ERASMUS UNIVERSITEIT ROTTERDAM
ERASMUS SCHOOL OF ECONOMICS

IS THE ECB UNCONVENTIONAL MONETARY POLICY EFFECTIVE?

An event–study on ECB unconventional monetary policy announcements

Abstract

After the financial crisis in 2008, many central banks began to use unconventional monetary policy in order to boost the effective transmission of monetary policy and to provide additional direct monetary stimulus to the economy. This study will make use of an event study to analyse the impact of those unconventional monetary policies implemented by the European Central Bank on nominal and real long-term interest rates. The long-term interest rates being considered are the 10-year government bond yield, the 5 and 10-year corporate bond yield (AAA and BBB) and the 5y5y swap forward rate for the Eurozone. The results show that unconventional monetary policy conducted by the ECB had a significant effect on real and nominal and long-term interest rates.

Keywords: Inflation expectations, Unconventional monetary policy, European Central Bank, Long-term interest rates, Event study

JEL Classification: G14, E42, E44

MSc Economics & Business
Master Specialisation: Financial Economics
Thesis supervisor: Dr. Jan Lemmen

Ines Leite Pereira
413310

Rotterdam, 28th of July 2016

Contents

List of tables

List of figures

1. Introduction

The global financial crisis of 2008 and the subsequent recession have motivated fundamental changes in the design and implementation of monetary policy. Many central banks reduced policy rates to near zero (or even negative) in 2009 and adopted less conventional policies in order to provide additional monetary stimulus. Central banks of major advanced economies started using unconventional monetary policies, mainly being purchases of longer-maturity assets. Price stability is a key objective of any central bank (Gospodinov & Wei, 2015). In order to achieve that, the majority of countries around the world use the short-term interest rate as the primary monetary policy instrument. By adjusting the interest rates, central banks can regulate the money supply. If monetary policy-makers want to decrease the amount of money in an economy, they will increase the interest rate, making it more attractive to deposit funds at the central bank and reducing borrowing from the central bank. Instead, if monetary policy-makers want to increase the money supply, they will decrease the interest rates. Therefore, the interest rate channel plays a very important role in the transmission of monetary policy.

Nominal interest rates denote payment received by an investor relative to either the asset's principal (face) amount or its market price, whereas real interest rates refer to interest rates after adjusting for inflation or expected inflation. Accounting for inflation allows one to know what one is really getting. For instance, if prices rise by 2% and the nominal interest rate is 2% one can say that in real terms the interest rate being paid is 0%.

As a standard practice, central banks cut nominal interest rates when the economy is struggling. They do that to discourage savings and encourage borrowing. Such a measure should increase the amount of money being spent and hopefully boost inflation and, consequently, increase economic growth.

The collapse of Lehman Brothers on 15 September 2008 led to severe instability of financial markets. Central banks became more apprehensive about the risk of their economies getting caught in a situation of low inflation, low economic growth and interest rates at the zero lower bound, as happened in Japan after the collapse of the financial bubble in the early 1990's. Hence, central banks across the world made large and rapid cuts to their interest rates.

It is fairly common to observe negative real interest rates due to high levels of inflation. In the case of nominal interest rates, negative values have not been so usual. However, during exceptional timeframes we have seen that negative nominal interest rates are possible.

Since 1980, global real interest rates have strongly declined. Two examples of countries exhibiting very low interest rates are Japan during the 90's and the United States after the financial crisis in 2008. Even though interest rates were very low after the financial crisis (2008), no one would expect that they would ever become negative. However, in July 2009 Sweden's Riksbank lowered its deposit rate to -0.25%, which means that banks had to pay 0.25% interest on money they deposited at the central bank. By doing so, it was the first central bank in the world to implement a negative nominal interest rate. The main goal was to force banks to increase lending to businesses during the financial crisis of 2008. There was no precedent in economic history for negative nominal interest rates. They fell close to zero in 1932 during the Great Depression in the United States but they never turned negative (Hannoun, 2015).

What does it mean for investors to have negative interest rates? In nominal terms, if I hold one euro, I will still have one euro tomorrow, next week, or next year. On the other hand, if I invest money at an interest rate of -2%, one euro today would be worth ninety-eight cents a year from now (Keister, 2011). No one is willing to hold an investment with a negative return when there is the option of holding currency (with no return). Nevertheless, it is important to be aware that holding currency is not costless. Safeguarding and transacting large quantities of currency is expensive. One could think about the risks and difficulties of making all transactions with cash. For instance, paying rent or management of large quantities of money by the government. Many individuals are willing to keep money in bank accounts even if they have to pay a negative interest rate (Keister, 2011).

According to Keynes, once nominal interest rates reach zero, monetary policy can do no more (zero lower bound). Thus, in the case of reaching the zero lower bound only fiscal policy could work since interest rates cannot go below zero. That is the idea behind the designation of the "zero lower bound" defined by Keynes. Nowadays, interest rates are not the only policy tools that can be used. Some other monetary or non-monetary policy tools that are being used are quantitative easing (QE), exchange rate depreciation and expansionary fiscal policy. According to Meier (2009), unconventional monetary policies can be used as complement and/or as an extension of standard operations centered around the setting of short-term interest rates. Meier (2009) mentioned in his paper that some authors found that the impact of monetary policy on the real economy is fully described by the current policy rate and the expected path of future policy rates. Therefore, at a lower bound only if unconventional measures change the public's expectations about the future path of policy there is a channel to influence the economic activity. Expectations of future policy rates can have immediate effects above and beyond the current rate, through their impact on long term yields. With short-term interest rates at the lower bound, the communication channel gains even greater importance. However, the announcement must be credible to affect expectations.

Since unconventional monetary policies were implemented after the financial crisis of 2008, there has been a special concern in understanding what kind of impact can they bring to the economy. Hence, I decided to conduct a research to measure the effectiveness of the European Central Bank (ECB) unconventional monetary policies.

Some research on the power of central banks' statements has already been conducted. Bernanke, Reinhart and Sack (2004) studied the particular case of Federal Reserve's (Fed) statements by using an event study analysis. They found indeed that Fed statements have had a significant impact on market expectations of future policy rates, above and beyond the effect of current interest rate changes. They also analysed the case of Japan. However, in this case the results were mixed. On the one hand, they did not find any significant evidence of the impact of the Bank of Japan's announcements on one-year expectations. On the other hand, they found an effect on the shape of the yield curve.

After the financial crisis of 2008, the ECB established some extra conventional and unconventional monetary policies in effect in order to boost the economy in the euro area. They began by announcing two liquidity providing longer-term refinancing operations (LTROs) with a three-year maturity on the 21st December 2012 and on the 29th February 2012. Additionally, they conducted a series of targeted longer-term refinancing operations (TLTROs) in order to improve bank lending to the non-financial private sector. The first TLTRO was announced on the 16th September 2014 and the last one on the 3rd May 2016. These two extra longer-term refinancing operations were not enough and the ECB decided to go further by introducing, on the 2nd July 2009, the covered bond purchase programme (CBPP). Within CBPP the ECB started buying covered bonds in order to support a specific financial market segment that had become a key source of funding for European banks and that was particularly affected by the financial crisis. Not too long after that, on the 2nd July 2009 the ECB launched the securities market programme. It consisted out of the ECB buying particular assets (government bonds from "troubled" countries) in order to repair the monetary transmission channel in the euro area.

On the 26th of July 2012, Mario Draghi stated that the ECB would do whatever it takes to save the euro[1]. Following that statement, on the 22nd January 2015, Draghi presented a new asset purchase programme. It comprises the third covered bond purchase programme (CBPP3), together with an asset-backed securities purchase programme (ABSPP) and a public sector purchase programme (PSPP). The PSPP is a brand new programme. The ECB started buying assets from the public sector whereas up to that point they had only been buying private sector assets. The goal is to address the risks of a too long period of low inflation. Later on, the ECB added a Corporate Sector Purchase Programme (CSPP) to the expanded asset purchase programme. The latter started on the 8th June 2016

[1] https://www.ecb.europa.eu/press/key/date/2012/html/sp120726.en.html

and aims to purchase investment-grade euro-denominated bonds issued by non-bank corporations established in the euro area.

Together with the programmes mentioned before, the ECB started to lower the interest rates. On the 5th of June 2014 they announced for the first time that they would set a negative deposit facility rate (-0.10%). Two years after the deposit facility rate is even lower (-0.4%). When the ECB decided to cut interest rates below zero, it did so in order to boost confidence, reinforce lending and most importantly to raise growth (Randow, 2012). The ECB wants to make sure that there is no fall in prices (deflation) as that would make the recovery of the economy even more difficult. Still, it is not guaranteed that negative interest rates will have the results that they were meant to have.

The main purpose of this master thesis is to measure the effects of the ECB's unconventional monetary policy mentioned above on nominal and real long-term interest rates. In order to extend the research that has been done on the effectiveness of unconventional monetary policy, I consider negative deposit facility announcements as unconventional monetary policy. In particular, I am interested in testing the effect of the negative deposit facility rate announcements. In this study, the long-term nominal interest rates considered are 10-year government bond yield, 10 and 5 years AAA and BBB corporate bond yields. To assess the impact on real rates, I use the 5y5y swap forward rate as a measure of inflation expectations. Swap forward rates and corporate bond yields allow us to determine the extent to which ECB announcements on asset purchases affect yields on assets that have not been purchased by the ECB. If the impact on these yields is significant, then ECB policies are having spillover effects to other markets.

As mentioned before, the unconventional monetary policy followed by the ECB is not only comprised of negative nominal interest rates but also large-scale asset purchases. Those measures were expected to be temporary, but instead in almost every advanced economy, the interest rates remain at lower bounds and the expectations that they will rise are very low. According to Hannoun (2012), more than four years after the credit crisis started in mid-2007, there is no sign that monetary policy is changing: interest rates remain extremely low (or in some cases negative) and balance sheets continue to expand. Thus, there is a risk that the unconventional policy may become the new standard and that might have adverse side effects. Hannoun (2012) mentions two side effects: the first one is that balance sheet adjustments in the economy are being delayed. Central banks can supply liquidity but cannot solve underlying solvency problems. So, they can buy time and fix that in the short run conditions are stabilized but in the long run this is unsure. Likewise, low interest rates delay the acknowledgment of losses. Low yields decrease the interest paid on government debt, which might make governments more willing to spend. Therefore, prolonged zero interest rate policy and balance sheet policies might delay the necessary adjustment. The second side effect is the risk of creating incentives for leveraging-

up and excessive financial risk-taking. Over time, this can lead to greater leverage and financial fragility (Hannoun, 2012).

Seven years after the financial crisis the recovery of the economies in the euro area remains weak. Hannoun (2015) warns for the risk of having another financial crisis in the case of prolonged ultra-low or negative rates. In Meier's opinion (2009), even though there are benefits from unconventional measures in providing monetary stimulus, there are also risks associated with such policies. The effects of unconventional monetary policy are controversial mainly due to the uncertainty about the variable lags of monetary transmission.

Unconventional measures are very challenging for policy makers. First, they need to determine the correct size of the monetary stimulus. Making a mistake at this point could reverse the impact wanted. Secondly, the impact on inflation expectations is not certain. Thirdly, they need to know when to stop with unconventional measures. A late exit could lead the economy from inflation undershooting directly into overshooting. An early exit can also be reversed. Two examples of an early exit are the Fed in 1937 and the Bank of Japan in 2000. Both decisions were reversed when the policy makers understood that the recovery of the economy was still not sustainable (Meier, 2009).

The remainder of the master thesis is organized as follows. Section 2 presents some theoretical background on important concepts mentioned through out the research. Section 3 reviews literature on this topic. Section 4 summarizes all the data. In section 5 the event study methodology will be discussed. Section 6 presents the results of the research. Section 7 concludes.

2. Theoretical Background

2.1 The Fisher equation

"The bridge or link between income and capital is the rate of interest." (Fisher, 1930)

The rate of interest is sometimes referred to as the price of money. This idea comes from Fisher's definition of interest rate. He defined the interest rate as the percentage of premium paid on money at one date in terms of money one year later.

Fisher was the first to formalize the theory of the relationship between inflation and interest rates started by Thornton in 1802. In 'The Theory of Interest" (Fisher, 1930), this relationship is tested. Fisher starts chapter II, "*Money interest and real interest*" by saying that the influence of changes in the purchasing power of money on interest rates will be different according to whether or not those changes are foreseen. Hence, Fisher decided to assume 'perfect foresight', which means that changes in prices are foreseen. For example, if the prices are going up constantly, the interest rate is going to be continuously high but not increasingly, because people can foresee changes in prices. Under perfect foresight, the price of one basket of goods, which costs one dollar at the beginning of the year is not fixed and will rise precisely at the rate of the expected inflation π^e and will cost $(1 + \pi^e)$ at the end of the year (Fisher, 1930).

The second chapter also includes some limitations of theory. According to Fisher (1930), the rate of interest cannot theoretically sink below zero. As long as the monetary standard is gold or other immutable commodity there is always the opportunity of hoard it, therefore, the interest rate is unlikely to fall to zero or below zero. The *Fisher equation* can be written as:

$$(1 + i) = (1 + r)(1 + \pi^e) \Leftrightarrow i = r + \pi^e + r\pi^e \quad (1)$$

where i stands for nominal interest rate, r for the real interest rate and π^e for the expected inflation.

According to the *Fisher equation* (or sometimes referred as the *Fisher effect*) the nominal interest rate is equal to the sum of the real rate of interest, expected inflation and the product of the real rate and expected inflation. As long as the expected inflation and the real interest rates are small, the cross term $(r\pi^e)$ is assumed to be small and it can be left out. Then, the equation is the following:

$$i \approx r + \pi^e \quad (2)$$

The relationship between the level of interest rates and inflation is one of the most studied topics in economics. There has been a lot of research on whether the Fisher effect exists in practice or not. According to Mishkin (1991), the Fisher effect only occurs during certain periods. In his paper, he presents empirical evidence for a long run Fisher effect in which inflation and interest rates have a

common stochastic trend when they exhibit trends. However, Mishkin (1991) did not find evidence for a short-run Fisher effect. According to the author, the findings are more consistent with the views expressed in Fisher (1930) than with the standard characterization of the so-called Fisher effect in the past fifteen years. Fisher (1930) did not state that there ought to be a strong short-run relationship between expected inflation and interest rates. Rather, he viewed the positive relationship between inflation and interest rates as a long-run phenomenon (Mishkin, 1991).

Even though Fisher assumed that interest rates could not be negative, he did not say that negative interest rates were impossible. Actually, in his book "*The theory of interest*" he gives an example where interest rates would have to be negative for his equation to hold: "*When the appreciation is fast, the rate of interest in the upward-moving standard, in order to equalize the burden, would have to be zero or even negative. For instance, if the rate of interest expressed in gold is 4 per cent, and if wheat appreciates relatively to gold at 4 per cent also, the rate of interest expressed in wheat, if perfectly adjusted, would theoretically have to sink to zero. But zero or negative interest is practically almost impossible*" (Fisher, 1930, page 40).

2.2 Term structure of interest rates

The term structure of interest rates is the relation between different interest rates with different term-to-maturity. To display the term structure of interest rates on securities of a particular type at a particular point in time, economists use a diagram called the yield curve. As result, term structure theory is often described as the theory of the yield curve (Russell, 1992). By providing a complete schedule of interest rates across time the term structure embodies the market's anticipations of future events (Cox et al., 1985).

2.2.1 Expectations Hypothesis

The expectations hypothesis (EH) states that the long term interest rate comprises a weighted average of the current interest rate and the expected future short-term interest rate (Russell, 1992):

$$(1 + rs_T)^T = (1 + rs_1)(1 + rf_1) \dots \left(1 + {}_{T-1}rf_T\right) = (1 + rs_{T-1})^{T-1}\left(1 + {}_{T-1}rf_T\right) \quad (3)$$

where rs_T is the spot yield on T-year bond and ${}_{T-1}rf_T$ is the implied one-year rate t years ahead.

This theory implies that the long term interest rate is just based on the expected future short-term interest rates. Following the EH, when monetary authorities adjust the current short-term rate, they are influencing long term interest rates as well (Cossetti & Guidi, 2009).

The EH states that if short-term interest rates are expected to rise, then longer yields should be higher than shorter ones. Mainly because if that was not the case, investors would only buy the shorter bonds and when they would mature they would just roll over the investment.

The term structure plays a major role in monetary policy-making. The long term interest rates can be also seen as expectations of the future short-term interest rates. Hence, the efficacy of monetary policy can be evaluated by looking at the impact on long-term interest rates.

2.3 Inflation expectations

The monetary policy transmission mechanism is present through the relationship between short-term (central banks' instrument) and long term rates (Cossetti & Guidi, 2009). The spread between long nominal and real yields is used by many central banks to gauge inflation expectations and the entire yield curve is used to estimate market expectations about the future of monetary policy (Assenmacher & Gerlach, 2008).

As I mentioned previously price stability is the main goal of central banks. In order to achieve the desired price stability that is optimal for central banks they intend to anchor inflation expectations. As such, inflation expectations play an important role in determining the long-term interest rates and the shape of the yield curve which in turn affects the state of macroeconomic activity and long-run economic growth. Consequently, measuring inflation expectations is of major importance for policy makers, investors and market participants (Gospodinov & Wei, 2015). Some useful information about inflation expectations can be inferred from the market price of inflation-linked bonds, inflation swaps and derivatives.

In order to be able to find whether unconventional monetary policies provide stimulus to the real economy, it is crucial to analyse the impact on inflation expectations. The response of inflation expectations is a metric for gauging the credibility as perceived by financial markets of the asset purchase programme's ability to address deflation risks. The ECB has been using the 5y5y forward swap rate has a measure of inflation expectations. As such, I decided to use it also in this research.

2.4 Monetary policy in the Eurozone

"The primary objective of the European System of Central Banks shall be to maintain price stability."

