Sovereign Risk, European Crisis-Resolution Policies, and Bond Spreads[*]

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We study the effects of a wide range of European crisis-resolution policies, including large-scale asset purchase programs of the ECB, on ten-year sovereign bond spreads of seven European countries. Our results based on daily data on bond spreads suggest that policies that are directly geared towards easing the funding strains of the sovereigns and improving market liquidity have been most effective in calming the European sovereign markets. Quantitatively the largest effects on bond spreads are due to announcements of ECB's SMP program and OMTs. At the same time, announcements of financial assistance programs have typically increased somewhat the perceived riskiness of long-term bonds in the guarantor countries but reduced the bond spreads in the countries receiving funding.

JEL Codes: F34, E42, G15.

1. Introduction

European sovereign crises have led to a number of policy initiatives by the European authorities, including the decision to establish the

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European Stability Mechanism (ESM) as a follow-up to the European Financial Stability Facility (EFSF) and the European Financial Stability Mechanism. A number of important policy measures have also been directed to enforce commitment to common fiscal rules and improve surveillance power of the union over national budgetary policies in order to improve the fiscal discipline and policy coordination within the euro area.

At the same time, the European Central Bank (ECB) has used a series of non-standard policy measures to contain pressure to the financial system. The ECB has provided both short-term and long-term liquidity support to banks, lowered its main policy rate to historically low levels, and set up large-scale asset purchase programs, like in many other central banks, to revive dysfunctional segments of the capital markets. Enhanced liquidity support has included lengthening of the maximum maturity of refinancing operations, extension of the eligible collateral list, provision of liquidity in foreign currencies, and provision of unlimited liquidity at a fixed rate. The ECB's Covered Bond Purchase Program (CBPP) and Securities Market Program (SMP) were set up to purchase private and public bonds from the markets. The aim of these two programs was to support the functioning of a specific financial market segment that was severely affected by the financial crisis. Speculation over a possible breakup of the European Monetary Union intensified in late 2011 and early 2012, culminating in a "whatever-it-takes" speech by ECB President Mario Draghi in July 2012 and the announcement of the ECB's Outright Monetary Transactions (OMTs) in September of the same year. In contrast to the SMP, OMTs would be without an ex ante quantitative limit but would be conditional on participation in the EFSF/ESM program.

In this paper, we study the impact of these euro-wide policy decisions on the long-term sovereign bond yields of seven euro-area countries: Germany, France, Spain, Italy, Portugal, Greece, and Ireland. We study the policy announcement effects with an empirical model, where the explanatory variable is the change in the spread between the ten-year government bond yield and the ten-year euro swap rate. Our daily data runs from January 1, 2007, to September 30, 2013.

In order to estimate reliably the announcement effect, we control for the effect of credit risk, liquidity risk, and the general risk

appetite, as they have been found[1] to be the main risk factors determining the yields of the European sovereign bonds. The policy decisions are added to the model by using dummy variables with a two-day event window (the announcement day and the day after). As a robustness check, we allow for possible rumors to have an effect and use a three-day event window instead. Another robustness analysis relates to the stability of the parameter estimates during the sample period.

Our results suggest that many policy decisions have had significant effects in the European bond market. The announcement of the ECB's SMP and OMTs have had a significant negative effect on yield spreads in all of the seven euro-area countries considered in this study. At the same time, we do not find lasting impact of the liquidity support decisions on yield spreads, and the same applies for the ECB's Covered Bond Purchase Program (CBPP). The latter is understandable, given that the CBPP was directed to support banks' market funding at the early phase of the crisis, when the European sovereign debt markets were still relatively calm.

The financial support packages have typically decreased bond spreads in receiving countries, but these effects are statistically rather weak. At the same time, the financial support programs have had a relatively significant positive effect on bond spreads in the guarantor countries. This may reflect the fact that financial support programs are de facto risk-sharing mechanisms between the euro-area member countries. The decisions regarding the European Financial Stability Facility (EFSF) seem to have decreased the yields, while the decision on the European Economic Recovery Plan (EERP) had a significant increasing effect on the yields of most of the countries, as expected. Other policy decisions, mainly related to the strengthening of the growth and stability pack and to improving the fiscal discipline, have not had a lasting impact on bond spreads. Our data sample also includes the Greek debt restructuring, for which we find a very strong negative effect on yields in Greece. In other

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[1]See, e.g., Arghyrou and Kontonikas (2012), Barbosa and Costa (2010), Barrios et al. (2009), Favero, Pagano, and von Thadden (2010), Fontana and Scheicher (2010), Manganelli and Wolswijk (2009), Pozzi and Woslwijk (2012), and Sgrerri and Zoli (2009).

countries—such as France, Italy, and Ireland—it had a significant positive effect on sovereign spreads.

As for the risk factors, we find that the role of macroeconomic news, which we use to proxy country-specific credit risk, has been relatively unimportant for most of the countries in our study. At the same time, we have found relatively strong evidence that during the crisis (after May 2010), bond spreads became more sensitive to changes in the risk appetite of the markets and to changes in liquidity risk. We also found some evidence of increased interdependency of the bond spreads after May 2010.

Our paper contributes to the literature studying the determination of sovereign yields in Europe, in that it focuses on a wide range of policy and macroeconomic news factors. In contrast to many other papers, we use high-frequency data, which allows us to focus on the announcement effects. Our paper also contributes to the literature on large-scale asset purchases, albeit our focus is limited to the impact of the ECB's asset purchase announcements on sovereign bond prices only. For instance, Krishnamurthy and Vissing-Jorgensen (2011, 2013) find that announcements of U.S. Federal Reserve quantitative easing programs typically have had a negative effect on Treasury yields as well as on corporate bonds and agency mortgage-backed securities (MBS). Rai (2013) has found that the U.S. Federal Reserve's "unconventional" policy initiatives have been effective in reducing market spreads, yet somewhat less so in reducing bond spreads. Most effective have been the policies that broadened the range of collateral eligible for secured funding from the Federal Reserve. At the same time, fiscal policy announcements led, if anything, to increases in spreads. Our results suggest that the announcement of central bank asset purchases directed to the stressed sovereign markets can also have a rather large effect on bond spreads, in line with, e.g., Gagnon et al. (2011), Hamilton and Wu (2012), and Krishnamurthy and Vissing-Jorgensen (2011, 2013) for the United States.

The rest of the paper is organized as follows. The second section summarizes the findings of the literature related to our paper. Our empirical model is presented in the third section, and the estimation results of the empirical model are presented in the fourth section. The fifth and final section concludes our findings.

2.   Determinants of the Sovereign Bond Yields

There exists a vast literature studying the factors that determine the yields of the euro-area sovereign bonds. The earlier literature focused on understanding the convergence in the euro-area sovereign bond yields after introducing the EMU. The more recent literature has been trying to explain the fast divergence of the yields in the same set of sovereign bonds.

   In this section we first take a closer look at the evolution of the euro-area government bond yields. We then provide some theoretical background for the empirical studies explaining the determinants of the sovereign bond yields and finally summarize the main results of the empirical literature.

2.1   Evolution of Euro-Area Government Bond Yields and Policies

After the introduction of the euro, the yields of the euro-area sovereign bonds converged rapidly. At that time, this development was believed to be fairly natural. Given that there was no longer exchange rate and inflation risk, it was quite understandable that the yields were decreasing. Liquidity and credit risk decreased as well, along with the falling cost of public debt. The phase of convergence was followed by a few years of apparent harmony, and the credit market focused more on corporate bonds and other "more exciting" debt instruments.

   The markets turned their focus to the euro-area sovereign debt market again after the collapse of Lehman Brothers in September 2008. Figure 1 presents the evolution of sovereign bond yields for selected euro-area countries. It can be seen that the development during the past five years has been dramatic. It appears that there has been a regime shift in the pricing of the European sovereign bonds.

   When the financial crisis intensified and spread to the real economy, the euro-area governments provided support for the banking sector. Fiscal stimulus measures, such as the European Economic Recovery Plan, were implemented in order to support failing macro-economies. However, the strength of the spillovers from financial markets to the real economy was surprisingly strong, leading to

Figure 1. Yields of the Ten-Year Government Bonds for Selected Euro-Area Countries
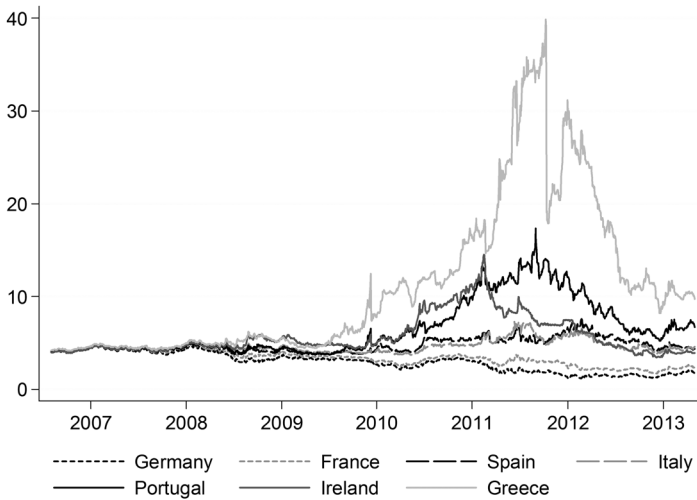
deterioration of macroeconomic fundamentals in many euro-area countries and significant widening of the euro-area bond yields since late 2008.

