

The ECB Unconventional Monetary Policies: Have They Lowered Market Borrowing Costs for Banks and Governments?*

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This paper evaluates the impact of the ECB's 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 money markets, covered bond markets, and sovereign bond markets. The results show that (i) exceptional liquidity measures (three-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 refinancing costs of banks and governments in the presence of high sovereign risk. Moreover, we show that the ECB asset purchases fed through into other asset prices: bank covered bond purchases diminished sovereign spreads, while sovereign bond purchases reduced covered bond spreads.

JEL Codes: E43, E44, E52, E58.

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1. Introduction

Following the 2007–9 financial crisis, the euro zone 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 euro-zone states. The situation was further deepened by the negative feedback loop between the sovereign distress and bank insolvency. Indeed, euro-zone banks were heavily exposed to sovereign debt, while euro-zone governments bore the responsibility of rescuing their banking systems. The European Central Bank (ECB) faced the 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 euro zone and stabilizing the 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 the euro-zone 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 long-term refinancing operations (three-year LTROs), lowering the ECB deposit rate to 0 percent, and unlimited liquidity provisions (the fixed-rate full-allotment procedure, FRFA). By using the Factiva press database, we make sure to include other important events that occurred on monetary policy announcement days. Finally, we test the impact of all announcements on money-market spreads, covered bond spreads, and sovereign bond spreads.

We find that three-year LTROs and cutting the ECB deposit rate to 0 percent significantly reduced persistent money-market tensions in the euro zone. Furthermore, our results show that central bank interventions in sovereign markets (SMP and OMT) are particularly effective when sovereign risk is high: periphery euro-zone

countries benefited the most from the sovereign bond purchasing programs, while the French spread reacted very little if at all. The strong impact in the troubled periphery countries confirms the ECB's capacity to establish more homogeneous credit conditions in the euro zone. Interestingly, the effects of the ECB's asset purchases were not limited to the market of intervention. *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 presence of a feedback loop between sovereigns and the banking sector in the euro zone might be a source of this additional effect of the ECB asset purchases.

There exists an important literature about the effects of unconventional monetary policies in the United States, the United Kingdom, and Japan.¹ The empirical evidence of the impact of the ECB's unconventional monetary policies on financial markets is also growing rapidly.² 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, Nobili, and Picillo (2011), and Brunetti, di Filippo, and Harris (2011), who did not find significant effects of exceptional refinancing operations up to one year on money-market tensions.³ We complement these papers by showing that only

¹For 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, see Joyce et al. (2011); and for Japan, see Ueda (2012, 2013).

²We present here the impact of the ECB unconventional monetary policies on financial markets, but there exists also a large literature on their effects on macroeconomic variables (see, for instance, Lenza, Reichlin, and Pill 2010 or Peersman 2011).

³Abbassi and Linzert (2011) find that three-month special LTROs diminished the three-month and six-month Euribor (significance at 10 percent), twelve-month special LTROs diminished only the twelve-month Euribor (significance at 5 percent), and six-month LTROs were not significant at all. However, when the sample is split into two periods (August 2007–October 2008 and October 2008–June 2009), none of the special LTROs is significant. Angelini, Nobili, and Picillo

stronger liquidity measures (three-year LTROs and 0 percent deposit rate at the ECB) reduced significantly 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 the effectiveness of the covered bond purchases in reducing *sovereign* bond market 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 euro-zone countries. Independently, Eser and Schwaab (2013), Ghysels et al. (2013), and Pattipeilohy et al. (2013) find similar announcement results. Moreover, De Pooter, Martin, and Pruitt (2012), Eser and Schwaab (2013), and Ghysels et al. (2013) 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 sovereign market tensions in the peripheral euro zone.⁴ Interestingly, we also find that both sovereign bond purchase programs (OMT and SMP) were very effective in reducing *covered* bond market distress and therefore lowering longer-term bank funding costs.

Finally, we show that simultaneous analysis of asset purchases and liquidity measures on bank and government borrowing costs is essential for a 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

(2011) find that one-month and three-month special LTROs diminish the long-term interbank spread only after the failure of Lehman Brothers (three-month LTROs are significant at 5 percent, while one-month LTROs are significant at 10 percent), and six-month LTROs had an unexpected positive sign and increased the interbank spread. Brunetti, di Filippo, and Harris (2011) show further that special three-month LTROs increased both the level of the bid-ask spread and its volatility, contributing to higher uncertainty in money markets.

⁴Recently, Falagiarda and Reitz (2013) measured the announcement effect for the OMT on Italian spreads.

able to capture the significant impact of the ECB sovereign asset purchases on bank borrowing cost, which might be explained by the sovereign-banking nexus in the euro zone.

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 the increase in bank covered bond spreads was mostly due to increased sovereign default probability.

The remainder of this paper is organized as follows. The ECB's unconventional monetary policy announcements and their objectives are described in 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.

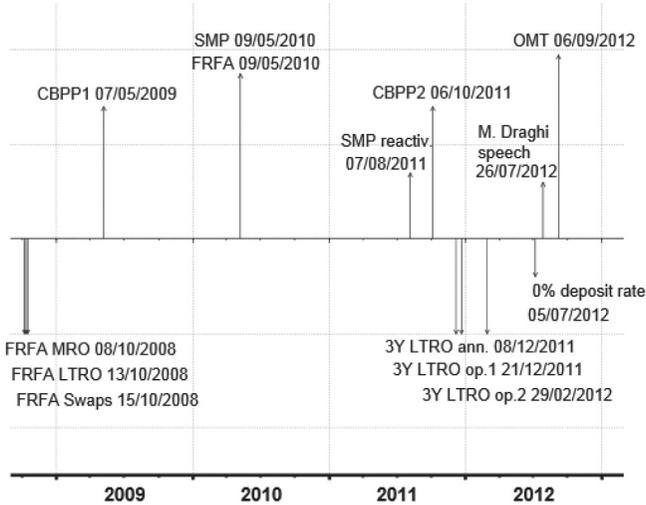
2. The ECB's Unconventional Monetary Policies

This section presents the ECB's unconventional policies, their theoretical foundations, and the objectives they were meant to attain. Even though we do not test the transmission channels of these policies in the empirical section, the theoretical background is important for the interpretation of the results. We regroup unconventional policies into two categories: (i) exceptional liquidity provisions (three-year LTROs, the fixed-rate full-allotment procedure, and setting the deposit rate to zero) and (ii) asset purchases (sovereign bond and covered bond purchase programs). Figure 1 presents a timeline of non-conventional monetary policy announcements considered in this paper.

