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The effects of macroeconomic, fiscal and monetary policy announcements on sovereign bond spreads☆

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ABSTRACT

We assess the impact of announcements corresponding to different fiscal and monetary policy measures on 10-year sovereign bond yield spreads (relative to Germany) of 10 EMU countries during the period 01:1999-07:2016. Implementing country-fixed effects OLS regressions, we find that the European Commission's (EC) releases of the excessive deficit procedure significantly affect yield spreads. The EC releases of higher debt and better budget balance forecasts contribute to the rise and the decline of spreads, respectively. Moreover, we find that the announcements of the ECB's key interest rates together with the longer-term refinancing operations (LTROs) and the first covered bond purchase programme (CBPP1) negatively affect sovereign yield spreads in our sample of EMU countries. There was also some capital market mispricing of the sovereign bond risk in the Euro area before the Global Financial Crisis, notably regarding government debt forecasts.

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1. Introduction

The economic literature suggests that government's borrowing costs depend on the fundamental economic conditions, particularly the fiscal stance and key macroeconomic developments (see, e.g., Poghosyan, 2014).[3] There seems to be a great deal of understanding that an under-pricing of sovereign risk in the Economic and Monetary Union (EMU) occurred before the 2008–2009 Global Financial Crisis (GFC) (see e.g., Gibson et al., 2014; Basse et al., 2018). In contrast, the period that followed this event, particularly during the economic and subsequent sovereign debt crisis that took place, an general overpricing of risk was observed in many countries (Gibson et al., 2014).[4] Such developments were caused both by the fluctuations in the risk appetite and by Euro area country-specific concerns regarding underlying economic fundamentals.

Therefore, the successful elimination of fears of a looming Eurozone break-up following the GFC, can be partly attributed to improvements in economic fundamentals (particularly in periphery European countries) (Muellbauer, 2014).[5] This suggests that

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[3] For example, as governments debt rises, sovereign bond yields should go up in recognition of the higher risk (default, monetization-driven depreciation and inflation) carried by investors holding government securities.

[4] Note, however, that investors that bought Greek government debt at prices of about 100 before the GFC lost a sizeable portion of their investment and, most likely, they do not share this point of view. We thank an anonymous referee for this point.

[5] For recent surveys discussing the latest crisis with an European perspective refer to Gibson et al. (2014); Moro (2014) or Gruppe et al. (2017).

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economic announcements (which often include release of new economic projections and/or announcements of (fiscal or monetary) policy decisions by EU institutions) are an important source of information, containing news that typically spills over internationally across markets, affecting sovereign bond yields (Andersen et al., 2006). To the extent that fundamentals are well captured by forecasts produced by official (and/or private sector) agencies, the release of such forward-looking views on an economy's performance can affect yields by offering market participants valuable insights and by shaping their expectations on potential portfolio returns.[6]

Rational investors absorb and incorporate all the available information at their disposal in real-time, meaning that there are no information rigidities, thus a release of new information will cause a rearrangement in their investment portfolio. A forecast revision in a positive and desirable way (e.g. higher GDP growth, lower public debt, lower unemployment, etc.) should bring the sovereign yields down, as more investors are interested in buying bonds of this country due to the lower risk of default. The same would be true of a positive assessment of the EC relative to a Stability and Growth Program of a given country. In addition, monetary policy events, typically the ECB's conventional and unconventional monetary policies, would also play a role in the development of sovereign yield spreads, directly or indirectly either via changes in the aggregate demand or via changes in the fiscal behavior.

In this paper, we study the impact of macroeconomic, fiscal and monetary developments and well-defined events on sovereign bond yield spreads in 10 EMU countries. Such developments cover the European Commission (EC) releases (twice a year until autumn 2012 and three times a year afterwards) of short-term economic forecasts for the member states of the EMU. This is a natural and legitimate avenue of research that has been somewhat neglected in the literature in the sense that most papers have not look closely at the role played by different types of forecasts (see Section 2 for details). We consider one source for macroeconomic and fiscal expectations: the EC's forecasts.[7] Additionally, we have collected information on the EC's announcements regarding the excessive deficit procedures (EDP) that contains information regarding the adoption of appropriate policy responses to correct excessive deficits and/or debts by the member states. Moreover, we study the impact of the monetary policy events such as the announcements of the ECB's interest rates together with the announcements of unconventional monetary policy on the sovereign bond yield spreads of the sample countries.

We contribute to the literature notably by: i) constructing a set of fiscal events, type 1 and type 2, related to the EC announcements of fiscal developments and excessive debt procedures related decisions in 10-Euro area countries; ii) conducting an identification and analysis of conventional and non-conventional monetary policy events; iii) assessing the impact of fiscal and monetary policy events on 10-year sovereign bond yield spreads; iv) considering both core and non-core EMU countries in the effects of different policy instruments in their spreads; v) inspect the impact of the GFC with a before-and-after analysis

This paper also fits well within the literature addressing the interconnectedness between banks and governments, particularly in the context of the EMU with many direct state interventions and bailouts following the unfolding of the crisis (some important references include e.g., Ejsing and Lemke, 2011; Ludwig and Sobański, 2014; Gibson et al., 2018, and Wegener et al., 2019). Moreover, it is a study relevant for the field of law since this paper's results can help the discussions on the proper (optimal?) handling of sovereign credit risk under Basel III, notably in the aftermath of the GFC.