Long-term interest rates started to rise, especially in those countries that had accumulated deficits during the tranquil times or otherwise had a banking sector that was particularly vulnerable to international financial crises. The crisis hit especially hard in Greece, where debt markets have been under severe stress since mid-2010. Later on, the debt crisis started to spread also to other financially vulnerable euro-area countries with well-known consequences. Greece, Ireland, Portugal, and most recently Cyprus were driven out from the markets and received funding from the European crisis-resolution mechanisms and the International Monetary Fund (IMF). In connection with widening spreads, the large euro-area countries Spain and Italy also suffered from deteriorating market sentiment driving up the yields and hampering their ability to roll over debt and finance their deficits at sustainable rates. Sovereign debt crises also spread to the banking system, causing interbank markets to dry up, and revealed the vulnerability of the European banking system to the sovereign risk.

Euro-area sovereign crises have led to a number of policy actions and initiatives by the European fiscal authorities, including the decision to establish the European Stability Mechanism as a follow-up to the European Financial Stability Facility and the European Financial Stability Mechanism. These crisis-resolution mechanisms were created in order to provide financing to troubled euro-area sovereigns that faced financing difficulties. Financing from these mechanisms would be conditional on macroeconomic adjustment programs, in line with the IMF practice.

A number of important policy initiatives have also been directed to improve the fiscal discipline within the euro area. For example, Europe has agreed on the so-called fiscal compact which will strengthen coordination of fiscal and economic policy; the European semester enables the European Commission to view member states' budgetary and structural policies before their implementation; and the Macroeconomic Imbalances Procedure aims at detecting excessive macroeconomic imbalances. From the institutional perspective, all these policies have a common goal of enforcing commitment to common rules and improving surveillance power in economic and financial matters by the union. The fiscal compact aims to bring the balanced budget rules to Europe in the same way as in the United States, where many states and local communities are subject to balanced budget rules.

At the same time, the ECB has used a series of non-standard policy measures to contain pressure to the financial system by providing both short-term and long-term liquidity support and has lowered its main policy rate to historically low levels. Enhanced credit support measures have included lengthening of the maximum maturity of refinancing operations, extension of the eligible collateral list, provision of liquidity in foreign currencies, and provision of unlimited liquidity at a fixed rate. The ECB has also acquired private and public bonds within its Covered Bond Purchase Program and Securities Market Program, which were tailored to support the liquidity of the money market and the transmission of monetary policy. As the speculation over the future of the European monetary union intensified in late 2011 and early 2012, ECB President Mario Draghi gave his "whatever-it-takes" speech in July 2012, followed by the announcement of the ECB's Outright Monetary Transactions in September of the same year.

But have these policy initiatives been effective? One way to look at it is to analyze the impact of the different policy announcements on sovereign bond yields. However, in order to estimate reliably the policy announcement effects, the proper choice of conditioning variables is important.

2.2   Theoretical Background

The empirical studies explaining the determinants of the sovereign bond yields often rely (loosely) on the structural model of Merton (1974). The key idea behind Merton's model is that a risky zero-coupon bond has the same payoff structure as a risk-free bond plus a put option on the firm's value, with a strike price equal to the face value of the firm's debt. Therefore, the value of the put option is the cost of eliminating the credit risk, and the default-risky bonds can hence be priced by using standard option pricing theory such as the Black-Scholes equation.

The model is relying on an assumption that the firm's default is triggered when the firm value falls below some threshold and that this threshold is a function of the amount of debt that the firm has. This relates the corporate credit risk to its fundamentals such as leverage ratio and the volatility of the firm value. The third factor that determines the price of a default-risky bond in the Merton model is the risk-free interest rate.

The original Merton model has been extended in various ways. The extension that is the most relevant to us is the one by Gapen et al. (2008). While the original Merton model considers the corporate bonds, Gapen et al. (2008) extend the model for the default-risky sovereign bonds. Gapen et al. (2008) state that the main factors underlying sovereign credit risk are the volatility of sovereign assets and a country's leverage.

Even though the Merton model has had an influence on some of the empirical studies on yield determination, most of the papers are purely empirical.[2] There exists ample empirical evidence, discussed in more detail in section 2.3, which suggests that besides the

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[2]In their recent paper, Arghyrou and Tsoukalas (2011) find the lack of theoretical background troublesome and propose a new theoretical framework for the European debt crisis. The key idea in their model is that in the currency union the systemic macroeconomic risks cannot be solved by currency adjustments,

credit risk, sovereign yields are affected by liquidity risk, by general risk appetite, and perhaps by the interaction of these three factors.

2.3   Empirical Evidence on Yield Determination

The empirical evidence on the determinants of the European sovereign bond yields is extensive yet mixed. Different factors have been found to be relevant depending on the set of countries under study, time period, data frequency, estimation methodology, or proxies for the different risk factors. One thing that almost all studies seem to agree upon, however, is that there exists a common risk factor that reflects investors' changing attitudes towards risk (Arghyrou and Kontonikas 2012; Barrios et al. 2009; Favero, Pagano, and von Thadden 2010; Manganelli and Wolswijk 2009; Pozzi and Woslwijk 2012; Sgherri and Zoli 2009). The rationale behind these findings is that higher uncertainty increases investors' risk aversion and this causes them to restructure their portfolios. Typically this is done in favor of bonds with safe-haven status, and hence the yields of the bonds with higher default risk increase.

Even though it is widely agreed that such a factor of general risk attitude or appetite exists, there is still an ongoing debate on how to measure this factor and what are the underlying causes of the changes in investors' risk aversion. Manganelli and Wolswijk (2009) suggest that the ECB policy rate is the key issue driving aggregate risk perception. Others concentrate less on the causes of uncertainty and settle for measuring risk attitude with some financial market variables that describe uncertainty in the global financial markets, such as the S&P 500 implied volatility index, i.e., VIX[3] (Arghyrou and Kontonikas 2012; Beber, Brandt, and Kavajecz 2009; Borgy et al. 2011; Gerlach, Schulz, and Wolff 2010) or the spread between the yields of U.S. corporate bonds

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but are instead diverted to the sovereign debt market and hence cause increasing default risk.

[3]The Chicago Board Options Exchange Volatility Index, i.e., VIX is constructed by using the implied volatility of the S&P 500 index options with different strikes. It reflects the expected movement in the S&P 500 index over the next thirty-day period and is hence typically used as an index of market sentiment or fear.

against U.S. Treasury bills (Attinasi, Checcherita, and Nickel 2009; Favero, Pagano, and von Thadden 2010; Haugh, Ollivaud, and Turner 2009).

Besides the common market risk factors, the models of yield determination also include country-specific risk factors. The most important of those is the sovereign credit risk. Most of the existing studies have used data sets with low frequency (monthly or quarterly). This has some advantages, such as being able to use the macroeconomic statistics (e.g., debt-to-GDP ratio, budget-deficit-to-GDP ratio, debt service ratio, and current account balance or expected fiscal positions by using forecasts on those same variables) that are released only rarely to describe the fiscal position and hence proxy the credit risk of the country (Aßmann and Boysen-Hogrefe 2012; Arghyrou and Kontonikas 2012; Attinasi, Checcherita, and Nickel 2009; Barrios et al. 2009; Haugh, Ollivaud, and Turner 2009). Some papers have also used a country's credit rating as a proxy for credit risk (e.g., Manganelli and Wolswijk 2009). The studies that use higher-frequency data typically use other measures for credit risk, such as credit default swap (CDS) premia[4] (Arghyrou and Kontonikas 2012; Barrios et al. 2009; Beber, Brandt, and Kavajecz 2009), because the variables that change as infrequently as once in a month or quarter would probably not have an effect on noisy daily yields.

The empirical evidence on the relevance of the fiscal imbalances is mixed. However, an increasingly common finding in the literature is that expected fiscal deficits have an effect on long-term government bond yields (Arghyrou and Kontonikas 2012; Attinasi, Checcherita, and Nickel 2009; Barbosa and Costa 2010; Gerlach, Schulz, and Wolff 2010; Sgherri and Zoli 2009). A good summary of the findings of this literature is provided by Haugh, Ollivaud, and Turner (2009). The impact of CDS premia on bond yields has been found to be positive. However, their use is somewhat problematic because of the potential endogeneity problems. Being a tradable instrument in the same

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[4]A credit default swap is an agreement between two parties in which one can buy "insurance" against a potential default of a bond. The buyer of the CDS makes a series of payments (i.e., premia) to the seller, and in case of default the seller will compensate the buyer for the losses incurred in the underlying bond contract.

markets, prices of credit default swaps are likely to be determined by the same factors as the bonds themselves.[5]

Another potential risk factor explaining the yield differentials is the liquidity risk. If the bond markets are large and deep, investors are able to find counterparties more easily and execute trades when they choose. In liquid markets it is also less likely that prices will change due to individual transactions. Due to these reasons, an investor will require a smaller premium in terms of the yield. Therefore, the liquidity risk premium measures the extra interest rate component an investor requires for bearing the liquidity risk.

Liquidity is typically considered hard to measure. The used proxies have been, e.g., bid-ask spreads (Aßmann and Boysen-Hogrefe 2012; Fontana and Scheicher 2010; Gómez-Puig 2009) or the size of the government bond markets (Arghyrou and Kontonikas 2012; Attinasi, Checherita, and Nickel 2009; Bernoth, von Hagen, and Schuknecht 2012; Gómez-Puig 2009; Haugh, Ollivaud, and Turner 2009), or some other measures such as the yield spread between bonds issued by KfW and German government bonds, used by Schwarz (2010).

The findings on the role of the liquidity risk seem to be mixed. Some find liquidity risk to be an important factor for yield determination (Arghyrou and Kontonikas 2012; Attinasi, Checherita, and Nickel 2009; Barrios et al. 2009; Favero, Pagano, and von Thadden 2010; Gerlach, Schulz, and Wolff 2010; Gómez-Puig 2009; Manganelli and Wolswijk 2009; Schwarz 2010; Sgherri and Zoli 2009), whereas sometimes it has not been found to have a significant impact on yields (Bernoth and Erdogan 2012; von Hagen, Schuknecht, and Wolswijk 2011).