(Article 127, Treaty on the Functioning of the European Union, Article 127 (1))[2]

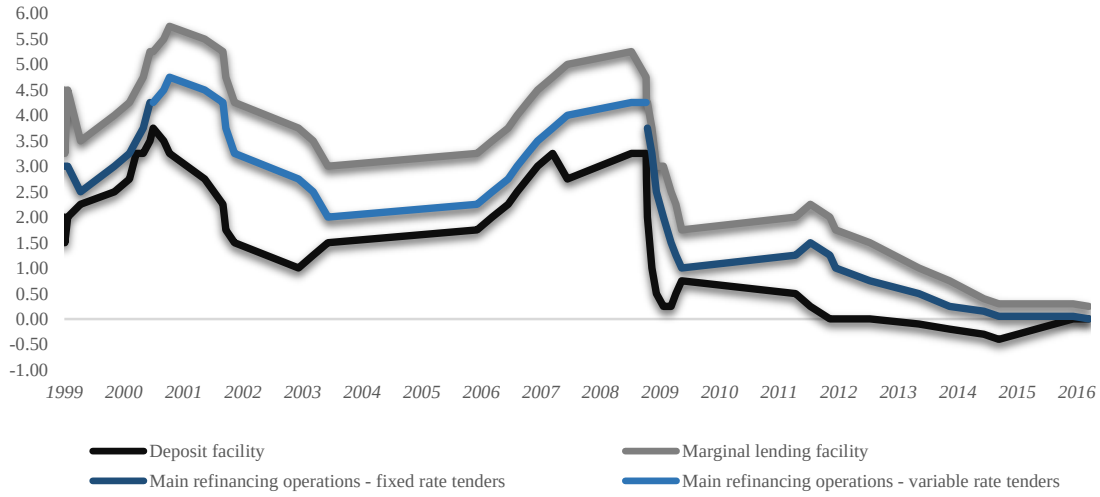
[2] http://www.lisbon-treaty.org/wcm/the-lisbon-treaty/treaty-on-the-functioning-of-the-european-union-and-comments/part-3-union-policies-and-internal-actions/title-viii-economic-and-monetary-policy/chapter-2-monetary-policy/395-article-127.html

Maintaining stable prices on a sustained basis is seen as a crucial pre-condition for increasing economic welfare and the growth potential of an economy. The ECB has defined price stability as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below 2% over the medium term. Monetary policy decisions are taken by the ECB's Governing Council. The Council meets every month to analyse and assess economic and monetary developments, the risks opposing price stability and to decide on the appropriate level of the key interest rates based on the ECB's strategy[3]. Monetary policy in the euro is a centralized decision by the ECB but it is implemented and executed by each National Central Bank.

For the Eurozone the key interest rates set by the Governing Council are:

- The rate on the marginal lending facility, which offers overnight credit to banks from the Eurosystem;
- The interest rate on the main refinancing operations (MROs), which normally provides the majority of the liquidity to the banking system. The interest rate can be in the form of fixed or variable rate;
- The rate on the deposit facility, which banks may use to make overnight deposits with the Eurosystem. The rate on the marginal lending facility, which offers overnight credit to banks from the Eurosystem.

Figure 1 – Key Interest Rates for Eurozone from 1999 to 2016



Source: ECB

2.4.1 Conventional monetary policy in the Eurozone

In order to minimize the risk exposure of their balance sheet central banks do not lend directly to the private sector or the government. Their conventional monetary policy mainly consists of setting a

[3] For more information: https://www.ecb.europa.eu/mopo/intro/objective/html/index.en.html

target for the overnight interbank interest rate and managing the liquidity supply through open market operations.

The main instruments used by the ECB are:

- Reserves: banks are obligated to hold 2 % of their liabilities as a deposit with the Eurosystem (on average during a month);
- Standing facilities (deposit facility and marginal lending facility setting by the ECB) can be used automatically on the initiative of the banks;
- Main refinancing operations (MROs): liquidity provided on a weekly basis to the banks. MROs are used to control short-term interest rates, to manage the liquidity and to signal the monetary policy stance in the euro area;
- Long–term refinancing operations (LTROs): liquidity provided for a period of 3 months at market. LTROs provide additional, longer-term refinancing to the financial sector;
- Fine–tuning operations: to deal with unexpected surpluses/shortages in the money market.

The weekly decisions taken by the ECB on monetary policy focus on allotment of MROs. The bids are collected every Monday by the National Central Banks and they are afterwards forwarded to the ECB. Every Tuesday morning the decision is made by the ECB on the size of the allotment (not on the minimum bid rate).

2.4.2 Unconventional monetary policy in the Eurozone

During abnormal times, conventional monetary policy instruments may prove insufficient to achieve the central bank's objective. Mostly due to the fact that some economic shocks are so powerful that the nominal interest rate needs to be brought down to zero (Pattipeilohy et al., 2013). At that level, any additional monetary stimulus it is called unconventional monetary policy and can be achieved in three complementary ways:

- by guiding medium to long term interest rate expectations;
- by changing the composition of the central bank's balance sheet (credit easing);
- by expanding the size of the central bank's balance sheet (quantitative easing).

Unconventional monetary policies can be defined as a class of operations that use the central bank's balance sheet in order to directly affect a broader set of market rates, asset prices and even lending amounts. As such, they represent an attempt to short-circuit and/or enhance the usual transmission from money market rates into financial conditions facing the wider economy (Meier, 2009).

"QE may work, but it is not a panacea." (Meier, 2009)

Even though according to theory unconventional operations may work the truth is that unconventional monetary policy involves even more uncertainty than conventional about the economic impact of some operations (Meier, 2009). In that sense, it becomes important to observe the impact of unconventional monetary policy.

The non-standard monetary measures applied by the ECB from 2009 until now are:

- Extra liquidity-providing long term refinancing operations;
- Target longer-term refinancing operations;
- Asset purchases programmes;
- Low/negative deposit facility rate[4].

2.4.2.1 Description of the ECB unconventional monetary policy announcements

In this section, I will briefly describe the main unconventional policy announcements of the ECB used in this research from 2009 until 2016.

Longer-term refinancing operations

The Governing Council announced two liquidity-providing long-term refinancing operations (LTROs) with a three-year maturity (maturing on 29 January 2015 and on 26 February 2015) and the option of early repayment after one year. The first operation was allotted on the 21st of December 2011 and the second LTRO was allotted on the 29th of February 2012.

Table A Longer-term refinancing operations announcements

Announcement date	Description of the announcement
08/12/2011	The Governing Council announced 2 three-year LTROs[5]
21/12/2011	Allotment of the first LTRO
29/02/2012	Allotment of the second LTRO

Target longer-term refinancing operations

The ECB announced on the 5th of June 2014 that it would conduct a series of targeted longer-term refinancing operations (TLTROs) intended to improve bank lending to the non-financial private sector in the euro area, excluding loans to households for house purchase, over a period of two years. All TLTROs will mature in September 2018. The interest rate on the TLTROs is fixed over the life of each operation at the rate on the Eurosystem's main refinancing operations (MROs) prevailing at the time of take-up, plus a fixed spread of 10 basis points. Twenty-four months after each TLTRO,

[4] In this research, I consider the negative deposit facility rate announcement as unconventional monetary policy measure, even though, previous literature considers changes on deposit facility as conventional monetary policy.
[5] https://www.ecb.europa.eu/press/pr/date/2011/html/pr111208_1.en.html

counterparties have the option to repay any part of the amounts they were allotted in that TLTRO at a six-monthly frequency.[6]

Table B: Target longer-term refinancing operations announcements

Announcement date	Description of the announcement
05/06/2014	The Governing Council decided to conduct a series of TLTROs.
29/07/2014	ECB publishes legal act relating to TLTRO (I)
16/09/2014	Announcement of the first TLTRO (I)
18/09/2014	The ECB allots €82.6 billion in first TLTRO
09/12/2014	Announcement of the second TLTRO (I)
11/12/2014	The ECB allots 129.8 billion in second TLTRO (I)
17/03/2015	Announcement of the third TLTRO (I)
19/03/2015	The ECB allots 97.8 billion in third TLTRO (I)
16/06/2015	Announcement of the fourth TLTRO (I)
18/06/2015	The ECB allots 73.7 billion in fourth TLTRO (I)
22/09/2015	Announcement of the fifth TLTRO (I)
24/09/2015	The ECB allots 15.5 billion in fifth TLTRO (I)
09/12/2015	Announcement of the sixth TLTRO (I)
11/12/2015	The ECB allots 18.3 billion in sixth TLTRO (I)
10/03/2016	The ECB announced new series of TLTROs (II).
22/03/2016	Announcement of the seventh TLTRO (I)
24/03/2016	The ECB allots 7.3 billion in seventh TLTRO (I)
03/05/2016	ECB publishes legal act relating to the new series of TLTROs (II)

Securities markets programme

The Securities Markets Programme (SMP) was meant to buy particular assets (government bonds from "troubled" countries) in order to repair the monetary transmission channel in the euro area. The SMP ended in September 2012 but it was replaced by another programme entitled Outright Monetary Transactions (OMT). This program consists of purchasing unlimited amounts of sovereign bonds of member states subject to a European Stability Mechanism (ESM) [7] programme on secondary markets. OMT is aimed as a pure 'credit easing' which means that the purchases of government bonds (with one to three years maturity) in secondary market would just change the assets composition of the central banks. The OMT programme was announced at the same time as the president of the ECB (Mario Draghi) announced to do "whatever it takes to save the euro".

[6] http://www.ecb.europa.eu/press/pr/date/2014/html/pr140605_2.en.html

[7] The European Stability Mechanism (ESM) is an intergovernmental organization that operates as a permanent firewall for the euro zone in order to safeguard and provide instant access to financial assistance programmes for member states of the euro zone in financial difficulty, with a maximum lending capacity of €500 billion.

Table C: Securities market programme announcements

Announcement date	Description of the announcement
09/05/2010	The ECB announced the SMP
14/05/2010	The ECB published the decision on the SMP
07/08/2011	The Governing Council decided to relaunch the SMP after a period of inactivity [8]
06/09/2012	The SMP ended and the OMT started. Decisions on a number of technical features regarding the OMT in secondary sovereign bond markets

To activate the OMT program towards a specific country four conditions have to be met. First, the country must have received financial support from the European Stability Mechanism (ESM). Second, the government must comply with the reform efforts required by the respective ESM program. Third, the OMT program can only start if the country has regained complete access to private lending markets. Fourth, the country's government bond yields are higher than what can be justified by the fundamental economic data. Due to the fact that any country in the group of eligible states for OMT support did not meet the requirements, the programme has not been activated yet. (Acharya et al., 2015).

Covered bond purchase programmes (CBPP, CBPP2 and CBPP3)

Covered bonds are bonds issued by credit institutions, which are secured by a protected group of high-quality assets (such as mortgage loans or public sector debt). Covered bonds grant the holder privileged claims on the pool of cover assets upon default of the issuer. As a result of these advantages, covered bonds have proved enormously successful in Europe and they have become a key source of funding for European banks. More than 80% of the total of covered bond outstanding globally belongs to six EU countries (Germany, Spain, Denmark, France, Sweden and the UK).

Since the financial crisis started in 2008 investors have been switching preferences towards less risky assets such as government bonds. This means that covered bonds became less attractive. In order to prevent the covered bond market from failing the ECB decided to purchase 60 billion euro covered bonds. The programme was fully implemented on the 30th of June 2010. According to the ECB[9], the aim of the CBPP has been to support a specific financial market segment that is important for the funding of banks and that had been particularly affected by the financial crisis. As the euro area did not recover from the sovereign crisis by 2011, the ECB decided to launch a new covered bond purchase programme (CBPP2) on 6th of October 2011. The purchases consisted out of 40 billion of euro-denominated covered bonds in both the primary and the secondary markets.

[8] http://www.ecb.europa.eu/press/pr/date/2011/html/pr110807.en.html
[9] https://www.ecb.europa.eu/press/pr/date/2010/html/pr100630.en.html

Table D: Covered bond purchase programme announcements

Announcement date	Description of the announcement
07/05/2009	The ECB decided to purchase euro-denominated covered bonds issued in the euro area (CBPP1)
02/07/2009	The ECB started with the purchases of covered bonds (CBPP1)
30/06/2010	The CBPP1 ended (ECB reached the amount purchased of 60 billion)
06/10/2011	The ECB decided to start the second CBPP
03/11/2011	The ECB started with the purchases of covered bonds (CBPP2)
31/10/2012	The CBPP2 ended (ECB reached the amount purchased of 16.4 billion)

Expanded asset purchase programme (APP)

On the 22nd of January 2015,[10] the Governing Council of the ECB decided to launch an expanded asset purchase programme (APP). It consists of a third covered bond purchase programme (**CBPP3**), an asset-backed securities purchase programme (**ABSPP**) and a public sector purchase programme (**PSPP**). The latter is a completely new programme for the ECB. So far, the ECB has been only buying assets from the private sector.

In order to fight the risks of a too prolonged period of low inflation the ECB started buying public sector securities on 9th March 2015. The securities covered by the PSPP include nominal and inflation-linked central government bonds and bonds issued by recognized agencies, international organizations and multilateral development banks located in the euro area. The expanded asset purchase programme is expected to be carried out until September 2016 and in any case until the Governing Council sees a sustained adjustment in the path of inflation. Combined monthly purchases in public and private sector securities will amount to €60 billion. On the 3rd December 2015 the ECB announced an extension of the APP until March 2017 and an increase in the monthly purchase up to EUR 80 bn. On the 20th of October 2014, the Eurosystem started to buy covered bonds under a third covered bond purchase programme (CBPP3). The ABSPP started on 21 November 2014 and consists out of purchasing in both primary and secondary markets senior and guaranteed mezzanine tranches of asset-backed securities (ABSs).

Table E: Expanded asset purchase programme announcements

Announcement date	Description of the announcement
04/09/2014	The ECB announced a new CBPP (3) and a new ABSPP
20/10/2014	The ECB started to buy covered bonds (CBPP3)
21/11/2014	The ECB started the ABSPP
22/01/2015	The ECB announced the expanded asset purchase program.
09/03/2015	The ECB started to buy public sector securities under the PSPP
18/03/2015	The Governing Council decided on the criteria for which mezzanine tranches of ABS would be considered for purchase under the ABSPP

[10] https://www.ecb.europa.eu/press/pr/date/2015/html/pr150122_1.en.html

Corporate Sector Purchase Programme

The Corporate Sector Purchase Programme (CSPP) is a new programme that has been added to the existing elements of the asset purchase programme (APP). According to the ECB[11], the CSPP aims to purchase investment-grade euro-denominated bonds issued by non-bank corporations established in the euro area. It will be included in the combined monthly purchases that increased on the 1st of April 2016 to €80 billion.

Table F: Corporate sector purchase programme announcements

Announcement date	Description of the announcement
10/03/2016	The ECB added the CSPP to the APP
21/04/2016	The ECB announced details of the CSPP
08/06/2016	The ECB started CSPP

Negative deposit facility rate

The deposit facility rate is one of the three interest rates that the ECB sets every six weeks as part of its monetary policy. The rate defines the amount of interest the banks receive for depositing money at the central bank overnight. Since the 11th of June 2014, this rate has been negative[12]. The 11th of June 2014 was the first time in the Eurozone that the Governing Council of the ECB set the deposit facility rate negative. Following the ECB's example, Sweden set negative nominal interest rates combined with bond buying; Denmark and Switzerland also cut their nominal interest rates below zero in order to protect the currency's peg to the euro (Warner, 2015).

Table G: Negative deposit facility rate announcements

Announcement date	Description of the announcement
05/06/2014	The Governing Council announced for the first time that the deposit facility rate would be below zero (-0.10)
11/06/2014	The ECB started applying the -0.10 deposit facility rate.
04/09/2014	The Governing Council set deposit facility rate even more negative (-0.20)
10/09/2014	The ECB started applying the -0.20 deposit facility rate.
03/12/2015	The Governing Council set deposit facility rate even more negative (-0.30)
09/12/2015	The ECB started applying the -0.30 deposit facility rate.
10/03/2016	The Governing Council set deposit facility rate even more negative (-0.40)
16/03/2016	The ECB started applying the -0.40 deposit facility rate.

[11] https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310_2.en.html

[12] https://www.ecb.europa.eu/explainers/tell-me/html/what-is-the-deposit-facility-rate.en.html

3. Literature Review

In this chapter, I introduce some of the literature that has been conducted on unconventional monetary policy by the ECB and also by another central banks (e.g. Bank of Japan, Bank of England and Federal Reserve).

3.1 Previous literature on the effect of unconventional monetary policy in the euro area

Eser and Schwaab (2013) tested the yield impact of the Securities Market Programme launched by ECB on the 14th May 2010. Even despite the sovereign debt crisis, they show that government bond purchases during the SMP were effective in affecting yields for Spain, Italy, Ireland, Portugal and Greece (also known as PIIGS). One of their aims during their research was to estimate how long the effects were going to last. They found evidence for both transitory and long-run effects.

Falagiarda and Reitz (2015) studied the effects of ECB announcements regarding unconventional monetary policy operations on the sovereign spreads of Greece, Ireland, Italy, Portugal, and Spain relative to Germany between 2008 and 2012. Their results showed that ECB unconventional monetary policy announcements reduced long-term government bond yield spreads substantially relative to German counterparts in all countries, except for Greece. In particular, they found that news about the Securities Markets Programme strongly affected the "PIIGS", while the Outright Monetary Transactions announcements only had a significant impact in Italy and Spain.

Brand et al. (2010) wanted to study the impact of central bank communications and decisions on the yield curve by using high frequency data on money market interest rates. They affirmed that market expectations of the path of monetary policy might change considerably during the ECB's press conference and that these changes have a considerable impact on longer-term yields. Additionally, their results show that news coming from ECB communication matter more for long-term interest rates than news about actual monetary policy decisions.

The ECB Economic Bulletin (2015)[13] presented an article that evaluates the transmission of the ECB's non-standard measures announced. It focuses on the targeted longer-term refinancing operations (TLTROs), the expanded asset purchase programme (APP) and on the public sector purchase programme (PSPP). The results suggested that these policies together had significantly lowered yields, with the effects generally increasing with maturity and riskiness. For instance, ten-year yields declined by about 70 basis points for the euro area. They used inflation swap rates as a measure of the private sector's inflation expectations for maturities between one and five years. The estimated change in

[13] https://www.ecb.europa.eu/pub/pdf/other/eb201507_article01.en.pdf

inflation swap rates due to the APP is around 30 basis points for the one-year maturity and around 20 basis points for the five-year maturity.

3.2 Previous literature on the effect of unconventional monetary policy on other central banks: USA, Japan and England

Bank of Japan

Berkmen's (2012) paper assesses the impact of quantitative easing in Japan on economic activity and inflation during 1998-2010. Instead of using government bond spreads as a proxy for QE, the author measures the effectiveness of asset purchasing programs through the following four variables: the economic activity variable (growth or unemployment rate), the inflation, the interest rate and the government bond spread over the policy rate. The paper finds some evidence that monetary easing by the Bank of Japan has supported economic activity, even though the statistical significance varies according to the different measures used for economic activity. Furthermore, there is no evidence of an impact on the exchange rate and the effect on inflation is weak.

Lam (2011) measured the impact of the new asset purchase program under the Bank of Japan's Comprehensive Monetary Easing (CME)[14] on financial markets. An event study approach is used where the author analyses how financial markets responded to the announcement of the QE by the Bank of Japan, whether the impact comes mostly from the first announcement of the QE or the subsequent QE and which asset purchases, private risky assets or government securities, are more effective in reducing risk premia. He concludes that easing measures used by the Bank of Japan had a statistically significant impact on bond yields and equity prices, but no outstanding effect on the exchange rate and inflation expectation. Moreover, Lam concluded that the impact arises from the announcement effect rather than from the actual operations or purchases. Lam (2011) went further and analysed the hypothetical scenario of the impact on financial markets if CME had not included private asset purchases. He concludes that including private risky assets in the program is a crucial factor to support asset prices.