Our main results show that the ECB's key interest rates announcements mainly the deposit facility, main refinancing operations and marginal lending facility rate tenders, negatively affected the bond yield spreads of the sample countries. Moreover, the announcements of the nonstandard measures of the ECB notably the first covered bond purchase programme and the longer-term refinancing operations contributed to decreasing the spreads. Regarding the impact of the fiscal policy events, we found that the EC releases of the economic forecasts on government debt and budget balance contribute to increase and decrease the spreads respectively. The EC releases of the excessive deficit procedures (EDP) contribute in reducing the yield spreads.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature. The following section presents the empirical methodology and describes the data used. Section 4 discusses the main empirical results and includes several robustness checks and sensitivity analysis. The last section concludes and elaborates on policy implications.

2. Literature

There is a vast literature looking at the determinants of sovereign yields. Studies looking specifically at EMU's bond yields include the work by Manganelli and Wolswijk (2009).

Some studies, in the spirit of this paper, have proxied fundamentals using expectations about the future values of key macroeconomic variables and related these to interest rates or yields or financial variables. Canzoneri et al. (2003) using Congressional Budget Office (CBO) budget forecasts, found that there existed a sizable and statistically significant effect of projected surpluses on the spread between long-term treasury yields and Treasury bill yields. Strauch et al. (2004) conclude that when actual output growth exceeds its forecast, the budget balance improves when compared with budget predictions. Moulin and Wierts (2006) identified effects from divergence in predictions in GDP as well as from expenditure or revenue items. Beirne and Fratzscher (2013), based on panel regressions, found that the increase of interest rate spreads in the Eurozone could be explained by a combination of deteriorating fundamentals and an increased sensitivity of investments for these fundamentals. Afonso and Nunes (2015) assessed whether forecast revisions of macro variables affected sovereign yields in a sample of 15 European countries between 1999 and 2012. They found that corrections in both macro and fiscal variables had a strong influence in sovereign bond yields (and more strongly so in countries characterized by weak fundamentals). Gödl and Kleinert (2016) explored whether and to what extent government bond yields were driven by fundamentals as opposed to market sentiments. Similarly, to our approach, they also relied on EC's forecasts, which they argued to be important sources of information to investors for assessing the future solvency of governments. These authors provided empirical evidence that government bond yields indeed react to negative economic forecasts. More recently, De Grauwe et al. (2017) also found that government bond markets in the Eurozone to be highly sensitive to changing fundamentals.

In terms of possible cross-country spillover effects, Gómez-Puig and Sosvilla-Rivero (2014) find evidence of contagion in the aftermath of the current euro debt crisis, for the sovereign yields of 11 EMU countries, using a data sample covering the period January

[6] Expectations have long been ascribed a central role in macroeconomics (Pigou, 1927). For instance, Balduzzi et al. (2001) considered the effects of US announcements on US yields outcomes using high frequency intraday data.

[7] Nowadays, the EC releases on a regular basis short-term economic forecasts for more than 180 variables of member states of the Economic and Monetary Union (EMU). Most studies suggest that forecasts produced by international organizations are less subjected to biases. Keereman (1999) was the first to examine the track record of EC forecasts and argued that its forecasts displayed a reasonable track record.

1999 to December 2012. In addition, Gibson et al. (2017) report, for five distressed euro area countries, feedback effects between sovereign spreads, sovereign credit ratings, and bank credit ratings. Sensoy et al. (2019) also mention the existence in EMU of a high degree of sovereign bond market integration in the period preceding the recent financial crises, while segmentation becomes more obvious afterwards.

Regarding specific event studies there are different methodologies in the literature, mostly carried out typically via the definition of dummy variables events (either as a standalone or via interactive multiplicative dummies), both with high frequency or lower frequency data. Afonso and Strauch (2007) evaluate to which extent relevant fiscal policy events taking place in 2002 produced a reaction in the long-term bond segment of European capital markets, and they uncover some evidence in that direction. Arru et al. (2013) conducted a study including six countries from the EMU where they gauge about the impact of macroeconomic data releases – the so-called standardized news – from several macro-areas such as US, Japan and EU. They find a reaction by the sample countries, excluding Spain, from positive news in the US, and that macroeconomic surprises on the Euro-area business cycle affect the volatility of the series for four of the six sample countries and these reactions are only captured by negative surprises.

Focusing on the second type of the fiscal policy events that we use in this paper, we can mention a very recent study by Kalan et al. (2018) who estimate the effects of the fiscal rules specifically the Excessive debt procedure (EDP) on sovereign yield spreads for the 28 EU countries over the period 1999–2016. Using dynamic panel estimation techniques, they find that the sovereign spreads of countries under an EDP are higher than countries that are not under an EDP.

On the other hand, the monetary policy events literature gives some important insights about how markets react to central bank's monetary policy. For the Euro area, Andersson et al. (2009) found evidence in the German long-term bond market and in EURIBOR futures market that agents predict well the ECB's monetary policy, reflecting transparency in ECB's monetary policy conduction.[8] Interestingly, Brand et al. (2010), for the money market yield, found that expectations from monetary policy change considerably during ECB's press conferences. Finally, Andersson et al. (2009) compares the ECB's and the FED's monetary policy and concludes that both US bond and stock markets react more to the FED's monetary policy decisions than respectively the Euro area bond and stock market react to the ECB's monetary policy decisions. Moreover, Afonso et al. (2018) mention that unconventional monetary policy measures affect the pricing of sovereign risk not only directly, but also indirectly through changes in banking risk, while Ambler and Rumler (2019) also report significant effects of monetary policy unconventional announcements on real interest rates

In addition to economic fundamentals and specific monetary or fiscal policy events as determinants of sovereign bond yields or spreads, other factors have been found in the literature to be relevant predictors and that we employ in our empirical analysis. In particular, it is important to account for international risk, typically approximated using indexes of US stock market implied volatility or the spread between the yields of US corporate bonds against US treasury bills (Silvapulle et al., 2016). Another aspect is the liquidity risk, usually proxied using bid-ask spreads (Favero et al., 2010).

