

THE DRAGHI PUT: WHEN UNEXPECTED WORDS ON JOINT-LIABILITY SPEAK LOUDER THAN ACTIONS

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Abstract

This paper explores the process of re-convergence of GIIPS sovereign bond yields, which restarted in Q3 2012. We empirically analyse the impact of conventional and unconventional monetary policy and fiscal support measures in the EMU on bond pricing behaviour.

We find that yield re-convergence of 2-, 5- and 10-year bond yield spreads and 5- and 10-year CDS spreads can be explained by crisis policy actions unknown to investors before uncertainty spread on markets.

We find first evidence for a superior yield-spread driving factor, namely, investors' uncertainty about joint liability within the EMU during times of crisis.

Keywords: (un-)conventional monetary policy, quasi-fiscal bailouts, dynamic macro panel, FGLS, GARCH.

JEL Classification: E63, E43, F43, G15

1 Introduction

It is believed that Mario Draghi's pledge to "do whatever it takes" to defend the "integrity of the union" set off the re-convergence of interest rates among the European Monetary Union (EMU) member states of Greece, Ireland Italy, Portugal and Spain, which are also known as the GIIPS states (Eichengreen, 2015, p. 415). Figure 1, p. 32 shows that beginning in Q3 2012, interest rate spreads between the GIIPS and the German 10-year government bonds again declined.

What influenced the re-convergence of interest rates among the GIIPS countries? Are yield spread movements driven by uncertainty about joint liability within the EMU? To answer these research questions, three hypotheses are tested with a dynamic panel data model of the GIIPS countries over the period from 2007 to 2015:

First, fiscal fundamentals are assumed to have an impact on the yield spreads only until unconventional and quasi-fiscal crisis measures were imposed and until uncertainty about solidarity within the EMU declined. Second, only unexpected crisis measures reduced the spreads because they lowered the market volatility. Finally, credible announcements of those measures, e.g., the Securities Market Programme (SMP) or the European Financial Stability Facility (EFSF), were sufficient to reduce stressed EMU countries' refinancing costs.

In addition, our analysis is motivated by theoretical concerns: The standard asset-pricing theory seems to provide less explanatory power because it primarily focuses on country-specific components in determining bond prices.

The paper is structured as follows. In Section 2, a brief literature review involving the determinants of government bond yield spreads within the EMU is given. Subsequently, the hypotheses are formulated. In addition, the data are described and an explanation of the empirical methodology and its identification strategy is provided (Section 3). A dynamic panel data model is used to test the hypotheses in Section 4. The first regressions target monetary policy actions, which are also described explicitly in this part. Next, the same is performed for fiscal policy measures. In Section 5 of this paper, the robustness of the baseline regression results and a generalized autoregressive conditional heteroscedasticity (GARCH) model for a country-specific analysis are the focus. In the final Section, the main results are summed, and a short discussion of further research and follow-up studies is provided.

2 Government bond yields in the EMU

In theory, the interest rates of government bonds can be explained, for example, via an asset-pricing model, as in Cochrane (2005). The price of an asset, which determines the asset's yield, is given by the future expected cash flow added to risk premiums. Thus, price differentials between two assets with the same cash flow should be zero only if those assets have identical risk-return properties. The following literature review will show which factors determined the bond yield differentials within the Eurozone.

2.1 Determinants of government bond yields in the literature

There are several strands of literature in this field of research regarding the various observable periods of yield spreads.¹ The first strand of literature includes works that explain the drivers of the European sovereign bond markets before the introduction of the euro. The second strand analyses the bond yield determinants during the first decade of the common currency, when the bond yields were compressed. The third strand is associated with existing literature on the influencing factors of sovereign bond yields during the financial and European sovereign debt crisis.

Government bond yields varied widely among the later EMU countries before the euro was introduced (Sapir, 2011). The literature on the reasons for those spreads finds exchange-rate movements and risk, controls on capital movements and diversities in tax treatments, and liquidity risk and credit risk to be the main drivers for the observed yield spreads (Codogno et al., 2003; Gómez-Puig, 2006; Klepsch, 2011). In the same vein, Sinn (2010) emphasizes the strategy of countries with high sovereign debts to devalue their currencies as a reason for the different interest rates of government bonds.

The introduction of Europe's common currency on January 1, 1999 paved the way for an integrated government bond market in the EMU (Sapir, 2011). The government bond yields issued by the EMU member states began converging steadily after the euro was announced. Controls on capital movements had been removed before the EMU began. As soon as the currency was implemented and the exchange-rate risk and different tax treatments were removed, variations among interest rates on

¹ Figures A1 through A4 illustrate the various periods of yield spreads within the EMU.

government bonds converged into a narrow interest-rate bandwidth that reached its lowest variance in 2004 and 2005.²

Although differences in country-specific credit and liquidity remained after the introduction of a common currency, their impact on the bond-pricing process changed. This is the main conclusion of the second strand of literature, which focuses on the yield spreads within the EMU during the first decade of the euro. Before the common currency, investors claimed a higher yield either if a country's risk of default was higher (credit risk) or if there was a higher potential risk of selling illiquid securities in inferior market conditions (liquidity risk) compared to another country. Bernoth et al. (2012) and Schuknecht et al. (2008) provide empirical evidence that with the introduction of the common currency, a country's risk of default was no longer part of the bond-pricing process. Bernoth et al. (2012) and Schuknecht et al. (2008) find a lower impact of fiscal performance on yield spreads after the introduction of the euro. Furthermore, Bernoth et al. (2012), Codogno et al. (2003) and Geyer et al. (2004) also find a lower impact of liquidity risk for yield spreads with the beginning of the EMU because the integration of the financial markets increased.³ Codogno et al. (2003) suggest that yield spreads in the EMU are primarily driven by a common factor, namely, investors' risk aversion, which may be an important driver of bond yields because it represents the market participants' current affinity for risk. In times of economic downturns, uncertainty about income increases. As a result, investors become more risk averse and demand a higher yield on assets so that they are compensated for the additional component of doubtful income (Codogno et al., 2003; Geyer et al., 2004).

The financial crisis and its repercussions on public finance in the EMU triggered a rebound of the spreads (Manganelli and Wolswijk, 2009). Especially after this crisis culminated into the European sovereign debt crisis, spreads between the German bund (the benchmark)⁴ and other euro-area government bonds reached values exceeding those observed before the EMU was established. This development is illustrated in Figure 1.

² Figure A1 illustrates this process. A detailed overview of the convergence of government bond yields after the euro was introduced is provided by Pagano and Thadden (2004).

³ The liquidity risk is primarily measured by the issue size and bid-ask spreads (Manganelli and Wolswijk, 2009). Conversely, Gómez-Puig (2006) find an impact of liquidity risk on yield spreads via alternative measures. She uses the relative market size levels as a measure of liquidity and argues that small EMU countries decreased in relative liquidity compared to the German bond market. This, in turn, results in higher spreads (Gómez-Puig, 2006).

⁴ Germany is selected as the benchmark country, following Favero et al. (2000). The authors associate the benchmark bond with the lowest yield value. Dunne et al. (2002) provide an interesting discussion of defining a benchmark status, criticizing the lowest yield value selection rule. A robustness test analyses the yields instead of the spreads to account for that critique (Chapter 5).

[Figure 1 about here]

The heterogeneous yield spreads during the crisis period triggered a third wave of research that analyses the determinants of those spreads in the absence of exchange-rate risks.

Barrios et al. (2009) conduct an empirical analysis of government bond yield spreads in the euro area during the financial crisis. In this study, general risk perception is a major driving factor. Furthermore, the authors find that macroeconomic fundamentals have played a more critical role since the beginning of the financial crisis. This is an indicator of investors beginning to discriminate between countries, compared to the pre-crisis situation in which government bond yields were more homogenous. This finding is confirmed by Klepsch (2011), whose empirical study shows the existence of a positive influence of fiscal variables on yield spreads that increases in interaction with the financial crisis period. The varying influence of a country's credit risk on yield spreads before and during the crisis may indicate the existence of an additional factor that influences the impact of credit risk on the valuation of a bond. As we describe in detail in Section 2.2, we hypothesize that this factor represents investors' uncertainty about joint liability within the EMU. We further the research of Barrios et al. (2009) and Klepsch (2011) by analysing the impact of the credit risk not only in interaction with the sovereign debt crisis but also in interaction with the period after the most important unconventional and quasi-fiscal crisis measures were implemented by various EMU institutions.

A wide range of literature focuses on the role of the communication of different institutions and authorities in bond yield spreads in the EMU during the debt crisis. These institutions include central banks (CBs), government councils and rating agencies.

Beetsma et al. (2013), Büchel (2013), Mohl and Sondermann (2013) and Zoli (2013) examine the effects of public statements on the GIIPS' credit default swaps (CDS) and bond yield spreads. Although their studies differ with respect to their samples and methodologies, they arrive at the common conclusion that news affecting the financial support of a crisis country could reduce that country's yield spreads. Our study aims to expand their contributions by distinguishing the effects of the announcement and the implementation of conventional and unconventional political measures, respectively.

Some studies have analysed the impact of the ECB's unconventional policy measures related to bond yield spreads within the EMU. Beetsma et al. (2014) and Eser and Schwaab (2013) find that the SMP had a reducing impact on yield spreads of the GIIPS vis-à-vis Germany. Szczerbowicz (2015) provides a comprehensive study of all of the ECB's unconventional measures between 2007 and 2012 and concludes that the SMP and Outright Monetary Transactions (OMT) were the most effective measures for lowering the long-term borrowing costs of banks and governments. Like Szczerbowicz (2015), we explore the ECB's non-standard (unconventional) monetary policy actions. In addition, we do the same regarding the EMU states' policy interventions, which also aimed at reducing the yield spreads and affected investors' beliefs about solidarity within the EMU.⁵

Figure 1 indicates that as of Q3 2012, one can observe an unambiguous tendency of spread reduction vis-à-vis Germany.⁶ Given the studies that have been published in this field of research, there is a focus on the crisis period, which is characterized by its permanent increase in yield spreads. The period of re-convergence raises a variety of interesting questions that must be thoroughly investigated. Therefore, we expand the research by additionally focusing on the observable re-convergence of yields around 2013.⁷

The potential second period of yield-spread convergence is of focal concern for this project. More importantly, this period could provide further information about the relevance of credit risk. Moreover, this period could clarify the role and importance of EMU institutions or crisis mechanisms during the crisis. Finally, and most interestingly, the re-convergence of yields offers the opportunity to empirically analyse whether bond prices in the GIIPS are primarily driven by a previously unknown factor: investors' uncertainty about joint liability within the EMU.

2.2 Uncertainty about joint liability within the EMU

Before the introduction of the euro, a period of bond yield convergence and financial market integration had begun (Sapir, 2011). This convergence may be explained by the formation of ex ante expectations of a bailout upon the occurrence of large-scale events such as financial or sovereign debt crises (Neck and Sturm, 2008a). These expectations might stem from a potential time-inconsistency of

⁵ Blinder et al. (2008) provide a detailed general overview of the role of the CB's communication, which will be of interest to this paper because the effect of announcements is compared to the effect of the allotment of a measure.

⁶ Figure A2 through Figure A4 show the 10-year bond yield spreads during the respective periods.

⁷ Table B1, p. 41 provides an overview of recent studies on the determinants of yield spreads in the EMU.

the no-bailout clause in Article 125 of the Treaty on the Functioning of the European Union (TFEU).⁸ Therefore, market participants had a reason to expect bailouts for troubled EMU countries. For that reason, they formed their requested bond prices based on European information, not country-specific issues (Baskaran and Hessami, 2011; Neck and Sturm, 2008a). However, it remained uncertain whether bailouts would occur because they had never been explicitly introduced before the debt crisis.

The main hypothesis of this project is as follows: Varying levels of uncertainty about joint liability within the EMU are one major driver of yield spreads during the European sovereign debt crisis. With the outbreak of the financial crisis and the increasing possibility of a break-up or collapse of the Eurozone, implicit bailout expectations were jeopardized. It was uncertain whether EMU states would truly vouch for troubled governments. Accordingly, yields de-converged and country-specific characteristics again gained importance for the bond-pricing process.

Unconventional crisis policy measures by EMU institutions are expected to have a quasi-fiscal effect on investors. Therefore, they reduced investors' uncertainty about joint liability within the EMU and thus, bond yield spreads. For these reasons, the yield spreads during the crisis reflect – among other factors that we will control for – implicit bailout expectations that were ambiguous and thus uncertain for a long time after the outbreak of the crisis.

With regard to this hypothesis, several sub-hypotheses are formulated:

1. In line with Barrios et al. (2009) and Klepsch (2011), country-specific characteristics such as fiscal fundamentals are assumed to be significant for yield spreads only during the period of the sovereign debt crisis when uncertainty about joint liability within the EMU was high and investors had to assume that no other countries within the EMU guarantee for the repayment of a crisis country's credits. Therefore, a specific country's credit risk will be important for investors' bond pricing behaviour (Barrios et al., 2009; Klepsch, 2011). We hypothesize that this country-specific credit risk played a minor role after the various EMU institutions' implementation of the most important unconventional policy measures. We assume that those measures reduced investors' uncertainty about joint liability within the EMU. Therefore, investors could expect that other members of the EMU would also guarantee the repayment of a crisis country's credits.

⁸ Time inconsistency occurs if a policy chosen at time for time differs from the policy chosen for the same period at that period without any change in the environment (Drzen, 2001, chap. 4).

2. Conventional measures by various EMU institutions in reaction to the crisis, such as the establishment of new treaties with respect to governmental institutions or the ECB's reduction of the policy rate, were less effective in reducing GIIPS yield spreads compared to unconventional fiscal (e.g., EFSF, EFSM) and monetary (e.g., SMP, OMT) policy measures. The hypothesis is that the latter were effective in reducing investors' uncertainty about joint liability within the EMU, thus lowering yield spreads.

3. Additionally, and in accordance with previous empirical findings (e.g., Mohl and Sondermann, 2013) that communication by EMU institutions influences yield spreads, we hypothesize that announcements of unconventional policy measures have a stronger impact than the actual allotment of those measures, provided they are credible. The reason for this hypothesis is that to reduce investors' uncertainty about joint liability within the EMU, it is sufficient to communicate that rescue measures will take place.

Although several political interventions have been the object of study, explanations for the re-convergence of EMU yields are still lacking.

3 Data and empirical strategy

Before testing the hypotheses elucidated in the previous Section, this Section aims at explaining the underlying dataset, its data properties, the empirical model and its identification strategy.

3.1 Data sources and definitions

Based on the empirical research about government yield spreads in the EMU (Section 2.1), a dataset is created that should include all of the factors that are relevant to government interest rates. Additionally, motivated by the hypotheses in 2.2, the impact of crisis measures is the focus of this analysis. Thus, various dummy variables that attempt to model the crisis policy process as adequately as possible are the core of this dataset. Below, the variables from the empirical part are explained along with the motivation for including them in this study.⁹

⁹ In the Appendix C, a detailed overview of all of the variables is provided (Table C1. p. 42).

Financial data

The government bond yields are daily data obtained from the Thomson Reuters Datastream database. The sample is composed of six countries (Germany and the GIIPS) for the time period from January 1, 2007 through March 31, 2015. The financial data have different maturities: the bond yield data have 2-, 5- and 10-year maturities, whereas the CDS have 5- and 10-year maturities. With regard to the research question, if unconventional policy measures by EMU institutions could reduce uncertainty about joint liability within the EMU (and thus yield spreads), the financial data are the dependent variables.¹⁰

Fiscal fundamentals

The data for fiscal fundamentals are selected based on the theoretical and empirical finding that a country's credit risk impacts the price of a bond and ultimately the yield spreads if the credit risk of the benchmark country is different (see Section 2.1). To control for credit risk, a government's debt as share of gross domestic product (GDP) as set forth in the Thomson Reuters Datastream database is included. The frequency of the fiscal data is quarterly.¹¹

The perceived credit risk in the global economy may also have an impact, as in Gerlach et al. (2010). This perceived risk is measured using the Treasury Bill Eurodollar Difference (TED) spread, which is the three-month LIBOR rate minus the three-month US Treasury bill rate. The data are available in the Thomson Reuters Datastream database.

Finally, perceptions of a country's financial sustainability, which can result from the ratings of a credit rating agency (CRA), can influence the size of a risk adjustment, as is shown, e.g., in Afonso et al. (2012). Thus, we include a credit rating variable that is updated quarterly and ranges from 1 to 20, where the highest value is equal to a triple A. A country's credit rating is available in the Thomson Reuters Datastream database.

Some empirical studies also use variables that control for the general economic situation (Ehrmann and Sondermann, 2012; Nickel et al., 2011). This inclusion is motivated by the fact that government revenues tend to decrease in a weak economic environment, causing debt and thus credit risk to

¹⁰ The formal empirical model and its dependent and independent variables are described in Section 3.2.

¹¹ To prevent breaks in the time structures, the method used by Klepsch (2011) is followed and all low frequency data are held constant until a new observation occurs.

increase (Attinasi et al., 2009). According to the theory of asset pricing, the price of a bond (and therefore its yield) is affected by changes in the default risk. To control for the Eurozone's market-wide change in business climate, the total stock market index for the European Union (EU) can serve as a good proxy, as in De Bruyckere et al. (2013).

Financial risk aversion

Because investors' risk aversion turned out to be a major driver of yield spreads (Codogno et al., 2003), it is important to model this effect by finding good proxies. In theory, more risk-averse investors require higher yields to be compensated for uncertainty. As a global risk-aversion measure, the Volatility Index (VIX) (Chicago Board of Exchange) is selected from the Thomson Reuters Datastream database. This is used in most studies (e.g., Beetsma et al., 2014; Codogno et al., 2003; Eser and Schwaab, 2013; Klepsch, 2011). The VIX measures the volatility of the United States (US) equity market and is based on the S&P 500 Index (SPX^{SM}). Because the SPX^{SM} measure of risk aversion is created based on the US market, a measure of investors' willingness to bear risk in the Euro market is also required. In this study, the EURO STOXX 50 Volatility index (VSTOXX) is used, following Arghyrou and Kontonikas (2012) and Glick and Leduc (2012).

Fiscal and monetary policy data

The main part of the dataset is composed of variables for monetary and fiscal policy events during the sovereign debt crisis. As the literature review shows, some recent studies include the impact of public statements in their analysis (Beetsma et al., 2014, 2013; Büchel, 2013; Mohl and Sondermann, 2013). Our focus, however, is on a specific crisis measure and its impact. Therefore, all crisis policy announcements and implementations are collected from different programme reports. The distinction between an announcement and the conduct of an intervention enables an assessment of whether announcements have a different effect than implementations.¹² This will be important for explaining the third hypothesis. For the fiscal policy measures, we create different dummy variables that represent the main bailout measures and fiscal treaties between 2007 and 2015. For example, a crisis country that is currently involved in an economic adjustment programme has a value of one for the related dummy variable. Disbursements by various institutions during the programme, for example, the

¹² Thus far, such a distinction is possible.

International Monetary Fund (IMF) and the European Financial Stability Facility (EFSF), are represented by additional dummy variables that take a value of one for all days that a disbursement took place.

The monetary policy events are created in the same manner as the fiscal policy events. The idea is to generate variables for each unconventional monetary policy event. Taken together, these event variables represent dummies that take on the value of one if any unconventional action is conducted. The basic sources for the construction of the variables are monthly and annual reports published by the ECB. Furthermore, a historical ECB dataset on all long-term refinancing operations (LTROs) and the main refinancing operations (MROs) are used to create a comprehensive set of data that represents the ECB's conventional and unconventional measures.¹³

Based on this dataset, the main dependent variables are the various government bond yield and CDS spreads. The main explanatory variables are the crisis policy measures taken by EMU institutions. The dataset begins in January 2007 and ends in March 2015. The starting point in 2007 is selected because at that point in time, the crisis had not begun and no political intervention had been implemented. The countries that are included are Germany and the GIIPS states. Therefore, we ultimately arrive at a panel dataset with a small panel dimension N (countries) and a large T attributable to the daily time dimension.