2.1 *Exceptional Liquidity Provisions*

Significant tensions appeared on the euro-zone interbank market at the onset of the subprime crisis. The general uncertainty concerning banks' balance sheet health led to the increase in the spread between the risky interbank rate (Euribor) and the riskless rate

Figure 1. Timeline of the Unconventional Monetary Policy Announcements



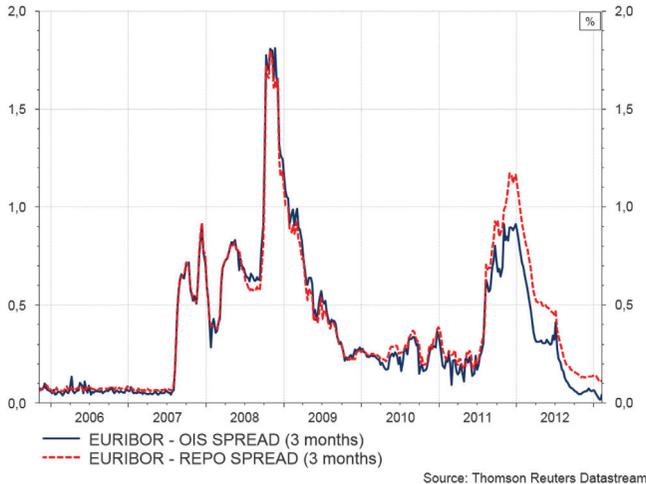
Notes: All the announcements are described in table 5 in the appendix. Dates shown in this figure are in day/month/year format.

(figure 2). The euro-zone sovereign debt crisis further impaired the money-market functioning, as the banks held important amounts of risky sovereign debt issued by periphery euro-zone 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 three-year refinancing operations (three-year LTROs). 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 was also a part of the ECB's non-standard toolbox. Traditionally, open-market operations were conducted through variable-rate tenders.⁵ Under the FRFA

⁵It should be noted, however, that the fixed tenders for the main refinancing operations (MROs) were applied in the beginning of the Eurosystem (from January 1999 to June 2000) and are compatible with the conventional monetary policy framework (Ayuso and Repullo 2003).

Figure 2. Money-Market Spreads in the Euro Zone

procedure, banks could satisfy all their liquidity needs at an interest rate specified in advance (the interest rate on the main refinancing operations). After Lehman Brothers collapsed, the ECB introduced the FRFA procedure for all open-market operations and for 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 Federal Reserve. Two days later, on October 15, 2008, the ECB announced an FRFA procedure for its LTROs. The ECB decided to return to a variable-rate tender procedure in the regular three-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 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 three-year LTROs as a fixed-rate procedure with full allotment. The first three-year 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 three-year LTROs were incomparable in length to other liquidity measures and 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 the interbank market, as this aspect was crucial for extending credit to firms and households. The liquidity measures can be effective in stabilizing the interbank market for several reasons. A liquidity shortage has a negative impact on financial institution lending capabilities and may result in a 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's unconventional measures diminish these adverse effects. They also reduce 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. In order to overcome banks' reluctance to lend to each other, the ECB lowered its deposit rate to 0 percent on July 5, 2012. While the markets expected a cut in the deposit rate on that day, the move to zero was a surprise.⁶ This measure was not a 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 encouraging banks to lend available money in the interbank market and not store it at the ECB.

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

⁶From "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.

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 that has no preference between markets and assets with 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’s purchases of bank covered bonds and euro-zone 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 the 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 will be able to easily sell the assets to the ECB.⁷

⁷De Pooter, Martin, and Pruitt (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.

The sovereign debt crisis in Europe increased 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 euro zone. Such projections cut off these countries' access to market refinancing or made it extremely costly, leading to a "self-fulfilling" prophecy: default or exit of a country from the euro zone. 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 the private sector's expectations of the future monetary policy ("signaling effect").⁸ In this paper, however, we focus on the ECB's 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 euro zone but not necessarily to ease credit conditions in aggregate (Coeuré 2012). Increased spreads on covered and sovereign bond markets in some member countries were a reflection of these divergent credit conditions in the euro zone.

2.2.1 Sovereign Bond Purchases

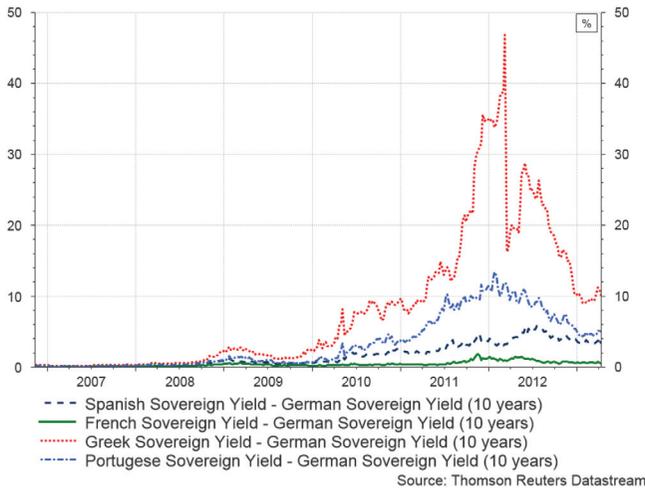
The Greek sovereign debt crisis in spring 2010 triggered a fire sale of some euro-zone government bonds. The ECB announced on Sunday, May 9, 2010 the Securities Market Programme (SMP) as a part of European Union efforts to stabilize the euro.⁹ The program was designed to purchase sovereign bonds and therefore to "ensure depth and liquidity in those market segments which are dysfunctional" (figure 3).¹⁰ The SMP was from the start a source of division within the ECB. Critics said that the ECB was overstepping

⁸Accumulation of risky assets on the central bank's 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.

⁹On the same day, the European Financial Stability Facility (EFSF) was established.

¹⁰The official ECB press release was issued on May 10, 2010: "ECB Decides on Measures to Address Severe Tensions in Financial Markets."

Figure 3. Sovereign Bond Spreads in the Euro-Zone Countries



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's 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 U.S.-style quantitative easing and to ensure that the monetary policy stance was not affected, the ECB decided to sterilize these purchases via specific operations designed to reabsorb the injected liquidity.¹¹ Another notable difference between the SMP and the Federal Reserve 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 euro-zone crisis and the risk of contagion to Italy and Spain made the ECB resume the program in August 2011. The ECB bought €219.5 billion of euro-zone government bonds within the SMP.