3. Methodology and data

3.1. Methodology

Our empirical analysis considers first the main determinants of sovereign spreads on a panel of 10 EU countries, namely: industrial production (percentage change with respect to Germany) and real effective exchange rate (both retrieved from the EC forecasts), international risk (proxied by the VIX) and the bid-ask spread. As a second step, we assess the additional relevance of specific fiscal and monetary events for sovereign spreads from January 1999 until July 2016.

The event variables are constructed by flag procedure assuming that there are two types of events, positive and negative, corresponding to a lower (higher) sovereign spread. Using monthly data, when there is a positive or a negative event on a given month, we attribute the values -1 or 1 respectively and 0 for the non-event months. The monetary events are selected by collecting the interest rate policy announcements done by the ECB during the sample period. The fiscal policy events are collected from the EC website, based on the EU fiscal surveillance mechanism. With the purpose of capturing the fiscal policy decision-making in the EU, the assembled events are divided in two groups. One is composed by press releases resulting from the Commission assessment of the stability and convergence programs. The second group is essentially composed by press releases related with the EDP's that were implemented during the sample period.

We estimate directly the set of different determinants of sovereign bond yield spreads on the entire panel of 10 Euro area countries. Our main regression equation is the following:

$$spreads_{it} = \alpha_i + \beta_i X_{it} + \varepsilon_{it} \quad (1)$$

where $spreads_{it}$ denotes the sovereign bond yield spread relative to Germany's, X_{it} is a vector of determinants already identified above. The coefficient β measures the degree of sensitivity of sovereign spreads to a given determinant. α_i denote country effects capturing unobserved heterogeneity across countries and time-unvarying factors such as geographical or institutional aspects. We decided not to include time effects since in our list of controls (present in vector X_{it}) we add the VIX which is only time-varying but not across country units. Finally, ε_{it} is a disturbance term satisfying standard assumptions of zero mean and constant variance.

Eq. (1) was first estimated by Ordinary Least Squares (OLS) with robust standard errors clustered at the country level. Note that we have estimated first a pooled OLS model, a country fixed effects model – like the one represented by Eq. (1) – and a random effects model. Hausman test results comparing both the pooled and random effects models with the fixed effects one, reveal a preference for the latter. As a result, this is the model chosen for the remainder of the paper.[9] We consider specifications without country effects, the country fixed effects specification depicted by Eq. (1) and also a random-effects model. A Hausman test comparing the three models confirms that the country fixed effects is the preferred one, which is then used in the remainder of the paper.[10] In the robustness section, we take into account potential endogeneity concerns by re-estimating (1) with a Two Stage Least Squares approach.

Moreover, Eq. (1) will be expanded to consider the several fiscal policy events (EC forecasts and EDP announcements), $FPevent_{it}$, and monetary policy events (conventional and non-conventional

[8] For a closer look at the impact of the financial crisis on the decoupling–recoupling hypothesis and the risk premium specific on stock index futures of the Greek market refer to Floros et al. (2013).

[9] We thank an anonymous referee for this comment.

[10] We thank an anonymous referee for this comment and suggestion.

measures), $MPevent_{it}$, as possible determinants of sovereign yield spreads:

$$spreads_{it} = \alpha_i + \beta_i X_{it} + a_i FPevent_{it} + b_i MPevent_{it} + \varepsilon_{it}. \quad (2)$$

3.2. Data

Our empirical analysis relies on a panel of ten Euro area countries (Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal and Spain) using monthly data between January 1999 and July 2016. Following existing literature, we will model spreads on a fixed block of determinants that deal with international risk conditions, liquidity risk and credit risk. First, international financial risk will be proxied by the S&P 500 implied stock market volatility index (VIX), a common proxy for global financial instability (Beber et al., 2008; Bernoth and Erdogan, 2012). We expect a higher (lower) value for the global risk factor VIX to cause an increase (reduction) in government bond spreads. Second, the 10-year government bond bid-ask spread will serve as our measure of bond market illiquidity, with a higher value of this spread indicating a fall in liquidity leading to an increase in government bond yield spreads (Codogno et al., 2003). We will capture credit risk using a number of macro and fiscal indicators. Third, one expects a real exchange rate appreciation to increase spreads as justified by Arghyrou and Kontonikas (2012).

In addition, to capture the effects of economic growth, we use the annual growth rate of industrial production (relative to that of Germany), capturing the argument of Alesina et al. (1992) according to which sovereign debt becomes riskier during periods of economic slack.

Moreover, we add to the model four types of events as explanatory variables. We add the ECB's interest rates announcements on the Deposit Facility (DF), Marginal Lending Facility (MLF) and Main Refinancing Operations (MROs) and call them as Monetary Policy (MP) type 1 events. These monetary policy decisions are taken in the context of the "standard" monetary policy stance, via the key interest rates.