Honda et al. (2013), based on a VAR methodology, examine the effect of the QE on aggregate output and prices and its transmission channel. They look at the effects of the QE in Japan from 2001-2006. They concluded that any additional injection of money is effective even when short-term nominal interest rates are zero. However, there is no impact on the price level. In order to test the transmission channel, they considered the following financial variables: short-to long term nominal interest rates, stock prices, foreign exchange rates and bank lending. From these variables, they concluded that QE

[14] According to Lam (2011), "Comprehensive Monetary Easing (CME) differs from the typical quantitative easing in other central banks by including purchases of risky assets in an effort to reduce term and risk premia."

increased aggregate output through the stock price channel. Hence, a QE shock first raises stock prices and then increases the output level. They also found empirical evidence that people did not spend money to purchase bonds, which is consistent with the liquidity trap theory. On the contrary, they find that people use the injected money to purchase stocks.

Federal Reserve

Gagnon et al. (2011) used an event-study analysis of Federal Reserve communications to obtain the effect of Large-Scale Asset Purchases Program (LSAP). They examine changes in the following financial variables around the official communications of asset purchases: 2-year and 10-year Treasury yields, the 10-year agency debt yield, the current-coupon 30-year agency MBS yield, the 10-year Treasury term premium, the 10-year swap rate, and the Baa corporate bond index yield. They conclude that the Federal Reserve's LSAP programs were successful at lowering longer-term private borrowing rates and stimulating economic activity. However, the agency debt yield and the MBS yield changed very little. Moreover, they found evidence of LSAPs broader effects. Swap rate and the Baa corporate bond yield also decreased significantly.

D'Amico and King (2010) investigated the effects of LSAP conducted by Fed on yields. They conducted a panel of daily CUSIP-level data. Their results suggested that, on average, LSAP reduced yields by about 30 basis points across the yield curve during the life of the program. The effects were most pronounced in securities with 10 to 15 years of maturity. They estimated that these yields would have been 50 basis points higher in the absence of the program. They also found that the decreases on yields are generally higher for the specific securities being bought and for securities of similar maturities.

Neely (2010) also followed an event study methodology that evaluates the impact of Federal Reserve's unconventional monetary policy on long term bond yields. However, he brought something new to the current literature, by also estimating the impact on nominal international long bond yields in local currencies and exchange rates. The unconventional policies significantly reduced the 10-year nominal yields for Australia, Canada, Germany, Japan and the United Kingdom. The USD also depreciated against the currencies of those countries.

Krishnamurthy and Vissing-Jorgensen (2010) analyse the effect of Federal Reserve's purchase of long term Treasuries and other long-term bonds on nominal and real long-term interest rates. In order to do that they designed an event study based on the announcements dates of long-term asset purchases by the Federal Reserve in the late 2008 to 2009 period. They find a large and significant decrease in nominal interest rates on long-term safe assets (Treasuries and Agency bonds). Additionally, they conclude that both QE (1 and 2) had a smaller effect on less safe assets, such as Baa corporate rates

and mortgage rates. They believe the reason behind that is the fact that Baa corporate rates and mortgage rates are more relevant for corporate and households long-term borrowing. According to Krishnamurthy and Vissing-Jorgensen (2010), the type of asset purchased by the central bank matters for the final outcome, as well as, the type of interest rate being used to test the impact of the asset purchases. Besides, as most of the economy is funded by debt (not risk free as government bonds) observing effects on government bonds might be misleading (Krishnamurthy and Vissing-Jorgensen, 2010). Therefore, I decided to investigate the effect not only on government bond yield but also on corporate bond yields (AAA and BBB). Krishnamurthy and Vissing-Jorgensen (2010) used agency bonds to measure the impact of asset purchases. During QE1 the agency yields decrease 164 basis points and the Agency MBS yields fall by 116 basis points. Furthermore, they use information from inflation swap rates and they find evidence that expected inflation increased as a result of the first QE (increased 71 basis points), but it did not change a lot as a result of the second QE.

Wright (2012) also provides evidence that asset purchases conducted by Fed decreased long-term interest rates. Although the impact is statistically significant, the effect fades rapidly over the subsequent months. He uses a structural VAR method[15] with daily data to measure the effects of monetary policy on long-term interest rates since the moment the federal funds rate has been stuck at the zero lower bound. By using the same methodology as Rigobon (2003) and Rigobon and Sack (2003, 2004, 2005) the author concludes that monetary policy shocks have effects on both long term Treasury and corporate bond yields. The results show that quantitative easing (QE1, QE2 and QE3) declines interest rates, but that these are reversed over the subsequent months. However, it is not certain whether the result come from the economic stimulus provided by the Federal Reserve action (QE) or whether it was because the markets overreacted to the announcement of the quantitative easing.

According to theory, ultra-low rates could boost equity prices in the long term, all else being equal. For example, by lowering the discount rate that investors use they could anticipate an increase in the present value of future cash flows, which should boost the stock-market valuation. Another explanation might be that as yields on fixed-income securities decline, investor may shift into equities and other assets in search of higher yields, increasing demand for these assets and therefore their prices (Koller, Dobbs & Lund, 2014). However, according to Koller, Dobbs and Lund (2014) the impact on equity prices might not be significant. In their paper, they mentioned that could happened due to "rational expectations". As the investors take today's ultra-low rate as temporary, the discount rate used to value future cash flows is not going to be reduced in the future. The second reason that

[15] The structural VAR uses economic theory to sort out the contemporaneous links between variables. It requires identifying assumptions that allow correlations to be interpreted causally (Stock and Watson, 2001).

they mentioned is that if investors had reduced their discount rate in the future we would expect P/E ratios to rise. However, the last years P/E ratios have remained constant.

Bank of England

In March 2009, the Bank of England began a quantitative easing programme. Joyce at al. (2010) intended to verify the impact of those large purchases of assets on financial markets. They conducted an event study method that focused on the reaction of the market prices over a fairly narrow interval after the QE-related news was announced. Their goal is to capture the market's response to the news, isolated from other factors that may also have been affecting asset prices. According to the authors, there are three main channels through which QE might affect prices: the macro/policy news channel, portfolio-rebalancing channel and the liquidity premia channel. Their analysis suggests that there was a decrease on gilt yields (about 100 basis points lower) due to the QE announcements mainly through a portfolio rebalancing effect.

Meier (2009) through an event study concludes that the quantitative easing programme conducted by the Bank of England was "moderately encouraging". He found evidence of a direct impact on gilt yields. Moreover, the asset purchases of the Bank of England have coincided with a recovery of asset prices, a decline in risk spreads and a moderate increase in breakeven inflation rates. On the other hand, he also found that the sterling pound has gradually appreciated since the launch of the QE, which is against the theory.

Zhu and Meaning (2011) investigated the effectiveness of the asset purchase programmes implemented by the Federal Reserve (LSAP)[16] and the Bank of England (APF)[17]. They used two different methodologies. First, they used an event study based on the Gagnon et al. (2011) methodology in which they conclude that the impact was significant to the first announcements but really small to the announcements of latter extensions of the programmes. Secondly, they used the methodology of D'Amico and King (2010) and they found that yields fell significantly over the course of each programme (which matches with the results from the first method). They found that on a one-day event window the asset purchase programmes announcements significantly reduced yields of government bonds yields and that the prices of some risky assets increased as the programmes were announced. There was also a sizeable reduction in corporate bond yields. The first announcements preceded significant depreciations in the nominal effective exchange rates of the US dollar and sterling. However, the impact was little for the later programmes. They conclude that recent asset purchases seem to have been effective, but there are limitations for further actions. Firstly, long-term government bond yields are already very low and the scope for further reduction becomes smaller as

[16] Federal Reserve's Large-Scale Asset Purchase
[17] Bank of England's Asset Purchase Facility

more purchases are carried out. Secondly, it may be difficult to achieve the same degree of effectiveness as with the initial programmes once the surprise or novelty element fades. Lastly, central banks face some risks with large holdings of longer-term securities and riskier private debt.

Breedon, Chadha and Waters (2012) studied the impact of the first quantitative easing programme conducted by the Bank of England (from March 2009 to February 2010) on asset prices. They estimated a simple term structure model driven by several macroeconomics factors. Then, they used this model to estimate a predicted yield curve over the QE period. The difference between the predicted and the actual yield curve over the QE period can be interpreted as an estimate of the portfolio balance impact of QE. Breedon, Chadha and Waters (2012) wanted to observe the spillover effects from the QE on the US forward interest rates[18]. They followed the same announcement effect methodology as Gagnon et al. (2011), where they examined both the 1-day and the 2-day changes, which were measured from the day before the FED announcement and the day after the announcement. During the QE programme, there were eight federal open market committee statements. They found out that the impact on US forward interest rates varies depending on maturity and the size of the announcement window. Moreover, they concluded that QE is indeed effective in influencing long-term bond yields through a portfolio balance effect. However, the broader impact of QE on other assets and on the economy remains controversial. Mainly due to the fact that QE has been implemented during a credit crunch, which does not allow to distinguish the impact of conventional measures from unconventional (Breedon, Chadha & Waters, 2012).

Kapetanios et al. (2012) observed the impact on output and inflation of QE conducted by the Bank of England. They had to carry out a counterfactual analysis of what would have happened to GDP and inflation if QE had not been implemented. After that, the difference between the counterfactual and the baseline prediction (when QE happens) is the measure of the macroeconomic impact. Their results suggested that without QE inflation would have been low or even negative and real GDP would have fallen even more. Likewise, Gambacorta et al. (2012) carried out a cross country analysis to find the impact on the macro economy during the financial crisis. They estimated a panel structural vector autoregressive (SVAR) model with monthly data over a sample period. The countries included in the analysis were Canada, the euro area, Japan, Norway, Sweden, Switzerland, the United Kingdom and the United States. They concluded that expansions of the central banks' balance sheet lead to a significant but at the same time temporary rise in output and prices. The impact on the price level appears to be less persistent and weaker. Their results demonstrated that unconventional monetary policy measures used by central banks in the wake of the global financial crisis provided temporary support to their economies.

[18] Forward interest rate can be viewed as the rate set at time t on a contract to purchase a bond at time t + 1,2,3,… (Fama and Bliss, 1987)

3. Data

The data set considered in this study includes daily long term interest rates for 11 out of 19 countries that have the euro as their physical currency since 2002 (Austria, Belgium, Germany, Greece, Finland, France, Ireland, Italy, Netherlands, Portugal and Spain). The long-term interest rates considered in this research are the 10-year on-the-run government benchmark bond yields. They were collected from Datastream. Thomson Reuters Datastream compiles the benchmark yield data from the central bank of each country. These on-the-run government benchmark yields have already been used in previous literature as a measure of long-term interest rates (e.g. Carvalho & Fidora (2015) and Falagiarda & Reitz (2015)). While applying the market model to compute the expected return, the synthetic Euro benchmark bond was used as the "market return". It consists out of a weighted average yield of the benchmark bond series from each European Monetary Union member mentioned above[19].

To evaluate the impact on other securities different from government bonds, corporate bond yield data is also considered in this research. A 10-year and 5-year benchmark on corporate bond yields is utilized for two different types of credit ratings: AAA (prime) and BBB (lower medium grade). The data was collected from Datastream for the Eurozone.

In order to measure the medium term inflation expectations, it is employed the Euro Inflation Swap Forward 5y5y. It measures expected inflation (on average) over the five-year period that begins five years from today. This rate is used by central banks to get information on the market's future inflation expectations. The swaps are traded daily. The data on Euro Inflation Swap Index was collected from Bloomberg for the Eurozone.

The dataset starts on the 1st of March 2009 and ends on 5th of July 2016. The number of unconventional monetary policy announcements that occurred during that period were 44. Two of the announcements were made on a Sunday (07/08/2011[20] and 09/05/2010[21]). As there are no yield data on weekends, I decided to place them on the Monday. In order to be able to capture the impact of each announcement, I removed the announcements that followed each other within 30 days. Hence, the final number of announcements accounts to 22.

19 The weightings used are the 1996 real GDP as published by Eurostat. The precise formula is the following: $Austria \times 0.03139 + Belgium \times 0.03866 + Finland * 0.02339 + France \times 0.22064 + Germany \times 0.31315 + Ireland \times 0.01132 + Italy \times 0.20039 + Netherlands \times 0.05596 + Portugal \times 0.01255 + Spain \times 0.09257$

20 The Governing Council decided to relaunch the SMP after a period of inactivity.

21 The ECB announced the Securities Markets Programme (SMP).

4. Methodology

The focus of the present research is to evaluate the impact of ECB unconventional monetary policy on long-term interest rates (10-year government bond yield) for the following euro area countries: Austria, Belgium, Germany, Greece, Finland, France, Ireland, Italy, Netherlands, Portugal and Spain. Furthermore, the impact of ECB non-standard measures is also going to be tested on inflation expectations and on corporate bond yields for the Eurozone. The way to conduct this study is by using an event-study.

4.1 Event study

The event study methodology allows to evaluate whether movements of a time series around a certain date are consistent with normal returns or if they can be considered abnormal in a statistically significant way. Event study methods were first developed in the financial economics literature, originally introduced by Eugene Fama, Lawrence Fisher, Michael Jensen and Richard Roll in the paper *"The Adjustment of Stock Prices to New Information"* in 1969, as a method to test the efficient markets hypothesis using the analysis of returns around an unanticipated event (Sandler & Sandler, 2012).

The event study approach relies on the efficient market hypothesis and also on the rational expectation hypothesis, by which prices and returns incorporate all the information available. Thus, long term interest rates should react to announcements regarding unconventional monetary policy because expectations are being affected by those announcements (Rivolta, 2014).

When using an event study it is implicitly assumed that the event set includes all announcements that have affected expectations about the future of monetary policy; monetary policy expectations have not been affected by anything other than these announcements; responses can be measured in windows wide enough to capture long-run effects but not so wide that information affecting yields through other channels is likely to have arrived and markets are efficient in the sense that all the effects on yields occur when market participants update their expectations and not when actual purchases take place (Gagnon et al., 2011).

There are some disadvantages associated with the event study methodology. The assumptions mentioned above are very strong and if misused can bias the results of a research. It is impossible to control for other factor(s) that occur at the same time. In order to make sure that these flaws do not influence the results of this research, I decided to analyse the yield changes in a narrow interval of time around each announcement. Moreover, I selected a control period (estimation window) that does

not include the event window. To do be able to do that, I had to exclude unconventional monetary policy announcements following each other within 30 days.

In this research, an event-study analysis of the ECB monetary policy announcements will be used to estimate the effects of monetary policy implemented between May 2009 and June 2016. In particular, changes in nominal and real long-term yields (10-year government bond yields, 5y5y swap forward rate and corporate bond yields) around official communications on unconventional monetary policy are going to be examined, by taking the cumulative changes as a measure of the overall effects.

To conduct an event study, an event window and estimation window were selected. The day of the announcement is the event day and therefore, it is defined as t=0. However, I am not only interested on the yield changes on the day of the announcement itself but also on the days surrounding the event day. Selecting the window length involves a trade-off between allowing sufficient time for revised expectations to become fully incorporated in asset prices and keeping the window narrow enough to make it unlikely to contain the release of other important information (Gagnon et al., 2011). Following Gagnon et al. (2011), I considered a two day window, [-1,0] and [0,1], around the announcements. A two day window measures the day prior (or after) to the announcement until the closing day of the announcement. The two day window [0, 1] allows for the fact that it can take some time before the market adapts to the announcements of the ECB. Also, [-1,0] allows for the fact that investors have rational expectations and they can anticipate then announcement[22]. Furthermore, I also use a three day window [−1,+1]. There is no uniform agreement on the estimation period (Sorokina et al., 2013). I selected an estimation window of 30 days. As the estimation window should be defined prior to the event window, the control period for this event study is [-32,-2]. Doing so guarantees that the event period is not included in the estimation period which prevents the results of being influenced by the returns around the event (Mackinlay, 1997).

The calculation of the event's impact requires measuring abnormal returns. In this particular research, the "returns" are abnormal yield changes. The abnormal yield change is the actual ex post change of the yield over the event window minus the normal yield change over the event window (Mackinlay, 1997). The normal yield change is the expected yield change in case no event had occurred. The abnormal yield change can be calculated as follows:

$$Abnormal\ yield\ change_{it} = Actual\ Yield\ Change_{it} - Expected\ Normal\ Yield\ Change_{it} \quad (4)$$

where t means period of time and i country.

[22] According to the rational expectations theory efficient markets react to a policy measure in anticipation of its actual implementation.

To obtain the expected yield change the following models can be reviewed:

- Constant mean return model
- CAPM
- Arbitrage pricing theory
- Market model

In this study two models were applied. The constant mean return model and the market model. The first model assumes that expected returns can differ by country, but are constant over time. The formula of the expected yield change according to constant mean return model is as follows:

$$Expected\ Normal\ Yield\ Change_{it} = \mu_{it} + \varepsilon_{it} \quad (5)$$
$$E(\varepsilon_{it}) = 0 \quad Var(\varepsilon_{it}) = \sigma_{\epsilon_t}^2$$

where μ_{it} is the mean of the yield changes on the estimation window per period-t and country (i).

The market model consists out of a statistical model that relates the return of any given security to the return of the market portfolio (Mackinlay, 1997). In this research, the market model relates the yield change of each country to the weighted average yield of the benchmark bond series from each European Monetary Union country. According to the market model, the formula of the expected yield change can be write as follows:

$$Expected\ Normal\ Yield\ change_{it} = \alpha_i + \beta_i Y_{mt} + \varepsilon_{it} \quad (6)$$
$$E(\varepsilon_{it}) = 0 \quad Var(\varepsilon_{it}) = \sigma_{\epsilon_t}^2$$

where Y_{mt} is a weighted average yield of the Eurozone yields[23], and ε_{it} is the zero mean disturbance term. α_i, β_i and $\sigma_{\epsilon_t}^2$are the parameters of the market model.

After calculating the expected normal yield change the abnormal yield change can be calculated as follows:

$$Abnormal\ yield\ change_{it} = Y_{it} - \mu_{it} + \varepsilon_{it} \text{ (for the constant mean return model)} \quad (7)$$
$$Abnormal\ yield\ change_{it} = Y_{it} - \alpha_i + \beta_i Y_{mt} + \varepsilon_{it} \text{ (for the market model)} \quad (8)$$

where Y_{it} designates the actual yield change.

