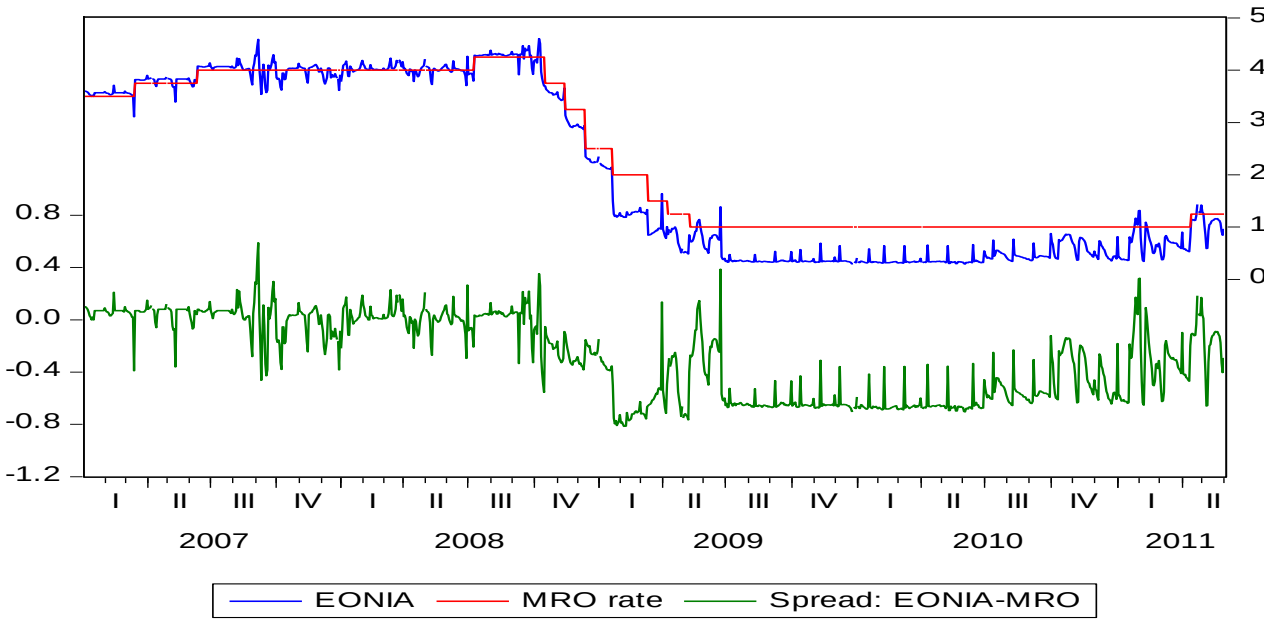
- Fixed-rate full-allotment (FRFA)
- Easing of collateral (EOC)
- Longer-term repurchase operations (LTRO)
- Foreign exchange liquidity provision (FEL)

1. Financial market tensions

1.1 Spread: Eonia-MRO

The main reason why the ECB applied FRFA measures was to do with the dysfunctioning of the traditional monetary policy transmission mechanism. The ECB relies on the money markets to pass on its monetary policy stance. Since August 2007 however, "financial market activity fell dramatically, volatility spiked and the global financial system came close to seizing up" (Trichet, 2009, September 4). In that turmoil, the ECB started to lose control over steering the Euro Overnight Index Average (Eonia) (Figure 3). The spread between the Eonia and the minimum bid rate had become increasingly volatile, and even negative, with a standard deviation up to 20 bps between August 2007 and March 2008 (Appendix 4).

Figure 3 Eonia, MRO rate (right axis) and the spread (left axis)



Source: Reuters EcoWin and ECB Press Releases (2007-2011)

As explained in Part I, the ECB prefers to have the overnight rate close to the ECB's main refinancing rate in order to properly steer its monetary policy stance. Steering overnight interest rates is crucial for the ECB as this provides an anchor for the term structure of interest rates. Furthermore, a large spread between the Eonia and the main refinancing rate could blur the signalling of the stance of monetary policy and therefore hinder the ECB's ability to steer the overnight rate (Linzert and Schmidt, 2008). Such a loss of control over the short end of the yield curve may furthermore have immense costs in terms of credibility and commitment to the central bank.

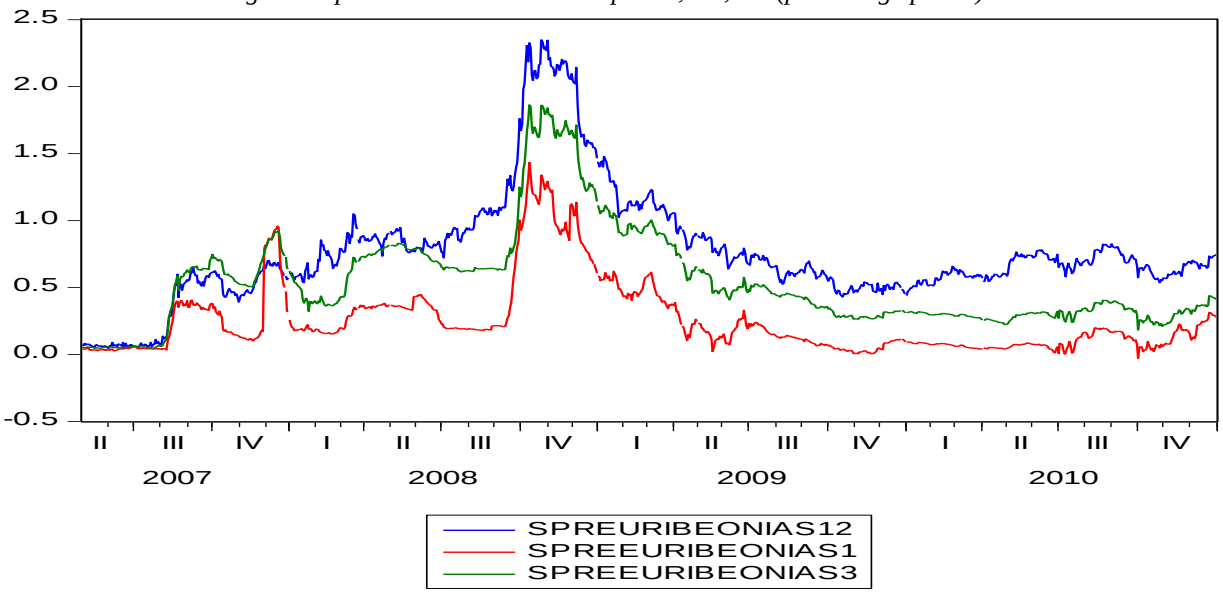
1.2 Spread: MR-MBR

Another aspect was the increasing volatility of the minimum bid rate. The spread between the marginal rate (MR, the lowest successful bid rate) and the minimum bid rate of the MRO had in pre-turmoil times been around 7 basis points, and started to increase in August 2007, fluctuating for one year between 3 basis points and 27 basis points (ECB, 2009a). The ECB needs the marginal rate to be stable and predictable in order to make precise decisions about the allotment amount and liquidity needs that would match its monetary policy stance.

1.3 Spread: Euribor-Eoniaswap

A further important indicator of money market tensions is the spread between Euribor and Eoniaswap (spread between unsecured and secured overnight lending) which rose to very high levels from July 2007, peaking in October 2008 after the Lehman Brothers collapse (Figure 4).This development is especially alarming since the euro interest rate swap market was previously one of the largest and most liquid markets in the world, while Eonia swap rates are widely considered to be the pre-eminent benchmark at the short end of the euro yield curve (Remolona & Wooldridge, 2003).

Figure 4 Spread: Euribor-Eoniaswap 12m, 3m, 1m (percentage points)

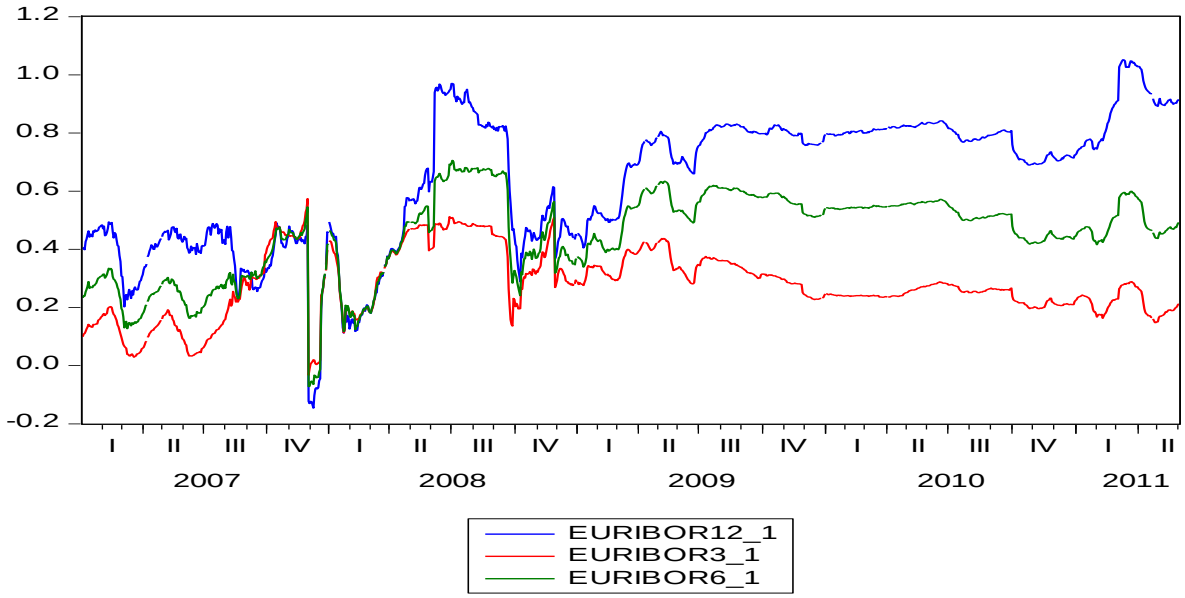


Source: Reuters EcoWin

1.4 Spread: Euribor different maturities

Similarly, the spread between Euribor different maturities rose considerably from the beginning of 2008 (Figure 5).That reflected banks' re-assessment of borrower's creditworthiness and their willingness to lend, since it was hard (impossible) to identify which companies had been exposed to the US subprime mortgage products. If interbank lending does not work, then banks also lack finances which they can lend down the transmission channel to non-financial corporations and private consumers.

Figure 5 Spread: Euribor 12-1, 6-1 and 3-1 (percentage points)



Source: Reuters EcoWin

As Jean-Claude Trichet explained it:

"The first motivation for introducing enhanced credit support was to address the seizing up of the money market. If left unaddressed, this seizing up would have rendered the refinancing of many bank assets impossible, risking a massive and disorderly deleveraging by credit institutions. This, in turn, would have seriously hampered the monetary policy transmission mechanism and ultimately curtailed the expansion of credit to firms and households in the euro area." (Trichet, 2009, September 4)

2. Changes in monetary transmission process

The above analysis shows that it was the immediate transmission from the ECB to the money markets which stopped working as it should. When the first step of the transmission channel is dysfunctional, then all the latter steps do not work as well. Therefore, regardless if one believes in interest rate channel theory, credit channel theory, or some other, none of these transmission mechanisms worked, since the monetary policy was not properly steered down by the money markets.

Furthermore, the theoretical discussion under Part I showed that neither of the key theories recognises the importance of money markets in steering the monetary policy stance. Also, the credit channel, which focuses on the external financial premium and the loan supply

restrictions, does not identify the amount of power that the money markets have been given. In addition, the conventional theories regarding money supply, demand, central banking system and monetary transmission mechanism mostly use an assumption of "stable market circumstances"[11], making them useless in the times of financial turmoil.

One of the reasons for the problems with monetary transmission could be to do with changes in banks' business models and market funding patterns, which have modified the transmission mechanism (Gambacorta & Marques-Ibanez, 2011). For example, banks are increasingly relying on short-term market-based funding sources, such as the securitisation market, instead of the traditional lending, based on the amount of bank deposits. That has led to growing power of the financial markets, having an increased importance in the monetary transmission process.[12]

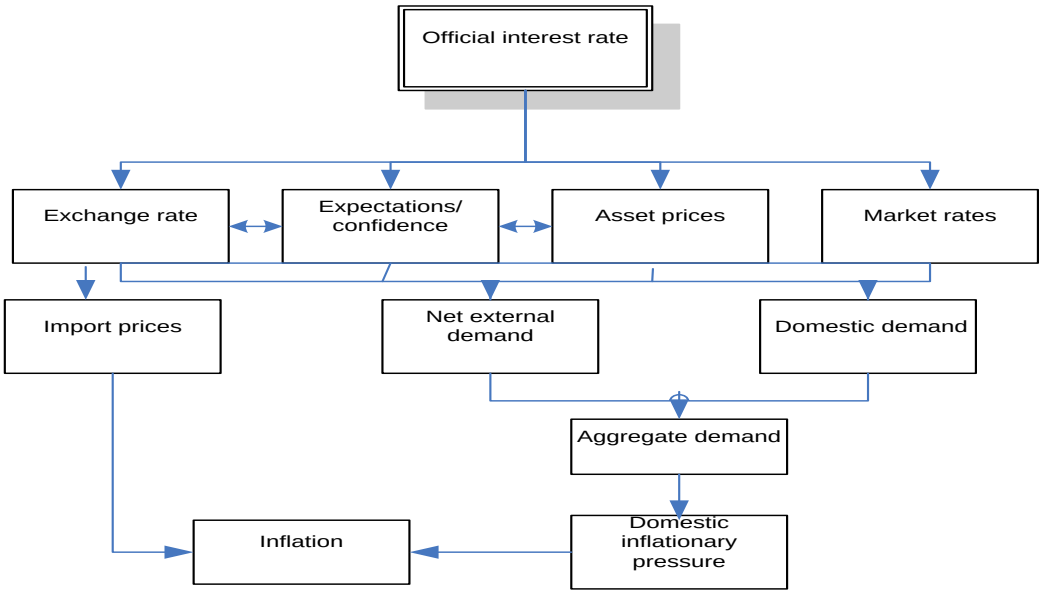
"The financial crisis has exposed the inadequacy of banks' liquidity risk-management practices. It has shown that the build-up of contingent liquidity claims, arising for instance from off-balance sheet financing vehicles, and excessive reliance on financial markets for providing funding are conditions doomed to generate financial instability." (Smaghi, 2010, September 29)

Thus, the more traditional picture of the first stages of the monetary transmission process (Figure 6), where the market rates, asset prices, expectations and exchange rates represent the first level in the transmission, should be adapted to reflect the changed market conditions. Today, monetary transmission looks more similar to that depicted by the ECB, where the money markets are on top of the transmission process, right after the central bank interest rate setting (Figure 7). Furthermore, expectations are also included under the first stage of the transmission process. That explains why central banks put so much focus on "effective communication". Financial markets are not only reacting to the actual interest rate changes but are also trying to interpret the expected future rate from press releases and speeches made by the key ECB figures (i.e. the president).

[11] For example, Colander et al. (2009) write about the systemic failure of academic economics in relation to the financial crises. They write about how there is an implicit view behind standard equilibrium models where the markets and economies are inherently stable and that they only temporarily get off track.

[12] According to ECB (2007), "Major market developments identified as impacting the liquidity risk management of banks include the shortening time horizon for payment obligations, the use of more market based and potentially more volatile funding sources and the increasing need for high quality collateral" (pgs.7-8).

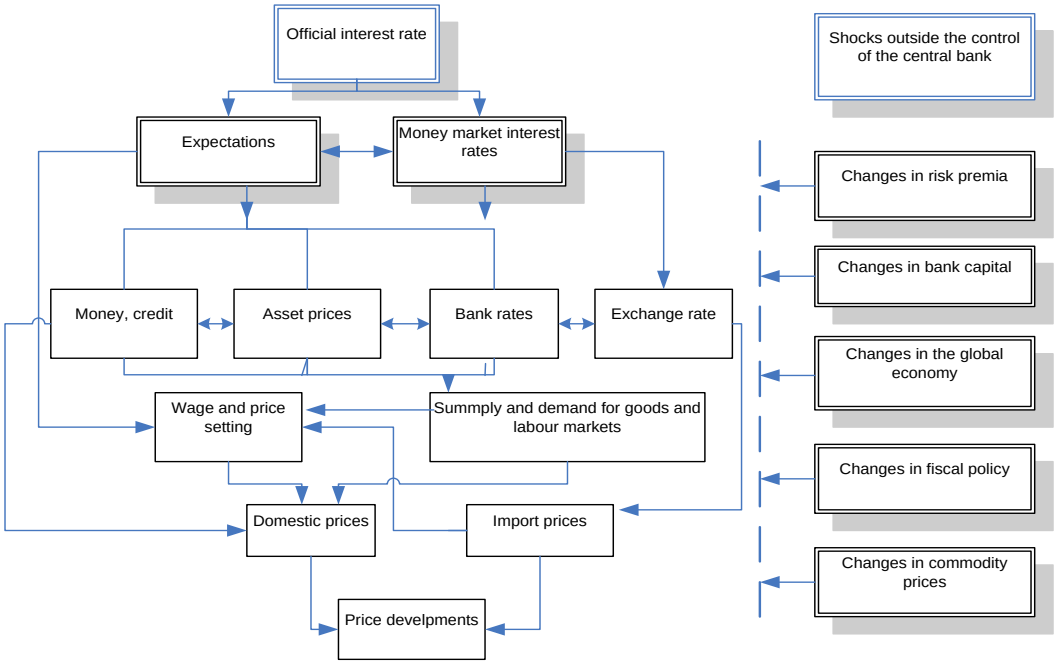
Figure 6 Monetary policy transmission mechanism: Traditional view



Note: For simplicity, this chart omits some important connections between variables

Source: HM Treasury (2003)

Figure 7 Monetary policy transmission mechanism: Contemporary view



Source: ECB (1)

3. Preliminary measures leading to FRFA application

Before the ECB started on the FRFA measures, it also used some preliminary open market operations to ease market tensions. These are important to know, although in this paper, they are not included under the FRFA category.

As a response to the tensions in the financial markets in August 2007, the ECB started conducting supplementary fine-tuning and main refinancing operations in various forms. As mentioned under the first respective announcement on the 9th of August 2007 (Appendix 5:A), they intended to allot 100% of the bids, providing full allotment but with a variable rate. That was the fist announcement of a series to come, where among others, the ECB decided to conduct MROs at a variable rate with no specified benchmark allotment (Appendix 5:B); MROs with a variable rate and lower bound of benchmark allotment (Appendix 5:C); fine-tuning operations with a fixed rate and specified target benchmark amount (Appendix 5:D); and MROs with a minimum bid rate and full allotment (Appendix 5:E).

4. Fixed rate full allotment procedure (FRFA)

4.1 Details and timing

The core of the FRFA procedure was that banks were granted access to unlimited liquidity at ECB's policy rate via regular open market operations. It was in October 2008 that the first FRFA announcement was made, shortly after the collapse of the Lehman Brothers:[13]

"As from the operation settled on 15 October, the weekly main refinancing operations will be carried out through a fixed rate tender procedure with full allotment at the interest rate on the main refinancing operation, i.e. currently 3.75%."(ECB PR, 2008b).

This announcement overrode the previous decision made on the same day to cut by 50 basis points the minimum bid rate on the main refinancing operations conducted as variable rate tenders (ECB PR, 2008c).That signalled a great amount of confusion amongst the ECB's decision makers, since two very different approaches were taken during the course of the same day.

The second important step in the FRFA procedure was a week later when the ECB announced that all LTROs would be carried out through a fixed rate tender procedure (ECB PR, 2008d).

[13] Lehman Brothers filed for Chapter 11 bankruptcy protection on September 15, 2008 (Lehman Brothers PR, 2008).

That gave banks the opportunity to borrow unlimited funds for period of more than a week, which is the length of its MRO operations (see section LTRO for details about the length and application of the LTROs).

