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by Matteo Falagiarda and Stefan Reitz

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JEL classification: E43, E52, E58, G01, G12

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Matteo Falagiarda* Stefan Reitz†

August 14, 2013‡

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1 Introduction

As the recent financial crisis unfolded international investors became increasingly concerned with the sustainability of government debt in a number of European countries. Long-term government bond spreads relative to Germany have increased dramatically for most euro area countries. In particular, during the period 2008-2010 the Italian spread vis-á-vis Germany widened to almost 200 basis points from about 30 basis points, the average level after the introduction of the euro in 1999. Since the mid-2011, the Italian long-term government bond yield differential has widened even more markedly reaching peaks of over 550 basis points in the late months of 2011 in connection with the Italian political crisis. Only at the end of 2012 the surge in the spread calmed down approaching the 300 basis point level.

This unprecedented increase in euro area sovereign bond yield spreads reflects growing concerns in financial markets about governments' capacity to satisfy their future debt obligations. In fact, an increasing spread indicates a significant risk premium that investors demand when lending to a specific government, which, in turn, suffers the higher cost of borrowing and a limited capacity to access capital markets. There is strong empirical evidence that countries borrowing excessively, i.e. with a high debt-to-GDP ratio and/or with substantial fiscal deficits, are likely to face financial markets asking for higher default premia (Goldstein and Woglom, 1991; Bayoumi et al., 1995; Schuknecht et al., 2009). This market-based mechanism of fiscal discipline seems to have been switched off until the first half of 2008, when bond yields of Italian government debt - and, more generally, of a number of other euro area countries - were relatively close to the German ones (Figure 1).

[Figure 1 about here]

The reassessment and differentiation of country risk by financial markets can also be observed by looking at the pattern of the Italian sovereign credit default swaps (CDS) premia (Figure 2). The time series evolves very similar to the Italian bond yield spread over the last five years with a first substantial increase in the late 2008 and a dramatic hike starting from the mid of 2011. Recent contributions in the empirical literature (Attinasi et al., 2011; Gerlach et al., 2010; Arghyrou and Kontonikas, 2012; De Santis, 2012) have found that the widening of euro countries' sovereign bond spreads relative to the German Bund observed during the recent crisis is due both to countries' fiscal positions and/or macroeconomic fundamentals, and to more general factors such as liquidity risk, international risk aversion or contagion effects.

[Figure 2 about here]

Besides facing serious sovereign debt tensions, the euro area was earlier also severely stressed by the breakdown of financial and interbank markets following Lehman Brothers' collapse in 2008. To stop the meltdown of the financial system, governments, international and European institutions proposed unprecedented unconventional measures, such as bank-rescue packages, bailout agreements, and financial-support schemes. When it comes to monetary policy the European Central Bank (ECB) as well as the Federal Reserve and the Bank of England reduced their key interest rates to historically low levels (Figure 3). In fact, the zero-lower bound (ZLB) of interest rates quickly became a serious concern for monetary policy as conventional monetary

policy measures consisting of standard open market operations were unable to restore the functioning of interbank markets. While the monetary authorities in the US and the UK intervened by implementing unprecedented non-sterilized interventions often referred to as *Quantitative Easing* (QE),[1] the ECB adopted a less aggressive strategy by launching a number of *temporary* non-standard measures and programs to face liquidity and sovereign debt problems. As a result of non-standard monetary policies, the asset side of the balance sheet of the Federal Reserve and the Bank of England almost tripled in the last five years, whereas that of the ECB almost doubled.

[Figure 3 about here]

While the effectiveness of unconventional monetary programs in the US and the UK has been extensively analyzed,[2] the evidence on the unconventional measures adopted by the ECB is scarce. Existing contributions to the literature focused on the core variables of monetary policy and investigated the effect of specific ECB unconventional policies on interbank rates (Abbassi and Linzert, 2011), on covered bond markets (Beirne et al., 2011), on money market rates (Angelini et al., 2011), on some monetary and credit variables (Giannone et al., 2011), on bank credit volumes (Peersman, 2011), and on macroeconomic variables (Lenza et al., 2010). Currently, however, there have been no studies on the impact of ECB unconventional monetary measures on the perceived sovereign risk of euro area countries. In fact, important spillover effects from monetary to fiscal policy may arise as extensive liquidity provision may reduce the risk of government bailouts thereby decreasing expected future debt-to-GDP ratios. As stressed by Gerlach et al. (2010) and Arghyrou and Kontonikas (2012), the role of domestic banking sectors is crucial, with the financial system transforming global risk into sovereign risk through two channels. First, in periods of financial stress banks should be recapitalized by governments, increasing its fiscal liabilities. Second, poor banking liquidity limits lending flows to private agents, exacerbating the recession and raising fiscal imbalances. The supporting spillover effect provides a strong incentive for governments to demand a continuation of unconventional monetary policy measures. This clearly contrasts with the central bank's ultimate goals, if the exit from non-standard measures is significantly postponed. To what extent these spillover effects establish a policy trade-off is an empirical question.[3]

The paper aims at filling this gap by empirically investigating whether and to what extent the unconventional monetary operations conducted by the ECB affected the Italian sovereign risk premium. Focusing on the period between 2008 and 2012, we assess the effect of ECB communications about unconventional monetary policies on the Italian spread vis-á-vis Germany.[4] More than fifty events (press conferences, press releases and speeches) concerning non-standard monetary operations are identified and classified with respect to the relevant ECB program. A

[1] QE policies are discussed in several studies (Krugman, 1998; Svensson, 2003; Bernanke and Reinhart, 2004; Orphanides, 2004; Borio and Disyatat, 2010; Joyce et al., 2012). These measures include purchases of treasuries, private securities, direct loans to banks, households and companies, and extensions of existing lending facilities.

[2] See, for example, Klyuev et al. (2009), Meier (2009), Baumeister and Benati (2010), Blinder (2010), Doh (2010), Neely (2010), Gagnon et al. (2011), Joyce et al. (2011b), Kozicki et al. (2011), Krishnamurthy and Vissing-Jorgensen (2011), Meaning and Zhu (2011), Swanson (2011), Bridges and Thomas (2012), Chen et al. (2012), Christensen and Rudebusch (2012), D'Amico et al. (2012), Falagiarda (2013), Glick and Leduc (2012), Hamilton and Wu (2012), Joyce and Tong (2012), Kapetanios et al. (2012), and Wright (2012).

[3] In a sense, our work tries to open the *black box* of the transmission of extraordinary interventions.

[4] For a survey on the theory and evidence of central bank communications, see Blinder et al. (2008).

comprehensive event study analysis is conducted to observe the patterns of the Italian spread within a narrow time interval around each ECB announcement. As a robustness check, GARCH models are implemented to control for other factors than ECB communications affecting spread movements, such as disruption in financial markets, credit risk developments, and the business climate. Following Wright (2012), we isolate the surprise component of each central bank announcement by using the futures of Italian long-term bonds.

The results suggest that ECB communications about unconventional monetary policy measures substantially decreased the perceived sovereign risk of Italy. Particularly, the events occurring during the period 2010-2012 were more effective in reducing the Italian spread vis-á-vis Germany compared to events that took place at the onset of the crisis in 2008-2009. Not surprisingly, among the different types of unconventional operations, those introduced specifically to tackle sovereign debt tensions are found to be particularly effective in diminishing the Italian spread. These findings are important to guide monetary and fiscal policy in designing and implementing future unconventional programs.

The remainder of the paper proceeds as follows. Section 2 briefly presents the main non-standard measures recently implemented by the ECB. In Section 3, we discuss the main channels through which unconventional operations may affect financial markets and the economy. Section 4 and Section 5 report the empirical results from the event-study and the econometric analysis, respectively. Section 6 concludes.

2 ECB Unconventional Monetary Policies during the Crisis

In the aftermath of the financial crisis of 2007-2008, the ECB took a number of temporary non-standard measures aimed mainly at restoring a proper functioning of interbank markets. In fact, interbank markets were severely stressed due to solvency concerns, a consequent widespread lack of confidence, and liquidity hoarding of market participants. Financial markets suffered from substantial drawdowns as investors cut their exposures, with massive consequences for the real sector of the economy. During this stage, ECB unconventional measures included:[5] a) unlimited provision of liquidity through 'fixed rate tenders with full allotment', allowing banks to get unlimited access to central bank liquidity at the main refinancing rate, subject to appropriate collateral; b) extension of the list of eligible collateral assets for refinancing operations; c) extension of the maturity of long-term refinancing operations, in order to reduce uncertainty and improve liquidity conditions for banks; d) liquidity provision in foreign currencies through swap lines with other central banks, in order to enhance banks' foreign currency funding.

A comprehensive package of non-standard measures was adopted by the ECB in May 2009, the *Enhanced Credit Support* (ECS), which reorganized the set of measures previously implemented and added to them. The five pillars characterizing the ECS included the four types of operations listed above plus a program of outright purchases of covered bonds, the so-called *Covered Bond Purchase Programme* (CBPP1). A further program of this kind was announced in November 2011 (CBPP2). The goal of the two programs was to rekindle the functioning of the covered bond market, constituting an essential source of banks' refinancing. Figure 4 displays the amount of bonds purchased by the ECB under CBPP1 and CBPP2 over time.

[5]For more details, see de Haan et al. (2012).

Under CBPP1, the ECB purchased euro-denominated covered bonds at a value of €60 billion over the period between May 2009 and June 2010. The purchases of CBPP2 were conducted between November 2011 and October 2012. The total amount of bonds acquired under CBPP2 was substantially smaller than under CBPP1.