We also consider the Unconventional Monetary policy events of the ECB as MP type 2 events specifically the announcements of the longer-term refinancing operations (LTROs), securities market programme (SMP) and the first corporate bond purchase programme (CBPP1).[11] On the latter, according to Gürtler and Neelmeier (2018), "public covered bonds are one of the most important refinancing instruments for banks providing loans to public sector entities and have often been considered almost default-risk-free in the past".[12] These measures would be more in the context of the design of liquidity operations in implementation of the monetary policy stance.

Although the ECB's legitimacy of buying unlimited sovereign bonds was questioned in German courts, the European Court of Justice (ECJ) ruled for its legality. Indeed, for instance, the ECJ found that the PSPP, the public sector purchase programme "does not exceed the ECB's mandate. The programme falls within the area of monetary policy, in respect of which the *EU* has exclusive competence for the Member States whose currency is the euro and observes the principle of proportionality".[13]

Table 1
Events' nomenclature.

	MP events	FP events
Type 1	Interest rate announcements	EDP related decisions
Type 2	Unconventional Monetary policy (TLTRO and purchase programs)	EC fiscal forecasts

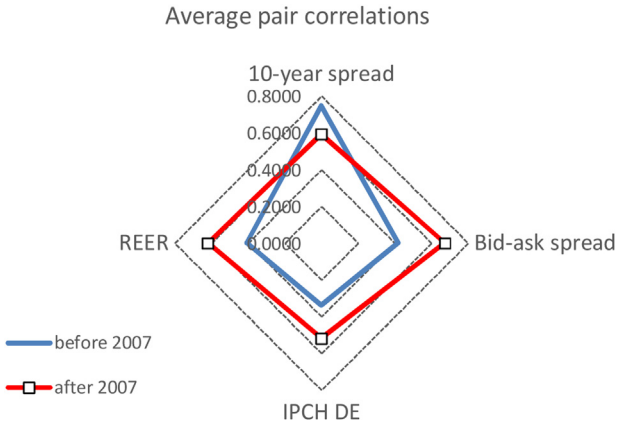

Fig. 1. Average country-pair bilateral correlations.
Note: 10 year bond yield spread against German bond; 10-year bond yield bid-ask Spread; Real Effective Exchange Rate, CPI based; annual growth rate differentials of IPCH (seas adjusted) vs Germany.

Moreover, the ECJ argued that the purchases did not exceed the mandate regarding the primary objective of price stability, and support the general economic policies of the Union according with the principle of an open market economy with free competition (see article 3 of the Treaty of the European Union). [14]

Finally, regarding the fiscal policy events, we consider the EC's EDP decisions as FP type 1 events, and the fiscal forecasts of the EC of the government debt, budget balance and current account balance as Fiscal Policy (FP) as type 2 events. Table 1 summarizes the nomenclature of both monetary and fiscal policy events.

Table A1 in the Appendix presents the summary statistics of the relevant variables while Table A2 shows detailed data definitions and sources. The dataset is unbalanced; the intersection of key variables entering in Eq. (1) yields at most 1940 observations and not necessarily the full set of 10 years times 211 months, that is, 2110 observations. In addition, Tables A3–A5 provide the fiscal and monetary events dataset that we have constructed for our empirical analysis.

Finally, Fig. 1 illustrates the average country-pair bilateral correlation for the baseline variables, before and after the beginning of the GFC, the end of 2007. Interestingly, a clear stylised conclusion is the decrease of the correlation for the 10-year sovereign yield spreads after 2007, within the 10 euro countries under analysis. Such development can hint at a possible decoupling of sovereign yields after the GFC.

4. Empirical results

4.1. Baseline

We started off with the pooled OLS, then with the country fixed effects alternative and finally the random effects estimators. Since the Hausman test favours the country fixed effects model (see

[11] This first programme started on 2 July 2009 and terminated on 30 June 2010 when it reached a nominal amount of €60 billion. The assets bought under this programme will be held to maturity. The second programme (CBPP2) started on November 2011 and ended on 31 December 2012 when it reached the amount of €16.4 billion.

[12] For a recent empirical analysis of the impact of covered bond programmes on liquidity risk in times of crisis looking specifically at Germany, see Wegener et al. (2019).

[13] See, Court of Justice of the European Union, Press Release No 192/18, Luxembourg, 11 December 2018. Judgment in Case C-493/17, Heinrich Weiss and Others.

[14] Article 119, article 127 (1), (2) of the TFEU (2012).

Table 2
Baseline and Monetary Policy Events (type 1 and 2) – fixed effects OLS.