In March 2010, the ECB attempted to start phasing out alternative policy measures by returning to the traditional auction method for 3-month LTRO operations (ECB PR, 2010a). However, two months later it returned to the FRFA procedure, due to escalating tensions in the financial markets and continuingly high need for liquidity in certain debt-burdened countries in Europe (ECB PR, 2010c). As for today (November, 2011), the ECB has announced the continuation of the FRFA procedure until at least July 2012 on its MROs (ECB PR, 2011a).

4.2 Rationale

FRFA procedure was to provide funding to the financial sector, which started experiencing great liquidity problems, as was measured previously by enhanced spreads and corresponding high volatility. Liquidity shortages posed a great problem since banks had become increasingly dependent on the money markets in refinancing their short-term liabilities. With FRFA, the ECB tried to help out financial institutions to get access to unlimited funding in hope of stabilizing the money markets and thus repairing the monetary transmission mechanism.

"The first motivation for introducing enhanced credit support was to address the seizing up of the money market. If left unaddressed, this seizing up would have rendered the refinancing of many bank assets impossible, risking a massive and disorderly deleveraging by credit institutions. This, in turn, would have seriously hampered the monetary policy transmission mechanism and ultimately curtailed the expansion of credit to firms and households in the euro area" (Trichet, 2009, September 4).

5. Long term repurchasing operations (LTROs)

5.1. Details and timing

With LTROs, the ECB started conducting longer term open market operations supplementary to the existing 3-month LTROs. As a first measure, the ECB conducted an additional 3-month supplementary LTRO, as announced on the 22nd of August 2007:

"Today the European Central Bank's Governing Council has decided to conduct a supplementary liquidity-providing longer-term refinancing operation with a maturity of three months for an amount of €40 billion. This operation is a technical measure aimed at supporting the normalisation of the functioning of the euro money market. It is conducted in addition to the regular monthly longer-term refinancing operations, which remain unaffected" (ECB PR, 2007b).

The next step was the introduction of a 6-month LTRO, as the following announcement shows:

"*The Governing Council decided at its meeting on 27 March 2008 to conduct supplementary longer-term refinancing operations (LTROs) with a maturity of six months. In addition, the Governing Council decided to conduct further supplementary LTROs with a three month maturity. The regular monthly LTROs remain unaffected"* (ECB PR, 2008a).

Lastly, the ECB started offering liquidity through 1-year LTROs as announced on the 7th of May 2009:

"The Governing Council of the European Central Bank has today decided to conduct liquidity-providing longer-term refinancing operations (LTROs) with a maturity of one year. The operations will be conducted as fixed rate tender procedures with full allotment, and the rate in the first of these operations will be the rate in the main refinancing operations at that time. In subsequent longer-term refinancing operations with full allotment, the fixed rate may include a spread in addition to the rate in the main refinancing operations, depending on the circumstances at the time"(ECB PR, 2009b).

Although in the beginning of these operations, LTROs were conducted at the rate of the main refinancing operations, the ECB added in the previous announcement that it may demand a higher rate in the future. That was subsequently required for several of the 6-months and 12-months LTROs, where the interest rate was calculated as the average minimum bid rate of the MROs over the life of their operations (ECB PR, 2009d and 2010a).

5.2. Rationale

The LTRO measures increased the maturity structure of the ECB's refinancing operations. With these operations, the ECB managed to increase the ratio of LTROs to MROs from one third before the turmoil to two-thirds in September 2008 (ECB, 2009b). The motivation was to encourage banks to switch to medium-term financing and for the time being, become less dependent on the short-term money market funding.

"A third motivation was to give banks a more medium-term perspective in their liquidity planning, making them less vulnerable to short-term shocks and attenuating the maturity mismatch on their balance sheet. By giving banks a longer planning horizon we could further support their credit provision to the economy" (Trichet, 2009, September 4).

6. Foreign Exchange Liquidity (FEL)

6.1 Details and timing

FEL essentially meant providing liquidity in foreign currencies to the euro markets by granting loans (mostly) in dollars to banks in the euro area. The first announcement of the measure was made on 12th of Dec 2007, when the ECB decided to start offering US dollar funding to Eurosystem counterparties:

"The Governing Council of the ECB has decided to take joint action with the Federal Reserve by offering US dollar funding to Eurosystem counterparties. The Eurosystem shall conduct two US dollar liquidity-providing operations, in connection with the US dollar Term Auction Facility, against ECB-eligible collateral for a maturity of 28 and 35 days"(ECB PR, 2007c).

These USD liquidity- providing operations increased over time in terms of size and number of participants, with a substantial number of central banks participating (Smaghi, 2009, April 6). In the beginning of 2008, the operations were temporarily discontinued, but resumed again in March, when liquidity pressures in the funding markets increased again after the collapse of Bear Stearns.

In October 2008, on the same day when the ECB announced that all LTROs will be carried out through a FRFA procedure, the ECB added a new FEL measure, namely foreign exchange swaps. That measure was taken in addition to the existing tenders, in which the Eurosystem

offered dollar liquidity against ECB-eligible collateral. By assenting to conduct swaps, the central banks agreed to exchange domestic currencies, at the current prevailing market exchange rate, and to reverse the swaps at the same exchange rate at a fixed future date. The EUR/USD foreign exchange swap tenders were carried out at a fixed price (i.e. swap point) with full allotment (ECB PR, 2008d). Euro liquidity absorption resulting from the provision of foreign currency to Eurosystem counterparties via FX swaps was discontinued in January 2010 (ECB, 2008j).

In addition, the Eurosystem started a Swiss franc swap arrangement, by providing Swiss francs against the euro (ECB PR, 2008e). Finally, the Eurosystem signed agreements with the central banks of several other European countries in order to improve the provision of euro liquidity to their banking sectors. Among others, it applied temporary liquidity swap facility with the Bank of England (ECB PR, 2010d), Sveriges Riksbank (ECB PR, 2009c) and Danmarks Nationalbank (ECB PR, 2008g).

6.2. Rationale for using FEL measures

FEL measures were meant to improve the provision of foreign currency liquidity to the European banking sector. Many European banks have assets in dollars and are therefore dependent on dollar funding. In line with the euro area liquidity problems, the same liquidity demand appeared for dollars and later for euros for banks outside the EMU. International lending was however even more difficult than lending between European counterparties, due to the huge losses in the financial markets over there. Thus market funding, which previously had regulated itself via supply and demand forces, stopped functioning and the central banks set up the liquidity and currency swap facilities in order to create an unlimited availability of "non-market" supply of dollars and key European currencies.

"A fourth issue we needed to address was the currency mismatch in banks' balance sheets and the malfunctioning of the international swap market. This was particularly relevant for US dollars, given the need of European banks to fund their dollar assets. We therefore began to supply liquidity to European banks in US dollars, backed by a swap facility established with the Fed" (Trichet, 2009, September 4).

7. Easing of Collateral (EOC)

7.1. Details and timing

The fourth measure that the ECB used was increasing the amount of assets which were eligible as collateral for open market operations and the marginal lending facility. Firstly, on Feburary 2007, the Governing Council decided to treat covered bonds issued from 1st of January 2008 in the same way as all other marketable assets within Eurosystem credit assessment framework (ECB PR, 2007a). That announcement however did not concern bank covered bonds, since most of them were already accepted as collateral before this decision was made.

On the 15th of October 2008, the ECB announced that it would add further assets to its single framework, among others marketable debt instruments denominated in other currencies than the euro (dollar, pound and yen) and issued in the euro area; and debt instruments issued by credit institutions, which are traded on the accepted non-regulated markets (ECB PR, 2008d). Furthermore, the ECB decided to lower its minimum credit-rating threshold for marketable and non-marketable assets from "A-" to "BBB-", with the exception of asset-backed securities. That made a significant amount of credit claims (including bank loans) eligible as collateral. Greek marketable debt instruments, which were issued or guaranteed by the Greek government, were exempted from this minimum credit rating threshold from May, 2010 (ECB PR, 2010b). The same exemption was made in March 2011 for the Irish marketable debt instruments guaranteed by the Irish government (ECB PR, 2011b). For several of the eligible assets the ECB applied additional haircuts[14], most likely to compensate for the higher risk.

7.2 Rationale

Increasing the number of eligible collateral made sure that Eurosystem counterparties could make full use of the other liquidity providing operations mentioned above, most notably from the FRFA and LTRO operations. This was especially important for banks which had to refinance assets such as mortgage-backed securities, which had become less liquid. Furthermore, when the sovereign debt crises intensified and the credit rating of Greece and Ireland was lowered, the ECB made exemptions for these countries so that they still could use Eurosystem open-market operations to obtain the necessary funding. As Jean-Claude Trichet explained it (2009, September 4):

[14] Haircut refers to the deduction (in percentages) of the market value of the underlying asset when evaluating the collateral.

"As a second measure, we expanded the collateral eligible in our liquidity providing operations. This offered an opportunity for banks to refinance assets that had become less liquid in the wake of the market turmoil. While the quantitative impact of this measure was not large in aggregate terms, it was important as it gave reassurance to banks that a larger share of their balance sheet could be refinanced at any time in case of need."

8. Part II summary

Part II answered Research question 1, which asked for reasons for using non-traditional monetary policy methods. It was shown that the money markets started experiencing large liquidity problems in the face of increased and highly volatile spreads. The major problem was that the ECB had lost control of steering Eonia close to the main refinancing rate, which in normal times allows for credit institutions to have normal liquidity conditions so that that the monetary policy stance will be transferred from money markets further down the transmission chain. Furthermore, the spread between the marginal rate and the main refinancing rate had become very volatile, which inhibits the ECB to make accurate decisions about the allotment amount. In addition, the spread between euribor different maturities as well as between Euribor and Eoniaswap increased significantly, indicating banks' worries about the creditworthiness of the counterparties.

It was the first stage of the monetary transmission, the money markets, which did not allow for the transmission mechanism to work. And the importance of money markets and financial intermediaries has been largely downplayed in the frameworks of the traditional transmission theories. Due to changes in funding patterns, banks have become increasingly dependent on refinancing their short-term liabilities from the money markets and that is one reason for the seriousness of the liquidity problems during the crises.

Since the normal functioning of the transmission mechanism stopped working, the ECB implemented a new approach, which they considered most appropriate for providing liquidity to the Eurosystem. The first four measures applied by the ECB were fixed-rate full allotment procedure, long-term repurchasing operations, easing of collateral and foreign exchange liquidity provision.

It was already in the beginning of 2007, when the ECB started enhancing the list of eligible collateral by allowing covered (corporate) bonds to be treated as other marketable assets in Eurosystem operations. In August 2007, the ECB started supplementary liquidity measures through fine-tuning operations and MROs, which were not FRFA but instead they used various combinations of variable rate, fixed rate, no-benchmark amount and specified target benchmark amount. In the same month, the first LTRO measures were announced, followed by US dollar liquidity operations in December 2007, while in October 2008, the first FRFA key announcements were made.

FRFA operations provided unlimited liquidity to the banks at a pre-specified interest rate. LTRO measures gave access to much longer-term funding, by providing repurchase operations with a maturity of up to 1 year. EOC measures made sure that banks could also refinance assets which had become most illiquid during the crises and later on, that debt-burdened Greece and Ireland could continue participating in OMOs after their credit ratings were downgraded. FEL measures granted banks with liquidity in foreign currencies; liquidity, which was crucial for the sector with large international (especially dollar) holdings.

Part III Empirical Analysis

Part III presents the empirical analysis, with a purpose to measure the effectiveness of the four alternative monetary policy measures on lowering some of the money market tensions. The objective is to evaluate the effect of non-traditional monetary policy announcements on financial asset prices. Financial market response gives an idea of the immediate market reaction, while the real effects of the measures would take a much longer time horizon to evaluate. Part III starts by describing the model setup, data types and the expected results, the latter drawing on the rationale for using non-traditional measures as explained under Part II. After that, estimation results for each of the four measures are presented and evaluated. Part III answers Research Question 2.

1. Financial assets

Three types of financial asset prices are used for this study: interest rate spreads, market indices and exchange rates. The interest rate spreads are: spreads between Euribor different maturities (Euribor 12-1 and Euribor 3-1) and between Euribor and Eoniaswap rates (Euribor-Eoniaswap12m and 1m). Appendix 6 contains the summary statistics. The market indices used are Euronext 100 index; Athex General Index; Barcelona SE, General 63 Index; and Deutche Børse DAX 30. Summary statistics for the time series is presented under Appendix 7. The exchange rates under analysis are CHF/EUR and $/EUR. Both exchange rates are provided as indirect quotations, i.e. units of foreign currency ($ and CHF) to home currency (EUR). Appendix 8 contains the summary statistics.[15] Since the interest rate spreads are more difficult to interpret, the following paragraphs provide a short summary of the Euribor, Eonia and Eoniaswap rates and how to translate their respective spreads.

1.1 Euribor

Euribor rate is a daily quote rate, which each Panel Bank believes one prime bank is quoting to another prime bank for interbank term deposits within the eurozone (EBF (b)). The Panel Banks fixing the Euribor are 44 banks with the highest volume of business in the eurozone money markets. Euribor is quoted for the maturities of one, two and three weeks and for twelve maturities from one to twelve months (EBF (b)).

[15] Note that for some of the alternative monetary policy tool estimations, the benchmark period is slightly smaller than the whole dataset. However, this does not have big impact on the mean and standard deviation of the series.

1.2 Spread Euribor 12-1 and 3-1

The spread between Euribor different maturities indicates the change of the relationship between the interest rate and the time to maturity. It is called the term structure of the interest rates or the yield curve. The typical term-structure is upward-sloping, meaning that the interest rate for longer maturities is higher than that for the shorter.[16] That is to compensate for uncertainly relating to the future path of interest rates (term premium). The spread furthermore reflects future expectations of the ECB changing the rate on its main refinancing operations. If a rate increase it expected, the spread is likely to rise and if rate reduction is expected, the spread should become smaller.

A decrease in the spread between Euribor different maturities may, besides lower term premium, show decreasing credit risk premium and/or liquidity risk premium. For the purposes of this paper, liquidity risk will represent "the cost charged by a lender to insure against a liquidity shock during the period in which the loan is outstanding" De Socio (2011). Credit risk will stand for the probability that the counterparty will default on its loan obligations.

1.3 Eonia

Eonia is a weighted average of all overnight unsecured lending transactions in the interbank market, initiated within the euro area by the Panel Banks (EBF (c)). The panel of reporting banks is the same as for the Euribor. Under normal conditions, the ECB uses Eonia to signal its monetary policy stance by steering it close to its refinancing rate. It is very important that this holds since the overnight rate represents the first step in the monetary policy transmission process.

1.4 Eoniaswap index

Eoniaswap index is a rate that each Panel Bank believes is the mid market rate of Eonia Swap quotations between prime banks.[17] It is the fixed rate that banks are willing to accept in return for receiving the average Eonia over the period of the contract. In a way, the Eoniaswap index is similar to the Euribor, since it is a guess of the Panel Banks, not a real average such as the Eonia. Eonia swap itself is similar to a plain vanilla interest rate swap transaction where a

[16] In extreme market situations, the yield curve may become inverted. That happened during the financial crisis for certain governmental bonds. That was to do with heightened insecurity about the short-term prospects of for example Greece, while the markets had bigger trust in the solution to the debt problems after to the European-IMF bailout packages would be implemented.

[17] Panel Banks quoting Eonia Swap Index are not the same as for the Euribor and Eonia fixings.

fixed rate interest cash flow is exchanged for a variable rate (Eonia) cash flow, calculated on a notional cash amount (EBF (d)). The payer of the fixed rate (swap rate) pays a rate agreed upon at the end of the maturity and the receiver pays the variable.

1.5 Spread Euribor-Eoniaswap

The spread between Euribor and Eoniaswap is a good indicator of the money market tensions in the euro area. Eoniaswap rate reflects the same risk premiums as Euribor (credit risk premium, liquidity risk premium and term premium). Yet, the total risk is higher for long-term Euribor deposits compared to the Eoniaswap contracts, since the latter is able to adapt to the short-term changes in the market rates since the daily changes in the Eonia rate are taken into account when settling the contract. Thus in shaky market situations, Euribor fluctuates more than the Eoniaswap rate and the spread between those therefore reflects the perceived credit and liquidity risk in the money markets (Appendix 9).[18]

2. Data transformation

The downloaded time series of the market index and exchange rate data show the level of the index/exchange rate. For the purpose of the estimations, the daily change is calculated, as a percentage change of the rate/index from the previous day. The following formula is used, whereby the obtained time series is in percentages.

$$((t_1-t_0)/t_0)*100$$

The downloaded data series of the interest rate spreads is given in percentages. The series are transformed into first differences. The daily change of spread is retrieved by using the following simple formula:

$$(spread_{t1}-spread_{t0})*100$$

Contrary to the market indices and exchange rates, the transformed interest rates spreads are in basis points (percentage points*100). The decision to use data in this form is based on graphical and statistical inspection, where the differenced time series is more normally distributed with fewer extreme observations. For example the simple spread between Euribor 12 and 1 months shows an upward moving trend and several large fluctuations (Appendix

[18] Since Euribor rates are fixed at 11 a.m., while Eonia swap rates are collected at 6.30 p.m, then the spread between the two rates also reflects changes in the yield curve between these points in time during the day.

10). When transformed into percentage changes, the graphical inspection shows very big jumps (up to 500%) due to the small size of the spread (Appendix 11). The differenced series looks most evenly distributed and thus it provides the most accurate estimation results (Appendix 12).

3. GARCH and LS models

The General Autoregressive Conditional Hetereoskedasticity model GARCH (1,1) (Bollerslev 1986) is used to estimate the impact on market indices and exchange rates. The reason for using GARCH (1,1) is that the model accounts for some main characteristics of the financial time series which are large fluctuations, clustering of volatility and fat tails (excess kurtosis).

The Least Squares (LS) estimation is used for evaluating the announcement effect on the interest rates spreads. The reason for using LS estimation is that interest rate spreads follow a different investment strategy than that of a market index and exchange rate, where the investment return is directly related to an increase/decrease of the index/exchange rate. The Ordinary Least Squares (OLS) standard errors are correct when the residuals are independent and identically distributed. When the residuals are correlated across observations however, the OLS standard errors can be biased and either over- or underestimate the true variability of the coefficient estimates. Since the residuals or the interest rate series are not homoscedastic (they do not have the same variance), White's heteroscedascisity consistent standard errors are used.

The model for the mean estimation equation has a market index, exchange rate or interest rate spread as a dependent variable and a dummy as an explanatory variable. The estimated coefficients of the dummies will firstly show if the announcement days had any significant impact on these asset prices. The significance is determined by looking at the estimated p-values. The significance level for the empirical analysis is chosen to be 5%. If the estimated coefficients are significant, then all other things being equal, the announcement had a positive or negative impact on the average daily change of the asset price, depending on the sign of the coefficient. GARCH estimation will furthermore enable to identify if the announcement days increased the average volatility of the asset price time series by looking at the significance of the variance equation dummy coefficient. More detailed description of model and variables can be found under Appendix 13.

A dummy variable is created for each announcement day and furthermore, for its {+1} and {-1,+1} window days to see if the announcements had any effect on the average daily changes of the respective assets. The reason for looking at the window dates in parallel to the key event days is to take into account the different market closing times and the different fixing times of certain assets.[19]

The actual results are presented in the following manner: Firstly, for each alternative monetary policy tool, an overview of the key dates and announcement contents is presented. Second, the estimation results will be given. These include presenting results for the event day itself, which are represented by dummies 1A-1G, depending on the number of key events. Estimations results for the window days are also presented. There are two types of window dates. Firstly, {+1} window date, which represents key event day itself and one day after, and secondly, {-1;+1} window dates, representing the day itself and one day before and one day after. The {+1} window date dummies are labelled with an ending "2" (i.e. 1A2 and 1B2) and {-1;+1} window dates with an ending "3" (i.e. 1A3 and 1B3).

FRFA analysis will be conducted in a more thorough manner than for the other policy tools. That is important for showing the complexity of translating and interpreting the numbers depending on the dummy setup. Because of page limitations, the same will not be done for the other measures.