A program especially designed to address sovereign-debt tensions was introduced by the ECB in May 2010. The so-called *Securities Market Programme* (SMP) involved purchases of euro area government bonds in the secondary markets, in order to ensure depth and liquidity in those market segments that were dysfunctional. The impact of these interventions was sterilized through specific operations to reabsorb the injected liquidity. Some details on the securities acquired under the SMP have been released in February 2013 and are reported in Table 1.

[Table 1 about here]

Approximately one half of the securities purchased by the ECB are Italian government bonds with an average remaining maturity of 4.5 years. The timing of SMP purchases is depicted in Figure 4, which shows that SMP operations have been carried out in two big waves, one in the first half of 2010 and the other in the second half of 2011.

A further program aimed at responding to the turbulences surrounding the European sovereign-debt crisis has been proposed in July 2012 and adopted in September 2012. According to this program, labeled *Outright Monetary Transactions* (OMT), once a government asks for financial assistance, the ECB can purchase government-issued bonds maturing in 1 to 3 years, provided that the bond-issuing country agrees to specific domestic measures (the so-called *conditionality* principle). The declared objective of the program is to safeguard "an appropriate monetary policy transmission and the singleness of the monetary policy" by lowering bond yields, especially at the long end of the yield curve, and thus reducing borrowing costs for countries and providing confidence to investors in the sovereign-bond markets. Also in this case, the liquidity created through the OMT is fully sterilized. Notice that, at the end of 2012, no OMT purchases were carried out yet. Thus, it can be argued that so far OMT was communication without intervention, in contrast with SMP that, being little transparent, was intervention without communication.

To gauge the effectiveness of different ECB unconventional operations, we classify them into seven categories:

- Liquidity provisions in foreign currencies through swap lines with other central banks (FOR).
- Unlimited provisions of liquidity through fixed rate tenders with full allotment for the main refinancing operations (FRTFA).
- Extensions of the list of collateral assets (COLL).
- Operations concerning long-term refinancing operations, such as extension of the maturity, new special long-term refinancing operations, and introduction of fixed rate tenders with full allotment (LTRO).
- Outright purchases of covered bonds (CBPP).
- Purchases of government bonds carried out under the Securities Market Programme (SMP).

- Purchases of government bonds carried out under the Outright Monetary Transactions (OMT).

This classification is used throughout the empirical part of the paper, where the effects of ECB non-standard operations are investigated. As long as financial markets are informationally efficient, the effect of monetary policies on asset prices occurs via changes of market expectations, typically at times when they are disclosed to market participants. We use the term announcement (or event) to refer to any means by which an unconventional policy decision was communicated to financial markets by the ECB, including press conferences, press releases and speeches. Table 2 reports all the events identified related to unconventional operations over the period 2008-2012. For each event we report the day and the exact time when it was announced, the type of the announcement, the nature of the measure announced, and a brief description.

[Table 2 about here]

3 The Channels of Unconventional Monetary Policies

In the literature, a number of different channels are reported through which ECB announcements may have affected the Italian spread. However, we decided to abstain from restricting the empirical model, which would imply a test of a specific transmission channel. Instead, we opt for a more general framework attempting to quantify the overall impact of ECB policy news regarding unconventional measures in the last five years. Nevertheless, in this section we briefly review the transmission mechanisms of unconventional monetary policies. First of all, unconventional monetary policies may affect asset prices and the real economy via the *signaling channel* emphasizing the role of expectations of private agents. In particular, central bank announcements are likely to exert their effects on financial markets through their influence on agents' expectations of future economic conditions and policy actions.

Another important channel of unconventional monetary policies is the so called *portfolio rebalancing channel* according to which purchases carried out by a central bank imply a rebalancing of investors' portfolios.[6] A necessary condition is the imperfect substitutability among different assets, i.e. assets are not perceived as perfect substitutes by investors.[7] By purchasing a particular security, the monetary authority reduces the amount of that security held by private agents usually in exchange of risk-free reserves. As a result, the asset price increases and the interest rate falls, creating more favorable conditions for economic recovery through the traditional monetary transmission mechanisms.[8]

Unconventional measures may then influence the economic system through the *liquidity premia channel*, also labeled *market functioning channel*. In a crisis like the one occurred after

[6] The portfolio balance approach was first described by Tobin (1958).

[7] Imperfect substitutability may emerge when agents are risk-averse and different assets have different risk characteristics, or when investors have "preferred habitats" (Vayanos and Vila, 2009).

[8] The reduction in yields is driven by a reduction of the risk premium, which may consist of different components. For instance, if the central bank purchases long-term government securities, it removes assets with high maturity from the market, i.e. high duration risk. Thus, less duration risk leads the market to require a lower term premium to bear that risk (Gagnon et al., 2011). A central bank engaging in purchases of private assets is also able to affect the premium associated with credit and liquidity risk. Whatever the effect at work, the likely outcome is a decrease in interest rates. A detailed analysis of all the determinants of the portfolio rebalancing channel is contained in Krishnamurthy and Vissing-Jorgensen (2011).

the demise of Lehman Brothers, markets are characterized by poor liquidity and, therefore, high liquidity risk premia on specific assets. The presence of a central bank acting as a protagonist in the markets could substantially improve market functioning and reduce liquidity risk premia. This new role of the central bank may make investors more prone to behave actively in the markets, knowing that they may sell assets to the monetary authority if necessary.

Non-standard monetary measures consisting of asset purchases, special loans, and extension of existing lending facilities are mostly financed by the creation of new central bank's reserves. Therefore, commercial banks experience an increase in their reserve balances at the central bank. This could promote an expansion of lending opportunities by banks. Through this *credit channel*, or *bank lending channel*, banks may provide more loans to households and companies, fostering consumption and investment spending.

How do ECB non-standard measures fit into this classification? All the types of unconventional operations implemented by the ECB may potentially signal future intentions and future economic developments (*signaling channel*), improve overall market functioning (*liquidity premia channel*) and work through the *credit channel*. However, only purchases of securities (CBPP, SMP, OMT) are able to affect financial markets and the economy through the *portfolio rebalancing channel*, which has been found to be one of the most important channels of unconventional monetary policies in the US and in the UK (Gagnon et al., 2011; Joyce et al., 2011a). Therefore, we might expect these latter programs to exert a larger impact on the Italian spread vis-á-vis Germany than the other ones, as they may affect asset prices via a wider set of transmission channels. This conjecture is strengthened by the fact that the SMP and OMT have been introduced with the declared objective to fight the sovereign debt tensions of the euro area. As a result, the signaling and liquidity effects might be amplified in comparison with other kinds of non-standard operations.

Beyond these traditional transmission channels the ECB unconventional measures aimed at improving the functioning of interbank markets (FOR, FRTFA, COLL, LTRO, CBPP) may influence government bond spreads via banks' balance sheets. As stressed by Arghyrou and Kontonikas (2012), the role of domestic banking sectors is crucial, with the financial system transforming global risk into sovereign risk through two channels. First, in periods of financial stress banks should be recapitalized by governments, increasing its fiscal liabilities. Second, poor banking liquidity limits lending flows to private agents, exacerbating the recession and raising fiscal imbalances. Gerlach et al. (2010) show that during the height of the current crisis, up to almost one percentage point of euro area sovereign spreads can be explained by these banking related factors. Thus, the effect of unconventional operations designed to improve the health of interbank markets may help reduce the sovereign risk of a country.

4 An Event-Study Analysis

In this section, we perform an event-study analysis of ECB communications of unconventional monetary policy operations. In particular, we adopt a strategy similar to those recently used in Neely (2010), Gagnon et al. (2011), Krishnamurthy and Vissing-Jorgensen (2011) and Glick and Leduc (2012) to study the effect of non-standard measures implemented by the Federal Reserve. More specifically, we focus on changes in the Italian spread around ECB communications

concerning non-standard monetary policy measures. Inspired by Craine and Martin (2008), we first report in Table 3 the standard deviations of daily spread changes (in basis points) for event and non-event days over the entire period 2008-2012 as well as over each individual year.

[Table 3 about here]

As for the entire sample period, the figures show that the standard deviation of spread changes on event days is more than twice that on non-event days stressing the importance of ECB announcements on spread movements. Moreover, the volatility of spread changes has generally increased over time both for event and non-event days. Lastly, the difference in volatility between event and non-event days in 2008 and 2009 was less pronounced than in the subsequent years suggesting that ECB communications of unconventional operations had a higher impact on the spread in 2010-2012 than in 2008-2009.

The third column of Table 4 presents daily changes in the Italian spread on each ECB announcement day, as well as the cumulative and average effect over all announcements. Moreover, it shows the cumulative and average effect when distinguishing events by year and type of the operation. The cumulative spread changes are considered as a measure for the overall effects. Basis points spread changes are measured using a one-day window, and are calculated as the difference between the closing spread value on the event day and the closing spread value on the day before. Moreover, we also report pseudo p-values defined as the proportion of daily changes during the period 2008-2012 that are larger in absolute value than the actual change on the announcement day (Neely, 2010; Glick and Leduc, 2012).

[Table 4 about here]

The figures reported in the third column of Table 4 indicate that the cumulative effect of ECB announcements on the Italian spread was a reduction of around 200 basis points, which amounts to an average reduction for each announcement of 3.7 basis points. If we distinguish events by year, the cumulative effect is substantially higher in 2010-2012 than in 2008 and 2009. In particular, whereas events happening in 2008 even exhibit a positive cumulative effect on the spread,[9] 2010 is the year with the highest cumulative and average effect in absolute value. By considering the nature of the operations announced, we can verify that SMP events feature the highest cumulative and average effect on the Italian spread, followed by the OMT and CBPP. The figures regarding FOR announcements show a large cumulative effect, but a rather small average effect. FRTFA and COLL events are instead associated with a negligible impact on the spread, both in terms of cumulative and average effect.