In order to measure the total impact of the announcement within the event window, the cumulative abnormal yield change has to be calculated. The cumulative abnormal yield change (CAYC) is the sum of the abnormal yield changes over a certain period around the event. For instance, if I consider

[23] The formula can be found in chapter 4 (Data).

the three day event window [-1,1]. The respective CAYC is just the sum of the abnormal yield changes on the day before the event, the event day itself and the day after the event.

$$Cumulative\ abnormal\ yield\ change_{it} = \sum Abnormal\ yield\ change_{it} \quad (9)$$

3.2 Statistical significance

After calculating the abnormal yield change and cumulative abnormal yield change their significance needs to be tested. Therefore, I compute a t-test statistic to check whether the average abnormal yield change for each country used in the event study are statistically different from zero. Under the null hypothesis, the cumulative abnormal average yield change is equal to zero. This means that if the null hypothesis is not rejected, yields remained unchanged after the announcements of unconventional monetary policy. Opposite to that, the alternative hypothesis states that the cumulative abnormal average yield is different than zero.

$$H_0: Cumulative\ abnormal\ yield\ change = 0$$
$$H_1: Cumulative\ abnormal\ yield\ change \neq 0$$

In order to test the null hypothesis, the following t-test is conducted:

$$T - test\ statistic = \frac{\sum Abnormal\ Yield\ change/N}{\sigma/\sqrt{N}} = \frac{Cumulative\ yield\ change/N}{\sigma/\sqrt{N}} \sim N(0,1) \quad (10)$$

where N is the number of days in the event window and σ is the standard deviation of the abnormal yield change.

I use a two-sided t-test. Based on the test statistic resulting from (8), I either reject or accept the null hypothesis. There are three levels of significance (1%, 5% and 10%) at which the null hypothesis can be rejected. In a two-sided t-test, if $-2.576 < t > 2.576$, then the null hypothesis is reject at 1% significance level. If $-1.96 < t > 1.96$, then the null hypothesis is rejected at 5% significance level. Lastly, if $-1.645 < t > 1.645$ then the null hypothesis is rejected at 10%.

4. Results

Tables related with the results of the event study can be found in Appendix I to XIII.

If the null hypothesis is rejected, then unconventional monetary policy announcements are having a positive or negative effect on yields (Sawson, 2011). When the ECB purchases bonds directly, the total supply of long term bonds available in the market decreases. As the supply of the bonds decreases, the price of the bonds should rise and the long-term government yields should fall. Additionally, unconventional monetary policy announcements can have a signaling effect regarding future monetary policy. However, not all types of unconventional monetary policy announcements have a clear sign prediction of the yield change. Expectations of easier monetary policy might cause longer-term nominal interest rates to either rise or fall (Sawson, 2011). For example, when the ECB cut the deposit facility to greater negative values (on the 10th of September 2014), it could have been interpreted by the market as a sign that the interest rates would be maintained at a low level for a longer period. Hence, the nominal long-term interest rates were expected to decrease.

Even though the sign of the yield change might change according to the type of the unconventional monetary policy announcement, I expect that the ECB announcements will lower nominal long-term interest rates and, as desired by the ECB, increase inflation expectations.

4.1 Overall effect of the ECB unconventional monetary policy

For both models (the market model and the constant mean return model) and interest rates (10-year government bond yield, swap forward rate 5y5y and corporate bond yields) considered in this research, the abnormal returns are not significant. Still, some conclusions can be drawn about them. Both models show that only when t=1 (one day after the announcement), the abnormal returns decreased. This implies that the market might take some time to react to the ECB unconventional monetary policy announcements.

According to both models (the market model and the constant return model), all the CAYCs, on the 10-year long-term interest rates, are significant at 1% (see tables H and I). The cumulative abnormal 10-year government bond yield change decreased by 3.747 percentage points, during the day and the day immediately after the announcement [0,1]. Albeit, not all the significant changes in the 10-year government bond yield are negative (as expected). Therefore, there is evidence that unconventional monetary policies conducted by the ECB are affecting long-term interest rates significantly, however, the sign of that impact is not totally clear.

Table H: Overall significance of the abnormal and cumulative abnormal 10-year government bond yield changes computed by using the market model.

	AYC [-1]	AYC [0]	AYC [1]	CAYC [-1,0]	CAYC [-1,1]	CAYC [0,1]
Abnormal Yield change	0.001	0.001	-0.002			
T-test	0.011	0.004	-0.010			
Cumulative Abnormal Yield change				0.005***	0.190***	-0.167***
T-test				10.162	2.823	-2.736

*** p<0.01, ** p<0.05, * p<0.1

Table I: Overall significance of the abnormal and cumulative abnormal 10-year government bond yield changes computed by using the constant mean return model.

	AYC [-1]	AYC [0]	AYC [1]	CAYC [-1,0]	CAYC [-1,1]	CAYC [0,1]
Abnormal Yield change	0.007	0.004	-0.019			
T-test	0.027	0.008	-0.079			
Cumulative Abnormal Yield change				2.490***	-2.116***	-3.747***
T-test				23.361	-17.634	-35.035

*** p<0.01, ** p<0.05, * p<0.1

Opposite to what is aimed by the ECB, the results indicate that inflation expectations are decreasing around the date of the announcements of non-standard monetary policy. These results are significant for CAYC [-1,0] and CAYC [-1,1]. According to table J, the yield was 4.928 percentage points lower for CAYC [-1,1].

Table J: Overall significance of the abnormal and cumulative abnormal changes of 5y5y swap forward rate computed by using the constant mean return model.

	AYC [-1]	AYC [0]	AYC [1]	CAYC [-1,0]	CAYC [-1,1]	CAYC [0,1]
Abnormal Yield change	-0.004	0.002	-0.003			
T-test	-0.099	0.017	-0.040			
Cumulative Abnormal Yield change				-0.065***	-0.141***	-0.042
T-test				-2.906	-4.928	-1.570

*** p<0.01, ** p<0.05, * p<0.1

The effect on corporate bond yields is different among the maturities and different credit ratings. For AAA corporate 10-year bond yield, CAYCs [-1,0] and [-1,1] are significant at 1%. But, instead of decreasing the yields, unconventional monetary policy is actually creating a positive yield change. For BBB corporate 10-year bond yield, the change is also positive and significant for CAYC [-1,1] at 10% significance level. On the contrary, the AAA corporate 5-year bond yield is decreasing for all CAYCs (all significant at 1%) which means that unconventional monetary policy is having the desired spillover effect to the corporate 5-year AAA bond yields. However, as the AAA corporate bonds are very similar to government bonds in terms of security, this decrease in yields does not necessarily mean that unconventional monetary policy is affecting corporations and households interest rates. The BBB corporate yield is considered more accurate to measure the spillover effects to other markets of non-standards monetary policy. The yield change of BBB corporate 5-year bond yield increased for all CAYCs and they are significant for CAYC [-1,0] and CAYC [-1,1] at 1% significance level. The BBB rates (or Baa rates) are, according to some papers (e.g. Krishnamurthy and Vissing-Jorgensen, 2010), a robust way of checking unconventional monetary policy spillover effects. Krishnamurthy and Vissing-

Jorgensen (2010) stated that if the objective of unconventional monetary policies is to reduce interest rates paid by the majority of corporations and households, then it is important to observe the impact on other types of yields (e.g., less secure yields). Krishnamurthy and Vissing-Jorgensen (2010) found that the effect on Baa rates was one third smaller when compared to the effect on government bond yields. In this research, I found that instead of lowering BBB corporate bond yields, ECB unconventional monetary policy is actually increasing yields at a significant level.

Table K: Overall significance of the abnormal and cumulative abnormal changes of AAA 10-year corporate bond yield computed by using the constant mean return model.

	AYC [-1]	AYC [0]	AYC [1]	CAYC [-1,0]	CAYC [-1,1]	CAYC [0,1]
Abnormal Yield change	0.016	0.004	-0.006			
T-test	0.074	0.017	-0.025			
Cumulative Abnormal Yield change				0.457***	0.332***	-0.026
T-test				6.339	3.799	-0.357

*** p<0.01, ** p<0.05, * p<0.1

Table L: Overall significance of the abnormal and cumulative abnormal changes of BBB 10-year corporate bond yield computed by using the constant mean return model.

	AYC [-1]	AYC [0]	AYC [1]	CAYC [-1,0]	CAYC [-1,1]	CAYC [0,1]
Abnormal Yield change	0.003	-0.002	0.002			
T-test	0.037	-0.021	0.140			
Cumulative Abnormal Yield change				0.029	0.070*	-0.005
T-test				1.023	1.760	-0.144

*** p<0.01, ** p<0.05, * p<0.1

Table M: Overall significance of the abnormal and cumulative abnormal changes of AAA 5-year corporate bond yield computed by using the constant mean return model.

	AYC [-1]	AYC [0]	AYC [1]	CAYC [-1,0]	CAYC [-1,1]	CAYC [0,1]
Abnormal Yield change	0.053	-0.198	0.069			
T-test	0.092	-0.056	0.035			
Cumulative Abnormal Yield change				-3.180***	-1.662***	-2.838***
T-test				-4.063	-1.867	-3.226

*** p<0.01, ** p<0.05, * p<0.1

Table N: Overall significance of the abnormal and cumulative abnormal changes of BBB 5-year corporate bond yield computed by using the constant mean return model.

	AYC [-1]	AYC [0]	AYC [1]	CAYC [-1,0]	CAYC [-1,1]	CAYC [0,1]
Abnormal Yield change	0.004	0.002	0.000			
T-test	0.040	0.014	0.001			
Cumulative Abnormal Yield change				0.117***	0.120***	0.040
T-test				3.780	2.592	0.943

*** p<0.01, ** p<0.05, * p<0.1

Overall, the unconventional monetary policy pursued by the ECB had significant effect on 10-year nominal long term interest rates. The significant results found for the swap forward rate and the corporate bond yields show that unconventional monetary policy conducted by ECB had widespread effects.

4.2 Effect of the ECB unconventional monetary policy per country and per announcement

Whether the effect of each ECB announcement on the nominal and real long-term interest is positive or negative is not straightforward to conclude. Appendix IV and VIII to XIII show the cumulative abnormal yield changes per announcement for both models.

When the ECB purchases long-term government bonds, the supply decreases. This policy affects interest rates through a portfolio balance: The ECB reduces the portfolio of long term versus short-term bonds for the investors and, consequently, lowers long-rates against short rates (Krishnamurthy and Vissing-Jorgensen, 2010). Even though the results are not significant during the first time that ECB started buying covered bonds (07/05/2009), they still show that the cumulative abnormal 10-year government bond yield decreased. Instead, when they decided to start the second purchase of covered bonds (CBPP2) the cumulative abnormal yield change increased. This might imply that the effectiveness of the policy declines with each CBPP announcement. After the announcement of the Securities Market Programme (10/5/2010), the cumulative abnormal 10-year government bond yield decreased and the inflation expectations increased, significantly, for all CAYCs (at 1% level). The effect on corporate bond yields is not completely clear in terms of the sign of the yield change and not significant. The results for the 10-year government bond yield match the findings of Eser and Schwaab (2013). I also found that yields decreased for the PIIGS countries (Portugal, Ireland, Italy, Greece and Italy).

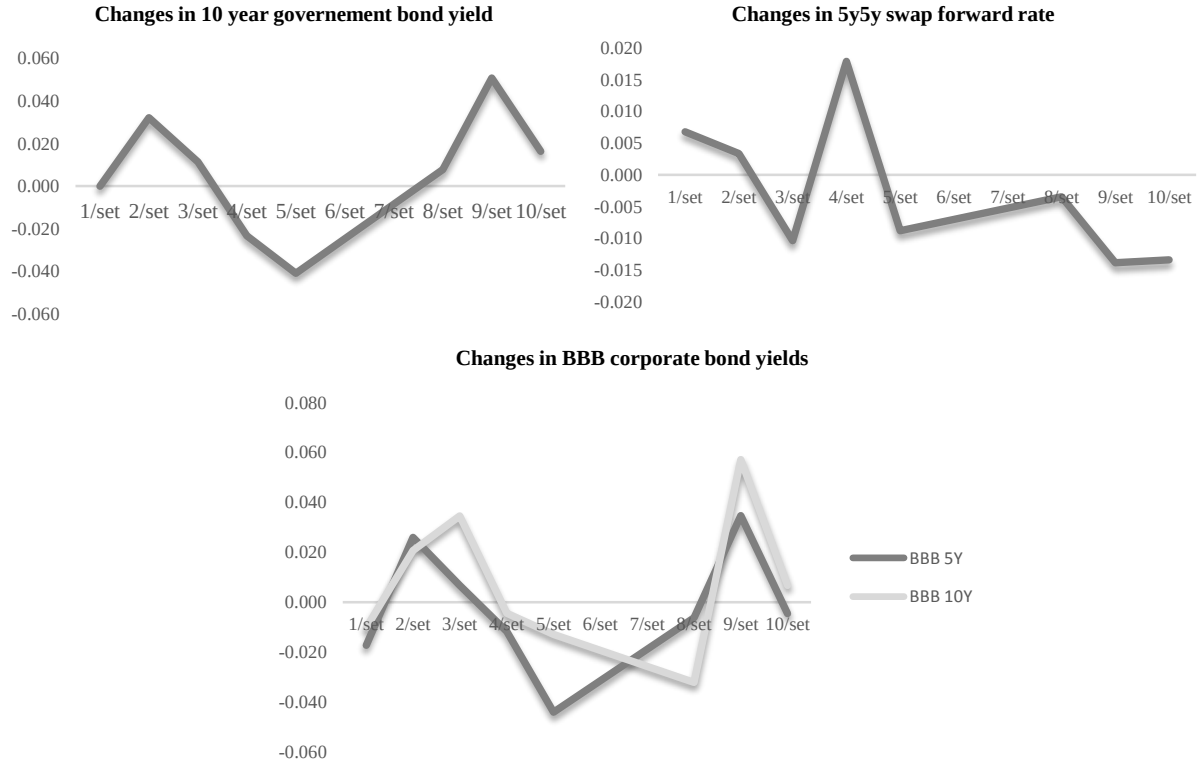
Giving the constant mean return model, announcements of LTROs lowered yields for all the CAYCs. In similar way, the BBB 10-year and 5-year corporate bond yields decreased for almost the entire lot of LTROs announcements. This outcome shows that the ECB is being effective in reducing nominal long-term interest rates by targeting longer-term refinancing operations. On the other hand, Appendix IX shows that during all the TLTROs announcements the 5y5y swap forward rate decreased significantly, meaning that inflation expectations are also falling with the LTROs announcements.

Following the Expectations Hypothesis, one would expect that when the ECB lowered the deposit facility rate to negative values, the long term interest rate would consequently fall. The results show that on the 11th of June 2014, when the ECB started to apply a -0.10 deposit facility, the cumulative abnormal yield changes increased (not significantly) according to the constant mean return model, which is not in line with the theory mentioned before. The corporate bond yields also increased for the same period. Only the expected inflation decreased significantly at 5%. Besides the announcement on 04/09/2014, there was no announcement regarding the deposit facility rate that had led to a negative yield impact for the 10-year government bonds and for the BBB corporate bond yield.

On the 4th of September of 2014, the ECB announced the new asset-backed securities purchase programme (ABSPP) and at the same time they lowered the deposit rate facility to historical negative levels (-0.20). The combination of these two announcements was expected to significantly affect nominal and real long term interest rates. As predictable, the effect for the entire Eurozone was negative on the cumulative abnormal 10-year government bond yield and on BBB 5-year bond yield

but not significant. Figure 2 shows the negative cumulative change in yield for the 10-year government bond and corporate bonds at the time of the announcement and afterwards. The inflation expectations rose on 4th of September and then fell afterwards. Making use of the constant mean return model, all the countries considered in the research presented a negative significantly cumulative 10-year government bond yield change (see Appendix V). Nonetheless, according to the market model only the PIIGS countries had a negative yield change. The inflation expectations during this announcement increased but not significantly.

Figure 2 – Changes in nominal and real long term interest rates around the unconventional monetary policy announcement on the 4th of September 2014



Source: Datastream & Bloomberg

Tables V to VII show the cumulative abnormal yield changes for 10-year government per Eurozone country when using the constant mean return model for the 10-year government bond yield. One announcement that stands out for its significantly negative impact is the one on the 21st of November 2014 when the ECB started buying securities through the ABSPP. For all the CAYCs and all countries the yield change decreased during this announcement. The results are also significant and negative for the BBB 10 and 5 year corporate bond yield. Therefore, the announcement (04/09/2014) and the implementation (21/11/2014) of the ABSPP Programme had a significantly impact on real and nominal long-term interest rates.

5. Conclusion

In this study, I found that unconventional monetary policy conducted by the ECB after the financial crisis of 2008 had a significant effect on real and nominal long-term interest rates, which is in line with the previous literature mentioned before. Nevertheless, whether non-standard monetary policies are decreasing or increasing changes in nominal and real long-term interest rates around the announcement date is uncertain.

Abnormal long-term yields are only decreasing on the day after an ECB announcement (t=1), which might imply that the market is taking some time to react to the ECB unconventional monetary policy announcements.

Regarding the overall significance of unconventional monetary policy, the results for both models (the market model and the constant mean return) enumerated in this study are very similar. All the CAYCs, on 10-year long-term interest rates, are significant at 1% (see tables H and I). The cumulative abnormal yield (10-year government bond) decreased by 3.747 percentage points during CAYC [0,1], at 1% significance level. Albeit the fact that not all the significant changes in the 10-year government bond yield are negative (as expected).

The effect on corporate bond yields is different amongst maturities and different types of credit ratings. A greater decline on the BBB corporate 10-year bond yield would mean that the effect of unconventional monetary policy is being spread over corporations and households. However, the outcome obtained indicates that BBB corporate 10-year yield changed positively around the announcements and only CAYC [-1,1] is significant at 10%. Likewise, the BBB corporate 5-year bond yield change increased for all CAYCs and they are significant for CAYC [-1,0] and CAYC [-1,1] at 1% level. Overall, the effect on BBB corporate 10-year bond yields is significant but the sign of the cumulative abnormal yield change is opposite to what was expected. As predictable, the AAA corporate 5-year bond yield followed the same pattern as the 10-year government bond yield and declined for all CAYCs (all significant at 1%)

Against to what is aimed by the ECB, the inflation expectations decreased around the announcements of non-standard monetary policy meaning that unconventional monetary is in fact decreasing inflation expectations. CAYC [-1,0] and CAYC [-1,1] are significant at 1% level.

The fact that nominal long-term interest rates are decreasing together with expected inflation means that the real term interest rates might decrease even further. These effects are contradictory to what has

been intended by the ECB. When using unconventional monetary policy, the main goal of the ECB is to raise the inflation rate through investor's inflation expectations, so that Eurozone can recover from the actual stagnated low level of inflation and achieve their main purpose, price stability (around 2% inflation).