4. Expected results

Expected results are based on the rationale for using non-traditional monetary policy measures as explained under Part II. The expected results for each of the three asset prices are presented in the same order by which are tested empirically: interest rate spreads, stock markets indices and exchange rates.

4.1 Interest rate spreads

FRFA, LTRO and FEL measures were implemented to provide liquidity to the financial sector and help to support inter-bank lending. EOC measures were to strengthen the other three measures so that certain assets which had become illiquid in the inter-bank market could

[19] Eonia is fixed at 6 p.m. and is published between 6.45 p.m. and 7.00 p.m. (CET). Euribor is fixed at 10:45 a.m. and published at 11 a.m. (CET) (EBF (a) and (b)).

still be used as collateral in Eurosystem open market operations.[20] Therefore, these operations should have lowered the excessive risk premium on the money markets and the spread between Euribor12-1m and 3-1m and between Euribor and Eoniaswap should have decreased.[21]

4.2 Market indices

Efficient communication plays a vital role in the ECB's monetary policy transmission. The alternative monetary policy announcements were meant to send a positive signal to the markets and reassure that the ECB has things under control. All other things being equal, if the market participants have trust in the ECB and its capability to come out of the crises using the most correct methods, it should have sent positive signals to the markets. Thus, the stock market indices should have increased. It should be noted however, that the market indexes may be hard to interpret, since its movements include all other information that the market participants have access to. Interest rate spreads on the other hand are more directly related to the alternative policy announcements, since money markets are directly influenced by these measures.[22]

4.3 Exchange rates

As mentioned above, FRFA, LTRO, EOC and FEL are expected to decrease money market spreads. According to exchange rate channel theory (which rests on UIP condition), lower interest rates would lead to depreciation in the euro currency. A lower exchange rate increases domestic exports, which can increase economic wealth. However, as mentioned under Part I, UIP is not found to hold very well and one reason for that is to do with market expectations. For example, if markets expect the alternative monetary policy measures to support future economic growth, then they would increase investments in euro and thus lead to a stronger currency.

Another factor to take into account is that the announcements of the credit enhancement measures are to do with creating trust in the ECB and in the euro. Especially since 2009,

[20] Exempting Greece and Ireland from the credit rating threshold of BBB-, served a similar purpose. However, the latter is more to do with the CBPP and SMP programs, which are not analysed in this paper, and for that one should look at the governmental bond yield changes on the respective announcement days.

[21] Decreasing spread expectations are also to do with ECB cutting its main refinancing rate since October 2008, as Euribor also reflects expectations of the further interest rate changes.

[22] For future analysis, it could be relevant to look at stock market indices for banking sector only, since that would decrease the "noise" which can be caused by news related to other information, i.e. publication of corporation's annual accounts, change in profitability forecasts etc.

when the European debt crises deepened, discussions about the sustainability of EMU also intensified. Thus, in a situation where there is lower trust in the euro and its viability, investors often invest in currencies which traditionally have been considered "safe heavens", one of which is the Swiss franc. That would lower the demand for euros in favour of the "more safe" currency, thus depreciating the euro against the Swiss franc.

The previous points make it difficult to state in which direction the exchange rate should be expected to have moved. The ECB would hope to see a weaker euro in order to stimulate economic growth. That was especially important in times of great bankruptcy fears and very low growth forecasts, which could lead Europe to an even bigger recession. At the same time, the stronger euro would signal that the ECB managed to win market trust, with investors increasing their investments in the euro and in the EMU in general. That is why the exchange rate estimations will be analysed with no pre-specified expected results.

5. FRFA

5.1 Announcement contents

The sample period ranges from 9/01/2008 to 6/02/2011. The start data is chosen around 1 month before the first FRFA announcement, and the end date was the approximate time when the data was downloaded. The key event dates represent two days where the ECB announced the first time use of the fixed rate full allotment procedure.

Dummies 1A and 1B were created to represent the two FRFA announcement days. Dummy 1A represents the first date, 8th of October 2008. On this day, the Governing Council decided to conduct weekly MROs as fixed rate tender procedure with full allotment (ECB PR, 2008b). Furthermore, on the same day, the ECB had another important announcement: It decided to reduce the corridor of the standing facilities from 200 bps to 100 bps around the interest rate of its main refinancing operations, and to reduce the minimum bid rate by 50 basis points to 3.75 % (ECB PR, 2008c). This is important information for the sake of data inference, although it is not possible to evaluate the individual effect of each of these announcements as they occurred on the same day.

Dummy 1B represents the second day, 15th of October 2008, when the Governing Council announced that all the LTROs will be carried out as fixed rate full allotment tender procedure

(ECB PR, 2008d). On the same day, the ECB made three other (non-FRFA) announcements: First they announced expansion of Eurosystem collateral framework. Second, they decided to start offering EUR/CHF foreign exchange swaps by providing Swiss francs against the euro (ECB PR, 2008e) and third, to provide US dollar liquidity through foreign exchange swaps (ECB PR, 2008d). For an extended overview of the FRFA announcements see Appendix 14.

5.2 Estimation results: Interest rate spreads

Spread: Euribor12-1m and 3-1m

By conducting LS estimation on the daily data, it is possible to evaluate the impact of the announcements on the interest rate spreads. The first key announcement (1A) decreased the average spread of Euribor12-1 by -2,2 basis points and increased the average Euribor3-1 spread by 0,14 basis points (Table 1). Both results are highly significant (p-values much below 0,05).

Euribor is an estimation of the Panel Banks and not an actual average of transactions. Thus, the banks might have seen FRFA as a solution that would ease the liquidity problems in the longer-term perspective (shown by Euribor12-1 decline), lowering the term premium on interbank lending. Furthermore, the decreasing spread can be a response on the announcement of the interest rate decrease that happened on the same day. The increase of the Euribor3-1 rate however, shows that the Panel Banks did not feel secure about the short term interbank lending prospects, despite the unlimited liquidity supply from the ECB.

The second key announcement (1B) provided opposite results: positive effect (+1,7 basis points) on the Euribor 12-1 spread, whereas the Euribor3-1 was negative by 0,36 basis points. Both results are highly significant. One explanation for the results could be that the banks saw the coordinated efforts of the central banks working together as strengthening the short term lending prospects, while the longer term forecasts had become more uncertain. Since there were several other announcements on that day, it is not possible to separate the announcement effects from one other. However, all of these measures were to decrease the Euribor spread as explained under the "Expected results".

Table 1 FRFA: Euribor12-1 and 3-1: Key event days

	Euribor12_1M		Euribor 3_1M	
Dummy	Coefficient	P-value	Coefficient	P-value
FRFA1A	-2.20	0	0.14	0
FRFA1B	1.70	0	-0.36	0

When including the window dates (1A2, 1A3, 1B2, 1B3), then both spreads for key dates 1A and 1B have positive coefficients (Table 2). Nevertheless, only the coefficients of 1B's window dates on Euribor 12-1 are significant. That means that key event 1B and also both its window days have had an above-average positive influence on the Euribor12-1 spread. That is opposite to what was expected.

Table 2 FRFA: Euribor 12-1 and 3-1: Window days

	Euribor 12_1M		Euribor 3_1M	
Dummy	Coefficient	P-value	Coefficient	P-value
FRFA1A2	3.77	0.37	3.65	0.14
FRFA1A3	1.82	0.58	2.45	0.20
FRFA1B2	2.37	0.00	0.65	0.36
FRFA1B3	2.48	0.00	0.82	0.10

When estimating key dates together (1A and 1B included in one equation), then the actual event days are negative, while the window dates estimations have positive coefficients (Appendix 15). Since the coefficients of the summarized estimations are all insignificant, no above-average result can be concluded. [23]

Spread: Euribor-Eoniaswap12m and 1m

The estimations show that on the first announcement day (1A), the Euribor-Eoniaswap 12-1 and 3-1 spreads increased by around 10-11 basis points compared to the average daily change over the period (Table 3). The key event 1B on the other hand decreased the average spreads by around 3 basis points. Both results are highly significant.

[23] The fact that the summarized results (window dates are also summarized, since they include more than one dummy) are not significant while the single estimations are, is to do with the LS estimation and the model build-up. Where more than 1 date is included in one dummy having a value "1", the more extreme results are closer to "normal" compared to when including only 1 dummy (dummy takes value 1 on one date only).

Table 3 FRFA: Euribor-Eoniaswap12m and 1m: Key event days

	Euribor-Eoniaswap12m		Euribor-Eoniaswap1m	
Dummy	Coefficient	P-value	Coefficient	P-value
DFRFA1A	11.24	0	10.40	0
DFRFA1B	-3.86	0	-3.10	0

The fact that the FRFA MRO (1A) announcement increased the spreads is not in line with the expected results of the ECB, since they applied these measures mainly to lower tensions on the money markets. The decrease of the spreads on the second announcement day is according to expectations. That result could be to do with the large amount of decisions that were taken on that day by the ECB, the FED and the Swiss central bank to lower tensions on the financial markets.

As to the window dates, the only significant change was that of the Euribor-Eoniaswap1m (Table 4).[24] Namely, the window days of key event 1A (1A2 and 1A3) increased the average daily change of the spread by around 9 basis points. Similar results are received when looking at the summarized impact of FRFA event dates (Appendix 16). All the coefficients are insignificant, and all but one are positive.

Table 4 FRFA: Euribor-Eoniaswap12m and 1m: Window days

	Euribor-Eoniaswap12m		Euribor-Eoniaswap1m	
Dummy	Coefficient	P-value	Coefficient	P-value
DFRFA1A2	-0.40	0.96	9.76	0.00
DFRFA1A3	5.46	0.46	8.74	0.00
DFRFA1B2	1.70	0.67	-1.79	0.06
DFRFA1B3	-5.75	0.39	-5.20	0.07

Interest rate spread summary

The expected results were decreasing money market spreads. The actual results were somewhat different. Only the Euribor12-1m spread decreased significantly as a reaction to the first announcement of FRFA on MROs, while all the other spreads increased. Key event 1B, which besides the announcement of FRFA application on all LTROs, also includes key

[24] Although coefficient significance levels for Euribor-Eoniaswap 1m on key event 1B2 and 1B3 dummies are very close to 5%, thus on the border to be considered significant.

announcements of EOC and FEL measures, managed to decrease both Euribor-Eoniaswap spreads as well as the Euribor 3-1 spread, while the Euribor 12-1 spread increased. Thus, the announcements of FRFA, EOC and FEL measures on the 15th of October 2008, managed to ease some of the money market tensions.

5.3 Estimation results: Market indices

According to the GARCH (1,1) estimation, key announcement 1A had a negative impact on the Euronext 100 Index. The GARCH estimation shows that the day decreased the average index by around 6% (Table 5). The same market reaction can be seen when looking at key date 1B. On that day, the average daily index decreased by -6,7%. Large falls in the index can also be seen when taking into account the window dates (Appendix 17). Despite the apparently high index decrease, the GARCH estimation provides statistically insignificant coefficients for both key dates and the window dates. Thus according to the GARCH estimation, it cannot be concluded that these days had any above-average effect on the average daily change of the Euronext index.

Table 5 FRFA: Euronext 100: Key event days

	Euronext 100	
Dummy	Coef	P-value
DFRFA1A	-6.16	1
DFRFA1B	-6.67	1

The fact that the coefficients are so large and still insignificant indicates that it is necessary to double check the estimation for errors. Checking the histogram data of the Euronext time series will help to compare the key date observations with that of the mean and standard deviation of the sample period. The maximum and minimum observations in the sample are +10.9% and -8,6%, with the mean close to 0 and standard deviation of 1,77 (Appendix 18). That implies that a 6,1% and 6,7% fall (the actual daily change of the index on days 1A and 1B respectively), are rather extreme observations, laying more than 3 standard deviations away from the mean. Thus, it seems that the GARCH model, which uses unequal variances, underestimates the magnitude of the actual index fall, which confirms the need for rechecking the estimations. Before doing so, one could compare the summarized estimation results for the Euronext 100 with three other key European market indices: Barcelona SE General 63 index, Athex General index and Dax 30 index.

As for the Euronext index, the two key announcements together give a -6.43 coefficient estimation for the key announcement days, and -5,19 and -3,06 for the {+1} and {-1;+1} window dates respectively (Table 6). The results for the Spanish, Greek and German markets are quite similar: On the key event days, the average daily change of the index decreased between 5-6% and slightly less when including the window days. All the mean equation as well as the variance equation coefficients are insignificant, although when looking at the histogram data of the other market indices, the actual daily changes seem very large (Appendix 7). Thus, it is worthwhile to double check all these estimations for validity.

Table 6 FRFA: Market indices: Summarized results

	Euronext 100		**Barcelona SE**		**Athex**		**Dax 30**	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Key dates together	-6.43	0.89	-5.05	0.92	-5.3	0.64	-6.19	0.86
Key dates {+1} window	-5.19	0.16	-4.57	0.63	-4.03	0.31	-5.08	0.15
Key dates {-1,+1} window	-3.06	0.07	-2.03	0.38	-2.06	0.42	-2.98	0.14

Robustness of the results

One way to check if the GARCH has provided accurate results is to change the settings of the GARCH estimation. That can be done by changing the error distribution from student's t to normal and the algorithm from BHHH to Marquardt. However, this provides very similar results. Another option is to estimate the coefficient with the LS method, which gives a rather different picture: the coefficients of the dummies are approximately the same as given by GARCH, but all of them are highly significant (Table 7). In general (and for most of the other estimations made in the course of this paper), the LS estimation should provide very close results to that of the GARCH estimation, but in our case the p-values are far too different, implying some program or calculation error. That shows the importance of double-checking the "more extreme" results with the actual values of the time series as well as comparing the respective figures with the mean and the standard deviation of the benchmark period. The question is whether the LS estimates are BLUE[25], since the market index time series does not

[25] For the Classical Linear Regression Model it is a condition that the ordinary least squares (OLS) estimators are BLUE. BLUE stands for best linear unbiased estimate. The problem with using LS for financial time series is that often one of the assumptions that the error term has a constant variance (homoskedasticity) is not satisfied.

have a normal distribution. Yet, in current case, the LS estimation results seem to be more accurate, especially since the p-values are far away from 0,05 (p=0).

Table 7: FRFA: Market indices: Estimation with LS

	Euronext 100		Barcelona SE		Athex General		Dax 30	
	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value
Key dates together	-6.42	0	-4.97	0	-5.57	0	-6.21	0
Key dates {+1} window	-5.09	0	-4.43	0	-4.16	0	-4.99	0
Key dates {-1,+1} window	-3.09	0	-2.35	0.01	-2.47	0.01	-3.08	0

As mentioned earlier however, there were three other important announcements on key date 1B, and which one had bigger or smaller influence on the estimations is not determined. Yet the message to the market could be similar: The markets may have reacted negatively, perhaps because the announcement of these unusual measures signalled the seriousness of the crises and the possible negative spillovers from the financial sector to the other sectors in the economy.

In conclusion it can be said that the GARCH (1,1) provides insignificant coefficients, while according to the LS estimation, these days added highly negatively to the average daily change of the selected European indices. After checking for the time series distribution statistics, the LS estimations seem to be most accurate and these results are taken as valid in the scope of the current research paper. Thus, in conclusion, the markets reacted very negatively to the FRFA (and the FEL and the EOC) announcements.

5.4. Estimation results: Exchange rates

For estimating the reaction of the exchange rates, GARCH (1,1) estimation method is used, and comparison with LS will only be brought in case the results seem non-reliable.

GARCH estimation on key announcement 1A provides positive coefficients for both, CHF/EUR and $/EUR exchange rates (Table 8). That could be translated as a stronger euro. Key event 1B on the other hand has negative coefficients, thus weakening the euro against both currencies. Yet, since all the coefficients are insignificant, the key announcements seem not to have had any above-average influence on the exchange rates. Furthermore, estimations

with the window dates (1A2, 1A3, 1B2, 1B3) give largely insignificant coefficients as well (Appendix 19). Neither is there a significant impact on the variance equation, meaning that the announcement days did not increase or decrease the average daily variance of the exchange rates.

Table 8 FRFA: Exchange rates: Key event days

	CHF/EUR		$/EUR	
Dummy	Coefficient	P-value	Coefficient	P-value
DFRFA1A	0.13	1	0.73	1
DFRFA1B	-0.62	1	-0.93	1

The exchange rate could otherwise be expected to increase on key event 1A, where the ECB announced lowering the rate on its main refinancing operations. If the interest rate decreases (all other things being equal), investors seek out investments with higher return prospects, which should weaken the euro (increasing the S/EUR and CHF/EUR exchange rates). However, this effect is most likely to be seen starting from the actual day when the lowered rate was applied (15th of October 2008) and furthermore, does not necessarily hold if the markets expect the FRFA measures to increase future economic growth.

Checking the LS estimation, the results are very similar, with very high p-values (insignificant coefficients). Also the histogram data reveals that the actual daily exchange rate changes on the key event days are not extreme observations (Appendix 20). Thus, it cannot be concluded that FRFA announcements had any influence on the mean of the average daily change on either the $/EUR or the CHF/EUR exchange rates.

5.5 FRFA Summary

The announcement of the first time use of FRFA on MROs (1A) increased most of the money market spreads under analysis, despite the fact that the ECB also announced lowering the spread on the main refinancing operations. The second key day however (1B) was quite successful in lowering the interest rate spreads. That could be explained by a large number of key announcements that took place on the same day. The markets however reacted very

negatively to the FRFA announcements, while no impact on the exchange rates could be verified.

6. LTRO

6.1 Announcement contents

LTRO benchmark period is from 2-07-2007 to 30-09-2010. The start date is approximately one month before the first LTRO announcement and the end date one month after.

There are three key LTRO dates, which is when the ECB announced the supplementary LTRO measures (Appendix 21). The first key date (1A) stands for the 22nd of August 2007, where the Governing Council announced the use of a supplementary LTRO with a maturity of 3 months (ECB PR, 2007b). Dummy 1B represents the 28th of March 2008, which is when the ECB announced the first time use of supplementary 6-months LTRO (ECB PR, 2008a). The third announcement was made on the 7th of May 2009 (dummy 1C), which was the day when the Governing Council decided to conduct liquidity providing 1-year LTRO (ECB PR, 2009b). On the third day, the ECB made two other announcements: First, the interest rate on the MROs was to be decreased by 25bps to 1% (ECB PR, 2009b2) and second, the ECB announced that it would start buying euro-denominated covered bonds issued in the euro area (Trichet, 2009, May 7).

6.2 Estimation results: Interest rate spreads

Spread: Euribor12-1m and 3-1m

Both Euribor12-1 and 3-1 have positive and significant coefficients on almost all the key event days 1A-1C (Table 9).[26] Out of 12 window date estimations (1A2, 1A3, 1B2, 1B3, 1C2, 1C3), 4 estimations were significant, all of them having positive dummy coefficients (Appendix 22). That means that the Euribor spreads increased above average on the LTRO announcement days, which is opposite to what was expected. The LTRO measures were to lower the tensions on the money markets by providing supplementary longer-term liquidity and to encourage banks to switch from short-term to medium term funding. Yet by looking at the reaction of the Euribor Panel Banks, they seem to have estimated the risk of lending in both-shorter and longer term even higher.

[26] Note that Euribor 3-1 coefficient on key date 1A is on the border.

Table 9 LTRO: Euribor12-1 and 3-1: Key event days

	Euribor 12_1M		Euribor 3_1M	
Dummy	Coefficient	P-value	Coefficient	P-value
LTRO1A	2.76	0	0.18	0.06
LTRO1B	2.46	0	2.28	0
LTRO1C	0.46	0	0.28	0.00

Spread: Euribor-Eoniaswap12m and 1m

All the estimations for the Euribor-Eoniaswap12 and 1-month spreads give negative and significant coefficient estimates, whereas the biggest decline happened on day 1A, where the average daily spreads decreased by around 18 and 5 bps respectively (Table 10). In contrary to the key days, half of the coefficients of the window date estimations are positive, signalling a spread increase. Nevertheless, since the p-values are very high, these results are insignificant (Appendix 23). Thus, the LTRO announcements managed to lower money market tensions by decreasing liquidity and/or credit risk premium.

