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Have they lowered market borrowing costs for banks and governments?

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The ECB's Unconventional Monetary Policies: Have they lowered market borrowing costs for banks and governments? [1]

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Abstract

This paper evaluates the impact of the European Central Bank's (ECB) unconventional policies on bank and government borrowing costs. We employ event-based regressions to assess and compare the effects of asset purchases and exceptional liquidity announcements on the money markets, covered bond markets, and sovereign bond markets. The results show that (i) exceptional liquidity measures (3-year loans to banks and setting the ECB deposit rate to zero) significantly reduced persistent money market tensions and that (ii) asset purchases were the most effective in lowering the refinancing costs of banks and governments in the presence of high sovereign risk. In particular, we show how the interdependence between sovereign and bank risk amplifies the effectiveness of the ECB's asset purchases: bank-covered bond purchases diminish sovereign spreads while sovereign bond purchases reduce covered bond spreads.

Keywords: ECB, Unconventional monetary policy, Sovereign bond spreads, Covered bond spreads, Money market spreads

JEL codes: E43; E44; E52; E58.

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Introduction

Following the 2007-2009 financial crisis, the eurozone was further hit by the sovereign debt crisis that started in Greece and spread to other member countries. The debt crisis led to the fragmentation of the single financial market and resulted in important differences in credit conditions across the eurozone states. The situation was further deepened by the negative feedback loop between the sovereign distress and bank insolvency. Indeed, eurozone banks were heavily exposed to sovereign debt while eurozone governments bore the responsibility of rescuing their banking systems. The European Central Bank (ECB) faced a difficult task of restoring monetary transmission to support the economy in these exceptional circumstances. However, the traditional monetary tool - the ECB main refinancing rate – was not effective in equalizing the borrowing conditions across the eurozone and stabilizing malfunctioning interbank market. Therefore, the ECB implemented several unconventional monetary policies to attain its goals.

The objective of this paper is to evaluate the effectiveness of these unconventional monetary policies. We employ event-based regressions to measure the impact of the ECB policies on the market borrowing costs for banks and governments in core and periphery eurozone countries. To this purpose, we create a timeline of unconventional monetary policy announcements and classify them into distinct categories: long-term sovereign bond purchases (Securities Markets Programme, SMP), short-term sovereign bond purchases (Outright Monetary Transactions, OMT), covered bond purchase programs (CBPP1 and CBPP2), three-year refinancing operations (3y LTRO), lowering the ECB deposit rate to 0% and unlimited liquidity provisions (Fixed-rate full-allotment procedure, FRFA). By using Factiva press database, we make sure to include other important events that occurred on monetary policy announcement days. In order to put the impact of the ECB sovereign bond purchase programs into perspective, we also consider quantitative easing announcements in the US. Finally, we test the impact of all announcements on money market spreads, covered bond spreads and the sovereign bond spreads.

We find that 3-year refinancing operations and cutting the ECB deposit rate to zero percent significantly reduced persistent money market tensions in the eurozone. Furthermore, our results show that central bank interventions in sovereign markets (SMP and OMT) are particularly effective when the sovereign risk is high: periphery eurozone countries benefited the most from the sovereign bond purchasing programs while German spreads reacted very little if at all. The strong impact in the troubled periphery countries confirms the ECB's capacity to establish more homogenous credit conditions in the eurozone. Interestingly, the ECB's asset purchases had important spill-over effects. *Sovereign* bond purchases impacted not only *sovereign* bond spreads but also bank *covered* bond

spreads. Likewise, *covered* bond purchases diminished not only *covered* bond spreads but also *sovereign* bond spreads. The interdependence of bank and sovereign risk reinforces the transmission of the ECB's asset purchases.

There exists an important literature about the effects of unconventional monetary policies in the US, the UK and Japan.[3] The empirical evidence of the ECB's unconventional monetary policies on financial markets is also growing rapidly.[4] In the following literature review, we focus on the three markets relevant for our analysis: money markets, covered bond markets and sovereign bond markets and explain how we contribute to the literature.

The impact of the ECB exceptional liquidity measures on interbank lending was studied via regression analysis by Abbassi and Linzert (2011), Angelini et al. (2011) and Brunetti et al. (2011) who did not find significant effects of exceptional refinancing operations up to one year on money market tensions.[5] We complement these papers by showing that only stronger liquidity measures (3y LTRO and 0% deposit rate at the ECB) reduced significantly the interbank distress.

Concerning covered bond markets, Beirne et al. (2011) evaluated via an event study and regression analysis the impact of the first covered bond purchasing program (CBPP1) and found that it was effective in lowering covered bond spreads. Our paper confirms this effect not only for CBPP1 but also for the second covered bond purchasing program (CBPP2). Moreover, we show important spillover effects of covered bond purchases, namely their effectiveness in reducing *sovereign* bond markets distress.

There are also several studies that measure the impact of the first sovereign bond purchasing program (SMP) on sovereign bond markets. In this paper, we find that the SMP announcement reduced greatly the spreads in the periphery eurozone countries. Independently, Eser and Schwaab (2013), Ghysels et al. (2013) and Pattipeilohy et al. (2013) find similar announcement results. [6]

[3] For the United States see for instance Hamilton and Wu (2012), Krishnamurthy and Vissing-Jorgensen (2011), Szczerbowicz (2011) or Taylor and Williams (2009), for the United Kingdom Joyce et al. (2011) and for Japan Ueda (2012) and Ueda (2013).

[4] We present here the impact of the unconventional monetary policies on financial markets but there exists also a large literature on their effects on macroeconomic variables (see for instance Peersman (2011) or Lenza et al. (2010)).

[5] Abbassi and Linzert (2011) find that 3M special LTROs diminished 3M and 6M Euribor (significance at 10%), 12M special LTRO diminished only 12M Euribor (significance at 5%), while 6M LTROs were not significant at all. However, when the sample is split in two periods (Aug 2007-Oct 2008 and Oct 2008 – June 2009), none of the special LTROs is significant. Angelini et al. (2011) find that 1M and 3M special LTROs diminish long-term interbank spread only after Lehman failure (3M LTRO are significant at 5% while 1M LTROs at 10%) while 6M LTROs had unexpected positive sign and increased the interbank spread. Brunetti et al. (2011) show further that special 3M LTROs increased both the level of the bid-ask spread and its volatility contributing to higher uncertainty in money markets.

[6] The earlier version of this paper was published as a CEPII working paper nr.36 in 2012.

Moreover, Eser and Schwaab (2013), Ghysels et al. (2013) and De Pooter et al. (2012) show that the actual SMP operations were also effective in reducing sovereign spreads. We add to this literature by providing new evidence on the second sovereign bond purchase program (OMT) which proved effective in reducing the sovereign market tensions in the peripheral eurozone.[7] Interestingly, we also find that both sovereign bond purchase programs (OMT and SMP) were very effective in reducing *covered* bond markets distress and therefore lower longer-term bank funding costs.

Most importantly, we show that simultaneous analysis of asset purchases and liquidity measures on bank and government borrowing costs is essential for better understanding of the unconventional monetary policies effectiveness in the presence of sovereign risk. In particular, by studying both bank and sovereign funding markets we are able to capture the interdependence of bank and sovereign risks and the amplifying effect of this negative feedback loop on the ECB asset purchases.

This finding has important policy implications. First, the ECB can reduce the sovereign spreads not only through sovereign bond purchases but also through bank covered bond purchases, which has important implications given the political and operational constraints of the ECB. Second, it can diminish bank long-term refinancing costs and lower covered bond spreads by purchasing either covered or sovereign bonds. Sovereign bond purchases are in fact even more effective suggesting that increase in bank covered bond spreads was mostly due to increased sovereign default probability.

Our results can provide some guidance in the context of the current debate on reducing the interest rate on reserves to 0% and/or moving the deposit rate at the central bank into the negative territory. We show that lowering the ECB deposit rate to zero percent was effective in reducing money market tensions which is of particular relevance to the central bankers facing the banks' reluctance to lend to each other.

The reminder of this paper is organized as follows. The ECB's unconventional monetary policy announcements and their objectives are described in the section 2. Methodology and data are presented in section 3. In section 4 we estimate the impact of the ECB's announcements on money market, covered bond and sovereign bond spreads. Section 5 concludes.

[7] Recently, Falagiarda and Reitz (2013) measured the announcement effect for the OMT on Italian spreads.

2. The ECB's unconventional monetary policies

In this section we present the ECB's unconventional policies, their theoretical foundations and the objectives they were meant to attain. We regroup these policies into two categories: 1) Exceptional liquidity provisions (3-year longer-term refinancing operations, fixed-rate full-allotment procedure and setting the deposit rate to zero) and 2) Asset purchases (sovereign bond and covered bond purchase programs).

2.1 Exceptional liquidity provisions

Significant tensions appeared on the eurozone interbank market at the onset of the subprime crisis. The general uncertainty concerning the banks' balance sheet health led to the increase in the spread between risky interbank rate (Euribor) and riskless rate (Figure 1). The eurozone sovereign debt crisis further impaired the money market functioning as the banks held important amounts of risky sovereign debt issued by periphery eurozone countries.

The ECB reacted very promptly to the tensions on the interbank market and implemented several additional liquidity measures. In this paper, we focus on the impact of the strongest ECB liquidity innovations: announcements of the fixed-rate full-allotment procedure (FRFA) and the 3-year refinancing operations (3y LTRO). We also consider the announcement of setting the ECB deposit rate to zero as it was the first time the ECB hit this limit.

The fixed-rate procedure with full allotment (FRFA) was an important part of the ECB's non-standard toolbox. Traditionally, the open market operations were conducted through variable-rate tenders. Under the FRFA procedure, the banks could satisfy all their liquidity needs at the interest rate specified in advance (the interest rate on the main refinancing operations). After the Lehman Brothers collapsed the ECB introduced the fixed-rate full-allotment procedure for all open market operations and for the foreign liquidity swaps. First, late on October 8, 2008, the ECB announced that all weekly main refinancing operations (MROs) would be carried out through a fixed-rate tender procedure with full allotment. On October 13, 2008 it decided to provide unlimited dollar funding in coordinated action with the Fed. Two days later, on October 15, 2008 the ECB announced a FRFA procedure for its longer-term refinancing operations (LTROs). The ECB decided to return to variable-rate tender procedure in the regular 3-month LTROs in March 2010 but the Greek debt crisis forced it to resume the FRFA procedure in the regular LTROs on May 10, 2010. By ensuring banks' continued access to liquidity the ECB intended to offset liquidity risk in the market.