By extending the event window to two days (from the closing level of the spread on the day before to that on the day after the announcement), as in Neely (2010), we allow for delayed reactions to news by market participants. The results are reported in the fourth column of Table 4. The pseudo p-values are now defined as the proportion of two-day spread changes during the period 2008-2012 that are larger in absolute value than the actual two-day change on the announcement day. The findings show that there has been a general increase (in absolute value) in the cumulative and average effects in comparison with a one-day window, both considering

[9] In Section 5 we provide some intuition for this empirical result.

all the events and the events distinguished by year and type, suggesting a delayed reaction of financial market participants to ECB news. More specifically, the two-day window analysis implies a cumulative effect of all events of approximately minus 286 basis points. Except for events in 2010, the cumulative and average impact of ECB announcements is amplified substantially for all the years compared to the one-day window case. Also, these considerations remain valid when distinguishing the events by type, except for events related to CBPP operations.

Lastly, a different two-day window is adopted (from the closing level of the spread on the second day prior to the announcement to that on the day of the announcement) to better capture possible anticipation effects. The results are presented in the last column of Table 4. They indicate that ECB news have been generally subjected to some anticipation effect. In fact, the cumulative spread changes for all events are much higher in absolute value than using a one-day window, i.e. around minus 329 basis points. The same pattern is observable by looking at the cumulative and average effects when announcements are distinguished by year and type, with the exception of COLL events.

This section has provided some evidence on the effectiveness of ECB announcements of non-standard operations in reducing the Italian spread. The results are consistent with the idea that there were delayed market adjustments as well as a certain degree of anticipation by market participants. However, it is worth emphasizing some general limitations of event-study analyses. As has been stressed in the literature, it is necessary to assume that markets are informationally efficient, i.e. the majority of the impact of ECB unconventional policies on the spread does not occur when operations are actually implemented, but when market expectations about those measures are formed. Hence, the choice of the event window length is crucial, since it involves a trade-off between keeping the interval narrow to avoid the noise produced by extraneous information, and choosing a wider window to identify potential delayed and/or anticipated reactions of market participants. For this reason, the results obtained using two-day windows are, on the one hand, less accurate in comparison with those obtained using a one-day window, as extending the event window increases necessarily the noise in the estimates of the announcement effect. On the other hand, they are able to better capture market reactions that are incorporated with delay and/or anticipation in asset prices. The difficulties to identify accurately other relevant news affecting the spread and the anticipation effects of agents may potentially generate biases in the estimates of spread changes. Therefore, a more formal analysis is needed to better gauge the relationship between ECB news and the perceived Italian sovereign risk. In the next section, we use time-series econometrics to tackle these issues by controlling for expectations of market participants and for other factors that could affect the Italian spread vis-á-vis Germany.

5 The Time Series Analysis

5.1 The Surprise Content of ECB Announcements

Since the expected part of monetary policy decisions is already priced into the market before a central bank announcement, it is only the surprise component that drives movements in yields (Kuttner, 2001; Fracasso et al., 2003). Therefore, to avoid the estimation bias that may arise from anticipated monetary policy decisions it is necessary to isolate the surprise component of

monetary policy announcements. Moreover, the change in monetary policy could actually reflect the authorities' response to asset price developments. As stressed by Rigobon and Sack (2004), the causality between monetary policy decisions and asset prices runs in both directions. This endogeneity may introduce a significant bias in empirical estimations. To mitigate this problem it is useful to employ high-frequency data and focus on a narrow time interval around the policy decision. By shrinking the time period around the announcement, it becomes more likely that the monetary policy shock is the predominant driver of asset prices within that time window. If the variance of the monetary policy shock becomes infinitely large relative to the variances of the other disturbances, then the bias goes to zero (Rigobon and Sack, 2004).

Incorporating these considerations, we construct a monetary policy surprise indicator by adopting the technique recently proposed by Wright (2012) and employed by Glick and Leduc (2012). In particular, Wright (2012) uses intra-daily data on medium- and long-term interest rate bond futures to identify the surprise component of Federal Reserve announcements during the recent zero-lower-bound period. Futures prices are a natural and market-based proxy for expectations of central bank policy actions, and, therefore, have been frequently used in the literature to isolate monetary policy surprise shocks (Kuttner, 2001; Fleming and Piazzesi, 2005; Gürkaynak, 2005; Gürkaynak et al., 2005a,b; Mirkov, 2011).[10] It is worth noting that, by quantifying the communications' variable, it is also possible to better assess both the direction and magnitude of the shock in comparison with models employing dummy variables.

In the present paper, the monetary policy surprise shock is computed as yield changes of Italian long-term bond futures (EUREX-Euro BTP futures index) from 15 minutes before each ECB announcement to 1 hour and 45 minutes afterwards.[11] As in Wright (2012), yield changes are constructed as returns on the futures contract divided by the duration of the cheapest-to-deliver asset in the deliverable basket. Since EUREX futures on Italian government bonds have been introduced in September 2009, for events occurring earlier we employ EUREX-Euro Bund futures. This choice is justified by the fact that until the first months of 2010 Italian and German long-term bond futures prices have been very highly correlated. The monetary policy surprise observations have been standardized for comparison purposes. Positive changes in the index of BTP future prices are associated with positive values of the surprise indicator, while negative movements with negative values. The monetary policy surprise indicator for each ECB announcement of unconventional operations is reported in the last column of Table 2.

5.2 The Econometric Methodology

This sub-section investigates, through the lenses of time-series econometrics, whether and to what extent ECB communications of non-standard operations have been capable of influencing the spread between the Italian and German long-term government bonds. More specifically, we investigate the effect of communications on the spread in a standard GARCH framework,

[10] Other ways to identify the unanticipated component of monetary policy announcements include the use of polls on market participant expectations (Ehrmann and Fratzscher, 2003, 2004, 2007a,b) and newspaper articles (Rosa, 2012).

[11] As stressed by Wright (2012), the selection of a quite wide window is supported by the fact that the events under scrutiny represent the interpretation of statements and speeches, as opposed as specific numerical values. Therefore, markets need more time to digest the new information and a relatively wide window is more suitable. Nevertheless, the use of narrower windows provides very similar results.

originally proposed by Bollerslev (1986) to model time-varying volatility.[12] The conditional mean of the model is an augmented autoregressive process where both the lagged endogeneous as well as the monetary policy variable are statistically insignificant for lag orders exceeding two and were omitted for reasons of parsimony:

$$\Delta S_t = \alpha + \sum_{i=1}^{2} \beta_i \Delta S_{t-i} + \sum_{i=0}^{2} \gamma_i UNC_{t-i} + \boldsymbol{\delta} \Delta \mathbf{X_t} + \varepsilon_t, \tag{1}$$

where ΔS_t is the first difference of spread between Italian and German government bonds,[13] UNC_t is the monetary policy surprise indicator calculated as explained in the previous subsection, and $\mathbf{X_t}$ represents a vector of controls. Let the error process be such that $\varepsilon_t = \nu_t \sqrt{h_t}$, where ν_t is an i.i.d. sequence with zero mean and $\sigma_\nu^2 = 1$. The conditional variance of ε_t is modeled as an ARMA(1,1) process:

$$h_t = c + a\varepsilon_{t-1}^2 + bh_{t-1}. \tag{2}$$

The vector of control variables $\mathbf{X_t}$ includes: a) A volatility index for the euro area ($EuroVIX_t$) to control for financial turmoil, as in Glick and Leduc (2012) and Arghyrou and Kontonikas (2012). We expect a positive relationship between ΔS_t and $\Delta EuroVIX_t$. b) The *total stock market index* for the EU ($EUDS_t$) to control for market-wide business climate changes in the EU, as in De Bruyckere et al. (2012). We expect a negative sign for the coefficient of $EUDS_t$ in the model. c) The TED spread (TED_t), calculated as the three-month LIBOR rate less the US Treasury bill rate, to control for perceived credit risk in the global economy, as in Gerlach et al. (2010). The expected sign of the coefficient of this variable is positive. d) The credit default swap (CDS) of Greece ($CDSGreece_t$) to control for the turbulences due to the Greek sovereign crisis. We expect a positive relationship between this variable and the Italian spread.[14] Lastly, we also added a dummy variable (MPE_t) to account for the fact that five unconventional events listed in Table 2 coincide with a reduction of the key ECB interest rates.

Parameters are estimated by (quasi-) maximum likelihood using the Broyden, Fletcher, Goldfarb and Shanno (BFGS) numerical algorithm with robust standard errors. The model is estimated using daily data obtained from the Thomson Reuters-Datastream database, covering the period 01:01:2008-31:12:2012. Details on the data employed in the analysis are reported in the Appendix.

5.3 The Results

The sample period from 2008 to 2012 covers both the global financial crisis as well as the European government debt crisis giving rise to the possibility of a different sovereign bond

[12] The estimation of a GARCH-M model reveals that the conditional volatility does not help to explain the spread, a finding in line with Taylor (1992). The results are available from the authors upon request.

[13] As in Attinasi et al. (2011), Gerlach et al. (2010) and Arghyrou and Kontonikas (2012).