Table 10 LTRO: Euribor-Eoniaswap 12m and 1m: Key event days

	Euribor-Eoniaswap12m		Euribor-Eoniaswap1m	
Dummy	Coefficient	P-value	Coefficient	P-value
LTRO1A	-17.49	0	-4.72	0
LTRO1B	-0.29	0.0348	-1.22	0
LTRO1C	-0.49	0.0004	-3.32	0

6.3 Estimation results: Market indices

According to the GARCH (1,1) estimation, the Euronext 100 index has a negative dummy coefficient on 2 out of 3 event days (Table 11). All the coefficients are insignificant. The window dates have insignificant (and mostly positive) coefficients as well, while the dummy coefficients of the variance equations are all negative and insignificant (Appendix 24). When looking at the summarized estimations for all the key dates and window dates for Euronext 100 and the other European market indexes, the results are still insignificant but most of the coefficients are positive (Appendix 25).

There seems to be one quite large coefficient in the Euronext estimations, namely the coefficient for dummy 1A. In line with the robustness check conducted under FRFA, all the three key announcement estimations are tested with the LS method to see if the p-values are the same (should be very close if the model estimates are correct). The result is very similar however; almost identical and insignificant coefficient values (Appendix 26). When checking the histogram statistics of the market indices (Appendix 7), it can be seen that this is due to the rather large standard deviation of the time series (between 1,6 and 2 for all the four markets). That means that a daily change of around 1,78% (actual daily change of Euronext 100 on date 1A) is not outside confidence bounds and thus the H0 (the dummy day having no impact on the average daily change of the market index) is not rejected. The same test will not be conducted for the summarized results for the other market indices, since the coefficient values are very small. Consequently, the LTRO announcements had no above-average impact on the market indices.

Table 11 LTRO: Euronext 100: Key event days

	Euronext 100	
Dummy	Coefficient	P-value
LTRO1A	1.80	0.9974
LTRO1B	-0.40	0.9995
LTRO1C	-0.17	0.9996

6.4 Estimation results: Exchange rates

The estimations give mostly positive coefficients for the CHF/EUR and $/EUR exchange rates. This hints a move towards a stronger euro. None of the coefficients is significant however. All the window dates estimations provide also positive and insignificant coefficients (Appendix 27). Thus, it cannot be concluded that the LTRO announcements had any significant impact on exchange rates.

Table 12 LTRO: Exchange rates: Key event days

	CHF/EUR		**$/EUR**	
Dummy	Coefficient	P-value	Coefficient	P-value
LTRO1A	0.37	0.9885	-0.15	0.9976
LTRO1B	0.31	0.9867	0.05	0.9998
LTRO1C	0.53	0.9816	0.26	0.999

6.5 LTRO Summary

The LS estimation results show that the LTRO measures did not increase the confidence of the Panel Banks which set the Euribor rates, shown by the increasing spreads between the Euribor different maturities. Thus, in contrary to the expected results, the announcements increased the risk premium of the interbank financing. At the same time however, the announcements had the wished effect on Euribor-Eoniaswap12 and 1, lowering the average daily change of the spreads. Thus, the ECB managed to decrease the credit and/or liquidity risk premium on the money markets. The market index estimations provided mixed results, with several positive and negative coefficients. The exchange rate movements pointed towards a stronger euro. However, due to large p-values, the empirical analysis reveals no significant impact on either the market indices or the exchange rates.

7. FEL

7.1 Announcement contents

FEL benchmark period ranges from 2nd of July 2007 to 2nd of June 2011. There are 7 key dates; all representing the days where the ECB announced its first time use of the FEL measures (Appendix 28).

The first date (1A) represents 12th of December 2007, which is the first time when the ECB started cooperating with the FED, offering US dollar liquidity to the European counterparties (ECB PR, 2007c). The second key date (1B) is 15th of October 2008, when the ECB announced that it would also start offering US dollar liquidity through EUR/USD swaps (ECB PR, 2008d). On the same day the ECB and the Swiss National Bank (SNB) also decided to start conducting EUR/CHF foreign exchange swaps providing Swiss francs against euro (ECB PR, 2008e). On 16th of October 2008 (1C) the Magyar Nemzeti Bank (MNB) and the ECB established an agreement on repurchase transactions, which would provide the MNB with a facility to borrow up to EUR 5 billion in order to provide additional support to the MNB's operations (ECB PR, 2008f). Key date 1D stands for an announcement date 27th of October 2008, where Danmarks Nationalbank and the ECB established a reciprocal swap line (ECB PR, 2008g). On key date 1E (6th of April 2009), the Bank of England, the ECB, the Federal Reserve, the Bank of Japan, and the Swiss National Bank announced swap arrangements that would enable the provision of foreign currency liquidity by the Federal Reserve to American financial institutions (ECB PR, 2009a). With that agreement, they

would provide euro, yen, sterling and Swiss francs to the Federal Reserve in case the latter needed it. On the 10th of June 2009 (1F) the ECB and Sveriges Riksbank decided to activate their temporary reciprocal currency agreement (swap line) whereby the Swedish central bank could borrow euros from the ECB in exchange for Swedish kronor (ECB PR, 2009c). The last key date (1G) represents 17th of December 2010, where the ECB and the Bank of England announced a temporary liquidity swap facility, under which the Bank of England could provide, if necessary, up to GBP 10 billion to the ECB in exchange for euros (ECB PR, 2010d).

7.2 Estimation results: Interest rate spreads

Spread: Euribor 12-1m and 3-1m

The majority of the key event dates had positive and significant impact on both Euribor spreads (Table 13). Key date 1G was the only estimation (establishment of temporary liquidity GBP swap line), which had no significant impact on neither of the spreads. The announcement days that gave negative coefficients are 1F, which decreased both Euribor spreads;1A, which lowered the Euribor12-1m spread; and 1B, which decreased the Euribor 3-1m spread.

When looking at the window dates, half of the Euribor 12-1 estimations (7 estimations) were significant (Appendix 29). Out of those, 5 had positive coefficients and 2 negative. Out of the 14 Euribor 3-1 window date estimations, 5 had significant results with 3 positive and 2 negative coefficients. In summary, most of the FEL announcements increased the Euribor spreads, which is not what was expected, since a majority of the spreads should have decreased.

Table 13 FEL: Euribor 12-1 and 3-1: Key event days

	Euribor 12_1M		Euribor 3_1M	
Dummy	Coefficient	P-value	Coefficient	P-value
FEL1A	-0.44	0	0.21	0.0089
FEL1B	1.66	0	-0.39	0
FEL1C	2.96	0	1.61	0
FEL1D	1.16	0	2.11	0
FEL1E	1.86	0	0.81	0
FEL1F	-0.64	0	-0.59	0
FEL1G	0.16	0.0816	0.11	0.1741

Spread: Euribor-Eoniaswap12m and 1m

Six estimations out of seven gave significant results for both Euribor-Eoniaswap spreads on the FEL announcement days (Table 14). 4 estimations gave negative coefficients for Euribor-Eoniaswap12m spread and 3 for the 1-month spread. On these days, the index decreased the average daily spread change between 0,3 and 4 basis points. The window date estimations gave 3 significant results for the longer term spread (12m), whereas only one of the coefficients was negative (Appendix 30). Five estimations were significant for the shorter term spread (1m), while three of the coefficients were negative. Compared to the Euribor spreads, these results are slightly closer to the expected, since almost around half of the estimations managed to decrease the spreads.

Table 14 FEL: Euribor-Eoniaswap 12m and 1m: Key event days

	Euribor-Eoniaswap12m		Euribor-Eoniaswap1m	
FEL1A	Coefficient	P-value	Coefficient	P-value
FEL1B	-0.31	0.0099	1.50	0
FEL1C	-3.91	0	-3.10	0
FEL1D	7.19	0	-0.50	0
FEL1E	-1.51	0	-2.70	0
FEL1F	-1.41	0	0.50	0
FEL1G	1.29	0	2.90	0
DFEL1G	0.09	0.4588	0.10	0.3869

7.3 Estimation results: Market indices

According to the GARCH (1,1) estimation, the Euronext 100 index provides mostly negative dummy coefficients on the key FEL announcement days (Table 15) and when including the window days (Appendix 31). Most of the coefficients are insignificant however. When looking at the summarized results (all the seven key announcement days together) for the Euronext and the other European market indices, the result is similar: Most of the coefficients are negative with very high p-values (Appendix 32). Furthermore, the estimations give insignificant coefficients for the variance equation dummies as well.

Since some of the coefficients as well as the actual daily changes of the Euronext series are rather large, it is important to double check the estimations as was done under FRFA and LTRO parts. When redoing the estimations using the LS method, three of the key events (1B,

1C, 1D) are found to have largely negative and significant impact on the average daily change of the Euronext time series (Appendix 33). Furthermore, also the summarized market indices with LS estimation reveal significant and negative reaction for the Euronext, Dax 30, Barcelona SE and the Athex General indices (Appendix 34). Thus, opposite to the expected results, the FEL announcements caused an above-average fall in key European stock market indices.

Table 15 FEL: Euronext 100: Key event days

	Euronext 100	
Dummy	Coefficient	P-value
FEL1A	0.24	0.9997
FEL1B	-6.63	0.9999
FEL1C	-5.38	1
FEL1D	-3.94	0.9997
FEL1E	-0.57	0.9998
FEL1F	0.65	0.9996
FEL1G	-0.42	0.9925

7.4 Estimation results: Exchange rates

Slightly more than half of the coefficients of the CHF/EUR and $/EUR exchange rates on the FEL key announcement days are negative (Table 16). The negative coefficients imply decreasing exchange rates, thus weakening of the euro against the Swiss franc and the dollar. All the coefficients are insignificant though. Estimations with the window dates provide similar results, whereas most of the coefficients are negative (Appendix 35). Thus, the FEL announcements did not cause any higher-than average movement in the daily exchange rate changes.

Table 16 FEL: Exchange rate: Key event days

	CHF/EUR		$/EUR	
Dummy	Coefficient	P-value	Coefficient	P-value
FEL1A	-0.10	0.9979	-0.03	0.9999
FEL1B	-0.61	0.9983	-1.04	0.9937
FEL1C	-0.84	0.9904	-0.94	0.9868
FEL1D	-0.86	0.9971	-1.10	0.9962
FEL1E	0.09	0.9999	0.48	0.9989
FEL1F	0.02	1	0.98	0.9964
FEL1G	-0.86	0.9702	0.13	0.9996

7.5 FEL summary

Most of the FEL announcements did not provide the expected fall in the Euribor spreads. The Euribor-Eoniaswap spreads on the other hand decreased on around half of the key announcement days. The latter decrease means that the ECB managed to partly lower the liquidity and/or credit risk premium on the money markets. On the key FEL announcements days, the European stock market indices fell significantly, indicating the negative market reaction as to the use of these measures. Although the exchange rate changes implied weakening of the euro, due to insignificant coefficient results, no impact could be verified.

8. EOC

8.1 Announcement contents

EOC benchmark period ranges from 3rd of January 2007 to 2nd of June 2011. There are 6 key dates, which represent the days when the ECB announced its first time use of the EOC measures (Appendix 36).

The first announcement (1A) happened on the 22nd of February 2007, when the Governing Council of the ECB decided to start treating covered bonds issued from the 1st of January 2008 in the same way as other marketable assets within the Eurosystem (ECB PR, 2007a). The second date is 15th of October 2008 (1B), when the ECB added several assets as eligible in its collateral operations, including marketable debt instruments denominated in currencies other than the euro and euro-denominated syndicated credit claims governed by UK law

(ECB PR, 2008d). Key date 1C represents 17th of November 2008, when the ECB announced that it started accepting euro-denominated syndicated credit claims, governed by the law of England and Wales as collateral in its credit operations (ECB PR, 2008h). Event 1D stands for an announcement made on the 19th of December 2008, when VP Lux S.à r.l., incorporated in Luxembourg, which is a subsidiary of the Danish central securities depository Værdipapircentralen A/S, was assessed and found to be compliant with Eurosystem user standards (ECB PR, 2008i). On dummy day 1E (3rd of May 2010), the Governing Council decided to suspend the application of the minimum credit rating threshold in the collateral eligibility requirements in the case of marketable debt instruments issued or guaranteed by the Greek government (ECB PR, 2010b). The last important date, 31st of March 2011 (1F), is when the same suspension was announced to be granted to marketable debt instruments guaranteed by the Irish government (ECP PR, 2011b).

8.2 Estimation results: Interest rate spreads

Euribor 12-1m and 3-1m

4 out of 6 key estimations give positive and significant coefficients for the Euribor12-1 spread.[27] For the Euribor3-1m spread on the other hand, the majority of the coefficients are negative. The window date estimations give similar results. All the six significant coefficients for the Euribor 12-1 spread are positive, whereas two out of four significant dummies are negative for the 3-1 spread (Appendix 37). This shows that the EOC measures did not relieve tensions in the interbank market for longer-term financing, while some of the announcements managed to ease the short-term liquidity tensions.

Table 17 EOC: Euribor 12-1 and 3-1: Key announcement days

	Euribor 12_1M		Euribor 3_1M	
Dummy	Coefficient	P-value	Coefficient	P-value
EOC1A	-2.04	0	-1.61	0
EOC1B	1.66	0	-0.41	0
EOC1C	1.76	0	1.89	0
EOC1D	0.46	0	-0.51	0
EOC1E	0.16	0.0584	0.09	0.2172
EOC1F	-0.44	0	-0.01	0.8524

[27] Key announcement 1E coefficient has a p-level slightly over 0,05

Spread: Euribor-Eoniaswap12m and 1m

Out of 6 EOC estimations, 3 of the coefficients of the Euribor-Eoniaswap12m spread and 4 of the 1-month spread are negative (Table 18). As to the window estimations, the only significant coefficient for the longer Euribor-eoniswap spread was positive, while an equal amount of significant positive and negative results (3 and 3) were obtained for the shorter spread (Appendix 38). That shows that some of the EOC announcements managed to lower the credit/liquidity risk premium on the markets, while others did not.

Table 18 EOC: Euribor-Eoniaswap 12m and 1m: Key event days

	Euribor-Eoniaswap12m		Euribor-Eoniaswap1m	
Dummy	Coefficient	P-value	Coefficient	P-value
EOC1A	-0.3514	0.0013	-0.2174	0.0268
EOC1B	-3.9514	0	-3.1174	0
EOC1C	3.0486	0	-1.1174	0
EOC1D	0.3486	0.0014	-3.1174	0
EOC1E	-1.8514	0	0.3826	0.0001
EOC1F	2.2486	0	0.9826	0

8.3 Market indices

Just as in the case of FRFA, FEL, and LTRO, the GARCH estimation provides mostly negative and insignificant coefficients for the EOC estimations on the Euronext 100 index (Table 19). The same result is obtained when looking at the summarized key announcement day estimations and the window dates estimations for other European market indexes (Appendix 39).

Because two of the key event days have rather large coefficients (1B and 1C), it is necessary to double-check the estimations just as it was undertaken under the previous parts. The LS estimation method reveals that only key event 1B had a largely significant and negative coefficient, while the other estimations provide insignificant results (Appendix 40). Estimating the summarized key dates with the LS method, all the coefficients for the key European stock markets have significant and negative coefficients (Appendix 41). Thus, key announcement 1B separately and the 7 key events together had a largely negative impact on the average daily change of the Euronext 100 index.

Table 19 EOC: Euronext 100: Key announcement days

	Euronext 100	
Dummy	Coefficient	P-value
EOC1A	0.21	0.9982
EOC1B	-6.64	0.9998
EOC1C	-2.65	0.9983
EOC1D	-0.31	0.9996
EOC1E	0.36	0.9997
EOC1F	-0.88	0.9916

8.4 Exchange rates

Estimating the announcements effects on the CHF/EUR exchange rate gives positive coefficients for 4 out of 6 estimations, while almost all the $/EUR coefficients are negative (Table 20). Estimations with both window dates give very similar results (Appendix 42). That would otherwise mean a stronger than average euro compared to the Swiss francs and weaker than average compared to the dollar. Because the coefficients are insignificant, no impact on exchange rates can be determined.

Table 20 EOC: Exchange rates: Key event days

	CHF/EUR		$/EUR	
Dummy	Coefficient	P-value	Coefficient	P-value
EOC1A	0.10	0.9978	-0.36	0.8138
EOC1B	-0.64	0.9994	-0.99	0.9879
EOC1C	0.34	0.9999	-0.15	0.9999
EOC1D	0.54	0.9978	-4.63	0.9402
EOC1E	-0.08	0.9999	-0.65	0.9963
EOC1F	0.10	0.9999	0.80	0.9934

The estimations provide one very large coefficient however, -4,6 for the $/EUR exchange rate on announcement day 1D. The histogram of the time series (Appendix 8) reveals that the maximum and minimum daily change of the $/EUR exchange rate is +4,12% and -4,625% respectively. Therefore, -4,625%, which is the actual daily change on key date 1D (19th of December 2008) represents the largest daily fall in the whole time series, thus it should give a significant results. Redoing the estimation with the Least Squares method gives a coefficient estimate of -4,64 with a p-value of 0, thus a largely significant result (Table 21).

On the 19th of December 2008, VP Lux, a subsidiary of the Danish securities clearing and settlement provider was found to be compliant with Eurosystem user standards. This announcement would hardly cause such an impact on the $/EUR exchange rate. It appears that there were other important announcements on that day, where the ECB, the FED and other central banks decided to continue the US dollar liquidity-providing operations whereas the EUR/USD foreign exchange swap operations were announced to be discontinued at the end of January given the limited demand (ECB PR, 2008j). The latter announcement was not included under the FEL measures since current empirical analysis only looks at the first-time announcements of these measures. Yet, it is necessary to look at it now, since it provides important insight for the data inference. Thus in summary, the only significant result on exchange rates is for key announcement day 1D, which implies a much weaker EUR compared to the dollar. However, this reaction was not a response to the key announcements of either the EOC or the FEL measures, but on that of prolonging of a FEL measure.

Table 21 EOC: $/EUR exchange rate: Key event 1D: LS estimation

	$/EUR	
Dummy	Coefficient	P-value
EOC1D	-4.64	0

8.5 EOC summary

EOC announcements managed to ease the shorter term interbank tensions, which can be seen by large decrease in the daily change of Euribor3-1 spread, while the longer term spread mostly increased. Thus the announcements were not able to lower the risk premium of longer-term interbank lending. Some of the EOC announcements decreased the Euribor-Eoniaswap spreads, lowering the liquidity and/or credit premium on the money markets. The stock markets reacted negatively to the key announcements, while there was no detectable effect on the exchange rates.

9. Part III summary

Part III presented the results of the empirical analysis in order to answer Research Question II: "Did the alternative monetary policy measures manage to achieve their purpose?" In order to answer this, firstly the basic descriptions of the GARCH (1,1) and LS models, as well as

data selection and transformation were provided. Second, an overview of the expected estimation results were given, which was based on the rationale for using alternative monetary policy measures as discussed under Part II. The expected results were decreasing money market spreads, increased stock market indices, while no expected reaction was specified for the exchange rates. Third, the actual empirical analysis results were presented and examined for the three financial asset prices: interest rate spreads, market indices and exchange rates.

FRFA

There were two key announcements of the FRFA procedure – application of the FRFA procedure on all the main refinancing operations and on all the longer-term refinancing operations. The first announcement caused an above-average increase in most of the spreads, thus implying increasing risk premiums on the short- and long-term money markets. Only the Euribor12-1 spread declined, which most likely signalled the response to the ECB's second announcement about a rate decrease. The second key announcement managed to decrease most of the money market spreads under analysis. This was the day when, besides the FRFA procedure announcement, also announcements about EOC and FEL were made by several central banks in Europe as well as by the FED. Thus, it was most likely the coordinated efforts of the various central banks which managed to significantly lower money market tensions. Stock markets decreased significantly on the FRFA announcements days, while no impact on the exchange rates could be verified.