¹¹The sterilization of SMP seems mostly symbolic, as the FRFA procedure in all main refinancing operations leaves the control of monetary base in the hands of banks participating in these operations.

The euro-zone 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 euro-zone periphery increase rapidly, as market participants were pricing in the possibility of some countries leaving the Monetary Union. As a response, ECB President Mario Draghi announced in July 2012 that the central bank would do “whatever it takes to save the euro.”¹² 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. The objective of the new program, like the objective of the SMP, was to repair the monetary policy transmission mechanism and restore homogeneous credit conditions throughout the euro zone. More precisely, the purchases of euro-zone 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 three 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 met 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.¹³ The ECB has not purchased any sovereign bonds within OMT since the announcement of the program.

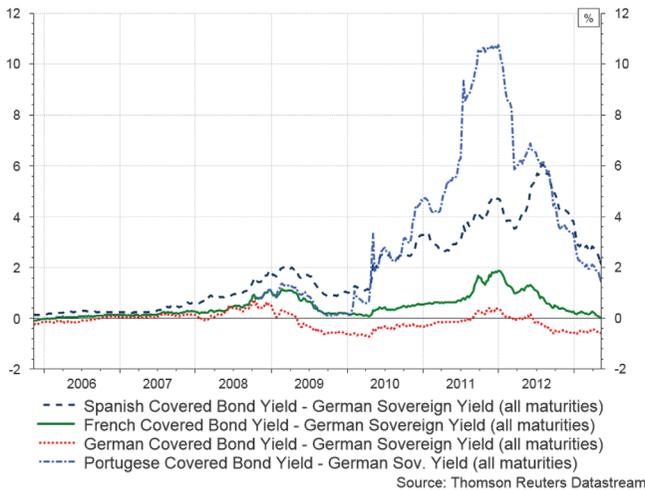
2.2.2 Covered Bond Purchases

Covered bonds are securities issued by credit institutions to assure their medium- and long-term refinancing. They are collateralized by

¹²See Draghi (2012).

¹³See the introductory statement to the ECB press conference, November 3, 2011, available at <http://www.ecb.int/press/pressconf/2011/html/is111103.en.html>.

Figure 4. Covered Bond Spreads in the Euro-Zone Countries



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 covered bonds were 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 August 2007, this market dried up after Lehman Brothers collapsed in September 2008, as investors turned to government bonds and other less risky assets (figure 4). To prevent a credit crunch, the ECB announced on May 7, 2009 that it would purchase €60 billion of euro-denominated covered bonds issued in the euro zone. 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.¹⁴ The objectives of the Covered Bond Purchase Programme (CBPP1) were the following: promoting the ongoing

¹⁴From "Trichet Drags ECB Into New Era Over Weber's Bond Objections," Bloomberg, May 7, 2009.

decline in money-market term rates; easing funding conditions for credit institutions and enterprises; encouraging credit institutions to maintain and expand their lending to clients; and 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 (CBPP2) of €40 billion 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's 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 euro zone, the effect of an event should be reflected in asset prices over a short period of time.

One should note, however, that while the event-based regressions allow measuring the impact of the ECB measures on announcement days, they do not indicate whether these effects were persistent. Wright (2012) employs the VAR methodology and shows that the effects of the quantitative easing (QE) implemented by the Federal Reserve wear off over the next few months. There are several possible reasons for this yield behavior. First, QE might have triggered higher growth and inflation expectations that would finally increase rates. Second, and more relevant in the euro zone, the initial effect of the announcement could be offset if the markets subsequently learn that the measure may not be fully implemented. For instance, it is plausible that the support of the German chancellor for the OMT increased the credibility of the announcement, while the public objections of Axel Weber to the SMP contributed to the revision

of the markets' initial assessment of the measure.¹⁵ Other factors, such as subsequent news about deficit, fiscal consolidation, euro-zone bailout facilities, or banking union agreements, can contribute to the reversal or reinforcement of the ECB measures.¹⁶ Even though the evaluation of the long-term effectiveness of the ECB measures cannot be accomplished with the event-based methodology, we believe that their short-term impact on financial markets is still important. During the crisis, even temporary relief to bank and government funding markets was crucial for the euro-zone financial stability.

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)
 - Three-year LTROs: announcement (three-year LTRO)
 - Three-year LTROs: operation dates (three-year LTRO op.)
 - 0 percent 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)

¹⁵From "Doubts on ECB Bond Buying," *Financial Times*, June 8, 2010: "The effectiveness of the bond purchasing programme has certainly been undermined by comments from Axel Weber, Germany's Bundesbank president, who has called for a tight limit on the amount of bonds to be bought."

¹⁶From "Burden Switches to EU Politicians," *Financial Times*, September 7, 2012 (after the OMT announcement): "The stunning two-day rally in euro-zone debt markets after Thursday's European Central Bank decision to overhaul and restart its sovereign bond buying plan is not the first time traders have cheered what appeared to be decisive action by European Union policymakers. In the past, however, that optimism has often been followed by sharp sell-offs triggered by rating downgrades, bungled communication or leaders failing to follow through on the policies they had promised."

In the empirical section we estimate the following regressions:

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

where the dependent variable is the money-market spread, ΔS_t^M (section 4.1); covered bond spread, ΔS_t^C (section 4.2); and sovereign bond spread, ΔS_t^S (section 4.3). $NC_{i,t}$ are dummies for unconventional monetary policy announcements; F_t is a dummy for the European rescue funding program announcements (EFSF and ESM); C_t is a dummy for the sovereign debt crisis; $\Delta S_{t-n}^{M,C,S}$ are lagged values of dependent variable included to correct for the autocorrelations of the residuals ($n = 3$ for all money-market spreads except the Euribor-repo spread, for which $n = 4$; $n = 1$ for covered bond and sovereign spreads); D_t are dummies for the working day of the week (Monday, Tuesday ...); and ε_t is a stochastic error term.

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.¹⁷ We define unexpected announcements based on the qualitative content of the news flow

¹⁷As a robustness check, we tested the impact of smaller supplementary liquidity announcements but did not find any significant effect. We explain this issue in the next section.

in the financial press that followed and preceded each measure. It is worth noting that the majority of the measures considered were announced on unscheduled ECB Governing Council meetings, rendering the anticipation of the measure unlikely. Moreover, the unconventional toolbox being quite large, the exact choice of the measure was more difficult to anticipate. Yet, some of the measures were partly anticipated, which is the case of the three-year LTROs and OMT. We decided to include them in the analysis given their novelty. The strong reaction of the interbank market in the case of the three-year LTROs and of the covered and sovereign bond markets in the case of OMT confirms that these events still incorporated some elements of surprise.¹⁸ In the case of leakage before the announcement, our findings constitute a lower bound for the effectiveness of the ECB measures.