Besides the overall effect of the ECB unconventional monetary policy, the yield changes behave different depending on the type announcement itself and also on which Eurozone country is being analysed. I found evidence of a significant cumulative abnormal negative yield change on LTROs for all the CAYCs (on 10-year government bond yield and BBB 10-year and 5-year corporate bond yields). However, the inflation expectations also declined significantly during those announcements. Additionally, I found that the effect on long term interest rates can be more persistent and aligned with the theory for a specific group of countries during some announcements. In particular, I found that the 4th of September of 2014 significantly lowered the 10-year government bond yield and BBB 5-year bond yield for Portugal, Ireland, Italy, Greece and Spain (PIIGS).

Regarding the impact of ECB negative deposit facility rate announcements, the results are blurred. In some of the announcements the cumulative abnormal yield changes positively, in others negatively. However, the announcements made on 04/09/2014 and 10/03/2014 on deposit facility rate together with another policy announcement (04/09/2014 and 10/03/2014) rose the inflation expectations at 1% significance level.

All in all, unconventional monetary policy conducted by the ECB had a significant effect on nominal and real long term interest rates. At this point of time it has been already 7 years after the first unconventional monetary policy intervention. Still it remains unclear whether the long term impact of those measures will eventually have the desired effect or if the ECB will just continue on adding more unconventional programmes and maintain nominal interest rates negative hoping that one day they will increase inflation to the desired 2%. If the ECB continues on maintaining these ultra-low interest rates it might get to a point where they will be counterproductive (Hannoun, 2015). When interest rates are very low, governments have no incentive to reduce their debt and in fact are more willing to borrow. This implies that low rates are only hiding the problem and not fighting it. Other challenges that might arise from low interest rates are related with banks. Should they pass the negative interest rates on to their clients or just decrease their profits? For how long can the banks maintain? Also insurance companies and pension funds are put at risk. For further research I would suggest not only observing the effect on the days around the announcements but also investigate the risks that might be consequence of prolonged low interest rates.

References

Acharya, V.V., Eisert, T., Eufinger, C. & Hirsch, C. W. (2015). 'Whatever it Takes: The Real Effects of Unconventional Monetary Policy'. IMF Conference: 16th Jacques Polak Annual Research Conference.

Anderson, R. G., & Liu, Y. (2013). 'How Low Can You Go? Negative Interest Rates and Investors' Flight to Safety'. Federal Reserve Bank of St. Louis, *The Regional Economist*, issue January.

Assenmacher, K. & Gerlach, S. (2008). 'The Term Structure of Interest Rates across Frequencies'. *ECB Working Paper No. 976.*

Berkmen, S. P. (2012). 'Bank of Japan's Quantitative and Credit Easing: Are They Now More Effective?'. *IMF Working Paper* No. 12/2.

Bernanke, B. S., Reinhart, V. R. & Sack, B. P., (2004).'Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment'.*FEDS Working Paper* No. 2004-48.

Brand, C., Buncic, D. & Turunen, J. (2010).' The Impact of ECB Monetary Policy Decisions and Communication on the Yield Curve'. *European Economic Review*, 8 (6), 1266-1298.

Breedon, F., Chadha, J. S., & Waters, A. (2012). 'The financial market impact of UK quantitative easing'. *Oxford Review of Economic Policy*, 28 (4), 702-728.

Bowdler, C. & Radia, A. (2012). 'Unconventional monetary policy: the assessment'. *Oxford Review of Economic Policy*, 28 (4), 603–621.

Carvalho, D. & Fidora, M. (2015). 'Capital Inflows and Euro Area Long-Term Interest Rates'. *ECB Working Paper No. 1798*.

Cossetti, F. & Guidi, F. (2009). 'ECB monetary policy and term structure of interest rates in the Euro area: an empirical analysis'. *Università Politecnica delle Marche Dipartimento di Economia*. Quaderno di ricerca n. 334.

Cox, J.C., Ingersoll, J.E. & Ross, S.A. (1985). 'A theory of the term structure of interest rates'. *Econometrica*, Vol. 53, No. 2, 385-408.

D'Amico, S. & King T. (2010). 'Flow and stock effects of large-scale treasury Purchases'. *Federal Reserve Board Finance and Economics Discussion Series*, 2010–52.

Eser, F. & Schwaab, B. (2013). 'Assesing Asset Purchases within the ECB's Securities Markets Programme'. *ECB Working paper series No.1587.*

Falagiarda, M. & Reitz, S. (2015). 'Announcements of ECB unconventional programs: Implications for the sovereign spreads of stressed euro area countries'. *Journal of International Money and Finance*, 53, (C), 276-295.

Fisher, I. (1930). 'The Theory of Interest'. *New York: Macmillan Co.*

Gagnon, J., Raskin J.M., Remasche J. & Sack, B. (2011). 'The financial market effects of the Federal Reserve's large-scale asset purchases'. *International Journal of Central Banking*, (7), (1), 3–43.

Gambacorta, L., Hofmann, B. & Peersman, G. (2012). 'The Effectiveness of Unconventional Monetary Policy at the Zero Lower Bound: A Cross-Country Analysis'. *BIS working papers, 384.*

Georgoutsos, D. A. & Migiakis, P. M. (2012). 'Benchmark Bonds Interactions Under Regime Shifts'. *European Financial Management*, Vol. 18, Issue 3, 389-409.

Gerlach, S., & Lewis, J. (2010). 'Zero lower bound, ECB interest rate policy and the financial crisis'. *De Nederlandsche Bank Working Paper No. 254.*

Ghysels, E., Idier, J., Manganelli , S. & Vergote, O. (2014). 'A High Frequency Assessment of the ECB Securities Markets Programme'. *ECB Working Paper No. 1642*

Gospodinov, N. & Wei, B. (2015). 'A Note on Extracting Inflation Expectations from Market Prices of TIPS and Inflation Derivatives'. *Federal Reserve Bank of Atlanta.* Retrieved June 2, 2016 from https://www.frbatlanta.org/-/media/Documents/news/speeches/2015/note-on-extracting-inflation-expectations.pdf.

Guidolin, M. & Thornton, D. L. (2008). 'Predictions of Short-Term Rates and the Expectations Hypothesis of the Term Structure of Interest Rates'. *ECB Working Paper No. 977.*

Hannoun, H. (2012). 'Monetary policy in the crisis: testing the limits of monetary policy'. *47th SEACEN Governors' Conference.* Seoul, Korea, 13-14.

Hannoun, H. (2015). 'Ultra-low or negative interest rates: what they mean for financial stability and growth'. *Bank for Interantional Settlements*, Eurofi High-Level Seminar. Riga.

Honda, Y., Kuroki, Y., Tachibana, M. (2013). 'An Injection of Base Money at Zero Interest Rates:
Empirical Evidence from the Japanese Experience 2001–2006'. *Japanese Journal of Monetary and Financial Economics,* (1), 1-24.

Joyce, M., Lasaosa, A., Stevens, I. & Tong, M. (2010). 'The Financial Market Impact of Quantitative Easing'. *Bank of England Working Paper No. 393.*

Kapetanios, G., Mumtaz, H., Stevens, I. & Theodoridis, K. (2012). 'Assesing the economy-wide effects of quatitative easing'. *The Economic Journal*, 122, F316-F347.

Keister, T. (2011). 'Why Is There a "Zero Lower Bound" on Interest Rates?'. *Federal Reserve Bank of New York: Liberty Street Economics*. Retrieved June 2, 2016 from http://libertystreeteconomics.newyorkfed.org/2011/11/why-is-there-a-zero-lower-bound-on-interest-rates.html

Koller, T., Dobbs, R., & Lund, S. (2014, Winter). 'What effect has quantitative easing had on your share price?'. *McKinsey on Finance,* 49, 15-18.

Krishnamurthy, A., & Vissing-Jorgensen, A. (2010). 'The Effects of Quantitative Easing on Long-term Interest Rates'. *Kellogg School of Management*.

Lam, W. R. (2011). 'Bank of Japan's Monetary Easing Measures: Are They Powerful and Comprehensive?'. *IMF Working Papers,* 1-18.

Mackinlay, A.C. (1997). 'Event Studies in Economics and Finance'. *Journal of Economic Literature*. Vol. XXXV, 13-39.

Meaning, J., & Zhu, F. (2011). 'The impact of recent central bank asset purchase programmes'. *BIS Quarterly Review,* December 2011.

Meier, A. (2009). 'Panacea, curse, or nonevent? Unconventional monetary policy in the United Kingdom'. *IMF Working Paper,* No. 09/163, 1-47.

Mishkin, F. S. (1991). 'Is the Fisher Effect for Real? A Reexamination of the Relationship between Inflation and Interest Rates'. *NBER Working Paper No. 3632*.

Neely, J. C. (2010). 'The Large-Scale Asset Purchases Had Large International Effects'. *Federal Reserve Bank of St.Louis*, Working paper 2010-018C.

Pattipeilohy, C., van den End, J., Tabbae, M., Frost, J. & de Haan, J. (2013). 'Unconventional Monetary Policy of the ECB during the Financial Crisis: An Assessment and New Evidence'. *De Nederlandsche Bank Working Paper No. 381.*

Randow , J. (2012). 'Draghi May Enter Twilight Zone Where Fed Fears to Tread'. *Bloomberg*. Retrieved June 2, 2016 from http://www.bloomberg.com/news/articles/2012-06-26/draghi-may-enter-twilight-zone-where-bernanke-fears-to-tread

Rigobon, R. (2003). 'Identification Through Heteroskedasticity'. *Review of Economics and Statistics*, 85, 777-92.

Rigobon, R. & Brian, S. (2003). 'Measuring the Response of Monetary Policy to the Stock Market'. *Quarterly Journal of Economics*, 118, 639-669

Rigobon, R. & Brian, S. (2004). 'The Impact of Monetary Policy on Asset Prices'. *Journal of Monetary Economics*, 51, 1553-1575

Rigobon, R. & Brian, S. (2005). 'The Effects of War risk on US Financial Markets'. *Journal of Banking and Finance*, 29, 1769-1789

Rivolta, G. (2014). 'An Event Study Analysis of ECB Unconventional Monetary Policy'. *Department of Economics, Management and Quantitative Methods at Università degli Studi di Milano*, Working paper nr.2014-02.

Russell, S. (1992). 'Understanding the term structure of interest rates: the expectations theory'. *Federal Reserve Bank of St. Louis Review*, (74), 4

Sandler, D. & Sandler, R. (2012). 'Multiple Event Studies in Public Finance and Labor Economics: A Simulation Study with Applications', *Journal of Economic and Social Measurement*, IOS Press, (39), No 1-2, 31-57.

Sawson, E.T. (2011). 'Let's Twist Again: A High-Frequency Event-Study Analysis of Operation Twist and Its Implications for QE2', *Federal Reserve Bank of San Francisco*, Working Paper 2011-08.

Warner, J. (2015). 'Negative interest rates put world on course for biggest mass default in history'. *The Telegraph*. Retrieved June 2, 2016 from

http://www.telegraph.co.uk/finance/comment/jeremy-warner/11569329/Jeremy-Warner-Negative-interest-rates-put-world-on-course-for-biggest-mass-default-in-history.html

Wright, J. H. (2012). 'What Does Monetary Policy Do to Long-Term Interest Rates at the Zero Lower Bound?'. *The Economic Journal*, (122), Issue 564, F447-F466

Appendix

Appendix I. Cumulative Abnormal Yield Change [-1,1] for the 10-year government bond yield and significant t-test for all the 22 unconventional monetary policy announcements (calculated by using the market model)

		Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
07/05/2009	CAYC	-0.01***	0.0016	0.0027	0.0097	0.0032	-0.0636*	-0.0128	-0.008	0.0044	-0.037***	-0.01**
	T-test	-3.715	0.6210	0.5195	1.3231	0.8973	-1.8543	-1.0655	-1.340	0.5475	-2.6506	-2.164
02/07/2009	CAYC	-0.008***	0.0046**	0.0019	0.0065***	-0.0003	-0.01***	-0.029***	-0.003	0.0042***	-0.0062*	-0.003
	T-test	-3.755	1.9861	1.2495	6.0324	-0.1599	-11.411	-4.2729	-0.636	5.0815	-1.8434	-0.712
10/05/2010	CAYC	0.0556	0.0137	0.0539	0.0506	0.0787	-0.3447	-0.2075	-0.061	0.0664	-0.2750	-0.104
	T-test	1.3157	0.7543	0.9235	1.0888	0.8067	-0.8191	-1.2085	-0.840	1.2553	-1.1309	-1.061
30/06/2010	CAYC	0.0255	-0.019***	-0.004	-0.021***	0.0163	-0.04***	-0.019***	0.0004	-0.0093	-0.0394**	0.0110
	T-test	1.6387	-14.607	-0.389	-3.144	1.0365	-11.484	-3.6387	0.0347	-0.7063	-2.2357	0.5425
08/08/2011	CAYC	-0.019	0.0036	-0.011	0.0352	-0.0277	0.1491*	0.1854	0.0083	-0.0186	0.1642	-0.031
	T-test	-0.478	0.1560	-0.150	1.4689	-0.4116	1.7020	0.7939	0.1754	-0.3266	0.9127	-8.160
06/10/2011	CAYC	0.0112	0.0214	0.0394*	0.0103	0.0505**	-0.0642	0.0239	-0.029	0.0467**	-0.0040	-0.038
	T-test	0.5014	0.4540	1.7246	0.5213	2.3654	-10.224	1.5732	-1.204	2.1214	-0.6332	-3.391
08/12/2011	CAYC	-0.041	0.0096	-0.055	-0.027	-0.0672	0.0240	-0.0425*	0.0366	-0.0527	-0.0270	0.0893***
	T-test	-1.499	0.3046	-0.747	-1.360	-1.1188	0.5242	-1.7960	1.3509	-1.2154	-1.4691	4.0726
29/02/2012	CAYC	0.0135	0.0160***	0.0106	-0.033*	0.0143	-0.0310	0.0221	-0.024	0.0079	0.0857**	0.0278***
	T-test	0.8282	3.7588	0.5261	-1.771	0.4023	-0.9041	0.8628	-1.582	0.4230	2.4023	5.6877
06/09/2012	CAYC	0.0478***	0.0473***	0.0807*	0.0387***	0.0948**	0.0332**	-0.0327*	-0.02**	0.0795**	-0.0689	-0.078**
	T-test	2.7278	3.9782	1.7006	5.0543	2.4771	2.1434	-1.8174	-2.484	2.4947	-1.5412	-2.501
31/10/2012	CAYC	-0.015	0.0010	0.0096	0.0497	0.0001	0.0521**	0.0101*	-0.02**	0.0055	0.0055	-0.013
	T-test	-1.105	0.0855	0.6545	1.1633	0.0103	2.4395	1.8614	-2.049	0.4777	0.7996	-1.247
21/12/2012	CAYC	-0.017***	-0.0231	-0.045***	-0.006	-0.0319**	0.0098	0.0242	0.0273***	-0.0362**	-0.0034	-0.002
	T-test	-2.642	-0.8258	-4.416	-0.701	-2.4574	0.3191	1.0628	3.1485	-2.1036	-0.3773	-0.335
11/06/2014	CAYC	0.0981	-0.0003	-0.004	0.0517	-0.0347***	-0.0212	-0.0294	-0.010	-0.0105	-0.0532	0.0026
	T-test	1.0086	-0.0343	-0.988	0.9494	-8.0777	-0.3499	-1.0299	-0.520	-1.5067	-1.1835	0.0700
04/09/2014	CAYC	0.0331*	0.0153***	0.0264***	0.0213**	0.0763***	-0.0225*	-0.034**	-0.045***	0.0400***	-0.0219**	-0.052***
	T-test	1.7742	3.1907	2.9679	2.4284	4.1571	-1.6252	-2.3186	-3.214	4.6465	-2.5056	-7.466
21/11/2014	CAYC	0.0245**	0.0389***	0.0156	0.0343***	0.0139	-0.0222	0.0231*	-0.021	0.0174	-0.0191	-0.033
	T-test	2.0531	4.0249	0.6093	2.7984	0.3954	-0.8867	1.7054	-1.041	1.2156	-0.7749	-2.039
22/01/2015	CAYC	-0.064	-0.0094	-0.063	-0.003	0.0276	-0.0634	-0.0236	0.0026	-0.0027	-0.0403	-0.002
	T-test	-0.338	-0.1497	-0.323	-0.081	0.1647	-0.6194	-1.2990	0.0401	-0.0263	-0.9998	-0.023
09/03/2015	CAYC	-0.076	0.0701	0.0589	-0.037	-0.0988	0.0991	-0.0101	0.0379	-0.0905	0.1116	0.0694
	T-test	-1.202	1.6109	0.5141	-0.637	-0.5626	1.3764	-0.4292	0.5185	-0.9116	1.0667	0.7659
16/06/2015	CAYC	0.0047	-0.0079	0.0100	-0.014	-0.0651	0.0996**	0.0403***	0.0213	-0.0329	0.0289	0.0415
	T-test	0.0766	-0.3995	0.3676	-0.666	-0.7287	2.2716	12.7217	1.4838	-0.6425	0.6034	0.6507
22/09/2015	CAYC	0.0037	-0.0001	0.0037	-0.009	-0.0122	0.0318	-0.0061	-0.003	0.0053	0.0362	0.0251
	T-test	0.1091	-0.0029	0.2465	-0.592	-0.3721	1.3365	-0.1447	-0.202	0.2037	1.4556	0.9435
03/12/2015	CAYC	0.0034	-0.0013	0.0008	-0.058	0.0076	0.0233	0.0122	0.0196	0.0086	-0.0148	0.0025
	T-test	0.0588	-0.0297	0.0360	-0.731	0.1381	0.7139	0.2972	1.3161	0.1460	-0.5786	0.0730
10/03/2016	CAYC	0.0718	0.0294	0.1436	0.0787	0.2855	-0.0609*	0.0078	-0.078**	0.1797**	-0.09***	-0.084***
	T-test	1.0244	2.2679	1.4200	0.6663	0.7491	-1.6613	0.2866	-2.550	2.2320	-7.1473	-3.321
21/04/2016	CAYC	-0.003	0.0172	-0.116*	0.0261	0.1596	-0.0936*	-0.0647	-0.022	-0.0554***	0.0047	-0.006
	T-test	-0.050	0.2870	-1.732	0.3089	0.5448	-1.8645	-1.1179	-0.463	-2.8442	0.1027	-0.190
08/06/2016	CAYC	-0.000	-0.0131	0.0857***	0.0098	-0.1765	0.0287	0.0836	-0.014	-0.0109	-0.0321**	-0.029
	T-test	-0.01	-0.3205	6.3974	0.2781	-0.5641	1.0623	1.0695	-0.930	-0.1930	-2.1707	-1.056

Appendix II. Cumulative Abnormal Yield Change [-1,0] for the 10-year government bond yield and significant t-test for all the 22 unconventional monetary policy announcements (calculated by using the market model)