3.2 Econometric modelling

Because of the high persistence of financial time series, the panel data model needs to contain a lagged dependent variable.¹⁴ Equation (1) shows the dynamic panel data model that explains the yield spreads in the GIIPS countries.

$$(1) \text{spreads}_{i,t} = \alpha_0 + \rho \text{spreads}_{i,t-1} + \beta X_{i,t} + \lambda \text{crisispolicy}_{i,t} + \sum_{i=1}^4 \delta_i D_i + \sum_{i=1}^4 \gamma_i D_i \times \text{crisis} \\ + \sum_{i=1}^4 \mu_i D_i \times \text{postcrisis} + \varepsilon_{i,t}$$

with $i = 1, \dots, 5$ denoting the GIIPS countries; and $t = 1, \dots, 3012$ denoting the daily time dimension.

¹³ See Table C1. p. 42, for a complete list and description of all fiscal and monetary policy measures.

¹⁴ A panel data model that includes the past values of variables is called a dynamic panel data model (Wooldridge, 2010).

The residual analysis of this regression using a fixed effects (FE) estimator shows three important characteristics.¹⁵ First, the variance of the error process differs across units. This phenomenon is called groupwise heteroscedasticity.¹⁶ Second, cross-sectional dependence (CD) is present.¹⁷ It occurs when the errors are contemporaneously correlated across cross-sectional units, e.g., because of common temporal shocks such as, in this case, the European sovereign debt crisis (Sarafidis and Wansbeek, 2012). A third issue is represented by serial correlation in the idiosyncratic errors of the panel data model.¹⁸ This issue implies that the error term is not independent and identically distributed (i.i.d.); therefore, the FE estimator cannot be used.

Equation (1) is estimated using a feasible generalized least squares (FGLS) estimator because it allows for correction of groupwise heteroscedasticity, CD and serial correlation of the error term.

The dependent variable is the government bond yield spread of country i at time t vis-à-vis Germany. The yield spreads are calculated for different maturities: i.e., for 2-, 5-, and 10-year bond yields and for 5- and 10-year CDS premia. Because these series are highly persistent, the first lag of the dependent variable ($\rho 1spreads_{i,t-1}$) is included as a regressor to transform the highly persistent time series in a weakly dependent process.¹⁹ $\beta X_{i,t}$ is a set of control variables that is selected following several studies of the determinants of government bond yields in the EMU (2.1) and includes all of the variables described in Section 3.1.²⁰

For the credit risk, which is measured via credit ratings, a positive impact on the yield spreads is expected because a higher credit-risk spread increases yield spreads.²¹ Referring to the first hypothesis in Section 2.2, we expect this correlation to occur particularly during the European sovereign debt crisis period, when uncertainty about bailouts was high.

¹⁵ When using the FE estimator, the country dummies are not included because the estimation methodology already controls for country-specific time-invariant effects.

¹⁶ A modified Wald statistic for groupwise heteroscedasticity in the residuals of a FE regression model is calculated, following Baum (2001) and Greene (2012). Homoscedasticity is the null hypothesis of this test, which is rejected at the 1% significance level for all different dependent variables (Table C2, p. 45).

¹⁷ A Breusch-Pagan Lagrange Multiplier (LM) test for cross-sectional independence in the residuals of a FE model is conducted, following Baum (2001), Breusch and Pagan (1980) and Greene (2012). The test is valid for large T and small N. The null hypothesis of no CD is rejected for all government bond yields at the 1% significance level (Table C2, p. 45).

¹⁸ A Wald test for serial correlation in the idiosyncratic errors, as discussed by Drukker (2003), is conducted. The null hypothesis of no serial correlation is rejected (Table C2, p. 45).

¹⁹ A weakly dependent process is integrated at order zero. Averages of this sequence satisfy the standard limit theorem (Wooldridge, 2013). The lags of higher orders have no impact and are omitted for reasons of parsimony.

²⁰ Fiscal fundamentals are also displayed in spreads vis-à-vis Germany.

²¹ The debt to GDP ratio and the credit risk are not included both in the regression to avoid multicollinearity.

In addition to the analysis of the varying impact of a country's credit risk on yield spreads during the crisis, the country dummies provide further evidence for or against the first hypothesis in Section 2.2. We expect country-specific characteristics to have an impact, especially during the debt crisis because uncertainty about joint liability within the EMU was high and country-specific information has therefore been crucial for investors' bond-pricing behaviour. We assume that GIIPS country information increased yield spreads because, e.g., specific ill-designed fiscal institutions raised the fear of investors with respect to fiscal sustainability and thus a country's demanded yields (positive and significant γ_i). With respect to the main hypothesis, the uncertainty about joint liability within the EMU declines with the EMU institutions' unconventional crisis measures. Thus, country-specific properties should no longer increase yield spreads in interaction with the post-crisis policy period (insignificant μ_i coefficient).

The main explanatory variables are the crisis policy measures. The term $\lambda \text{crisispolicy}_{i,t}$ includes all policy measures that were implemented by different EMU institutions. Consequently, the parameter of interest is λ , which shows whether political interventions in the EMU have an impact on bond yield spreads. A negative correlation is expected in general, according to the main hypothesis set forth in Section 2.2. The crisis interventions are distinguished according to whether they are conventional and unconventional measures and further by announcement and disbursement actions to account for the second and third hypotheses. Finally, the idiosyncratic error of the model is $\varepsilon_{i,t}$.

Identification strategy

A causal interpretation is only possible in the absence of endogeneity. Omitted variable bias, simultaneity bias and measurement errors are factors that lead to an endogeneity problem in the regression. First, the omitted variable bias occurs if components that influence both the dependent and the explanatory variable are omitted from the regression (Wooldridge, 2013).

The probability of this bias is reduced by the serious consideration of influencing components from previous studies. In the panel data context, an omitted variable bias is most likely to occur because of the unobserved heterogeneity of the panels. This problem is ruled out through the integration of the country dummy variables that control for all time-consistent individual effects. A model

misspecification caused by an omitted variable bias is therefore unlikely.²² The same holds for a bias caused by a measurement error because the data are derived only from reliable databases such as Thomson Reuters, the ECB's statistical warehouse, etc.

The simultaneity bias that occurs if the direction of the effect could be reversed is a more serious concern in this analysis. With regard to the assumed reducing impact of crisis policy measures on the yield spreads the effect could be the other way around, too: An increase in yield spreads triggers the crisis policy measures so that there is a positive relationship. We assume that crisis policy measures are not strictly exogenous because they were installed only in response to the sovereign debt crisis (in general, therefore, there might be a positive relationship). However, the several disbursements and purchases of crisis policy measures are mostly predetermined by referring to the daily frequency of the dataset. Before the markets open, it has already been decided whether a purchase or disbursement will take place on that day because it requires time to discuss a strategy that involves a large number of institutions (e.g., in the case of the SMP, both the ECB and all of the national CBs had to agree to the purchase process). Using daily data, the probability of a simultaneity bias becomes generally low, following several studies (e.g., Brutti and Sauré, 2015; Eser and Schwaab, 2013).

4 Empirical results

Below, the estimation results of equation (1) are discussed. The variables of interest are the different measures of the EMU institutions during the debt crisis period with regard to the uncertainty about the joint liability hypothesis of Section 2.2. These variables are described briefly before their impacts on the yield spreads are studied. Table 1 analyses the monetary-policy interventions, whereas Table 2 focuses on the EMU states' crisis measures.

4.1 The ECB and its role during the financial and European sovereign debt crisis

Since the outbreak of the financial crisis and especially as this crisis turned into the European sovereign debt crisis, the ECB has begun to expand its standard monetary policy measures to ease credit and liquidity constraints (Carpenter et al., 2013).

²² In the robustness analysis, all of the variables that show a significant effect are regressed on the yield spreads within a single regression (Table 3).

The implemented unconventional measures can be roughly grouped into exceptional liquidity measures and purchases of assets, as, e.g., in Szczerbowicz (2015). The former group of measures began by expanding the acceptance of a wide range of collateral and the easing of lending rules. Because this was a somewhat “soft” measure, these actions were followed by several additional liquidity measures. These measures were beyond the framework of the exerted open market operations that had previously been implemented.²³ On August 22, 2007, the ECB decided to conduct additional 3-month LTROs with a variable rate tender procedure; on March 27, 2008, it decided to start conducting 6-month LTROs.²⁴ The ECB’s non-standard toolbox was expanded on October 8, 2008, when the MROs’ tender procedure switched from a variable-rate tender to a fixed-rate tender with full allotment (FRFA). This implied the provision of unlimited liquidity at the policy rate. Several days later, the LTROs were allotted using the same procedure. Previously, this tender procedure was kept unchanged, with the exception of a short return to the variable-rate tender between April 28, 2010, and May 10, 2010. The same tender procedure was applied to the additional LTROs that were systematically implemented as the debt crisis continued. Initially, the maturity was doubled and two 12-month LTROs were announced. Finally, the strongest liquidity innovation took place on December 8, 2011, when the ECB announced the implementation of LTROs with a maturity of 36 months. The most recent unconventional measure was the June 5, 2014, implementation of targeted LTROs (TLTROs), which aimed at improving bank lending to the euro area’s non-financial private sector.²⁵

The second group of unconventional policy measures, purchases of assets, was aimed at reducing speculation and self-fulfilling prophecies by market participants (European Central Bank, 2016d). This type of measure can be described as credit easing that has the property of modifying the composition of assets if financially stressed securities are purchased by the central bank.²⁶

Until now, many programmes have been established that can be generally described as asset purchases. The first such programme was the CBPP, which was announced on June 4, 2009. Two

²³ The regular open market operations of the ECB comprise weekly-allotted MROs, 3-month LTROs and fine-tuning and structural operations (European Central Bank, 2016a, 2016b).

²⁴ The following dates of the monetary policy measures are based on the ECB’s Statistical Data Warehouse, a historical dataset of the ECB as well as on their ad hoc communication of additional policy measures (European Central Bank, 2016a, 2016c).

²⁵ See Appendix D, Figure D2, p. 46, for an overview of the allotted and total values of the additional LTROs.

²⁶ Credit easing can be further divided between pure and quantitative credit easing. The former results in sterilization of purchases through the disposal of other central bank assets (like the SMP). Quantitative credit easing occurs if purchases are part of the central bank’s balance-sheet expansion (Szczerbowicz, 2015).

additional CBPPs followed. The target of those measures is to “...enhance the functioning of the monetary policy transmission mechanism, support financing conditions in the euro area, facilitate credit provision to the real economy and generate positive spillovers to other markets” (European Central Bank, 2016d). One of the most-criticized programmes in the context of asset purchases, the SMP, was implemented on May 10, 2010. The reason for the criticism is that this programme represented the first time that the ECB had intervened in public and private debt securities markets in the euro area.

[Figure 2 about here]

Figure 2 shows the size of several SMP purchases and the total holdings under the programme. On September 6, 2012, the OMT replaced the SMP. Both programmes were aimed at ameliorating the financially stressed environment that had been affecting the mechanisms of monetary policy transmission. Finally, in June 2014 an asset-based securities purchase programme (ABSPP) and a public-sector purchase programme (PSPP) joined the ECB’s growing list of non-standard policy activities. Together with the third CBPP, these measures were integrated into an expanded asset-purchase programme (APP) to address the risks of an overly long period of low inflation. This programme’s monthly purchases will involve both public- and private-sector securities.²⁷

Finally, an intervention that cannot be attributed to either of these two general definitions but that is very likely to have had an impact on the severe tensions in certain market segments and the fear of the EMU drifting is indicated by Mario Draghi’s speech at the Global Investment Conference in London on July 26, 2012: “Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough.” (European Central Bank, 2016e).

The impact of all of these described measures is part of the empirical analysis that is elaborated below.

²⁷ For a brief overview of the ECB’s asset-purchase programmes and their corresponding defined targets, see European Central Bank (2016d). Figure D3, p. 47 and Figure D4, p. 47 illustrate the purchases and total holdings under several established asset-purchase programmes.

Impact of monetary policy measures on bond yield and CDS spreads

Table 1 was estimated using a FGLS estimator correcting for CD, heteroscedasticity and autocorrelation of the error term. Table 1 shows the estimation results of Equation (1), and the $\lambda_{crisispolicy_{i,t}}$ term includes monetary policy measures as its main explanatory variable.

Columns (1) through (5) show five dependent variables. The first three columns are government bond yield spreads with 10- 5- and 2-year maturity. Columns (4) and (5) display CDS spreads with 10- and 5-year maturity as the dependent variable. Column (6) adds several interaction terms for testing the first hypothesis, with the 10-year bond yields as the dependent variable.²⁸

The purpose of this research project is to determine whether various institutions' unconventional policy measures can lower yield spreads and return investors to their pre-crisis behaviour. The overall picture of Table 1 provides some evidence that the ECB's unconventional policy measures can induce this behavioural change.

[Table 1 about here]

Stronger measures, such as SMP or OMT, are particularly likely to achieve a yield-spread reduction. This finding is in line with the previous findings of Beetsma et al. (2014), Eser and Schwaab (2013) and Szczerbowicz (2015).

The estimation results of the various lagged dependent variables always show a positive and highly significant influence, indicating high persistence of the financial time series. The included control variable, referring to investors' risk aversion (Euro-STOXX), is in line with the findings of both the theory and the empirical evidence (2.1). An increase in risk aversion significantly increases the yield spreads.

The country dummies in column (1) through (5) control for unobserved heterogeneity. Greece, Ireland and Portugal show significantly higher spreads compared to the base category of Italy.²⁹

The results of the country dummies and fiscal fundamentals are crucial in finding explanations for the first hypothesis. In this respect, column (6) is of interest. The country dummies of Greece, Italy,

²⁸ Yields instead of spreads are used so that Germany can be chosen as the country dummy baseline category for testing the first hypothesis. Therefore, the country dummies in interaction with different periods are of special interest with regard to column (6).

²⁹ Italy is the base group category because it has never been a programme country and usually had the lowest bond yields in the GIIPS. Germany cannot be chosen because it is already the base category for the yield spread calculation. Because the country effects compared to Germany are of interest with regard to the first hypothesis, column (6) analyses the yields instead of the spreads that Germany can be used as the base category for the country dummies.

Ireland, Spain and Portugal, with Germany as the omitted category, have a significant impact on yields in interaction with the sovereign debt crisis dummy.³⁰ These countries' yields are significantly higher compared to the base category of Germany.³¹ This finding implies that, especially during the European sovereign debt crisis, country-specific effects gained influence and that investors began to distinguish among the countries of the EMU. This result provides the first evidence for our main hypothesis: If investors are uncertain about joint liability within the EMU and must assume responsibility for repayment of a country's credits, they begin to distinguish among the countries based on their individual characteristics.

To complete the conjecture of the first hypothesis, the second interaction term specification is also important. An interaction term of the post-crisis policy period and the country dummies is included to enable a comparison of the interaction with the crisis dummy. Draghi's famous speech is chosen because it was one of the last ECB crisis interventions. Thus, the time after the speech can be treated as the post-crisis policy period.

The empirical findings are consistent with the first hypothesis: The country-specific, time-invariant effects were insignificant after Draghi's speech. This indicates that investors stopped demanding higher yields for bonds because of differences in national settings and returned to their pre-crisis behaviour, in which EMU characteristics formed the bond prices.

The credit risk is expected to create a similar picture with respect to the first hypothesis. This risk is measured by a country's credit rating. The measured effect is significant, particularly for the crisis period, which can be observed in columns (1), (2), (5) and (6). For the first five columns, we apply the rule: The higher the total distance of a country's rating from the German rating (triple A), the higher the yield spreads. This relationship holds only until Draghi announced the ECB's new philosophy. The interaction term of the post-crisis policy period and the credit rating spread is negative and significant at the 1% level, which contradicts the theory but supports the hypothesis. The finding implies that after Draghi's announcement, investors no longer demanded a higher yield for a greater risk of default, as suggested by the theory. This indicates that after the speech, it was the EMU's credit risk that was relevant to the bond-pricing process, not the credit risk of a single EMU country. This supports our

³⁰ The European sovereign debt crisis dummy takes the value 1 as of November 5, 2009 until July 26, 2012, when Mario Draghi's speech took place.

³¹ Klepsch (2011) arrives at a similar finding in her analysis, but her crisis dummy represents the financial crisis.

main hypothesis, i.e., that investors' bond-pricing behaviour is also affected by their uncertainty about joint liability within the EMU. If uncertainty about those expectations is reduced, investors change their bond-pricing behaviour accordingly. Column (6) confirms this relationship.³²

With regard to the second hypothesis, it is important to distinguish between conventional and exceptional ECB policies. The ECB's main conventional instrument is the policy rate. However, reducing this rate to stimulate the economy and thus decrease governmental spending burdens has no reductive impact on yield spreads.³³ Nevertheless, the scope of using the policy rate as a crisis instrument was rapidly restricted because the rate was already less than 1% at the end of 2012 (Figure D1, p. 46).³⁴ Referring to the categorization of the unconventional measures, most of the exceptional liquidity measures have no significant reductive impact on the bond yield spreads of the GIIPS compared to asset purchases.³⁵ One possible explanation is that only the unconventional measures with an implicit bailout message affected investors' expectations. In particular, programmes under which GIIPS assets were purchased in secondary markets are likely to have an implicit bailout message and thereby reduce investors' uncertainty about joint liability within the EMU. "Stronger" exceptional measures were more effective in reducing the yield spreads of stressed EMU countries. On the day of establishment of the SMP and OMT, yield and CDS spreads were significantly lower compared to any other day (at the 1% significance level). For example, the 10-year bond yield spreads of the GIIPS countries were on average 91.5 basis points (bp) lower on the day the SMP was established. For the day of the OMT founding, the reductive effect on 10-year bond yield spreads was 23.7 bp. Furthermore; the purchases of assets under the SMP have a strongly decreasing impact on the yield spreads. The 10- and 5-year bond yield and CDS spreads were significantly lower on the days that purchases were made under the SMP. Ten-year bond yield spreads were on average 2.5 bp lower on days when a purchase took place compared to other days.

³² The credit rating variable from column (6) shows a country's rating value instead of the rating spread vis-à-vis Germany because the underlying regression of column (6) analyses the yields instead of the spreads. Thus, the interpretation changes: a higher rating implies a lower credit risk and yield (negative relationship). For the spread regressions from columns (1) to (5), the credit rating spread is the absolute distance to the German rating. Consequently, the higher the distance, the worse the rating and thus the higher the yield spreads (positive relationship).

³³ For the 10-year bond yields of column (6), the coefficient is significant but the sign does not go in the expected direction. Therefore, no meaningful interpretation is possible.

³⁴ Burkhard and Fischer (2009) investigate the role of non-conventional central bank policy communication by the Swiss National Bank (SNB) when short-term interest rates reached zero.

³⁵ The announcements of additional 6-month and 36-month LTROs, were the only LTROs that significantly reduced some bond yield spreads. The size of all allotted LTROs in EUR bn for the observed period is shown in Figure D2, p. 46.

Based on the other asset purchase programmes, only the establishment of the second CBPP and purchases under that programme could significantly reduce 10- and 5-year bond yield spreads at the 5% significance level.³⁶

Additional evidence for the second hypothesis is provided by Draghi's speech in London. A strong yield-spread reducing effect can be attributed to his announcement. On the day that the speech was delivered, yield and CDS spreads significantly declined. And, more interestingly, as the analysis of the interaction terms shows, investors changed their bond pricing behaviour after Draghi's speech.

Because no purchases had yet been made under the OMT and Draghi's speech in London was merely an announcement of bailouts in the event that they became necessary, the third hypothesis is corroborated. This observation indicates that the yield and CDS spreads were mainly driven by the ECB presenting the prospect of financial support. In addition, the third hypothesis can be confirmed by observing the 6- and 36-month LTROs. The announcements of allotments of these types of LTROs significantly reduced the spreads for which the allotment day no longer had a reductive effect.³⁷

4.2 The role of EMU government policy during the crisis

For the EMU countries, especially Ireland, the financial crisis required huge bailout measures by the national governments to rescue distressed banks and other financial service providers. Moreover, measures directed at stimulating the economy, which was threatened by recession, increased fiscal expenditures. Simultaneously, government revenues decreased because of the weakening economy. Consequently, the public debt and deficits of the EMU member states sharply increased.

The perilous situation of fiscal sustainability in the presence of some EMU countries' increasing refinancing costs led to rescue packages by different institutions and newly implemented crisis mechanisms (European Commission, 2016; Federal Ministry of Finance, 2016a). Figure 3 provides an overview of the disbursements that have been made under these programmes. The first adjustment programme was established on May 2, 2010, by the Eurogroup and was aimed at providing Greece

³⁶ Both the volume of the purchases under the various asset purchase programmes and their total holdings are illustrated in Figure D3 and Figure D4, p. 47.