LTROs

There were three key LTRO announcements, where the ECB stated that it would start offering supplementary longer term financing with maturities of 3-months, 6-months and 12 months. The announcements managed to decrease the spreads between Euribor and Eoniaswap rate, while all the Euribor term spreads increased. Thus, the liquidity/credit premium was decreased, while the general risk premium on the inter-bank lending increased. No significant effect was verified on the stock market indices and the exchange rates.

FEL

Foreign exchange liquidity measures had 7 key event days. These days include announcements where the ECB stated that it would start offering US dollar liquidity swaps, US dollar currency swaps, and swap lines with several other European countries. More than half of the FEL announcements decreased the Euribor-Eoniswap spreads, which means that

the ECB managed to partly lower the liquidity and/or credit risk premium on the money markets. At the same time, Euribor12-1m and 3-1m spreads increased on most of the announcement days, representing a rather negative reaction of the Panel Banks. Several European stock market indices fell significantly on the announcement days, indicating a negative market reaction as to the use of these measures. Although the exchange rate changes implied a weakening of the euro, due to insignificant coefficient results, no impact could be verified.

EOC

There were 6 key announcements made about the EOC measures, where the ECB decided to add several assets as acceptable collateral to Eurosystem operations. These assets include covered (bank) bonds, debt instruments denominated in other currencies than the euro, whereas marketable debt instruments issued or guaranteed by the Greek and Irish governments were exempted from the minimum credit rating threshold.

EOC announcements managed to ease the short-term interbank tensions on the majority of the key event days (lower than average Euribor3-1m spreads), while the longer term risk premium mostly increased. Furthermore, more than half of the announcements managed to lower the liquidity/credit risk premium in the markets, indicated by an above average daily decline of the Euribor-Eoniswap spreads. Stock markets reacted negatively to news about the EOC measures, while no impact on exchange rates could be determined.

FRFA, LTROs, FEL and EOC together

When looking at all the four alternative monetary policy tools together, then majority of the corresponding announcements decreased both Euribor-Eoniaswap spreads. 14 out of the 15 announcements gave significant results for both spreads; whereas 10 had an above-average negative impact (Table 22). The opposite was true for the Euribor spreads, where most of the announcements had a positive impact on the average daily change of the time series. The Euribor 12-1 and 3-1 spreads increased on 10 and 9 announcement days respectively.

Table 22 Estimation results: Interest rate spreads: Coefficient signs

	Euribor12-1	Euribor3-1	Euribor-Eoniaswap12m	Euribor-Eoniaswap1m
FRFA1A	neg	pos	pos	pos
FRFA1B	pos	neg	neg	neg
LTRO1A	pos	pos	neg	neg
LTRO1B	pos	pos	neg	neg
LTRO1C	pos	pos	neg	neg
FEL1A	neg	pos	neg	pos
FEL1B	pos	neg	neg	neg
FEL1C	pos	pos	pos	neg
FEL1D	pos	pos	neg	neg
FEL1E	pos	pos	neg	pos
FEL1F	neg	neg	pos	pos
FEL1G	*	*	*	*
EOC1A	neg	neg	neg	neg
EOC1B	pos	neg	neg	neg
EOC1C	pos	pos	pos	neg
EOC1D	pos	neg	pos	neg
EOC1E	pos	*	neg	pos
EOC1F	neg	*	pos	pos

* Insiginficant coefficient

Market reaction was evaluated by looking at four key European stock market indices, where all the key announcement days were estimated together for each alternative monetary policy category. Due to the specific way the dummies were set up, the GARCH model often underestimated the significant daily changes of the time series, and was therefore complemented with LS estimations. The latter revealed a significant fall in all the market indices on the days where the first time use of the FRFA, FEL and EOC procedures were announced (Table 23).

Table 23 Estimation results: Market indices: Coefficient signs

Key dates together	Euronext 100	Barcelona SE	Athex General	Dax 30
FRFA	neg	neg	neg	neg
LTRO	*	*	*	*
FEL	neg	neg	neg	neg
EOC	neg	neg	neg	neg

* Insignificant coefficient

The exchange rate estimations gave only one significant result (1D on $/EUR, Table 24), which was not caused by any of the first-time announcements (which is the focus of current paper), but by an announcement about extending the US dollar liquidity providing operations instead. The latter led to a significant rise in the value of the US dollar. The reason why the first-time announcements of the alternative policy tools did not have significant impact on the exchange rates could be that these measures were most directly connected to the money market spreads. That also goes well with the fact that no expected results could be determined for the exchange rates, since both - a change to a stronger and a weaker euro has its own advantages.

Table 24 Estimation results: Exchange rates: Coefficient signs

	CHF/EUR	$/EUR
FRFA1A	*	*
FRFA1B	*	*
LTRO1A	*	*
LTRO1B	*	*
LTRO1C	*	*
FEL1A	*	*
FEL1B	*	*
FEL1C	*	*
FEL1D	*	*
FEL1E	*	*
FEL1F	*	*
FEL1G	*	*
EOC1A	*	*
EOC1B	*	*
EOC1C	*	*
EOC1D	*	neg
EOC1E	*	*
EOC1F	*	*

* Insignificant coefficient

Conclusion

This thesis looked at four types of non-traditional monetary policy methods that the ECB has used in order to deal with the financial crises: FRFA, LTROs, FEL and EOC. The purpose of the paper was to answer two research questions:

1) Why did the ECB find it necessary to use alternative monetary policy measures?
and
2) Did these measures manage to achieve their purpose?

Part I of this thesis served as a basis for answering Research Question 1. First, an overview of some of the traditional monetary policy transmission theories was provided. Interest rate channel theory explains how households and firms react to a central bank's interest rate changes. When the central banks lower the interest, relative prices in the economy change, given a certain amount of price and wage stickiness. Firms and households increase investments and this may lead to higher economic growth. The credit channel, which is divided into the bank lending channel and the broad credit channel, both deal with how changing the amount of credit available to the banking sector may alter firms' and households' spending and investment decisions. The narrow bank lending channel focuses on the supply of bank loans, and the broad credit channel on the external finance premium in the credit markets. The exchange rate channel looks at how a change in the central bank interest rate affects the exchange rates. Lower interest rates would accordingly lead to currency depreciation, since investors start investing abroad, where they can earn a higher return. Depreciation of a currency leads to increased exports and higher economic growth. The asset price channel describes how monetary policy can influence different asset prices. For example, equity prices are expected to rise when the interest rate decreases, since their present value is discounted at a lower rate. The traditional theories have in many cases received much criticism and have not found enough empirical support. Lately, new lines of thought have risen, including the increasing role of central bank communication in steering market expectations and influencing the transmission of monetary policy.

Second, the paper explained the way the ECB conducts its monetary policy in "normal times". The primary goal of the ECB is to guarantee price-stability in the medium- to long-term. The ECB conducts economic and monetary policy analysis in order to assess its monetary policy

stance. The given monetary policy stance is thereafter used in the ECB's monetary policy operations, which are divided into three types: open market operations, standing facilitates and reserve requirements. Open market operations include main refinancing operations, longer-term refinancing operations, structural operations and fine-tuning operations. Standing facilities can be used for depositing excess funds on the deposit facility or lending overnight from the marginal lending facility, depending on the liquidity situation of the banks. All credit institutions in the EMU have to hold deposits (required reserves) with their national banks in order to stabilize money market interest rates and to avoid large liquidity fluctuations. The overall aim of monetary policy operations is to pass on the ECB's monetary policy stance, by regulating the overnight rate so that balanced liquidity conditions are achieved.

Part II provided an answer to Research question I. Based on the way the ECB generally conducts its monetary policy, the analysis of the key monetary policy transmission channels, and the description of the market tensions in the beginning of the financial crises, the following key points were drawn:

- Financial market tensions started in the middle of 2007.
- The spread between the marginal rate and the minimum bid rate on the main refinancing operations increased to very high levels. The ECB needs the marginal rate to be stable in order to make precise decisions about the allotment amount to match liquidity needs. A large spread between the Eonia and the MBR could blur the signalling of the stance of monetary policy and therefore hinder the ECB's ability to steer the overnight rate.
- The ECB lost control over steering Eonia, shown by the increasing spread between Eonia and the minimum bid rate. Steering overnight interest rates is crucial for the ECB as this provides an anchor for the term structure of interest rates.
- The spread between Euribor different maturities increased. That signals increasing distrust among the Panel Banks, whereas to compensate, the risk premium for the lending rate was increased.
- The spread between Euribor and Eoniaswap rates enlarged, which shows increasing credit and/or liquidity risk premium on the money markets.
- It was the first stage of monetary policy transmission, the money markets, which stopped working. That signaled the amount of power that the financial institutions have in the transmission mechanism and an element that various traditional theories fail to acknowledge. In this environment, the ECB was unable to conduct its monetary policy in

a normal way, since the high risk premiums on the money markets did not let it pass on its monetary policy stance.

These were the reasons why the ECB decided to start using alternative monetary policy tools. Part III in this paper analysed the four firstly implemented policies: FRFA, LTRO, EOC and FEL. In order to answer Research Question II, an empirical analysis was conducted, which measured the effect of the alternative monetary policy announcements on three types of financial assets: interest rate spreads, market indices and exchange rates. Using financial markets for measuring that impact provides the most immediate reactions to these measures.

The purpose of this investigation was to see if the alternative measures had the expected effects. The expected results were lower spreads, which would decrease money market tensions and help the ECB steer its monetary policy stance. Furthermore, the markets indices were expected to increase, which would signal approval of the alternative monetary policy tools. For exchange rates, no expected results were determined.

The empirical analysis made use of two types of models. The GARCH (1,1) estimation method was used for measuring the impact on exchange rates and stock market indices. The LS estimation method was used for measuring the change in the interest rate spreads (and double-checking GARCH results), which was also the focus of this paper. The estimations revealed that the majority of the alternative monetary policy announcements caused an above-average decrease in the Euribor-Eoniaswap spreads. Thus, these announcements had the expected effect, lowering the liquidity/credit risk premium inherent to the pricing of the Euribor and Eoniaswap interest rates. In contrast, the majority of the Euribor spreads increased on the key announcement days, indicating increasing tension in the inter-bank lending markets. The key stock market indices fell significantly on the key announcement days of the FRFA, FEL and EOC measures. The GARCH method revealed no impact on the exchange rates.

The results are not very close to what was expected. The reason might be that the unlimited liquidity provision in euros and foreign currencies in longer and shorter term maturities was not sufficient to alleviate the tensions, which had arisen from the beginning of the financial crises. The escalated mistrust about the other financial intermediaries and their investment positions had increased to excessive levels. The ECB was trying to increase the functionality

of the money markets by providing unlimited liquidity, which the credit institutions largely used. However, the interbank lending rates did not normalize, as the risk premiums increased, inhibiting the return to efficient pricing conditions on the financial markets. Furthermore, when market confidence declines, and trust in the financial system shivers, then central bank communications might not be able have the expected positive effect on the stock markets.

For the purposes of future research, there are several more investigations that could be interesting. First, one could measure the announcement effects on the two other alternative monetary policy tools, which are not covered in this paper: Covered Bonds Purchase Program and Securities Market Program. Second, the impact of the "non-key announcements" (prolonging or changing a specific measure) as well as "negative announcements" (stopping or phasing out a measure) could be measured. Third, it could be interesting to estimate the accrued interest rate change on the key announcement days, to see how much the spreads changed in total. Last, one could measure the long-term effects of these monetary policies on the total amount of inter-bank lending and on lending to the private sector.

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Appendix 1 Key terms

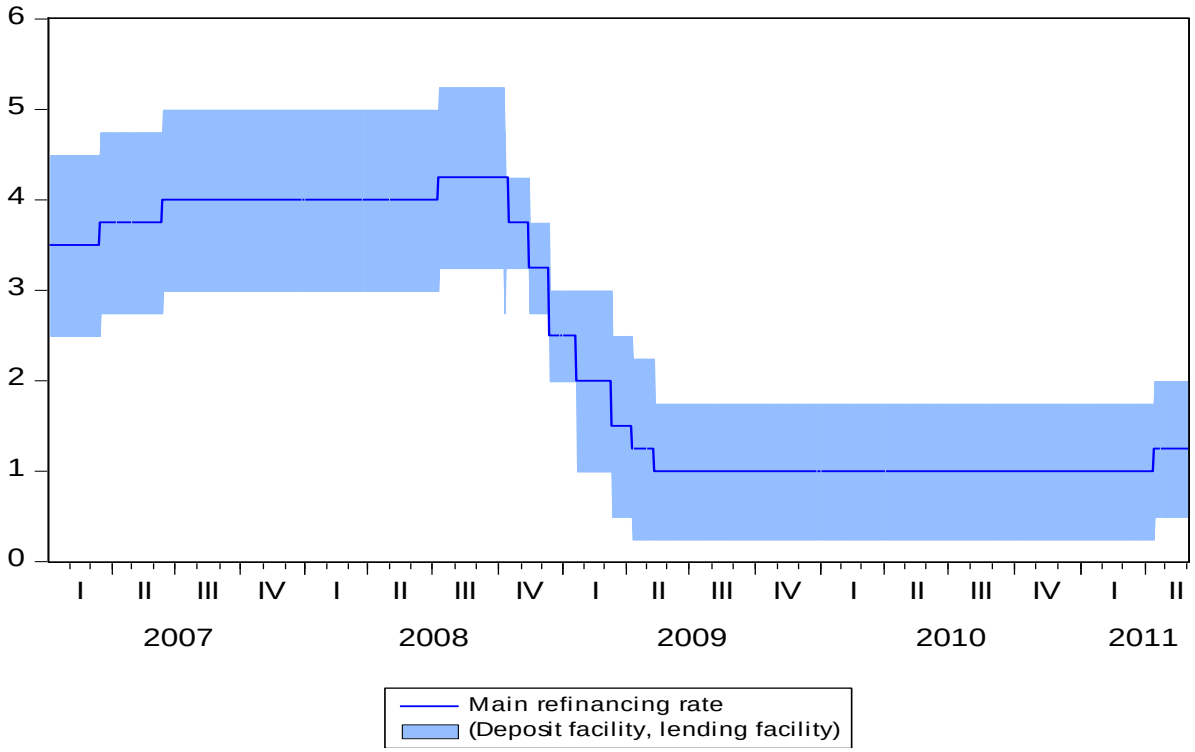
Abbreviation	Meaning
Bps	Basis points
CBPP	Covered Bonds Purchase Program
ECB	European Central Bank
EOC	Easing of Collateral
ESCB	European System of Central Banks
ESCB	European System of Central Banks
EU	European Union
FED	Federal Reserve
FEL	Foreign Exchange Liquidity
FOMC	Federal Open Market Committee
FRFA	Fixed Rate Full Allotment
GARCH	Genaral Autoregressive Conditional Heteroscedasticity
HICP	Harmonised Index of Consumer Prices
LS	Least Squares
LTRO	Long-term Repurchase Opreations
MBR	Minimum Bid Rate
MRO	Main Refinancin Operations
NCB	National Central Bank
OMOs	Open Market Operations
SMP	Securities Market Program

Appendix 2 Price stability and its importance

There are several reasons for the importance of price stability. Stable prices are important for the real value of income and wealth, while unexpected inflation inevitably leads to unintended and arbitrary redistribution. Price stability is especially important for the lowest income groups in the society. These groups have a relatively higher share of their savings invested in cash and savings accounts, the value of which will directly diminish in line with inflation. Typically, their access to financial markets is rather limited; leaving them with little room to evade the "inflation tax". Pensioners for example constitute a group that is particularly vulnerable to inflation. They are dependent on their pension savings accumulated during their working life and if not invested in a proper manner, they will largely lose value. Using the logic behind the Malthusian Law[28] by (Haemig, 2005), in case of inflation of 2%, the price level will double in 35 years; at 4% inflation, it would only take 17,5 years. Another issue is that in a zero-inflation environment, it is easier to compare prices and, therefore, to make better informed decisions about consumption and investment. Price stability also contributes to lower levels of both nominal and real interest rates. As inflation erodes the real value of nominal assets and, in an inflationary environment; lenders typically require an inflation risk premium to compensate them for inflation risks associated with their investment (ECB (k)).

[28] Malthusian Law is also called exponential law and the law of 70. The Rule of 70 is a useful rule of thumb that roughly explains the time periods involved in exponential growth at a constant rate. For example, if growth is measured annually then a 1% growth rate results in a doubling every 70 years. At 2% doubling occurs every 35 years.

Appendix 3 Standing facilities corridor



Source: ECB (33)

Appendix 4 Eonia spread (basis points)

Statistics on the EONIA spread in the course of maintenance periods before and during the turmoil				
EONIA spread		**before the last week**	**last week, excl. last day**	**last day**
before the turmoil (Mar. 2004 to July 2007)	standard deviation	3.1	7.4	23.8
	average	7.3	5.3	5.1
during the turmoil Aug. 2007 to March 2008	standard deviation	12.3	20.3	15.9
	average	0.7	-4.0	-0.2

Source: ECB (g4)

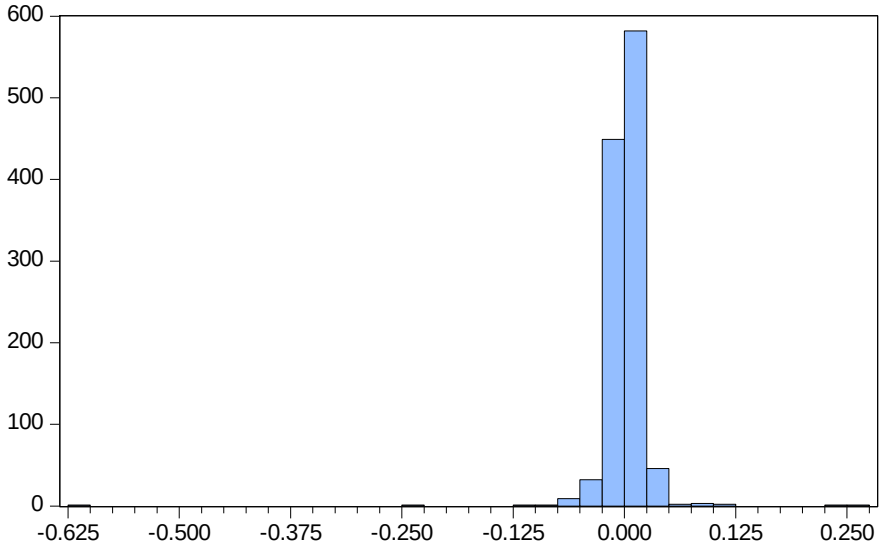
Appendix 5 Preliminary announcements of liquidity provision

	Date	Type of operation	Announcement
A	8/9/2007	Fine-tuning operation	Following the communication given earlier this morning on the ECB page "Announcements on operational aspects", this liquidity-providing fine-tuning operation aims to assure orderly conditions in the euro money market. The ECB intends to allot 100% of the bids it receives.
B	8/13/2007	Main refinancing operation	In this refinancing operation, the ECB aims to ensure the continued normalisation of money market conditions. The allotment amount will be consistent with this aim and will not be bound by the published benchmark allotment amount.
C	8/20/2007	Main refinancing operation	Consistently with the normalisation of conditions on the shortest term of the money market, the ECB intends to gradually reduce the large reserve surplus which has accumulated in the first weeks of this reserve maintenance period. The allotment amount in this main refinancing operation will exceed the published benchmark of €227 billion by an amount which is consistent with this aim.
D	12/7/2007	Fine-tuning operation	Consistently with its recent communications, and given the tendency of very short term money market rates to move away from the minimum bid rate, the ECB is launching a fine-tuning operation in which it offers to absorb up to €8 billion at a fixed rate of 4.00%. The operation will settle today and mature on 12 December 2007. The ECB continues to aim at balanced liquidity conditions on the last day of the maintenance period, and will, in case of a need, launch another fine-tuning operation on that day.
E	12/17/2007	Main refinancing operation	The allotment amount in this two week operation will not be bound by the benchmark amount but will be decided, as announced, in full consistency with the aim of keeping interest rates close to the minimum bid rate. Specifically, as a minimum the ECB will satisfy all bids at or above the weighted average rate of the MRO settled on 12 December, i.e. 4.21%.