The 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 in regression in order to separate their effects. We use the 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 May 8–9, 2010 when several monetary measures were decided and, in particular, the SMP was created. In parallel, the euro-zone 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 announcements concerning the EFSF and the ESM developments as well as the

¹⁸Even though some market participants evoke the possibility of an unconventional measure announcement, the remaining uncertainty does not allow a full pricing of the event until the actual announcement takes place.

¹⁹Factiva 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).

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 euro-zone countries were the highest.²¹ Additionally, in case the ECB announcements and the spreads react to unobserved news, we control for this factor by including the VIX volatility index.

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 mainly a 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's change in spreads. These measures are often politically contested and involve a long decision process.

4. Results

4.1 Money Market

Since August 2007 the spreads between unsecured and secured rates on the interbank market increased to previously unseen levels (figure 2). The ECB was determined to support money-market activity, as interbank lending is a key element of the successful monetary transmission. The three-year LTROs, FRFA procedure, covered bond purchase programs, and setting the deposit rate to zero favored interbank lending by reducing funding constraints and increasing the cost of liquidity holding. Sovereign bond purchase programs could also have a positive 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 equation (1), where the dependent variable ΔS_t^M is a two-day change in three-month

²⁰We 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.

²¹A detailed description of all dummies used in the regressions can be found in table 5 in the appendix.

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) the Euribor-OIS spread,²² (ii) the Euribor-repo spread,²³ (iii) the Euribor-German Treasury bill spread, and (iv) the certificate of deposit (CD)-OIS spread.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 the Euribor rate that make it less sensitive to manipulation than LIBOR. First, forty-three banks contribute to Euribor, as opposed to fifteen 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 a crisis, the contributing banks are more inclined to diminish the latter, as high borrowing rates send a negative signal about their financial standing.

There is also a timing issue related to the Euribor-OIS spread. The 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 the Euribor rate. In order to ensure that the markets had the possibility to react to all announcements, we consider a two-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 0 percent and announcing three-year LTROs diminished money-market spreads

²²The 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 index 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.

²³The repo rate is the rate at which, at 11:00 a.m. Brussels time, one bank offers (in the euro zone and worldwide) funds in euros to another bank if, in exchange, the former receives from the latter the best collateral within the most actively traded European repo market.

²⁴A certificate of deposit is a debt instrument issued by banks and other financial institutions.

Table 1. Impact of the ECB's Unconventional Monetary Policies on the Money Market

This table presents regression results for the euro-zone money market: $\Delta S_t^M = \alpha + \sum_{i=1}^7 \beta_i N C_{i,t} + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^4 \gamma_n \Delta S_{t-n}^M + \sum_{l=1}^4 \theta_l D_t + \varepsilon_t$. Dependent variables are two-day changes in money-market spreads: Euribor-OIS (three-month Euribor rate minus three-month overnight index swap rate), Euribor-repo (three-month Euribor rate minus three-month repo rate), Euribor-Bubill (three-month Euribor rate minus three-month German Treasury bill), and CD-OIS (three-month certificate of deposit rate minus three-month overnight index swap rate). Independent variables are dummy variables: EFSF/ESM = 1 when important developments about the EFSF and the ESM are announced (May 10, 2010; March 14, 2011; March 26, 2012; June 29, 2012); SMP = 1 when longer-term sovereign bond purchases are announced (May 10, 2010; March 14, 2011; OMT = 1 when short-term sovereign bond purchases are announced (September 6, 2012); CBPP1 and CBPP2 = 1 on May 7, 2009 and October 6, 2011; three-year LTRO announcement = 1 on December 8, 2011; three-year LTRO operations = 1 on December 21, 2011 and February 29, 2012; FRFA = 1 on October 9, 2008; October 13, 2008; October 15, 2008; and May 10, 2010; 0% deposit rate at the ECB = 1 on July 5, 2012. Long-term coefficients are reported: $\text{coeff}/(1 - \sum_{n=1}^4 \gamma_n)$. 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 [0.55]	0.00 [0.30]	0.00 [0.61]	0.00 [0.41]
EFSF/ESM	0.02 [0.28]	0.02 [0.15]	0.02 [0.64]	-0.01 [0.89]
SMP	0.27 [0.31]	0.03 [0.89]	-0.27 [0.19]	0.07 [0.62]
OMT	-0.02*** [0.00]	-0.02*** [0.00]	-0.01* [0.08]	
CBPP1 and CBPP2	-0.07*** [0.00]	-0.12 [0.42]	-0.06*** [0.00]	-0.04 [0.14]
Three-Year LTRO Announcement	-0.22*** [0.00]	-0.14*** [0.00]	-0.06*** [0.00]	
Three-Year LTRO Operations	-0.06*** [0.03]	-0.05*** [0.03]	-0.03*** [0.00]	-0.12*** [0.00]
FRFA	-0.32 [0.24]	-0.03 [0.89]	0.22 [0.26]	-0.04 [0.79]
0% Deposit Rate at the ECB	-0.24*** [0.00]	-0.10*** [0.00]	-0.14*** [0.00]	
Observations	1,365	1,364	1,278	1,187
R-squared	0.48	0.61	0.33	0.21

Notes: Robust p-values are in brackets. *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

the most significantly. The Euribor-OIS spread fell by 24 basis points after the ECB decided to lower its deposit rate to 0 percent, while the Euribor-repo and Euribor-German Treasury bill spreads fell by, respectively, 10 and 14 basis points.²⁵ The announcement of three-year LTROs reduced the Euribor-OIS spread by 22 basis points, the Euribor-repo spread by 14 basis points, and the Euribor-German Treasury bill spread by 6 basis points. Interestingly, the spreads fell also on the days of the three-year LTROs, even though market participants knew the operation dates in advance. The effect of operations was smaller and less significant than the announcement effect for the Euribor spreads (3 to 6 basis points) but reached 12 basis points for the CD-OIS spread. The FRFA procedure, on the other hand, did not reduce the spreads. These results confirm that three-year operations were indeed exceptional measures and incomparable to other liquidity facilities which were found ineffective in reducing money-market tensions. In particular, Angelini, Nobili, and Picillo (2011) find that liquidity risk was not the most important determinant of the spreads and therefore liquidity measures, such as LTROs up to one year, were not able to affect them.²⁶ Our results show that in the presence of high credit risk, stronger ECB measures such as three-year LTROs, cutting the deposit rate to 0 percent, or bank debt asset purchases can lower the spreads.