Other variables that have been included in the models of yield determination are, e.g., the risk-free interest rate (e.g., Fontana and Scheicher 2010; Oliveira, Curto, and Nunes 2012), local stock market indices (e.g., Oliveira, Curto, and Nunes 2012), volatility of the local asset markets (e.g., Barrios et al. 2009; Fontana and Scheicher 2010, Oliveira, Curto, and Nunes 2012), foreign exchange market

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[5]Bond spreads and CDS premia have been found to move in tandem in the long run, yet there is some evidence that the CDS market tends to move ahead of the bond market in pricing adjustment, meaning that past values of CDS premia help to forecast bond yield spreads (see, e.g., Palladini and Portes 2011).

volatility (e.g., Barrios et al. 2009; Fontana and Scheicher 2010), and term structure variables (Fontana and Scheicher 2010; Oliveira, Curto, and Nunes 2012). None of these variables has gained a status of belonging to the set of "core risk factors" that includes the three variables mentioned above.

One reason that could explain the mixed empirical findings is that the relevance of the different risk factors changes over time, as suggested by, e.g., Aßmann and Boysen-Hogrefe (2012), Arghyrou and Kontonikas (2012), Barrios et al. (2009), Oliveira, Curto, and Nunes (2012), and many others. It might not be very surprising that the risk factors would have changed between the pre-EMU, pre-crisis, and crisis periods, but it has also been suggested that there have been two or three regime shifts during the financial crisis (Barbosa and Costa 2010; Caceres, Guzzo, and Segoviano 2010).

Many studies (e.g., Arghyrou and Kontonikas 2012; Bernoth, von Hagen, and Schuknecht 2010) confirm that the markets have been penalizing bad fiscal positions more during the financial crisis. Also, the required liquidity risk premium has been found to be higher during the crisis (Aßmann and Boysen-Hogrefe 2012). The relevance of the global investors' risk aversion has also increased during the crisis (Arghyrou and Kontonikas 2012; Barrios et al. 2009; Bernoth, von Hagen, and Schuknecht 2010; Haugh, Ollivaud, and Turner 2009; Sgherri and Zoli 2009) and the market has also priced the interaction between risk aversion and credit and liquidity risks (Manganelli and Wolswijk 2009; von Hagen, Schuknecht, and Wolswijk 2011).

Contagion in the euro-area sovereign markets has been studied, e.g., by Arghyrou and Kontonikas (2012), Caceres, Guzzo, and Segoviano (2010), and Claeys and Vašíček (2012). Arghyrou and Kontonikas (2012) use monthly ten-year bond data for ten euro-area countries covering the period from January 1999 to February 2010 and find that many EMU countries, especially Portugal, Ireland, and Spain, have experienced contagion from Greece. Claeys and Vašíček (2012) also find significant spillover effects in these countries. According to Caceres, Guzzo, and Segoviano (2010), after September 2008, risk of contagion was also an important factor in pricing the euro-area sovereign bonds.

Of the number of papers examining the yield determination during the financial crisis, the paper that comes closest to ours is that of Attinasi, Checherita, and Nickel (2009). They study the

determinants of the sovereign bond yields in ten euro-area countries during the period from July 31, 2007, to March 25, 2009. Besides studying the risk factors, they examine the announcements of the government rescue packages for banks. They find that the announcements of the rescue packages have caused repricing of the sovereign risk, but the actual amount of the package has not had a significant effect on government bond yields. Therefore, the results of Attinasi, Checherita, and Nickel (2009) suggest that the stress in the national banking sector was transferred to the public sector through governments' rescue packages.

Instead of using announcements on banking rescue packages, this paper contributes to the literature by studying the impact of the announcements on various political decisions made in Europe during the financial and sovereign debt crises. To the best of our knowledge, the effect of a wide range of policy decisions on euro-area sovereign yields has not been studied before, yet such studies have been conducted with the U.S. data.[6] Our paper differs from others also by data frequency. In order to be able to capture the policy impact from other factors in the bond markets, we need to use daily data. Other papers typically concentrate on lower-frequency dynamics (weekly, monthly, or quarterly) of the sovereign bond markets. Our empirical model on yield determination and policy effects is explained more carefully in the next section.

3.   Empirical Model on Yield Spreads

This section presents the empirical model used for studying the determinants of the yield spreads on the European sovereign bonds. We first describe the financial market data set, then the policy decisions of interest, and finally the econometric model to be estimated.

3.1   Financial Market and Macroeconomic Data

Our data set of dependent variables includes daily yield spreads between the benchmark ten-year government bond[7] and the ten-year

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[6]Eser and Schwaab (2013) focus only on the effects of the ECB's SMP program on yield changes and find relatively large and significant announcement effects.

[7]All the data were obtained from Thomson-Reuters and Bloomberg.

euro swap rate from January 1, 2007, to September 30, 2013 for the following countries: Germany (DE), France (FR), Spain (ES), Italy (IT), Portugal (PT), Ireland (IE), and Greece (GR).[8] The dependent variable is henceforth denoted as $y_{i,t}$ for the country i, where $i = \{DE, FR, ES, IT, PT, IE, GR\}$ and day t. The group of countries was selected such that it includes both countries in stress and those that are healthier. The selected countries also vary in terms of the size of the economy.

The ten-year bond maturity was chosen because it has been the most common horizon used in the similar literature; also, the markets for ten-year bonds are relatively active. The euro swap rate (e.g., Beber, Brandt, and Kavajecz 2009) and German government bond yield (e.g., Arghyrou and Kontonikas 2012; Haugh, Ollivaud, and Turner 2009) have both been used as a measure for the risk-free interest rate in the literature. From these two we chose to use the first one, because the euro swap rate has some advantages compared with use of the German bund yield. First, it allows for adding Germany in the analysis and second, according to, e.g., Beber, Brandt, and Kavajecz (2009), it is commonly seen as the preferred measure of a risk-free rate by market participants.

As discussed in sub-section 2.3, there exists wide empirical evidence that the sovereign bond yields are determined by three main risk factors: credit risk, liquidity risk, and general risk appetite. Following the literature, we attempt to capture these risk factors by using their relevant proxies as explanatory variables in our regression.

We proxy a country's credit risk by a set of macroeconomic indicators, including different measures of the country's fiscal and economic stance—such as budget balance, current account balance, GDP, and unemployment—as well as confidence indicators, such as consumer and business confidence.[9]

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[8]Due to lack of data on some explanatory variables, the dates are not exactly these for all countries.

[9]In the high-frequency analysis such as ours, the country credit risk has been typically measured with CDS premia (e.g., Arghyrou and Kontonikas 2012, Barrios et al. 2009, and Beber, Brandt, and Kavajecz 2009). However, as discussed in sub-section 2.3, the use of CDS premia might introduce some endogeneity problems in the estimation. This was, in fact, the case in our model, and hence we decided not to measure credit risk with CDS premia.

However, instead of using macroeconomic variables that change only once per month or quarter as a regressor for daily bond spread, we incorporate the macroeconomic variables in the form of news announcements.[10] Our macroeconomic news data set includes the scheduled releases of the selected macroeconomic indicators published in the Bloomberg World Economic Calendar. Besides the released figure of a macro indicator k (denoted as $A_{t,i,k}$), the data also comprises the market forecast for each released figure, denoted as $F_{t,i,k}$. The market forecast is the median of all the individual survey forecasts that Bloomberg collects from the market agents before the announcement. The available macroeconomic variables differ between countries somewhat, and the selected indicators for each country are presented in table 5 in appendix 1.

Naturally, the market should only react to new information and, hence, only part of the announced macroeconomic figure that surprises the market—i.e., news—should affect the bond spreads. Following the literature, news is defined as standardized surprise $S_{t,i,k} = (A_{t,i,k} - F_{t,i,k})/\hat{\sigma}_{k,i}$, where $\hat{\sigma}_{k,i}$ is the standard deviation of the surprises $(A_{t,i,k} - F_{t,i,k})$ of macroeconomic indicator k estimated from the entire sample period for country i. We combine the news of different indicators in the single variable $MNEWS_{t,i}$ for each country separately. This variable takes a non-zero value on those days t when there is a news announcement.[11]

The second country-specific risk factor, liquidity risk, is measured by the bid-ask spread[12] of the ten-year bond yield, henceforth denoted as $BAS_{t,i}$. As for the general risk aversion, we use the VIX (VIX_t) to proxy the risk appetite of the global investors and the iTraxx Europe index[13] ($ITRX_t$) to proxy the general risk atmosphere in the European debt markets. We also considered other indicators describing uncertainty in the financial markets, but they all turned

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[10]There exists a vast literature on the macroeconomic news announcement effects on bond yields and other financial market data. See, e.g., Andersen et al. (2003).

[11]Before combining the indicators, the surprises of the indicators for which the negative (positive) surprise indicates good (bad) news, such as in the case of unemployment, were multiplied by -1.

[12]Bid-ask spreads were collected from Reuters.

[13]The Markit iTraxx Europe index comprises 125 equally weighted credit default swaps on investment-grade European corporate entities.

out to be insignificant and were hence left out of the final model specification. These indicators were the VSTOXX index[14] to describe the uncertainty in the European stock markets, the one-month implied volatility of the EUR/USD exchange rate to represent the stress in the currency markets, the squared bond yield changes to measure the uncertainty in a particular sovereign bond market, and the weekly CISS index[15] by Hollo, Kremer, and Lo Duca (2012) to describe the level of systemic risk at the European financial markets.

Besides the different risk factors, we considered including the three-month Euribor interest rate to proxy the risk-free short-term interest rate in the model, but it turned out to be statistically insignificant and was hence left out of the final model specification.

In order to capture direct dependence between different countries' yield spreads and possible contagion effects between the countries, we include the lagged bond yield spreads of all the countries as explanatory variables. We recognize that this is only a crude approximation to capture the contagion effects in a noisy daily data. Besides these risk factors and the contagion variables, our model includes dummy variables for the policy decisions. These are discussed in more detail in the next sub-section.