Specification Regressors	(1) baseline	(2) MP type 1	(3)	(4)	(5)	(6)	(7) MP type 2	(8)	(9)	(10)
IP_PCH_DEU	−0.0970**	−0.1018**	−0.0996**	−0.1016**	−0.1011**	−0.1314**	−0.0965**	−0.0973**	−0.0401	−0.0984**
	(0.034)	(0.036)	(0.035)	(0.036)	(0.036)	(0.043)	(0.034)	(0.035)	(0.089)	(0.038)
vix	0.0031	−0.0016	−0.0016	−0.0024	−0.0026	0.0234***	0.0041	0.0046	0.0200	0.0435***
	(0.006)	(0.007)	(0.008)	(0.008)	(0.008)	(0.005)	(0.005)	(0.005)	(0.017)	(0.012)
reer	−0.0324	−0.0327	−0.0326	−0.0327	−0.0327	−0.0706	−0.0318	−0.0315	0.0820**	0.0099
	(0.030)	(0.030)	(0.029)	(0.029)	(0.029)	(0.041)	(0.029)	(0.029)	(0.028)	(0.013)
bid_ask	6.1898***	6.1767***	6.1818***	6.1768***	6.1775***	5.7623***	6.2332***	6.2418***	3.7152***	4.1265***
	(0.792)	(0.793)	(0.793)	(0.793)	(0.793)	(0.768)	(0.768)	(0.765)	(0.554)	(0.579)
D.DF		−0.6644**		−0.4758***						
		(0.212)		(0.116)						
D.MLF			−0.5707**	−0.2609						
			(0.237)	(0.203)						
D.MRO					−0.7382**					
					(0.264)					
D.CMRO						−0.0000*				
						(0.000)				
D.LTRO							−0.0015			
							(0.001)			
D.Net_LTRO								−0.0018		
								(0.002)		
D.SMP_p									0.0078	
									(0.011)	
D.CBPP1_p										−0.2572**
										(0.104)
Observations	1,940	1,940	1,940	1,940	1,940	1,304	1,940	1,940	704	804
R-squared	0.5989	0.6003	0.6000	0.6004	0.6004	0.6342	0.6000	0.6004	0.8287	0.8023

Note: Dependent variable is the 10-year bond yield spread (relative to Germany). Robust standard errors clustered at the country level are in parenthesis below each coefficient estimate. Prefix "D" denotes first difference of a given variable. Country and time effects were estimated but omitted for reasons of parsimony. A constant term was also estimated but omitted. *, **, *** denote statistical significance at the 10, 5, and 1 percent level, respectively.

Appendix Table A6), that is the one preferred for the remainder of the paper's analyses.

Specifically, in the first step, we estimate the baseline model considering the main determinants of sovereign yield spreads identified earlier. We find that, industrial production and the bid-ask spread have a negative (spread decreasing) and positive (spread increasing) statistically significant impact on yield spreads respectively (as expected) when using the Pooled OLS and fixed effect OLS. We do not find evidence of statistically significant impacts of neither VIX nor REER on yield spreads. However, we found a positive and statistically significant impact of VIX on the spreads in our robustness analysis.

4.1.1. MP type 1 events

Considering the first type of the monetary policy events, we find that all of the ECB's key interest rates announcements contribute to reduce the spreads when running Pooled OLS and fixed effects OLS. For instance, when considering the results of the pooled OLS regression, we see that the announcement of rates on the DF contributed to reduce the spreads by 0.607 percentage points on average. The announcement of interest rates on the MLF contributed to reduce the spreads by 0.533 percentage points and the announcement of the rates on the MROs contributed to decrease the spreads by 0.570 percentage points on average when running fixed effects OLS regressions. However, when considering the rates on the DF and MLF in a single regression, the impact of the MLF disappears in both types of regressions (see Table 2). The country-specific rates on the MROs also contribute to decreasing the spreads. These results are in line with the literature which highlights the relevance of the ECB's news releases (see, e.g., Brand et al., 2010) and the literature that found that the ECB's key interest rates contribute to reducing the spreads (see, e.g., Afonso and Jalles, 2019).

4.1.2. MP type 2 events

Using the second type of the monetary policy variables in fixed effects OLS regressions, we find that the impact of the announcement of the SMPs on spreads is positive, but not statistically significant. However, in this specification (specification (9)), the real effective exchange rate contributes to increase spreads (we find a positive and statistically significant coefficient estimate) which is in line with our expectations. In addition, we find that the announcements of the CBPP1 contribute to decreasing the spreads (negative significant signs) by 0.257 percentage points on average (for recent literature on the CBPP and of the ECB's quantitative-easing schemes refer to Falagiarda and Reitz, 2015; Gibson et al., 2018).

However, we do not find any statistically significant impact of longer-term refinancing operations announcements on 10-year sovereign bond yield spreads.

4.1.3. FP type 1 events

Considering the event type related to EC fiscal decisions in the regressions, we find that EC releases on the Excessive Deficit Procedures (EDP) have a positive and statistically significant impact on spreads when running fixed effects regressions (see Table 3). This means that noncomplying with the EU fiscal framework (that is, being under an EDP) contributes to an average increase in spreads of 0.595 percentage points for fixed effects regressions. This is in line with the results obtained by Kalan et al. (2018).

4.1.4. FP type 2 events

Adding the second type of fiscal policy event variables to the baseline model, we observe that the announcements of two years-ahead forecasts of public debt contribute to the increase in spreads (approximately 0.08 percentage points on average for fixed effects regressions). However, when using both 1 year and 2 years-ahead forecasts announcements in one regression, the one year ahead debt forecast announcements lead to a fall in spreads (not statistically significant in fixed effects regressions) while the two year-ahead forecast announcements lead to a rise in spreads.

The announcements of the 1 year and 2 years ahead forecasts of the budget balance tend to lower spreads in fixed effect regres-

Table 3
Baseline and Fiscal Policy Events (type 1 and 2) –fixed effects OLS.