³⁷ An LTRO allotment is always announced one day before the LTRO is allotted.

with bilateral loans.³⁸ Euro-area member states and the IMF disbursed EUR 73 billion (bn) from May 2010 until the end of December 2011.³⁹

[Figure 2 about here]

In December 2010, Ireland was the second EMU country that could no longer finance itself through national resources. Thus, an Irish economic adjustment programme was adopted. Its objectives included restoration of the banking sector, fiscal adjustment to recreate fiscal sustainability and growth-enhancing reforms. The financial package, which was worth EUR 85 bn, was financed through the European Financial Stabilization Mechanism (EFSM) with EUR 22.5 bn, the EFSF with EUR 17.7 bn, bilateral contributions of Sweden, Denmark, and the United Kingdom (UK) with EUR 4.8 bn and the IMF with EUR 22.7 bn. Furthermore, EUR 17.5 bn was provided by the Irish Treasury and National Pension Reserve Fund.⁴⁰ (European Commission, 2016)

The EFSM and EFSF were activated to provide financial assistance to EU member states suffering financial difficulties. The EFSM is an intergovernmental agreement in the context of joint EU and IMF support, whereas the EMU countries declared the EFSF a temporary crisis-resolution mechanism.⁴¹

As intended, Ireland completed its programme by the end of 2013 and was placed under post-programme surveillance (PPS). This status will be maintained at least until 2031.⁴²

On May 17, 2011, Portugal was assigned the status of a so-called programme country. The objectives of this programme were similar to those of the Irish programme. The overall target was to restore financial sustainability, thus reducing the permanent increasing yields of government bonds. EUR 78 bn was disbursed from 2011 to mid-2014, when the EFSM, the EFSF and the IMF intended to jointly finance the financial package.⁴³ In June 2014, Portugal quit the Economic Adjustment Programme and was placed under PPS. (European Commission, 2016)

³⁸ The bilateral loans are also called the “Greek Loan Facility” (GLF). Initially, the GLF was EUR 80 bn. It was reduced by EUR 2.7 bn because of Slovakia’s exit. It was then further reduced by EUR 4.3 bn because Portugal and Ireland requested financial assistance themselves (European Commission, 2016).

³⁹ For an overview of the disbursements under the Greek adjustment programmes, see Table D3, p. 49.

⁴⁰ The disbursements were made from 2010 to 2013 and are listed in Table D1, p. 48.

⁴¹ For a detailed description of the mechanisms, see Rodrigo Olivares-Caminal (2012).

⁴² The PPS is intended to observe and evaluate the repayment process of the outstanding loans. “Under PPS, the Commission, in liaison with the European Central Bank, will (i) conduct regular review missions in the Member State to assess its economic, fiscal and financial situation; and (ii) prepare semi-annual assessments if Ireland’s economic, fiscal and financial situation and determine whether corrective measures are needed” (European Commission, 2016).

⁴³ Several disbursements are shown in Table D2, p. 48.

At the beginning of 2012, Greek government bond yield spreads increased to nearly 50% (see Figure A3). Thus, the finance ministers from the euro area agreed on the implementation of a Second Economic Adjustment Programme for Greece. The requirement for floating financial assistance of EUR 164.5 bn was private-sector involvement. Furthermore, the release of disbursements by the IMF and EFSF was accompanied by reform efforts and progress in the area of fiscal sustainability. (European Commission, 2016)

Spain was the final country that required financial assistance because of huge problems in the banking sector. In July 2012, the Eurogroup agreed on an 18-month financial assistance programme (Federal Ministry of Finance, 2016a). The European Stability Mechanism (ESM), a newly installed crisis mechanism beginning on October 8, 2012, was utilized to finance the programme. Requirements for financial support were bank-specific and horizontal conditionality.⁴⁴ Like the EFSF, the ESM is an intergovernmental support mechanism, whereas the ESM is a permanent financial institution that replaced the temporary crisis mechanism of EFSF. Spain used just under EUR 41.3 bn of the EUR 100 bn available and successfully exited the programme in January 2014. Like Ireland and Portugal, Spain is now placed under PPS.

Impact of fiscal policy measures on government bond yield and CDS spreads

Table 2 shows the regression results of Equation (1). The term $\lambda_{crisispolicy}_{i,t}$ includes all main crisis measures, implemented during periods when a country was part of an Economic Adjustment Programme. Further, the term comprises several mechanisms and treaties that had been implemented during the crisis to enforce the credibility of sustainable fiscal behaviour.

The overall picture of Table 2 shows that some of the EMU fiscal institutions' crisis measures could significantly reduce bond yield and CDS spreads of the GIIPS countries vis-à-vis Germany. For the first hypothesis, the estimates of the credit-rating spreads show a similar picture as in Table 1. The same holds for the control variables.

[Table 2 about here]

Because the results of Table 1 provide the first evidence for the acceptance of the second and third hypotheses of Section 2.2, it is important to inquire whether the impact of fiscal policy crisis measures

⁴⁴ These preconditions are included in the Memorandum of Understanding (MoU), which describes the intended restructuring of banks over the next five years (European Commission, 2016).

can provide further evidence to strengthen these conjectures. To analyse the second hypothesis, the measures were distinguished according to their conventionality.

The establishment of contracts such as the six-pack treaty or the fiscal compact are declared as conventional measures because they do not provide monetary support for countries in financial trouble. These treaties affect the institutional setting of several EMU countries and attempt to restore investors' beliefs in the sustainability of particular EMU countries' public debt. In contrast, financial support packages are designated as unconventional crisis interventions because they are banned by the no-bailout clause.

The estimated effects of the six-pack treaty and the fiscal compact show that conventional crisis measures could not significantly reduce the yield and CDS spreads of the GIIPS. The signature and ratification process of the fiscal compact by EU leaders even increased the bond yield spreads of some maturities (at the 5% and 10% significance levels). This finding confirms the expectation that fiscal treaties reinforced a country's responsibility for its own financial situation and thus increased investors' uncertainty about the joint liability within the EMU. Consequently, yield spreads rose.

A different impact could be found for the huge bailout packages under newly installed institutions such as the EFSM, EFSF or ESM. Financial support from these crisis mechanisms were a signal to investors that the EMU as a whole is responsible for a specific country's financial situation, which resulted in decreasing uncertainty about joint liability and therefore shrinking yield and CDS spreads. In conclusion, the differing impacts of conventional and unconventional fiscal policy crisis measures on GIIPS yield and CDS spreads support the second hypothesis regarding the impact of crisis measures based on their conventionality.

IMF disbursements and approvals could not significantly reduce the yield and CDS spreads of the GIIPS under neither a first nor a second economic adjustment programme. Explanations for this observation can be provided by the IMF's institutional characteristics. The IMF is not an institution established by EMU members to prevent a collapse of the Eurozone, compared to the EFSF and the ESM. Disbursements by the IMF constitute external financial support and thus do not signal investors that the EMU countries vouch for each other. Put another way, uncertainty about joint liability within the EMU can only be influenced through EMU institutions.

Therefore, disbursements by EMU institutions such as the EFSFM, EFSF or ESM, which were established with the goal of supporting stressed EMU members, are much more effective in convincing investors of solidarity within the EMU. These disbursements reduced uncertainty about joint liability within the EMU and thereby high yields that are required to compensate for the danger of a crisis country's exit.

To find evidence for the third hypothesis, a more detailed view of several disbursements by the crisis institutions is required. The crisis measures were conducted under the framework of the economic adjustment programmes. Concerning the third sub-hypothesis, within a programme we expect the announcement of a tranche to have a stronger impact on yield and CDS spreads than the disbursement of this tranche.

The estimated coefficients reveal that within a first economic adjustment programme, disbursements of tranches by the EFSM and EFSF could not significantly reduce a programme country's refinancing costs. However, the release of tranches by the EFSM or EFSF significantly reduced both bond yield and CDS spreads. The estimated effect is statistically and economically significant. For example, 10-year bond yield spreads were on average 5 bp lower on days when EFSM tranches were released, and the 5-year CDS spreads 725 bp. Five-year bond yield spreads were on average 24.2 bp lower on days of releases of disbursements by the EFSF compared to other days (at the 1% significance level).⁴⁵ These findings are in line with the third hypothesis, suggesting that the announcement of financial support had already calmed investors' uncertainty about joint liability within the EMU and thus the demanded yields.

For disbursements under a second economic adjustment programme, the relationship is reversed. In this case, the disbursements significantly reduced the spreads instead of their approvals and thus, the third hypothesis is weakened. This may be because Greece was the only country under a second economic adjustment programme and amid high uncertainty about financial support for Greece, only the actual payment of a rescue measure could calm investors' fear of a Greek default and its yield spreads vis-à-vis Germany.

⁴⁵ Disbursements under the ESM and the EMU states had no release date.

Overall, the hypotheses can be confirmed by adducing the first two regression results; however, the robustness of the results has not yet been considered. Thus, the next section will analyse the robustness of the baseline regression.

5 Robustness and further analysis

The robustness of the findings of the baseline regression is tested in several ways. First, all policy interventions that show a significant impact on the yield spreads are commonly regressed on the various dependent variables.

Furthermore, as explained in footnote 4, our use of Germany as the benchmark country for the yield spread calculation might be criticized not only because of the selection rule but also because the German CDS and bond yields might also be affected by the various crisis interventions. To account for this potential drawback, the dependent variables of Table 3 panel B, are the government bond yield and CDS premia instead of the spreads. Regarding the regression of Table 3, only the variables that showed a significant impact are included. The results of Table 3 reveal no changed relationship compared to the findings of Tables 1 and 2. The main hypothesis – that unconventional crisis measures by different EMU institutions lower yield spreads – can be confirmed (Table 3, Panel A)

[Table 3 about here]

With regard to the first hypothesis, a country's credit risk measured by the credit ratings was relevant, particularly during the period of the sovereign debt crisis. After the main crisis measures had been implemented and before the crisis started, a country's credit risk had only a minor impact. This confirms the hypothesis that yield spreads within the EMU are affected by investors' uncertainty about the joint liability within the EMU, as explained in Section 4. The same holds for the analysis of the yields in Table 3, Panel B.

As an additional analysis, we studied the countries separately to determine whether the measures had different effects with regard to the respective countries. In observing the residuals of the yield spreads during the European Sovereign debt crisis, the high time-varying volatility is suspicious (see Figure E1).

The FGLS estimator used in the baseline regression is unsuitable for modelling the volatility of the error term. Therefore, a GARCH model is used to permit the conditional variance to depend on the

previous variance and the previous period's squared residuals.⁴⁶ This should be considered as a motivation for further research. Two pre-conditions must be fulfilled to justify the use of a GARCH model:

1. Clustering volatility in the residuals⁴⁷; and
2. ARCH effect in the residuals.

If those pre-conditions hold, the residuals of a regression are conditionally heteroscedastic and thus can be represented by a GARCH model.⁴⁸ The GARCH model always has a conditional mean equation (equation (2)) and a conditional variance equation (equation (3)).

$$(2) \text{ spreads}_t = \alpha_0 + \rho 1\text{spreads}_{t-1} + \beta X_t + \lambda \text{crisispolicy}_t + \varepsilon_{i,t}$$

with $t = 1, \dots, 3012$ denoting the daily time dimension.

Equation (2) includes the same variables as equation (1). However, this equation was estimated separately for each country. The error process is assumed to be $\varepsilon_t = v_t \sqrt{h_t}$, and v_t is an i.i.d. sequence with zero mean, and $\sigma_v^2 = 1$. The conditional variance of ε_t then is:

$$(3) h_t = c + \alpha h_{t-1} + \beta \varepsilon_{t-1}^2$$

where h_t is the variance of the residuals derived from the mean equation, αh_{t-1} is the GARCH term because it represents the previous variance, and $\beta \varepsilon_{t-1}^2$ is the previous period's squared residuals and the so-called ARCH term (Tsay, 2010).

The results of the mean equation partially confirm the findings of the linear panel data analysis, especially for monetary policy interventions. SMP, OMT, the second CBPP and Draghi's speech remain the strongest measures for yield spread reduction.

The EMU institutions' crisis measures for countries under an economic adjustment programme show the expected effects for Ireland and Spain. For Portugal, the results do not coincide with the hypothesis.

The credit rating spread variables' interaction with the different periods confirms the findings of the baseline regression and provides further evidence for the first hypothesis. Overall, this additional analysis has introduced an estimator for GIIPS bond yield spreads that allows for non-linearity in the

⁴⁶ For more technical details about GARCH models, see Tsay (2010).

⁴⁷ Under clustering volatility of the residuals, periods of high residual volatility are followed by periods of high residual volatility and vice versa (Mandelbrot, 1963).

⁴⁸ For a detailed description of the testing procedure, see Appendix E. The test results for the data at hand are also displayed (Table E1, p. 51).

residuals. The results of this final regression must be treated with caution because the Ljung-Box (LB) Q-statistics indicate the presence of autocorrelation (Table E2). The null hypothesis of this test assumes no autocorrelation, which is rejected for all countries and dependent variables (Ljung and Box, 1978). Therefore, the model is not reasonably specified. The presence of autocorrelation suggests that non-linearity also occur in the mean equation. Subsequent research should build on this issue and analyse the hypotheses in the framework of a non-linear model such as, e.g., a regime-switching model.

6 Conclusions

The central intention of this paper was to investigate whether yield spread movements of the GIIPS during the European sovereign debt crisis were primarily driven by investors' uncertainty about joint liability within the EMU. For this purpose, the focus was on the observable re-convergence of yield spreads and the established crisis measures by EMU institutions. The overall empirical findings, which are based on a dynamic panel data analysis using daily data for the period from January 2007 to March 2015, suggest that yield re-convergence is mostly explained by the impact of various EMU institutions' unconventional crisis measures on GIIPS yield spreads. The validation of the three hypotheses shows that a country's refinancing costs depend upon investors' expectations about joint liability, at least in the GIIPS countries of the EMU. Three hypotheses were developed and tested in this paper.

Evidence for the first hypothesis (Section 2.2) is provided by the differing impact of a country's credit risk and its country-specific characteristics on yield spreads during the distinct periods (Section 4). The default risk of a particular country was relevant, especially during the sovereign debt crisis. This finding supports the existing literature by Barrios et al. (2009) and Klepsch (2011). We continued those authors' research by investigating a country's credit risk in interaction with the post-crisis policy period (Section 4). After the main crisis measures were put in place, a country's credit risk no longer explained the yield spreads of the GIIPS. This supports the hypothesis that fiscal fundamentals play a minor role if investors' uncertainty about joint liability is low, such that investors expect other EMU member states to guarantee for repayment of a crisis country's outstanding debt liabilities.

Among the unconventional interventions of the ECB, the largest impact can be assigned to the establishment of the SMP and OMT and to purchases under the SMP, which is in line with the findings of e.g., Beetsma et al. (2014), Eser and Schwaab (2013) and Szczerbowicz (2015). In addition, we have found significant spread-reducing effects of the establishment of the second CBPP, announcements of 3-year LTROs and Draghi's July 2012 speech (Section 4.1). Concerning measures by the EMU, the release of EFSM, EFSF tranches, and the disbursements of tranches by the EMU states and the ESM had the largest impact (Section 4.2). These findings provide evidence in favour of the second hypothesis, and consequently, the conjecture that investors' uncertainty about joint liability within the EMU drives the yield spreads is confirmed.

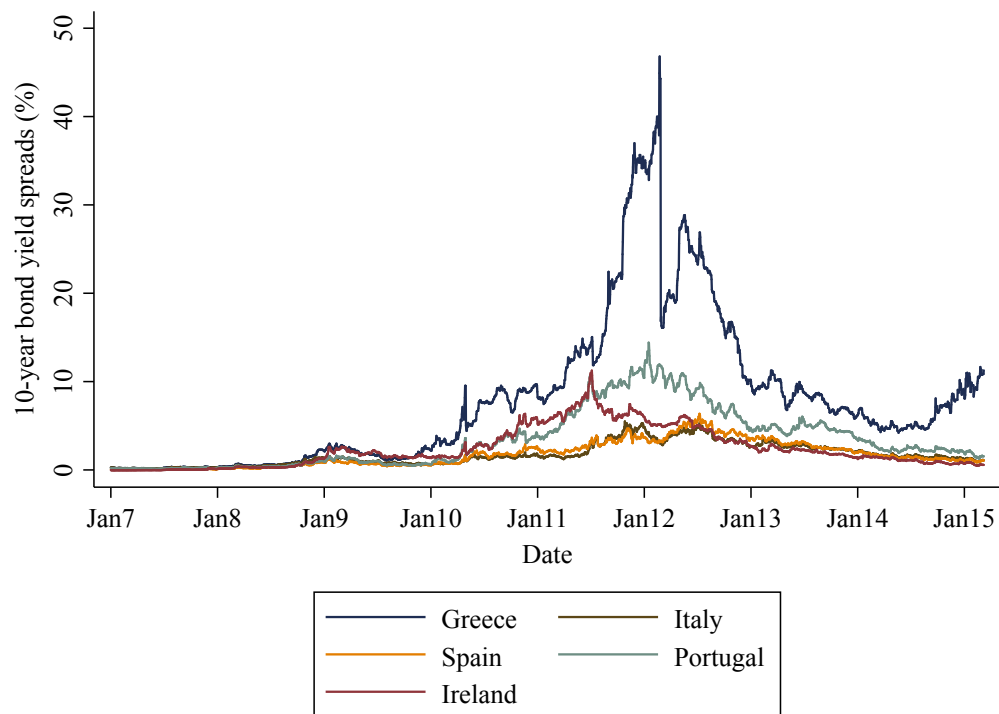
With regard to previous empirical findings that communication by EMU institutions impacts yield spreads (e.g., Mohl and Sondermann, 2013), we have found that within the several crisis measures, announcements mostly turned out to be more effective than explicit disbursements of financial support. Thus, the third hypothesis is corroborated.

The baseline regression results are robust to several variable changes of the regression and to analysing the yields of bonds and CDS instead of the spreads vis-à-vis Germany (Section 5). Furthermore, the non-linear time series GARCH regression of Italy, Portugal, Spain and Ireland also confirms most of the results of the baseline regression. The GARCH regression set forth above shows that there is clustering volatility of the residuals. Therefore, non-linear modelling of the variance is required.

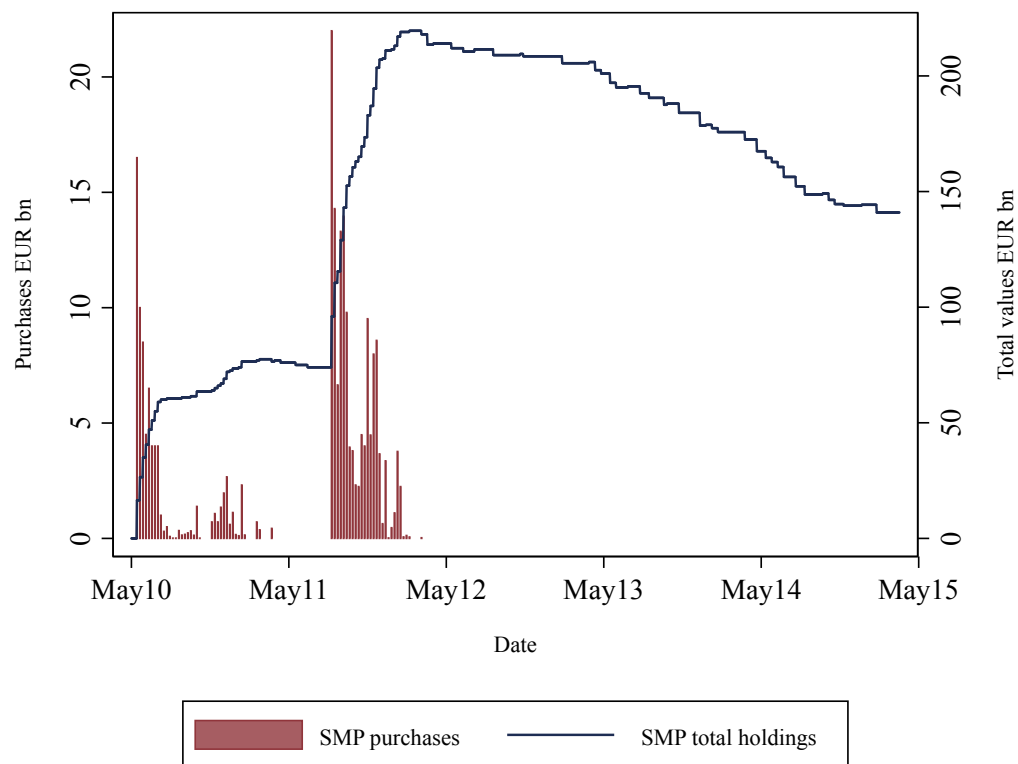
Furthermore, the residual analysis of the GARCH regression suggests that non-linearity also occur in the mean equation (Table E2). Thus, it is not only the variance that needs to be modelled in a non-linear way. These findings should motivate further research. A regime-switching model might be an appropriate choice for follow-up studies. The sovereign debt crisis exhibits structural breaks, e.g., Draghi's speech. This study shows that the period after Draghi's announcement was characterized by huge changes in the impact of yield spread determinants compared to the period prior to this event. In such cases, non-linear regressions can provide large efficiency gains over linear regressions.