3.2   Policy Decisions

All the European-wide policy decisions we are interested in are listed in table 1. To study the impact of these events, we create dummy variables for each policy decision such that each dummy variable equals one on the day the policy decision was announced and on the day after. The motivation behind this two-day window is that in some cases the decision was reached in the evening when the markets were already closed for that day. Hence the market reacts to the announcement only in the day following the announcement. Also, it

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[14]The VSTOXX index measures the implied volatility of the EURO STOXX 50 index options and is created jointly by Deutche Borse and Goldman Sachs to measure volatility in the euro area.

[15]The CISS index is a composite index using information from the total of fifteen individual financial stress measures from financial intermediaries (banks and non-banks), money markets, securities (stocks and bonds), and foreign exchange markets. Linear interpolation is used for changing weekly data frequency to daily. This index is maintained and updated frequently by the ECB.

Table 1. Categories of the Policy Decisions

ECB Collateral Requirements Relaxed ($ECBcrl_t$) Oct. 15, 2008; May 3, 2010; Jul. 7, 2011; Dec. 8, 2011; Mar. 8, 2012; Jun. 22, 2012; Sep. 6, 2012; Dec. 19, 2012; May 2, 2013; Jul. 5, 2013
ECB Collateral Requirements Restricted ($ECBcrs_t$) May 25, 2007; Nov. 26, 2008; Apr. 8, 2010; Feb. 28, 2012; Jul. 20, 2012; Mar. 22, 2013; Jun. 28, 2013
ECB Liquidity Support ($ECBls_t$) Aug. 22, 2007; Sep. 6, 2007; Mar. 28, 2008; Oct. 7, 2008; May 7, 2009; Aug. 4, 2011; Oct. 6, 2011; Dec. 8, 2011
ECB Covered Bond Purchase Program ($ECBcb_t$) Jun. 4, 2009; Oct. 6, 2011
ECB Securities Market Program ($ECBsmp_t$) May 10, 2010
ECB Outright Monetary Transactions Program ($ECBomt_t$) Sep. 6, 2012
ECB Draghi "Whatever-It-Takes" Speech ($ECBdhi_t$) Jul. 26, 2012
Support Package Request ($SPreq_t$) Nov. 21, 2010; Apr. 8, 2011; Jun. 25, 2012; Jun. 27, 2012
Support Package Decisions ($SPdec_t$) Apr. 12, 2010; May 10, 2010; Nov. 28, 2010; May 16, 2011; Jul. 21, 2011; Feb. 20, 2012; Jul. 20, 2012; Mar. 25, 2013
Support Package Conditions Relaxed ($SPcrl_t$) Nov. 27, 2012; Mar. 16, 2013
Greece Debt Restructuring ($Drst_t$) Mar. 9, 2012
Decisions on ESM (ESM_t) Oct. 28, 2010; Nov. 29, 2010; Dec. 16, 2010; Mar. 21, 2011; Feb. 2, 2012; Mar. 30, 2012; Jul. 9, 2012
Widening of the Mandate of EFSF/ESM ($EFSF_t$) Jun. 20, 2011; Jul. 21, 2011; Oct. 26, 2011; Mar. 30, 2012
European Economic Recovery Plan ($EERP_t$) Nov. 26, 2008
Other Decisions Related to European Economic Governance (OD_t) May 27, 2009; Sep. 29, 2010; Mar. 11, 2011; Mar. 25, 2011; Nov. 8, 2011; Dec. 19, 2011; Mar. 2, 2012; Jun. 29, 2012; Dec. 14, 2012
Notes: The table presents the policy announcements divided into corresponding categories.

might be that the effect of some of the decisions on sovereign risk are difficult to judge, and hence the market is processing the decision longer than one day. In some cases, it is also likely that the market already anticipates the forthcoming decision on the day before. Therefore, we run a robustness check with a three-day window that allows for both pre- and post-announcement-day drifts in the yield spreads.

Altogether we have identified a very large number of important policy decisions since January 2007, as documented in appendix 2. We divide the policy decisions into sixteen categories and combine the dummy variables belonging to the same category to reduce multi-collinearity problems in the estimation and improve the economic interpretation of the results.

The first seven categories include the important policy decisions made by the ECB. The ECB's collateral requirements were changed in a number of occasions. We capture separately the decision that eased and restricted the collateral requirements by dummy variables $ECBcrs$ and $ECBcrl$, respectively. The dummy variable related to the ECB's liquidity support decisions is denoted as $ECBls_t$. The policy announcements related to the ECB's Covered Bond Purchase Program and Securities Market Program are studied separately, and the dummy variables for these categories are denoted as $ECBcb_t$ and $ECBsmp_t$, respectively. Finally, we allow a separate dummy variable for the announcement of the ECB's OMTs, $ECBomt$, in September 2012 and ECB President Mario Draghi's "whatever-it-takes" speech in July 2012.

As for the rest of the groups, we try to disentangle the decisions that have implied a possible launch of the new financial support program (requests for the support packages, denoted as $SPreq_t$, and the announcements related to the final decisions of the support packages, denoted as $SPdec_t$, are studied separately), announcements related to the creation of the ESM (denoted as ESM_t), decisions on widening of the EFSF mandate (denoted as $EFSF_t$), announcement of the European Economic Recovery Plan (denoted as $EERP_t$), and other decisions related to European economic governance (denoted as OD_t). These other decisions are primarily related to strengthening of the Stability and Growth Pact, and improving fiscal discipline and fiscal coordination in the euro area. For example, Europe has agreed on the so-called fiscal compact, which will strengthen coordination

of fiscal and economic policy; the European semester enables the European Commission to view member states' budgetary and structural policies before their implementation; and the Macroeconomic Imbalances Procedure aims at detecting excessive macroeconomic imbalances.

3.3   ECB Interest Rate Decisions

Compared with the other ECB policy decisions, the decisions related to the interest rates are different in a sense that, similarly to the macroeconomic news described in section 3.1, the announcement day and time of the interest rate decisions are known beforehand. The ECB interest rate decisions (and other monetary policy decisions) are made by the Governing Council of the ECB, which meets twice a month. The monetary policy decisions are made at the first meeting of each month, typically taking place on the first Thursday of the month. Hence, market agents are able to form expectations on the released decision before it is announced. Besides collecting the survey forecasts for macroeconomic statistics, Bloomberg also collects the market agents' forecasts of the ECB interest rate decision. By using the market forecast for each released interest rate decision, we can create an interest rate surprise variable $ECBir_t = (A_{t,ir} - F_{t,ir})/\hat{\sigma}_{ir}$, where $A_{t,IR}$ is the decision on the interest rate made at day t, $F_{t,ir}$ is the market forecast for the interest rate, and $\hat{\sigma}_{IR}$ is the standard deviation of the interest rate surprises estimated from the entire sample period. Hence, unlike the other policy announcement variables that are two- or three-day dummies, $ECBir_t$ takes a value of the interest rate surprise on those days when the ECB makes interest rate decisions, and zero otherwise.

3.4   The Model

To study the determinants of the yield spreads of the European sovereign bond markets, and the impact of the fiscal and monetary policy decisions in Europe during the debt crisis, we estimate the following model (1) with the ordinary least squares estimation method separately for all the countries ($i = Germany, France, Spain, Italy, Portugal, Ireland, Greece$).

The dependent variable and the explanatory variables are explained in sub-sections 3.1 and 3.2. Unit-root tests[16] suggest that the dependent variable is non-stationary for most of the countries and hence the model is estimated in first differences.[17] α is a constant, β_i for $i = \{DE,\ FR,\ ES,\ IT,\ PT,\ IE,\ GR\}$ are parameters that describe the potential contagion effects between countries, γ_j for $j = \{MNEWS,\ BAS,\ VIX,\ ITRAXX\}$ are parameters for controlling the effects of the different risk factors, δ_k for $k = \{IR, CRL, CRS, LS, CB, SMP, OMT, DHI\}$ capture the impact of the ECB policy decisions, ϕ_l for $l = \{SPreq,\ SPdec,\ SPrl,\ DEBTrst,\ ESM,\ EFSF,\ EERP,\ OD\}$ give the impact of the other policy decisions, and $\varepsilon_{i,t}$ is the error term of the model. The Newey-West standard errors (with thirty lags) are used because of the undefined form of autocorrelation and heteroskedasticity in the residuals.

$$
\begin{aligned}
\Delta y_{t,i} = {} & \alpha_i + \sum_{i=1}^{7} \beta_i \Delta y_{t-1,i} + \gamma_{MNEWS} MNEWS_{t,i} \\
& + \gamma_{BAS} \Delta BAS_{t,i} + \gamma_{VIX} \Delta VIX_t + \gamma_{ITRX} \Delta ITRX_t \\
& + \delta_{ECBir} ECBir_t + \delta_{ECBcrl} ECBcrl_t + \delta_{ECBcrs} ECBcrs_t \\
& + \delta_{ECBls} ECBls_t + \delta_{ECBcb} ECBcb_t + \delta_{ECBsmp} ECBsmp_t \\
& + \delta_{ECBomt} ECBomt_t + \delta_{ECBdhi} ECBdhi_t + \phi_{SPreq} SPreq_t \\
& + \phi_{SPdec} SPdec_t + \phi_{SPrl} SPrl_t + \phi_{DEBTrst} DEBTrst_t \\
& + \phi_{ESM} ESM_t + \phi_{EFSF} EFSF_t + \phi_{EERP} EERP_t \\
& + \phi_{OD} OD_t + \varepsilon_{t,i}
\end{aligned}
\tag{1}
$$

4. The Results

In this section we present the estimation results of the empirical model as described above. The main results are presented in table 2.