\		Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
07/05/2009	CAYC	-0.003**	0.0000	0.0051**	0.0102*	-0.0002	-0.048	-0.013	-0.0076	0.0042	-0.032***	-0.005***
	T-test	-2.5186	-0.0151	2.2233	1.8947	-1.5428	-1.259	-1.136	-1.2236	0.4627	-3.5261	-14.666
02/07/2009	CAYC	-0.004***	0.0017	0.0022***	0.0048***	-0.0002	-0.01***	-0.02***	-0.0016	0.0026***	-0.0051	-0.0045
	T-test	-2.9155	1.4262	3.4503	4.9380	-0.0819	-10.98	-17.68	-0.3081	2.9727	-1.4984	-1.3285
10/05/2010	CAYC	0.0584*	0.0122	0.0518	0.0462	0.0755	-0.274	-0.179	-0.0602	0.0582	-0.2148	-0.0988
	T-test	1.8274	0.6022	0.8430	0.9431	0.7165	-0.571	-0.969	-0.7805	1.0378	-0.7799	-0.9814
30/06/2010	CAYC	0.0274***	-0.012***	-0.0032	-0.011*	0.0077	-0.024***	-0.010**	-0.0008	-0.0112	-0.015***	0.0080
	T-test	22.3197	-31.09	-0.3035	-1.934	0.4432	-9.699	-2.381	-0.0585	-0.8981	-4.2357	0.3419
08/08/2011	CAYC	-0.0336	0.0171	-0.0404	0.0075	-0.0370	0.1365	0.2100	0.0255	-0.0359	0.1748	-0.018***
	T-test	-1.2295	2.1626	-0.6680	6.4668	-0.5213	1.7460	0.9366	0.5998	-0.6994	1.0039	-14.898
06/10/2011	CAYC	0.0081	0.0414	0.0365*	0.0196***	0.0425**	-0.044***	0.0191	-0.032**	0.0377*	-0.0037	-0.032***
	T-test	0.3127	1.4993	1.8724	3.0998	2.1825	-6.191	1.1535	-2.0985	1.6537	-0.5249	-3.8506
08/12/2011	CAYC	-0.0334	0.0261**	-0.085***	-0.006	-0.0849***	0.0460***	-0.044***	0.0417***	-0.0621***	-0.029***	0.0691***
	T-test	-1.1060	2.0852	-8.8467	-0.767	-80.809	5.0803	-14.32	4.5676	-3.4838	-3.0598	3.5977
29/02/2012	CAYC	0.0178	0.0118***	-0.0013	-0.010*	-0.0115	-0.000	0.0213	-0.0104	-0.0042	0.0516	0.0199***
	T-test	1.6062	2.6101	-0.0708	-1.686	-0.6013	-0.012	0.7843	-0.7146	-0.2986	1.2881	3.9155
06/09/2012	CAYC	0.0280	0.0374***	0.0790**	0.0298***	0.0690	0.0191	-0.015	-0.027***	0.0628*	-0.0222	-0.0494
	T-test	1.4666	4.0447	2.3858	5.5054	1.6035	1.1174	-0.877	-8.4978	1.9194	-0.7110	-1.3816
31/10/2012	CAYC	-0.0012	0.0060	0.0154**	0.0050	0.0047**	0.0206***	0.0058	-0.007***	0.0096	-0.0001	-0.0021
	T-test	-0.3205	0.6668	2.3256	0.6360	2.3513	5.6023	0.9637	-5.2201	1.1512	-0.0246	-0.5794
21/12/2012	CAYC	-0.014***	-0.0262	-0.033***	-0.009***	-0.0239*	0.0155	0.0011	0.0239***	-0.0353***	0.0031	0.0008
	T-test	-2.9474	-0.9939	-2.7167	-3.649	-1.6733	0.4868	0.3117	16.7782	-8.2057	0.6275	0.1161
11/06/2014	CAYC	0.0987	-0.0018	-0.0022	0.0511	-0.0220***	-0.021	-0.026	-0.0125	-0.0083	-0.0551	-0.0137
	T-test	1.0243	-0.2076	-0.4590	0.9138	-4.8277	-0.309	-0.835	-0.6250	-1.0817	-1.4074	-0.4023
04/09/2014	CAYC	0.0310**	0.0107*	0.0174*	0.0092*	0.0536***	-0.018	-0.013***	-0.0287*	0.0277***	-0.0183**	-0.036***
	T-test	2.0827	1.9474	1.6907	1.7952	2.5966	-1.190	-4.495	-1.7863	2.8348	-2.3585	-4.7446
21/11/2014	CAYC	0.0116	0.0288***	0.0023	0.0219	-0.0086	-0.022	0.0207	-0.0059	0.0047	-0.0102	-0.0141
	T-test	1.0461	2.8977	0.0888	1.5584	-0.3273	-0.835	1.6411	-0.3174	0.4127	-0.3618	-1.0932
22/01/2015	CAYC	0.0597	0.0297	0.0491	0.0220***	0.1065	-0.084	-0.026**	-0.0360	0.0581	-0.0392	-0.0499
	T-test	0.4707	0.8098	0.3043	3.7913	0.8922	-0.889	-2.509	-1.0519	0.9744	-0.9485	-0.9606
09/03/2015	CAYC	-0.0337	0.0255	-0.0311	-0.002	-0.0267	0.0360	-0.012	0.0152	-0.0284	0.0485	0.0260
	T-test	-0.5039	0.7444	-0.6054	-0.043	-0.1397	0.5553	-0.455	0.1836	-0.2829	0.4321	0.2634
16/06/2015	CAYC	0.0323	0.0070	-0.0032	0.0045*	-0.0841	0.0916***	0.0254***	0.0177	-0.0084	0.0323	0.0388
	T-test	0.6555	0.7990	-0.1202	1.7700	-1.1160	3.5574	9.4741	1.1428	-0.1543	0.6390	0.5454
22/09/2015	CAYC	-0.019**	-0.0125	-0.0072	-0.016	-0.0105	0.0181	0.0150	0.0084*	-0.0121	0.0379**	0.0192
	T-test	-1.9631	-1.3288	-1.5764	-6.844	-0.2785	0.6721	0.4199	1.7199	-0.9410	2.3397	0.6310
03/12/2015	CAYC	-0.0289	-0.030***	0.0120	-0.071	0.0372	0.0031	0.0192	0.0134	-0.0275	0.0035	0.0215
	T-test	-0.7464	-4.3521	0.7507	-0.982	1.2447	0.0989	0.4421	0.7830	-0.7531	0.1948	1.0347
10/03/2016	CAYC	0.0944***	0.0150	0.0679	0.1282***	-0.0305	-0.042	0.0128	-0.034**	0.1734***	-0.056***	-0.073***
	T-test	15.439	1.1847	0.6382	3.4347	-0.1400	-1.005	0.4444	-1.9710	35.028	-4.2494	-20.797
21/04/2016	CAYC	-0.0069	-0.0073	-0.0604	0.0138	0.1973	-0.057	-0.046	-0.0240	-0.0320	-0.0175	-0.0009
	T-test	-0.0889	-0.1196	-0.8449	0.1418	0.6589	-0.996	-0.691	-0.4580	-1.5380	-0.4503	-0.0236
08/06/2016	CAYC	0.0163	-0.0067	0.0660***	0.0282*	0.0083	0.0245	0.0922	-0.0151	0.0303***	-0.030***	-0.037***
	T-test	0.5128	-0.1433	44.1070	1.7426	0.0288	0.8216	1.4311	-1.0117	5.3303	-4.1442	-40.947

Appendix III. Cumulative Abnormal Yield Change [0,1] for the 10-year government bond yield and significant t-test for all the 22 unconventional monetary policy announcements (calculated by using the market model)

		Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
07/05/2009	CAYC	-0.004***	0.0005	-0.0009	0.0073	0.0034	-0.06**	-0.0121	-0.008	0.0069	-0.0252	-0.0104*
	T-test	-9.3261	0.1703	-0.2528	0.8728	0.9755	-2.102	-0.9628	-1.230	1.0700	-1.5824	-1.8534
02/07/2009	CAYC	-0.006***	0.0044***	0.0011	0.0036***	-0.0014	-0.01***	-0.022***	0.0005	0.0025***	-0.002***	-0.0027
	T-test	-6.5309	2.9187	0.6423	18.905	-1.2334	-6.786	-3.4767	0.1699	3.1677	-10.798	-0.5191
10/05/2010	CAYC	0.0424	-0.0025	0.0587	0.0519	0.0936	-0.448	-0.2103	-0.07	0.0653	-0.3053*	-0.1048
	T-test	0.8846	-0.4616	1.0753	1.1995	1.0737	-1.463	-1.3647	-1.029	1.3343	-1.6508	-1.1054
30/06/2010	CAYC	0.0125	-0.013***	0.0032	-0.013*	0.0211***	-0.028***	-0.011**	-0.006	0.0026**	-0.034**	-0.0047
	T-test	0.7707	-12.428	0.8106	-1.721	5.5012	-20.60	-2.0200	-0.713	1.9979	-2.1616	-0.4383
08/08/2011	CAYC	-0.0157	-0.0089	-0.0209	0.0309	-0.0447	0.1200	0.1925	0.0168	-0.0263	0.1638	-0.0222***
	T-test	-0.3472	-0.4920	-0.2610	1.2587	-0.7077	1.2667	0.7961	0.3288	-0.4306	0.8850	-7.4088
06/10/2011	CAYC	0.0201	-0.0131	0.0309	0.0037	0.0390*	-0.039***	0.0226*	-0.020	0.0393*	0.0014	-0.0268**
	T-test	1.4556	-0.4870	1.2291	0.1665	1.7071	-18.28	1.7182	-0.737	1.8545	0.7047	-2.0694
08/12/2011	CAYC	-0.0397*	-0.0097	-0.0170	-0.021	-0.0243	0.0055	-0.0190	0.0203	-0.0305	-0.0078	0.0452***
	T-test	-1.6676	-0.4170	-0.2197	-0.927	-0.4074	0.1108	-0.8627	0.6669	-0.6180	-0.6644	9.6127
29/02/2012	CAYC	-0.0009	0.0124***	0.0203***	-0.031**	0.0296	-0.039*	0.0250	-0.026***	0.0171**	0.0800***	0.0153***
	T-test	-0.1218	3.1393	5.9393	-2.076	1.3460	-1.817	1.0617	-31.23	2.3724	6.8021	34.8691
06/09/2012	CAYC	0.0434***	0.0332**	0.0578	0.0265***	0.0818***	0.0322***	-0.034***	-0.017	0.0645**	-0.073***	-0.0713***
	T-test	11.4342	2.4772	1.0624	3.0245	2.7074	8.0175	-16.384	-1.325	2.0816	-3.6725	-5.1337
31/10/2012	CAYC	-0.0123	0.0025	0.0052	0.0512	-0.0033	0.0399*	0.0102***	-0.017*	-0.0035	0.0033	-0.0141*
	T-test	-0.8278	0.1959	0.3100	1.3377	-0.5480	1.7390	5.9085	-1.906	-0.7344	0.4172	-1.6660
21/12/2012	CAYC	-0.007***	0.0032	-0.037***	0.0001	-0.0271**	0.0180	0.0254	0.0146*	-0.0164	-0.0025	0.0007
	T-test	-3.0974	1.0533	-4.5138	0.0080	-2.4441	0.6114	1.2199	1.8586	-1.1184	-0.2401	0.1038
11/06/2014	CAYC	0.0006	0.0050***	-0.0007	-0.002	-0.021***	0.0239	-0.0009	0.0062***	-0.0025	-0.0060	0.0266***
	T-test	0.3200	2.6047	-0.2119	-0.594	-5.3896	1.0105	-0.1480	4.6488	-1.3408	-0.6106	4.3094
04/09/2014	CAYC	0.0250	0.0127***	0.0126**	0.0193***	0.0598***	-0.021*	-0.029**	-0.039***	0.0310***	-0.009***	-0.0374***
	T-test	1.1964	3.6941	2.2870	3.8291	4.1381	-1.747	-2.2260	-6.762	4.8096	-5.2205	-6.2492
21/11/2014	CAYC	0.0242***	0.0294***	0.0274***	0.0304***	0.0313**	-0.024	0.0064***	-0.027***	0.0208***	-0.028***	-0.0320***
	T-test	16.5252	3.1514	31.0264	5.4422	2.2936	-1.029	3.8325	-9.689	4.5818	-2.7492	-6.4538
22/01/2015	CAYC	-0.1571*	-0.0426	-0.168***	-0.011	-0.0853	0.0254*	-0.0053	0.0376	-0.0616	0.0000	0.0489
	T-test	-1.7463	-1.1961	-2.999	-0.284	-1.1777	1.6883	-0.4994	0.9550	-1.0254	-0.0108	1.0436
09/03/2015	CAYC	-0.093***	0.0745***	0.1001	-0.062***	-0.181***	0.1135***	0.0086	0.0716***	-0.1265***	0.1435***	0.1057***
	T-test	-11.633	5.0805	1.2539	-10.51	-4.9184	8.8790	1.6030	2.7406	-54.7260	8.3656	5.6211
16/06/2015	CAYC	0.0132	-0.0071	0.0247***	-0.017	0.0146	0.0667	0.0289***	0.0048*	-0.0016	-0.013**	-0.0134
	T-test	0.1925	-0.3106	15.8367	-0.898	0.6258	1.3172	35.7243	1.8702	-0.0334	-2.1736	-0.7111
22/09/2015	CAYC	0.0182	0.0015	0.0050	0.0002	0.0118	0.0362***	0.0043	-0.010	0.0178	0.0254	0.0003
	T-test	0.6583	0.0636	0.2991	0.0143	0.7754	4.0943	0.0918	-0.739	1.0446	0.8859	0.0253
03/12/2015	CAYC	-0.0015	0.0101	0.0028	-0.059	0.0039	0.0063	0.0243	0.0214**	0.0041	-0.0074	0.0022
	T-test	-0.0231	0.2173	0.1106	-0.692	0.0618	0.1856	0.6353	2.3402	0.0604	-0.2552	0.0543
10/03/2016	CAYC	0.0215	0.0156	0.0565	0.0333	0.1919	-0.061**	0.0158	-0.052	0.0955	-0.068***	-0.0458**
	T-test	0.3219	1.1756	0.5950	0.2515	0.4360	-2.553	0.6158	-1.478	1.1521	-41.731	-1.9636
21/04/2016	CAYC	0.0388	0.0513***	-0.121***	0.0679	0.2107	-0.094***	-0.075**	-0.036	-0.0290	-0.0060	-0.0246*
	T-test	1.2217	21.5546	-11.472	1.5676	0.7366	-4.585	-1.9913	-0.900	-1.6306	-0.1188	-1.7758
08/06/2016	CAYC	0.0074	0.0138	0.0534	0.0038	-0.0367	0.0016	0.0053	-0.014	-0.0289	-0.0133	-0.0095
	T-test	0.1813	0.5209	3.7948	0.0943	-0.1101	0.2276	0.2340	-0.890	-0.5401	-1.3692	-0.3603

Appendix IV. Cumulative Abnormal Yield Change for the 10-year government bond yield and significant t-test for all event windows per announcement (for the average of the Eurozone countries, calculated using market model)

	CAYC (-1,1)		**CAYC (0,1)**		**CAYC (-1,0)**	
Date announcement	CAYC	T-test	CAYC	T-test	CAYC	T-test
07/05/2009	-0.0106	-0.2838	-0.0092	-0.3424	-0.0081	-0.3276
02/07/2009	-0.0039	-0.2267	-0.0027	-0.2562	-0.0024	-0.3065
10/05/2010	-0.0612	-0.2330	-0.0753	-0.3013	-0.0477	-0.2674
30/06/2010	-0.0089	-0.2404	-0.0064	-0.2812	-0.0040	-0.2013
08/08/2011	0.0399	0.2758	0.0350	0.2961	0.0370	0.2834
06/10/2011	0.0062	0.0974	0.0053	0.1371	0.0085	0.1885
08/12/2011	-0.0139	-0.1672	-0.0089	-0.2582	-0.0146	-0.1915
29/02/2012	0.0101	0.1757	0.0093	0.1967	0.0077	0.2850
06/09/2012	0.0193	0.1821	0.0130	0.1714	0.0192	0.3182
31/10/2012	0.0078	0.1925	0.0057	0.1866	0.0052	0.4663
21/12/2012	-0.0096	-0.2297	-0.0025	-0.0952	-0.0089	-0.3211
11/06/2014	-0.0010	-0.0137	0.0026	0.1397	-0.0012	-0.0203
04/09/2014	0.0034	0.0486	0.0023	0.0520	0.0033	0.0819
21/11/2014	0.0066	0.1503	0.0053	0.1369	0.0027	0.1150
22/01/2015	-0.0219	-0.4030	-0.0381	-0.3650	0.0082	0.0990
09/03/2015	0.0123	0.0913	0.0141	0.0894	0.0016	0.0369
16/06/2015	0.0115	0.1533	0.0092	0.2640	0.0140	0.2330
22/09/2015	0.0069	0.2380	0.0101	0.5342	0.0020	0.0741
03/12/2015	0.0004	0.0097	0.0007	0.0227	-0.0043	-0.0962
10/03/2016	0.0440	0.2075	0.0185	0.1680	0.0232	0.2010
21/04/2016	-0.0140	-0.1094	-0.0016	-0.0119	-0.0037	-0.0372
08/06/2016	-0.0062	-0.0513	-0.0016	-0.0465	0.0161	0.2912

Appendix V. Cumulative Abnormal Yield Change [-1,1] for the 10-year government bond yield and significant t-test for all the 22 unconventional monetary policy announcements (calculated by using the constant return model)

		Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
07/05/2009	CAYC	0.0323**	0.0427***	0.0510**	0.0543**	0.0659**	-0.0275	0.0030	0.0160***	0.0531*	0.0112	0.0288
	T-test	2.0766	2.7811	2.4115	2.1076	2.5009	-1.4669	0.5198	3.4703	1.8230	0.8715	1.4273
02/07/2009	CAYC	-0.0190	-0.0070	-0.0108	-0.0056	-0.0147	-0.0197	-0.036***	-0.0112	-0.0081	-0.0154	-0.0143
	T-test	-0.8705	-0.3203	-0.4788	-0.2429	-0.5126	-1.1525	-2.8351	-0.9990	-0.3414	-0.9963	-0.5760
10/05/2010	CAYC	0.0337	-0.0078	0.0278	0.0280	0.0525	-0.3363	-0.2080	-0.0707	0.0398	-0.2735	-0.1088
	T-test	0.9581	-0.2313	0.6551	0.8561	0.6524	-0.8108	-1.2091	-0.8935	1.0856	-1.1297	-1.0769
30/06/2010	CAYC	0.0055	-0.041***	-0.0187	-0.037***	-0.0011	-0.047***	-0.030***	-0.0120	-0.0253	-0.051***	-0.0055
	T-test	0.2700	-5.0045	-1.3478	-3.0132	-0.0538	-12.07	-3.3208	-1.6326	-1.5177	-2.6464	-0.3535
08/08/2011	CAYC	-0.0117	-0.0549	0.0134	0.0216	0.0127	0.0205	-0.0816**	-0.1996*	0.0039	-0.068***	-0.2005
	T-test	-0.3369	-1.2625	0.2435	0.7042	0.3325	1.4057	-2.0725	-1.8936	0.0957	-5.8836	-1.6241
06/10/2011	CAYC	0.0716***	0.0618	0.1127***	0.0808***	0.1390***	-0.0164**	0.0229	-0.0065	0.1196***	0.0048	-0.024**
	T-test	5.0794	1.0948	4.3329	2.6591	5.3737	-2.5453	1.4935	-0.2697	5.7122	1.0946	-2.0328
08/12/2011	CAYC	-0.0001	0.0535	-0.0274	0.0154	-0.0513	0.0170	-0.0266	0.0835	-0.0317	-0.0205	0.1248***
	T-test	-0.0096	1.1091	-0.4217	0.3130	-0.9110	0.3958	-1.1463	1.4319	-0.9378	-1.0649	4.5983
29/02/2012	CAYC	-0.0127	-0.0202*	-0.0075	-0.057**	0.0009	-0.0272	0.0213	-0.073***	-0.0066	0.0636*	-0.0203
	T-test	-0.5390	-1.6914	-0.4585	-2.2367	0.0278	-0.8193	0.8302	-2.6863	-0.4377	1.9127	-1.1651
06/09/2012	CAYC	0.0042	-0.0024	0.0531	-0.0069	0.0691*	0.0066	-0.0375*	-0.0984***	0.0372	-0.0790	-0.130***
	T-test	0.2976	-0.0957	0.9966	-0.3257	1.8142	0.5402	-1.9284	-6.0536	1.0152	-1.6401	-3.0075
31/10/2012	CAYC	-0.0123	0.0034	0.0135	0.0523	0.0041	0.0536**	0.0128**	-0.0144***	0.0095	0.0067	-0.0065
	T-test	-1.1639	0.3835	1.3331	1.1550	0.9265	2.3234	2.1952	-2.7039	0.9409	0.8139	-0.9586
21/12/2012	CAYC	-0.0137	-0.0205	-0.044***	-0.0031	-0.029***	0.0095	0.0253	0.0329***	-0.0335*	-0.0031	0.0011
	T-test	-1.3335	-0.6502	-5.1596	-0.2492	-2.5884	0.3110	1.0610	5.2502	-1.6564	-0.3429	0.1175
11/06/2014	CAYC	0.1552	0.0491*	0.0471	0.1022	0.0124	0.0136	0.0156***	0.0445**	0.0398	-0.0036	0.0558***
	T-test	1.1407	1.8958	1.4849	1.1485	0.4220	0.3602	5.9875	2.4476	1.4451	-0.2132	5.2598
04/09/2014	CAYC	-0.0016	-0.0295	-0.0149	-0.0204	0.0315	-0.0355	-0.0639	-0.0667*	-0.0048	-0.0464*	-0.0858*
	T-test	-0.0304	-0.5100	-0.2418	-0.4296	0.5822	-1.3642	-1.1877	-1.6462	-0.0858	-1.9017	-1.7457
21/11/2014	CAYC	-0.0596	-0.0553*	-0.0707	-0.0547	-0.0722	-0.0679*	-0.0492*	-0.0731***	-0.0614	-0.063**	-0.074**
	T-test	-1.5442	-1.7811	-1.5262	-1.5657	-1.1926	-1.7288	-1.8266	-3.1596	-1.5394	-1.9733	-4.5432
22/01/2015	CAYC	-0.1332	-0.1175	-0.1261	-0.1181	-0.0913	-0.1369***	-0.1025	-0.0763	-0.1302	-0.1141	-0.0922
	T-test	-0.4658	-0.5341	-0.4376	-0.6212	-0.2683	-5.4229	-0.9636	-0.9535	-0.4550	-1.5668	-1.1299
09/03/2015	CAYC	-0.3183	-0.2462	-0.3428*	-0.2402	-0.3537	0.0739	-0.1395*	-0.0723*	-0.3359	-0.0308	-0.0493
	T-test	-1.3525	-1.3383	-1.7705	-1.1811	-1.0023	1.3707	-1.9485	-1.9363	-1.2248	-0.9407	-1.5638
16/06/2015	CAYC	-0.0669	-0.0688	-0.0650**	-0.0753	-0.1523***	0.0929**	-0.0214	-0.0253	-0.0906**	0.0001	0.0004
	T-test	-1.0109	-1.4039	-2.4042	-1.3052	-4.3851	2.1258	-0.5199	-0.5297	-2.2883	0.0012	0.0042
22/09/2015	CAYC	-0.0635	-0.0626	-0.0655	-0.0726	-0.1164	0.0230*	-0.0512	-0.0255	-0.0705	0.0193	0.0102
	T-test	-0.5683	-0.5577	-0.5590	-0.7018	-0.8698	1.7323	-1.3595	-0.6711	-0.5989	1.1200	0.2074
03/12/2015	CAYC	0.3078	0.2823	0.3433	0.2833	0.4637	0.0613***	0.2545	0.1960	0.3581	0.0928	0.1768
	T-test	1.5288	1.3282	1.1546	1.4003	1.1219	7.8229	1.0706	1.2458	1.4995	0.8434	1.0384
10/03/2016	CAYC	0.1480	0.1031	0.2364	0.1454	0.5213	-0.0572	0.0551	-0.0502	0.2816	-0.0709	-0.0501
	T-test	0.5074	0.4974	1.0208	0.4649	1.4520	-1.5987	0.3551	-0.4550	0.7442	-1.1991	-0.6724
21/04/2016	CAYC	0.1056	0.0979	0.0555	0.1200	0.4073	-0.0912*	0.0416	0.0392	0.1013	0.0392	0.0440
	T-test	0.4868	0.5995	0.3002	0.5623	0.6469	-1.9380	0.4608	1.0252	0.4278	1.5006	1.0959
08/06/2016	CAYC	-0.1667	-0.1241	-0.0514	-0.1331	-0.5361	0.0154	-0.0394	-0.0631***	-0.1720*	-0.0441**	-0.0580*
	T-test	-1.4962	-1.3196	-0.7428	-1.4717	-1.1480	0.7249	-0.6654	-5.1421	-1.8078	-2.4934	-1.9429

Appendix VI. Cumulative Abnormal Yield Change [-1,0] for the 10-year government bond yield and significant t-test for all the 22 unconventional monetary policy announcements (calculated by using the constant return model)

		Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
07/05/2009	CAYC	0.0255	0.0310*	0.0415**	0.0440*	0.0471	-0.0209	-0.0011	0.0107**	0.0410	0.0041	0.0267
	T-test	1.5333	1.8043	2.0134	1.6528	1.5747	-0.9902	-0.2751	2.0225	1.2720	0.3018	1.3837
02/07/2009	CAYC	-0.0178	-0.0122	-0.0131	-0.0098	-0.0175	-0.0182	-0.0234	-0.0116	-0.0122	-0.0162	-0.0178
	T-test	-0.7502	-0.5741	-0.5447	-0.3991	-0.5763	-1.0388	-1.5954	-1.0720	-0.4943	-1.1177	-0.7161
10/05/2010	CAYC	0.0446***	-0.0013	0.0355	0.0321	0.0590	-0.2686	-0.1797	-0.0662	0.0415	-0.2139	-0.1020
	T-test	3.3654	-0.0338	0.9043	1.0771	0.7115	-0.5682	-0.9689	-0.7761	1.2437	-0.7801	-0.9715
30/06/2010	CAYC	0.0162*	-0.024***	-0.0116	-0.020*	-0.0020	-0.029***	-0.016**	-0.0077	-0.0201	-0.021***	-0.0012
	T-test	1.8893	-3.1608	-0.7278	-1.7258	-0.0863	-113.27	-1.9702	-0.9058	-1.0965	-26.809	-0.0684
08/08/2011	CAYC	-0.0270	-0.0367	-0.0181	-0.0050	0.0002	0.0183	-0.0353	-0.1656	-0.0153	-0.039***	-0.1742
	T-test	-1.2198	-0.7301	-0.4220	-0.4558	0.0043	1.2357	-1.1319	-1.5348	-0.4356	-6.1534	-1.4031
06/10/2011	CAYC	0.0541***	0.0722*	0.0924***	0.0733***	0.11***	-0.0073*	0.0184	-0.0153	0.0932***	0.0030	-0.021*
	T-test	4.5290	1.9574	34.485	7.4568	135.03	-1.8619	1.0927	-0.7530	15.315	0.5940	-1.8259
08/12/2011	CAYC	0.0029	0.0648***	-0.061***	0.0320	-0.070***	0.0399***	-0.030*	0.0830*	-0.0437***	-0.0233	0.1003***
	T-test	0.7339	2.7110	-4.6804	0.7558	-4.9907	12.1993	-1.8450	1.7279	-99.3330	-1.5694	9.8126
29/02/2012	CAYC	0.0053	-0.006***	-0.0099	-0.022***	-0.0179	0.0016	0.0209	-0.034*	-0.0112	0.0410	-0.0031
	T-test	0.3978	-3.4466	-0.5943	-2.7467	-0.9953	0.0926	0.7720	-1.8384	-0.8658	1.0705	-0.3498
06/09/2012	CAYC	0.0086	0.0152***	0.0667**	0.0095***	0.0575	0.0073	-0.0169	-0.06***	0.0439*	-0.0267	-0.0726*
	T-test	0.6813	8.3237	2.3004	6.8907	1.4681	0.5520	-0.9632	-4.3041	1.6642	-0.8159	-1.6680
31/10/2012	CAYC	-0.0013	0.0059	0.0152***	0.0049	0.0046	0.0206***	0.0057	-0.0068*	0.0095	-0.0002	-0.0023
	T-test	-0.5218	0.7588	3.3014	0.7480	1.1207	4.5968	1.2315	-1.8521	0.9078	-0.0308	-0.3317
21/12/2012	CAYC	-0.0139	-0.0259	-0.0322***	-0.0094	-0.0236**	0.0155	0.0012	0.0246***	-0.0350***	0.0031	0.0012
	T-test	-1.6286	-0.8739	-3.8658	-1.4402	-2.1460	0.4916	0.2507	4.3830	-4.5231	0.5858	0.1086
11/06/2014	CAYC	0.1465	0.0395	0.0407	0.0933	0.0174	0.0077	0.0117***	0.0332	0.0337	-0.0137	0.0307
	T-test	1.0588	1.4338	1.2376	1.0032	0.5787	0.1783	5.7587	1.6482	1.1529	-4.9808	6.2539
04/09/2014	CAYC	0.0315	0.0113	0.0179	0.0097	0.0542**	-0.0178	-0.0124	-0.0284	0.0283	-0.0180	-0.0353
	T-test	1.5622	0.2830	0.3444	0.2618	2.2014	-0.6295	-0.3700	-0.7551	0.7955	-1.0553	-0.8360
21/11/2014	CAYC	-0.0655***	-0.0575***	-0.0768***	-0.0598***	-0.0875***	-0.0637**	-0.046**	-0.0536**	-0.0675***	-0.0500	-0.0524***
	T-test	-166.77	-27.836	-5.1368	-22.154	-5.7381	-1.9875	-2.0840	-2.1174	-46.864	-1.4863	-2.8725
22/01/2015	CAYC	0.0433	0.0042	0.0342	-0.0051	0.0785	-0.1010***	-0.0449	-0.0545	0.0280	-0.0566	-0.0711
	T-test	0.1822	0.0202	0.1306	-0.0286	0.2533	-4.2304	-0.3871	-0.5915	0.1063	-0.7346	-0.7672
09/03/2015	CAYC	-0.1207	-0.0880	-0.1753	-0.0755	-0.1182	0.0269	-0.0581	-0.0244*	-0.1165	-0.0027	-0.0166
	T-test	-0.5467	-0.5285	-0.8607	-0.4115	-0.3349	0.5521	-1.0294	-1.9324	-0.4547	-0.1228	-0.7189
16/06/2015	CAYC	-0.0005	-0.0210	-0.0375	-0.0238	-0.1243***	0.0885	-0.0029	-0.0037	-0.0348***	0.0191	0.0199
	T-test	-0.1342	-0.5723	-1.2698	-0.4912	-12.263	4.2617	-0.0664	-0.0736	-3.0700	0.2648	0.1958
22/09/2015	CAYC	-0.0842	-0.0730	-0.0742	-0.0774	-0.1113	0.0096	-0.0286	-0.0130	-0.0855	0.0215	0.0047
	T-test	-0.7905	-0.6194	-0.5954	-0.7137	-0.7776	0.8222	-0.6744	-0.3001	-0.7210	1.6339	0.0839
03/12/2015	CAYC	0.2336	0.2149	0.3073	0.2233	0.4305	0.0358***	0.2281	0.1656	0.2739	0.0963	0.1718
	T-test	1.0279	0.8919	0.9749	0.9885	1.0048	15.3681	0.8941	0.9664	1.0185	0.8584	0.9926
10/03/2016	CAYC	0.2921***	0.2061***	0.3085***	0.3011***	0.5809***	-0.0327	0.1354**	0.0377	0.4377***	-0.0079**	0.0147
	T-test	8.4390	7.7042	5.4343	4.1272	6.3295	-0.8134	2.5085	1.1718	7.3680	-2.4087	0.6853
21/04/2016	CAYC	0.0838	0.0599	0.0821	0.0919	0.4034	-0.0550	0.0424	0.0269	0.0983	0.0113	0.0409
	T-test	0.3359	0.3180	0.4131	0.3744	0.5844	-1.0294	0.4196	0.6098	0.3668	0.7179	0.9793
08/06/2016	CAYC	-0.0906	-0.0781	-0.0221	-0.0637	-0.2229	0.0159	0.0132***	-0.047***	-0.0732	-0.0380***	-0.0559***
	T-test	-0.7327	-0.7212	-0.2870	-0.6705	-0.4583	0.7090	3.8609	-3.8976	-0.8804	-2.7273	-3.2498

Appendix VII. Cumulative Abnormal Yield Change [0,1] for the 10-year government bond yield and significant t-test for all the 22 unconventional monetary policy announcements (calculated by using the constant return model)

		Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
07/05/2009	CAYC	0.0279**	0.0358***	0.0405*	0.0457*	0.0573***	-0.028*	0.0016	0.0133***	0.0487**	0.0159***	0.0251
	T-test	1.9602	2.8903	1.8746	1.8346	2.9027	-1.9014	0.2359	4.7360	1.9905	8.7910	1.1982
02/07/2009	CAYC	-0.0220	-0.0115	-0.0163	-0.0129	-0.0211	-0.0193	-0.0312***	-0.0109	-0.0144	-0.0145	-0.0178
	T-test	-1.1312	-0.5208	-0.7822	-0.6084	-0.7918	-1.1709	-5.0376	-0.9339	-0.6354	-0.8957	-0.7185
10/05/2010	CAYC	0.0180	-0.0267**	0.0297	0.0269	0.0644	-0.4383	-0.2108	-0.0803	0.0357	-0.3036*	-0.1103
	T-test	0.4518	-1.9763	0.6589	0.7671	0.8305	-1.4470	-1.3666	-1.1280	0.9109	-1.6466	-1.1419
30/06/2010	CAYC	0.0017	-0.025***	-0.0049	-0.022*	0.0117	-0.032***	-0.0175*	-0.012***	-0.0060	-0.040**	-0.014***
	T-test	0.0715	-2.9021	-0.5311	-1.6485	1.1891	-8.0978	-1.8368	-3.3160	-1.4172	-2.0365	-2.7182
08/08/2011	CAYC	-0.0092	-0.0617**	0.0010	0.0186	-0.0082	0.0040***	-0.0484	-0.1707*	-0.0060	-0.046***	-0.1755
	T-test	-0.2314	-2.4479	0.0159	0.5365	-0.2477	8.6296	-1.0930	-1.6621	-0.1358	-3.4194	-1.4293
06/10/2011	CAYC	0.0505***	0.0072	0.0679**	0.0392	0.0836***	-0.015***	0.0221*	-0.0090	0.0760***	0.0058***	-0.0197
	T-test	3.2494	0.2578	2.4898	1.6174	3.2864	-4.1715	1.6837	-0.3384	3.2618	2.6162	-1.5721
08/12/2011	CAYC	0.0005	0.0331	0.0096	0.0206	-0.0088	-0.0013	-0.0034	0.0661	-0.0101	-0.0015	0.0798***
	T-test	0.0740	0.5958	0.1665	0.3817	-0.1836	-0.0296	-0.3352	1.0174	-0.2965	-0.2124	2.5924
29/02/2012	CAYC	-0.0219	-0.0166	0.0059***	-0.050**	0.0188	-0.0367*	0.0243	-0.065***	0.0054	0.0622***	-0.0232**
	T-test	-1.5696	-1.3116	6.3834	-2.4311	1.0045	-1.7512	1.0259	-5.1450	1.4684	3.6410	-2.0871
06/09/2012	CAYC	0.0062	-0.0091	0.0342	-0.0124	0.0599	0.0095	-0.0378***	-0.076***	0.0285	-0.082***	-0.1157***
	T-test	0.4104	-0.3484	0.5569	-0.6031	1.6260	0.8750	-11.476	-16.707	0.6797	-3.6307	-240.34
31/10/2012	CAYC	-0.0104	0.0043	0.0082	0.0531	-0.0002	0.0411	0.0123***	-0.013***	-0.0004	0.0042	-0.0089***
	T-test	-0.8969	0.4548	0.7063	1.2760	-0.2808	1.6444	6.4528	-5.1915	-0.6890	0.4443	-17.723
21/12/2012	CAYC	-0.0025	0.0072**	-0.032***	0.0049	-0.0230**	0.0175	0.0271	0.0234***	-0.0121	-0.0020	0.0062
	T-test	-0.8656	2.0621	-3.6873	0.6293	-1.9801	0.5938	1.2896	3.4616	-0.7958	-0.1913	0.9767
11/06/2014	CAYC	0.0128***	0.0156***	0.0103***	0.0090	-0.011***	0.0314	0.0088***	0.0179***	0.0083**	0.0046	0.0379***
	T-test	2.7396	4.2688	4.1442	1.0340	-8.3974	1.5893	9.6136	3.6946	2.1662	0.2951	3.1199
04/09/2014	CAYC	-0.0274	-0.0551**	-0.0498***	-0.044***	-0.0079	-0.0408***	-0.0744***	-0.0713***	-0.0368	-0.046***	-0.0893***
	T-test	-0.7074	-2.0786	-3.1698	-2.6680	-0.2104	-7.6256	-2.6189	-13.713	-1.2466	-4.2082	-7.6464
21/11/2014	CAYC	-0.0267	-0.0276	-0.0248	-0.0235	-0.0208	-0.0520	-0.0373	-0.0589***	-0.0269	-0.0544*	-0.0572***
	T-test	-0.6946	-0.8607	-0.6711	-0.7013	-0.4045	-1.1885	-1.2413	-2.9449	-0.6878	-1.8558	-4.2789
22/01/2015	CAYC	-0.274***	-0.2245***	-0.2743***	-0.2048***	-0.285***	-0.098***	-0.138***	-0.0952*	-0.2762***	-0.124***	-0.1030*
	T-test	-3.4566	-11.906	-5.9113	-9.7278	-5.2823	-3.7212	-6.0676	-1.8439	-6.8487	-13.389	-1.6921
09/03/2015	CAYC	-0.3684***	-0.2855***	-0.3570***	-0.2941***	-0.471***	0.0848***	-0.1387***	-0.0538	-0.4058***	-0.0186	-0.0294
	T-test	-13.675	-9.2402	-16.228	-8.3396	-6622.7	9.2676	-5.7733	-1.2802	-12.2822	-0.4941	-0.8186
16/06/2015	CAYC	-0.0687	-0.0766***	-0.0610***	-0.0876***	-0.0856***	0.0590	-0.0416***	-0.0486	-0.0675	-0.0456***	-0.0604***
	T-test	-1.0718	-4.0253	-10.047	-5.6932	-2.9862	1.1758	-9.1911	-9.0761	-1.5334	-6.0717	-2.8281
22/09/2015	CAYC	-0.0746	-0.0850	-0.0907	-0.0881	-0.1323	0.0240***	-0.0581***	-0.0406***	-0.0871	0.0020	-0.0204
	T-test	-0.6424	-0.8040	-0.8395	-0.9024	-1.0839	8.5925	-4.4955	-2.5954	-0.7444	0.3115	-0.6532
03/12/2015	CAYC	0.3046*	0.2953*	0.3472	0.2846*	0.4627	0.0446***	0.2680	0.1989	0.3556*	0.1007	0.1775
	T-test	1.9508	1.8384	1.2612	1.7293	1.1675	6.9551	1.2451	1.4410	1.8993	0.9351	1.0603
10/03/2016	CAYC	0.0193	0.0134	0.0538	0.0313	0.1849	-0.0609***	0.0144	-0.0529	0.0925	-0.0686	-0.0468
	T-test	0.0626	0.0613	0.2718	0.0913	0.6079	-5.0697	0.0823	-0.4312	0.2286	-1.1946	-0.5637
21/04/2016	CAYC	0.1884	0.1621*	0.1139	0.1968	0.5507	-0.0904***	0.0709	0.0478**	0.1861	0.0415***	0.0445
	T-test	1.3015	1.8827	0.6816	1.3990	1.0144	-5.0407	0.9774	2.0581	1.0326	2.8607	1.1607
08/06/2016	CAYC	-0.0596	-0.0309	-0.0018	-0.0538	-0.1815	-0.0038	-0.0443	-0.0339***	-0.0938	-0.0181***	-0.0215
	T-test	-0.6432	-0.5058	-0.0316	-0.6319	-0.4079	-1.3932	-0.7277	-51.135	-0.9041	-3.0426	-1.2418