Since 2007 the ECB has implemented other exceptional liquidity measures: gradual lengthening of the maturity of the longer-term refinancing operations (LTROs) up to one year. These liquidity provisions are very close to standard monetary measures and were often expected by the market participants. However, on December 8, 2011, the ECB took an unprecedented measure to conduct the three-year refinancing operations (3y LTRO) as a fixed rate procedure with full allotment. The first 3y LTRO was offered on December 21, 2011 and the second on February 29, 2012. The banks borrowed more than €1 trillion which covered their immediate funding needs and prevented them from selling assets and curtailing some types of lending. The announcement of 3y LTROs surprised the financial markets as these operations were incomparable by their length to other liquidity measures. They also considerably increased the credit risk on the ECB balance sheet.

The main objective of the ECB exceptional liquidity provisions was to restore the smooth functioning of interbank markets as this aspect was crucial for extending credit to firms and households. The liquidity measures can be effective in stabilizing interbank market for several reasons. The liquidity shortage has a negative impact on financial institution lending capabilities and may result in credit crunch. Liquidity-constrained banks excessively hoard liquidity for precautionary reasons and proceed to fire sales of assets affecting negatively their prices. By ensuring funding liquidity, the ECB unconventional measures diminish these adverse effects. They also reduce the banks' uncertainty with respect to funding liquidity of other market participants and therefore diminish counterparty risk premiums.

Despite unlimited liquidity being available, the interbank market was still not functioning as the risk-averse eurozone banks preferred to hoard liquidity at the ECB overnight deposit facility. In order to overcome banks' reluctance to lend to each other the ECB lowered its deposit rate to 0% on July 5, 2012. While the markets expected a cut in the deposit rate on that day, the move to zero was a surprise.[8] This measure was not strictly unconventional measure but it was the first time that the ECB hit the zero bound and it was perceived as moving into "new territory". While not a liquidity measure *per se*, it was aimed at reinforcing the existing liquidity tools by forcing banks to lend available money in the interbank market and not store it at the ECB.

[8] From "Euro hurt by ECB rate cuts", Financial Times, July 6, 2012: "The euro fell sharply to its lowest level (…) after the European Central Bank cut its main interest rate as expected to 0.75 per cent and, in a surprise move, the rate on its deposit facility to zero". See also "Euribor rates fall ahead of ECB rate decision", Reuters News, July 5, 2012.

2.2 Purchases of assets

In a period of financial distress, the central bank can modify the composition of its assets by purchasing the securities that suffer from temporary liquidity problems or are undervalued by financial markets. This policy is sometimes called "credit easing". The purchases can be sterilized by disposal of the other central bank assets ("pure credit easing") or be a part of the central bank balance-sheet expansion ("quantitative easing").

The effectiveness of credit easing is based on the "portfolio rebalancing effect": when securities are not perfect substitutes, reducing the quantity of selected assets available for private investors increases their prices and diminishes yields by suppressing the risk premia (Bernanke, 2010). The portfolio rebalancing effect is controversial from a theoretical point of view. A representative-agent model of Eggertsson and Woodford (2003) predicts no effect for such operations on price level or output. However, replacing a representative agent with no preference between markets and assets by heterogeneous agents can also provide rationale for central bank asset purchasing. In the preferred-habitats model of Vayanos and Vila (2009) the interest rates of all maturities are determined through the interaction between risk-averse arbitrageurs and investor clienteles with preferences for specific maturities. In this framework, the central bank purchases of long-term Treasuries can lower the long-term yields because they create a "scarcity effect" that arbitrageurs cannot eliminate. Moreover, the purchases can be effective as they shorten the average maturity of government debt and therefore the duration risk held by arbitrageurs.

In this paper we investigate the effects of the ECB purchases of bank covered bonds and eurozone sovereign debt. These assets are more risky than government bonds considered in Vayanos and Vila (2009) and the duration risk is not the only one that the central bank takes on its balance sheet. By purchasing above mentioned assets the ECB also accepts the liquidity and default risk that private investors do not want to hold and replaces it with risk-free reserves. Private investors can ask for smaller liquidity compensation when buying covered or sovereign bonds if they know that they would be able to easily sell the assets to the ECB.[9]

The sovereign debt crisis in Europe increased the default risk in the sovereign bond markets. Market participants started to price in not only high probability of sovereign default but also the probability that some member states would exit the eurozone. Such projections cut off these countries' access to market refinancing or made it extremely costly leading to "self-fulfilling" prophecy: default or exit

[9] De Pooter et al. (2012) build a structural search-based asset pricing model that accounts for default risk in Europe and gives rationale for the ECB sovereign bond purchases.

of a country from the eurozone. By purchasing government bonds, and indirectly securing the sovereign debt, the ECB intended to prevent this "bad equilibrium" outcome.

There exists another transmission channel of central bank asset purchases which instead of reducing risk premia has an impact on private sector's expectations of the future monetary policy ("signaling effect").[10] In this paper however, we focus on the ECB impact on risk premia rather than on agents expectations of future monetary policy given that the ECB objective was to restore homogeneous credit conditions throughout the eurozone, but not necessarily to ease credit conditions in aggregate (Coeuré, (2012)). Increased spreads on covered and sovereign bond markets in some member countries were the reflection of these divergent credit conditions in the eurozone.

2.2.1 Sovereign bond purchases

The Greek sovereign debt in spring 2010 triggered a fire sale of some eurozone government bonds. The ECB announced on Sunday, May 9, 2010 the Securities Market Programme (SMP) as a part of European Union efforts to stabilize the euro.[11] The program was designed to purchase sovereign bonds and therefore to "ensure depth and liquidity in those market segments which are dysfunctional" (Figure 2).[12] The SMP was from the start a source of division within the ECB. The critics said that the ECB was overstepping its mandate by buying public debt in secondary markets and that the bond purchases would increase the inflationary pressures as well as undermine the ECB credibility. However, the ECB insisted that the SMP was temporary and merely aimed at improving the transmission of the monetary policy. In order to distinguish the SMP from the US-style quantitative easing and to ensure that the monetary policy stance is not affected, the ECB decided to sterilize these purchases via specific operations designed to re-absorb the injected liquidity.[13] Another notable difference with the Fed sovereign bond purchases is that the ECB gave no details on the amount of bonds to be purchased, their origin or how long it intended the program to last. The purchases stopped unofficially in January 2011 but the intensity of the eurozone crisis and the risk of

[10] Accumulation of risky assets on central bank balance sheet associated with important balance sheet expansion can be understood by financial markets as a signal that the monetary easing will continue longer than previously expected. Indeed, raising interest rates in these circumstances would expose the central bank to capital losses on the assets it holds.

[11] On the same day the European Financial Stability Facility (EFSF) was established.

[12] The official ECB press release was issued on May 10, 2010: "ECB decides on measures to address severe tensions in financial markets".

[13] The sterilization of SMP seems mostly symbolic as the fixed-rate full-allotment procedure in all main refinancing operations leaves the control of monetary base in hands of banks participating in these operations.

contagion to Italy and Spain made the ECB resume the program in August 2011. The ECB bought 219.5 billion euros of eurozone government bonds within SMP.

The eurozone debt crisis continued in the beginning of 2012 as the critical financial standing of Spanish banks was revealed. The concerns about their solvency and *in fine* solvency of the Spanish government made the sovereign yields in the eurozone periphery increase rapidly as market participants were pricing in the possibility of some countries leaving the monetary union. As a response, the ECB President Mario Draghi announced in July 2012 that the central bank would do "whatever it takes to save euro".[14] On September 6, 2012, the ECB announced the sovereign bond purchasing program: Outright Monetary Transactions (OMT) and at the same time officially terminated the SMP.[15] The objective of the new program, just as the objective of the SMP, was to repair monetary policy transmission mechanism and restore homogeneous credit conditions throughout the eurozone. More precisely, the purchases of the eurozone periphery sovereign debt were intended to reduce the risk premia related to fears of the reversibility of the euro. Despite the shared objective, the OMT was different from the SMP in several aspects. First, the maximum maturity of bonds purchased was set to 3 years whereas the SMP concerned longer-term bonds. Second, there was a conditionality attached to participating in the OMT: the ECB would only purchase sovereign debt of a given country if its government complied with a full or precautionary macroeconomic adjustment program set by the European Financial Stability Facility (EFSF) or the European Stability Mechanism (ESM). Third, the ECB decided to forgo its seniority status with respect to private creditors. Finally, once the country meets the access conditions, the ECB would intervene without limits whereas the SMP was always presented as "temporary" and "limited" which was hardly reassuring for investors.[16]

2.2.2 Covered bond purchases

Covered bonds are securities issued by credit institutions to assure their medium and long-term refinancing. They are collateralized by a dedicated pool of loans, typically mortgage loans and public-sector loans and remain on the lender's balance sheet. They are seen as safer than other bank bonds, because they give investors a claim on the credit institution itself and on the cover pool of collateral as well. At the end of 2007 it was the most important privately issued bond segment in Europe's capital markets (ECB, 2008). Despite their initial resilience to the financial turmoil that started in

[14] Draghi (2012).
[15] The ECB has not purchased any sovereign bonds within OMT since the announcement of the program.
[16] Introductory statement to the ECB press conference, November 3, 2011 available at: http://www.ecb.int/press/pressconf/2011/html/is111103.en.html

August 2007, this market dried up after the Lehman Brothers collapsed in September 2008, as investors turned to government bonds and other less risky assets (Figure 3). To prevent the credit crunch, the ECB announced on May 7, 2009 that it would purchase €60 billion of euro-denominated covered bonds issued in the eurozone. This decision was surprising for the markets which were expecting the rate cut and the lengthening of the lending program but not the purchases of private debt, which were perceived as a change in strategy.[17] The objective of the Covered Bond Purchase Programme (CBPP 1) were the following: a) promoting the ongoing decline in money market term rates; b) easing funding conditions for credit institutions and enterprises; c) encouraging credit institutions to maintain and expand their lending to clients; and d) improving market liquidity in important segments of the private debt securities market.

At the end of June 2010 the ECB stopped the covered bond purchases but as the sovereign crisis deepened in autumn 2011 it proceeded to further measures supporting the covered bond markets. On October 6, 2011 it announced the second Covered Bond Purchase Programme (CBPP 2) of €40bn in favor of euro-denominated covered bonds in both primary and secondary markets.

3. Methodology

We apply event-based regressions to measure the impact of the ECB unconventional monetary policies on bank and government borrowing costs. The borrowing conditions for banks are measured by money market spreads (short-term funding) and covered bond spreads (longer-term funding). Government borrowing costs are approximated by sovereign bond spreads. Event-based regressions allow testing the impact of an economic event on financial market data. In modern financial markets, such as those in the eurozone, the effect of an event should be reflected in asset prices over a short period of time.

We use daily data from July 2, 2007 until September 27, 2012 with the exception of Italian and Portuguese covered bond series available respectively from January 2, 2009 and October 31, 2008. We rely on dummy variables to discriminate between days when announcements were made or not. Based on the ECB press releases we create a database of unconventional monetary policy news. The announcements are classified into seven categories described in the previous section:

- Exceptional liquidity measures:
  - Fixed-rate full-allotment procedure (FRFA)

[17] "Trichet Drags ECB Into New Era Over Weber's Bond Objections", May 7, 2009, Bloomberg.