We find that bank covered bond purchases (CBPP1 and CBPP2) also diminished the spreads, but the magnitude of the results is

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

²⁶This result might be also explained by the “crowding-out” effect of the ECB liquidity interventions as shown in Brunetti, di Filippo, and Harris (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 LTROs up to one year and—like Angelini, Nobili, and Picillo (2011) and Brunetti, di Filippo, and Harris (2011)—found no significant impact of these announcements, while other results remained valid.

smaller. The significant effects range from 6 to 7 basis points for the Euribor-OIS and Euribor-German Treasury bill spreads. On the other hand, sovereign bond purchases had either a 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 the 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.²⁸ In general, adding financial variables that determine spreads in normal times, such as the VIX, weakens slightly the impact of unconventional monetary policies, as these policies also have an impact on the VIX. Given the robustness of the results under both specifications, we decided to use as a benchmark the regression without the VIX.

4.2 Covered Bond Market

While the money market provides banks with short-term funding, the 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 4). Covered bond purchase programs were the main unconventional policy designed to reduce the covered bond spreads. However, other ECB unconventional measures could also reduce the cost of refinancing on this market. First, three-year LTROs and the FRFA procedure were 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 homogeneous credit conditions across the euro-area member countries. Therefore, the effectiveness of the ECB measures is reflected not only by the overall euro-zone spread decrease but also by the particular

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

²⁸The results with the VIX variable are available upon request.

impact in the periphery euro-zone countries. This is why we test the impact of the ECB policies not only on the synthetic euro-zone spread but also on the individual spreads in the core and periphery euro-zone countries.

We measure the impact of the ECB's unconventional monetary policies on covered bond spreads by estimating equation (1), where the dependent variable ΔS_t^C is a one-day change in covered bond spread in the euro zone and in its member countries: France, Germany, Ireland, Italy, Portugal, and Spain.²⁹ The spreads are calculated as the difference between covered bond yields in each country with respect to the 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 bond indexes seem appropriate, as the ECB bought covered bonds of different maturities.³⁰

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

It is interesting to note that sovereign bond purchases have a 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 the 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 euro-zone countries (Germany, −10 bp; France, −7 bp). The second sovereign bond purchasing

²⁹Datastream does not provide the iBoxx covered bond rates for Greece.

³⁰CBPP1: 3–10 years, with strong focus on maturities up to 7 years; CBPP2: Up to 10.5 years residual maturity, according to the ECB website.

Table 2. Impact of the ECB's Unconventional Monetary Policies on the Covered Bond Market

This table presents regression results for the euro-zone covered bond market: $\Delta SC_t = \alpha + \sum_{i=1}^7 \beta_i NC_{i,t} + \varphi_1 Ft + \varphi_2 Ct + \gamma_n \Delta SC_{t-1} + \sum_{l=1}^4 \theta_l D_l + \varepsilon_t$. Dependent variables are one-day changes in covered bond spreads in the euro zone and its member countries: France, Germany, Ireland, Italy, Portugal, and Spain. The spreads are calculated as the difference between all-maturities covered bond yields for each country with respect to the corresponding German sovereign bond yield. Independent variables are dummy variables: EFSF/ESM = 1 when important developments about the EFSF and ESM are announced (May 10, 2010; March 14, 2011; March 26, 2012; and June 29, 2012); SMP = 1 when longer-term sovereign bond purchases are announced (May 10, 2010; OMT = 1 when short-term sovereign bond purchases are announced (September 6, 2012); CBPP1 and CBPP2 = 1 on May 7, 2009 and October 6, 2011; three-year LTRO announcement = 1 on December 8, 2011; three-year LTRO operations = 1 on December 21, 2011 and February 29, 2012; FRFA = 1 on October 9, 2008; October 13, 2008; October 15, 2008; and May 10, 2010; 0% deposit rate at the ECB = 1 on July 5, 2012. Long-term coefficients are reported: $\text{coeff}/(1 - \gamma)$. Constant, day dummies, and lags of dependent variables are included but not reported.

	Euro Zone	France	Germany	Ireland	Italy	Portugal	Spain
Sov. Crisis	0.01*** [0.00]	0.01*** [0.00]	0.00** [0.04]	0.01*** [0.00]	0.02*** [0.00]	0.04*** [0.00]	0.02*** [0.00]
EFSF/ESM	-0.04*** [0.00]	-0.02*** [0.00]	-0.03*** [0.00]	-0.06*** [0.00]	-0.06*** [0.00]	-0.12* [0.07]	-0.08*** [0.00]
SMP	-0.19*** [0.00]	-0.07*** [0.01]	-0.10*** [0.01]	-0.46*** [0.00]	-0.31*** [0.00]	-1.63*** [0.00]	-0.34*** [0.00]
OMT	-0.06*** [0.00]	-0.04*** [0.00]	-0.05*** [0.00]	-0.10*** [0.00]	-0.11*** [0.00]	-0.49*** [0.00]	-0.12*** [0.00]
CBPP1 and CBPP2	-0.04*** [0.00]	-0.04*** [0.00]	-0.05*** [0.02]	0.04 [0.57]	-0.10*** [0.00]	-0.09 [0.26]	-0.06*** [0.00]
Three-Year LTRO An.	-0.04*** [0.00]	-0.05*** [0.00]	-0.02*** [0.00]	-0.05*** [0.00]	-0.03*** [0.00]	0.03 [0.78]	-0.03*** [0.00]
Three-Year LTRO Op.	-0.01 [0.34]	-0.01 [0.20]	-0.01 [0.77]	-0.01 [0.68]	-0.04 [0.17]	0.00 [0.97]	-0.01 [0.31]
FRFA	-0.04 [0.14]	-0.03 [0.22]	-0.03 [0.42]	-0.04 [0.47]	-0.04 [0.01**]	-0.06** [0.03]	-0.06** [0.03]
0% Deposit	-0.00 [0.10]	-0.02*** [0.00]	-0.01*** [0.00]	-0.01 [0.28]	0.01** [0.03]	-0.10 [0.38]	0.07*** [0.00]
Observations	1,368	1,368	1,368	1,368	973	1,018	1,368
R-squared	0.13	0.08	0.06	0.13	0.17	0.27	0.19