With regards to the asset-pricing theory, this study encourages further effort in theoretical research because the general theory does not adequately fit the EMU government's bond-pricing situation.

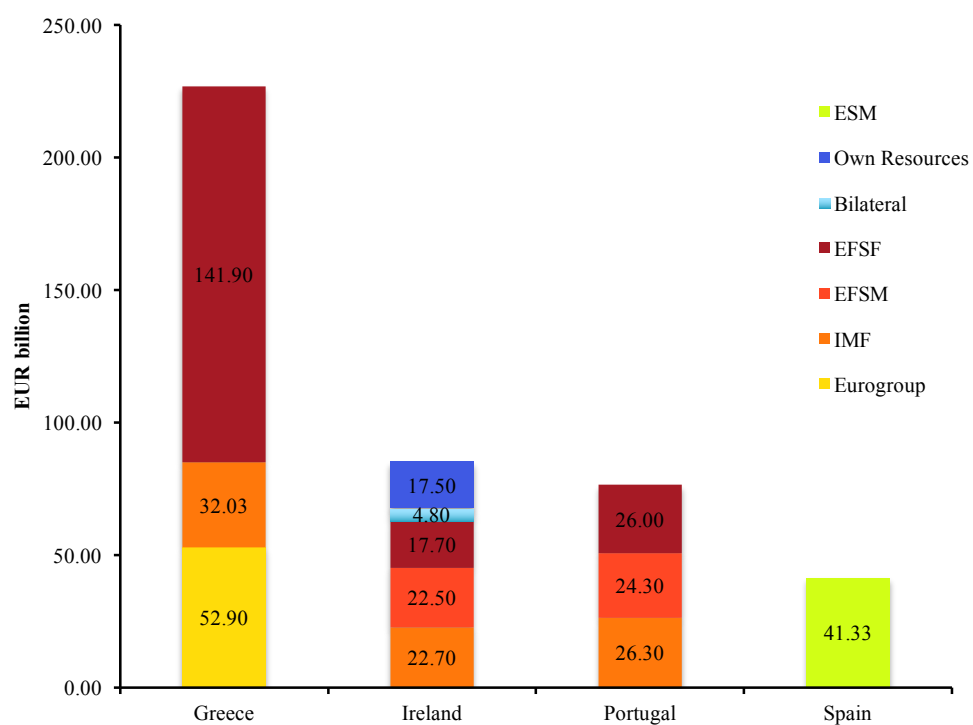
This paper's primary contribution to the existing literature was to find initial evidence for a superior yield-spread driving factor, namely, investors' uncertainty about joint liability within the EMU. Nevertheless, subsequent studies that model the structural breaks of the sovereign debt crisis will be required to corroborate this paper's findings.

FIGURE 1 – GOVERNMENT BOND YIELD SPREADS OF THE GIIPS VIS-À-VIS GERMANY

Source: Thomson Reuters Datastream and own illustration.

FIGURE 2 – ECB PURCHASES UNDER THE SMP

Source: Own illustration. The weekly purchases under the SMP were taken from the open-market operations communication of the ECB.

FIGURE 3 – TOTAL VOLUMES UNDER ECONOMIC ADJUSTMENT PROGRAMMES

Notes: IMF values succumb exchange rate fluctuations because they are initially denominated in Special Drawing Rights (SDRs). The Greek values include disbursements under the first and second economic adjustment programmes. Bilateral loans for Ireland were made by Sweden, Denmark and the UK. Own resources came from the Irish Treasury and the National Pension Reserve Fund.

Source: Own illustration values are obtained from the EFSF, the European Commission, the IMF and the ESM.

TABLE 1 – IMPACT OF ECB INTERVENTIONS ON BOND YIELD AND CDS SPREADS, BASELINE REGRESSION

Dependent Variables:	10-year bond yield spreads (1)	5-year bond yield spreads (2)	2-year bond yield spreads (3)	10-year CDS spreads (4)	5-year CDS spreads (5)	10-year bond yield (6)
Lagged dependent variable	0.991*** (0.001)	0.995*** (0.001)	0.996*** (0.001)	0.998*** (0.001)	0.999*** (0.000)	0.992*** (0.001)
Greece	0.065*** (0.019)	0.154*** (0.043)	0.776*** (0.278)	19.524*** (5.491)	19.280*** (5.653)	
Ireland	0.055*** (0.013)	0.047*** (0.018)	0.049 (0.056)	1.569 (1.184)	1.600 (1.065)	
Spain	-0.003 (0.002)	-0.003 (0.003)	-0.004 (0.011)	-0.208 (0.229)	-0.162 (0.204)	
Portugal	0.011** (0.005)	0.011 (0.007)	-0.000 (0.019)	0.235 (0.502)	0.204 (0.496)	
Euro-STOXX	0.002*** (0.001)	0.002** (0.001)	0.002 (0.004)	0.237** (0.104)	0.197** (0.091)	-0.000 (0.000)
Total stock market index for the EU	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	0.001 (0.006)	0.002 (0.005)	0.000 (0.000)
Total holdings under the CBPP	0.000 (0.001)	0.000 (0.001)	-0.004 (0.005)	0.016 (0.131)	0.016 (0.114)	0.000 (0.001)
Purchases under the CBPP	0.001 (0.011)	0.011 (0.016)	0.020 (0.042)	0.408 (1.680)	0.379 (1.739)	-0.003 (0.006)
Second CBPP established	-0.073 (0.074)	-0.174* (0.104)	-0.140 (0.267)	2.618 (11.123)	2.648 (11.269)	0.042 (0.042)
Total holdings under the second CBPP	0.001 (0.001)	0.002 (0.002)	0.002 (0.008)	-0.161 (0.198)	-0.074 (0.174)	-0.001 (0.001)
Purchases under the second CBPP	-0.018** (0.008)	-0.024** (0.011)	-0.027 (0.032)	-1.862 (1.158)	-1.847* (1.102)	-0.003 (0.004)
Third CBPP established	-0.069 (0.073)	-0.012 (0.103)	0.067 (0.265)	-4.258 (11.043)	-4.424 (11.192)	-0.019 (0.042)
Total holdings under the third CBPP	-0.001 (0.002)	-0.000 (0.002)	-0.004 (0.009)	-0.014 (0.232)	0.010 (0.205)	-0.000 (0.001)
Purchases under the third CBPP	-0.023 (0.039)	-0.009 (0.054)	0.016 (0.169)	-1.006 (5.833)	-0.856 (5.736)	-0.010 (0.022)
ABSPP established	-0.020 (0.082)	-0.028 (0.116)	-0.021 (0.296)	-0.502 (12.351)	0.025 (12.523)	-0.030 (0.047)
Total holdings under the ABSPP	0.004 (0.023)	0.000 (0.030)	0.006 (0.141)	-0.179 (3.424)	-0.337 (2.997)	0.006 (0.013)
Purchases under the ABSPP	0.017 (0.044)	0.010 (0.061)	0.082 (0.194)	-0.529 (6.634)	0.006 (6.527)	-0.002 (0.025)
SMP established	-0.915*** (0.076)	-1.057*** (0.106)	-0.981*** (0.288)	-66.053*** (11.333)	-62.488*** (11.410)	-0.200*** (0.043)
Total holdings under the SMP	-0.000 (0.000)	0.000 (0.000)	-0.000 (0.001)	-0.012 (0.019)	-0.007 (0.017)	0.000* (0.000)
Purchases under the SMP	-0.025** (0.011)	-0.028* (0.015)	-0.001 (0.048)	-3.966** (1.632)	-3.210** (1.578)	-0.007 (0.006)
OMT established	-0.237*** (0.073)	-0.341*** (0.103)	-0.305 (0.266)	-39.654*** (11.037)	-47.696*** (11.166)	-0.025 (0.042)
PSPP established	0.092 (0.075)	0.054 (0.105)	0.081 (0.269)	1.225 (11.235)	1.241 (11.420)	-0.038 (0.043)
Purchases under the PSPP	-0.009 (0.060)	0.019 (0.082)	-0.084 (0.274)	1.618 (8.981)	0.873 (8.600)	-0.004 (0.034)
Total holdings under the PSPP	0.001 (0.002)	0.000 (0.002)	0.005 (0.008)	0.021 (0.221)	0.016 (0.197)	0.000 (0.001)
APP established	-0.021 (0.076)	-0.045 (0.107)	-0.032 (0.276)	-6.430 (11.469)	-4.278 (11.612)	-0.075* (0.044)
Regular 3-month LTROs with a fixed-rate tender	-0.020 (0.028)	-0.042 (0.037)	0.030 (0.163)	2.948 (4.115)	0.723 (3.595)	-0.008 (0.016)
Allotment of a regular 3-month LTRO	0.007 (0.010)	0.013 (0.014)	0.006 (0.035)	-0.350 (1.473)	-0.252 (1.497)	0.001 (0.006)
STROs with a fixed-rate tender	0.007 (0.013)	0.003 (0.017)	0.036 (0.080)	0.755 (1.908)	0.114 (1.653)	0.004 (0.007)
Announcement of an STRO	0.013 (0.010)	0.027* (0.014)	0.018 (0.040)	0.848 (1.530)	0.644 (1.522)	-0.003 (0.006)
Allotment of an STRO	-0.001 (0.010)	-0.008 (0.014)	0.003 (0.040)	-0.819 (1.551)	-0.964 (1.553)	0.011* (0.006)
Additional 3-month LTROs with a fixed-rate tender	-0.018 (0.021)	-0.023 (0.027)	-0.071 (0.128)	-2.065 (3.093)	-2.124 (2.686)	0.004 (0.012)
Announcement of an additional 3-month LTRO	0.127* (0.069)	0.172* (0.096)	-0.077 (0.271)	4.748 (10.352)	3.877 (10.327)	0.007 (0.039)
Allotment of an additional 3-month LTRO	0.036 (0.069)	-0.002 (0.097)	-0.073 (0.268)	-3.080 (10.379)	-0.030 (10.380)	0.035 (0.039)
Announcement of an additional 6-month LTRO	-0.107** (0.045)	-0.154** (0.062)	0.061 (0.177)	-2.759 (6.661)	-2.595 (6.627)	-0.039 (0.025)
Allotment of an additional 6-month LTRO	0.008 (0.044)	0.036 (0.062)	0.116 (0.171)	7.815 (6.608)	5.053 (6.613)	-0.017 (0.025)
Announcement of an additional 12-month LTRO	0.001 (0.053)	0.012 (0.074)	0.072 (0.205)	1.925 (7.946)	1.682 (7.947)	0.030 (0.030)
Allotment of an additional 12-month LTRO	-0.005 (0.053)	0.030 (0.074)	-0.182 (0.206)	7.239 (7.982)	4.659 (7.985)	-0.032 (0.030)
Announcement of an additional 36-month LTRO	-0.074 (0.053)	-0.131* (0.074)	-0.113 (0.205)	-5.008 (7.956)	-6.416 (7.964)	-0.005 (0.030)
Allotment of an additional 36-month LTRO	0.015 (0.054)	0.007 (0.075)	0.064 (0.208)	0.024 (8.083)	-12.571 (8.091)	0.023 (0.031)
Announcement of a TLTRO	0.024 (0.046)	0.030 (0.065)	0.011 (0.180)	3.786 (6.957)	3.725 (6.961)	-0.009 (0.026)
Allotment of a TLTRO	0.005	-0.003	0.003	0.225	0.180	0.015

	(0.046)	(0.065)	(0.180)	(6.952)	(6.956)	(0.026)
ECB policy rate	-0.017	-0.026	-0.004	-2.083	-0.722	-0.021*
	(0.021)	(0.027)	(0.128)	(3.061)	(2.662)	(0.012)
Draghi's speech	-0.233***	-0.484***	-0.414	-22.643**	-26.186**	-0.061
	(0.074)	(0.104)	(0.267)	(11.045)	(11.179)	(0.042)
Reserve ratio	-0.007	0.026	0.019	-3.993	-3.187	0.025**
	(0.022)	(0.028)	(0.128)	(3.135)	(2.730)	(0.013)
Central Bank eases lending rules	-0.022	-0.015	-0.124	-0.644	0.072	0.011
	(0.022)	(0.029)	(0.112)	(3.218)	(2.918)	(0.012)
Implementation of a bank supervision	-0.006	-0.009	-0.016	-1.051	-0.733	-0.011
	(0.013)	(0.017)	(0.081)	(1.921)	(1.661)	(0.007)
Interaction term of credit rating spreads and pre-crisis period	-0.010	-0.002	-0.018	0.335	-0.105	
	(0.015)	(0.022)	(0.040)	(1.523)	(1.629)	
Interaction term of credit rating spreads and European sovereign debt crisis	0.006***	0.005***	0.006	0.111	0.145*	
	(0.001)	(0.001)	(0.004)	(0.089)	(0.084)	
Interaction term of credit rating spreads and post-crisis policy period	-0.005***	-0.006***	-0.005	-0.132	-0.256*	
	(0.001)	(0.002)	(0.006)	(0.147)	(0.139)	
1 lag of the purchases under the SMP	-0.022**	-0.025*	0.005	-2.538	-2.245	-0.003
	(0.011)	(0.015)	(0.047)	(1.655)	(1.608)	(0.006)
1 lead of the purchases under the SMP	-0.024**	-0.043***	-0.028	-4.725***	-4.729***	-0.000
	(0.011)	(0.015)	(0.047)	(1.627)	(1.584)	(0.006)
2 leads of the purchases under the SMP	-0.029***	-0.024	-0.020	-4.031**	-3.148**	0.004
	(0.011)	(0.015)	(0.041)	(1.595)	(1.606)	(0.006)
Interaction term of Greece and the European sovereign debt crisis						0.081***
						(0.027)
Interaction term of Italy and the European sovereign debt crisis						0.011**
						(0.005)
Interaction term of Ireland and the European sovereign debt crisis						0.050***
						(0.015)
Interaction term of Spain and the European sovereign debt crisis						0.014***
						(0.004)
Interaction term of Portugal and the European sovereign debt crisis						0.025***
						(0.009)
Interaction term of Greece and the post-crisis policy period						-0.095***
						(0.034)
Interaction term of Italy and the post-crisis policy period						-0.026***
						(0.006)
Interaction term of Ireland and the post-crisis policy period						-0.031***
						(0.008)
Interaction term of Spain and the post-crisis policy period						-0.036***
						(0.008)
Interaction term of Portugal and the post-crisis policy period						-0.048***
						(0.010)
Debt to GDP ratio (%)						-0.000***
						(0.000)
Interaction term of credit ratings and pre-crisis period						0.001
						(0.002)
Interaction term of credit ratings and European sovereign debt crisis						-0.006***
						(0.001)
Interaction term of credit ratings and post-crisis policy period						0.000
						(0.000)
Constant	0.017	-0.029	0.212	1.180	-0.917	0.114*
	(0.108)	(0.140)	(0.629)	(15.711)	(13.710)	(0.067)
N	9,855	9,855	9,855	9,855	9,855	11,826

Notes: The table reports coefficients estimated by FGLS correcting for CD, heteroscedasticity and autocorrelation of the error term. Robust standard errors are in parentheses. Columns (1) through (5) display 5 bond yield and CDS spread variables of the GIIPS countries with different maturities. In column (6), the dependent variable is the 10-year bond yield instead of the spread, and Germany is included in the regression. For purchases under asset programmes, 2 lags and leads were taken into account. In the table only those lag and lead variables are reported that showed a significant impact. The sample for the 10- and 5-year CDS starts on November 1, 2008, because the FGLS estimator cannot handle missing values and for some countries, the CDS data first begins at this point in time. *** (**, *) indicates statistical significance at the 1 (5, 10)% level.

TABLE 2 – IMPACT OF FISCAL POLICY ON YIELD AND CDS SPREADS, BASELINE REGRESSION

Dependent Variables:	10-year bond yield spreads (1)	5-year bond yield spreads (2)	2-year bond yield spreads (3)	10-year CDS spreads (4)	5-year CDS spreads (5)
Lagged dependent variable	0.989*** (0.001)	0.994*** (0.001)	0.990*** (0.002)	0.993*** (0.002)	0.998*** (0.001)
Greece	0.072*** (0.027)	0.112** (0.053)	0.757*** (0.281)	22.840*** (5.680)	20.353*** (5.772)
Ireland	0.064*** (0.015)	0.050*** (0.019)	0.074 (0.053)	3.063* (1.716)	1.798 (1.549)
Spain	-0.003 (0.003)	-0.003 (0.004)	-0.003 (0.013)	-0.127 (0.463)	-0.050 (0.383)
Portugal	0.012** (0.005)	0.012 (0.008)	0.007 (0.018)	0.484 (0.653)	0.253 (0.632)
Euro-STOXX	0.002** (0.001)	0.001** (0.001)	0.004** (0.002)	0.265*** (0.090)	0.250*** (0.093)
Total stock market index for the EU	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.003 (0.004)	0.005 (0.004)
Greek haircut	-0.074 (0.049)	-0.045 (0.051)	-0.095 (0.109)	-4.936 (6.034)	-4.279 (6.273)
First economic adjustment programme	-0.001 (0.004)	-0.001 (0.005)	-0.004 (0.017)	-0.465 (0.618)	-0.290 (0.532)
Disbursement by the euro-area member states under a first programme	-0.147 (0.252)	-0.243 (0.534)	-0.817 (2.913)	-311.875*** (72.410)	-128.133* (68.934)
Release of a disbursement by the IMF under a first programme	0.014 (0.019)	0.049 (0.037)	-0.036 (0.073)	2.449 (2.355)	1.063 (2.180)
Disbursement by the IMF under a first programme	0.015 (0.019)	-0.031 (0.037)	0.026 (0.073)	-0.006 (2.327)	-0.337 (2.153)
Release of a disbursement by the EFSM under a first programme	-0.046** (0.022)	-0.038 (0.042)	-0.124 (0.082)	-7.248*** (2.691)	-6.629*** (2.493)
Disbursement by the EFSM under a first programme	0.028 (0.022)	0.029 (0.043)	0.094 (0.082)	5.346* (2.729)	3.636 (2.525)
Disbursement by the EFSF under a first programme	0.023 (0.020)	0.028 (0.039)	0.007 (0.075)	1.588 (2.473)	0.454 (2.314)
Release of a disbursement by the EFSF under a first programme	-0.077* (0.040)	-0.242*** (0.078)	-0.007 (0.142)	1.372 (4.920)	3.416 (4.747)
Disbursement of the ESM under a first programme	-0.028 (0.035)	-0.067 (0.048)	-0.074 (0.073)	-6.341* (3.850)	-5.349 (3.527)
Second economic adjustment programme	0.028 (0.034)	0.116 (0.077)	2.354*** (0.680)	53.482*** (16.541)	11.801 (17.196)
Disbursement of the EFSF under a second programme	-1.201*** (0.142)	0.100 (0.301)	0.548 (1.637)	0.999 (37.107)	-1.688 (36.646)
Release of a disbursement by the EFSF under a second programme	-0.062 (0.344)	-0.134 (0.730)	0.535 (3.977)	3.022 (94.025)	2.108 (91.814)
Release of a disbursement by the IMF under a second programme	-0.035 (0.322)	0.089 (0.683)	0.366 (3.725)	-1.508 (88.121)	-1.661 (86.046)
Disbursement of the IMF under a second programme	0.111 (0.242)	-0.031 (0.510)	0.354 (2.766)	1.716 (58.579)	1.744 (58.856)
Six-pact treaty	0.008 (0.019)	0.007 (0.019)	-0.006 (0.052)	-0.510 (2.479)	-0.779 (2.554)
Agreement permanent crisis mechanism	0.006 (0.017)	-0.004 (0.017)	0.028 (0.045)	0.146 (2.166)	-0.270 (2.233)
EFSF	0.006 (0.010)	0.003 (0.010)	0.002 (0.027)	0.735 (1.311)	0.706 (1.349)
Agreement on ESM	-0.023 (0.021)	-0.040* (0.021)	-0.076 (0.055)	-2.141 (2.680)	-1.869 (2.763)
EU leaders sign the fiscal compact	0.053 (0.045)	0.092* (0.047)	0.151 (0.103)	7.480 (5.654)	7.051 (5.874)
Fiscal Compact ratification	0.063** (0.028)	0.015 (0.029)	0.024 (0.073)	1.534 (3.636)	1.290 (3.747)
Interaction term of credit rating spreads and pre-crisis period	-0.011 (0.016)	-0.001 (0.022)	-0.019 (0.035)	0.234 (1.854)	-0.179 (1.686)
Interaction term of credit rating spreads and European sovereign debt crisis	0.008*** (0.002)	0.005*** (0.002)	0.012** (0.005)	0.497*** (0.189)	0.252 (0.160)
Interaction term of credit rating spreads and post-crisis policy period	-0.006*** (0.001)	-0.006*** (0.002)	-0.007* (0.004)	-0.266 (0.177)	-0.252 (0.182)
Constant	-0.034 (0.063)	-0.063 (0.063)	-0.165 (0.167)	-11.881 (8.195)	-13.993* (8.416)
N	9,865	9,865	9,865	9,865	9,865

Notes: The table reports coefficients estimated by FGLS correcting for CD, heteroscedasticity and autocorrelation of the error term. Robust standard errors are in parentheses. Columns (1) through (5) display 5 bond yield and CDS spread variables of the GIPS countries with different maturities. In column (6), the dependent variable is the 10-year bond yield instead of the spread, and Germany is included in the regression. The sample for the 10- and 5-year CDS starts on November 1, 2008; because the FGLS estimator cannot handle missing values and for some countries, the CDS data first begins at this point in time. *** (**, *) indicates statistical significance at the 1 (5, 10)% level.