– Three-year LTRO: announcement (3y LTRO)

– Three-year LTRO: operation dates (3y LTRO op)

– 0% deposit rate at the ECB (0% deposit)

• Asset purchases:

– Covered bond purchase programs (CBPP1 and CBPP2)

– Longer-term sovereign bond purchase program (SMP)

– Short-term sovereign bond purchase program (OMT)

The analysis of monetary policy announcements via event-based regressions presents several potential difficulties. First, the announcements studied must be unanticipated by the market participants (MacKinlay, 1997). Otherwise, the impact of the event is incorporated before it is announced and there is no change in yields and prices on the announcement day. In other terms, only surprising events can be appropriately evaluated within this methodology. In practice, many of the unconventional ECB measures were anticipated by the markets. This is principally the case of supplementary liquidity announcements, such as lengthening the maturity of the refinancing operations up to one year, which are quite close to conventional liquidity provisions and do not imply much risk on the ECB balance sheet. For that reason we focus our analysis only on the major unconventional policy announcements that were surprising and important news to the markets, such as asset purchase programs or three year refinancing operations.[18]

Second issue linked to event-based regressions is the simultaneous occurrence of other events on the day of monetary announcement that might affect the variables of interest and therefore bias the results. It seems particularly important during the crisis when there were sometimes several policy measures announced on the same day. When these events coincide with monetary policy announcements it is necessary to include them into regression in order to separate their effects. We use Factiva press database to check if there were other major events that might have influenced our variables of interest, i.e. interest rate spreads.[19] The most striking example of simultaneous announcements is the weekend of 8-9 May 2010 when several monetary measures were decided and in particular the SMP was created. In parallel, the eurozone politicians founded the European Financial Stability Fund (EFSF). Even though both the SMP and the EFSF were intended to purchase sovereign debt it is useful to separate the effects of the two measures as they are conducted by different institutions. To assure a correct specification of our event-based regression model we include announcement concerning the EFSF and the European Stability Mechanism developments as

[18] As a robustness check we tested the impact of smaller supplementary liquidity announcements but did not find significant effect. We explain this issue in the next section.

[19] Factiva is an information and research tool owned by Dow Jones & Company. It offers online articles from both licensed and free sources (Wall Street Journal, Reuters and Financial Times among others).

well as the dummy for the sovereign debt crisis. [20] The crisis dummy is equal to 1 during the periods when the concerns about solvency of the periphery eurozone countries were the highest. [21] Additionally, in case the ECB announcements and the spreads reacted to unobserved news, we control for this factor including VIX volatility index and present the results in the Appendix.

Finally, there might be a simultaneous causal relationship between the ECB's unconventional policy announcements and the financial market spreads. However, we believe that this is the main problem when the actual operations are being evaluated and is negligible when the announcement effect is considered. For instance, the ECB's asset purchases were most likely on the days when the sovereign spreads increased. However it is not plausible that the ECB announced their important unconventional measures based on the previous day change in spreads. These measures are often politically contested and involve long decision process.

4. Results

4.1 Money market

Since August 2007 the spreads between unsecured and secured rates on interbank market increased to previously unseen levels (Figure 1). The ECB was determined to support money market activity as the interbank lending is a key element of the successful monetary transmission. The three-year LTRO, FRFA procedure, covered bond purchase programs and setting the deposit rate to zero were directly aimed at restoring interbank lending. Sovereign bond purchase programs could also have positive spill-over effect on money markets given that banks were holding large quantities of euro area sovereign debt.

To test the impact of unconventional policy measures on the money market spreads we estimate the following equation:

$$\Delta S_t^M = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^{4} \gamma_n \Delta S_{t-n}^M + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t \quad (1)$$

where $NC_{i,t}$ are dummies for seven types of unconventional monetary policy announcements discussed in section 2; F_t is a dummy for the European rescue funding program announcements

[20] We checked several other categories of announcements that might affect the spreads, such as European Summits or conventional monetary policy surprises, but they did not occur on the same days as unconventional monetary policy announcements.

[21] We define the crisis dummy according to Google Trends which show how often a particular search-term ("eurozone sovereign debt crisis" in our case) is entered relative to the total search-volume across various regions of the world. The results were cross-checked with main sovereign debt crisis events reported by Reuters, The Wall Street Journal and The Daily Telegraph in their crisis timelines.

(EFSF and ESM); C_t is a dummy for sovereign debt crisis; ΔS_{t-n}^M are lagged values of dependent variable included to correct for the auto-correlations of the residuals (n=3 for all spreads except Euribor-Repo spread for which n=4); D_t are dummies for the working day of the week (Monday, Tuesday…) and ϵ_t is a stochastic error term.

The dependent variable S_t^M is a 2-day change in 3-month money market spreads. We use four alternative measures of money market distress reflecting the difference between unsecured and secured (or risk-free) three-month interest rates: i) Euribor – OIS[22], ii) Euribor – Repo[23], iii) Euribor - Germany Treasury bill and iv) certificate of deposit (CD) – OIS[24]. Among these measures, the Euribor-OIS is the most commonly cited barometer of interbank market tensions. The recent revelations about Libor and Euribor manipulation by one of the contributing banks cast some doubts on its credibility. However, there are two particular features of Euribor rate that make it less sensitive to manipulation than Libor. First, 43 banks contribute to Euribor as opposed to 15 in the Euro Libor panel, which reduces the weight of the eventual misreporting contributor. Second, Euribor is an average lending rate while Libor is an average borrowing rate. During crisis, the contributing banks are more inclined to diminish the latter as high borrowing rates send the negative signal about their financial standing.

There is also a timing issue related to the Euribor-OIS spread. Euribor rate is published at 11:00 a.m. Brussels time (10:00 GMT) while the last update of the OIS rate in Datastream is done at 19:15 GMT. Therefore, many announcements on a given day are not taken into account by Euribor rate. In order to ensure that the markets had the possibility to react to all announcements we consider 2-day event window: the change in spread one day after the announcement with respect to the day before ($\Delta S_t^M = S_{t+1}^M - S_{t-1}^M$).

Table 1 reports the estimation results. Among all unconventional ECB policies, reducing the ECB deposit rate to zero percent and announcing 3-year LTRO diminished money market spreads the most significantly. The Euribor-OIS spread fell by 24 basis points after the ECB decided to lower its deposit rate to 0%, while Euribor-Repo and Euribor-German Treasury bill fell by respectively 10 and

[22] The Euro Interbank Offered Rate (Euribor) is an average interbank borrowing rate published daily at 11:00 a.m. (Brussels time) by the European Banking Federation (EBF). The overnight-indexed swap (OIS) rate represents market expectations of the monetary policy rate over the future months. There is no exchange of principal and only the net difference in interest rates is paid at maturity, so there is very little default risk in the OIS market.

[23] Repo is the rate at which, at 11.00 a.m. Brussels time, one bank offers, in the eurozone and worldwide, funds in euro to another bank if in exchange the former receives from the latter the best collateral within the most actively traded European repo market.

[24] Certificate of deposit is a debt instrument issued by banks and other financial institutions.

14 basis points.[25] The announcement of 3-year LTRO reduced the Euribor-OIS spread by 22 basis points, Euribor-Repo spread by 14 basis points and the Euribor-German Treasury bill by 6 basis points. Interestingly, the spreads fell also on the days of the 3-year LTRO operations, even though market participants knew the operation dates in advance. The effect of operations is smaller and less significant than the announcement effect for the Euribor spreads (3 to 6 basis points) but reaches 12 basis points for the CD-OIS spread. These results confirm that 3-year operations were indeed exceptional measures and incomparable to other liquidity facilities which were found ineffective in reducing money market tensions. In particular, Angelini et al. (2011) find that the liquidity risk was not the most important determinant of the spreads and therefore liquidity measures, such as LTROs up to 1 year, were not able to affect them.[26] Our results show that in presence of high credit risk, stronger ECB measures such as 3y LTRO, cutting the deposit rate to 0% or bank debt asset purchases can lower the spreads.

We find that bank covered bond purchases (CBPP 1 and 2) also diminished the spreads but the magnitude of the results is smaller. The significant effects range from 6 to 7 basis points for Euribor-OIS and Euribor-German bill spreads. On the other hand, sovereign bond purchases had either very small impact (OMT) or no impact at all (SMP).

We conducted additional tests including the variables that drive money market spreads in normal times, such as risk aversion proxy, VIX.[27] The results do not change significantly with the exception of the impact of the OMT which becomes positive and insignificant once the VIX is added. In general adding financial variables that determine spreads in normal times, such as VIX, usually weakens slightly the impact of unconventional monetary policies as these policies have also an impact on VIX. Given the robustness of the results under both specifications we decided to use as benchmark the regression without the VIX and present the results with that control in Table 1A in the Appendix.

It is worth noting, that even though interbank spreads fell after 3-year LTRO announcement and after the deposit rate was reduced to to zero, smaller and medium banks that do not participate in Euribor

[25] The coefficient is not reported for the CD-OIS spread as there was no quotation for 3-month certificate of deposit on the day of the announcements. We use Reuters time series for the 3-month certificate of deposit and German Treasury bill while the Euribor, Repo and OIS rates come from Datastream.

[26] This result might be also explained by the "crowding out" effect of the ECB liquidity interventions as shown in Brunetti et al. (2011). The unlimited liquidity available at the central bank impairs the important functions of interbank transactions such as information aggregation, price discovery and peer monitoring. However, shorter-term liquidity measures became quite common during the crisis and they might have been anticipated by the markets which could also explain the lack of the effect on the announcement days. The difficulty of identifying the surprise component of smaller liquidity measures prevented us from including them in our analysis. Nevertheless, we conducted tests with announcements of lengthening the maturity of LTRO up to one year and as Angelini et al. (2011) and Brunetti et al. (2011) found no significant impact of these announcements while other results remained valid.

[27] VIX is a measure of the implied volatility of S&P 500 index options.

rate may still have significant difficulties in financing themselves through interbank market. They represent a small part of euro banking system assets but often lend to small and medium enterprises which makes them particularly important for the eurozone recovery.

4.2 Covered bond market

While money market provides banks with short-term funding, covered bond market is one of their longer-term funding sources. Despite its relative soundness in the beginning of the crisis, this market also dried up after the Lehman Brothers collapse leading to unusually high risk premia (Figure 3). Covered bond purchase programs were the main unconventional policy designed to reduce the covered bond spreads. However, other ECB's unconventional measures could also reduce the cost of refinancing on this market. First, 3-year LTRO and FRFA procedure intended to diminish bank funding risk and therefore encourage investors to ask for smaller risk compensation on bank debt instruments, such as covered bonds. Second, sovereign bond purchases by improving the balance sheets of banks holding sovereign assets could increase their creditworthiness and diminish covered bond spreads.