Source: ECB (29)

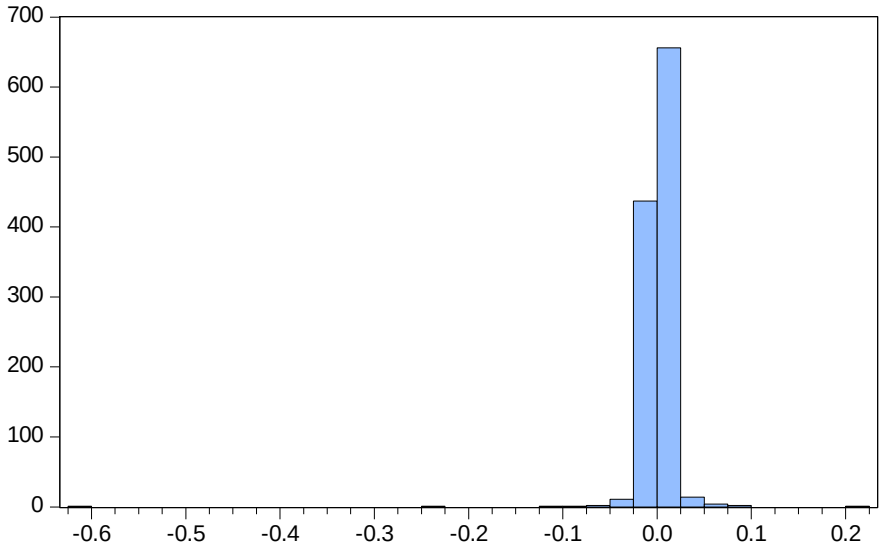
Appendix 6 Histogram statistics: Interest rate spreads

Euribor 12-1



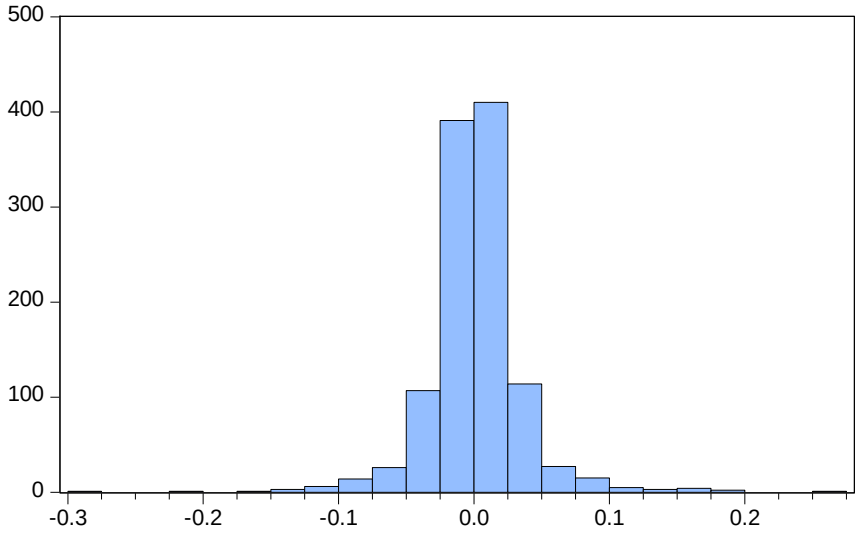
Series: SPREURIB12_1	
Sample 1/03/2007 6/02/2011	
Observations 1131	
Mean	0.000453
Median	0.000000
Maximum	0.272000
Minimum	-0.607000
Std. Dev.	0.027030
Skewness	-9.148452
Kurtosis	247.7374
Jarque-Bera	2838394.
Probability	0.000000

Euribor 3-1



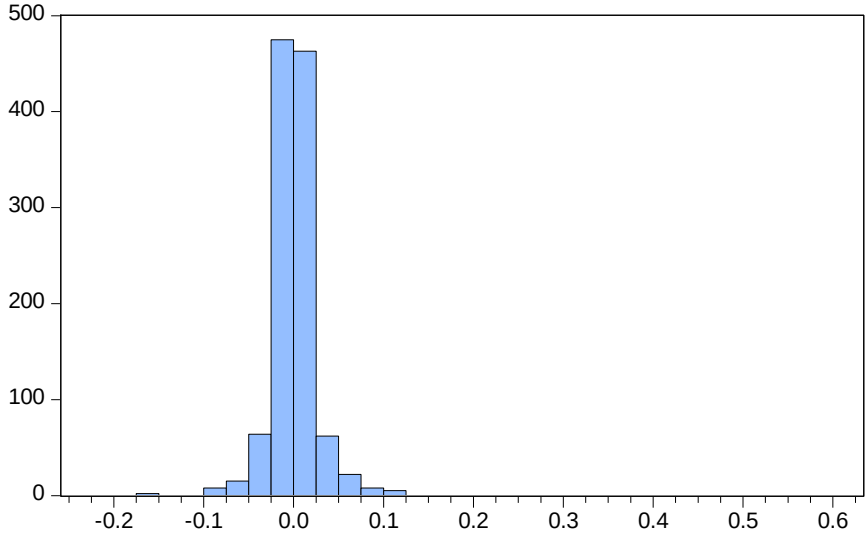
Series: SPREURIB3_1	
Sample 1/03/2007 6/02/2011	
Observations 1131	
Mean	0.000102
Median	0.000000
Maximum	0.223000
Minimum	-0.607000
Std. Dev.	0.023189
Skewness	-16.06219
Kurtosis	435.3660
Jarque-Bera	8858197.
Probability	0.000000

Euribor-Eoniaswap12m



Series: SPREURIBEONIAS12M	
Sample 1/03/2007 6/02/2011	
Observations 1131	
Mean	0.000511
Median	0.000000
Maximum	0.260000
Minimum	-0.287000
Std. Dev.	0.036018
Skewness	0.109032
Kurtosis	13.63909
Jarque-Bera	5336.327
Probability	0.000000

Euribor-Eoniswap1m

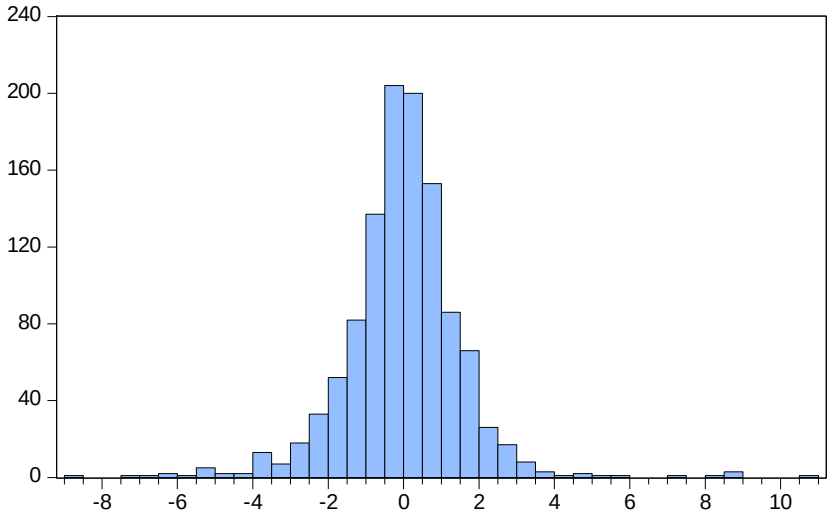


Series: SPREURIBEONIAS1M	
Sample 1/03/2007 6/02/2011	
Observations 1131	
Mean	0.000154
Median	-0.001000
Maximum	0.618000
Minimum	-0.230000
Std. Dev.	0.032399
Skewness	6.301366
Kurtosis	127.4825
Jarque-Bera	737729.0
Probability	0.000000

Source: Reuters EcoWin

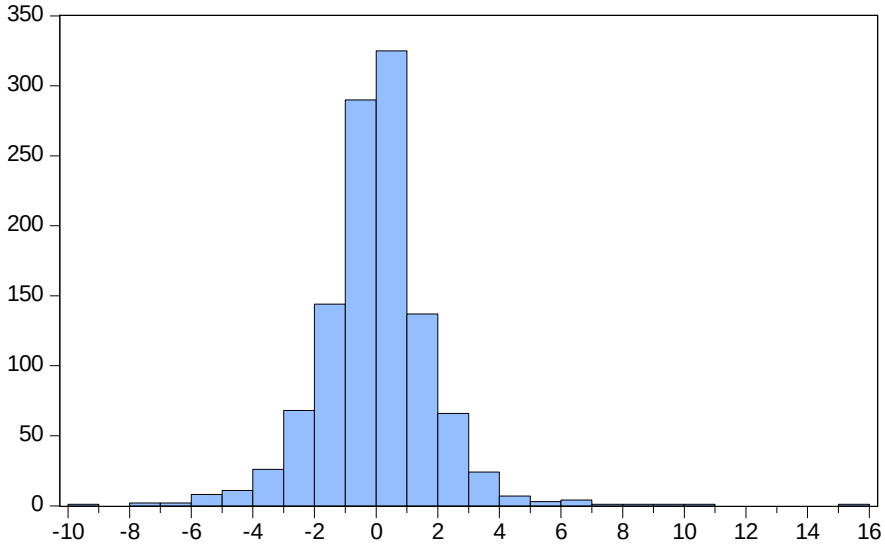
Appendix 7 Histogram statistics: Market indices

Euronext 100



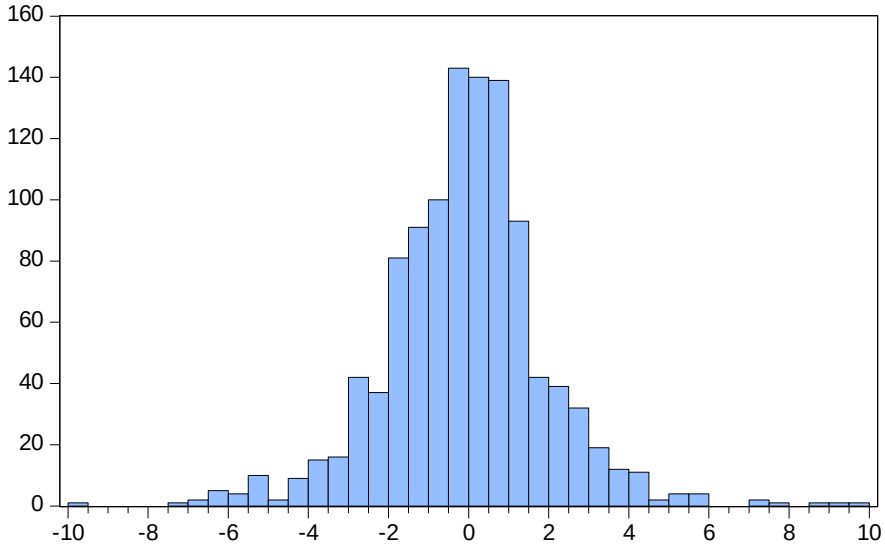
Series: EUROZONE	
Sample 1/03/2007 6/02/2011	
Observations 1131	
Mean	-0.017157
Median	0.013420
Maximum	10.87309
Minimum	-8.562202
Std. Dev.	1.592844
Skewness	0.332712
Kurtosis	10.18028
Jarque-Bera	2450.463
Probability	0.000000

Barcelona SE



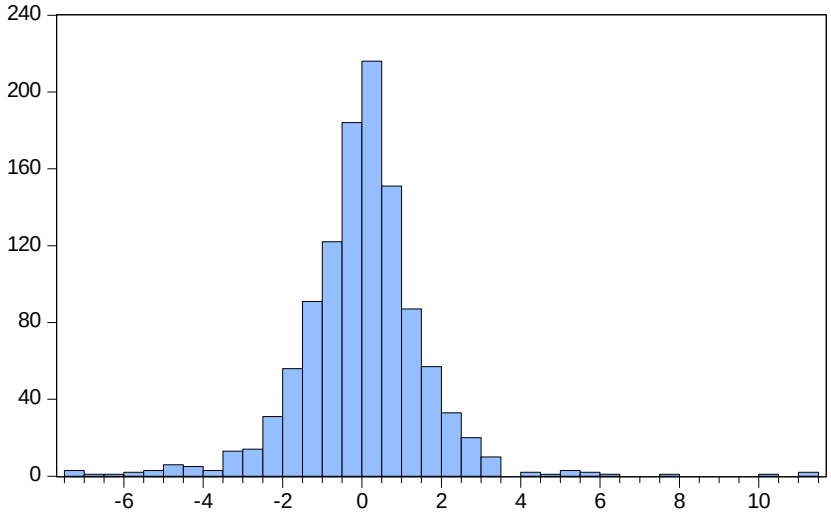
Series: SPAIN	
Sample 1/03/2007 6/02/2011	
Observations 1123	
Mean	-0.017497
Median	0.029275
Maximum	15.80062
Minimum	-9.211940
Std. Dev.	1.851613
Skewness	0.612431
Kurtosis	11.02147
Jarque-Bera	3080.967
Probability	0.000000

Athex General



Series: GREECE	
Sample 1/03/2007 6/02/2011	
Observations 1102	
Mean	-0.093430
Median	-0.019959
Maximum	9.542664
Minimum	-9.709722
Std. Dev.	2.005157
Skewness	0.045365
Kurtosis	5.474179
Jarque-Bera	281.4596
Probability	0.000000

DAX 30

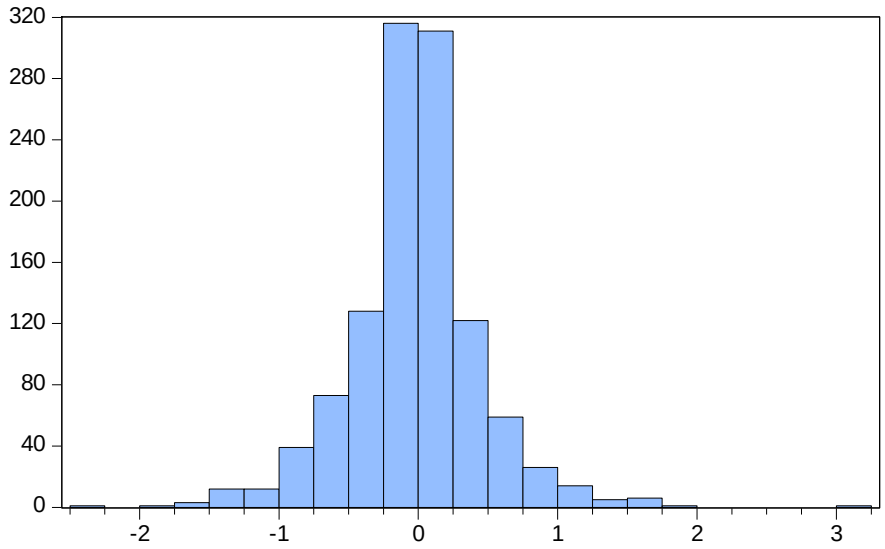


Series: GERMANY	
Sample 1/03/2007 6/02/2011	
Observations 1122	
Mean	0.003234
Median	0.062593
Maximum	11.40189
Minimum	-7.229505
Std. Dev.	1.624391
Skewness	0.444673
Kurtosis	10.82880
Jarque-Bera	2902.288
Probability	0.000000

Source: Reuters EcoWin

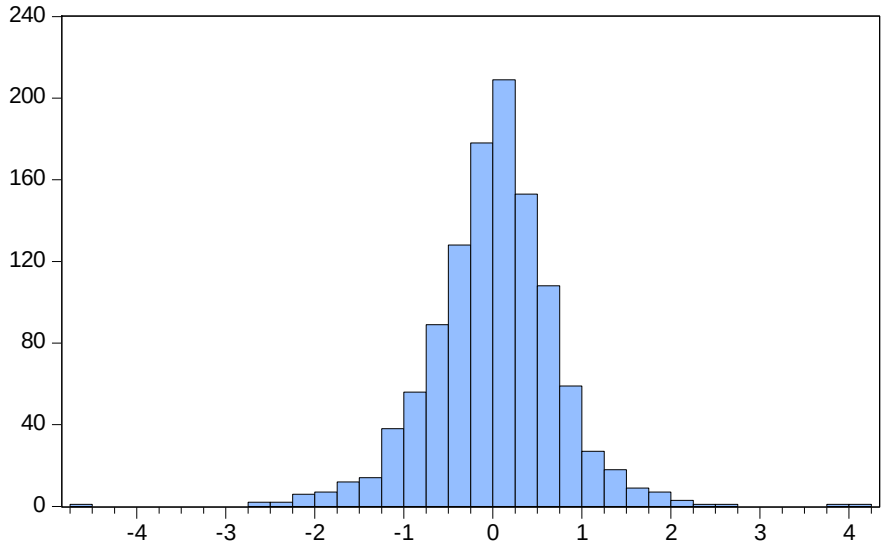
Appendix 8 Histogram statistics: Exchange rates

CHF/EUR



Series: EXCHFEUR	
Sample 1/04/2007 6/02/2011	
Observations 1130	
Mean	-0.023845
Median	-0.013504
Maximum	3.066613
Minimum	-2.424973
Std. Dev.	0.472389
Skewness	0.115111
Kurtosis	6.629515
Jarque-Bera	622.7420
Probability	0.000000

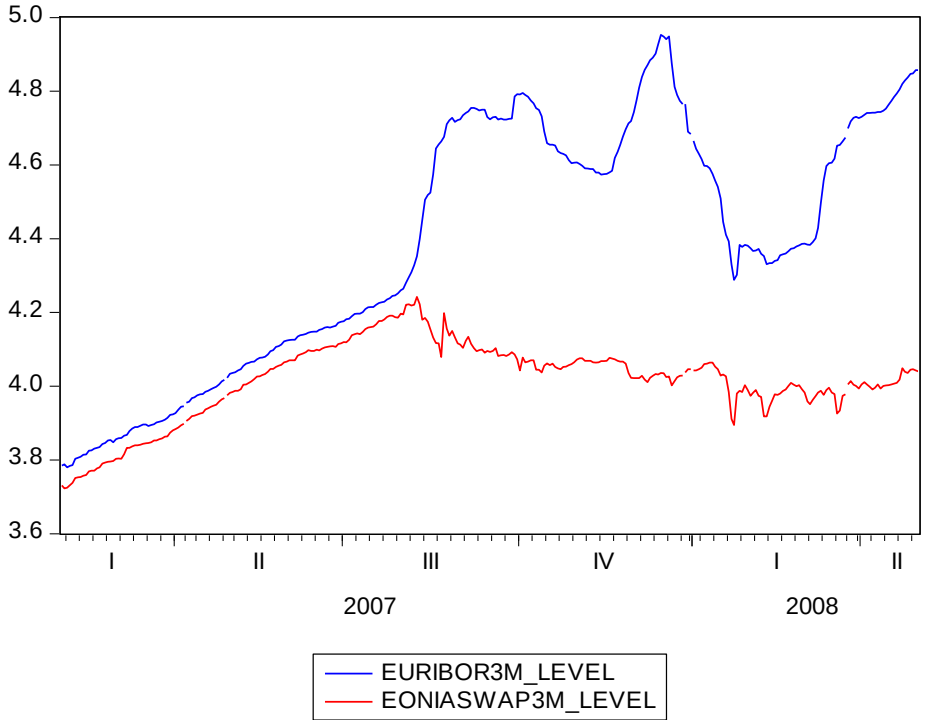
$/EUR



Series: EXDOLLAREUR	
Sample 1/04/2007 6/02/2011	
Observations 1130	
Mean	0.010445
Median	0.032219
Maximum	4.120335
Minimum	-4.625068
Std. Dev.	0.719005
Skewness	-0.098880
Kurtosis	6.782941
Jarque-Bera	675.6340
Probability	0.000000