TABLE 3 – ROBUSTNESS: COMMON ANALYSIS OF THE BAILOUT MEASURES BY EMU INSTITUTIONS

Panel A: Bond yield and CDS spreads as dependent variables					
Dependent Variables:	10-year bond yield spreads (1)	5-year bond yield spreads (2)	2-year bond yield spreads (3)	10-year CDS spreads (4)	5-year CDS spreads (5)
Lagged dependent variable	0.993*** (0.001)	0.995*** (0.001)	0.993*** (0.002)	0.995*** (0.001)	0.999*** (0.001)
Greece	0.049* (0.026)	0.094* (0.052)	0.662** (0.276)	21.033*** (5.516)	19.947*** (5.650)
Ireland	0.003 (0.003)	0.002 (0.004)	0.004 (0.010)	0.108 (0.355)	-0.021 (0.311)
Spain	0.005** (0.002)	0.004* (0.002)	0.005 (0.005)	0.095 (0.163)	0.100 (0.141)
Portugal	0.014*** (0.005)	0.015** (0.007)	0.014 (0.013)	0.804 (0.550)	0.395 (0.541)
Euro-STOXX	0.002*** (0.000)	0.002*** (0.000)	0.003*** (0.001)	0.204*** (0.059)	0.174*** (0.060)
Second CBPP established	-0.060 (0.080)	-0.176* (0.102)	-0.213 (0.158)	-0.381 (9.933)	5.839 (11.109)
Purchases under the second CBPP	-0.013 (0.008)	-0.021** (0.009)	-0.024 (0.017)	-1.515 (1.002)	-1.887* (1.076)
SMP established	-0.941*** (0.080)	-0.995*** (0.101)	-0.979*** (0.159)	-54.909*** (9.931)	-56.452*** (11.081)
Purchases under the SMP	-0.018 (0.011)	-0.020 (0.014)	-0.017 (0.024)	-2.997** (1.437)	-2.844* (1.561)
OMT established	-0.214*** (0.079)	-0.346*** (0.101)	-0.243 (0.157)	-41.681*** (9.871)	-46.535*** (11.032)
Announcement of an additional 6-month LTRO	-0.055 (0.036)	-0.090** (0.045)	-0.020 (0.071)	-1.567 (4.456)	-1.543 (4.972)
Announcement of an additional 36-month LTRO	-0.055 (0.056)	-0.126* (0.072)	-0.124 (0.111)	-1.674 (6.999)	1.466 (7.833)
Draghi's speech	-0.202** (0.079)	-0.504*** (0.101)	-0.542*** (0.157)	-18.527* (9.865)	-21.691** (11.029)
Greek haircut	-0.092** (0.047)	-0.046 (0.049)	-0.064 (0.103)	-3.942 (5.900)	-3.245 (6.165)
Disbursement by the euro-area member states under a first programme	-0.143 (0.243)	-0.199 (0.517)	-0.604 (2.810)	-261.460*** (62.287)	-95.525 (61.719)
Release of a disbursement by the EFSM under a first programme	-0.045** (0.021)	-0.040 (0.042)	-0.112 (0.076)	-6.464** (2.512)	-6.467*** (2.421)
Release of a disbursement by the EFSF under a first programme	-0.068* (0.039)	-0.247*** (0.077)	-0.013 (0.133)	1.112 (4.614)	3.014 (4.633)
Disbursement by the ESM under a first programme	-0.015 (0.032)	-0.075 (0.046)	-0.089 (0.066)	-5.197* (2.987)	-5.012* (2.786)
Second economic adjustment programme	0.035 (0.033)	0.076 (0.075)	1.397** (0.611)	28.939** (13.759)	0.675 (14.519)
Disbursement by the EFSF under a second programme	-1.192*** (0.141)	0.085 (0.301)	0.475 (1.634)	0.373 (37.069)	-2.688 (36.509)
Agreement on ESM	-0.007 (0.020)	-0.021 (0.020)	-0.045 (0.044)	0.784 (2.462)	2.563 (2.527)
EU leaders sign the fiscal compact	0.058 (0.044)	0.084* (0.046)	0.129 (0.096)	4.718 (5.502)	2.803 (5.740)
Fiscal Compact ratification	0.059** (0.027)	0.003 (0.028)	-0.002 (0.061)	-0.457 (3.385)	-0.905 (3.474)
Interaction term of credit rating spreads and pre-crisis period	-0.011 (0.016)	-0.003 (0.022)	-0.017 (0.034)	0.271 (1.517)	-0.115 (1.391)
Interaction term of credit rating spreads and European sovereign debt crisis	0.005*** (0.001)	0.004*** (0.001)	0.007** (0.003)	0.168* (0.098)	0.108 (0.087)
Interaction term of credit rating spreads and post-crisis policy period	-0.005*** (0.001)	-0.005*** (0.001)	-0.006** (0.003)	-0.202 (0.144)	-0.220 (0.142)
1 lead of the purchases under the SMP	-0.015 (0.012)	-0.036*** (0.014)	-0.040* (0.024)	-4.002*** (1.445)	-4.420*** (1.570)
2 leads of the purchases under the SMP	-0.019* (0.011)	-0.012 (0.013)	-0.025 (0.022)	-3.425** (1.348)	-2.993** (1.489)
Constant	-0.044*** (0.014)	-0.035*** (0.014)	-0.069** (0.031)	-4.214** (1.672)	-3.739** (1.711)
N	9,855	9,855	9,855	9,855	9,855
Panel B: Bond yields and CDS premia as dependent variables					
Dependent Variables:	10-year benchmark bond (1)	5-year benchmark bond (2)	2-year benchmark bond (3)	10-year CDS premia (4)	5-year CDS premia (5)
Lagged dependent variable	0.996*** (0.001)	0.997*** (0.001)	0.996*** (0.001)	0.997*** (0.001)	1.000*** (0.001)
Greece	0.017 (0.014)	0.042 (0.028)	0.256* (0.148)	13.320*** (4.116)	12.950*** (4.235)
Ireland	0.004 (0.002)	0.003 (0.003)	0.006 (0.006)	0.218 (0.302)	0.067 (0.262)
Spain	0.002 (0.001)	0.001 (0.002)	0.002 (0.004)	0.036 (0.140)	0.015 (0.121)
Portugal	0.003 (0.003)	0.003 (0.004)	0.004 (0.008)	0.368 (0.418)	0.063 (0.420)
Euro-STOXX	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.130*** (0.035)	0.115*** (0.036)
Second CBPP established	-0.013 (0.060)	-0.074 (0.076)	-0.085 (0.130)	-8.800 (8.707)	-5.083 (9.845)
Purchases under the second CBPP	-0.006 (0.006)	-0.015** (0.006)	-0.016 (0.006)	-1.433* (0.672)	-1.588* (0.672)

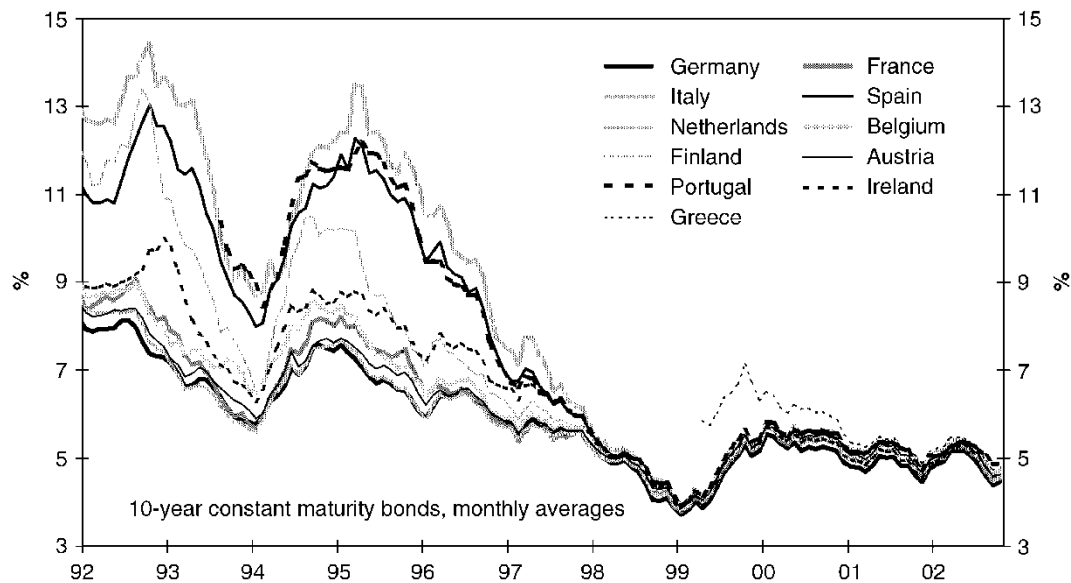
	(0.006)	(0.007)	(0.013)	(0.805)	(0.876)
SMP established	-0.702***	-0.869***	-0.912***	-67.299***	-68.027***
	(0.060)	(0.075)	(0.129)	(8.642)	(9.772)
Purchases under the SMP	-0.012	-0.008	-0.005	-2.227*	-2.474*
	(0.009)	(0.010)	(0.020)	(1.220)	(1.344)
OMT established	-0.158***	-0.222***	-0.159	-40.234***	-47.637***
	(0.060)	(0.075)	(0.129)	(8.647)	(9.774)
Announcement of an additional 36-month LTRO	-0.044	-0.110**	-0.089	-4.953	-5.164
	(0.042)	(0.054)	(0.091)	(6.132)	(6.938)
Draghi's speech	-0.212***	-0.465***	-0.583***	-21.398**	-23.536**
	(0.060)	(0.075)	(0.129)	(8.647)	(9.774)
Greek haircut	-0.071**	-0.029	-0.065	-3.080	-2.728
	(0.035)	(0.038)	(0.084)	(4.715)	(5.044)
Disbursement by the euro-area member states under a first programme	-0.121	-0.172	-0.255	-251.897***	-85.192
	(0.197)	(0.418)	(2.269)	(57.285)	(56.967)
Release of a disbursement by the IMF under a first programme	0.011	0.047	-0.040	2.997	1.778
	(0.015)	(0.031)	(0.055)	(2.137)	(2.096)
Release of a disbursement by the EFSM under a first programme	-0.046***	-0.035	-0.103*	-6.658***	-6.799***
	(0.018)	(0.035)	(0.062)	(2.443)	(2.396)
Release of a disbursement by the EFSF under a first programme	-0.072**	-0.238***	0.007	0.873	2.577
	(0.032)	(0.063)	(0.108)	(4.418)	(4.500)
Disbursement by the ESM under a first programme	-0.013	-0.076**	-0.073	-5.173*	-5.290*
	(0.027)	(0.038)	(0.059)	(3.131)	(2.856)
Second economic adjustment programme	0.021	0.012	0.802*	15.286	-11.114
	(0.022)	(0.051)	(0.443)	(11.615)	(12.332)
Disbursement by the EFSF under a second programme	-1.192***	0.075	0.405	0.888	-2.050
	(0.115)	(0.243)	(1.323)	(34.147)	(33.746)
Fiscal Compact ratification	0.036*	-0.004	-0.002	-0.773	-1.060
	(0.021)	(0.021)	(0.051)	(2.702)	(2.857)
EU leaders sign the fiscal compact	0.032	0.048	0.070	4.632	4.505
	(0.031)	(0.033)	(0.074)	(4.097)	(4.377)
Interaction term of credit rating spreads and pre-crisis period	-0.002***	-0.001	-0.002	-0.151**	-0.091
	(0.001)	(0.001)	(0.001)	(0.075)	(0.067)
Interaction term of credit rating spreads and European sovereign debt crisis	-0.001*	-0.000	-0.002	-0.009	0.037
	(0.001)	(0.001)	(0.002)	(0.070)	(0.063)
Interaction term of credit rating spreads and post-crisis policy period	-0.001**	-0.003***	-0.002	-0.083	-0.077
	(0.001)	(0.001)	(0.002)	(0.084)	(0.087)
1 lead of purchases under the SMP	-0.004	-0.019*	-0.024	-3.300***	-3.706***
	(0.009)	(0.010)	(0.020)	(1.221)	(1.349)
2 leads of purchases under the SMP	-0.002	0.001	-0.009	-3.505***	-3.527***
	(0.008)	(0.010)	(0.018)	(1.162)	(1.301)
Constant	0.039***	0.020	0.048	-1.759	-2.547*
	(0.014)	(0.014)	(0.031)	(1.603)	(1.536)
N	15,040	15,040	15,040	11,700	11,700

Notes: The table reports coefficients estimated by FGLS correcting for cross-sectional dependence, heteroscedasticity and autocorrelation of the error term. Robust standard errors are in parentheses. In panel A, columns (1) to (5) display 5 bond yield and CDS spread variables of the GIIPS countries with different maturities. In panel B, the yields and CDS premia are used instead of the spreads. The panel consists of the GIIPS. The sample for the 10- and 5-year CDS spreads starts on November 1, 2008; because the FGLS estimator cannot handle missing values and for some countries, the CDS data first begin at this point in time. Only those variables are included in the regression that showed a significant impact on spreads in the regressions of Table 1 and 2. *** (**, *) indicates statistical significance at the 1 (5, 10)% level.

Appendix

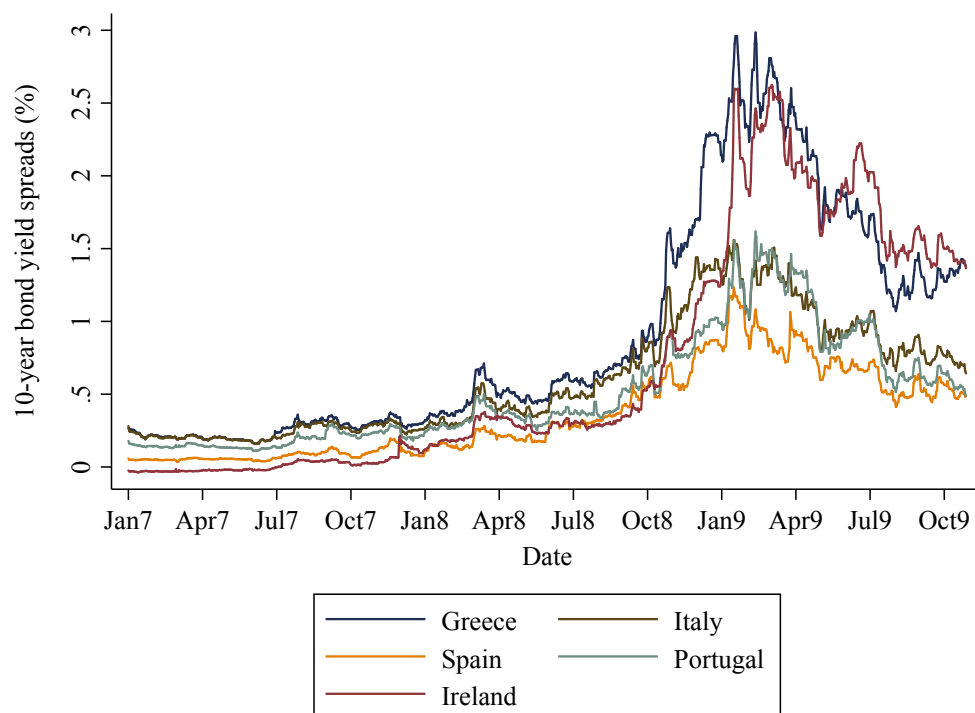
A Government bond yield spreads in the EMU

FIGURE A1 – GOVERNMENT BOND YIELDS BEFORE AND AT THE BEGINNING OF THE EMU

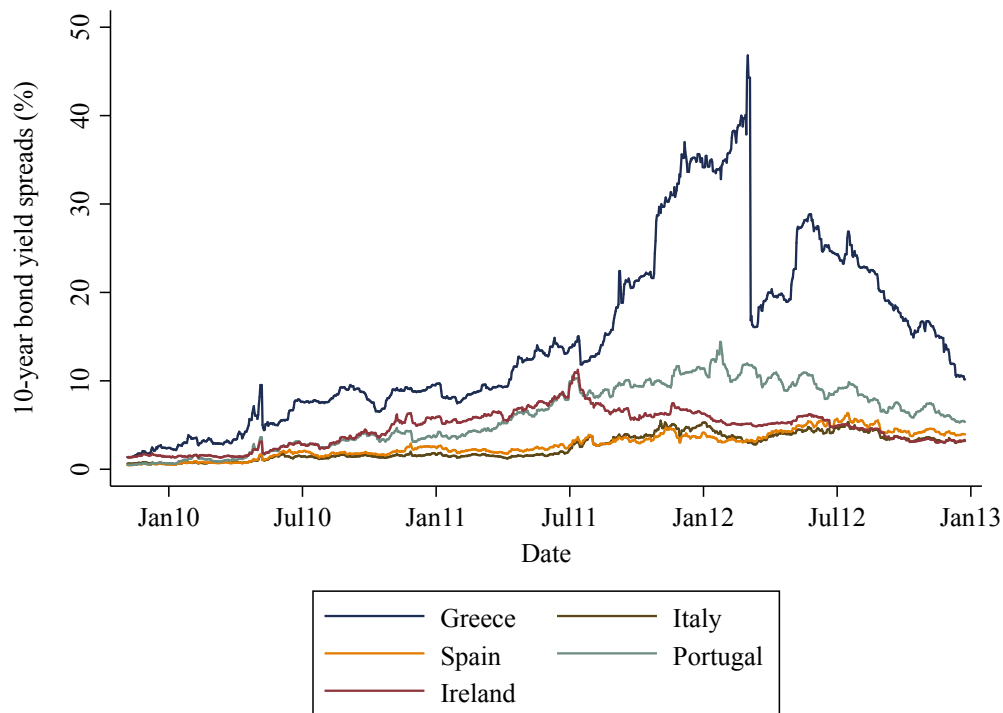


Source: Codogno et al. (2003), p. 507.