The ultimate objective of the ECB's asset purchases was to improve the monetary policy transmission and to restore the homogenous credit conditions across the euro area member countries. Therefore, the effectiveness of the ECB measures is reflected not only by the overall eurozone spread decrease but also by the particular impact in the periphery eurozone countries. This is why we test the impact of the ECB policies not only on the synthetic eurozone spread but also on the individual spreads in the core and periphery eurozone countries.

We measure the impact of the ECB's unconventional monetary policies on covered bond spreads by estimating the following regressions:

$$\Delta S_t^C = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \varphi_1 F_t + \varphi_2 C_t + \gamma \Delta S_{t-1}^C + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t \quad (2)$$

where $NC_{i,t}$ are dummies for seven types of unconventional monetary policy announcements discussed in section 2; F_t is a dummy for the European rescue funding program announcements (EFSF and ESM); C_t is a dummy for sovereign debt crisis; ΔS_{t-1}^C is a lagged value of dependent

variable included to eliminate the auto-correlations of the residuals; D_t are dummies for the day of the week (Monday, Tuesday…) and ϵ_t is a stochastic error term.[28]

ΔS_t^C is a 1-day change in covered bond spread in the eurozone and in its member countries: Germany, France, Italy, Ireland, Portugal and Spain.[29] The spreads are calculated as a difference between covered bond yield in each country with respect to corresponding German sovereign bond yield. All bond rates are synthetic benchmark yields provided by Iboxx and available from Datastream. They cover all maturities exceeding one year and are comparable among countries. The composed-maturity bonds indexes seem appropriate as the ECB bought covered bonds of different maturities.[30]

Table 2 presents the estimation results for the eurozone, France, Germany, Ireland, Italy, Portugal and Spain. At the eurozone level, long-term sovereign bond purchases (SMP) had the strongest impact and diminished the covered bond spread by 19 basis points. They were followed by short-term sovereign bond purchases, OMT (-6 bp), covered bond purchases (-4 bp) and 3y LTRO (-4 bp). The positive news concerning the European rescue funding programs (EFSF/ESM) also diminished spreads (-4 bp) while sovereign crisis dummy increased it (+1 bp).

It is interesting to note that sovereign bond purchases have bigger impact on covered bond spreads than covered bond purchases themselves. It seems that the sovereign risk in the euro area and the fact that the banks hold sovereign bonds play an important role in the ECB's unconventional policy transmission. Breaking up the results by country confirms this intuition.

Table 2 shows that SMP had a much stronger effect in troubled periphery countries (Portugal, -163 bp; Ireland, -46 bp; Spain, -34 bp; Italy -31 bp) than in core eurozone countries (Germany, -10 bp and France, -7 bp). The second sovereign bond purchasing program (OMT) also had the most important effect in the eurozone periphery. These results suggest that sovereign bond purchases have important spill-over effects on longer-term bank debt instruments when the sovereign risk is high. By diminishing sovereign risk in periphery countries, these purchases improve the credit standing of its financial institutions and increase the price of their covered bonds. Indeed, banks in these troubled countries hold important amount of sovereign debt and their own creditworthiness depends largely on the prices of the sovereign assets. These results show therefore the connection between bank and sovereign default risk: by diminishing sovereign default risk the ECB managed to reduce the risk compensation for the bank debt instruments. The reduction of covered bond spreads after the

[28] As in case of money markets, we conduct the robustness checks with VIX and obtain similar results (see the results in Table 2A in the Appendix).
[29] Datastream does not provide the Iboxx covered bond rates for Greece.
[30] CBPP 1: 3-10 years, with strong focus on maturities up to 7 years; CBPP 2: Up to 10.5 years residual maturity, according to ECB website.

announcements of European sovereign rescue facilities (EFSF/ESM), also designed to purchase sovereign debt, confirms that investors in bank covered bonds were sensible to measures reducing the probability of sovereign default. The presence of the sovereign-bank feedback loop increases the effectiveness of the ECB's asset purchases: *sovereign* bond purchases diminish bank *covered* bond spreads. In the next section we will show that the opposite is also true: purchases of bank *covered* bonds diminish *sovereign* bond spreads.

The measures directly aimed at relieving bank funding constraints were also effective but to smaller extent. As expected, covered bond purchase programs (CBPP 1 and 2) diminished covered bond spreads in all countries studied with the exception of Ireland and Portugal: France (-4 bp), Germany (-5 bp), Italy (-10 bp), Spain (-6 bp).[31] These results are not surprising given that the biggest amounts of the CBPP 1 were allocated to the central banks of Germany, France, Italy, Spain and Netherlands (ECBC, 2010). Furthermore, Italy and Finland were the main beneficiaries when the ratio of purchased amounts to the size of the outstanding covered bonds eligible under the CBPP 1 is taken into account. In contrast to the sovereign bond purchases however, covered bond purchases had quantitatively similar effects in periphery and core eurozone countries. They were not addressed to reduce the sovereign risk and worked through more traditional "scarcity channel".

The impact of 3-year LTRO had a comparable impact to covered bond purchases. It reduced spreads in France (-5 bp), Germany (-2 bp), Italy (-3 bp), Ireland (-5 bp) and Spain (-3 bp). 3y LTRO reduced longer-term bank funding constraints and therefore diminished bank liquidity and credit risk pulling the yield on bank debt down. The FRFA procedure also contributed to spread reduction, particularly in Spain (-6 bp).

Overall, our results show that measures designed to reduce the probability of sovereign default, such as sovereign bond purchases, diminish the most bank covered bond spreads. The connection between bank and sovereign risk extends therefore the impact of the ECB sovereign bond purchases from sovereign markets to covered bond markets. Measures aiming at reducing directly the bank funding cost were also effective, albeit to a smaller extent, in lowering the spreads and had homogenous effect across member states.

[31] We tested CBPP 1 and CBPP 2 separately and they both have similar impact on covered bond spreads with the exception of Ireland for which the 1st program increased the spreads and the second diminished it. Beirne et al. (2011) also find that the first CBPP did not reduce the Irish covered bond spreads.

4.3 Sovereign bond market

The sovereign yields in the periphery eurozone countries increased dramatically with respect to corresponding German yields since the sovereign debt crisis started (Figure 2). To ensure the depth and liquidity these markets, the ECB announced two government bonds purchasing programs (SMP and OMT). Moreover, other ECB policies, such as these addressed to banks (3-year LTRO, FRFA procedure or covered bond purchase programs) could in principle have a positive impact on sovereign spreads. Indeed, improving bank creditworthiness diminishes the probability of sovereign default by reducing the potential necessity of bank bail-out by a government. Furthermore, granted with abundant liquidity, banks could purchase themselves sovereign bonds and therefore increase their prices.

We measure the effects of the ECB's unconventional policies on sovereign spreads in periphery and core eurozone countries. Just as in case of covered bond spreads, the effectiveness of the ECB policies should be reflected by more homogeneous sovereign spreads across the eurozone after the ECB intervention. In other terms, the ECB measures should have bigger impact on the troubled periphery countries. Furthermore, we compare the impact of the ECB sovereign bond purchase programs with those implemented in the United States where sovereign risk was much smaller. To this end, we estimate the following equation:

$$\Delta S_t^S = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \delta Q_t + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^{2} \gamma_n \Delta S_{t-n}^S + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t \qquad (3)$$

where $NC_{i,t}$ are dummies for seven types of unconventional monetary policy announcements discussed in section 2; Q_t is a dummy for the Federal Reserve announcements related to government bond purchases (Quantitative Easing 1, Quantitative Easing 2 and Maturity Extension Program); F_t is a dummy for the European rescue funding program announcements (EFSF and ESM); C_t is a dummy for sovereign debt crisis; ΔS_{t-n}^S are lagged values of dependent variable included to eliminate the auto-correlations of the residuals (for the eurozone countries n=1, for the US n=2); D_t are dummies for the working day of the week (Monday, Tuesday…) and ϵ_t is a stochastic error term.[32]

Dependent variable ΔS_t^S is a 1-day change in 10-year sovereign bond spread. The spread is calculated as a difference between the 10-year sovereign yields in the eurozone or its member countries (France, Greece, Ireland, Italy, Portugal and Spain) and the 10-year German sovereign yield. The 10-year eurozone benchmark yield is available from Datastream and represents a weighted average of

[32] As in the case of money markets and covered bond markets, we conduct the robustness checks with VIX and obtain similar results (see the results in Tables 3A and 4A in the Appendix).

bond yields from each eurozone member.[33] The spreads for Germany and the US are calculated as a difference between their 10-year sovereign yield and their 10-year interest rate swap.

Table 3 presents the results for the eurozone, Greece, Italy, Ireland, Portugal and Spain, while the Table 4 the results for Germany, France and the US. The most striking result in the eurozone is the impact of the ECB longer-term sovereign bond purchase program (SMP) which reduced the spreads by 16 bp. The effect is particularly strong for the countries where the sovereign risk attained the highest levels: Greece (-485 bp), Ireland (-121 bp) and Portugal (-202 bp). Italy and Spain acknowledge the reduction of respectively 31 and 43 basis points while French and German spreads do not react to the SMP announcement. The SMP program was announced in the midst of the Greek debt crisis without any precision about the amounts or the regularity of the purchases. Every Monday, the ECB released information about the amount of bonds purchased the previous week but did not mention their country of origin. According to some analysts, in the first phase of the SMP the ECB purchased Greek, Irish and Portuguese bonds and this is reflected in our regression results.[34]

As the euro sovereign debt crisis was about to spread to Italy and Spain, the ECB confirmed its willingness to purchase actively the eurozone sovereign bonds. This announcement was made on Sunday, August 7, 2011 and was preceded by a positive appreciation of the Italian and Spanish austerity program execution. It was unambiguously understood by market participants as a promise to buy Italian and Spanish government bonds. We take this announcement into account (SMP 2) and report the results in Table 5. The overall effect on the benchmark eurozone spread is significant (-26 bp) and as expected the biggest impact is observed for Spain (-104 bp) and Italy (-81 bp).

The second sovereign bond purchase program, OMT, had a similar impact on benchmark eurozone sovereign spread (-14 bp). The program was announced in a context of sovereign debt crisis in Spain and the response of the Spanish spread to the OMT announcement was the strongest (-59 bp). The impact on Italian and Portuguese spreads was also significant at 5% (respectively -31 bp and -54 bp) while for Irish spreads only at 10% (-24 bp) and not significant for Greek spread. Again, the German spread did not react to the announcement while the French spread only to small extent (-7 bp, at the 10% significance level).

The OMT was announced on September 6, 2012 but some kind of the ECB intervention in sovereign markets was expected since Mario Draghi's speech on July 26, 2012, in which he promised to "do whatever it takes to save euro". We include this announcement into our regression and show the

[33] The weightings used are the 1996 real GDP as published by Eurostat.