Specification Regressors	(1) FP type 1	(2) FP type 2	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IP_PCH_DEU	−0.0976**	−0.0896***	−0.0491**	−0.1113**	−0.0794***	−0.0663**	−0.1112**	−0.0751***	−0.0274	−0.0590**
	(0.034)	(0.024)	(0.019)	(0.036)	(0.022)	(0.021)	(0.036)	(0.019)	(0.027)	(0.020)
vix	0.0029	0.0359***	0.0009	0.0099	0.0312***	−0.0002	0.0116*	0.0286***	0.0040	0.0041
	(0.006)	(0.009)	(0.006)	(0.006)	(0.007)	(0.007)	(0.005)	(0.006)	(0.007)	(0.007)
reer	−0.0325	0.0348***	−0.0253	−0.0199	0.0285**	−0.0301	−0.0162	0.0246*	−0.0172	−0.0233
	(0.030)	(0.011)	(0.028)	(0.030)	(0.011)	(0.029)	(0.028)	(0.012)	(0.028)	(0.030)
bid_ask	6.1617***	4.6529***	5.9212***	6.1769***	4.6468***	5.9777***	6.1260***	4.6702***	5.8841***	5.6646***
	(0.797)	(0.944)	(0.799)	(0.755)	(0.947)	(0.841)	(0.728)	(0.933)	(0.724)	(0.800)
EDP	0.5954**									
	(0.234)									
f1_debt		0.0594***						−0.0268		
		(0.017)						(0.024)		
f1_OB			−0.2059***						−0.5762*	
			(0.060)						(0.283)	
f1_CAB				0.0994*						−1.3492
				(0.048)						(0.775)
f2_debt					0.0570***			0.0818*		
					(0.017)			(0.038)		
f2_OB						−0.1750**			0.3680	
						(0.060)			(0.280)	
f2_CAB							0.1281**			1.4066*
							(0.048)			(0.752)
Observations	1,940	1,940	1,940	1,940	1,940	1,940	1,940	1,940	1,940	1,940
R-squared	0.6003	0.7467	0.6392	0.6083	0.7543	0.6300	0.6158	0.7551	0.6463	0.6572

Note: Dependent variable is the 10-year bond yield spread (relative to Germany). Robust standard errors clustered at the country level are in parenthesis below each coefficient estimate. Prefix "f1″ and "f2″ denote one or two years-ahead forecasts of a given variable, respectively. Country and time effects were estimated but omitted for reasons of parsimony. A constant term was also estimated but omitted. *, **, *** denote statistical significance at the 10, 5, and 1 percent level, respectively.

sions (we obtain negative and statistically significant coefficient estimates). We find that the impact of the announcement of the one-year ahead forecast of the budget balance on spreads is slightly higher than the announcements of the two years-ahead forecasts. When both forecasts are considered in one single regression the impact of the two years ahead forecast disappears irrespective of the type of regression.

Announcements of the current account balance forecasts contribute to an increase in spreads. Including both forecasts events in one regression, the announcement of one year-ahead forecast seems to have no significant impact on spreads and the two years-ahead forecast announcements have positive impact on spreads.

4.2. Robustness

Due to potential endogeneity concerns of some of our variables in the X_{it} vector, we rely on a Two-Stage-Least-Squares estimator to re-run Eq. (1). We employ lags of the dependent variable and regressors are the instruments. We use the Hansen *J* statistic – test of over identification – to test the validity of the over identifying restrictions. With the Kleibergen-Paap LM statistic – under identification test – we test whether our instruments are relevant.When running fixed effects IV (Table 4), the impact of VIX becomes statistically significant (positive as expected). All the remaining baseline variables remain qualitatively unchanged.

We then look at the diagnostic presented to assess the validity of the instrumental variable strategy. The under-identification test tests that the excluded instruments are r̈elevant(meaning correlated with the endogenous regressors). Our obtained statistics generally reject the null that the different equations are under-identified. Then the Hansen test statistics reveal that the instrument sets contain valid instruments (i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation) is not rejected (Table 5).

4.2.1. MP type 1

Running fixed effects IV (Table 4, specifications 2–6) gives us slightly different results. Whereas the announcement of the rates on the DF does not have significant impact on spreads anymore but MLF rates announcements lead to an increase in spreads. However, when we include both interest rates on the DF and MLF in a single regression we find that the announcement of DF rates contributes to lower spreads while the announcement of the MLF leads to a rise in spreads.

On the other hand, we do not find any statistically significant impact of MROs rates announcements on spreads but the country specific interest rates on MROs lead to a fall in spreads. In general, coefficient estimates turn out with a higher level of significance when running the fixed effects IV and the only variable that appears not to be significant is REER.

4.2.2. MP type 2

As we can observe in Table 4, the announcements of LTROs (LTRO includes also the TLTROs while Net_LTRO only includes the LTROs) together with the announcements of TLTRO-I and TLTRO-II and CBPP1 contribute in decreasing the spreads slightly SMP's impact is not significant anymore. Again, the ECB's asset purchases and the quantitative-easing policy seem to have played a relevant role in reducing sovereign bond yield spreads in the euro area. In addition, more variables of each specification appear to have significant impact on spreads when using country fixed effects IV.

4.2.3. FP type 1

When implementing fixed effects IV, the effect of an EDP event appears to increase bond spreads, as before and all the variables in the model appear to have statistically significant impact on the sovereign yield spreads (see Table 3).

4.2.4. FP type 2

Once more, both 1 year and 2 years-ahead forecasts announcements of public debt contribute to increase spreads when using them separately in the fixed effects IV regression but when both forecasts are included together in one regression, the 1 year-ahead forecasts announcement appears to decrease spreads. The one-year and two years-ahead forecast announcements of the

Table 4
Robustness: Monetary Policy Events (type 1 and 2) –fixed effects IV.