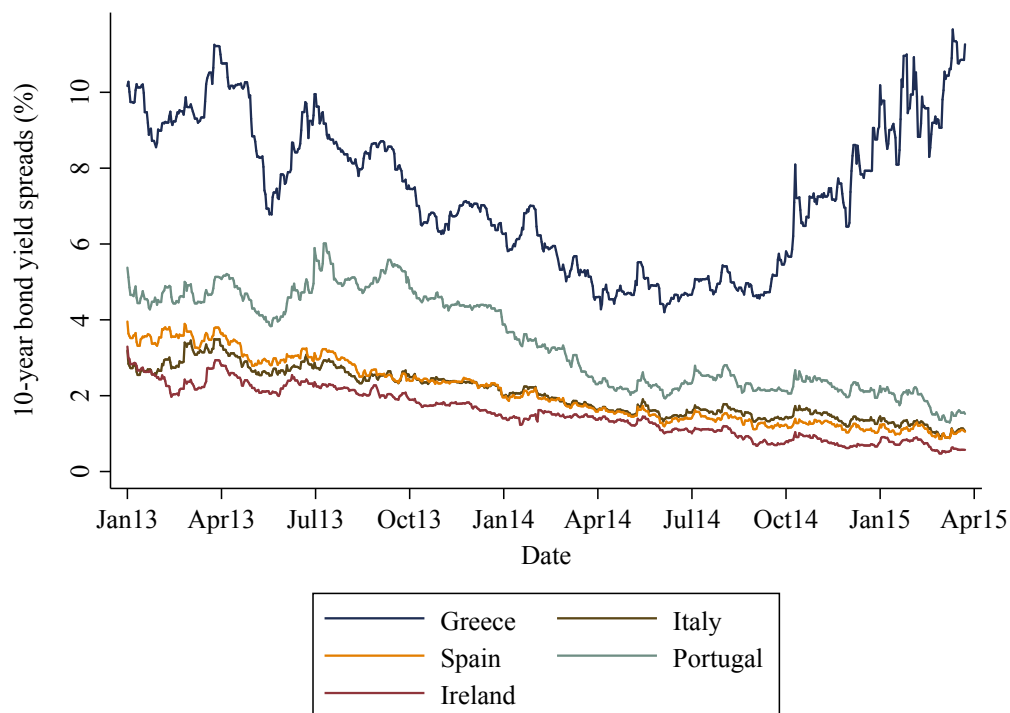
FIGURE A2 – GOVERNMENT BOND YIELD SPREADS OF THE GIIPS DURING THE FINANCIAL CRISIS



Source: Thomson Reuters Datastream and own illustration.

FIGURE A3 – GOVERNMENT BOND YIELD SPREADS OF THE GIIPS DURING THE EUROPEAN DEBT CRISIS

Source: Thomson Reuters Datastream and own illustration.

FIGURE A4– GOVERNMENT BOND YIELD SPREADS OF THE GIIPS SINCE 2013

Source: Thomson Reuters Datastream and own illustration.

B Literature Review

TABLE B1 – OVERVIEW OF RECENT STUDIES ON THE DETERMINANTS OF YIELD SPREADS IN THE EMU

Time periods	Yield spreads	Determinants of spreads	Empirical evidence
Phase 1: Before the euro was introduced	High bond yield differentials between EMU countries	Exchange rate risk, controls on capital movements, different tax treatments, credit risk, liquidity risk	Codogno et al. (2003), Geyer et al. (2004) and Gómez-Puig (2006)
Phase 2: 1999 – 2007, the first decade of the common currency	Compressed bond yields within the EMU	Devaluation risk (of high debt countries)	Sinn (2010)
		Credit risk (lower impact than in phase 1)	Bernoth et al. (2012)
		Liquidity risk, mixed evidence: Liquidity risk still relevant	Gómez-Puig (2006)
		Liquidity risk vanished	Bernoth et al. (2012), Codogno et al. (2003) and Geyer et al. (2004)
		International risk aversion	Codogno et al. (2003) and Geyer et al. (2004)
Phase 3: 2007 – 2013, the financial and sovereign debt crisis	GIIPS bond yield spreads increase vis-à-vis Germany	Credit risk (higher impact than in phase 2), International risk aversion	Barrios et al. (2009) and Klepsch (2011)
		Political communication	Beetsma et al. (2013), Büchel (2013), Mohl and Sondermann (2013) and Zoli (2013)
		ECB's unconventional monetary policy (SMP and OMT)	Beetsma et al. (2014), Eser and Schwaab (2013) and Szczerbowicz (2015)
Since 2013: Re-convergence of bond yields	To the beginning of 2013 the GIIPS bond yields converge to the German yield values again	No empirical analysis so far	

Source: Own illustration.

C The data and their properties

TABLE C1 – DATA, SOURCES AND DEFINITIONS

Variable	Description	Frequency	Source
Pre-crisis period	Dummy equals 1 from January 1, 2007 – November 5, 2009	Daily	
European sovereign debt crisis	Dummy equals 1 from November 5, 2009 – July 26, 2012	Daily	
Post-crisis policy period	Dummy equals 1 since Draghi had been hold his speech in London on July 26, 2012	Daily	
Financial data			
10-year bond yield	Government Bond yields with 10-year maturity	Daily	Thomson Reuters Datastream
10-year bond yield spreads	Difference between current bond yields vis-à-vis Germany		
5-year bond yield spreads	Difference between current bond yields vis-à-vis Germany	Daily	Thomson Reuters Datastream
2-year bond yield spreads	Difference between current bond yields vis-à-vis Germany	Daily	Thomson Reuters Datastream
10-year CDS spreads	Difference between current CDS vis-à-vis Germany	Daily	Thomson Reuters Datastream
5-year CDS spreads	Difference between current CDS vis-à-vis Germany	Daily	Thomson Reuters Datastream
Fiscal fundamentals			
Debt to GDP ratio (%)	A country's debt in % of GDP	Quarterly	Thomson Reuters Datastream
TED spread	The Treasury Bill Eurodollar Difference (TED) spread is an indicator of the perceived credit risk in the general economy	Daily	Thomson Reuters Datastream
Credit ratings	A country's credit rating ranging from 1 (Default) to 20 (triple A)		
Credit rating spreads	Total value of difference between current rating vis-à-vis Germany	Quarterly	Thomson Reuters Datastream
Financial risk aversion			
VIX-index	Volatility index of the US equity market	Daily	Thomson Reuters Datastream
Euro-STOXX	Volatility index of the Euro equity market	Daily	Thomson Reuters Datastream
Total stock market index for the EU	Total stock market index for the EU: EU-DS market	Daily	Thomson Reuters Datastream
Fiscal policy data			
First economic adjustment programme	Dummy equals 1 for a country who is currently in a first economic adjustment programme	Daily	European Commission (2016)
Disbursement by the euro-area member states under a first programme	Dummy equals 1 for a disbursement by the EMU states within the scope of a first programme	Daily	European Commission (2016)
Release of a disbursement by the IMF under a first programme	Dummy equals 1 for the release of a disbursement by the IMF within the scope of a first programme	Daily	International Monetary Fund (2016)
Disbursement by the IMF under a first programme	Dummy equals 1 for a disbursement by the IMF within the scope of a first programme	Daily	European Commission (2016)
Release of a disbursement by the EFSM under a first programme	Dummy equals 1 for the release of a disbursement by the IMF within the scope of a first programme	Daily	European Commission (2016)
Disbursement by the EFSM under a first programme	Dummy equals 1 for a disbursement by the EFSM within the scope of a first programme	Daily	European Commission (2016)
Release of a disbursement by the EFSF under a first programme	Dummy equals 1 for the release of a disbursement by the IMF within the scope of a first programme	Daily	European Financial Stability Facility (2016a)
Disbursement by the EFSF under a first programme	Dummy equals 1 for a disbursement by the EFSF within the scope of a first programme	Daily	European Financial Stability Facility (2016b) and Federal Ministry of Finance (2016b)
Disbursement by the ESM under a first programme	Dummy equals 1 for a disbursement by the ESM within the scope of a first programme	Daily	Federal Ministry of Finance (2016b)
Second economic adjustment programme	Dummy equals 1 for a country who is currently in a second economic adjustment programme	Daily	European Commission (2016)
Release of a disbursement by the EFSF under a second programme	Dummy equals 1 for the release by a disbursement by the EFSF within the scope of a first programme	Daily	European Financial Stability Facility (2016a)

Disbursement by the EFSF under a second programme	Dummy equals 1 for a disbursement by the EFSF within the scope of a second programme	Daily	European Financial Stability Facility (2016b) and Federal Ministry of Finance (2016b)
Release of a disbursement by the IMF under a second programme	Dummy equals 1 for the release of a disbursement by the IMF within the scope of a second programme	Daily	International Monetary Fund (2016)
Disbursement by the IMF under a second programme	Dummy equals 1 for a disbursement by the IMF within the scope of a second programme	Daily	European Commission (2016)
Greek haircut	Dummy equals 1 since the Greek haircut has taken place	Daily	Federal Ministry of Finance (2016a)
Six-pact treaty	Dummy equals 1 for the Six-pact treaty being active	Daily	European Commission (2016)
Agreement permanent crisis mechanism	Dummy equals 1 since the Agreement for a permanent crisis mechanism	Daily	Federal Ministry of Finance (2016a)
EFSSF	Dummy equals 1 if EFSF is in action	Daily	(European Financial Stability Facility, 2016a)
Agreement on ESM	Dummy equals 1 since the agreement for the ESM	Daily	Federal Ministry of Finance (2016a)
EU leaders sign the fiscal compact	Dummy equals 1 since the EU leaders has been signed the fiscal compact	Daily	Stiftung Wissenschaft und Politik (2016)
Fiscal Compact ratification	Dummy equals 1 since the fiscal compact has been ratified	Daily	Stiftung Wissenschaft und Politik (2016)

Monetary policy data

CBPP established	Dummy equals 1 on the day, the CBPP was established	Daily	European Central Bank (2016c, 2016d) and ECB Statistical Data Warehouse
Purchases under the CBPP	Dummy equals 1 for a purchase under the CBPP	Daily	ECB Statistical Data Warehouse
Total holdings under the CBPP	Total holdings under CBPP (in EUR bn)	Daily	ECB Statistical Data Warehouse
Second CBPP established	Dummy equals 1 on the day, the second CBPP was established	Daily	European Central Bank (2016c, 2016d) and ECB Statistical Data Warehouse
Purchases under the second CBPP	Dummy equals 1 for a purchase under the second CBPP	Daily	ECB Statistical Data Warehouse
Total holdings under the second CBPP	Total holdings under the second CBPP (in EUR bn)	Daily	ECB Statistical Data Warehouse
Third CBPP established	Dummy equals 1 on the day, the third CBPP was established	Daily	European Central Bank (2016c, 2016d) and ECB Statistical Data Warehouse
Purchases under the third CBPP	Dummy equals 1 for a purchase under the third CBPP	Daily	ECB Statistical Data Warehouse
Total holdings under the third CBPP	Total holdings under the third CBPP (in EUR bn)	Daily	ECB Statistical Data Warehouse
SMP established	Dummy equals 1 on the day, the SMP was established	Daily	European Central Bank (2016c, 2016d) and ECB Statistical Data Warehouse
Purchases under the SMP	Dummy equals 1 for a purchase under the SMP	Daily	ECB Statistical Data Warehouse
Total holdings under the SMP	Total holdings under the SMP (in EUR bn)	Daily	ECB Statistical Data Warehouse
OMT established	Dummy equals 1 on the day, the OMT was established	Daily	European Central Bank (2016c, 2016d)
OMT	Dummy equals 1 since the OMT has been established	Daily	European Central Bank (2016c, 2016d)
ABSPP established	Dummy equals 1 on the day, the ABSPP was established	Daily	European Central Bank (2016c, 2016d)
Purchases under the ABSPP	Dummy equals 1 for a purchase under the ABSPP	Daily	ECB Statistical Data Warehouse
Total holdings under the ABSPP	Total holdings under the ABSPP (in EUR bn)	Daily	ECB Statistical Data Warehouse
PSPP established	Dummy equals 1 on the day, the PSPP was established	Daily	European Central Bank (2016c, 2016d)
Purchases under the PSPP	Dummy equals 1 for a purchase under the PSPP	Daily	ECB Statistical Data Warehouse
Total holdings under the PSPP	Total holdings under the PSPP (in EUR bn)	Daily	ECB Statistical Data Warehouse
APP established	Dummy equals 1 on the day, the APP was established	Daily	European Central Bank (2016c,

2016b)

Total holdings under the APP	Total holdings under the APP (in EUR bn)	Daily	ECB Statistical Data Warehouse
MROs with a fixed rate tender procedure	Dummy equals 1 if MROs have been conducted with a fixed rate tender and full allotment	Daily	European Central Bank (2016a)
Regular 3-month LTROs with a fixed rate tender	Dummy equals 1 if the 3-month LTROs have been conducted with a fixed rate tender and full allotment	Daily	European Central Bank (2016a)
Allotment of a regular 3-month LTRO	Dummy equals 1 for the allotment of a regular 3-month LTRO	Daily	European Central Bank (2016a)
STROs with a fixed rate tender	Dummy equals 1 if STROs have been conducted with a fixed rate tender and full allotment	Daily	European Central Bank (2016a)
Announcement of an STRO	Dummy equals 1 for the announcement of an STRO	Daily	European Central Bank (2016a)
Allotment of an STRO	Dummy equals 1 for the allotment of an STRO	Daily	European Central Bank (2016a)
Additional 3-month LTROs with a fixed rate tender	Dummy equals 1 if additional 3-month LTROs have been conducted with a fixed rate tender and full allotment	Daily	European Central Bank (2016a)
Announcement of an additional 3-month LTRO	Dummy equals 1 for the announcement of an additional 3-month LTRO	Daily	European Central Bank (2016a)
Allotment of an additional 3-month LTRO	Dummy equals 1 for the allotment of an additional 3-month LTRO	Daily	European Central Bank (2016a)
Additional 6-month LTROs	Dummy equals 1 for additional 6-month LTROs being active	Daily	European Central Bank (2016a)
Announcement of an additional 6-month LTRO	Dummy equals 1 for the announcement of an additional 6-month LTRO	Daily	European Central Bank (2016a)
Allotment of an additional 6-month LTRO	Dummy equals 1 for the allotment of an additional 6-month LTRO	Daily	European Central Bank (2016a)
Additional 12-month LTROs	Dummy equals 1 for additional 12-month LTROs being active	Daily	European Central Bank (2016a)
Announcement of an additional 12-month LTRO	Dummy equals 1 for the announcement of an additional 12-month LTRO	Daily	European Central Bank (2016a)
Allotment of an additional 12-month LTRO	Dummy equals 1 for the allotment of an additional 12-month LTRO	Daily	European Central Bank (2016a)
Additional 13-month LTROs	Dummy equals 1 for additional 13-month LTROs being active	Daily	European Central Bank (2016a)
Additional 36-month LTROs	Dummy equals 1 for additional 36-month LTROs being active	Daily	European Central Bank (2016a)
Announcement of an additional 36-month LTRO	Dummy equals 1 for the announcement of an additional 36-month LTRO	Daily	European Central Bank (2016a)
Allotment of an additional 36-month LTRO	Dummy equals 1 for the allotment of an additional 36-month LTRO	Daily	European Central Bank (2016a)
TLTROs	Dummy equals 1 for TLTROs being active	Daily	European Central Bank (2016a)
Announcement of a TLTRO	Dummy equals 1 for the announcement of a TLTRO	Daily	European Central Bank (2016a)
Allotment of a TLTRO	Allotted value of a targeted LTRO	Daily	European Central Bank (2016a)
ECB policy rate	ECB's policy rate for MROs	Daily	Thomson Reuters Datastream
Draghi's speech	Dummy equals 1 on the day, Draghi hold his speech in London (July 26 th , 2012)	Daily	(European Central Bank, 2016e)
Reserve Ratio	ECB's reserve ratio (in %)	Daily	European Central Bank (2016a)
Central Bank eases lending rules	Dummy equals 1 if the central bank has been eased lending rules	Daily	European Central Bank (2016c, 2016d)
Implementing of a bank supervision	Dummy equals 1 since a bank supervision has been established	Daily	European Central Bank (2016c, 2016d)

Test results and data properties

The initial regression model is an FE model to control for unobserved country fixed effects.

Regression model: (A1) $spreads_{i,t} = \alpha_0 + \beta X_{i,t} + \varepsilon_{i,t}$

with $i = 1, \dots, 5$ denoting the GIIPS countries; and $t = 1, \dots, 3012$ denoting the daily time dimension. The controls $\beta X_{i,t}$ include the following: a measure of risk aversion (VSTOXX), total stock market index for the EU, TED spread and debt/GDP spreads.

TABLE C2 – TEST RESULTS FOR PANEL-SPECIFIC DATA PROPERTIES

	Cross-sectional dependence ¹	Groupwise heteroskedasticity ²	Serial Correlation ³
2-year bond yield spreads	20249.420 (0.0000)	6.5e+05 (0.0000)	3.223e+07 (0.0000)
5-year bond yield spreads	11914.583 (0.0000)	6.8e+05 (0.0000)	9511.380 (0.0000)
10-year bond yield spreads	11651.341 (0.0000)	2.7e+05 (0.0000)	987.509 (0.0000)
5-year CDS spreads	17177.653 (0.0000)	1.5e+05 (0.0000)	1605.987 (0.0000)
10-year CDS spreads	13743.833 (0.0000)	5.9e+05 (0.0000)	625.392 (0.0000)

Note: p-values are reported in parentheses.

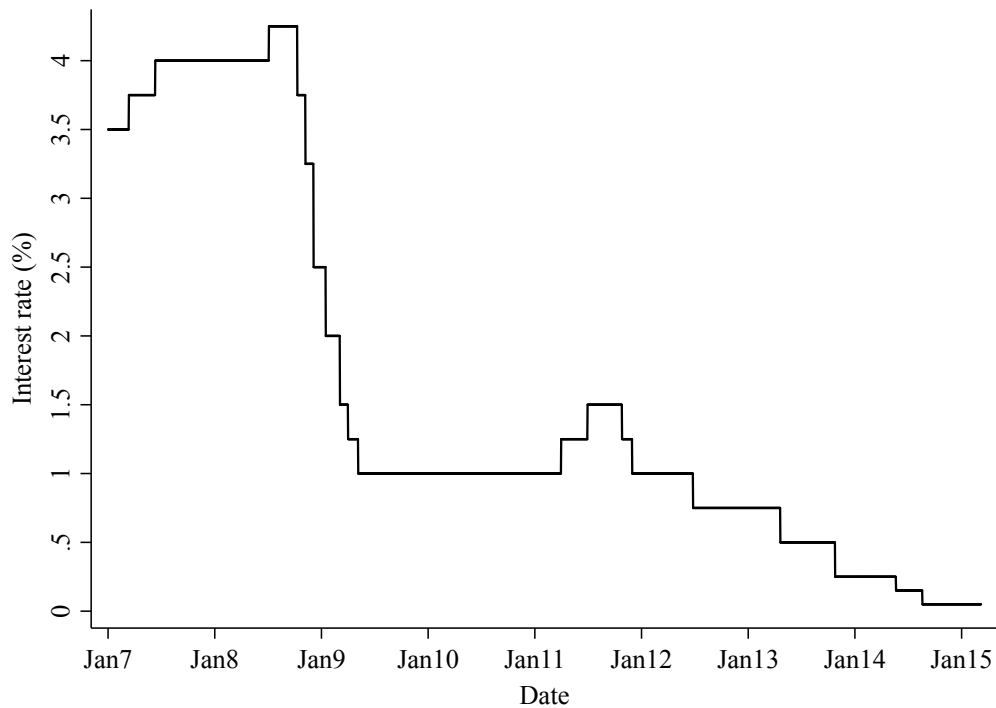
¹ CD is tested with the Breusch and Pagan (1980) LM test. The resulting test statistic of the Breusch and Pagan (1980) LM test is distributed $Chi - squared(d)$, where: $d = N_g * (N_g - 1) / 2$, under the null hypothesis of cross-sectional independence.

² Groupwise heteroscedasticity in the residual of a fixed-effects regression model is tested with a Wald statistic. It tests the hypothesis that $\sigma^2(i) = \sigma^2$ for $i = 1, N_g$, where N_g is the number of cross-sectional units. The resulting test statistic is distributed $Chi - squared(N_g)$ under the null hypothesis of homoscedasticity.

³ Wald test for the null hypothesis of no serial correlation.