[34] From "ECB keeps bond-buying programme dormant", Reuters, 01/08/2011: "(…) bond market traders and analysts say buying has been limited to Greek, Irish and Portuguese bonds and estimate that it holds around 45 billion euros of Greek debt."

results in Table 5. Spanish and Italian spreads fell after this announcement (respectively -56 bp and -48 bp). The response of Greek spread was also significant and high (-56 bp) contrary to the actual OMT announcement later on. The 26-July announcement triggered expectations of long-term sovereign spreads targeting but this feature was dismissed in the final version of the program which might have disappointed the potential investors on the Greek market.

As a comparison, we show in Table 4 that the US sovereign spreads also fell following the sovereign bond purchases announced by the Fed but the magnitude of the effect was much smaller (-5 bp).[35] The strong impact in the eurozone suggests that the central bank intervention in sovereign market is particularly effective when the sovereign risk is important. The fall of the sovereign bond spreads following the European rescue program announcements (EFSF/ESM, -13 bp) confirms that measures aimed at reducing sovereign default risk were effective in diminishing government borrowing costs in the eurozone.

Covered bond purchase programs (CBPP 1&2) were another measure that reduced the sovereign spreads (-5bp). This result reveals the second part of the sovereign-bank feedback loop we evoked in previous section. Reducing bank-funding risk diminishes sovereign risk as it reduces the probability of future government-led bailout. Therefore, the ECB measures that improve long-term funding conditions for banks, such as covered bond purchase programs, reduce the risk compensation required by investors in sovereign bonds. Table 3 shows that the effect of CBPP 1&2 is particularly important in periphery eurozone countries (Greece, -18 bp; Italy, -16 bp; Spain, -13 bp).

The puzzling result, however, is the reaction of the sovereign spreads following the important 3y LTRO announcement. Contrary to the expectations, the sovereign spreads rise following this announcement, especially in the Southern European countries (Table 3). The reaction of sovereign spreads to 3y LTRO announcement is opposite to interbank market and covered bond market reactions which were in line with the expectations. This result indicates that 3y LTRO improved significantly market borrowing costs for the eurozone banks but not governments. Given that 3y loans were granted to banks this response may seem natural. However, the 3y LTRO announcement significantly *increased* the government borrowing costs. This reaction suggests that there was another piece of "news" in the ECB announcement. Indeed, articles in the press confirm that market participants were expecting the ECB to reactivate its sovereign bond purchase program and they

[35] We study the impact of the sovereign spreads and not the sovereign yields which explains that our results are smaller than the overall yield reduction found by other studies (see Hamilton and Wu (2012), Szczerbowicz (2011) for instance). We consider only the announcements of the Treasury bond purchases. When MBS purchase announcement are included, the response of the US sovereign spread is also small (-3 bp).

were disappointed as it did not happen.[36] Therefore, the increase in sovereign spreads reflects mostly the market disappointment that a stronger measure, such as sovereign bond buying, was not announced to solve the eurozone crisis.

The reaction of the sovereign spreads to cutting the ECB deposit rate to zero seems to confirm that sovereign bond markets in eurozone were mostly driven by the market perception of the sovereign default risk. On July 5, 2012 the ECB reduced the deposit rate to zero but did not take any anti-crisis measures while the Italian and Spanish yields were very high. Therefore, this announcement (0% deposit at ECB in Table 3) reduced significantly money market spreads but increased Italian and Spanish sovereign spreads (+29 bp and +52 bp). The confirmation of this disappointment can be found in the press on that day.[37] The expected announcement came only 3 weeks later with Mario Draghi's "whatever it takes" speech (Table 5) and made the Italian and Spanish spreads decrease significantly (-48 bp and -56 bp).

Increase in sovereign spreads after the ECB failed to deliver strong anti-crisis measures expected by the markets highlights the challenges of unconventional monetary policies. Once the conventional monetary framework lost its primary role, it is much more difficult for the central bank to steer market expectations. [38]

Overall, we show that the measures that diminished sovereign risk were the most successful in reducing government borrowing costs. First, sovereign bond purchases proved the most effective in countries confronted with high default probability. Second, bank covered bond purchases also diminished sovereign spreads in the context of the sovereign-bank risk interdependence.

5. Conclusion

The presence of the sovereign risk is an important factor for the unconventional monetary policy implementation. The eurozone sovereign debt crisis contributed to dramatic increase in risk premia not only on sovereign debt markets but also on money markets and covered bond markets. The ECB

[36] See for instance "US Stocks Fall As ECB Disappoints On Bond Buying", December 8, 2011, Wall Street Journal and "ECB dampens bond-buying hopes", December 8, 2011, Reuters.

[37] From "Spanish, Italian bonds hammered after Draghi speech", July 5, 2012, Reuters: "President Mario Draghi failed to deliver any hint that bolder monetary easing steps were on the way". See also "European stocks, euro drop after ECB rate cut", July 5, 2012, Agence France Press: "the European Central Bank cut its key interest rate to a record low but did not unveil anti-crisis measures".

[38] Another example of expectations management difficulty is Ben Bernanke's testimony before the Congress on May 22, 2013 that markets interpreted as announcement of early tapering of unconventional monetary policies. This message led to substantial turmoil in the financial markets despite its moderate character.

traditional tool, interest rates decrease, did not prevent the market borrowing costs from diverging across the member states. The ECB's unconventional monetary policies, however, contributed significantly to soothing financial tensions in the eurozone. We find that the 3-year LTRO and setting the ECB deposit rate at 0%, unlike the shorter-term liquidity measures, were effective in reducing money market tensions. Furthermore, the measures aimed at diminishing the sovereign default risk proved the most effective in lowering longer-term risk premia. The ECB sovereign bond purchases (SMP and OMT) reduced significantly not only the sovereign spreads but also the bank covered bond spreads. This spill-over effect on bank funding market highlights the interdependence of the sovereign and bank solvency risk. This interdependence is further confirmed by the positive impact of the ECB purchases of bank covered bonds on sovereign spreads. Our results show that the sovereign-bank feedback loop amplifies the effectiveness of both bank covered bond and sovereign bond asset purchases in the eurozone.

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Figures

Figure 1: Money market spreads in the eurozone

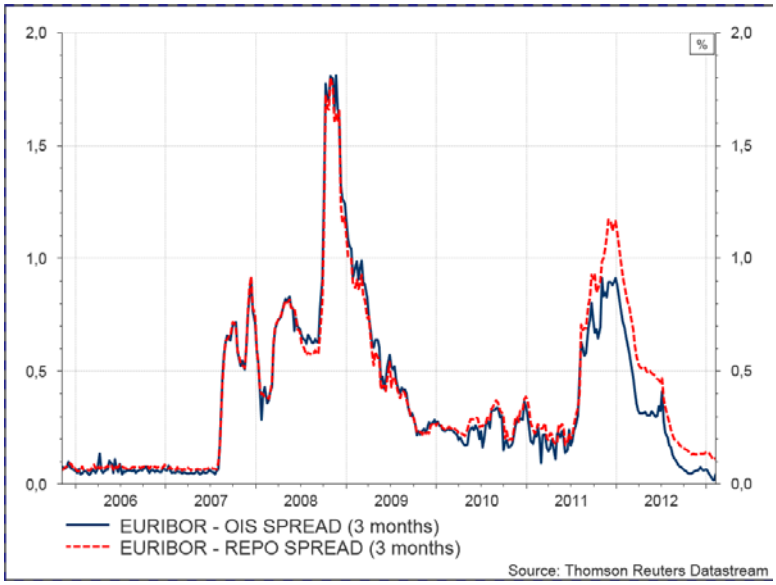


Figure 2: Sovereign bond spreads in the eurozone countries

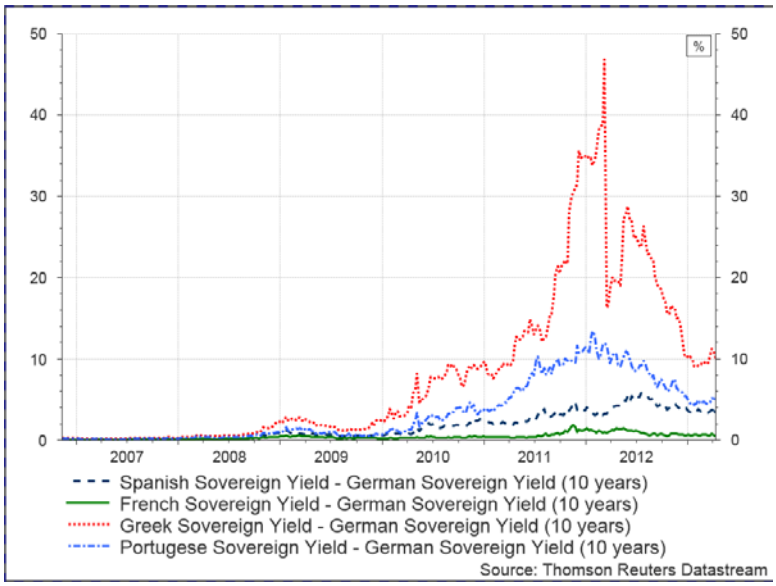
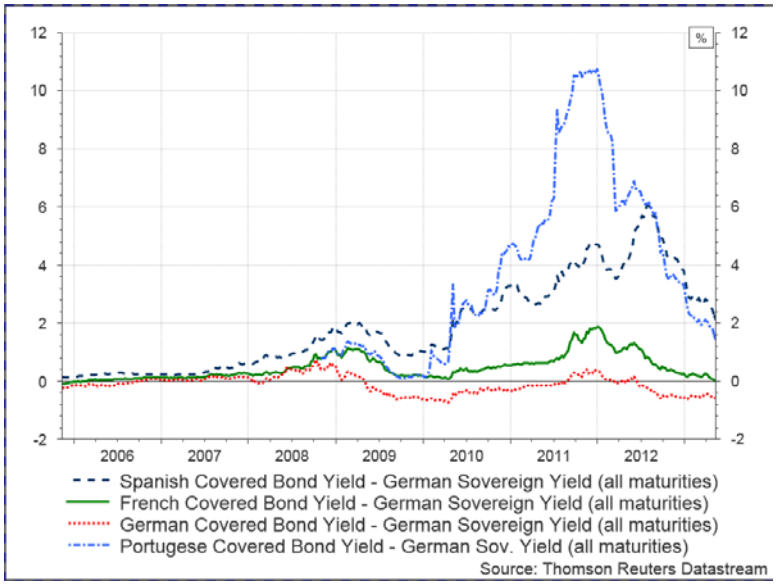


Figure 3: Covered bond spreads in the eurozone countries



Tables

Table 1: The impact of the ECB's unconventional monetary policies on money market

This table presents regression results for the eurozone money market: $\Delta S_t^M = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^{4} \gamma_n \Delta S_{t-n}^M + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t$. Dependent variables are 2-day changes in money market spreads: Euribor-OIS (3 month Euribor rate minus 3 month Overnight Index Swap rate), Euribor-Repo (3 month Euribor rate minus 3 month repo rate), Euribor-Bubill (3 month Euribor rate minus 3 month German Treasury bill) and CD-OIS (3 month certificate of deposit rate minus 3 month Overnight Index Swap rate). Independent variables are dummy variables: EFSF/ESM = 1 when important developments about the European Financial Stability Facility and European Stability Mechanism are announced (2010/05/10, 2011/03/14, 2012/03/26, 2012/06/29); Securities Markets Program (SMP) = 1 when longer-term sovereign bond purchases are announced (2010/05/10); Outright Monetary Transactions (OMT) = 1 when short-term sovereign bond purchases are announced (2012/09/06); Covered Bonds Purchase Programs = 1 on 2009/05/07 and 2011/10/06; 3Y LTRO announcement = 1 on 2011/12/08; 3Y LTRO operations = 1 on 2011/12/21 and 2012/02/29; Fixed-rate full-allotment = 1 on 2008/10/09, 2008/10/13, 2008/10/15 and 2010/05/10; 0% deposit rate at the ECB = 1 on 2012/07/05. Long-term coefficients are reported: coeff/(1-$\sum_{n=1}^{4} \gamma_n$). Constant, day dummies and lags of dependent variables are included but not reported.