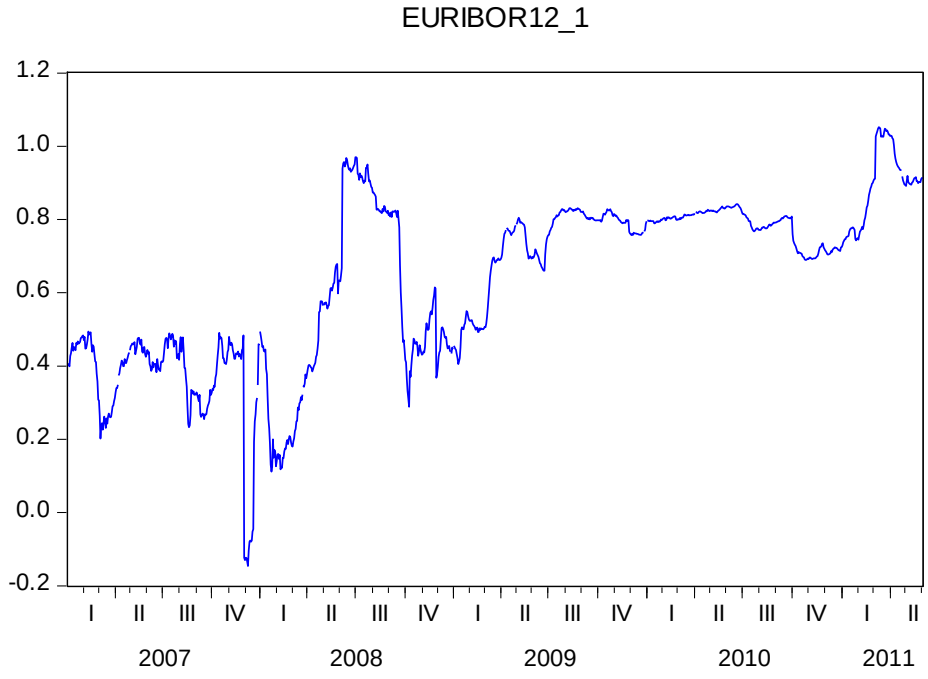
Source: Reuters EcoWin

Appendix 9 Euribor and Eoniaswap levels (percentages)



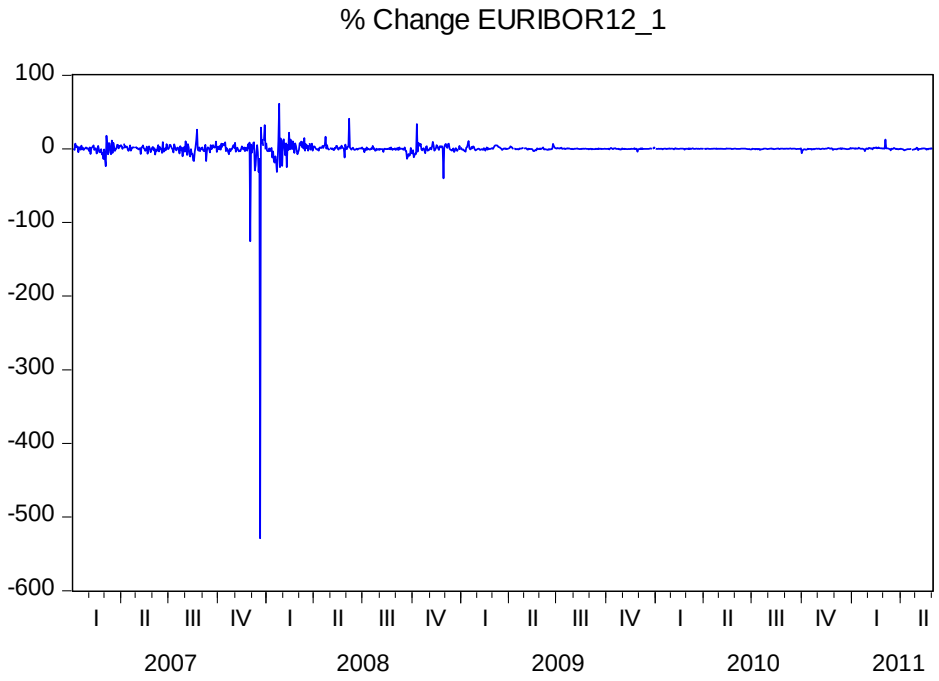
Source: Reuters EcoWin

Appendix 10 Euribor 12-1 level



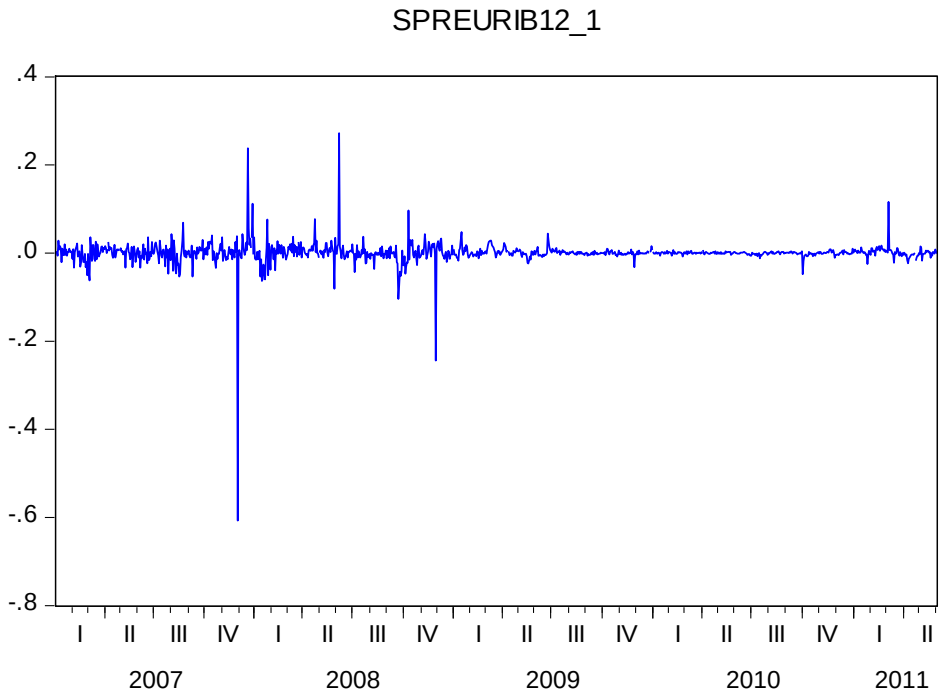
Source: Reuters EcoWin

Appendix 11 Euribor 12-1 percentage change



Source: Reuters EcoWin

Appendix 12 Euribor12-1 differenced



Source: Reuters EcoWin

Appendix 13 GARCH and LS specifications

All the estimations are conducted in EViews. The preferred optimization algorithm for GARCH is Berndt-Hall-Hall-Hausman (BHHH). As an alternative, the Marquardt algorithm may be used in some cases, where the BHHH estimation encounters an error with non-positive numbers, which cannot be taken into log as required by this algorithm. The maximum number of iterations for most of the estimations is 500, in some more complex calculations also 800 is used, in order to enable for more precise results.

GARCH estimation has a trade-off between accuracy and computational speed, where accuracy is chosen as the preferred method for current analysis. Both the innovations used in initializing MA estimation and the initial variance required for the GARCH terms are computed using backcasting methods[29]. For most of the estimations, student's t distribution is used for the error distribution, which is well suited for the time series with fat tails.

In Eviews, one can receive negative variance estimations, and this is an error. In order to deal with this problem, EGARCH model is used every time when this problem comes up. EGARCH allows the variance equation parameters to be either positive or negative and it can be used for double-checking the negative coefficients obtained by GARCH.

For the GARCH estimation, the following model is used, where the market index or exchange rate is used as a dependent variable and a constant and a dummy(s) as independent variables.

$$Y = C(1) + C(2)*X$$

Y= market index or exchange rate
C= constant
X= Dummy, where X=1 for event day(s), X=0 for non-event days

For interest rate spreads, LS estimation method with White Heteroskedasticity-Consistent Standard Errors and Covariance and degrees of freedom (DF) adjustment is used. Estimated model has interest rate spread as a dependent variable and a constant and a dummy(s) as independent variables.

[29] When computing backcast initial variances for GARCH, EViews first uses the coefficient values to compute the residuals of the mean equation, and then computes an exponential smoothing estimator of the initial values, with the smoothing parameter lambda (l) being 0.7 by default.

$$Y = C(1) + C(2)*X$$

Y= interest rate spread
C= constant
X= Dummy, where X=1 for event day(s), X=0 for non-event days

Appendix 14 FRFA dummy overview

Dummy	Date	Announcement contents
FRFA1A	10/8/2008	○ As from the operation settled on 15 October, the weekly MROs will be carried out through a fixed rate tender procedure with full allotment at the interest rate on the main refinancing operation, i.e. currently 3.75%. ○ As of 9 October, the ECB will reduce the corridor of standing facilities from 200 basis points to 100 basis points around the interest rate on the main refinancing operation.
FRFA1A2	10/8/2008 10/9/2008	{+1 } window of FRFA1A
FRFA1A3	10/7/2008 10/8/2008 10/9/2008	{-1,+1} window of FRFA1A
FRFA1B	10/15/2008	○ All LTROs will, until March 2009 be carried out through a fixed rate tender procedure with full allotment. ○ Continuation of two 3-month supplementary long-term refinancing operations (SLTRO), a 6-month SLTRO and a new 3-month SLTRO and four additional 6-month SLTROs ○ Rolling over a special term refinancing operation (STRO) ○ (Starting offering US dollar liquidity by exchange swaps)[a] ○ (Starting offering EUR/CHF foreign exchange swaps)[a] ○ (Expansion of Eurosystem collateral framework)[b]
FRFA1B2	10/15/2008 10/16/2008	{+1} window of FRFA1B
FRFA1B3	10/14/2008 10/15/2008 10/16/2008	{-1,+1} window of FRFA1B

a This announcement is included under FEL category
b This announcement is included under EOC category

Appendix 15 FRFA: Euribor 12-1 and 3-1: Summarized key announcements

FRFA	Euribor 12_1M		Euribor 3_1M	
	Coef	P-value	Coef	P-value
Key dates together	-0.25	0.85	-0.1	0.54
Key dates {+1} window	3.06	0.15	2.2	0.15
Key dates {-1,+1} window	2.15	0.19	1.6	0.12

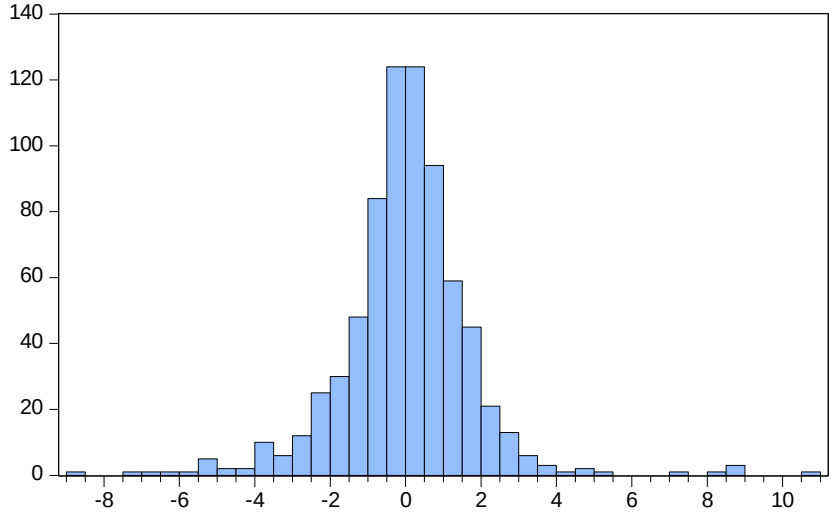
Appendix 16 FRFA: Euribor-Eoniaswap 12m and 1m: Summarized key announcements

FRFA	Euribor-Eoniaswap12m		Euribor-Eoniaswap1m	
	Coef	P-value	Coef	P-value
Key dates together	3.70	0.49	3.66	0.44
Key dates {+1} window	0.64	0.89	3.99	0.17
Key dates {-1,+1} window	-0.16	0.98	1.78	0.58

Appendix 17 FRFA: Euronext 100: Window days

	Euronext 100	
Dummy	Coef	P-value
FRFA1A2	-4.62	0.49
FRFA1A3	-2.56	0.51
FRFA1B2	-7.63	0.18
FRFA1B3	-3.7	0.19

Appendix 18 FRFA: Euronext 100: Histogram statistics: FRFA time period



Series: EUROZONE
Sample 8/01/2008 6/02/2011
Observations 728

Mean	0.003583
Median	0.028829
Maximum	10.87309
Minimum	-8.562202
Std. Dev.	1.772159
Skewness	0.388145
Kurtosis	9.584239
Jarque-Bera	1333.297
Probability	0.000000

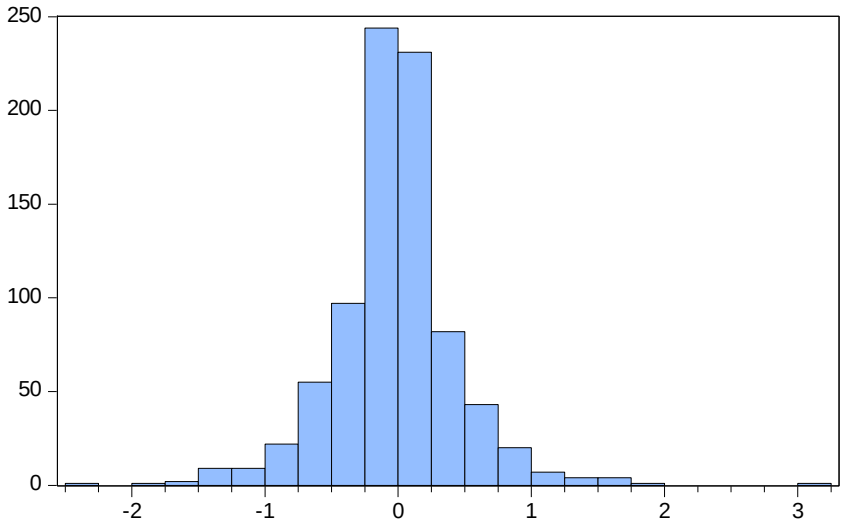
Source: Reuters EcoWin

Appendix 19 FRFA: Exchange rates: Window days

	CHF/EUR		$/EUR	
Dummy	Coef	P-value	Coef	P-value
FRFA1A2	-0.1	0.94	0.24	0.89
FRFA1A3	-0.08	0.95	0.11	0.95
FRFA1B2	-0.72	0.8	-0.93	0.99
FRFA1B3	-0.24	0.61	-0.19	0.83

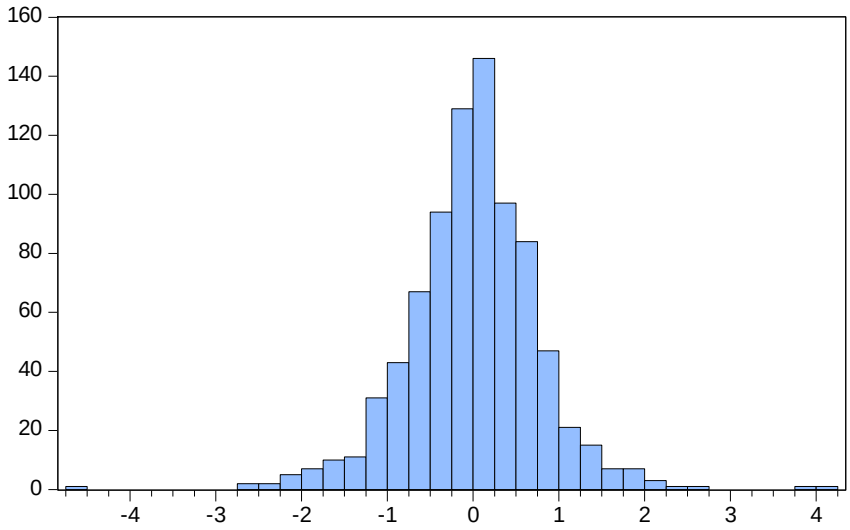
Appendix 20 Exchange rates: Histogram statistics: FRFA time period

CHF/EUR



Series: EXCHFEUR	
Sample 7/02/2007 9/30/2010	
Observations 833	
Mean	-0.025296
Median	-0.020938
Maximum	3.066613
Minimum	-2.424973
Std. Dev.	0.466233
Skewness	0.181720
Kurtosis	7.618966
Jarque-Bera	745.0815
Probability	0.000000

$/EUR



Series: EXDOLLAREUR	
Sample 7/02/2007 9/30/2010	
Observations 833	
Mean	0.004202
Median	0.020298
Maximum	4.120335
Minimum	-4.625068
Std. Dev.	0.766745
Skewness	-0.052333
Kurtosis	6.718139
Jarque-Bera	480.2075
Probability	0.000000

Source: Reuters EcoWin

Appendix 21 LTRO dummy overview

Dummy	Date	Announcement contents
LTRO1A	8/22/2007	○ Today the European Central Bank's Governing Council has decided to conduct a supplementary liquidity-providing longer-term refinancing operation (SPLTRO) with a maturity of three months (first time use of supplementary LTRO). This operation is a technical measure aimed at supporting the normalisation of the functioning of the euro money market. It is conducted in addition to the regular monthly longer-term refinancing.
LTRO1A2	8/22/2007 8/23/2007	{+1 } window of LTRO1A
LTRO1A3	8/21/2007 8/22/2007 8/23/2007	{-1,+1} window of LTRO1A
LTRO1B	3/28/2008	○ The Governing Council decided at its meeting on 27 March 2008 to conduct supplementary longer-term refinancing operations (LTROs) with a maturity of six months (first time use of 6m LTRO). ○ In addition, the Governing Council decided to conduct further supplementary LTROs with a three month maturity. These supplementary three-month and six-month LTROs are aimed at supporting the normalization of the functioning of the euro money market.
LTRO1B2	3/28/2008 3/31/2008	{+1} window of LTRO1B
LTRO1B3	3/27/2008 3/28/2008 3/31/2008	{-1,+1} window of LTRO1B
LTRO1C	5/7/2009	○ The Governing Council of the European Central Bank has today decided to conduct liquidity-providing longer-term refinancing operations (LTROs) with a maturity of one year (first time use of 1year LTRO). ○ (reducing the interest rate on MRO by 25 bps to 1%) ○ (announcement about the initiation of the covered bond purchase program (CBPP)) ○ (European Investment Bank will become an eligible counterparty in Eurosystem's monetary policy operations)
LTRO1C2	5/7/2009 5/8/2009	{+1} window of LTRO1C
LTRO1C3	5/6/2009 5/7/2009 5/8/2009	{-1,+1} window of LTRO1C

Appendix 22 LTRO: Euribor 12-1 and 3-1: Window days

	Euribor 12_1M		Euribor 3_1M	
Dummy	Coef	P-value	Coef	P-value
LTRO1A2	4.81	0.00	1.44	0.11
LTRO1A3	3.36	0.03	1.19	0.06
LTRO1B2	0.71	0.57	0.99	0.29
LTRO1B3	0.76	0.36	0.89	0.16
LTRO1C2	-0.04	0.92	0.34	0.00
LTRO1C3	0.23	0.50	0.35	0.00

Appendix 23 LTRO: Euribor-Eoniaswap 12m and 1m: Window days

	Euribor-Eoniaswap12m		Euribor-Eoniaswap1m	
Dummy	Coef	P-value	Coef	P-value
LTRO1A2	-3.35	0.74	-0.62	0.83
LTRO1A3	0.49	0.95	-0.22	0.91
LTRO1B2	0.45	0.38	-0.12	0.88
LTRO1B3	1.69	0.12	0.44	0.53
LTRO1C2	1.85	0.26	-1.67	0.16
LTRO1C3	1.16	0.35	-1.19	0.18

Appendix 24 LTRO: Euronext 100: Window days

Mean equation results

	Euronext 100	
Dummy	Coef	P-value
LTRO1A2	0.69	0.52
LTRO1A3	0.61	0.52
LTRO1B2	-0.03	0.99
LTRO1B3	0.18	0.92
LTRO1C2	0.84	0.52
LTRO1C3	1.07	0.35

Variance equation results

	Euronext 100	
Dummy	Coef	P-value
LTRO1A2	-0.91	0.10
LTRO1A3	-0.46	0.18
LTRO1B2	-0.57	0.19
LTRO1B3	-0.44	0.11
LTRO1C2	-0.25	0.83
LTRO1C3	-0.17	0.82