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[16]The results for unit-root tests are available from the authors upon request.

[17]Similar findings, albeit from a different sample, can be found in Fontana and Scheicher (2010). We could have also considered a co-integration analysis, but given the short sample with possible breaks in the series, we considered it to be out of the scope of this paper. Our focus is on policy effects and not on the yield dynamics per se.

Table 2. Estimation Results with a Two-Day Event Window

	Germany	France	Spain	Italy	Portugal	Ireland	Greece
γ_{MNEWS}	0.077	−0.026	0.021	−0.027	0.001	−0.029	−0.135**
γ_{BAS}	−0.003	0.136***	0.045	0.053	0.445***	0.124***	0.494***
γ_{VIX}	0.096**	0.046	−0.003	0.031	0.022	0.045	0.013
γ_{ITRX}	−0.262***	0.103*	0.333***	0.372***	0.191***	0.183***	0.085***
β_{DE}	−0.222***	−0.131***	−0.033	−0.025	−0.069	−0.095***	−0.041*
β_{FR}	0.001	−0.073	−0.050	−0.107*	0.045	0.097**	0.016
β_{ES}	0.011	−0.030	0.088**	−0.026	−0.059	0.034	0.068
β_{IT}	−0.159***	−0.015	−0.004	0.074	0.028	−0.031	−0.013
β_{PT}	−0.040	−0.096	−0.086*	−0.095*	0.136***	−0.024	0.052*
β_{IE}	0.046	0.062*	0.046*	0.076**	−0.000	0.097*	−0.052
β_{GR}	−0.004	0.030*	−0.033**	0.005	−0.012	−0.019	0.054*
δ_{ECBir}	0.227	0.168	0.055	0.054	0.093**	0.086	−0.059
δ_{ECBcrl}	0.175	−0.373**	−0.089	0.111	−0.315	0.016	0.570
δ_{ECBcrs}	−0.081	−0.004	0.097	−0.211	0.405	0.073	0.278
δ_{ECBls}	0.312	0.250	−0.123	0.124	−0.096	−0.420	−0.148
δ_{ECBcb}	0.259	−0.056	−0.100	−0.035	0.165	0.424	0.265
δ_{ECBsmp}	−0.756***	−0.864**	−2.399***	−1.508***	−3.801***	−3.739***	−2.980***
δ_{ECBomt}	−0.841**	−0.917***	−3.714***	−2.486***	−2.790***	−0.911***	−0.393
δ_{ECBdhi}	−0.111	−1.651***	−3.122***	−2.605***	−0.481*	−0.422***	−0.438***
ϕ_{SPreq}	−0.106	0.297	0.841**	0.447	0.568**	0.073	−0.111
ϕ_{SPdec}	0.153	0.454**	0.455	0.311	−0.260	−0.708	−0.094
ϕ_{SPrt}	−0.122	−0.457***	−0.427	−0.107	−0.071	0.155**	0.325
$\phi_{DEBTrst}$	−0.502***	0.446***	−0.154	0.472***	−0.343**	0.504***	−13.10***
ϕ_{ESM}	0.193	0.033	0.310	0.203	0.068	0.860***	0.437
ϕ_{EFSF}	−0.243	−0.898	−0.931***	−0.599**	−0.325	−1.231*	−0.455
ϕ_{EERP}	1.116***	0.892***	0.595*	1.235***	−0.113	0.265	−0.157
ϕ_{OD}	−0.020	0.261	−0.242	−0.174	−0.208	−0.262	−0.057

Notes: The table presents the estimation results of the model (1). The model is estimated in differences and using Newey-West standard errors with thirty lags. *, **, and *** denote the 10 percent, 5 percent, and 1 percent significance levels, respectively.

We first summarize the findings related to the three risk factors: credit and liquidity risk and the general risk appetite, as well as the contagion variables. We then summarize the impact of the policy decisions on the sovereign bond yields, and conclude with some robustness checks.

4.1   Risk Factors and Contagion Variables

According to our estimation results (table 2), the impact of macroeconomic news is statistically significant only in the case of Greece. The negative coefficient implies that better-than-expected (worse-than-expected) macroeconomic news has reduced (increased) the bond spreads in Greece. For all the other countries, the effects are not significant. Bid-ask spreads, which are used to proxy liquidity risk, are typically positive and in most cases very significant (France, Portugal, Ireland, Greece). Of the proxies for the risk appetite, the impact of the iTraxx index is significant in all the countries, while the VIX is significant only in the case of Germany. The coefficient estimates (negative for Germany and positive for other countries) for the iTraxx index are consistent with flight-to-quality behavior of the markets. These coefficients capture the widening of the spreads between other countries and Germany, reflecting decreasing risk appetite in the bond markets as the crisis intensified. As the VIX reflects more the riskiness of the stock markets than the general risk appetite in the European debt markets, it is perhaps not so surprising that it is insignificant in most of the countries.

All in all, these results suggest that the risk appetite in the sovereign bond markets is an important price determinant in the European bond markets, clearly more important than the surprises in country-specific macroeconomic news. On the basis of coefficients' size, the Italian and Spanish bond markets seem to be most sensitive to movements in risk appetite. In the case of Portugal, Ireland, and Greece, the risk appetite does matter, but the pricing reflects significantly also the liquidity risk, as proxied by the bid-ask spreads. This seems rather natural, given the difference of the size of the bond markets in these two groups of countries.

In contrast to the importance of risk appetite and liquidity risk, the direct relationship between the high-frequency movements of the countries' bond spreads seems to be rather weak. There is some evidence of a lagged negative relationship between some countries, (e.g., Germany and Italy), which could be explained by the flight to safety. There are also some significant parameter coefficients within the countries Spain and Portugal and Greece, as well as between Greece and Germany, but it is difficult to interpret these results systematically. These results become more significant and interpretable once we allow regime shifts in the parameter estimates (see section 4.3).

4.2   Policy Decisions

The impacts of the policy decisions vary greatly (table 2), both in magnitude and in significance. The unexpected interest rate decisions of the ECB have had a significant effect only in the case of Portugal. Decisions related to the ECB's collateral policy enter significantly only in the case of France, whereby relaxation of collateral requirements has decreased the bond spreads. The impact of the ECB's liquidity support decision on ten-year sovereign bond spreads is not statistically significant in any of the countries. This could simply reflect the fact that collateral, liquidity support, and covered bond program decisions were mainly targeted to the bank's funding and liquidity problems, rather than directly to the problems in sovereign markets. Moreover, many of these decisions were made at an early phase of the global financial crises, before the European sovereign bond markets became under stress. Consequently, in comparison to, e.g., Rai (2013) for the United States, we do not find that the ECB liquidity and collateral policies had significant effects on long-term bond spreads in Europe.[18]

In contrast, the ECB policy decisions directly targeted to the European sovereign debt markets have had a significant and large impact on bond spreads. The announcement of the ECB's

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[18]Note that Rai (2013) focuses on corporate bond spreads, while we study the impact of policies on sovereign bond spreads.

Securities Market Program, OMTs, and ECB President Draghi's "whatever-it-takes" speech have had a large negative effect on bond spreads in all of the seven countries in this study.[19]

Spain and Italy were affected most strongly, but coefficients are large and very significant also in Portugal, Ireland, and Greece. Consequently, in line with, e.g., Gagnon et al. (2011), Hamilton and Wu (2012), and Krishnamurthy and Vissing-Jorgensen (2011, 2013) for the United States, the ECB's announcements of large-scale asset purchase programs had a significant effect on bond spreads in Europe. At the same time, we did not find a statistically significant coefficient for the ECB's Covered Bond Purchase Program, which was specifically geared towards easing banks' market funding problems at an early phase of the financial crisis.[20] Given that the program was relatively small in size (€60 billion) and had actually ended already by June 2010, it is perhaps not surprising that we find no significant effect on the sovereign markets.

The decisions related to the financial support packages are mixed. In table 2, the decision to request financial support has typically not affected the markets significantly, except in Spain and Portugal, where the request decision has had a positive effect on bond spreads. When the decisions to grant financial support were finally agreed upon and announced publicly by the Eurogroup, the coefficient of the requesting country is always negative, albeit not statistically significant. This may reflect at least partly the fact that the decisions were largely anticipated well in advance.

In all other countries, the corresponding coefficients are positive, yet only in the case of France is the effect statistically significant. Albeit rather weak, the general drift in the bond spreads around the announcements of financial support packages seems to

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[19]The SMP was announced on May 10, 2010, with the aim of addressing the malfunctioning of certain sovereign bond markets, and by the end of December 2012 the Eurosystem's SMP holdings amounted to over €200 billion. While the SMP did not include any ex ante eligibility criteria, a necessary condition for the OMTs was strict and effective conditionality attached to an appropriate EFSF/ESM program. Another important difference to the SMP was that OMTs would be ex ante unlimited.

[20]The covered bond program category includes two decisions, the decisions on the first and the second program.

reflect the risk-sharing aspect of financial support programs: countries that were acting as guarantors of the loans through the EFSF and the ESM to troubled sovereigns, faced, if anything, increasing bond spreads, and those receiving the finances faced decreasing bond spreads.

Of the remaining policy decisions, we find consistent and rather strong effects on bond spreads due to the EFSF, Greek debt restructuring, and the EERP. The decisions related to the EFSF are associated with negative coefficients in all countries, yet these coefficients are not always significant, while the announcement of the European Economic and Recovery Plan (EERP) has increased the bond spreads significantly in Germany, France, Spain, and Italy. Short-run economic stabilization probably increased the uncertainty related to the long-run sustainability of the public sector, dominating the effect on bond spreads in most of the countries. The decision on the Greek debt restructuring apparently increased the perceived riskiness of French, Italian, and Irish government bonds, but reduced that of the others. The reduction in bond spreads was very strong in the case of Greece, but it had a non-negligible negative effect also on German bunds. As a result of Greek debt restructuring, investors shifted even more to high-quality German bunds, shying away from French, Italian, and Irish bonds. Hence, to some extent, decision over Greek debt restructuring aggravated the situation in European sovereign debt markets with negative spillovers to some already stressed sovereigns.