	Euribor-OIS	**Euribor-Repo**	**Euribor-Bubill**	**CD-OIS**
Sovereign crisis dummy	0.00	0.00	0.00	0.00
	[0.55]	[0.30]	[0.61]	[0.41]
EFSF/ESM	0.02	0.02	0.02	-0.01
	[0.28]	[0.15]	[0.64]	[0.89]
Securities Markets Prog. (SMP)	0.27	0.03	-0.27	0.07
	[0.31]	[0.89]	[0.19]	[0.62]
Outright Monetary Trans. (OMT)	-0.02***	-0.02***	-0.01*	
	[0.00]	[0.00]	[0.08]	
Covered Bonds P.P. 1 and 2	-0.07***	-0.12	-0.06***	-0.04
	[0.00]	[0.42]	[0.00]	[0.14]
3Y LTRO announcement	-0.22***	-0.14***	-0.06***	
	[0.00]	[0.00]	[0.00]	
3Y LTRO operations	-0.06**	-0.05**	-0.03***	-0.12***
	[0.03]	[0.03]	[0.00]	[0.00]
Fixed-rate full-allotment	-0.32	-0.03	0.22	-0.04
	[0.24]	[0.89]	[0.26]	[0.79]
0% deposit rate at the ECB	-0.24***	-0.10***	-0.14***	
	[0.00]	[0.00]	[0.00]	
Observations	1,365	1,364	1,278	1,187
R-squared	0.48	0.61	0.33	0.21

Robust pval in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 2: The impact of the ECB's unconventional monetary policies on covered bond market

This table presents regression results for the eurozone covered bond markets: $\Delta S_t^C = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \varphi_1 F_t + \varphi_2 C_t + \gamma \Delta S_{t-1}^C + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t$. Dependent variables are 1-day changes in covered bond spreads in the eurozone and its member countries: Germany, France, Italy, Ireland, Portugal and Spain. The spreads are calculated as a difference between all-maturities covered bond yields for each country with respect to corresponding German sovereign bond yield. Independent variables are dummy variables: EFSF/ESM = 1 when important developments about the European Financial Stability Facility and European Stability Mechanism are announced (2010/05/10, 2011/03/14, 2012/03/26, 2012/06/29); Securities Markets Program (SMP) = 1 when longer-term sovereign bond purchases are announced (2010/05/10); Outright Monetary Transactions (OMT) = 1 when short-term sovereign bond purchases are announced (2012/09/06); Covered Bonds Purchase Programs = 1 on 2009/05/07 and 2011/10/06; 3Y LTRO announcement = 1 on 2011/12/08; 3Y LTRO operations = 1 on 2011/12/21 and 2012/02/29; Fixed-rate full-allotment = 1 on 2008/10/09, 2008/10/13, 2008/10/15 and 2010/05/10; 0% deposit rate at the ECB = 1 on 2012/07/05. Long-term coefficients are reported: coeff/(1- γ). Constant, day dummies and lags of dependent variables are included but not reported.

	Eurozone	**Ireland**	**Italy**	**Portugal**	**Spain**	**France**	**Germany**
Sov. crisis	0.01***	0.01***	0.02***	0.04***	0.02***	0.01***	0.00**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.04]
EFSF/ESM	-0.04***	-0.06***	-0.06***	-0.12*	-0.08***	-0.02***	-0.03***
	[0.00]	[0.00]	[0.00]	[0.07]	[0.00]	[0.00]	[0.00]
SMP	-0.19***	-0.46***	-0.31***	-1.63***	-0.34***	-0.07***	-0.10***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.01]
OMT	-0.06***	-0.10***	-0.11***	-0.49***	-0.12***	-0.04***	-0.05***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
CBPP 1 & 2	-0.04***	0.04	-0.10***	-0.09	-0.06***	-0.04***	-0.05**
	[0.00]	[0.57]	[0.00]	[0.26]	[0.00]	[0.00]	[0.02]
3Y LTRO an.	-0.04***	-0.05***	-0.03***	0.03	-0.03***	-0.05***	-0.02***
	[0.00]	[0.00]	[0.00]	[0.78]	[0.00]	[0.00]	[0.00]
3Y LTRO op	-0.01	-0.01	-0.04	0.00	-0.01	-0.01	-0.01
	[0.34]	[0.68]	[0.17]	[0.97]	[0.31]	[0.20]	[0.77]
FRFA	-0.04	-0.04			-0.06**	-0.03	-0.03
	[0.14]	[0.47]			[0.03]	[0.22]	[0.42]
0% deposit	-0.00	-0.01	0.01**	-0.10	0.07***	-0.02***	-0.01***
	[0.10]	[0.28]	[0.03]	[0.38]	[0.00]	[0.00]	[0.00]
Observations	1,368	1,368	973	1,018	1,368	1,368	1,368
R-squared	0.13	0.13	0.17	0.27	0.19	0.08	0.06

Robust pval in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 3: The impact of the ECB's unconventional monetary policies on sovereign bond market (periphery eurozone countries)

This table presents regression results for the eurozone covered bond markets: $\Delta S_t^S = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \delta Q_t + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^{2} \gamma_n \Delta S_{t-n}^S + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t$. Dependent variables are 1-day changes in sovereign bond spreads in the eurozone and the periphery member countries. The spreads are calculated as a difference between 10-year sovereign bond yields for each country with respect to corresponding German sovereign yield. Independent variables are dummy variables: EFSF/ESM = 1 when important developments about the European Financial Stability Facility and European Stability Mechanism are announced (2010/05/10, 2011/03/14, 2012/03/26, 2012/06/29); Securities Markets Program (SMP) = 1 when longer-term sovereign bond purchases are announced (2010/05/10); Outright Monetary Transactions (OMT) = 1 when short-term sovereign bond purchases are announced (2012/09/06); Covered Bonds Purchase Programs (CBPP) = 1 on 2009/05/07 and 2011/10/06; 3Y LTRO announcement = 1 on 2011/12/08; 3Y LTRO operations = 1 on 2011/12/21 and 2012/02/29; Fixed-rate full-allotment = 1 on 2008/10/09, 2008/10/13, 2008/10/15 and 2010/05/10; 0% deposit rate at the ECB = 1 on 2012/07/05; U.S. QE = 1 on US bond purchase programs announcements (QE1: 2008/12/01, 2008/12/16, 2009/03/18; QE2: 2010-08-10, 2010-08-27, 2010-09-21, 2010-11-03; MEP: 2011/09/21. Long-term coefficients are reported: coeff/(1-$\sum_{n=1}^{2} \gamma_n$). Constant, day dummies and lags of dependent variables are included but not reported.

	Eurozone	Greece	Ireland	Italy	Portugal	Spain
Sov. crisis	0.01**	0.13***	0.02***	0.01**	0.02	0.02**
	[0.05]	[0.00]	[0.01]	[0.05]	[0.23]	[0.01]
EFSF/ESM	-0.13***	-0.25*	-0.52***	-0.28**	-0.46***	-0.43***
	[0.00]	[0.08]	[0.00]	[0.01]	[0.00]	[0.00]
SMP	-0.16***	-4.85***	-1.21***	-0.31***	-2.02***	-0.43***
	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]
OMT	-0.14***	0.05	-0.24*	-0.31***	-0.54***	-0.59***
	[0.00]	[0.30]	[0.09]	[0.00]	[0.01]	[0.00]
CBPP 1 & 2	-0.05***	-0.18***	-0.09	-0.16***	-0.08	-0.13*
	[0.00]	[0.00]	[0.39]	[0.00]	[0.58]	[0.09]
3Y LTRO an.	0.18***	1.21***	0.05	0.48***	0.09	0.33***
	[0.00]	[0.00]	[0.73]	[0.00]	[0.68]	[0.00]
3Y LTRO op	-0.00	-0.04	0.02	-0.01	0.38**	0.05
	[0.95]	[0.83]	[0.82]	[0.94]	[0.01]	[0.52]
FRFA	-0.02***	-0.00	-0.01	-0.04**	-0.08	-0.04
	[0.00]	[0.94]	[0.95]	[0.03]	[0.53]	[0.57]
0% deposit	0.11***	-0.04*	0.11	0.29***	0.33	0.52***
	[0.00]	[0.06]	[0.45]	[0.00]	[0.11]	[0.00]
U.S. QE	0.01	-0.05	0.02	0.01	0.00	0.03
	[0.24]	[0.41]	[0.77]	[0.44]	[0.99]	[0.42]
Observations	1,368	1,368	1,368	1,368	1,368	1,368
R-squared	0.18	0.04	0.20	0.15	0.21	0.21

Robust pval in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 4: The impact of the ECB's unconventional monetary policies on sovereign bond market (France, Germany and the United States)

This table presents regression results for the eurozone covered bond markets: $\Delta S_t^S = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \delta Q_t + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^{2} \gamma_n \Delta S_{t-n}^S + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t$. Dependent variables are 1-day changes in sovereign bond spreads in the eurozone, the core member countries and the US. The spreads are calculated as a difference between 10-year sovereign bond yields for each country with respect to corresponding German sovereign yield exept for Germany (10-year German OIS) and the US (10-year US OIS). Independent variables are dummy variables: EFSF/ESM = 1 when important developments about the European Financial Stability Facility and European Stability Mechanism are announced (2010/05/10, 2011/03/14, 2012/03/26, 2012/06/29); Securities Markets Program (SMP) = 1 when longer-term sovereign bond purchases are announced (2010/05/10); Outright Monetary Transactions (OMT) = 1 when short-term sovereign bond purchases are announced (2012/09/06); Covered Bonds Purchase Programs = 1 on 2009/05/07 and 2011/10/06; 3Y LTRO announcement = 1 on 2011/12/08; 3Y LTRO operations = 1 on 2011/12/21 and 2012/02/29; Fixed-rate full-allotment = 1 on 2008/10/09, 2008/10/13, 2008/10/15 and 2010/05/10; 0% deposit rate at the ECB = 1 on 2012/07/05. U.S. QE = 1 on US bond purchase programs announcements (QE1: 2008/12/01, 2008/12/16, 2009/03/18; QE2: 2010-08-10, 2010-08-27, 2010-09-21, 2010-11-03; MEP: 2011/09/21. Long-term coefficients are reported: coeff/(1-$\sum_{n=1}^{2} \gamma_n$). Constant, day dummies and lags of dependent variables are included but not reported.