Notes: Robust p-values are in brackets. *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

program (OMT) also had the most important effect in the euro-zone periphery. These results suggest that sovereign bond purchases have important effects on longer-term bank debt instruments when sovereign risk is high. By diminishing sovereign risk in periphery countries, these purchases improve the credit standing of the financial institutions and increase the price of their covered bonds. Indeed, banks in these troubled countries hold an important amount of sovereign debt, and their own creditworthiness depends largely on the prices of the sovereign assets. These results indicate 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 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 seems to matter for 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 a smaller extent. As expected, covered bond purchase programs (CBPP1 and CBPP2) diminished covered bond spreads in all countries studied, with the exception of Ireland and Portugal: France (-4 bp), Germany (-5 bp), Italy (-10 bp), and Spain (-6 bp).³¹ These results are not surprising, given that the biggest amounts of CBPP1 were allocated to the central banks of France, Germany, Italy, the Netherlands, and Spain (European Covered Bond Council 2010). Furthermore, Finland and Italy were the main beneficiaries when the ratio of purchased amounts to the size of the outstanding covered bonds eligible under the CBPP1 is taken into account. In contrast to the sovereign bond purchases, however, covered bond purchases had quantitatively similar effects

³¹We tested CBPP1 and CBPP2 separately and they both have a similar impact on covered bond spreads, with the exception of Ireland, for which the first program increased the spreads and the second diminished it. Beirne et al. (2011) also find that CBPP1 did not reduce the Irish covered bond spreads.

in periphery and core euro-zone countries. They were not addressed to reduce the sovereign risk and worked through the more traditional “scarcity channel.”

Three-year LTROs had an impact comparable to that of covered bond purchases. They reduced spreads in France (−5 bp), Germany (−2 bp), Ireland (−5 bp), Italy (−3 bp), and Spain (−3 bp). Three-year LTROs 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. Measures aiming at reducing directly the bank funding cost were also effective, albeit to a smaller extent, in lowering the spreads and had a homogeneous effect across member states.

4.3 Sovereign Bond Market

The sovereign yields in the periphery euro-zone countries increased dramatically with respect to corresponding German yields since the sovereign debt crisis started (figure 3). To ensure the depth and liquidity of these markets, the ECB announced two government bond purchasing programs (SMP and OMT). Moreover, other ECB policies, such as those addressed to banks (three-year LTROs, the 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 bailout by a government. Furthermore, granted with abundant liquidity, banks themselves could purchase sovereign bonds and therefore increase their prices.

We measure the effects of the ECB’s unconventional policies on sovereign spreads in periphery euro-zone countries and in France. Just as in the case of covered bond spreads, the effectiveness of the ECB policies should be reflected by more homogeneous sovereign spreads across the euro zone after the ECB intervention. In other terms, the ECB measures should have a bigger impact on the troubled periphery countries. To this end, we estimate equation (1), where the dependent variable ΔS_t^S is a one-day change in the

ten-year sovereign bond spread. The spread is calculated as the difference between the ten-year sovereign yields in the euro zone or its member countries (France, Greece, Ireland, Italy, Portugal, and Spain) and the ten-year German sovereign yield. The ten-year euro-zone benchmark yield is available from Datastream and represents a weighted average of bond yields from each euro-zone member.³²

Table 3 presents the results for the euro zone, France, Greece, Ireland, Italy, Portugal, and Spain. The most striking result in the euro zone is the impact of the ECB longer-term sovereign bond purchase program (SMP), which reduced the spreads by 16 basis points. The effect is particularly strong for the countries where 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 the French spread does 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.³³

As the euro sovereign debt crisis was about to spread to Italy and Spain, the ECB confirmed its willingness to purchase actively the euro-zone 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 (SMP2) and report the results in table 4. The overall effect on the benchmark euro-zone spread is significant (−26 bp) and, as expected, the biggest impact is observed for Spain (−104 bp) and Italy (−82 bp).

³²The weightings used are the 1996 real GDP as published by Eurostat.

³³From “ECB Keeps Bond-Buying Programme Dormant,” Reuters, August 1, 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.”

Table 3. Impact of the ECB's Unconventional Monetary Policies on the Sovereign Bond Market

This table presents regression results for the euro-zone sovereign bond market: $\Delta S_t^S = \alpha + \sum_{i=1}^9 \beta_i N C_{i,t} + \delta Q_t + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^2 \gamma_n \Delta S_{t-n}^S + \sum_{i=1}^4 \theta_i D_i + \varepsilon_t$. Dependent variables are one-day changes in sovereign bond spreads in the euro-zone member countries. The spreads are calculated as the difference between ten-year sovereign bond yields for each country with respect to the corresponding German sovereign yield. Independent variables are dummy variables: EFSF/ESM = 1 when important developments about the EFSF and the ESM are announced (May 10, 2010; March 14, 2011; March 26, 2012; June 29, 2012); SMP = 1 when longer-term sovereign bond purchases are announced (May 10, 2010); OMT = 1 when short-term sovereign bond purchases are announced (September 6, 2012); CBPP1 and CBPP2 = 1 on May 7, 2009 and June 10, 2011; three-year LTRO announcement = 1 on December 8, 2011; three-year LTRO operations = 1 on December 21, 2011 and February 29, 2012; FRFA = 1 on October 9, 2008; October 13, 2008; October 15, 2008; and May 10, 2010; 0% deposit rate at the ECB = 1 on July 5, 2012. Long-term coefficients are reported: $\text{coeff}/(1 - \sum_{n=1}^2 \gamma_n)$. Constant, day dummies, and lags of dependent variables are included but not reported.

	Euro Zone	France	Greece	Ireland	Italy	Portugal	Spain
Sov. Crisis	0.01** [0.05]	0.00 [0.17]	0.13*** [0.00]	0.02*** [0.01]	0.01** [0.05]	0.02 [0.23]	0.02** [0.01]
EFSF/ESM	-0.13*** [0.00]	-0.07*** [0.00]	-0.25* [0.08]	-0.52*** [0.00]	-0.28** [0.01]	-0.46*** [0.00]	-0.43*** [0.00]
SMP	-0.16*** [0.00]	-0.03 [0.48]	-4.85*** [0.00]	-1.21*** [0.00]	-0.31*** [0.01]	-2.02*** [0.00]	-0.43*** [0.00]
OMT	-0.14*** [0.00]	-0.07* [0.06]	0.05 [0.30]	-0.24* [0.09]	-0.31*** [0.00]	-0.54*** [0.01]	-0.59*** [0.00]
CBPP1 and CBPP2	-0.05*** [0.00]	-0.01 [0.76]	-0.18*** [0.01]	-0.09 [0.39]	-0.16*** [0.00]	-0.08 [0.58]	-0.13* [0.10]
Three-Year LTRO An.	0.18*** [0.00]	0.18*** [0.00]	1.21*** [0.00]	0.05 [0.73]	0.48*** [0.00]	0.09 [0.68]	0.33*** [0.00]
Three-Year LTRO Op.	-0.00 [0.95]	-0.03 [0.24]	-0.04 [0.83]	0.02 [0.82]	-0.01 [0.93]	0.38** [0.01]	0.05 [0.52]
FRFA	-0.02*** [0.01]	-0.02 [0.43]	-0.00 [0.94]	-0.01 [0.95]	-0.04** [0.03]	-0.08 [0.53]	-0.04 [0.57]
0% Deposit	0.11*** [0.00]	0.02 [0.64]	-0.04* [0.06]	0.11 [0.45]	0.29*** [0.00]	0.33 [0.11]	0.52*** [0.00]
Observations	1,368	1,368	1,368	1,368	1,368	1,368	1,368
R-squared	0.13	0.06	0.04	0.19	0.10	0.19	0.18