4.3   Robustness

In table 3 we present some robustness checks with respect to the lengthening of the event window from two to three days. Lengthening the event window by one day to include also the pre-announcement day allows to control for possible rumors and anticipation effects of the policy announcements. In table 4 we consider, in addition to a three-day event window, a regime shift, where we let the parameters of the risk factors and the lagged yield spreads of the other countries change after May 2010. For this purpose, we have created another dummy variable that equals one from May 2010 onwards. More specifically, our empirical model now reads as

Table 3. Estimation Results with a Three-Day Event Window

	Germany	France	Spain	Italy	Portugal	Ireland	Greece
γ_{MNEWS}	0.080*	−0.020	0.012	−0.022	0.008	−0.026	−0.169**
γ_{BAS}	−0.004	0.139***	0.046	0.056	0.449***	0.128***	0.546***
γ_{VIX}	0.099**	0.048	0.003	0.035	0.033	0.056	0.019
γ_{ITRX}	−0.261***	0.106*	0.339***	0.377***	0.202***	0.189***	0.084***
β_{DE}	−0.223***	−0.132***	−0.035	−0.023	−0.075	−0.103***	−0.038*
β_{FR}	0.003	−0.072	−0.051	−0.109	0.040	0.100**	0.013
β_{ES}	0.012	−0.024	0.091**	−0.024	−0.027	0.045	0.077
β_{IT}	−0.159***	−0.013	0.005	0.077	0.023	−0.037	−0.029
β_{PT}	−0.040	−0.103	−0.094**	−0.102*	0.131***	−0.018	0.066*
β_{IE}	0.045	0.058	0.056**	0.084***	0.005	0.101**	−0.042*
β_{GR}	−0.003	0.030	−0.035**	0.006	−0.010	−0.014	0.055
δ_{ECBir}	0.193	0.142	0.024	0.038	−0.005	0.058	−0.047
δ_{ECBcrl}	0.040	−0.158	0.053	0.173	−0.038	0.310	0.621
δ_{ECBcrs}	−0.149**	0.025	0.148	−0.231	0.349	0.113	0.217
δ_{ECBls}	0.046	0.154	0.068	0.131	−0.193	−0.454*	−0.041
δ_{ECBcb}	0.361	0.110	0.129	0.201	0.457*	0.591**	0.265
δ_{ECBsmp}	−1.139***	−0.835***	−1.525**	−0.682	−2.280***	−1.988***	−1.195***
δ_{ECBomt}	−0.291	−0.614*	−2.586***	−2.053***	−0.651	−0.489	−0.227
δ_{ECBdhi}	0.186	−0.936***	−2.531***	−2.089***	0.853***	−0.103	−0.568***
ϕ_{SPreq}	0.094	0.077	0.604**	0.406	0.266	0.009	−0.140
ϕ_{SPdec}	0.237***	0.222*	0.214	0.080	−0.304	−0.547	−0.146
ϕ_{SPrl}	−0.103	−0.261*	0.049	−0.048	0.317	0.917**	0.264**
$\phi_{DEBTrst}$	−0.336**	−0.243	−0.163	−0.238	−0.153	−0.245	−8.038***
ϕ_{ESM}	0.239	−0.091	0.227	0.075	−0.191	0.790***	0.393*
ϕ_{EFSF}	−0.231*	−0.709	−0.500**	−0.293	−0.148	−1.112*	−0.486
ϕ_{EERP}	1.388***	1.127***	1.185**	1.637***	0.446	0.723*	0.005
ϕ_{OD}	−0.150	0.145	−0.158	−0.080	−0.060	−0.221	−0.015

Notes: The table presents the estimation results of the model (1) with a three-day (−1, 0, 1) event window for the policy decision dummies. The model is estimated in differences and using Newey-West standard errors with thirty lags. *, **, and *** denote the 10 percent, 5 percent, and 1 percent significance levels, respectively.

$$\Delta y_{t,i} = \alpha_i + \sum_{i=1}^{7} \left(\beta_i + \beta_{i\_c}\right) \Delta y_{t-1,i}$$

$$+ \left(\gamma_{MNEWS} + \gamma_{MNEWS\_c}\right) MNEWS_{t,i}$$

$$+ \left(\gamma_{BAS} + \gamma_{BAS\_c}\right) \Delta BAS_{t,i} + \left(\gamma_{VIX} + \gamma_{VIX\_c}\right) \Delta VIX_t$$

$$+ \left(\gamma_{ITRX} + \gamma_{ITRX\_c}\right) \Delta ITRX_{t,i} + \mathcal{P}_t(\delta, \phi) + \varepsilon_t, \tag{2}$$

where $\mathcal{P}_t(\delta, \phi)$ is shorthand for the policy dummies in our regression (see equation (1)). In equation (1) β_i presents the effects of lagged yield spreads prior to May 2010 and $(\beta_i + \beta_{i\_c})$ presents the effect after May 2010. Similar interpretation applies to the rest of the coefficients related to the risk factors.

The first observation from tables 3 and 4 is that our results with respect to policy dummies remain largely unchanged: those policy decisions that were found to be important in table 2 remain important in tables 3 and 4. Our results with respect to importance of the risk factors are also largely unchanged when we move from a two-day to a three-day event window. Most interestingly, however, when we allow for the regime shift in the effect of our main control variables to bond spreads (table 4), we observe the following: First, in the case of Germany, the surprise component of macroeconomic news shifts sign after May 2010. Prior to May 2010, the macroeconomic news had a positive effect on bond yields in Germany, but afterwards the parameter γ_{MNEWS_c} in equation (2) turns negative, leaving the combined effect close to zero $(0.127 - 0.143)$.

The positive effect of macroeconomic news prior to May 2010 probably reflects the portfolio allocation effect whereby better-than-expected macroeconomic conditions lead investors to shift from less risky bonds to more risky but potentially higher yielding stock markets. The fact that this positive effect disappears after May 2010 (coefficient being close to zero) might be caused by the safe-haven status of German bunds that dominated the dynamics of the German bond spreads after the crisis escalated.

For Greece, the negative coefficient on the macroeconomic news variable reported in table 2 seems to be entirely driven by the negative coefficient after May 2010. For other countries, we still do not find significant coefficients in either of the periods. This is possibly

Table 4. Estimation Results with a Three-Day Event Window and Regime Shift

	Germany	France	Spain	Italy	Portugal	Ireland	Greece
γ_{MNEWS}	0.127**	0.018	−0.001	−0.056	−0.003	−0.027	0.019
γ_{MNEWS_c}	−0.143*	−0.089	−0.028	0.085	−0.002	0.021	−0.257***
γ_{BAS}	−0.005	0.074**	0.008	0.034	0.289***	0.042**	0.404***
γ_{BAS_c}	0.058	0.186*	0.115*	0.367**	0.163***	0.121***	0.084
γ_{VIX}	0.077	0.005	0.020	0.028	0.028**	0.027	0.005
γ_{VIX_c}	0.047	0.136*	−0.062	0.004	−0.013	0.053	0.034
γ_{ITRX}	−0.190**	−0.051	−0.003	0.042	0.014	0.000	0.014*
γ_{ITRX_c}	−0.153	0.303***	0.728***	0.714***	0.381***	0.384***	0.152***
β_{DE}	−0.163***	−0.087*	−0.079***	−0.078***	−0.078***	−0.127***	−0.024**
β_{DE_c}	−0.037	−0.033	0.106*	0.075	0.024	0.056	−0.019
β_{FR}	−0.065	−0.226***	0.004	0.013	0.010	0.065	0.002
β_{FR_c}	0.061	0.175**	−0.057	−0.147**	0.042	0.047	0.018
β_{ES}	0.252	0.225*	−0.103	0.061	0.094**	0.044	0.017
β_{ES_c}	−0.288*	−0.281**	0.217**	−0.107	−0.163**	−0.002	0.052
β_{IT}	−0.517***	−0.224***	−0.053	−0.208***	−0.020	−0.003	−0.027
β_{IT_c}	0.424***	0.228*	0.033	0.317***	0.052	−0.049	0.013
β_{PT}	−0.322**	−0.026	0.001	−0.030	−0.060	0.079	0.078
β_{PT_c}	0.294**	−0.057	−0.066	−0.046	0.216**	−0.094	−0.022
β_{IE}	0.219	0.226*	0.084	0.122	0.025	0.062	−0.029
β_{IE_c}	−0.185	−0.174	−0.048	−0.052	−0.029	0.039	−0.023
β_{GR}	0.218	0.205	0.377***	0.270	0.386**	0.324*	0.106
β_{GR_c}	−0.225	−0.176	−0.416***	−0.271*	−0.404**	−0.346*	−0.053

(continued)

Table 4. (Continued)