[14] Due to statistical insignificance, a proxy for international risk aversion has been omitted from the analysis. This finding is in line with the evidence in Kozicki et al. (2011). Also, Bund futures turnover as a proxy for liquidity conditions has been found not to be statistically significant.

market reaction to ECB announcements. For instance, the zero lower bond of interest rate was virtually reached only in the mid of 2009, and markets were repeatedly disappointed during 2008 following ECB refusals to move interest rates, while other central banks were cutting aggressively their policy rates. In this context, non-standard operations may have had undesired effects on market participants' behavior, as events perceived as a loosening of monetary policy could have been mainly considered by agents as a herald of unfavorable economic news (e.g. worsening macroeconomic outlook and increasing uncertainty), rather than a credible commitment by the ECB to improve market liquidity. This, in turn, may have raised the risk premium on Italian long-term treasuries and/or reduced German Bund rates within a 'flight to quality' context.

In early 2010, markets were again worrying about excessive national debt and demand higher risk premia from countries with elevated debt levels, budget deficits and current account deficits. Of course, this further complicates the financing of budget deficits and servicing existing bonds, particularly when GDP growth was shrinking. On May, 8th, 2010, the EU launched the European Financial Stability Facility constructed to maintain financial market stability in the euro area by issuing financial assistance to threatened member states. This coincides with a structural break in the linear relationship between the spread change and the above mentioned regressors. A formal Chow break test reveals a highly significant F-statistic of 47.27 suggesting to estimate the GARCH models in two sub-samples, the first ranging from January, 2nd, 2008 to May, 7th, 2010 and the second ranging from May, 10th, 2010 to December, 31st, 2012.

Table 5 reports the parameter estimates of the GARCH model in equation (1) and (2). Ljung-Box (LB) Q-statistics were computed to test for remaining autocorrelation in standardized and squared standardized residuals. The p-values of the calculated LB-Q values show that the null hypothesis of no-autocorrelation up to five and ten orders cannot be rejected. The estimated coefficients of the variance equation are statistically significant at conventional levels (not reported here), revealing clustering and long memory of the spread volatility. From these observations we can conclude that GARCH models are reasonably specified. Turning to the estimates of the mean equation, we find that, in the first sub-sample, the sign of the control variables are as expected and statistically significant. For example, a one percent increase of the European risk measure $EuroVIX_t$ increases the Italian government bond spread by 31 basis points. To a lesser extent, the spread also reacts negatively to changes of the global risk measure TED_t. In contrast, an improved economic outlook ($EUDS_t$) removes some pressure from Italian bonds. The figures also suggest some contagion effects from the Greek government debt crisis. Not surprisingly, the coefficient of the dummy variable MPE_t is negative, although statistically significant only at the ten percent level. With the transition to the second sub-sample, only $EUDS_t$ and, at the ten percent level, $EuroVIX_t$ remain significant.

[Table 5 about here]

The estimates of the monetary policy indicator are negative and highly significant in the second sub-sample suggesting that positive monetary policy surprises associated with ECB non-standard operations led to a substantial daily decline in the Italian spread. More precisely, a one standard deviation monetary policy surprise is estimated to lower the spread by around 13 basis points.[15] Since the coefficient of the surprise indicator is not subsequently reversed

[15] As stressed by Glick and Leduc (2012), the procedure to calculate the policy surprises does not ensure that a

(as indicated by insignificant lags at the five percent level) our analysis suggests a permanent impact of monetary policy on the Italian government bond spread. In line with the above argumentation leading to a structural break in early 2010 we find an adverse influence of ECB non-standard operations in the first sub-sample. Consistently with the findings of the event-study analysis, monetary policy surprises are positively correlated with the spread before the structural break occurred, and negatively in the remaining years. Besides the above mentioned argumentation leading to the sub-sample estimation, which highlights the potential role of risk premium movements, unconventional events right after the start of the crisis were mainly supplementary long-term refinancing operations and new liquidity-providing operations in foreign currency, which, as we will show in Table 8, do not exhibit any significant relationship with the Italian government bond spread. While confirming our approach, these results stress the importance of the prevailing market environment when predicting the influence of ECB policy measures.

Table 6 provides a more detailed view by distinguishing positive from negative monetary policy surprises. This is done by interacting the surprise monetary indicator with 0,1-dummies for positive and negative changes.

[Table 6 about here]

In the first sub-sample, positive surprises are associated with an increase in the spread, whereas negative surprises with a reduction generally reproducing the results of Table 5. It should be mentioned, however, that positive surprises exhibit a much larger influence on spreads than negative surprises, although coefficients are now only borderline significant. In the second sub-sample, we find a more symmetric contemporaneous influence of monetary surprises. A one standard deviation surprise affects the spread on average by 13 basis points in the expected direction. In case of negative shocks the impact is substantially diminished over the next trading day.

Within the event study analysis of section 4 we showed that the effect of ECB non-standard operations on the Italian spread seems to differ over time and across types of measure. While the sub-sample estimation of the GARCH model confirmed the time variation of results, we additionally check the robustness of the event study findings by distinguishing the policy events by typology. Due to the fact that some policy measures such as purchases of government bonds carried out under the *Securities Market Programme* or the *Outright Monetary Transactions* only occur in the second sub-sample we also provide a full-sample estimation.[16] Moreover, lags of higher than first order remain statistically insignificant and are skipped for parsimony. The estimation results are represented in Table 7.

[Table 7 about here]

From inspection of the full-sample estimation, we find that the ECB programs especially designed to improve conditions in euro area sovereign bond markets, i.e. the SMP and OMT, turn

positive surprise will lower the Italian spread and a negative surprise will increase it. Since the surprise component is obtained using the futures on long-term Italian government bonds, the indicator is able to capture only the expectations of agents about ECB announcements. Long-term bond yields, and consequently the spread, can also be affected by other factors such as risk and term premia.

[16] News on CBPP operations only occur twice in the second sub-sample rendering parameter estimates unreliable. Thus, we skipped this variable from estimation.

out to be most effective in influencing the Italian spread. A one standard deviation increase in the monetary policy indicator for these two programs is associated with a reduction in the spread of 16 basis points. The coefficient of announcements of CBPP events is concurrently also negative and statistically significant, but is overcompensated by a significant reversal on the following trading day. Lastly, there is no evidence that measures aimed at expanding the collateral have affected the interest rate differential, a result that remains valid for the other three types of non-standard monetary policy measures. When looking at the second sub-sample the following results are worth mentioning. Compared to the first column of Table 7 the coefficient of events related to the extension of the collateral for banks becomes strongly statistically significant. According to these figures, COLL communications were even more effective in affecting the Italian spread than SMP and OMT events. Announcements of policies regarding foreign currency agreements and fixed rate tenders with full allotment are confirmed to play no role in spread movements, while long-term refinancing operations seem to exhibit adverse effects on the spread. All in all, we found only weak evidence that news on measures specifically introduced to improve liquidity were able to affect the Italian sovereign spread. These findings are somewhat in contrast to the hypothesis in Gerlach et al. (2010), and are probably related to the relative soundness of the Italian banking sector during the recent crisis. In fact, in countries with a relatively less vulnerable banking sector, aggregate risk fluctuations are likely to exert a smaller influence on sovereign risk movements via this banking channel.

6 Concluding Remarks

As the perceived sovereign risk of Italy started to increase in 2008, the differential between the Italian long-term government bond yields and their German counterparts widened to unprecedented levels since the introduction of the euro. At the same time, the European Central Bank launched a series of non-standard operations and programs aimed at restoring the proper functioning of interbank and financial markets, but also influencing the euro area sovereign debt problems. This paper has investigated how ECB announcements of unconventional operations affected the Italian spread vis-á-vis Germany during the last five years. We have explored this relationship empirically through an event-study as well as a time series analysis. The results from the event-study indicate that ECB communications about non-standard operations were able to reduce the sovereign solvency risk of Italy. Moreover, events taking place during the period 2010-2012 were more effective in shrinking the Italian spread vis-á-vis Germany in comparison with events occurring at the onset of the crisis in 2008-2009. Lastly, announcements of operations regarding the *Covered Bond Purchase Programmes*, the *Securities Market Programme*, and *Outright Monetary Transactions* are associated with a much stronger and significant reduction of the differential between Italian and German long-term bond yields as compared with other kinds of unconventional measures. By controlling for market participants' expectations and other factors, the findings from the econometric analysis confirm that ECB announcements of unconventional measures influenced significantly the Italian spread in the last five years. In addition, events happening in 2010-2012 and those related to the *Securities Market Programme*, *Outright Monetary Transactions*, and, to some extent, *Extensions of Eligible Assets* were remarkably powerful in affecting the yield differential. From a policy-making point of view, this paper has

shown that the way the ECB 'bought time' during the last five years has been successful in downsizing the euro area sovereign debt crisis, at least for Italy.

References

Abbassi, P. and Linzert, T. (2011). The effectiveness of monetary policy in steering money market rates during the recent financial crisis. Working Paper Series 1328, European Central Bank.

Angelini, P., Nobili, A., and Picillo, C. (2011). The interbank market after August 2007: What has changed, and why? *Journal of Money, Credit and Banking*, 43(5):923–958.

Arghyrou, M. G. and Kontonikas, A. (2012). The EMU sovereign-debt crisis: Fundamentals, expectations and contagion. *Journal of International Financial Markets, Institutions and Money*, 22(4):658–677.

Attinasi, M., Checherita, C., and Nickel, C. (2011). What explains the surge in euro area sovereign spreads during the financial crisis of 2007-2009? In Kolb, R. W., editor, *Sovereign Debt: From Safety to Default*, pages 407–414. John Wiley & Sons, Inc.