Specification Regressors	(1) baseline	(2) MP type 1	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IP_PCH_DEU	−0.0205*** (0.004)	−0.0207*** (0.004)	−0.0199*** (0.004)	−0.0207*** (0.004)	−0.0201*** (0.004)	−0.0268*** (0.005)	−0.0203*** (0.004)	−0.0207*** (0.004)	−0.0125 (0.010)	−0.0274*** (0.008)
vix	0.0052*** (0.001)	0.0050*** (0.001)	0.0062*** (0.001)	0.0058*** (0.001)	0.0057*** (0.001)	0.0085*** (0.002)	0.0057*** (0.001)	0.0058*** (0.001)	0.0160** (0.007)	0.0153*** (0.004)
reer	−0.0008 (0.001)	−0.0008 (0.001)	−0.0007 (0.001)	−0.0008 (0.001)	−0.0007 (0.001)	−0.0046** (0.002)	−0.0005 (0.001)	−0.0004 (0.001)	0.0273*** (0.008)	0.0097* (0.006)
bid_ask	0.7490*** (0.051)	0.7491*** (0.051)	0.7469*** (0.051)	0.7453*** (0.051)	0.7483*** (0.051)	0.7775*** (0.062)	0.7751*** (0.051)	0.7780*** (0.051)	0.9084*** (0.084)	0.8983*** (0.080)
D.DF		−0.0239 (0.068)		−0.1928** (0.091)						
D.MLF			0.1158* (0.064)	0.2392*** (0.087)						
D.MRO					0.0595 (0.072)					
D.CMRO						−0.0000*** (0.000)				
D.LTRO							−0.0008*** (0.000)			
D.Net_LTRO								−0.0008*** (0.000)		
D.SMP_p									−0.0015 (0.004)	
D.CBPP1_p										−0.0402*** (0.014)
Observations	1,511 *0.004* *0.200*	1,511 *0.002* *0.489*	1,511 *0.003* *0.227*	1,511 *0.009* *0.181*	1,511 *0.003* *0.488*	1,511 *0.040* *0.685*	1,511 *0.003* *0.726*	1,136 *0.003* *0.893*	558 *0.005* *0.996*	655 *0.003* *0.787*

Note: Dependent variable is the 10-year bond yield spread (relative to Germany). Robust standard errors clustered at the country level are in parenthesis below each coefficient estimate. Prefix "D" denotes first difference of a given variable. Country and time effects were estimated but omitted for reasons of parsimony. A constant term was also estimated but omitted. The null hypothesis of the Kleibergen-Paap test is that the structural equation is underidentified (i.e., the rank condition fails). Stock-Yogo critical values were applied. The Hansen test is a test of overidentifying restrictions. *, **, *** denote statistical significance at the 10, 5, and 1 percent level, respectively.

Table 5
Robustness: Fiscal Policy Events (type 1 and 2) –fixed effects IV.

Specification Regressors	(1) FP type 1	(2) FP type 2	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IP_PCH_DEU	−0.1331*** (0.016)	−0.0223*** (0.004)	−0.0170*** (0.004)	−0.0210*** (0.004)	−0.0217*** (0.004)	−0.0182*** (0.004)	−0.0213*** (0.004)	−0.0205*** (0.004)	−0.0164*** (0.004)	−0.0176*** (0.004)
vix	0.0327*** (0.004)	0.0075*** (0.001)	0.0049*** (0.001)	0.0054*** (0.001)	0.0073*** (0.001)	0.0048*** (0.001)	0.0056*** (0.001)	0.0066*** (0.001)	0.0050*** (0.001)	0.0049*** (0.001)
reer	−0.0081* (0.004)	0.0032** (0.001)	−0.0005 (0.001)	−0.0004 (0.001)	0.0030** (0.001)	−0.0008 (0.001)	−0.0001 (0.001)	0.0019 (0.001)	−0.0003 (0.001)	−0.0009 (0.001)
bid_ask	4.7698*** (0.141)	0.7911*** (0.051)	0.7716*** (0.051)	0.7532*** (0.052)	0.8010*** (0.051)	0.7659*** (0.051)	0.7571*** (0.052)	0.8085*** (0.052)	0.7737*** (0.051)	0.7662*** (0.051)
EDP	0.3523* (0.199)									
f1_debt		0.0044*** (0.001)						−0.0071** (0.003)		
f1_OB			−0.0177*** (0.004)						−0.0294* (0.017)	
f1_CAB				0.0033 (0.004)						−0.1177*** (0.025)
f2_debt					0.0045*** (0.001)			0.0111*** (0.003)		
f2_OB						−0.0158*** (0.004)			0.0115 (0.016)	
f2_CAB							0.0058 (0.004)			0.1185*** (0.025)
Observations	1,511 *0.066* *0.113*	1,511 *0.074* *0.399*	1,511 *0.065* *0.989*	1,511 *0.097* *0.988*	1,511 *0.065* *0.292*	1,511 *0.091* *0.834*	1,511 *0.065* *0.323*	1,136 *0.065* *0.872*	558 *0.069* *0.696*	655 *0.056* *0.301*

Note: Dependent variable is the 10-year bond yield spread (relative to Germany). Robust standard errors clustered at the country level are in parenthesis below each coefficient estimate. Prefix "f1″ and "f2″ denote one or two years-ahead forecasts of a given variable, respectively. Country and time effects were estimated but omitted for reasons of parsimony. A constant term was also estimated but omitted. The null hypothesis of the Kleibergen-Paap test is that the structural equation is underidentified (i.e., the rank condition fails). Stock-Yogo critical values were applied. The Hansen test is a test of overidentifying restrictions. *, **, *** denote statistical significance at the 10, 5, and 1 percent level, respectively.

budget balance contribute to reduce spreads (negative and statistically significant coefficient) but when both are considered together in one regression the impact of the announcement of the 2 years-ahead forecast disappears. The announcements of the forecasts of the current account balance appear not to have any significant impact on the spreads. However, when using both forecasts in one regression, the announcement of the one year-ahead forecast seems to have a negative impact and the announce-

Table 6
Sensitivity: core vs non-core countries – fixed effects IV.