Notes: Robust p-values are in brackets. *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

Table 4. Impact of the ECB's Unconventional Monetary Policies on the Sovereign Bond Market (with SMP2 and M. Draghi speech)

This table presents regression results for the euro-zone sovereign bond market: $\Delta S_t^S = \alpha + \sum_{i=1}^7 \beta_i N C_{i,t} + \delta Q_t + \varphi_1 F_t + \varphi_2 C_t + \sum_{n=1}^2 \gamma_n \Delta S_{t-n}^S + \sum_{l=1}^4 \theta_l D_t + \varepsilon_t$. Dependent variables are one-day changes in sovereign bond spreads in the euro-zone member countries. The spreads are calculated as the difference between ten-year sovereign bond yields for each country with respect to the corresponding German sovereign yield. Independent variables are dummy variables: EFSF/ESM = 1 when important developments about the EFSF and ESM are announced (May 10, 2010; Mar. 14, 2011; Mar. 26, 2012; June 29, 2012); SMP = 1 when longer-term sovereign bond purchases are announced (May 10, 2010); SMP2 = 1 when SMP is reactivated (Aug. 8, 2011); OMT = 1 when short-term sovereign bond purchases are announced (Sept. 6, 2012); Draghi speech = 1 when M. Draghi gave his "whatever it takes" speech (July 26, 2012); CBPP1 and CBPP2 = 1 on May 7, 2009 and Oct. 6, 2011; 3-yr. LTRO announcement = 1 on Dec. 8, 2011; 3-yr. LTRO operations = 1 on Dec. 21, 2011 and Feb. 29, 2012; FRFA = 1 on Oct. 9, 2008; Oct. 13, 2008; Oct. 15, 2008; and May 10, 2010; 0% deposit rate at the ECB = 1 on July 5, 2012. 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.

	Euro Zone	France	Greece	Ireland	Italy	Portugal	Spain
Sov. Crisis	0.01* [0.06]	0.00 [0.18]	0.13*** [0.00]	0.02*** [0.01]	0.01* [0.07]	0.01 [0.24]	0.01** [0.02]
EFSF/ESM	-0.13*** [0.00]	-0.07*** [0.00]	-0.25* [0.08]	-0.52*** [0.00]	-0.28** [0.01]	-0.46*** [0.00]	-0.42*** [0.00]
SMP	-0.15*** [0.00]	-0.03 [0.48]	-4.85*** [0.00]	-1.22*** [0.00]	-0.30*** [0.01]	-2.03*** [0.00]	-0.42*** [0.00]
SMP2	-0.26*** [0.00]	0.03 [0.37]	0.10 [0.38]	0.18 [0.22]	-0.82*** [0.00]	-0.06 [0.78]	-1.04*** [0.00]
OMT	-0.14*** [0.00]	-0.07* [0.05]	0.05 [0.32]	-0.25* [0.09]	-0.31*** [0.00]	-0.54*** [0.01]	-0.59*** [0.00]
Draghi Speech	-0.19*** [0.00]	-0.12*** [0.00]	-0.56*** [0.00]	-0.10 [0.48]	-0.48*** [0.00]	-0.30 [0.15]	-0.56*** [0.00]
CBPP1 and CBPP2	-0.05*** [0.00]	-0.01 [0.74]	-0.18*** [0.01]	-0.09 [0.39]	-0.16*** [0.00]	-0.08 [0.58]	-0.13* [0.07]
3-Yr. LTRO An.	0.18*** [0.00]	0.18*** [0.00]	1.21*** [0.00]	0.05 [0.73]	0.48*** [0.00]	0.09 [0.69]	0.33*** [0.00]
3-Yr. LTRO Op.	-0.00 [0.94]	-0.03 [0.24]	-0.04 [0.83]	0.02 [0.82]	-0.01 [0.92]	0.38** [0.01]	0.05 [0.52]
FRFA	-0.02*** [0.00]	-0.02 [0.43]	-0.00 [0.93]	-0.01 [0.95]	-0.04* [0.02]	-0.08 [0.53]	-0.04 [0.53]
0% Deposit	0.11*** [0.00]	0.02 [0.64]	-0.04* [0.05]	0.11 [0.46]	0.28*** [0.00]	0.33 [0.11]	0.51*** [0.00]
Observations	1,368	1,368	1,368	1,368	1,368	1,368	1,368
R-squared	0.17	0.07	0.04	0.19	0.16	0.19	0.26

Notes: Robust p-values are in brackets. *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

The second sovereign bond purchase program, OMT, had a similar impact on the benchmark euro-zone 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 the Italian and Portuguese spreads was also significant at 5 percent (respectively, -31 bp and -54 bp), while it was only at 10 percent for the Irish spreads and was not significant for the Greek spread. The French spread reacted only to a small extent (-7 bp, at the 10 percent significance level).

The OMT was announced on September 6, 2012, but some kind of 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 the euro." We include this announcement in our regression and show the results in table 4. The French spread was reduced less (-12 bp) than the Spanish and Italian spreads after this announcement (respectively, -56 bp and -48 bp). The response of the Greek spread was significant and high (-56 bp), contrary to the actual OMT announcement later on. The July 26 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 potential investors on the Greek market.

The strong impact in the periphery euro zone suggests that central bank intervention in the sovereign market is particularly effective when 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 euro zone.