Baumeister, C. and Benati, L. (2010). Unconventional monetary policy and the Great Recession - Estimating the impact of a compression in the yield spread at the zero lower bound. Working Paper Series 1258, European Central Bank.

Bayoumi, T., Goldstein, M., and Woglom, G. (1995). Do credit markets discipline sovereign borrowers? evidence from U.S. states. *Journal of Money, Credit and Banking*, 27(4):1046–1059.

Beirne, J., Dalitz, L., Ejsing, J., Grothe, M., Manganelli, S., Monar, F., Sahel, B., Sušec, M., Tapking, J., and Vong, T. (2011). The impact of the Eurosystem's covered bond purchase programme on the primary and secondary markets. Occasional Paper Series 122, European Central Bank.

Bernanke, B. S. and Reinhart, V. R. (2004). Conducting monetary policy at very low short-term interest rates. *The American Economic Review*, 94(2):85–90.

Blinder, A., Ehrmann, M., Fratzscher, M., de Haan, J., and Jansen, D. (2008). Central bank communication and monetary policy: A survey of theory and evidence. *Journal of Economic Literature*, pages 910–945.

Blinder, A. S. (2010). Quantitative easing: Entrance and exit strategies. *Federal Reserve Bank of St. Louis Review*, Nov-Dec:465–480.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31(3):307–327.

Borio, C. and Disyatat, P. (2010). Unconventional monetary policies: an appraisal. *The Manchester School*, 78:53–89.

Bridges, J. and Thomas, R. (2012). The impact of QE on the UK economy - Some supportive monetarist arithmetic. Bank of England working papers 442, Bank of England.

Chen, H., Cúrdia, V., and Ferrero, A. (2012). The macroeconomic effects of large-scale asset purchase programmes. *The Economic Journal*, 122(564):F289–F315.

Christensen, J. H. E. and Rudebusch, G. D. (2012). The response of interest rates to US and UK Quantitative Easing. *The Economic Journal*, 122(564):F385–F414.

Craine, R. and Martin, V. L. (2008). International monetary policy surprise spillovers. *Journal of International Economics*, 75(1):180–196.

D'Amico, S., English, W., López-Salido, D., and Nelson, E. (2012). The Federal Reserve's large-scale asset purchase programmes: Rationale and effects. *The Economic Journal*, 122(564):F415–F446.

De Bruyckere, V., Gerhardt, M., Schepens, G., and Vander Vennet, R. (2012). Bank/sovereign risk spillovers in the European debt crisis. Working Paper Research 232, National Bank of Belgium.

de Haan, J., Oosterloo, S., and Schoenmaker, D. (2012). *Financial Markets and Institutions: A European Perspective*. Cambridge University Press.

De Santis, R. A. (2012). The Euro area sovereign debt crisis: Safe haven, credit rating agencies and the spread of the fever from Greece, Ireland and Portugal. Working Paper Series 1419, European Central Bank.

Doh, T. (2010). The efficacy of large-scale asset purchases at the zero lower bound. *Federal Reserve Bank of Kansas City Economic Review*, (Q II):5–34.

Ehrmann, M. and Fratzscher, M. (2003). Monetary policy announcements and money markets: A transatlantic perspective. *International Finance*, 6(3):309–328.

Ehrmann, M. and Fratzscher, M. (2004). Taking stock: Monetary policy transmission to equity markets. *Journal of Money, Credit and Banking*, 36(4):719–737.

Ehrmann, M. and Fratzscher, M. (2007a). Communication by central bank committee members: Different strategies, same effectiveness? *Journal of Money, Credit and Banking*, 39(2-3):509–541.

Ehrmann, M. and Fratzscher, M. (2007b). The timing of central bank communication. *European Journal of Political Economy*, 23(1):124–145.

Falagiarda, M. (2013). Evaluating Quantitative Easing: a DSGE approach. Unpublished manuscript.

Fleming, M. and Piazzesi, M. (2005). Monetary policy tick-by-tick. *Unpublished manuscript*.

Fracasso, A., Genberg, H. J., and Wyplosz, C. (2003). *How do central banks write? An evaluation of inflation reports by inflation targeting central banks*, volume 2. CEPR Publications.

Gagnon, J., Raskin, M., Remache, J., and 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.

Gerlach, S., Schulz, A., and Wolff, G. B. (2010). Banking and sovereign risk in the Euro area. CEPR Discussion Papers 7833.

Giannone, D., Lenza, M., Pill, H., and Reichlin, L. (2011). Non-standard monetary policy measures and monetary developments. In Chadha, J. and Holly, S., editors, *Interest Rates, Prices and Liquidity: Lessons from the Financial Crisis*, chapter 8.

Glick, R. and Leduc, S. (2012). Central bank announcements of asset purchases and the impact on global financial and commodity markets. *Journal of International Money and Finance*, 31(8):2078–2101.

Goldstein, M. and Woglom, G. (1991). *Market-based fiscal discipline in monetary unions: Evidence from the US municipal bond market*, volume 89. International Monetary Fund.

Gürkaynak, R. S. (2005). Using federal funds futures contracts for monetary policy analysis. Finance and Economics Discussion Series 2005-29, Board of Governors of the Federal Reserve System.

Gürkaynak, R. S., Sack, B., and Swanson, E. (2005a). Do actions speak louder than words? The response of asset prices to monetary policy actions and statements. *International Journal of Central Banking*, 1(1):55–93.

Gürkaynak, R. S., Sack, B., and Swanson, E. (2005b). The sensitivity of long-term interest rates to economic news: Evidence and implications for macroeconomic models. *The American Economic Review*, 95(1):425–436.

Hamilton, J. D. and Wu, J. C. (2012). The effectiveness of alternative monetary policy tools in a zero lower bound environment. *Journal of Money, Credit and Banking*, 44:3–46.

Joyce, M. A. S., Lasaosa, A., Stevens, I., and Tong, M. (2011a). The financial market impact of quantitative easing in the United Kingdom. *International Journal of Central Banking*, 7(3):113–161.

Joyce, M. A. S., Miles, D., Scott, A., and Vayanos, D. (2012). Quantitative easing and unconventional monetary policy - An introduction. *The Economic Journal*, 122(564):F271–F288.

Joyce, M. A. S. and Tong, M. (2012). QE and the gilt market: a disaggregated analysis. *The Economic Journal*, 122(564):F348–F384.

Joyce, M. A. S., Tong, M., and Woods, R. (2011b). The United Kingdom's quantitative easing policy: Design, operation and impact. *Bank of England Quarterly Bulletin*, Q3:200–212.

Kapetanios, G., Mumtaz, H., Stevens, I., and Theodoridis, K. (2012). Assessing the economy-wide effects of quantitative easing. *The Economic Journal*, 122(564):F316–F347.

Klyuev, V., de Imus, P., and Srinivasan, K. (2009). Unconventional choices for unconventional times: credit and quantitative easing in advanced economies. IMF Staff Position Note SPN/09/27.

Kozicki, S., Santor, E., and Suchanek, L. (2011). Central bank balance sheets and long-term forward rates. In Chadha, J. and Holly, S., editors, *Interest Rates, Prices and Liquidity: Lessons from the Financial Crisis*, chapter 7.

Krishnamurthy, A. and Vissing-Jorgensen, A. (2011). The effects of quantitative easing on interest rates: channels and implications for policy. NBER Working Papers 17555, National Bureau of Economic Research.

Krugman, P. R. (1998). It's baaack: Japan's slump and the return of the liquidity trap. *Brookings Papers on Economic Activity*, 1998(2):137–205.

Kuttner, K. N. (2001). Monetary policy surprises and interest rates: Evidence from the Fed funds futures market. *Journal of Monetary Economics*, 47(3):523–544.

Lenza, M., Pill, H., and Reichlin, L. (2010). Monetary policy in exceptional times. *Economic Policy*, 25(62):295–339.

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

Meier, A. (2009). Panacea, curse, or nonevent? Unconventional monetary policy in the United Kingdom. IMF Working Papers 09/163, International Monetary Fund.

Mirkov, N. (2011). The US term premia around the FOMC decisions. Working Paper Series 139, School of Finance - University of St.Gallen.

Neely, C. J. (2010). The large scale asset purchases had large international effects. Working Papers 2010-018, Federal Reserve Bank of St. Louis.

Orphanides, A. (2004). Monetary policy in deflation: the liquidity trap in history and practice. *The North American Journal of Economics and Finance*, 15(1):101–124.

Peersman, G. (2011). Macroeconomic effects of unconventional monetary policy in the Euro area. Working Paper Series 1397, European Central Bank.

Rigobon, R. and Sack, B. (2004). The impact of monetary policy on asset prices. *Journal of Monetary Economics*, 51(8):1553–1575.

Rosa, C. (2012). How "unconventional" are large-scale asset purchases? The impact of monetary policy on asset prices. Staff Reports 560, Federal Reserve Bank of New York.

Schuknecht, L., Von Hagen, J., and Wolswijk, G. (2009). Government risk premiums in the bond market: EMU and Canada. *European Journal of Political Economy*, 25(3):371–384.

Svensson, L. E. O. (2003). Escaping from a liquidity trap and deflation: the foolproof way and others. *The Journal of Economic Perspectives*, 17(4):145–166.

Swanson, E. T. (2011). Let's twist again: A high-frequency event-study analysis of Operation Twist and its implications for QE2. *Brookings Papers on Economic Activity*, 42(1):151–207.

Taylor, M. P. (1992). Modelling the yield curve. *The Economic Journal*, 102(412):524–537.

Tobin, J. (1958). Liquidity preference as behavior towards risk. *Review of Economic Studies*, 25(2):65–86.