	Eurozone	France	Germany	US
Sovereign crisis dummy	0.01**	0.00	-0.00	-0.00
	[0.05]	[0.17]	[0.39]	[0.38]
EFSF/ESM	-0.13***	-0.07***	0.02	-0.00
	[0.00]	[0.00]	[0.10]	[0.93]
Securities Markets Prog. (SMP)	-0.16***	-0.03	0.01	0.04
	[0.00]	[0.48]	[0.84]	[0.22]
Outright Monetary Trans. (OMT)	-0.14***	-0.07*	0.00	-0.01
	[0.00]	[0.05]	[0.99]	[0.77]
Covered Bonds P.P. 1 and 2	-0.05***	-0.01	0.01	0.00
	[0.00]	[0.76]	[0.41]	[0.96]
3Y LTRO annoucement	0.18***	0.18***	0.06**	0.00
	[0.00]	[0.00]	[0.01]	[0.95]
3Y LTRO operations	-0.00	-0.03	0.00	0.01
	[0.95]	[0.25]	[0.95]	[0.76]
Fixed-rate full-allotment	-0.02***	-0.02	0.02	-0.02
	[0.00]	[0.43]	[0.13]	[0.11]
0% deposit rate at ECB	0.11***	0.02	0.00	0.00
	[0.00]	[0.63]	[0.91]	[0.99]
Treasuries purchases (US)	0.01	0.01	0.00	-0.05***
	[0.24]	[0.44]	[0.59]	[0.00]
Observations	1,368	1,368	1,368	1,367
R-squared	0.13	0.06	0.08	0.24

Robust pval in brackets *** p<0.01, ** p<0.05, * p<0.1

Table 5: The impact of the ECB's unconventional monetary policies on sovereign bond market (with SMP 2 and M. Draghi speech)

This table presents regression results for the eurozone covered bond markets: $\Delta S_t^S = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \delta Q_t + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^{2} \gamma_n \Delta S_{t-n}^S + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t$. Dependent variables are 1-day changes in sovereign bond spreads in the eurozone and the periphery member countries. The spreads are calculated as a difference between 10-year sovereign bond yields for each country with respect to corresponding German sovereign yield. Independent variables are dummy variables: EFSF/ESM = 1 when important developments about the European Financial Stability Facility and European Stability Mechanism are announced (2010/05/10, 2011/03/14, 2012/03/26, 2012/06/29); Securities Markets Program (SMP) = 1 when longer-term sovereign bond purchases are announced (2010/05/10); Securities Markets Program 2 (SMP 2) = 1 when SMP is reactivated (2011/08/08); Outright Monetary Transactions (OMT) = 1 when short-term sovereign bond purchases are announced (2012/09/06); Draghi speech = 1 when M. Draghi pronounced his "whatever it takes" speech (2012/07/26). Covered Bonds Purchase Programs (CBPP) = 1 on 2009/05/07 and 2011/10/06; 3Y LTRO announcement = 1 on 2011/12/08; 3Y LTRO operations = 1 on 2011/12/21 and 2012/02/29; Fixed-rate full-allotment = 1 on 2008/10/09, 2008/10/13, 2008/10/15 and 2010/05/10; 0% deposit rate at the ECB = 1 on 2012/07/05; U.S. QE = 1 on US bond purchase programs announcements (QE1: 2008/12/01, 2008/12/16, 2009/03/18; QE2: 2010-08-10, 2010-08-27, 2010-09-21, 2010-11-03; MEP: 2011/09/21. Long-term coefficients are reported: coeff/(1-$\sum_{n=1}^{2} \gamma_n$). Constant, day dummies and lags of dependent variables are included but not reported.

	Eurozone	Greece	Ireland	Italy	Portugal	Spain
Sov. crisis	0.01*	0.13***	0.02***	0.01*	0.01	0.01**
	[0.06]	[0.00]	[0.01]	[0.07]	[0.24]	[0.02]
EFSF/ESM	-0.13***	-0.25*	-0.52***	-0.28**	-0.46***	-0.42***
	[0.00]	[0.08]	[0.00]	[0.01]	[0.00]	[0.00]
SMP	-0.15***	-4.85***	-1.22***	-0.30***	-2.03***	-0.42***
	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]
SMP 2	-0.26***	0.10	0.18	-0.81***	-0.06	-1.04***
	[0.00]	[0.38]	[0.21]	[0.00]	[0.78]	[0.00]
OMT	-0.14***	0.05	-0.25*	-0.31***	-0.54***	-0.59***
	[0.00]	[0.32]	[0.09]	[0.00]	[0.01]	[0.00]
Draghi speech	-0.19***	-0.56***	-0.10	-0.48***	-0.30	-0.56***
	[0.00]	[0.00]	[0.48]	[0.00]	[0.15]	[0.00]
CBPP 1 & 2	-0.05***	-0.18***	-0.09	-0.16***	-0.08	-0.13*
	[0.00]	[0.00]	[0.39]	[0.00]	[0.58]	[0.07]
3Y LTRO an.	0.18***	1.21***	0.05	0.48***	0.09	0.33***
	[0.00]	[0.00]	[0.73]	[0.00]	[0.69]	[0.00]
3Y LTRO op.	-0.00	-0.04	0.02	-0.01	0.38**	0.05
	[0.94]	[0.83]	[0.82]	[0.92]	[0.01]	[0.52]
FRFA	-0.02***	-0.00	-0.01	-0.04**	-0.08	-0.04
	[0.00]	[0.92]	[0.95]	[0.02]	[0.53]	[0.53]
0% deposit	0.11***	-0.04**	0.11	0.28***	0.33	0.51***
	[0.00]	[0.04]	[0.46]	[0.00]	[0.11]	[0.00]
U.S. QE	0.01	-0.05	0.01	0.01	0.00	0.03
	[0.24]	[0.40]	[0.77]	[0.45]	[0.99]	[0.40]
Observations	1,368	1,368	1,368	1,368	1,368	1,368
R-squared	0.17	0.04	0.19	0.16	0.19	0.26

Robust pval in brackets *** p<0.01, ** p<0.05, * p<0.1

Appendix:

Table A1: The impact of the ECB's unconventional monetary policies on money market (with VIX)

This table presents regression results for the eurozone money market: $\Delta S_t^M = \alpha + \Delta VIX_t + \sum_{i=1}^{7} \beta_i NC_{i,t} + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^{4} \gamma_n \Delta S_{t-n}^M + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t$. Dependent variables are 2-day changes in money market spreads: Euribor-OIS (3 month Euribor rate minus 3 month Overnight Index Swap rate), Euribor-Repo (3 month Euribor rate minus 3 month repo rate), Euribor-Bubill (3 month Euribor rate minus 3 month German Treasury bill) and CD-OIS (3 month certificate of deposit rate minus 3 month Overnight Index Swap rate). ΔVIX_t is a 2-day change in risk aversion proxy VIX. Other independent variables are dummy variables: EFSF/ESM = 1 when important developments about the European Financial Stability Facility and European Stability Mechanism are announced (2010/05/10, 2011/03/14, 2012/03/26, 2012/06/29); Securities Markets Program (SMP) = 1 when longer-term sovereign bond purchases are announced (2010/05/10); Outright Monetary Transactions (OMT) = 1 when short-term sovereign bond purchases are announced (2012/09/06); Covered Bonds Purchase Programs = 1 on 2009/05/07 and 2011/10/06; 3Y LTRO announcement = 1 on 2011/12/08; 3Y LTRO operations = 1 on 2011/12/21 and 2012/02/29; Fixed-rate full-allotment = 1 on 2008/10/09, 2008/10/13, 2008/10/15 and 2010/05/10; 0% deposit rate at the ECB = 1 on 2012/07/05. Long-term coefficients are reported: coeff/(1-$\sum_{n=1}^{4} \gamma_n$). Constant, day dummies and lags of dependent variables are included but not reported.

	Euribor-OIS	**Euribor-Repo**	**Euribor-Bubill**	**CD-OIS**
VIX	0.17***	0.16***	0.12**	0.08***
	[0.00]	[0.00]	[0.02]	[0.00]
Sovereign crisis dummy	0.00	0.00	0.00	0.00
	[0.48]	[0.34]	[0.56]	[0.38]
EFSF/ESM	0.02	0.02	0.02	-0.02
	[0.24]	[0.21]	[0.73]	[0.68]
Securities Markets Prog. (SMP)	0.33	0.17	-0.21	0.11
	[0.17]	[0.49]	[0.32]	[0.41]
Outright Monetary Trans. (OMT)	0.01	0.01	0.01	
	[0.13]	[0.46]	[0.45]	
Covered Bonds P.P. 1 and 2	-0.07***	-0.14	-0.06***	-0.04
	[0.00]	[0.42]	[0.00]	[0.15]
3Y LTRO annoucement	-0.20***	-0.15***	-0.05***	
	[0.00]	[0.00]	[0.00]	
3Y LTRO operations	-0.05*	-0.05*	-0.02**	-0.12***
	[0.09]	[0.06]	[0.03]	[0.00]
Fixed-rate full-allotment	-0.31	-0.12	0.21	-0.04
	[0.19]	[0.64]	[0.29]	[0.74]
0% deposit rate at ECB	-0.23***	-0.12***	-0.14***	
	[0.00]	[0.00]	[0.00]	
Observations	1,365	1,365	1,278	1,187
R-squared	0.50	0.61	0.33	0.22

Robust pval in brackets *** p<0.01, ** p<0.05, * p<0.1

Table A2: The impact of the ECB's unconventional monetary policies on covered bond market (with VIX)

This table presents regression results for the eurozone covered bond markets: $\Delta S_t^C = \alpha + \Delta VIX_t + \sum_{i=1}^{7} \beta_i NC_{i,t} + \varphi_1 F_t + \varphi_2 C_t + \gamma \Delta S_{t-1}^C + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t$. Dependent variables are 1-day changes in covered bond spreads in the eurozone and its member countries: Germany, France, Italy, Ireland, Portugal and Spain. The spreads are calculated as a difference between all-maturities covered bond yields for each country with respect to corresponding German sovereign bond yield. ΔVIX_t is a 1-day change in risk aversion proxy VIX. Other independent variables are dummy variables: EFSF/ESM = 1 when important developments about the European Financial Stability Facility and European Stability Mechanism are announced (2010/05/10, 2011/03/14, 2012/03/26, 2012/06/29); Securities Markets Program (SMP) = 1 when longer-term sovereign bond purchases are announced (2010/05/10); Outright Monetary Transactions (OMT) = 1 when short-term sovereign bond purchases are announced (2012/09/06); Covered Bonds Purchase Programs = 1 on 2009/05/07 and 2011/10/06; 3Y LTRO announcement = 1 on 2011/12/08; 3Y LTRO operations = 1 on 2011/12/21 and 2012/02/29; Fixed-rate full-allotment = 1 on 2008/10/09, 2008/10/13, 2008/10/15 and 2010/05/10; 0% deposit rate at the ECB = 1 on 2012/07/05. Long-term coefficients are reported: coeff/(1- γ). Constant, day dummies and lags of dependent variables are included but not reported.