Covered bond purchase programs (CBPP1 and CBPP2) were another measure that reduced the sovereign spreads (-5 bp). This result seems to reveal the second part of the sovereign-bank feedback loop we evoked in the previous section. Reducing bank-funding risk could indeed diminish sovereign risk, as it reduces the probability of future government-led bailout. Table 3 shows that the effect of CBPP1 and CBPP2 is particularly important in periphery euro-zone countries (Greece, -18 bp; Italy, -16 bp; Spain, -13 bp).

The puzzling result, however, is the reaction of the sovereign spreads following the important three-year LTROs announcement.

Contrary to expectations, sovereign spreads rise following this announcement, especially in the Southern European countries (table 3). The reaction of sovereign spreads to the three-year LTROs announcement is opposite to interbank market and covered bond market reactions, which were in line with expectations. This result indicates that three-year LTROs improved significantly market borrowing costs for the euro-zone banks but not governments. Given that three-year loans were granted to banks, this response may seem natural. However, the three-year LTROs announcement significantly *increased* 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 were disappointed that it did not happen.³⁴ 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 euro-zone crisis.

The reaction of the sovereign spreads to cutting the ECB deposit rate to zero seems to confirm that sovereign bond markets in the euro zone 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 percent deposit at ECB in table 3) reduced significantly money-market spreads but increased Italian and Spanish sovereign spreads (+29 bp and +52 bp, respectively). The confirmation of this disappointment can be found in the press on that day.³⁵ The expected announcement came only three weeks later, with Mario Draghi’s “whatever it takes” speech (table 4), and made the Italian and Spanish spreads decrease significantly (−48 bp and −56 bp, respectively).

³⁴See, for instance, “US Stocks Fall as ECB Disappoints on Bond Buying,” *Wall Street Journal*, December 8, 2011, and “ECB Dampens Bond-Buying Hopes,” Reuters, December 8, 2011.

³⁵From “Spanish, Italian Bonds Hammered after Draghi Speech,” Reuters, July 5, 2012: “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,” Agence France-Presse, July 5, 2012: “The European Central Bank cut its key interest rate to a record low but did not unveil anti-crisis measures.”

The 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 was much more difficult for the central bank to steer market expectations.³⁶

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 sovereign risk is an important factor for the unconventional monetary policy implementation. The euro-zone sovereign debt crisis contributed to a dramatic increase in risk premia not only on sovereign debt markets but also on money markets and covered bond markets. The ECB's traditional tool, interest rate 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 euro zone. We find that three-year LTROs and setting the ECB deposit rate to 0 percent, 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. Moreover, the ECB covered bond purchase programs diminished sovereign spreads, suggesting that the sovereign-bank feedback loop might amplify the effectiveness of the ECB's asset purchases in the euro zone.

³⁶ Another example of expectations management difficulty is Ben Bernanke's testimony before Congress on May 22, 2013 that markets interpreted as an announcement of early tapering of unconventional monetary policies. This message led to substantial turmoil in the financial markets despite its moderate character.

Appendix

Table 5. Description of Dummies Used in the Regressions

<i>Unconventional Monetary Policies Dummies</i>	
Asset Purchases:	
SMP	Announcement of the longer-term sovereign bond purchase program (Securities Markets Programme, SMP). The ECB Governing Council decided to launch the SMP in the midst of the Greek crisis on Sunday, May 9, 2010. ^a A related press release was published the next day.
SMP2	Reactivation of SMP announced on Sunday, August 7, 2011, when the Spanish and Italian sovereign bond markets came under tension.
Draghi Speech	M. Draghi's speech of July 26, 2012 in which he promised to do "whatever it takes to save the euro." ^b This speech triggered the expectations of ECB intervention in the sovereign markets.
OMT	Announcement of the ECB short-term sovereign bond purchase program (Outright Monetary Transactions, OMT) on September 6, 2012. No purchases were conducted within this program as of July 2014.
CBPP1 and CBPP2	Announcements of two ECB covered bond purchase programs (CBPP1 and CBPP2) on May 7, 2009, and on October 6, 2011. Both programs were designed to purchase covered bonds, i.e., securities issued by credit institutions backed by mortgages and public-sector debt.
Exceptional Liquidity Provisions:	
Three-Year LTRO An.	Announcement of the three-year longer-term refinancing operations (LTROs) on December 8, 2011. ECB banks were given the opportunity to obtain all liquidity needed for the period of three years at the interest rate fixed at the average rate of the main refinancing operations over the life of the operation.
Three-Year LTRO Op.	Dates of the two three-year LTROs conducted by the ECB. The first three-year LTRO was conducted on December 21, 2011 and the second on February 29, 2012.
FRFA	Announcements of the fixed-rate full-allotment (FRFA) procedure for different open-market operations: main refinancing operations (late on October 8, 2008), U.S. dollar funding (October 13, 2008), and LTROs (October 15, 2008). The reactivation of the FRFA procedure was announced on May 9, 2010.
0% Deposit	Announcement of the reduction to 0 percent of the interest rate on the ECB deposit facility.

(continued)

Table 5. (Continued)

<i>Sovereign-Crisis-Related Dummies</i>	
Sovereign Crisis	<p>The sovereign crisis dummy captures the effects of the sovereign debt crisis in the euro zone. It is equal to 1 when a euro-zone member faces severe debt tensions: January 27, 2010–June 18, 2010; October 15, 2010–December 3, 2012; March 7, 2011–December 23, 2011; March 19, 2012–June 22, 2012. The crisis periods were defined using Google Insights,^b which graphically shows how often the search term “euro-zone sovereign debt crisis” is entered relative to the total search volume across various regions of the world. The horizontal axis of the main graph represents time, and the vertical axis represents how often a term is searched relative to the total number of searches. The results were cross-checked with euro-zone crisis timelines provided by Reuters, the <i>Wall Street Journal</i>, and the <i>Daily Telegraph</i>.</p> <p>Announcements concerning important extensions of two bailout facilities created by the euro-zone member states: the European Financial Stability Fund (EFSF) and the European Stability Mechanism (ESM). The EFSF was created on May 9, 2010 and authorized along with the ESM to intervene in the primary markets for sovereign debt on Saturday, March 12, 2011. On March 26, 2012, A. Merkel agreed to increase the overall ceiling for EFSF/ESM lending to €700 billion, up from €500 billion. On June 29, 2012, the euro-zone leaders allowed the euro zone’s rescue funds to recapitalize Spain’s enfeebled banks directly and to buy Italian sovereign bonds.</p>
EFSF/ESM	

^aWhenever the announcement is made on weekends or after the market closure, we attribute a dummy equal to 1 on the following day.

^bSince the beginning of October 2012, Google Insights no longer exists. Some of its functions are included in Google Trends.

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