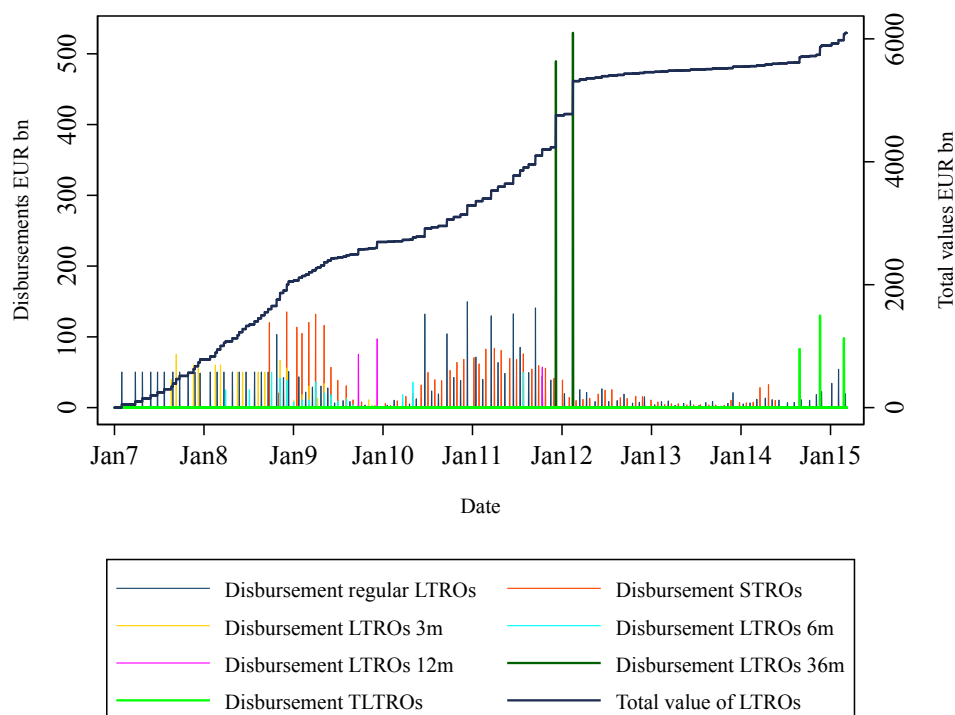
D Monetary and Fiscal Policy during the European sovereign debt crisis

FIGURE D1 – ECB REFINANCING RATE DEVELOPMENT

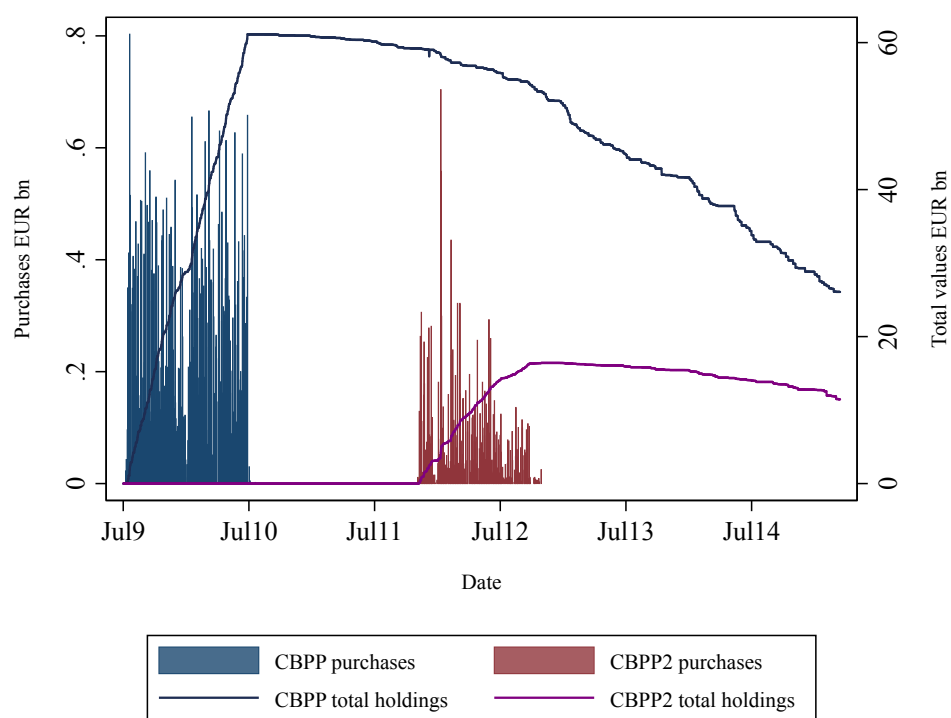


Source: Thomson Reuters Datastream and own illustration.

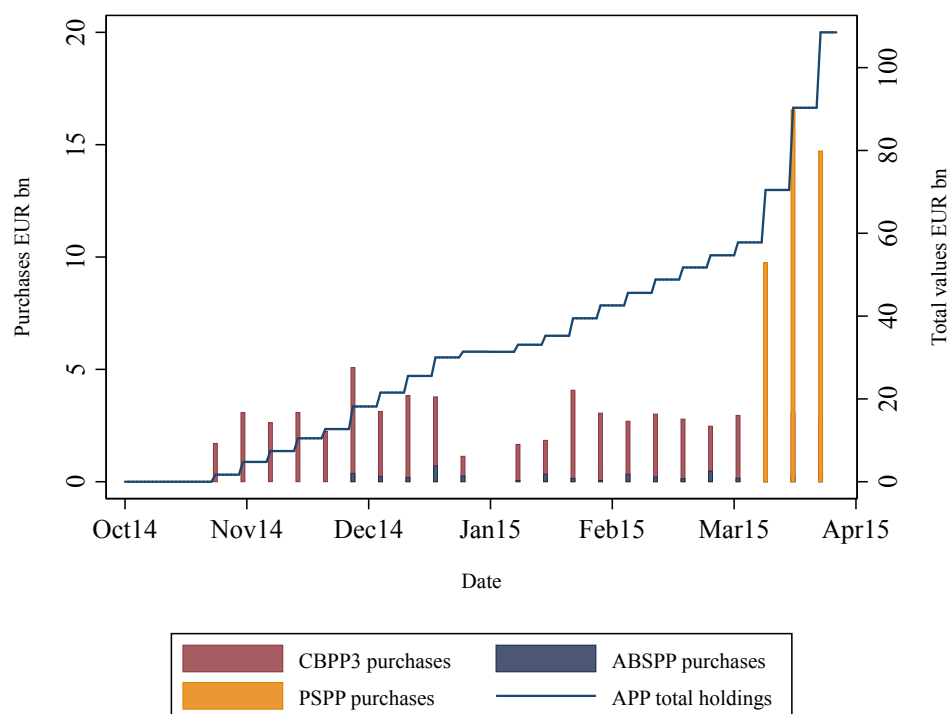
FIGURE D2 – DISBURSEMENTS AND TOTAL VALUES OF ALL LTROs



Notes: The total value of the LTROs is the sum of the included cumulative LTRO disbursements.
Source: Own illustration based on ECB's history of all open-market operations.

FIGURE D3 – ECB PURCHASES UNDER THE CBPP AND CBPP2

Source: ECB Statistical Data Warehouse and own illustration.

FIGURE D4 – ECB PURCHASES UNDER THE APP

Source: ECB Statistical Data Warehouse and own illustration.

TABLE D1 – DISBURSEMENTS UNDER THE IRISH ADJUSTMENT PROGRAMME (EUR BN)

1st Programme - Disbursements							
EFSM¹		EFSF¹		IMF²		Bilateral lenders³	
January 12, 2011	5.0	February 1, 2011	3.6	January 18, 2011	5.8	October 14, 2011	0.475
March 24, 2011	3.4	November 10, 2011	3.0	May 18, 2011	1.6	January 30, 2012	0.475
May 31, 2011	3.0	December 15, 2011	1.0	September 7, 2011	1.5	March 28, 2012	0.475
September 29, 2011	2.0	January 12, 2012	1.2	December 16, 2011	3.8	March 30, 2012	0.100
October 6, 2011	0.5	January 19, 2012	0.5	February 29, 2012	3.2	June 15, 2012	0.150
January 16, 2012	1.5	April 3, 2012	2.7	June 15, 2012	1.5	August 1, 2012	0.475
March 5, 2012	3.0	May 2, 2013	0.8	September 28, 2012	0.9	October 19, 2012	0.475
July 3, 2012	2.3	June 18, 2013	1.6	December 20, 2012	0.9	November 1, 2012	0.250
October 30, 2012	1.0	September 27, 2013	1.0	March 27, 2013	1.1	March 6, 2013	0.475
March 25, 2014	0.8	December 4, 2013	2.3	June 27, 2013	1.0	June 4, 2013	0.100
				September 27, 2013	0.8	June 6, 2013	0.475
				December 18, 2013	0.6	June 7, 2013	0.150
						September 26, 2013	0.475
						November 7, 2013	0.250
Total	22.5		17.7		22.7		4.800

Notes: ¹ EFSM and EFSF disbursements are denominated in EUR billion.

² IMF loans are subject to exchange rate fluctuations because they are initially denominated in SDRs.

³ Bilateral lenders: Denmark (EUR 0.1 billion disbursed), Sweden (EUR 0.15 billion disbursed), and United Kingdom (EUR 0.475 billion disbursed).

Source: European Commission, EFSF, IMF and National Treasury Management Agency (2016).

TABLE D2 – DISBURSEMENTS UNDER THE PORTUGUESE ADJUSTMENT PROGRAMME (EUR BN)

1st Programme - Disbursements							
	EFSM		EFSF		IMF¹		Total/quarter
Q2 2011	May 31, 2011	1.75	June 22, 2011	3.70	May 24, 2011	6.2	18.50
	June 1, 2011	4.75	June 29, 2011	2.20			
Q3 2011	September 21, 2011	5.00			September 14, 2011	4.0	11.20
	September 29, 2011	2.00					
Q4 2011	October 6, 2011	0.60	December 20, 2011	1.00	December 21, 2011	2.8	4.50
Q1 2012	January 16, 2012	1.50	January 12, 2012	1.70			4.20
			January 19, 2012	1.00			
Q2 2012	April 24, 2012	1.80	May 30, 2012	3.50	April 12, 2012	5.2	14.90
	May 4, 2012	2.70	May 30, 2012	1.70			
Q3 2012			July 17, 2012	1.50	August 6, 2012	1.4	4.10
			July 17, 2012	1.10			
Q4 2012	October 30, 2012	2.00	December 3, 2012	0.80	November 14, 2012	1.5	4.30
Q1 2013			February 7, 2013	0.80	January 18, 2013	0.8	1.60
Q2 2013			June 27, 2013	1.05	June 14, 2013	0.7	2.80
			June 27, 2013	1.05			
Q3 2013							0.00
Q4 2013			November 22, 2013	3.70	November 14, 2013	1.9	5.60
Q1 2014	March 25, 2014	1.80			February 18, 2014	0.9	2.70
Q2 2014			April 28, 2014	1.20	April 24, 2014	0.9	2.10
Q3 2014							0.00
Q4 2014	November 12, 2014	0.40					0.40
Total		24.30		26.00		26.3	76.90

Notes: ¹ IMF disbursements were initially in SDRs; the EUR equivalent was taken from the IMF press releases. The values are subject to exchange rate fluctuations.

Source: EFSF, European Commission and IMF press releases.

TABLE D3 – DISBURSEMENTS UNDER THE GREEK ADJUSTMENT PROGRAMMES (EUR bn)

1st programme		Euro area member states		IMF	Total	
1 st tranche		May 18, 2010	14.5	May 12, 2010	5.5	20.0
2 nd tranche		September 13, 2010	6.5	September 14, 2010	2.5	9.0
3 rd tranche		January 19, 2011	6.5	December 21, 2010	2.5	9.0
4 th tranche		March 16, 2011	10.9	March 16, 2011	4.1	15.0
5 th tranche		July 15, 2011	8.7	July 13, 2011	3.3	12.0
6 th tranche		December 14, 2011	5.8	December 7, 2011	2.2	8.0
1st programme - Total disbursements			52.9		20.1	73.0
2nd programme		EFSF		IMF	Total	
1 st disbursement	1 st tranche	March 12, 2012; April 10 and 25, 2012	29.7	March 19, 2012	1.6	
	2 nd tranche	March 12, 2012; April 10 and 25, 2012	4.9			
	3 rd tranche	March 19, 2012	5.9			
	4 th tranche	April 10, 2012	3.3			
	5 th tranche	April 19, 2012	25.0			
	6 th tranche	May 10, 2012	4.2			
	7 th tranche	June 28, 2012	1.0			
	Total		74.0			
2 nd disbursement	1 st tranche	December 17 and 19, 2012	34.3	January 16, 2013	3.24	
	2 nd tranche	January 31, 2013	2.0			
	3 rd tranche	February 28, 2013	2.8			
	4 th tranche	May 3, 2013	2.8			
	5 th tranche	May 31, 2013	7.2			
	Total		49.1			
3 rd disbursement	1 st tranche	May 17, 2013	4.2	June 6, 2013	1.73	
	2 nd tranche	June 25, 2013	3.3			
	Total		7.5			
4 th disbursement	1 st tranche	July 31, 2013	2.5	August 2, 2013	1.71	
	2 nd tranche	December 18, 2013	0.5			
	Total		3.0			
5 th disbursement	1 st tranche	April 28, 2014	6.3	May 30, 2014	3.6	
	2 nd tranche	July 9, 2014	1.0			
	3 rd tranche	August 14, 2014	1.0			
	Total		8.3			
2nd programme - Total disbursements			141.9		11.93	153.38
1st and 2nd programme - Total disbursements					32.03	226.8

Source: European Commission, EFSF and own illustration.

TABLE D4 – FINANCIAL ASSISTANCE FOR THE RECAPITALISATION OF THE SPANISH BANKING SECTOR

Programme Disbursements (in EUR bn)		
ESM		
1 st disbursement	December 11, 2012	39.468
2 nd disbursement	February 5, 2013	1.865
Total		41.333

Source: ESM and own illustration.

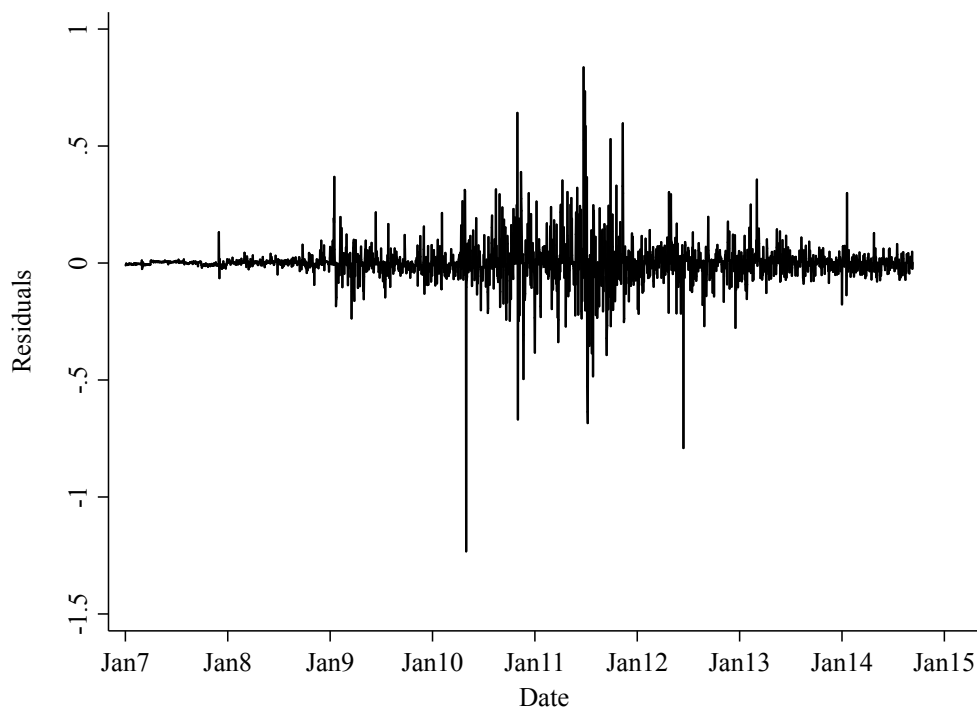
E GARCH model

Testing for the necessity of a GARCH model

Two preconditions must be fulfilled before a GARCH model can be used. First, clustering volatility in the residuals needs to be present. Second, an ARCH effect in the residual is required. The two preconditions can be tested as follows:

1. Run an OLS regression
2. Obtain the residuals of this model
3. Check for the presence of clustering volatility by plotting the residuals
4. Test for the presence of ARCH in the residuals with an Engle LM test

FIGURE E1 – BASELINE REGRESSION RESIDUALS FOR IRELAND



Source: Own illustration.

The underlying model is separately regressed for each country of the GIIPS.

$$(A2) \text{spreads}_t = \alpha_0 + \beta X_t + \varepsilon_t$$

with $t = 1, \dots, 3012$, denoting the daily time dimension. The controls βX_t include: A measures of risk aversion (VSTOXX), total stock market index for the EU and TED spread.

The graph shows clustering volatility in the residuals because periods of low volatility and periods of high volatility are separately grouped. With regard to the definition of Mandelbrot (1963), "...large changes tend to be followed by large changes – of either sign – and small changes tend to be followed by small changes..." (Mandelbrot, 1963, p. 418), the presence of clustering volatility can be confirmed.⁴⁹

The 4th step can be conducted with a post-estimation test. For the estimated regression of step 1, an ARCH LM test reveals whether the residuals have an ARCH process.

⁴⁹ The residuals of the regressions for the other countries look similar. Thus, clustering volatility for those countries can also be concluded.

TABLE E1 – TEST RESULTS FOR TIME-SERIES DATA PROPERTIES

Country	Dependent Variable	LM test for ARCH ¹	Breusch-Godfrey LM test for autocorrelation ²	Durbin's Alternative test for autocorrelation ³
Greece	2-year bond yield spread	18.482 (0.0000)	36.523 (0.0000)	36.857 (0.0000)
	5-year bond yield spread	0.000 (0.9866)	0.000 (0.9837)	0.000 (0.9838)
	10-year bond yield spread	0.002 (0.9634)	0.974 (0.3237)	0.971 (0.3245)
	5-year CDS spread	5.193 (0.0227)	107.798 (0.0000)	112.452 (0.0000)
	10-year CDS spread	89.588 (0.0000)	237.003 (0.0000)	262.461 (0.0000)
Italy	2-year bond yield spread	129.405 (0.0000)	24.963 (0.0000)	25.087 (0.0000)
	5-year bond yield spread	130.012 (0.0000)	18.019 (0.0000)	18.064 (0.0000)
	10-year bond yield spread	35.421 (0.0000)	38.736 (0.0000)	39.121 (0.0000)
	5-year CDS spread	20.958 (0.0000)	45.448 (0.0000)	46.127 (0.0000)
	10-year CDS spread	21.368 (0.0000)	42.947 (0.0000)	43.544 (0.0000)
Spain	2-year bond yield spread	15.650 (0.0001)	38.525 (0.0000)	38.905 (0.0000)
	5-year bond yield spread	29.674 (0.0000)	26.851 (0.0000)	27.003 (0.0000)
	10-year bond yield spread	34.589 (0.0000)	102.616 (0.0000)	106.063 (0.0000)
	5-year CDS spread	23.908 (0.0000)	30.302 (0.0000)	30.554 (0.0000)
	10-year CDS spread	25.850 (0.0000)	28.706 (0.0000)	28.926 (0.0000)
Portugal	2-year bond yield spread	1.470 (0.2254)	0.913 (0.3392)	0.907 (0.3410)
	5-year bond yield spread	7.151 (0.0075)	7.469 (0.0063)	7.450 (0.0063)
	10-year bond yield spread	5.901 (0.0151)	78.671 (0.0000)	82.800 (0.0000)
	5-year CDS spread	57.581 (0.0000)	33.485 (0.0000)	34.049 (0.0000)
	10-year CDS spread	62.200 (0.0000)	34.031 (0.0000)	34.619 (0.0000)
Ireland	2-year bond yield spread	83.517 (0.0000)	1.921 (0.1657)	1.915 (0.1664)
	5-year bond yield spread	144.576 (0.0000)	34.984 (0.0000)	35.285 (0.0000)
	10-year bond yield spread	86.343 (0.0000)	140.614 (0.0000)	147.391 (0.0000)
	5-year CDS spread	293.237 (0.0000)	97.354 (0.0000)	101.383 (0.0000)
	10-year CDS spread	211.233 (0.0000)	82.761 (0.0000)	85.599 (0.0000)

Notes: p-values are reported in parentheses. Autocorrelation and ARCH are both tested for 1 lag. Equation A2 is the underlying estimated model.