Appendix VIII. Cumulative Abnormal Yield Changes for the 10-year government bond yields and significant t-test for all the event windows per announcement (for the average of the Eurozone countries, calculated by using the constant mean return model)

	CAYC (-1,1)		**CAYC (0,1)**		**CAYC (-1,0)**	
Date announcement	CAYC	T-test	CAYC	T-test	CAYC	T-test
07/05/2009	0.0301	0.6296	0.0258	0.7505	0.0227	0.7333
02/07/2009	-0.0147	-1.0022	-0.0175**	-2.0543	-0.0154***	-2.7276
10/05/2010	-0.0749	-0.3107	-0.0905	-0.3927	-0.0563	-0.3367
30/06/2010	-0.0239	-0.7219	-0.0145	-0.6845	-0.0124	-0.6768
08/08/2011	-0.0495	-0.3444	-0.0456	-0.4766	-0.0452	-0.4992
06/10/2011	0.0514	0.5084	0.0281	0.5301	0.0430	0.6270
08/12/2011	0.0124	0.1315	0.0168	0.3858	0.0086	0.1024
29/02/2012	-0.0126	-0.2009	-0.0088	-0.1702	-0.0031	-0.1076
06/09/2012	-0.0168	-0.1524	-0.0177	-0.2294	0.0031	0.0499
31/10/2012	0.0112	0.2837	0.0082	0.2781	0.0051	0.4533
21/12/2012	-0.0071	-0.1706	0.0013	0.0518	-0.0086	-0.3105
11/06/2014	0.0483	0.6127	0.0132	0.7129	0.0401	0.6401
04/09/2014	-0.0307	-0.5242	-0.0493	-1.5276	0.0037	0.0931
21/11/2014	-0.0637***	-4.3244	-0.0373*	-1.7371	-0.0618***	-3.5458
22/01/2015	-0.1126***	-3.3113	-0.1907*	-1.6852	-0.0132	-0.1657
09/03/2015	-0.1868	-0.7197	-0.2125	-0.8014	-0.0699	-0.8075
16/06/2015	-0.0430	-0.3920	-0.0531	-0.9341	-0.0110	-0.1516
22/09/2015	-0.0432	-0.5612	-0.0592	-0.9052	-0.0465	-0.7106
03/12/2015	0.2563	1.2521	0.2582	1.5210	0.2165	1.4626
10/03/2016	0.1148	0.3637	0.0164	0.1525	0.2067	0.7364
21/04/2016	0.0873	0.4178	0.1375	0.5998	0.0805	0.4917
08/06/2016	-0.1248	-0.4853	-0.0493	-0.6809	-0.0602	-0.6628

Appendix IX. Cumulative Abnormal Yield Changes for the 5Y5Y swap forward rate and significant t-test for all event windows per announcement (for the average of the Eurozone countries, calculated by using the constant mean return model)

	CAYC (-1,1)		**CAYC (0,1)**		**CAYC (-1,0)**	
Date announcement	CAYC	T-test	CAYC	T-test	CAYC	T-test
07/05/2009	0.0101	0.2513	0.0077	0.1674	0.0294	1.1893
02/07/2009	0.0158	1.2376	0.0045	0.4321	0.0084	0.5881
10/05/2010	0.0693***	4.0522	0.0524***	3.1639	0.0514***	2.9204
30/06/2010	0.0276*	1.8070	0.0284***	9.1228	0.0118	0.8780
08/08/2011	-0.0055	-0.1639	0.0070	0.2061	-0.0259***	-26.02
06/10/2011	0.0338	1.5823	0.0364***	6.1871	0.0186	0.7835
08/12/2011	-0.0417***	-3.5135	-0.0210***	-2.9998	-0.0277**	-2.0215
29/02/2012	-0.0557**	-2.2949	-0.0386	-1.3860	-0.0224*	-1.9245
06/09/2012	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]
31/10/2012	0.0087	0.6510	0.0145***	3.6613	-0.0005	-0.0435
21/12/2012	0.0013	0.3123	-0.0015	-0.5960	0.0032	1.4434
11/06/2014	-0.0093**	-2.4116	-0.0069	-1.6143	-0.0080**	-2.4925
04/09/2014	0.0018	0.0649	0.0111	0.4164	0.0096	0.3391
21/11/2014	-0.0122	-0.2978	-0.0007	-0.0145	-0.0346***	-3.0004
22/01/2015	0.0187	0.2578	0.0086	0.1033	0.0561	1.5603
09/03/2015	-0.0486**	-2.2132	-0.0311	-1.2300	-0.0457***	-4.3071
16/06/2015	-0.0104	-1.0383	-0.0115	-1.3885	-0.0088	-0.7902
22/09/2015	-0.0245	-1.3584	-0.0239	-1.4613	-0.0208	-1.0703
03/12/2015	-0.0741***	-2.8336	-0.0650***	-4.8545	-0.0349**	-2.0843
10/03/2016	0.0124	0.4469	0.0265***	5.3707	0.0016	0.0535
21/04/2016	-0.0084	-0.4737	0.0021	0.1352	-0.0017	-0.0870
08/06/2016	-0.0414***	-2.6896	-0.0355***	-3.1463	-0.0180***	-2.8824

[1] There was no change in the AAA10Y swap forward rate from between these two dates

Appendix X. Cumulative Abnormal Yield Changes for the 10-year AAA corporate bond yield and significant t-test for all event windows per announcement (for the average of the Eurozone countries, calculated by using the constant mean return model)

	CAYC (-1,1)		**CAYC (0,1)**		**CAYC (-1,0)**	
Date announcement	CAYC	T-test	CAYC	T-test	CAYC	T-test
07/05/2009	0.0365	0.6511	0.0570*	1.8061	0.0238	0.3675
02/07/2009	-0.0125	-0.7876	0.0022	1.0082	-0.0147	-0.9988
10/05/2010	0.0701	1.1411	0.0661	1.0598	0.0682	1.1302
30/06/2010	-0.0065	-0.5584	0.0017	0.2062	-0.0031	-0.2386
08/08/2011	0.0039	0.1125	-0.0018	-0.0459	-0.0148	-0.5655
06/10/2011	0.1126**	2.0727	0.0395***	3.2827	0.0868	1.4632
08/12/2011	-0.0220	-0.6187	0.0011	0.0374	-0.0379***	-4.4992
29/02/2012	0.0064	1.0338	0.0084***	8.1723	0.0027	0.4121
06/09/2012	0.0459	1.0163	0.0394	0.7896	0.0511	1.3418
31/10/2012	0.0080	0.4788	0.0031	0.1623	-0.0030	-0.2319
21/12/2012	-0.0240	-2.2657	-0.0107	-1.3178	-0.0227***	-5.9246
11/06/2014	0.0289	1.1924	0.0035	0.5950	0.0243	0.9115
04/09/2014	0.0508	0.9525	-0.0012	-0.1219	0.0565	1.1843
21/11/2014	-0.0496	-1.1541	-0.0113	-0.3498	-0.0601***	-3.6168
22/01/2015	-0.0453	-0.2018	-0.1747***	-2.6276	0.0753	0.4104
09/03/2015	-0.1530	-0.6479	-0.2560***	-4.5026	0.0034	0.0168
16/06/2015	-0.0822	-1.7724	-0.0375	-0.8449	-0.0856***	-23.126
22/09/2015	-0.0668	-0.7370	-0.0842	-1.0662	-0.0642	-0.6485
03/12/2015	0.2084	1.6202	0.2218***	5.8411	0.1165	0.8126
10/03/2016	0.1873	1.1727	0.0839	0.4927	0.2305***	9.7793
21/04/2016	0.0353	-[1]	0.0235	-[1]	0.0235	-[1]
08/06/2016	0.0000	-[1]	-[1]	-[1]	0.0000	-[1]

[1] There was no change in the swap forward AAA10Y rate between these two dates

Appendix XI. Cumulative Abnormal Yield Changes for the 10-year BBB corporate bond yield and significant t-test for all event windows per announcement (for the average of the Eurozone countries, calculated by using the constant mean return model)

	CAYC (-1,1)		**CAYC (0,1)**		**CAYC (-1,0)**	
Date announcement	CAYC	T-test	CAYC	T-test	CAYC	T-test
07/05/2009	0.0134*	1.7287	0.0092	1.0267	0.0043	1.0582
02/07/2009	0.0112	0.3147	0.0096	0.2345	-0.0141	-0.8143
10/05/2010	0.0085	0.2413	-0.0156	-0.8825	0.0075	0.1841
30/06/2010	0.0023	0.2381	0.0076*	1.6735	-0.0037	-0.5489
08/08/2011	0.0078	0.1466	-0.0167	-0.3452	-0.0080	-0.1408
06/10/2011	0.0590	0.8447	0.0756	1.4909	-0.0041	-0.1420
08/12/2011	0.0161	0.3636	0.0392***	2.8119	0.0035	0.0704
29/02/2012	0.0079	0.8798	0.0106**	2.3106	0.0003	0.0494
06/09/2012	0.0251	0.6528	0.0129	0.2929	0.0407**	2.5182
31/10/2012	0.0675**	2.0673	0.0298	1.1056	0.0392	1.0783
21/12/2012	-0.0207***	-4.8727	-0.0127***	-2.8013	-0.0166***	-24.461
11/06/2014	0.0114*	1.6673	0.0075	0.9473	0.0116***	3.0867
04/09/2014	0.0327	0.7450	-0.0071	-0.8269	0.0405	1.0378
21/11/2014	-0.0179	-0.8459	-0.0007	-0.0481	-0.0250***	-2.6469
22/01/2015	-0.0913	-1.1109	-0.1094**	-2.4866	-0.0146	-0.2872
09/03/2015	-0.0554	-1.1627	-0.0686***	-20.370	-0.0227	-0.4623
16/06/2015	-0.0312	-1.3526	-0.0092	-0.5261	-0.0353***	-4.0913
22/09/2015	-0.0225	-1.5037	-0.0173	-1.0224	-0.0224*	-1.8982
03/12/2015	0.0438	0.8919	0.0563*	1.7595	-0.0003	-0.0124
10/03/2016	-0.0087	-0.1502	-0.0426**	-2.2331	0.0222	0.4853
21/04/2016	0.0500	0.9157	0.0605	1.4388	0.0408	0.6607
08/06/2016	-0.0392*	-1.7584	-0.0239	-0.9373	-0.0146	-0.9013

Appendix XII. Cumulative Abnormal Yield Changes for the 5-year AAA corporate bond yield and significant t-test for all event windows per announcement (for the average of the Eurozone countries, calculated by using the constant mean return model)

	CAYC (-1,1)		**CAYC (0,1)**		**CAYC (-1,0)**	
Date announcement	CAYC	T-test	CAYC	T-test	CAYC	T-test
07/05/2009	0.0183	0.3100	0.0457	1.2720	0.0134	0.1969
02/07/2009	-0.0247	-1.0495	-0.0156	-0.5738	-0.0305**	-2.4948
10/05/2010	0.2126	1.1803	0.0222	1.1187	0.2115	1.2482
30/06/2010	-0.0056	-0.5424	0.0024	0.4225	-0.0040	-0.3351
08/08/2011	-0.0043	-0.1062	-0.0036	-0.0777	-0.0258	-1.0544
06/10/2011	0.0688***	2.7156	0.0332*	1.7228	0.0426	1.4844
08/12/2011	-0.0399	-0.9783	-0.0117	-0.2975	-0.0538***	-20.73
29/02/2012	0.0094	1.6190	0.0084	1.5248	0.0079	1.3156
06/09/2012	0.0811	0.9727	0.0765	0.8676	0.0869	1.1196
31/10/2012	0.0127***	3.3001	0.0072*	1.8668	0.0111***	11871.99
21/12/2012	-0.0441***	-3.9291	-0.0278	-2.1962	-0.0365***	-9.1809
11/06/2014	0.0179	0.4217	-0.0162***	-3.1109	0.0234	0.5221
04/09/2014	-0.0271	-0.1678	-0.1149	-1.4084	0.0711	0.6810
21/11/2014	-0.1333	-1.5979	-0.0430	-0.7901	-0.1390***	-3.3349
22/01/2015	-0.1610	-0.3971	-0.3550*	-1.8893	0.1104	0.3979
09/03/2015	-0.4278	-0.5279	-0.7453	-1.5203	0.1900	0.4269
16/06/2015	-0.1900***	-4.6725	-0.1538***	-259.18	-0.1128***	-2.7950
22/09/2015	-0.1625	-0.6341	-0.1695	-0.6134	-0.2160	-0.9392
03/12/2015	-2.2213	-0.5168	-2.6259	-0.5772	-3.1831	-0.7973
10/03/2016	1.5088	0.9369	1.3485	0.7652	-0.0466	-0.1269
21/04/2016	-0.1502	-[(1)]	-0.1001	-[(1)]	-0.1001	-[(1)]
08/06/2016	0.0000	-[(1)]	0.0000	-[(1)]	0.0000	-[(1)]

[(1)] There was no change in the swap forward AAA5Y rate between these two dates

Appendix XIII. Cumulative Abnormal Yield Changes for the 5-year BBB corporate bond yield and significant t-test for all event windows per announcement (for the average of the Eurozone countries, calculated by using the constant mean return model)

	CAYC (-1,1)		**CAYC (0,1)**		**CAYC (-1,0)**	
Date announcement	CAYC	T-test	CAYC	T-test	CAYC	T-test
07/05/2009	0.0097	0.4822	0.0164	1.0506	0.0093	0.4099
02/07/2009	-0.0056	-0.2274	-0.0084	-0.3083	-0.0151	-0.7281
10/05/2010	0.0136	0.2562	-0.0222	-0.7669	0.0102	0.1670
30/06/2010	-0.0032	-0.2422	0.0065***	2.6623	-0.0076	-0.6531
08/08/2011	0.0410	0.6626	0.0159	0.2319	-0.0013	-0.0252
06/10/2011	0.0251	0.6045	-0.0083	-0.3988	0.0396	1.4581
08/12/2011	0.0007	0.0136	0.0146	0.2875	-0.0321***	-7.7113
29/02/2012	0.0026	0.1125	0.0052	0.1993	-0.0131*	-1.6596
06/09/2012	0.0223	0.4945	0.0174	0.3340	0.0397	1.3353
31/10/2012	0.0800	0.8890	0.0816	0.8907	-0.0066*	-1.9584
21/12/2012	-0.0284	-0.8409	0.0007	0.0386	-0.0193	-0.4943
11/06/2014	0.0126	0.6850	0.0005	0.0285	0.0205***	5.3651
04/09/2014	-0.0364	-0.8177	-0.0474	-1.4675	0.0034	0.1847
21/11/2014	-0.0110	-1.1854	-0.0130***	-3.2881	-0.0064	-0.6082
22/01/2015	-0.0473	-0.7702	-0.0719***	-5.8506	-0.0052	-0.0962
09/03/2015	0.0131	0.5472	0.0092	0.3315	-0.0053	-0.4018
16/06/2015	0.0074	0.5596	-0.0036	-1.0351	0.0074	0.5102
22/09/2015	-0.0101	-0.5195	-0.0109	-0.5117	-0.0153	-0.9072
03/12/2015	0.0966	1.1243	0.1213***	11.4025	0.0412	0.4545
10/03/2016	-0.0105	-0.0953	-0.0487	-0.4633	0.0664***	6.6599
21/04/2016	0.0053	0.0749	0.0277	0.3939	0.0266	0.3727
08/06/2016	-0.0574**	-2.0544	-0.0426	-1.3589	-0.0204**	-2.2308