Vayanos, D. and Vila, J.-L. (2009). A preferred-habitat model of the term structure of interest rates. Working Paper 15487, National Bureau of Economic Research.

Wright, J. H. (2012). What does monetary policy do to long-term interest rates at the zero lower bound? *The Economic Journal*, 122(564):F447–F466.

Tables and Figures

Table 1: Details on securities holdings acquired under the SMP

Issuer country	Outstanding amounts		Average remaining maturity (in years)
	Nominal amount (€ billion)	Book value (€ billion)	
Greece	33.9	30.8	3.6
Ireland	14.2	13.6	4.6
Italy	102.8	99.0	4.5
Portugal	22.8	21.6	3.9
Spain	44.3	43.7	4.1
Total	218.0	208.7	4.3

Source: ECB Press Release, 21 February 2013

Table 2: ECB unconventional monetary policy programs announcements

Date	Time (CET)	Event	Type	Description	Monetary surprise
10/01/2008	3:00 pm	PR	FOR	The GC decided to conduct US dollar liquidity-providing operations	-0.089
07/02/2008	2:30 pm	PC	LTRO	The GC decided to renew two outstanding supplementary longer-term refinancing operations	-0.088
11/03/2008	3:00 pm	PR	FOR	The GC decided to conduct US dollar liquidity-providing operations	0.040
28/03/2008	3:00 pm	PR	LTRO	The GC decided to conduct supplementary longer-term refinancing operations	-0.101
02/05/2008	3:00 pm	PR	FOR	The GC decided to enhance US dollar liquidity-providing operations	-0.355
30/07/2008	3:00 pm	PR	FOR	The GC decided to enhance US dollar liquidity-providing operations	0.125
31/07/2008	3:00 pm	PR	LTRO	The GC decided to renew two outstanding supplementary longer-term refinancing operations	0.229
04/09/2008	2:30 pm	PC	LTRO	The GC decided to renew three outstanding supplementary longer-term refinancing operations	-0.175
18/09/2008	9:00 am	PR	FOR	The GC decided to enhance US dollar liquidity-providing operations	0.114
26/09/2008	8:00 am	PR	FOR	The GC decided to enhance US dollar liquidity-providing operations	0.357
29/09/2008	4:00 pm	PR	FOR	The GC decided to double the temporary swap lines with the Fed	0.444
07/10/2008	2:15 pm	PR	LTRO, FOR	The GC decided to enhance a longer-term refinancing operation and expand US dollar liquidity-providing operations	-0.051
08/10/2008*	1:00 pm	PR	FRTFA	The GC decided to adopt a fixed rate tender procedure with full allotment	-0.406
13/10/2008	8:00 am	PR	FOR	The GC decided to conduct US dollar liquidity-providing operations	-0.334

Table 2: (continued)

15/10/2008	3:00 pm	PR	COLL, LTRO, FOR	The GC decided to expand the list of assets eligible as collateral, enhance the provision of longer-term refinancing operations, and provide US dollar liquidity through foreign exchange swaps	-0.367
18/12/2008	3:00 pm	PR	FRTFA	The GC decided that the main refinancing operations will continue to be carried out through a fixed rate tender procedure with full allotment for as long as needed	0.360
19/12/2008	3:00 pm	PR	FOR	The GC decided to continue conducting US dollar liquidity-providing operations	0.066
03/02/2009	3:00 pm	PR	FOR	The GC decided to extend the liquidity swap arrangements with the Fed	-0.337
05/03/2009*	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue the fixed rate tender procedure with full allotment for all main refinancing operations, special-term refinancing operations and supplementary and regular longer-term refinancing operations for as long as needed	-0.056
19/03/2009	3:00 pm	PR	FOR	The GC decided to continue conducting US dollar liquidity-providing operations	-0.226
06/04/2009	3:00 pm	PR	FOR	The GC decided to establish a temporary reciprocal currency arrangement (swap line) with the Fed	0.125
07/05/2009*	2:30 pm	PC, PR	LTRO, CBPP	The GC decided to proceed with the ECS. In particular, the GC decided to purchase euro-denominated covered bonds issued in the euro area, and to conduct liquidity-providing longer-term refinancing operations with a maturity of one year	-0.295
04/06/2009	2:30 pm	PC	CBPP	The GC decided upon the technical modalities of the CBPP1	-0.544
25/06/2009	3:00 pm	PR	FOR	The GC decided to extend the liquidity swap arrangements with the Fed	0.030
24/09/2009	3:00 pm	PR	FOR	The GC decided to continue conducting US dollar liquidity-providing operations	0.245
03/12/2009	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment for as long as is needed, and to enhance the provision of longer-term refinancing operations	0.036
04/03/2010	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment for as long as is needed, and to return to variable rate tender procedures in the regular 3-month longer-term refinancing operations	0.247
10/05/2010	Night 09/05	PR	SMP, FOR, LTRO	The GC decided to proceed with the SMP, to reactivate the temporary liquidity swap lines with the Fed, to adopt a fixed-rate tender procedure with full allotment in the regular 3-month longer-term refinancing operations, and to conduct new special longer-term refinancing operations	2.695
10/06/2010	2:30 pm	PC	LTRO	The GC decided to adopt a fixed rate tender procedure with full allotment in the regular 3-month longer-term refinancing operations	-0.010
02/09/2010	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment	-0.029

Table 2: (continued)

02/12/2010	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment	-0.043
17/12/2010	3:00 pm	PR	FOR	The ECB announced a temporary swap facility with the Bank of England	-0.019
21/12/2010	3:00 pm	PR	FOR	The GC decided to extend the liquidity swap arrangements with the Fed	0.106
03/03/2011	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment	-0.456
09/06/2011	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment	0.151
29/06/2011	3:00 pm	PR	FOR	The GC decided to extend the liquidity swap arrangements with the Fed	-0.133
04/08/2011	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment, and to conduct a liquidity-providing supplementary longer-term refinancing operation with a maturity of six months as a fixed rate tender procedure with full allotment	0.012
08/08/2011	Night 07/08	PR	SMP	The GC decided to actively implement its Securities Markets Programme for Italy and Spain	4.815
25/08/2011	3:00 pm	PR	FOR	The GC decided to extend the liquidity swap arrangement with the Bank of England	-0.074
15/09/2011	3:00 pm	PR	FOR	The GC decided to conduct three US dollar liquidity-providing operations in coordination with other central banks	0.043
06/10/2011	2:30 pm	PC	FRTFA, LTRO, CBPP	The GC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment, to conduct two liquidity-providing supplementary longer-term refinancing operation with a maturity of twelve and thirteen months as a fixed rate tender procedure with full allotment, and to launch a new covered bond purchase program (CBPP2)	-0.011
03/11/2011*	3:00 pm	PR	CBPP	The GC decided upon the technical modalities of CBPP2	-0.138
30/11/2011	3:00 pm	PR	FOR	The GC decided in cooperation with other central banks the establishment of a temporary network of reciprocal swap lines	1.510
08/12/2011*	2:30 pm	PC	LTRO, COLL	The GC decided to conduct two longer-term refinancing operations with a maturity of three years and to increase collateral availability	-1.263

Table 2: (continued)

09/02/2012	2:30 pm	PC	COLL	The GC approved specific national eligibility criteria and risk control measures for the temporary acceptance in a number of countries of additional credit claims as collateral in Eurosystem credit operations.	1.085
06/06/2012	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue to conduct its main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment	0.034
22/06/2012	3:00 pm	PR	COLL	The GC took further measures to increase collateral availability for counterparties	0.170
26/07/2012	12:00 noon	SP	OMT	Draghi's *London speech* ("... the ECB is ready to do whatever it takes to preserve the euro.")	2.541
02/08/2012	2:30 pm	PC	OMT	The GC announced that may undertake outright open market operations of a size adequate to reach its objective. Markets disappointed for lack of details about OMT	-3.084
27/08/2012	5:00 pm	SP	OMT	Asmussen's *Hamburg speech* supporting the new bond purchase program	0.046
06/09/2012	2:30 pm	PC	OMT, COLL	The GC announced the technical details of OMT and decided on additional measures to preserve collateral availability	0.455
12/09/2012	3:00 pm	PR	FOR	The GC decided to extend the liquidity swap arrangement with the Bank of England	0.377
06/12/2012	2:30 pm	PC	FRTFA, LTRO	The GC decided to continue conducting its main refinancing operations as fixed rate tender procedures with full allotment for as long as necessary, and to conduct 3-month longer-term refinancing operations as fixed rate tender procedures with full allotment	0.547
13/12/2012	3:00 pm	PR	FOR	The GC decided to extend the liquidity swap arrangements with the Fed	-0.062

Notes: PC indicates Press Conference; PR indicates Press Release; SP indicates Speech. * denotes that the event coincides with a reduction of the key ECB interest rates.