¹ Engle's ARCH LM tests checks for time-dependent volatility, i.e., for the presence of autoregressive conditional heteroscedasticity. Under the null hypothesis, the error has no ARCH effect. The test statistic is distributed chi squared. (Engle, 1982).

² The Breusch-Godfrey test for higher-order serial correlation in the disturbance assumes no autocorrelation under its null hypothesis and chi squared distribution.

³ Durbin's alternative test for serial correlation in the disturbance has the same null hypothesis and the same distribution as the Breusch-Godfrey LM test.

TABLE E2 – ROBUSTNESS: IMPACT OF BAILOUTS ON YIELD AND CDS SPREADS, GARCH MODEL

Panel A: Italy					
	10-year bond yield spreads (1)	5-year bond yield spreads (2)	2-year bond yield spreads (3)	10-year CDS spreads (4)	5-year CDS spreads (5)
Lagged dependent variable	0.991*** (0.005)	0.990*** (0.003)	0.986*** (0.005)	0.986*** (0.003)	0.990*** (0.003)
Euro-STOXX	0.000*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.059*** (0.020)	0.063*** (0.017)
Total stock market index for the EU	-0.000 (0.000)	0.000* (0.000)	0.000*** (0.000)	-0.000 (0.001)	-0.000 (0.001)
Second CBPP established	-0.158*** (0.013)	-0.193*** (0.020)	-0.244*** (0.021)	-0.760 (1.613)	-0.336 (1.632)
Purchases under the second CBPP	-0.015 (0.010)	-0.018* (0.011)	-0.006 (0.011)	-0.826 (0.889)	-1.211 (0.910)
Third CBPP established	-0.128*** (0.009)	-0.092*** (0.003)	-0.034*** (0.003)	-8.000*** (0.160)	-5.659*** (0.161)
Purchases under the third CBPP	-0.015 (0.013)	0.004 (0.008)	0.002 (0.006)	-1.395*** (0.524)	-0.793* (0.478)
SMP established	-0.498*** (0.008)	-0.582*** (0.011)	-0.578*** (0.040)	-69.175*** (1.586)	-69.600*** (1.478)
Purchases under the SMP	-0.002 (0.009)	-0.005 (0.012)	0.006 (0.022)	-1.250 (1.843)	-1.535 (1.848)
OMT established	-0.277*** (0.007)	-0.317*** (0.006)	-0.175*** (0.009)	-41.282*** (0.400)	-44.467*** (0.455)
Announcement of an additional 36-month LTRO	-0.083 (0.061)	-0.201 (0.156)	-0.229 (0.218)	-5.259 (3.410)	-7.130** (3.588)
Allotment of an additional 36-month LTRO	-0.038 (0.088)	0.009 (0.154)	-0.108 (0.150)	-6.450 (5.535)	-6.224 (5.528)
Draghi's speech	-0.415*** (0.011)	-0.605*** (0.011)	-0.842*** (0.019)	-26.830*** (0.644)	-26.891*** (0.733)
Interaction term of credit rating spreads and pre-crisis period	-0.002 (0.004)	-0.008 (0.006)	-0.010 (0.008)	0.105 (0.285)	-0.068 (0.284)
Interaction term of credit rating spreads and European sovereign debt crisis	-0.000 (0.004)	-0.005 (0.005)	-0.005 (0.007)	0.463* (0.265)	0.281 (0.275)
Interaction term of credit rating spreads and post-crisis policy period	-0.006*** (0.002)	-0.008*** (0.002)	-0.009*** (0.003)	-0.634*** (0.195)	-0.697*** (0.199)
Agreement on ESM	0.003 (0.023)	0.001 (0.034)	-0.029 (0.037)	-0.234 (2.170)	-0.327 (1.937)
Fiscal Compact ratification	0.024 (0.021)	0.005 (0.025)	-0.007 (0.045)	2.378 (1.805)	2.432 (1.785)
EU leaders sign the fiscal compact	0.027 (0.023)	0.076** (0.033)	0.107** (0.047)	1.589 (2.255)	2.231 (2.007)
Six-pact treaty	0.006 (0.006)	0.011 (0.008)	0.020 (0.021)	-0.028 (0.599)	0.085 (0.592)
Constant	0.003 (0.014)	-0.003 (0.019)	-0.005 (0.025)	-0.913 (1.428)	-1.177 (1.389)
L.arch	0.113*** (0.018)	0.103*** (0.018)	0.105** (0.044)	0.069*** (0.021)	0.068*** (0.021)
L.garch	0.911*** (0.012)	0.912*** (0.013)	0.912*** (0.034)	0.934*** (0.017)	0.935*** (0.018)
Constant	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.120 (0.087)	0.121 (0.093)
N	3,008	3,008	3,008	2,520	2,529
Ljung-Box Q test	30.2839 (0.0000)	12.4350 (0.0000)	19.1184 (0.0000)	37.1806 (0.0000)	38.2757 (0.0000)
Panel B: Spain					
	10-year bond yield spreads (1)	5-year bond yield spreads (2)	2-year bond yield spreads (3)	10-year CDS spreads (4)	5-year CDS spreads (5)
Lagged dependent variable	0.994*** (0.006)	0.989*** (0.004)	0.991*** (0.004)	0.988*** (0.003)	0.990*** (0.003)
Euro-STOXX	0.000*** (0.000)	0.000*** (0.000)	0.001*** (0.000)	0.043* (0.024)	0.040** (0.020)
Total stock market index for the EU	-0.000 (0.000)	-0.000 (0.000)	0.000* (0.000)	0.000 (0.001)	-0.000 (0.001)
Second CBPP established	-0.176*** (0.013)	-0.195*** (0.026)	-0.226*** (0.019)	2.712** (1.357)	2.847** (1.349)
Third CBPP established	-0.115*** (0.014)	-0.004 (0.003)	0.094*** (0.002)	-4.843*** (0.146)	-4.870*** (0.124)
Purchases under the third CBPP	-0.014 (0.016)	-0.012 (0.008)	-0.001 (0.003)	-0.895** (0.391)	-0.579 (0.362)
SMP established	-0.626*** (0.008)	-0.987*** (0.013)	-1.078*** (0.018)	-55.774*** (0.716)	-64.662*** (0.679)
Purchases under the SMP	-0.012 (0.009)	-0.003 (0.015)	-0.000 (0.015)	-0.718 (1.321)	-1.214 (1.322)
OMT established	-0.452*** (0.026)	-0.418*** (0.012)	-0.222*** (0.011)	-43.600*** (0.563)	-52.247*** (0.647)
Announcement of an additional 36-month LTRO	-0.012 (0.048)	-0.045 (0.035)	-0.029** (0.013)	-5.325*** (1.521)	-5.523*** (1.613)
Allotment of an additional 36-month LTRO	0.005 (0.037)	-0.002 (0.065)	-0.040 (0.084)	-1.507 (2.533)	-1.342 (2.615)
Draghi's speech	-0.437*** (0.032)	-0.587*** (0.019)	-0.712*** (0.025)	-24.776*** (0.895)	-24.429*** (1.000)
Interaction term of credit rating spreads and European sovereign debt crisis	0.011* (0.006)	0.016** (0.006)	0.013** (0.007)	1.094*** (0.384)	1.060*** (0.381)
Interaction term of credit rating spreads and post-crisis policy	-0.010 (0.000)	-0.010*** (0.000)	-0.010*** (0.000)	-0.505*** (0.000)	-0.607*** (0.000)

period	(0.019)	(0.003)	(0.003)	(0.182)	(0.180)
Disbursement by the ESM under a first programme	-0.060	-0.120***	-0.288	-7.482***	-7.447***
	(0.075)	(0.013)	(0.265)	(2.056)	(2.736)
Agreement on ESM	-0.039*	-0.058**	-0.048*	-2.303	-2.164
	(0.023)	(0.026)	(0.028)	(1.622)	(1.589)
Fiscal Compact ratification	-0.017	-0.026	0.007	-3.478*	-3.140*
	(0.028)	(0.035)	(0.027)	(1.779)	(1.781)
EU leaders sign the fiscal compact	0.038*	0.047	0.037*	2.256	2.437
	(0.022)	(0.029)	(0.021)	(1.452)	(1.496)
Six-pact treaty	-0.007	-0.003	-0.014	-0.189	-0.089
	(0.008)	(0.012)	(0.010)	(0.685)	(0.679)
1 lead of the purchases under SMP	-0.008	-0.024	-0.020	-2.073*	-2.223*
	(0.011)	(0.025)	(0.017)	(1.165)	(1.174)
Constant	0.002	-0.005	-0.038**	-0.613	-0.641
	(0.008)	(0.012)	(0.015)	(1.523)	(1.353)
L.arch	0.118***	0.076***	0.120***	0.057***	0.055***
	(0.014)	(0.014)	(0.028)	(0.014)	(0.013)
L.garch	0.909***	0.932***	0.893***	0.944***	0.947***
	(0.009)	(0.010)	(0.020)	(0.013)	(0.012)
Constant	0.000	0.000	0.000**	0.080	0.065
	(0.000)	(0.000)	(0.000)	(0.054)	(0.043)
N	3,008	3,008	3,008	2,520	2,529
Ljung-Box Q test	73.6640	19.9944	31.3345	23.3504	25.0214
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Panel C: Portugal

	10-year bond yield spreads (1)	5-year bond yield spreads (2)	2-year bond yield spreads (3)	10-year CDS spreads (4)	5-year CDS spreads (5)
Lagged dependent variable	0.992*** (0.007)	0.996*** (0.005)	0.998*** (0.006)	0.994*** (0.004)	0.995*** (0.003)
Euro-STOXX	0.001*** (0.000)	0.000*** (0.000)	0.000** (0.000)	0.028 (0.027)	0.037** (0.015)
Total stock market index for the EU	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)	0.001 (0.001)	0.001 (0.001)
Second CBPP established	-0.112*** (0.043)	-0.406*** (0.060)	-0.682*** (0.089)	3.715 (5.926)	1.287 (4.673)
Purchases under the second CBPP	-0.002 (0.036)	0.020 (0.083)	-0.040 (0.061)	-2.112 (1.655)	-4.606** (1.991)
Third CBPP established	-0.072*** (0.005)	-0.095*** (0.005)	0.178** (0.081)	-7.410*** (0.911)	-4.163*** (0.631)
Purchases under the third CBPP	-0.029** (0.012)	-0.031** (0.014)	0.006 (0.006)	-3.565** (1.445)	0.121 (1.208)
SMP established	-1.656*** (0.019)	-1.477*** (0.023)	-3.301*** (0.041)	-182.785*** (1.224)	-189.496*** (1.244)
Purchases under the SMP	0.010 (0.030)	-0.056 (0.034)	-0.086** (0.038)	-2.301 (3.882)	-1.382 (4.306)
OMT established	-0.176 (0.285)	-0.673*** (0.015)	-0.187*** (0.023)	-15.614*** (0.898)	-21.832*** (1.205)
Announcement of an additional 36-month LTRO	0.007 (0.086)	-0.007 (0.160)	-0.230** (0.095)	-1.957 (4.128)	-2.856 (3.407)
Allotment of an additional 36-month LTRO	0.116 (0.146)	-0.091 (0.102)	-0.205** (0.092)	16.935 (19.601)	23.380 (24.665)
Draghi's speech	-0.008 (0.035)	-0.083*** (0.030)	-0.470*** (0.040)	-8.985*** (1.402)	-12.674*** (1.985)
Interaction term of credit rating spreads and pre-crisis period	0.010 (0.009)	0.011 (0.008)	0.002 (0.010)	1.493* (0.770)	0.531 (0.528)
Interaction term of credit rating spreads and European sovereign debt crisis	0.014* (0.008)	0.015** (0.007)	0.007 (0.008)	1.731** (0.776)	0.829 (0.531)
Interaction term of credit rating spreads and post-crisis policy period	-0.005 (0.005)	-0.007 (0.008)	-0.003 (0.006)	-0.053 (0.257)	-0.558 (0.352)
First economic adjustment programme	0.004 (0.019)	-0.002 (0.014)	0.016 (0.020)	-3.164*** (1.045)	1.250* (0.717)
Release of a disbursement by the EFSM under a first programme	-0.049 (0.035)	-0.062 (0.041)	-0.026 (0.041)	-2.587 (3.621)	0.264 (3.322)
Disbursement by the EFSM under a first programme	0.045 (0.028)	0.035 (0.023)	-0.009 (0.048)	5.881 (3.936)	5.873*** (2.147)
Release of a disbursement by the EFSF under a first programme	-0.009 (0.027)	0.062 (0.092)	-0.060 (0.045)	3.347** (1.325)	3.509*** (1.226)
Disbursement by the EFSF under a first programme	-0.013 (0.105)	0.135 (0.145)	0.014 (0.060)	4.370 (3.307)	4.089 (2.510)
Agreement on ESM	-0.004 (0.047)	-0.090 (0.079)	-0.150* (0.078)	-0.584 (8.275)	-1.299 (4.828)
Fiscal Compact ratification	0.095 (0.074)	0.197 (0.121)	0.016 (0.152)	-0.028 (18.312)	-5.157 (39.538)
EU leaders sign the fiscal compact	-0.142** (0.062)	-0.158 (0.097)	0.056 (0.143)	-6.357 (20.043)	3.937 (39.694)
Six-pact treaty	-0.004 (0.024)	0.001 (0.026)	0.042 (0.037)	-3.423 (2.858)	0.233 (2.273)
1 lag of the purchases under SMP	-0.023 (0.015)	-0.030* (0.016)	-0.040 (0.026)	-1.418 (1.825)	-1.819 (1.461)
2 lags of the purchases under SMP	-0.026 (0.019)	-0.032** (0.015)	-0.045 (0.032)	-1.346 (2.237)	-1.979 (1.943)
Constant	-0.044 (0.029)	-0.057** (0.027)	-0.017 (0.033)	-5.964* (3.142)	-3.075 (2.149)
L.arch	0.155*** (0.035)	0.169*** (0.031)	0.225*** (0.062)	0.101*** (0.026)	0.114*** (0.029)
L.garch	0.890*** (0.020)	0.880*** (0.017)	0.857*** (0.028)	0.921*** (0.017)	0.912*** (0.019)
Constant	0.000	0.000	0.000	0.040	0.041

N	(0.000)	(0.000)	(0.000)	(0.042)	(0.040)
Ljung-Box Q test	3,008	3,008	3,008	2,340	2,500
	182.3301	17.7630	2.7474	59.7563	63.5139
	(0.0000)	(0.0000)	(0.0974)	(0.0000)	(0.0000)
Panel D: Ireland					
	10-year bond yield spreads (1)	5-year bond yield spreads (2)	2-year bond yield spreads (3)	10-year CDS spreads (4)	5-year CDS spreads (5)
Lagged dependent variable	0.993*** (0.007)	1.002*** (0.004)	0.986*** (0.009)	0.976*** (0.006)	0.985*** (0.004)
Euro-STOXX	-0.000 (0.000)	-0.000 (0.001)	0.002*** (0.000)	0.047* (0.025)	0.030* (0.018)
Total stock market index for the EU	-0.000** (0.000)	-0.000 (0.000)	0.000 (0.000)	-0.002** (0.001)	-0.001 (0.001)
Second CBPP established	-0.035 (0.023)	-0.163** (0.080)	-0.186** (0.082)	0.806 (3.525)	3.025 (2.677)
Purchases under the second CBPP	-0.012 (0.011)	-0.048*** (0.018)	0.031 (0.025)	-2.513 (1.728)	-2.499** (1.268)
Third CBPP established	-0.059*** (0.002)	-0.100* (0.058)	0.041*** (0.001)	-0.884*** (0.093)	-0.988*** (0.083)
Purchases under the third CBPP	-0.015*** (0.005)	-0.011*** (0.003)	-0.002 (0.003)	-0.586** (0.232)	-0.264** (0.110)
SMP established	-1.208*** (0.015)	-1.444*** (0.014)	-2.146*** (0.035)	-54.049*** (2.645)	-48.279*** (2.813)
Purchases under the SMP	-0.011 (0.014)	-0.008 (0.038)	-0.084 (0.057)	-0.509 (2.580)	-0.868 (2.015)
OMT established	-0.078 (0.091)	-0.151*** (0.015)	0.080*** (0.014)	18.453 (19.421)	-31.119 (20.799)
Announcement of an additional 36-month LTRO	-0.007 (0.008)	-0.139*** (0.018)	-0.127 (0.269)	0.918 (3.527)	1.008 (1.459)
Allotment of an additional 36-month LTRO	0.093** (0.041)	0.159*** (0.032)	-0.219 (0.231)	5.853 (9.589)	8.232 (8.553)
Draghi's speech on July 26, 2012	-0.057*** (0.019)	-0.202*** (0.016)	-0.788** (0.402)	-12.755*** (1.398)	-13.210*** (1.421)
Interaction term of credit rating spreads and pre-crisis period	-0.003 (0.005)	-0.016 (0.010)	0.008 (0.005)	1.176** (0.532)	0.726 (0.482)
Interaction term of credit rating spreads and European sovereign debt crisis	0.003 (0.006)	-0.000 (0.006)	-0.004 (0.008)	1.289*** (0.389)	0.892*** (0.338)
Interaction term of credit rating spreads and post-crisis policy period	-0.007** (0.003)	-0.005 (0.003)	0.003 (0.008)	-0.875*** (0.253)	-0.775*** (0.224)
First economic adjustment programme	0.012* (0.007)	-0.005 (0.008)	0.013 (0.015)	0.555 (0.394)	0.566 (0.443)
Release of a disbursement by the EFSM under a first programme	0.014 (0.035)	-0.133** (0.067)	-0.025*** (0.006)	-1.121 (0.691)	-0.457 (0.788)
Disbursement by the EFSM under a first programme	0.003 (0.015)	0.042 (0.036)	0.026 (0.017)	1.811 (2.113)	1.105 (1.845)
Release of a disbursement by the EFSF under a first programme	-0.051 (0.052)	-0.331*** (0.071)	-0.152 (0.260)	2.253 (2.501)	3.563 (2.292)
Disbursement by the EFSF under a first programme	-0.040** (0.019)	-0.047 (0.039)	0.091 (0.148)	-0.418 (0.394)	-0.443 (0.567)
Agreement on ESM	-0.020 (0.017)	-0.017 (0.047)	-0.191** (0.083)	-1.502 (2.157)	-3.918* (2.347)
Fiscal Compact ratification	0.037 (0.024)	0.011 (0.026)	-0.027 (0.077)	-0.231 (4.827)	0.455 (4.430)
EU leaders sign the fiscal compact	0.001 (0.009)	-0.001 (0.016)	-0.042 (0.032)	0.099 (4.889)	1.770 (4.497)
Six-pact treaty	0.008 (0.021)	0.034 (0.058)	0.287*** (0.111)	0.717 (1.760)	1.598 (1.386)
1 lag of the purchases under SMP	-0.003 (0.006)	-0.033** (0.016)	-0.011 (0.042)	-1.020 (1.241)	-0.232 (0.790)
Constant	0.054** (0.027)	0.075 (0.074)	-0.080* (0.045)	2.752 (2.111)	1.138 (1.871)
L.arch	0.139*** (0.019)	0.199** (0.078)	0.204*** (0.071)	0.070*** (0.026)	0.064*** (0.019)
L.garch	0.901*** (0.011)	0.865*** (0.031)	0.856*** (0.041)	0.938*** (0.020)	0.943*** (0.014)
Constant	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.016 (0.013)	0.006 (0.005)
N	3,008	3,008	3,008	2,354	2,363
Ljung-Box Q test	171.9290	39.1398	21.0180	94.2729	114.2683
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Notes: Garch (1,1) regressions of daily bond yield changes vis-à-vis Germany. Robust standard errors are in parentheses. Columns (1) through (5) display five different bond yield and CDS spread variables of the respective countries with different maturities. Ljung-Box Q test was performed for 1 autocorrelation of residuals. *** (**, *) indicates statistical significance at the 1 (5, 10)% level.

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