Appendix 25 LTRO: Stock market indices: Summarized key announcements

LTRO	Euronext 100		Barcelona SE		Athex General		Dax 30	
	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value
Key dates together	0.39	0.61	0.17	0.86	1.28	0.08	-0.60	0.28
Key dates {+1} window	0.72	0.16	0.02	0.97	0.49	0.46	0.21	0.69
Key dates {-1,+1} window	0.63	0.29	0.17	0.76	0.67	0.25	0.30	0.53

Appendix 26 LTRO: Euronext 100: Key announcement days: LS estimation

	Euronext 100	
Dummy	Coef	P-value
DLTRO1A	1.80	0.31
DLTRO1B	-0.40	0.82
DLTRO1C	-0.17	0.92

Appendix 27 LTRO: Exchange rates: Window days

	CHF/EUR		$/EUR	
Dummy	**Coef**	**P-value**	**Coef**	**P-value**
LTRO1A2	0.45	0.36	0.30	0.23
LTRO1A3	0.30	0.08	0.26	0.20
LTRO1B2	0.15	0.76	0.08	1.00
LTRO1B3	0.12	0.78	0.17	0.86
LTRO1C2	0.24	0.21	0.34	0.94
LTRO1C3	0.03	0.86	0.10	0.89

Appendix 28 FEL dummy overview

Dummy	Date	Announcement contents
FEL1A	12/12/2007	○ The Governing Council of the ECB decided to take joint action with the Federal Reserve by offering US dollar funding to Eurosystem counterparties. The Eurosystem shall conduct two US dollar liquidity-providing operations, in connection with the US dollar Term Auction Facility, against ECB-eligible collateral for a maturity of 28 and 35 days.
FEL1A2	12/12/2007 12/13/2007	{+1 } window of FEL1A
FEL1A3	12/11/2007 12/12/2007 12/13/2007	{-1,+1} window of FEL1A
FEL1B	10/15/2008	○ As from 21 October 2008, and at least until the end of January 2009, in parallel with the existing tenders in which the Eurosystem offers US dollar liquidity against ECB-eligible collateral, the Eurosystem will also offer US dollar liquidity through EUR/USD foreign exchange swaps. The EUR/USD foreign exchange swap tenders will be carried out at a fixed price (i.e. swap point) with full allotment. ○ Each Monday, starting on 20 October 2008, the Eurosystem and the Swiss National Bank (SNB) will conduct EUR/CHF foreign exchange swaps providing Swiss francs against euro with a term of 7 days at a fixed price.
FEL1B2	10/15/2008 10/16/2008	{+1 } window of FEL1B
FEL1B3	10/14/2008 10/15/2008 10/16/2008	{-1,+1} window of FEL1B
FEL1C	10/16/2008	○ The Magyar Nemzeti Bank (MNB) and the ECB have established an agreement on repurchase transactions, which will provide the MNB with a facility to borrow up to EUR 5 billion in order to provide additional support to the MNB's operations.
FEL1C2	10/16/2008 10/17/2008	{+1 } window of FEL1C
FEL1C3	10/15/2008 10/16/2008 10/17/2008	{-1,+1} window of FEL1C
FEL1D	10/27/2008	○ Danmarks Nationalbank is today announcing measures to improve liquidity in euro short-term markets. In support of these measures the ECB and Danmarks Nationalbank have today established a reciprocal currency arrangement (swap line) amounting to EUR 12 billion, which will remain in place as long as needed.
FEL1D2	10/27/2008 10/28/2008	{+1 } window of FEL1D
FEL1D3	10/24/2008 10/27/2008 10/28/2008	{-1,+1} window of FEL1D

Dummy	Date	Announcement contents
FEL1E	4/6/2009	○ The Bank of England, the European Central Bank (ECB), the Federal Reserve, the Bank of Japan, and the Swiss National Bank are announcing swap arrangements that would enable the provision of foreign currency liquidity by the Federal Reserve to US financial institutions. Should the need arise, euro, yen, sterling and Swiss francs would be provided to the Federal Reserve via these additional swap agreements with the relevant central banks. ○ The Governing Council of the ECB has decided to establish a temporary reciprocal currency arrangement (swap line) with the Federal Reserve. This agreement will provide the Federal Reserve with the capacity to offer liquidity of up to EUR 80 billion.
FEL1E2	4/6/2009 4/7/2009	{+1 } window of FEL1E
FEL1E3	4/3/2009 4/6/2009 4/7/2009	{-1,+1} window of FEL1E
FEL1F	6/10/2009	○ The European Central Bank (ECB) and Sveriges Riksbank have today decided to activate their temporary reciprocal currency agreement (swap line) whereby the Swedish central bank can borrow euro from the ECB in exchange for Swedish kronor. ○ The ECB and Sveriges Riksbank signed a swap agreement on 20 December 2007 with the aim of facilitating the functioning of financial markets and providing euro liquidity to the latter if needed. The maximum amount that can be borrowed by Sveriges Riksbank is EUR 10 billion, for a maturity of up to three months.
FEL1F2	6/10/2009 6/11/2009	{+1 } window of FEL1F
FEL1F3	6/09/2009 6/10/2009 6/11/2009	{-1,+1} window of FEL1F
FEL1G	12/17/2010	○ Within the framework of central bank cooperation, the European Central Bank (ECB) and the Bank of England are today announcing a temporary liquidity swap facility, under which the Bank of England could provide, if necessary, up to GBP 10 billion to the ECB in exchange for euro. The agreement expires at the end of September 2011.
FEL1G2	12/17/2010 12/18/2010	{+1 } window of FEL1G
FEL1G3	12/16/2010 12/17/2010 12/18/2010	{-1,+1} window of FEL1G

Appendix 29 FEL: Euribor 12-1 and 3-1: Window days

	Euribor 12_1M		Euribor 3_1M	
Dummy	Coef	P-value	Coef	P-value
FEL1A2	-0.03	0.92	0.31	0.00
FEL1B2	2.25	0.00	0.38	0.55
FEL1C2	0.15	0.76	0.48	0.45
FEL1D2	1.42	0.00	1.01	0.20
FEL1E2	1.62	0.00	0.76	0.00
FEL1F2	-0.53	0.00	-0.49	0.00
FEL1G2	0.17	0.07	0.11	0.16
FEL1A3	0.09	0.70	0.11	0.56
FEL1B3	2.35	0.01	0.33	0.68
FEL1C3	-0.18	0.77	0.10	0.87
FEL1D3	0.03	0.98	0.51	0.45
FEL1E3	1.83	0.00	0.71	0.00
FEL1F3	-0.58	0.00	-0.46	0.00
FEL1G3	0.16	0.10	0.01	0.91

Appendix 30 FEL: Euribor-Eoniaswap 12m and 1m: Window days

	Euribor-Eoniaswap12m		Euribor-Eoniaswap1m	
Dummy	Coef	P-value	Coef	P-value
FEL1A2	-1.39	0.07	0.90	0.04
FEL1B2	0.02	0.99	1.87	0.02
FEL1C2	-0.33	0.91	-2.14	0.01
FEL1D2	-12.33	0.12	-7.70	0.11
FEL1E2	3.87	0.20	0.66	0.41
FEL1F2	9.40	0.21	3.87	0.34
FEL1G2	-3.44	0.01	-3.70	0.00
FEL1A3	3.78	0.53	2.47	0.63
FEL1B3	1.01	0.57	-1.10	0.34
FEL1C3	-3.85	0.36	-3.03	0.09
FEL1D3	1.61	0.00	4.35	0.00
FEL1E3	1.75	0.00	2.51	0.14
FEL1F3	0.06	0.60	0.10	0.38
FEL1G3	-0.22	0.38	-0.16	0.50

Appendix 31 FEL: Euronext 100: Window days

	Euronext 100	
Dummy	**Coef**	**P-value**
DFEL1A2	-1.15	0.02
DFEL1A3	-0.88	0.07
DFEL1B2	-6.04	0.74
DFEL1B3	-3.61	0.26
DFEL1C2	-0.98	0.76
DFEL1C3	-3.11	0.26
DFEL1D2	-1.46	0.74
DFEL1D3	-2.23	0.55
DFEL1E2	-0.70	0.98
DFEL1E3	-0.79	0.94
DFEL1F2	0.50	0.97
DFEL1F3	0.40	0.95
DFEL1G2	-0.42	0.99
DFEL1G3	-0.40	0.52

Appendix 32 FEL: Stock market indices: Summarized key announcements

FEL	**Euronext 100**		**Barcelona SE**		**Athex General**		**Dax 30**	
	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value
Key dates together	-0.26	0.73	-0.40	0.67	0.44	0.70	-0.15	0.80
Key dates {+1} window	-0.57	0.22	-0.56	0.32	-0.15	0.84	-0.23	0.61
Key dates {-1,+1} window	-0.39	0.38	-0.20	0.69	-0.22	0.73	-0.21	0.59

Appendix 33 FEL: Euronext 100: Key announcement days: LS estimation

	Euronext 100	
Dummy	Coef	P-value
DFEL1A	0.24	0.89
DFEL1B	-6.63	0.00
DFEL1C	-5.38	0.00
DFEL1D	-3.94	0.02
DFEL1E	-0.57	0.73
DFEL1F	0.65	0.70
DFEL1G	-0.42	0.99

Appendix 34 FEL: Stock market indices: Summarized key announcements: LS estimation

FEL	Euronext 100		Barcelona SE		Athex General		Dax 30	
	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value
Key dates together	-2.30	0.00	-1.76	0.02	-0.63	0.43	-1.43	0.03
Key dates {+1} window	-1.12	0.02	-0.95	0.09	-1.07	0.09	0.29	0.55
Key dates {-1,+1} window	-0.88	0.03	-0.73	0.11	-1.20	0.02	0.06	0.89

Appendix 35 FEL: Exchange rates: Window days

	CHF/EUR		$/EUR	
Dummy	Coef	P-value	Coef	P-value
DFEL1A2	0.15	0.42	0.01	1.00
DFEL1A3	0.28	0.05	-0.12	0.88
DFEL1B2	-0.73	0.83	-0.95	0.97
DFEL1B3	-0.24	0.64	-0.21	0.80
DFEL1C2	-0.69	0.75	-0.80	0.96
DFEL1C3	-0.66	0.73	-0.96	0.93
DFEL1D2	-0.07	0.91	-0.42	0.72
DFEL1D3	-0.95	0.02	-0.95	0.26
DFEL1E2	-0.32	0.35	-0.88	0.06
DFEL1E3	-0.26	0.36	-0.45	0.30
DFEL1F2	-0.10	0.78	-0.27	0.42
DFEL1F3	-0.08	0.80	0.09	0.76
DFEL1G2	-0.86	0.97	0.13	1.00
DFEL1G3	-0.27	0.57	-0.37	0.44

Appendix 36 EOC dummy overview

Dummy	Date	Announcement contents
EOC1A	2/22/2007	○ Governing Council decided to treat covered bonds issued from 1 January 2008 in the same way as all other marketable assets within the Eurosystem credit assessment framework by subjecting them to the same rating requirements. Accordingly, these covered bank bonds are deemed to fulfil the Eurosystem credit standards if they comply strictly with the criteria set out in Article 22(4) of the UCITS Directive.
EOC1A2	2/22/2007 2/23/2007	{+1 } window of EOC1A
EOC1A3	2/21/2007 2/22/2007 2/23/2007	{-1,+1} window of EOC1A
EOC1B	10/15/2008	○ The Eurosystem will add the following instruments to the list of assets eligible as collateral in its credit operations: ○ Marketable debt instruments denominated in other currencies than the euro, namely the US dollar, the British pound and the Japanese yen, and issued in the euro area. These instruments will be subject to a uniform haircut add-on of 8%. ○ Euro-denominated syndicated credit claims governed by UK law. ○ Debt instruments issued by credit institutions, which are traded on the accepted non-regulated markets that are mentioned on the ECB website; this measure implies inter alia that certificates of deposits (CDs) will also be eligible when traded on one of these accepted non-regulated markets. All debt instruments issued by credit institutions, which are traded on the accepted non-regulated markets, will be subject to a 5% haircut add-on. ○ Subordinated debt instruments when they are protected by an acceptable guarantee as specified in section 6.3.2 of the General Documentation on Eurosystem monetary policy instruments and procedures. These instruments will be subject to a haircut add-on of 10%, with a further 5% valuation markdown in case of theoretical valuation. ○ Furthermore, the Eurosystem will lower the credit threshold for marketable and non-marketable assets from A- to BBB-, with the exception of asset-backed securities (ABS), and impose a haircut add-on of 5% on all assets rated BBB-. ○ (All LTROs will, until March 2009 be carried out through a fixed rate tender procedure with full allotment.) ○ (Continuation of two 3-month supplementary long-term refinancing operations (SLTRO), a 6-month SLTRO and a new 3-month SLTRO and four additional 6-month SLTRO)) ○ (Rolling over a special term refinancing operation (STRO)) ○ (starting offering US dollar liquidity by exchange swaps) ○ (starting offering EUR/CHF foreign exchange swaps)
EOC1B2	10/15/2008 10/16/2008	{+1 } window of EOC1B
EOC1B3	10/14/2008 10/15/2008 10/16/2008	{-1,+1} window of EOC1B

Dummy	Date	Announcement contents
EOC1C	11/17/2008	○ As of 17 November 2008, the Eurosystem will accept as collateral in its credit operations euro-denominated syndicated credit claims, governed by the law of England and Wales (English law).
EOC1C2	11/17/2008 11/18/2008	{+1 } window of EOC1C
EOC1C3	11/14/2008 11/17/2008 11/18/2008	{-1,+1} window of EOC1C
EOC1D	12/19/2008	○ The Governing Council of the European Central Bank (ECB) has updated the list of securities settlement systems (SSSs) eligible for the settlement of collateral for Eurosystem credit operations. ○ Two additional systems have been assessed against the "Standards for the use of EU securities settlement systems in ESCB credit operations" [1]. First, VP Lux S.à r.l., incorporated in Luxembourg and a subsidiary of the Danish central securities depository (CSD) Værdipapircentralen A/S (VP), was assessed and found to be compliant with the Eurosystem user standards. ○ Second, in the context of Slovakia's entry to the euro area as of 1 January 2009, the SSS operated by the CSD of the Slovak Republic, Centrálny depozitár cenných papierov SR a. s. (CDCP), was also assessed and considered to be compliant with the Eurosystem user standards. CDCP may be used by counterparties of the Eurosystem for the collateralisation of credit operations as of 1 January 2009. ○ Moreover, in March 2008 the National Treasury Management Agency, an eligible SSS in Ireland, closed its system for the settlement of Irish Government exchequer notes. As a result the system has been removed from the list of eligible SSSs.
EOC1D2	12/19/2008 12/22/2008	{+1 } window of EOC1D
EOC1D3	12/18/2008 12/19/2008 12/22/2008	{-1,+1} window of EOC1D
EOC1E	5/3/2010	○ The Governing Council of the European Central Bank (ECB) has decided to suspend the application of the minimum credit rating threshold in the collateral eligibility requirements for the purposes of the Eurosystem's credit operations in the case of marketable debt instruments issued or guaranteed by the Greek government. This suspension will be maintained until further notice. The suspension applies to all outstanding and new marketable debt instruments issued or guaranteed by the Greek government.
EOC1E2	5/3/2010 5/4/2010	{+1 } window of EOC1E
EOC1E3	4/30/2010 5/3/2010 5/4/2010	{-1,+1} window of EOC1E
EOC1F	3/31/2011	○ The Governing Council of the European Central Bank (ECB) has decided to suspend the application of the minimum credit rating threshold in the collateral eligibility requirements for the purposes of the Eurosystem's credit operations in the case of marketable debt instruments issued or guaranteed by the Irish government. The suspension applies to all outstanding and new marketable debt instruments. It will be maintained until further notice.
EOC1F2	3/31/2011 4/01/2011	{+1 } window of EOC1F
EOC1F3	3/30/2011 3/31/2011 4/01/2011	{-1,+1} window of EOC1F

Appendix 37 EOC: Euribor 12-1 and 3-1: Window days

	Euribor 12_1M		Euribor 3_1M	
Dummy	Coef	P-value	Coef	P-value
EOC1A2	-1.14	0.08	-1.11	0.00
EOC1A3	-1.45	0.00	-1.01	0.00
EOC1B2	2.31	0.00	0.59	0.41
EOC1B3	2.54	0.00	0.68	0.16
EOC1C2	1.06	0.04	1.79	0.00
EOC1C3	1.55	0.00	1.83	0.00
EOC1D2	0.31	0.02	-0.11	0.71
EOC1D3	-0.21	0.63	-0.04	0.85
EOC1E2	0.01	0.97	0.09	0.21
EOC1E3	-0.08	0.54	0.13	0.10
EOC1F2	-0.19	0.32	-0.31	0.17
EOC1F3	-0.15	0.34	-0.21	0.25

Appendix 38 EOC: Euribor-Eoniaswap 12m and 1m: Window days

	Euribor-Eoniaswap12m		Euribor-Eoniaswap1m	
Dummy	Coef	P-value	Coef	P-value
EOC1A2	0.13	0.70	-0.05	0.71
EOC1A3	-0.06	0.82	-0.05	0.67
EOC1B2	1.63	0.68	-1.80	0.05
EOC1B3	-6.71	0.28	-5.40	0.06
EOC1C2	3.98	0.00	1.50	0.42
EOC1C3	1.44	0.50	-0.19	0.92
EOC1D2	-0.52	0.42	-2.95	0.00
EOC1D3	-1.03	0.09	-2.05	0.01
EOC1E2	-0.17	0.88	0.35	0.00
EOC1E3	-0.10	0.90	0.25	0.04
EOC1F2	-0.12	0.94	1.35	0.00
EOC1F3	0.07	0.95	0.51	0.46

Appendix 39 EOC: Stock market indices: Summarized key announcements

EOC	**Euronext 100**		**Barcelona SE**		**Athex General**		**Dax 30**	
	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value
Key dates together	-0.52	0.66	-1.05	0.36	-0.83	0.38	-0.33	0.80
Key dates {+1} window	-0.27	0.64	-0.63	0.30	-0.80	0.21	-0.15	0.81
Key dates {-1,+1} window	-0.10	0.85	-0.45	0.40	-0.72	0.22	-0.03	0.94

Appendix 40 EOC: Euronext 100: Key announcement days: LS estimation

	Euronext 100	
Dummy	Coef	P-value
EOC1A	0.25	0.877
EOC1B	-6.64	0
EOC1C	-2.65	0.0961
EOC1D	-0.31	0.8438
EOC1E	0.36	0.8202
EOC1F	-0.83	0.6044

Appendix 41 EOC: Stock market indices: Summarized key announcements: LS estimation

EOC	Euronext 100		Barcelona SE		Athex General		Dax 30	
	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value
Key dates together	-1.64	0.01	-1.82	0.02	-2.06	0.01	-1.76	0.01
Key dates {+1} window	-1.48	0.00	-1.73	0.00	-2.10	0.00	-1.43	0.00
Key dates {-1,+1} window	-0.81	0.03	-0.94	0.03	-1.21	0.01	-0.63	0.10

Appendix 42 EOC: Exchange rates: Window days

	CHF/EUR		$/EUR	
Dummy	Coef	P-value	Coef	P-value
EOC1A2	0.00	1.00	0.00	0.97
EOC1A3	0.03	0.92	-0.03	0.91
EOC1B2	-0.73	0.83	-0.91	0.98
EOC1B3	-0.23	0.66	-0.24	0.77
EOC1C2	0.19	0.90	-0.17	0.99
EOC1C3	0.41	0.31	0.32	0.76
EOC1D2	0.02	0.98	-2.18	0.00
EOC1D3	-0.62	0.07	-0.08	0.86
EOC1E2	-0.06	0.99	-0.82	0.65
EOC1E3	-0.05	0.99	-0.27	0.63
EOC1F2	0.27	0.76	0.25	0.58
EOC1F3	0.28	0.73	0.18	0.69