Table 3: Standard deviations of daily basis point changes in the spread

	Event days	Non-event days
Entire sample	18.12	8.82
2008	5.11	2.94
2009	4.17	4.15
2010	19.42	5.43
2011	25.88	13.59
2012	24.18	12.17

Table 4: Effects of ECB unconventional monetary policy operations on the Italian spread

Date	Type	1-day window	2-day window (lagged effects)	2-day window (anticipation effects)
10/01/2008	FOR	2.6	1.5	4.3
		(0.56)	(0.81)	(0.55)
07/02/2008	LTRO	−0.2	−1.9	0.5
		(0.94)	(0.76)	(0.94)
11/03/2008	FOR	−3.5	−4.7	−2.8
		(0.48)	(0.52)	(0.68)
28/03/2008	LTRO	−1.8	−1.7	−3.1
		(0.66)	(0.79)	(0.65)
02/05/2008	FOR	−1.0	−2.1	−1.0
		(0.80)	(0.74)	(0.87)
30/07/2008	FOR	−0.3	−2.4	2.2
		(0.93)	(0.72)	(0.73)
31/07/2008	LTRO	−2.1	9.5	−2.4
		(0.62)	(0.30)	(0.72)
04/09/2008	LTRO	2.1	5.0	2.4
		(0.62)	(0.50)	(0.72)
18/09/2008	FOR	5.2	−3.6	6.6
		(0.34)	(0.61)	(0.42)
26/09/2008	FOR	4.0	21.0	2.2
		(0.44)	(0.10)	(0.73)
29/09/2008	FOR	17.0	16.0	21.0
		(0.07)	(0.15)	(0.10)
07/10/2008	LTRO, FOR	0.2	3.7	2.6
		(0.94)	(0.60)	(0.70)
08/10/2008*	FRTFA	3.5	3.2	3.7
		(0.48)	(0.64)	(0.60)
13/10/2008	FOR	−6.0	−12.3	−5.4
		(0.29)	(0.22)	(0.49)
15/10/2008	COLL, LTRO, FOR	−4.4	−2.9	−10.7
		(0.41)	(0.67)	(0.26)
18/12/2008	FRTFA	−0.2	1.5	1.8
		(0.94)	(0.81)	(0.77)
19/12/2008	FOR	1.7	2.2	1.5
		(0.68)	(0.73)	(0.81)
03/02/2009	FOR	−6.6	−18.6	−12.4
		(0.26)	(0.12)	(0.22)
05/03/2009*	FRTFA, LTRO	0.4	7.2	−5.7
		(0.90)	(0.39)	(0.47)
19/03/2009	FOR	4.6	−1.9	3.3
		(0.39)	(0.76)	(0.63)
06/04/2009	FOR	1.3	4.1	−8.6
		(0.74)	(0.57)	(0.33)
07/05/2009*	LTRO, CBPP	−10.0	−15.1	−12.7
		(0.15)	(0.16)	(0.21)
04/06/2009	CBPP	3.4	−1.2	3.5
		(0.50)	(0.85)	(0.62)
25/06/2009	FOR	−1.2	−1.7	−4.2
		(0.76)	(0.79)	(0.56)
24/09/2009	FOR	0.6	1.9	2.4
		(0.86)	(0.76)	(0.72)
03/12/2009	FRTFA, LTRO	−1.1	−8.1	−2.1
		(0.78)	(0.35)	(0.74)
04/03/2010	FRTFA, LTRO	−0.2	−3.8	−1.7

Table 4: (continued)

		(0.94)	(0.59)	(0.79)
10/05/2010	SMP, FOR, LTRO	−50.5	−49.2	−42.1
		(0.00)	(0.01)	(0.02)
10/06/2010	LTRO	−17.1	−13.1	−34.3
		(0.06)	(0.20)	(0.04)
02/09/2010	FRTFA, LTRO	−6.5	−11.6	−17.4
		(0.27)	(0.24)	(0.13)
02/12/2010	FRTFA, LTRO	−17.5	−19.4	−44.5
		(0.06)	(0.11)	(0.02)
17/12/2010	FOR	5.6	9.9	7.1
		(0.31)	(0.29)	(0.39)
21/12/2010	FOR	3.7	6.2	8.0
		(0.46)	(0.44)	(0.36)
03/03/2011	FRTFA, LTRO	0.0	−1.7	−2.0
		(0.98)	(0.79)	(0.75)
09/06/2011	FRTFA, LTRO	7.3	11.2	10.7
		(0.23)	(0.25)	(0.26)
29/06/2011	FOR	−10.2	−18.7	−14.2
		(0.15)	(0.12)	(0.18)
04/08/2011	FRTFA, LTRO	18.3	2.3	14.6
		(0.05)	(0.73)	(0.17)
08/08/2011	SMP	−71.4	−86.4	−87.4
		(0.00)	(0.00)	(0.00)
25/08/2011	FOR	0.2	6.4	0.9
		(0.94)	(0.43)	(0.88)
15/09/2011	FOR	−9.4	−16.0	−27.8
		(0.17)	(0.15)	(0.06)
06/10/2011	FRTFA, LTRO, CBPP	−16.9	−14.8	−22.3
		(0.07)	(0.17)	(0.09)
03/11/2011*	CBPP	−4.7	14.6	−8.5
		(0.38)	(0.17)	0.34
30/11/2011	FOR	−12.4	−44.1	−11.9
		(0.12)	(0.02)	(0.23)
08/12/2011*	LTRO, COLL	45.2	41.7	64.7
		(0.01)	(0.03)	(0.01)
09/02/2012	COLL	−13.2	4.8	−18.8
		(0.11)	(0.52)	(0.12)
06/06/2012	FRTFA, LTRO	−10.3	−15.9	−11.9
		(0.14)	(0.15)	(0.23)
22/06/2012	COLL	4.6	34.7	7.4
		(0.39)	(0.04)	(0.38)
26/07/2012	OMT	−43.7	−61.7	−58.9
		(0.01)	(0.01)	(0.01)
02/08/2012	OMT	41.2	11.2	22.7
		(0.01)	(0.25)	(0.09)
27/08/2012	OMT	−24.3	−13.1	5.0
		(0.03)	(0.20)	(0.50)
06/09/2012	OMT, COLL	−29.0	−54.5	−45.3
		(0.02)	(0.01)	(0.02)
12/09/2012	FOR	−14.1	−11.5	−22.5
		(0.10)	(0.24)	(0.09)
06/12/2012	FRTFA, LTRO	16.1	13.9	24.0
		(0.07)	(0.18)	(0.08)
13/12/2012	FOR	−0.4	−7.1	−10.1
		(0.90)	(0.39)	(0.28)

Table 4: (continued)

All events	Sum	−201.4	−286.7	−329.6
	Avg	−3.7	−5.3	−6.1
		(0.46)	(0.49)	(0.44)
Events distinguished by year				
Events 2008	Sum	16.8	32.0	23.4
	Avg	1.0	1.9	1.38
		(0.81)	(0.77)	(0.83)
Events 2009	Sum	−8.6	−33.0	−36.5
	Avg	−1.0	−3.7	−4.1
		(0.81)	(0.61)	(0.57)
Events 2010	Sum	−82.5	−81.0	−124.9
	Avg	−11.8	−11.6	−17.8
		(0.13)	(0.24)	(0.13)
Events 2011	Sum	−54.0	−105.5	−83.2
	Avg	−4.9	−9.6	−7.6
		(0.36)	(0.30)	(0.37)
Events 2012	Sum	−73.1	−99.2	−108.4
	Avg	−7.3	−9.9	−10.8
		(0.23)	(0.29)	(0.26)
Events distinguished by type				
FOR events	Sum	−73.3	−123.5	−111.6
	Avg	−2.9	−4.9	−4.5
		(0.53)	(0.50)	(0.54)
FRTFA events	Sum	−7.1	−36.0	−52.8
	Avg	−0.5	−2.8	−4.1
		(0.87)	(0.69)	(0.57)
LTRO events	Sum	−49.0	−64.7	−93.4
	Avg	−2.3	−3.1	−4.4
		(0.59)	(0.66)	(0.54)
COLL events	Sum	3.2	23.8	−2.7
	Avg	0.6	4.8	−0.5
		(0.84)	(0.52)	(0.93)
CBPP events	Sum	−28.2	−16.5	−40.0
	Avg	−7.1	−4.1	−10.0
		(0.24)	(0.56)	(0.29)
SMP events	Sum	−121.9	−135.6	−129.5
	Avg	−61.0	−67.8	−64.8
		(0.00)	(0.00)	(0.01)
OMT events	Sum	−55.8	−118.1	−76.5
	Avg	−14.0	−29.5	−19.1
		(0.10)	(0.05)	(0.11)

Notes: * denotes that the event coincides with a reduction of the key ECB interest rates. "P-values" in parentheses indicate the proportion of n-day spread changes during the period 01:01:2008-31:12:2012 that were larger in absolute value than the actual change in the n-day period around the event.

Table 5: Parameter estimates - All events

	01/02/08 to 05/07/10	05/10/10 to 12/31/12
Constant	0.082(0.120)	0.280(0.237)
ΔS_{t-1}	0.233(0.046)***	0.234(0.041)***
ΔS_{t-2}	−0.072(0.047)	−0.109(0.043)**
UNC_t	1.931(3.154)	−13.202(1.607)***
UNC_{t-1}	8.555(3.020)***	3.362(1.922)*
UNC_{t-2}	0.460(2.607)	−2.158(1.257)*
$\Delta EuroVIX_t$	0.311(0.128)**	0.464(0.246)*
MPE_t	−5.771(3.496)*	17.450(13.285)
$\Delta EUDS_t$	−0.018(0.008)**	−0.162(0.024)***
ΔTED_t	0.042(0.015)***	−0.047(0.127)
$\Delta CDSGreece_t$	0.026(0.010)**	−0.015(0.009)
Log-Likelihood	−1524.18	−2419.63
$Q(5)$	0.1620	0.5842
$Q(10)$	0.2787	0.8685
$Q^2(5)$	0.5121	0.1000
$Q^2(10)$	0.8023	0.4027
Observations	610	691

Notes: GARCH(1,1) regressions of daily basis point change in the spread. *** (**, *) indicates statistical significance at the 1 (5, 10) percent level. Robust standard errors in parenthesis. $Q(5)$ and $Q(10)$ is the statistical significance of the Ljung-Box Q test for the autocorrelations of the standardized residuals up to the 5th and 10th order, respectively. $Q^2(5)$ and $Q^2(10)$ is the statistical significance of the Ljung-Box Q test for the autocorrelations of the squared standardized residuals up to the 5th and 10th order, respectively.