	Germany	France	Spain	Italy	Portugal	Ireland	Greece
δ_{ECBir}	0.221	0.107	−0.050	−0.051	0.034	0.019	−0.085
δ_{ECBcrl}	0.106	−0.344*	−0.051	0.131	−0.333	0.072	0.567
δ_{ECBcrs}	−0.070	−0.073	−0.003	−0.277*	0.369	0.005	0.275
δ_{ECBls}	0.277	0.194	−0.271	−0.040	−0.160	−0.494	−0.198
δ_{ECBcb}	0.271	−0.090	0.038	0.137	0.230	0.443	0.307
δ_{ECBsmp}	−0.980***	−0.021	−1.033***	0.124	−3.041***	−2.829***	−2.509***
δ_{ECBomt}	−0.863**	−0.533	−2.971***	−1.661***	−2.376***	−0.525**	−0.190
δ_{ECBdhi}	−0.246	−1.372***	−2.373***	−1.892***	−0.155	−0.069	−0.272
ϕ_{SPreq}	−0.088	0.229	0.654**	0.260	0.490*	−0.027	−0.149
ϕ_{SPdec}	0.188	0.416**	0.304	0.171	−0.299	−0.760	−0.130
ϕ_{SPrl}	−0.073	−0.530***	−0.633	−0.286	−0.175	0.078	0.272
$\phi_{DEBTrst}$	−0.412***	0.470***	−0.256**	0.448***	−0.377**	0.457***	−13.07***
ϕ_{ESM}	0.236	0.045	0.215	0.155	0.062	0.835***	0.419
ϕ_{EFSF}	−0.372	−0.659	−0.474*	−0.180	−0.091	−0.950	−0.325
ϕ_{EERP}	1.139***	0.819***	0.637***	1.141***	−0.255	0.178	−0.186
ϕ_{OD}	−0.018	0.298	−0.137	−0.049	−0.157	−0.208	−0.031

Notes: The table presents the estimation results of the model (2), where the parameters for the risk factors and the contagion variables were allowed to change during the European debt crisis (after May 2010). The model is estimated in differences and using Newey–West standard errors with thirty lags. *, **, and *** denote the 10 percent, 5 percent, and 1 percent significance levels, respectively.

explained by the fact that the credit risk is typically very low in sovereign bonds compared with, e.g., corporate bonds, even though the perceived credit risk might have increased in recent years in some countries.

Second, liquidity risk as proxied by the bid-ask spread is typically more important after May 2010, and the same applies to the variable ITRXX, which proxies the risk appetite in the European bond markets. In fact, ITRXX is insignificant or only marginally significant in all but Germany prior to May 2010. Overall, then, the results clearly suggest that bond spreads became more sensitive to risk factors after May 2010.

As for the lagged yield spreads of the other countries, the results point to increasing interdependency after May 2010. In particular, the movements in Spanish, Italian, and Greek bond spreads after May 2010 have impacted more strongly other countries, suggesting that contagion effects became more important.

5. Conclusions

During the last five years or so, the European sovereign debt markets have experienced unprecedented turmoil. It is very important to understand which part of evolution of bond spreads is caused by expectations related to the changes in countries' economic fundamentals and underlying economic environment and which part is caused by the changes in the general risk appetite. If the increases in the bond spreads are caused by the increased credit risk, it is very likely that the yields are going to stay elevated for a very long time. In this case it is not enough to provide time and liquidity to these markets; the trust of the markets is gained only by improving the long-term sustainability of the government's fiscal position. It is also important to understand which actual policies have been successful in calming the stressed markets. In this paper we have focused on the impact of a wide range of policy announcements made during the latest financial crisis on the long-term sovereign bond yields of seven European countries. We examined these policy effects with an empirical model where we control the effect of credit and liquidity risks as well as general risk aversion and contagion between the countries.

We find that many policy decisions aimed at stabilizing the European debt crisis have had significant effects on the sovereign bond spreads. As expected, the decisions have caused a mixture of reactions in different countries. A decision that eases the pressure in one country may aggravate the situation in others, reflecting contagion but also the risk-sharing nature of some of the policy decisions. Quantitatively, the most significant effects are due to the announcement of the ECB's Securities Market Program, Outright Monetary Transactions, and ECB President Draghi's "whatever-it-takes-speech" in June 2012. Rather strong effects on bond spreads were also due to the decisions related to the European Financial Stability Facility, Greek debt restructuring, and the European Economic and Recovery Program. The decision on Greek debt restructuring led to a very strong decline of yield spreads in Greece, but at the same time it increased the perceived riskiness of French, Italian, and Irish government bonds. At the same time, all the decisions related to the new European economic governance have not been successful in reducing uncertainty in the countries whose sovereign debt markets have been under stress. Uncertainty related to fiscal sustainability was probably dominating the impact of those decisions that should improve the European fiscal landscape in the long run. This may also reflect the high political risk associated with these decisions and an unproven commitment of individual member states to collectively follow the rules.

As for the other risk factors, we find that macroeconomic news, which we have used as a proxy for credit risk, has played a somewhat more important role after May 2010, when the European debt crisis intensified. Overall, however, this factor is relatively unimportant for most of the countries in our study. At the same time, we have found relatively strong evidence that bond spreads became more sensitive to changes in risk appetite and liquidity risk, and also contagion effects strengthened after May 2010. Consistently with these, policies that were directly geared towards dispelling investors' fears on funding strains and on market illiquidity in the sovereign markets were apparently most efficient. The effectiveness of these measures shows that the European Monetary Union, as any monetary union, needs efficient backstop mechanisms that can be used in the event of crises.

Appendix 1. Macroeconomic News Variables

Table 5. Macroeconomic News Variables Used in Estimation

Indicator	Country						
	Germany	France	Spain	Italy	Portugal	Ireland	Greece
Budget Balance	X	X	X	X	X		
Current Account Balance	X	X	X	X	X	X	X
Trade Balance	X	X	X	X	X	X	
Government Spending	X						
General Government Debt				X			
GDP	X	X	X	X	X	X	X
Industrial Production	X	X	X	X	X	X	X
Unemployment	X	X	X	X	X	X	X
Consumer Confidence	X	X		X	X	X	
Business Confidence		X	X	X			
Economic Climate/Sentiment					X	X	
IFO Business Climate	X						
ZEW Survey Expectations	X						
PMI	X	X		X			

Notes: The table presents the sets of macroeconomic news variables that were used to construct an indicator *MNEWS* for each country. See the main text for further explanation.

Appendix 2. List of Policy Decisions

- May 25, 2007: ECB's amendment to the criteria for assets eligible as collateral for Eurosystem credit operations. (*ECBcrs*)
- August 22, 2007: ECB decided to conduct a supplementary liquidity-providing longer-term refinancing operation with a maturity of three months. (*ECBls*)
- September 6, 2007: ECB decided to conduct a supplementary liquidity-providing longer-term refinancing operation with a maturity of three months. (*ECBls*)
- March 28, 2008: ECB decided on supplementary six-month longer-term refinancing operations and continuation of the supplementary three-month longer-term refinancing operations. (*ECBls*)
- October 8, 2008: ECB decided that the weekly main refinancing operations will be carried out through a fixed-rate tender procedure with full allotment at the interest rate on the main refinancing operation. (*ECBls*)
- October 15, 2008: ECB decided on measures to further expand the collateral framework and enhance the provision of liquidity. (*ECBcrl*)
- November 26, 2008: ECB decided on changes to the temporary expansion of the eligibility of collateral. (*ECBcrs*) European economic recovery plan. (*EERP*)
- May 7, 2009: ECB decided to conduct liquidity-providing longer-term refinancing operations (LTROs) with a maturity of one year. (*ECBls*)
- May 27, 2009: New European financial supervisory framework. (*OD*)
- June 4, 2009: ECB decided on the Covered Bond Purchase Program. (*ECBcb*)
- April 8, 2010: ECB introduced graduated valuation haircuts for lower-rated assets in its collateral framework. (*ECBcrs*)
- April 12, 2010: €110 billion for Greece. (*SPdec*)
- May 3, 2010: ECB announced change in eligibility of debt instruments issued or guaranteed by the Greek government. (*ECBcrl*)
- May 10, 2010: €750 billion for European support package to secure stability the euro-area. (*SPdec*) ECB decided to

conduct interventions in the euro-area public and private debt securities markets (Securities Markets Program). (*ECBsmp*)

- September 29, 2010: New Economic Governance Package. (*OD*)
- October 28, 2010: The European Council agreed on the need to set up a permanent crisis-resolution mechanism. (*ESM*)
- November 21, 2010: Ireland requests financial support. (*SPreq*)
- November 29, 2010: Agreement of financial assistance program for Ireland (€85 billion). (*SPdeq*) Agreement on the key elements of the European Stability Mechanism. (*ESM*)
- December 16, 2010: The European Council agreed on limited amendment to the EU Treaty to underpin the permanent mechanism. (*ESM*)
- March 11, 2011: Pact for the euro was endorsed. (*OD*)
- March 21, 2011: Eurogroup+ agreed on the organizational and financial details of the ESM. (*ESM*)
- March 25, 2011: Heads of state finalize comprehensive package. (*OD*)
- April 8, 2011: Ministers acknowledged the Portuguese authorities' request for financial assistance. (*SPreq*)
- May 16, 2011: Agreement of financial assistance program to Portugal. (*SPdec*)
- June 20, 2011: Agreement to increase effective capacity and widen the mandate of the European Financial Stability Facility. (*EFSF*)
- July 7, 2011: ECB announces change in eligibility of debt instruments issued or guaranteed by the Portuguese government. (*ECBcrl*)
- July 21, 2011: Euro Zone Summit, second package for Greece (*SPdec*), and widening of the scope of EFSF/ESM. (*EFSF*)
- August 4, 2011: The Eurosystem decided to conduct a liquidity-providing supplementary longer-term refinancing operation with a maturity of approximately six months as a fixed-rate tender procedure with full allotment. (*ECBls*)
- October 6, 2011: ECB decided to conduct two longer-term refinancing operations—one with a maturity of approximately twelve months in October 2011, and another with a maturity of approximately thirteen months in December 2011. (*ECBls*)

ECB decided to launch a new Covered Bond Purchase Program in November 2011. (*ECBcb*)