	Eurozone	Ireland	Italy	Portugal	Spain	France	Germany
VIX	0.09***	0.18***	0.16***	0.25***	0.15***	0.07***	0.07***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Sov. crisis	0.01***	0.01***	0.02***	0.04***	0.02***	0.01***	0.00**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.03]
EFSF/ESM	-0.03***	-0.06***	-0.05***	-0.11***	-0.08***	-0.02***	-0.03***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
SMP	-0.16***	-0.53***	-0.27***	-1.56***	-0.36***	-0.06**	-0.07**
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.01]
OMT	-0.05***	-0.11***	-0.09***	-0.46***	-0.11***	-0.03***	-0.04***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
CBPP 1 & 2	-0.04***	0.03	-0.09***	-0.09**	-0.07***	-0.04***	-0.04**
	[0.00]	[0.70]	[0.00]	[0.01]	[0.00]	[0.00]	[0.03]
3Y LTRO an.	-0.05***	-0.07***	-0.05***	0.02	-0.05***	-0.06***	-0.03***
	[0.00]	[0.00]	[0.00]	[0.21]	[0.00]	[0.00]	[0.00]
3Y LTRO op	-0.01	-0.01	-0.03	0.01	-0.01	-0.01	-0.00
	[0.55]	[0.80]	[0.31]	[0.38]	[0.68]	[0.35]	[0.88]
FRFA	-0.04**	-0.07			-0.07***	-0.04	-0.03
	[0.01]	[0.21]			[0.00]	[0.12]	[0.26]
0% deposit	-0.01***	0.00	0.00	-0.11***	0.08***	-0.02***	-0.02***
	[0.00]	[0.58]	[0.84]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	1,368	1,367	973	1,018	1,367	1,367	1,368
R-squared	0.17	0.19	0.20	0.28	0.25	0.12	0.09

Robust pval in brackets *** p<0.01, ** p<0.05, * p<0.1

Table A3: The impact of the ECB's unconventional monetary policies on sovereign bond market (periphery eurozone countries, with VIX)

This table presents regression results for the eurozone covered bond markets: $\Delta S_t^S = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \delta Q_t + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^{2} \gamma_n \Delta S_{t-n}^S + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t$. Dependent variables are 1-day changes in sovereign bond spreads in the eurozone and the periphery member countries. The spreads are calculated as a difference between 10-year sovereign bond yields for each country with respect to corresponding German sovereign yield. ΔVIX_t is a 1-day change in risk aversion proxy VIX. Other independent variables are dummy variables: EFSF/ESM = 1 when important developments about the European Financial Stability Facility and European Stability Mechanism are announced (2010/05/10, 2011/03/14, 2012/03/26, 2012/06/29); Securities Markets Program (SMP) = 1 when longer-term sovereign bond purchases are announced (2010/05/10); Outright Monetary Transactions (OMT) = 1 when short-term sovereign bond purchases are announced (2012/09/06); Covered Bonds Purchase Programs (CBPP) = 1 on 2009/05/07 and 2011/10/06; 3Y LTRO announcement = 1 on 2011/12/08; 3Y LTRO operations = 1 on 2011/12/21 and 2012/02/29; Fixed-rate full-allotment = 1 on 2008/10/09, 2008/10/13, 2008/10/15 and 2010/05/10; 0% deposit rate at the ECB = 1 on 2012/07/05; U.S. QE = 1 on US bond purchase programs announcements (QE1: 2008/12/01, 2008/12/16, 2009/03/18; QE2: 2010-08-10, 2010-08-27, 2010-09-21, 2010-11-03; MEP: 2011/09/21. Long-term coefficients are reported: coeff/(1-$\sum_{n=1}^{2} \gamma_n$). Constant, day dummies and lags of dependent variables are included but not reported.

	Eurozone	Greece	Ireland	Italy	Portugal	Spain
VIX	0.12***	0.79	0.28***	0.30***	0.39***	0.25***
	[0.00]	[0.10]	[0.00]	[0.00]	[0.00]	[0.00]
Sov. crisis	0.01**	0.13***	0.02***	0.02**	0.02	0.02**
	[0.03]	[0.00]	[0.01]	[0.03]	[0.21]	[0.03]
EFSF/ESM	-0.13***	-0.21	-0.51***	-0.27***	-0.44***	-0.41***
	[0.00]	[0.18]	[0.00]	[0.01]	[0.00]	[0.00]
SMP	-0.12***	-4.60***	-1.12***	-0.21**	-1.91***	-0.35**
	[0.00]	[0.00]	[0.00]	[0.05]	[0.00]	[0.02]
OMT	-0.13***	0.14*	-0.21	-0.27***	-0.50**	-0.56***
	[0.00]	[0.14]	[0.14]	[0.00]	[0.02]	[0.00]
CBPP 1 & 2	-0.05***	-0.17**	-0.09	-0.15***	-0.08	-0.13**
	[0.00]	[0.04]	[0.39]	[0.00]	[0.59]	[0.01]
3Y LTRO an.	0.18***	1.16***	0.03	0.46***	0.06	0.32***
	[0.00]	[0.00]	[0.83]	[0.00]	[0.77]	[0.00]
3Y LTRO op	0.00	-0.01	0.03	-0.00	0.39***	0.06
	[0.98]	[0.94]	[0.76]	[0.98]	[0.01]	[0.55]
FRFA	-0.02**	-0.04	-0.02	-0.05**	-0.09	-0.05
	[0.04]	[0.72]	[0.83]	[0.02]	[0.43]	[0.21]
0% deposit	0.10***	-0.08***	0.09	0.27***	0.31	0.50***
	[0.00]	[0.00]	[0.51]	[0.00]	[0.13]	[0.00]
U.S. QE	0.01	-0.06	0.01	0.01	-0.00	0.03*
	[0.36]	[0.36]	[0.83]	[0.60]	[0.95]	[0.09]
Observations	1,368	1,368	1,368	1,368	1,368	1,368
R-squared	0.18	0.04	0.20	0.15	0.21	0.21

Robust pval in brackets *** p<0.01, ** p<0.05, * p<0.1

Table A4: The impact of the ECB's unconventional monetary policies on sovereign bond market (France, Germany and the United States, with VIX)

This table presents regression results for the eurozone covered bond markets: $\Delta S_t^S = \alpha + \sum_{i=1}^{7} \beta_i NC_{i,t} + \delta Q_t + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^{2} \gamma_n \Delta S_{t-n}^S + \sum_{l=1}^{4} \theta_l D_t + \epsilon_t$. Dependent variables are 1-day changes in sovereign bond spreads in the eurozone, the core member countries and the US. The spreads are calculated as a difference between 10-year sovereign bond yields for each country with respect to corresponding German sovereign yield except for Germany (10-year German OIS) and the US (10-year US OIS). ΔVIX_t is a 1-day change in risk aversion proxy VIX. Other independent variables are dummy variables: EFSF/ESM = 1 when important developments about the European Financial Stability Facility and European Stability Mechanism are announced (2010/05/10, 2011/03/14, 2012/03/26, 2012/06/29); Securities Markets Program (SMP) = 1 when longer-term sovereign bond purchases are announced (2010/05/10); Outright Monetary Transactions (OMT) = 1 when short-term sovereign bond purchases are announced (2012/09/06); Covered Bonds Purchase Programs = 1 on 2009/05/07 and 2011/10/06; 3Y LTRO announcement = 1 on 2011/12/08; 3Y LTRO operations = 1 on 2011/12/21 and 2012/02/29; Fixed-rate full-allotment = 1 on 2008/10/09, 2008/10/13, 2008/10/15 and 2010/05/10; 0% deposit rate at the ECB = 1 on 2012/07/05. U.S. QE = 1 on US bond purchase programs announcements (QE1: 2008/12/01, 2008/12/16, 2009/03/18; QE2: 2010-08-10, 2010-08-27, 2010-09-21, 2010-11-03; MEP: 2011/09/21. Long-term coefficients are reported: coeff/(1-$\sum_{n=1}^{2} \gamma_n$). Constant, day dummies and lags of dependent variables are included but not reported.

	Eurozone	France	Germany	US
VIX	0.12***	0.08***	-0.01	-0.03***
	[0.00]	[0.00]	[0.38]	[0.01]
Sovereign crisis dummy	0.01**	0.00	-0.00	-0.00
	[0.03]	[0.15]	[0.39]	[0.37]
EFSF/ESM	-0.13***	-0.06***	0.02	-0.00
	[0.00]	[0.00]	[0.11]	[0.87]
Securities Markets Prog. (SMP)	-0.12***	-0.01	0.00	0.03
	[0.00]	[0.85]	[0.91]	[0.32]
Outright Monetary Trans. (OMT)	-0.13***	-0.06*	-0.00	-0.01
	[0.00]	[0.10]	[0.98]	[0.68]
Covered Bonds P.P. 1 and 2	-0.05***	-0.01	0.01	0.00
	[0.00]	[0.76]	[0.41]	[0.97]
3Y LTRO annoucement	0.18***	0.18***	0.06**	0.00
	[0.00]	[0.00]	[0.01]	[0.90]
3Y LTRO operations	0.00	-0.03	0.00	0.00
	[0.98]	[0.28]	[0.96]	[0.79]
Fixed-rate full-allotment	-0.02**	-0.02	0.02	-0.02
	[0.04]	[0.33]	[0.13]	[0.12]
0% deposit rate at ECB	0.10***	0.01	0.00	0.00
	[0.00]	[0.71]	[0.90]	[0.95]
Treasuries purchases (US)	0.01	0.01	0.00	-0.05***
	[0.36]	[0.49]	[0.58]	[0.00]
Observations	1,368	1,368	1,368	1,367
R-squared	0.18	0.08	0.08	0.25

Robust pval in brackets *** p<0.01, ** p<0.05, * p<0.1