Table 6: Parameter estimates - Events distinguished by surprise direction

	01/02/08 to 05/07/10	05/10/10 to 12/31/12
Constant	0.038(0.098)	0.307(0.290)
ΔS_{t-1}	0.227(0.048)***	0.232(0.040)***
ΔS_{t-2}	−0.074(0.043)	−0.110(0.044)**
$UNCpos_t$	10.921(6.231)*	−13.688(1.644)***
$UNCpos_{t-1}$	5.689(5.428)	1.564(1.703)
$UNCpos_{t-2}$	−1.733(4.531)	−1.951(1.345)
$UNCneg_t$	1.599(3.151)	12.346(1.398)***
$UNCneg_{t-1}$	−5.843(3.177)*	−9.935(1.066)***
$UNCneg_{t-2}$	−0.944(3.381)	3.311(1.698)*
$\Delta EuroVIX_t$	0.315(0.129)***	0.453(0.220)**
MPE_t	−6.729(2.957)**	17.677(10.196)*
$\Delta EUDS_t$	−0.017(0.008)**	−0.161(0.022)***
ΔTED_t	0.039(0.014)***	−0.061(0.123)
$\Delta CDSGreece_t$	0.027(0.010)***	−0.001(0.007)
Log-Likelihood	−1521.56	−2416.66
$Q(5)$	0.2302	0.5939
$Q(10)$	0.3670	0.9109
$Q^2(5)$	0.5562	0.0995
$Q^2(10)$	0.8708	0.4027
Observations	610	691

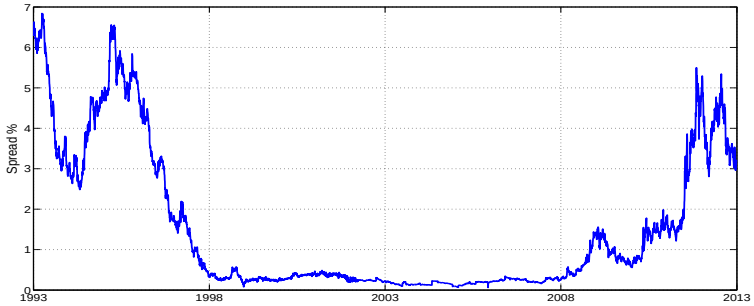
Notes: GARCH(1,1) regressions of daily basis point change in the spread. *** (**, *) indicates statistical significance at the 1 (5, 10) percent level. Robust standard errors in parenthesis. $Q(5)$ and $Q(10)$ is the statistical significance of the Ljung-Box Q test for the autocorrelations of the standardized residuals up to the 5th and 10th order, respectively. $Q^2(5)$ and $Q^2(10)$ is the statistical significance of the Ljung-Box Q test for the autocorrelations of the squared standardized residuals up to the 4th and 12th order, respectively.

Table 7: Parameter estimates - Events distinguished by type

	01/02/08 to 12/31/12	05/10/10 to 12/31/12
Constant	0.052(0.095)	0.301(0.237)
ΔS_{t-1}	0.228(0.032)***	0.218(0.0434)***
ΔS_{t-2}	−0.089(0.032)***	−0.095(0.037)**
FOR_t	3.143(5.558)	−17.733(9.358)*
FOR_{t-1}	6.043(4.288)	6.076(8.545)
$FRTFA_t$	2.278(8.042)	−19.259(13.985)
$FRTFA_{t-1}$	3.182(22.739)	12.672(12.887)
$LTRO_t$	2.381(4.614)	23.149(9.242)**
$LTRO_{t-1}$	4.559(6.936)	−2.854(7.932)
$COLL_t$	−10.904(10.535)	−18.036(6.719)***
$COLL_{t-1}$	5.075(8.059)	4.810(7.253)
$CBPP_t$	−6.225(2.555)**	−−
$CBPP_{t-1}$	8.293(1.770)***	−−
SMP_t	−16.854(1.677)***	−16.246(0.401)***
SMP_{t-1}	−2.340(2.487)	0.123(0.607)
OMT_t	−15.499(1.220)***	−13.575(0.792)***
OMT_{t-1}	4.713(3.211)	4.970(3.164)
$\Delta EuroVIX_t$	0.472(0.174)***	0.565(0.233)**
MPE_t	−8.965(3.851)**	22.589(13.623)*
$\Delta EUDS$	−0.026(0.009)***	−0.153(0.023)***
ΔTED_t	0.042(0.014)***	−0.013(0.123)
$\Delta CDSGreece_t$	0.014(0.008)**	−0.001(0.008)
Log-Likelihood	−4012.09	−2414.20
$Q(5)$	0.6803	0.4881
$Q(10)$	0.7884	0.5782
$Q^2(5)$	0.4429	0.2552
$Q^2(10)$	0.4910	0.5979
Observations	1301	691

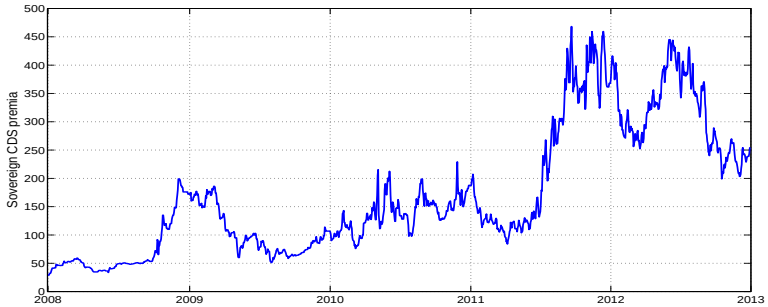
Notes: GARCH(1,1) regressions of daily basis point change in the spread. *** (**, *) indicates statistical significance at the 1 (5, 10) percent level. Robust standard errors in parenthesis. $Q(4)$ and $Q(12)$ is the statistical significance of the Ljung-Box Q test for the autocorrelations of the standardized residuals up to the 4th and 12th order, respectively. $Q^2(4)$ and $Q^2(12)$ is the statistical significance of the Ljung-Box Q test for the autocorrelations of the squared standardized residuals up to the 4th and 12th order, respectively.

Figure 1: Evolution of the Italian spread vis-á-vis Germany



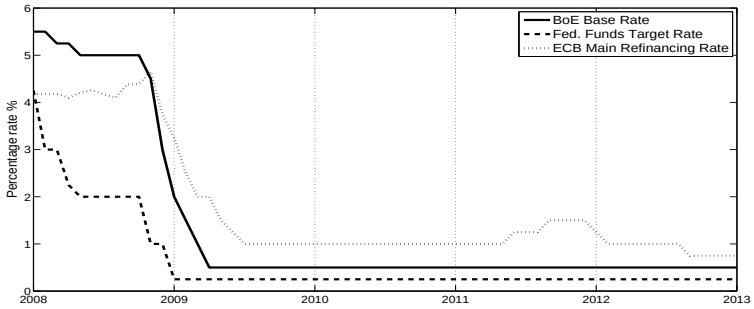
Note: Data from Thomson Reuters-Datastream.

Figure 2: Italian sovereign CDS premia (levels)



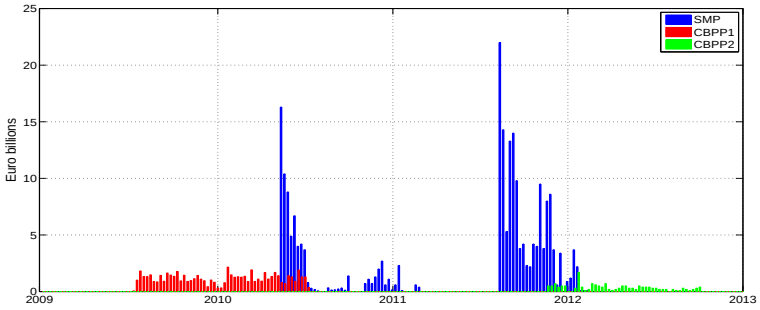
Note: Data from Thomson Reuters-Datastream.

Figure 3: Evolution of the policy rate in the UK, the US and the euro area



Note: Data from Thomson Reuters-Datastream.

Figure 4: ECB purchases under the CBPP1, CBPP2 and SMP



Note: Data from the ECB.

Appendix: The Data

Daily data (obtained from Thomson Reuters-Datastream):

- Long-term bond yield for Italy: Italy Benchmark Bond 10 YR - Redemption Yield (Datastream mnemonic: ITBRYLD)
- Long-term bond yield for Germany: Germany Benchmark Bond 10 YR - Redemption Yield (Datastream mnemonic: BDBRYLD)
- EuroVIX: VSTOXX volatility index (Datastream mnemonic: VSTOXXI)
- Total stock market index for the EU: EU-DS Market (Datastream mnemonic: TOTMKEU)
- TED spread: TED spread rate - middle rate (Datastream mnemonic: TRTEDSP)
- CDS Greece: National Bank of Greece SA Senior MM 10 Year - CDS premia (Datastream mnemonic: NBGA$AM)
- CDS Italy: Republic of Italy Senior CR 10 Year (Datastream mnemonic: ITGAEAC)

Intraday data (obtained from www.tickdatamarket.com):

- Bund futures: EUREX Euro-Bund Futures
- BTP futures: EUREX Long-term Euro-BTP Futures