- November 8, 2011: Enforcing budgetary discipline. (*OD*)
- November 26, 2011: Euro-area Finance Ministers agreed on the terms and conditions to leverage EFSF's capacity. (*EFSF*)
- December 8, 2011: ECB announced measures to support bank lending and money-market activity: two longer-term refinancing operations (LTROs) with a maturity of thirty-six months. (*ECBls*) ECB decided to increase collateral availability. (*ECBcrl*)
- December 19, 2011: EU member states support a substantial increase in the IMF's resources. (*OD*)
- February 2, 2012: Treaty establishing the European Stability Mechanism (*ESM*): New legal text of the ESM treaty. (*ESM*)
- February 20, 2012: New Greek package. (*SPdec*)
- February 28, 2012: ECB decided on the eligibility of Greek bonds used as collateral in Eurosystem monetary policy operations. (*ECBcrs*)
- March 2, 2012: Treaty on Stability, Coordination and Governance in the Economic and Monetary Union. (*OD*)
- March 8, 2012: ECB decided on the eligibility of bonds issued or guaranteed by the Greek government in Eurosystem credit operations. (*ECBcrl*)
- March 9, 2012: Private investors agreed to Greek debt restructuring. (*Drst*)
- March 30, 2012: The current overall ceiling for ESM/EFSF lending, as defined in the ESM Treaty, will be raised to €700 billion such that the ESM and the EFSF will be able to operate. (*ESM, EFSF*)
- June 22, 2012: ECB decided to take further measures to increase collateral availability for counterparties. (*ECBcrl*)
- June 25, 2012: The request of the Spanish government for financial assistance. (*SPreq*)
- June 27, 2012: The request of the Cypriot authorities for financial assistance. (*SPreq*)
- June 29, 2012: A single supervisory mechanism. (*OD*)
- July 9, 2012: The Eurogroup politically endorsed the ESM investment policy guideline. (*ESM*)

- July 20, 2012: ECB decided on the collateral eligibility of bonds issued or guaranteed by the Greek government. (*ECBcrs*) Package for Spain. (*SPdec*)
- July 26, 2012: Draghi speech in London. (*ECBdhi*)
- September 6, 2012: ECB made decisions on a number of technical features regarding the Eurosystem's outright transactions in secondary sovereign bond markets. (*ECBomt*) ECB decided on additional measures to preserve collateral availability for counterparties. (*ECBcrl*)
- November 27, 2012: Relaxing of financial/economic conditions for Greece. (*SPrelax*)
- December 14, 2012: The European Council agreed on a roadmap for the completion of the Economic and Monetary Union. (*OD*)
- December 19, 2012: ECB announced change in eligibility of debt instruments issued or guaranteed by the Greek government. (*ECBcrl*)
- March 16, 2013: Relaxing financial/economic conditions for Ireland and Portugal. (*SPrelax*)
- March 22, 2013: ECB announced changes to the use as collateral of certain uncovered government-guaranteed bank bonds. (*ECBcrs*)
- March 25, 2013: Support package for Cyprus. (*SPdec*)
- May 2, 2013: ECB announced change in eligibility of marketable debt instruments issued or guaranteed by the Cypriot government. (*ECBcrl*)
- June 28, 2013: ECB decided on the eligibility of marketable debt instruments issued or guaranteed by the Republic of Cyprus. (*ECBcrs*)
- July 5, 2013: ECB announced change in eligibility of marketable debt instruments issued or guaranteed by the Cypriot government. (*ECBcrl*)

References

Aßmann, C., and J. Boysen-Hogrefe. 2012. "Determinants of Government Bond Spreads in the Euro Area: In Good Times as in Bad." *Empirica* 39 (3): 341–56.

Andersen, T., T. Bollerslev, F. Diebold, and C. Vega. 2003. "Micro Effects of Macro Announcements: Real-Time Price Discovery in Foreign Exchange." *American Economic Review* 93 (1): 38–62.

Arghyrou, M., and A. Kontonikas. 2012. "The EMU Sovereign-Debt Crisis: Fundamentals, Expectations and Contagion." *Journal of International Financial Markets, Institutions and Money* 22 (4): 658–77.

Arghyrou, M., and J. Tsoukalas. 2011. "The Greek Debt Crisis: Likely Causes, Mechanics and Outcomes." *The World Economy* 34 (2): 173–91.

Attinasi, M.-G., C. Checherita, and C. Nickel. 2009. "What Explains the Surge in Euro-Area Sovereign Spreads during the Financial Crisis of 2007-09?" ECB Working Paper No. 1131.

Barbosa, L., and S. Costa. 2010. "Determinants of Sovereign Bond Yield Spreads in the Euro Area in the Context of the Economic and Financial Crisis." *Economic Bulletin* (Banco de Portugal) (Autumn): 131–50.

Barrios, S., P. Iversen, M. Lewandowska, and R. Setzer. 2009. "Determinants of Intra-Euro Area Government Bond Spreads during the Financial Crisis." European Economy Economic Paper No. 388, Directorate General Economic and Monetary Affairs, European Commission.

Beber, A., M. Brandt, and K. Kavajecz. 2009. "Flight-to-Quality or Flight-to-Liquidity? Evidence from the Euro-Area Bond Market." *Review of Financial Studies* 22 (3): 925–57.

Bernoth, K., and B. Erdogan. 2012. "Sovereign Bond Yield Spreads: A Time-Varying Coefficient Approach." *Journal of International Money and Finance* 31 (3): 639–56.

Bernoth, K., J. von Hagen, and L. Schuknecht. 2012. "Sovereign Risk Premiums in the European Government Bond Market." *Journal of International Money and Finance* 31 (5): 975–95.

Borgy, V., T. Laubach, J.-S. Mésonnier, and J.-P. Renne. 2011. "Fiscal Sustainability, Default Risk and Euro Area Sovereign Bond Spreads." Working Paper No. 350, Banque de France.

Caceres, C., V. Guzzo, and M. Segoviano. 2010. "Sovereign Spreads: Global Risk Aversion, Contagion or Fundamentals?" IMF Working Paper No. 10/120.

Claeys, P., and B. Vašíček. 2012. "Measuring Sovereign Bond Spillover in Europe and the Impact of Rating News." Working Paper No. 2012/07, Czech National Bank, Research Department.

Eser, F., and B. Schwaab. 2013. "Assessing Asset Purchases within the ECB's Securities Markets Programme." ECB Working Paper No. 1587.

Favero, C., M. Pagano, and E.-L. von Thadden. 2010. "How Does Liquidity Affect Government Bond Yields?" *Journal of Financial and Quantitative Analysis* 45 (1): 107–34.

Fontana, A., and M. Scheicher. 2010. "An Analysis of Euro Area Sovereign CDS and their Relation with Government Bonds." ECB Working Paper No. 1271.

Gagnon, J., M. Raskin, J. Remache, and B. Sack. 2011. "The Financial Market Effects of the Federal Reserve's Large-Scale Asset Purchases." *International Journal of Central Banking* 7 (1): 3–43.

Gapen, M., D. Gray, C. Lim, and Y. Xiao. 2008. "Measuring and Analyzing Sovereign Risk with Contingent Claims." *IMF Staff Papers* 55 (1): 109–148.

Gerlach, S., A. Schulz, and G. Wolff. 2010. "Banking and Sovereign Risk in the Euro Area." CEPR Discussion Paper No. 7833.

Gómez-Puig, M. 2009. "Systemic and Idiosyncratic Risk in EU-15 Sovereign Yield Spreads after Seven Years of Monetary Union." *European Financial Management* 15 (5): 971–1000.

Hamilton, J., and C. Wu. 2012. "The Effectiveness of Alternative Monetary Policy Tools in a Zero Lower Bound Environment." *Journal of Money, Credit and Banking* 44 (s1): 3–46.

Haugh, D., P. Ollivaud, and D. Turner. 2009. "What Drives Sovereign Risk Premiums? An Analysis of Recent Evidence from the Euro Area." OECD Economics Department Working Paper No. 718.

Hollo, D., M. Kremer, and M. Lo Duca. 2012. "CISS — A Composite Indicator of Systemic Stress in the Financial System." ECB Working Paper No. 1426.

Krishnamurthy, A., and A. Vissing-Jorgensen. 2011. "The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy." *Brooking Papers on Economic Activity* (Fall): 215–87.

———. 2013. "The Ins and Outs of LSAPs." In *Global Dimensions of Unconventional Monetary Policy*, 57–111. Proceedings of an annual Economic Policy Symposium sponsored by the Federal Reserve Bank of Kansas City, held in Jackson Hole, Wyoming, August 22–24.

Manganelli, S., and G. Wolswijk. 2009. "What Drives Spreads in the Euro Area Government Bond Market?" *Economic Policy* 24 (58): 191–240.

Merton, R. 1974. "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates." *Journal of Finance* 29 (2): 449–70.

Oliveira, L., J. Curto, and J. Nunes. 2012. "The Determinants of Sovereign Credit Spread Changes in the Euro-Zone." *Journal of International Financial Markets, Institutions and Money* 22 (2): 278–304.

Palladini, G., and R. Portes. 2011. "Sovereign CDS and Bond Pricing Dynamics in the Euro-area." NBER Working Paper No. 17586.

Pozzi, L., and G. Wolswijk. 2012. "The Time-Varying Integration of Euro Area Government Bond Markets." *European Economic Review* 56 (1): 35–53.

Rai, A. M. 2013. "The Impact of Policy Initiatives on Credit Spreads during the 2007–09 Financial Crisis." *International Journal of Central Banking* 9 (1): 45–104.

Sgherri, S., and E. Zoli. 2009. "Euro Area Sovereign Risk during the Crisis." IMF Working Paper No. 222.

Schwarz, K. 2010. "Mind the Gap: Disentangling Credit and Liquidity in Risk Spreads." Working Paper, Wharton School, University of Pennsylvania.

von Hagen, J., L. Schuknecht, and G. Wolswijk. 2011. "Government Bond Risk Premiums in the EU Revisited: The Impact of the Financial Crisis." *European Journal of Political Economy* 27 (1): 36–43.