Specification combinations Group of countries	(1) baseline Core EU	(2) MP type 1	(3) MP type 2	(4) FP type 1	(5) FP type 2	(6) Both FP	(7) baseline Non-Core EU	(8) MP type 1	(9) MP type 2	(10) FP type 1	(11) FP type 2	(12) Both FP
IP_PCH_DEU	−0.0149	−0.0402*	−0.0149	−0.0150	−0.0059	−0.0055	−0.1357*	−0.1587*	−0.1426*	−0.1358**	−0.1189**	−0.1191**
	(0.011)	(0.014)	(0.011)	(0.011)	(0.006)	(0.006)	(0.050)	(0.061)	(0.053)	(0.049)	(0.042)	(0.041)
VIX	0.0060***	0.0072**	0.0062***	0.0060***	0.0099***	0.0099***	−0.0050	0.0293*	−0.0006	−0.0054	0.0440**	0.0440**
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.011)	(0.011)	(0.009)	(0.011)	(0.014)	(0.013)
REER	0.0045	−0.0017	0.0047	0.0045	0.0119	0.0119	−0.0402	−0.0774	−0.0374	−0.0405	0.0395*	0.0394*
	(0.010)	(0.011)	(0.010)	(0.010)	(0.007)	(0.007)	(0.036)	(0.048)	(0.033)	(0.036)	(0.017)	(0.017)
bid_ask	22.7408**	23.9088*	23.1705**	22.7380**	21.4712**	21.4599**	6.1267***	5.8034***	6.2370***	6.0844***	4.3807**	4.3789**
	(7.177)	(8.781)	(7.626)	(7.178)	(6.765)	(6.761)	(0.829)	(0.760)	(0.775)	(0.833)	(0.991)	(0.984)
D.DF		−0.2556*						1.2782*				
		(0.098)						(0.563)				
D.MLF		−0.0530						1.5162				
		(0.107)						(0.714)				
D.MRO		−0.0310						−3.0587**				
		(0.237)						(0.921)				
D.LTRO		−0.0004	0.0001					−0.0035	0.0091			
		(0.000)	(0.000)					(0.002)	(0.006)			
D.CMRO		−0.0000						−0.0000*				
		(0.000)						(0.000)				
D.Net_LTRO			−0.0004						−0.0132			
			(0.000)						(0.008)			
EDP				0.0231		−0.0584				0.9175**		0.0576
				(0.055)		(0.040)				(0.307)		(0.324)
f1_debt					0.0107*	0.0107*					0.0663**	0.0663**
					(0.004)	(0.004)					(0.019)	(0.019)
f1_OB					−0.0240	−0.0245					−0.0280	−0.0273
					(0.022)	(0.022)					(0.018)	(0.021)
Observations	984	538	984	984	984	984	956	766	956	956	956	956
R-squared	0.4686	0.6384	0.4707	0.4687	0.6303	0.6309	0.5611	0.6029	0.5668	0.5635	0.7429	0.7429

Note: Dependent variable is the 10-year bond yield spread (relative to Germany). Robust standard errors clustered at the country level are in parenthesis below each coefficient estimate. Prefix "f1" and "f2" denote one or two years-ahead forecasts of a given variable, respectively. Country and time effects were estimated but omitted for reasons of parsimony. A constant term was also estimated but omitted.

ment of the two years-ahead forecasts has a positive impact on spreads.

Therefore, our results follow up to some extent the ones reported by related research, notably Favero et al. (2010) and Silvapulle et al. (2016), regarding liquidity risk; Afonso and Leite (2019) in the case of the more specific effects of quantitative easing on sovereign euro area yield spreads; and Sensoy et al. (2019) in terms EMU of a high degree of sovereign bond market integration before the GFC.

4.3. Sensitivity

The first issue that we look at is the sensitivity of our results on country's sub-sample, namely between core and non-core EMU countries. The bond spreads of some of the countries included in our analysis (Greece, Portugal, Spain and Italy) have witnessed a dramatic increase in the years following the European debt crisis. Carefully analysing how different policy instruments affect the spreads of these two different groups is important, as other papers have previously recognized (see e.g. Basse, 2014, and Gibson et al., 2015).

In Table 6 we see that the core baseline variables, such as the inflation rate, the VIX and the bid-ask spread, keep their expected signs, being also statistically significant. At the same time interest rates on the DF are relevant for both core and non-core EU countries. In addition, the statistical significance for the interest rates of MRO only occurs for the non-core EU country group, lowering, as previously observed, the sovereign bond spreads.

Regarding the fiscal policy events, we conclude that we find that bad news from the EDP releases by the EC have a positive and statistically significant impact on spreads in the case of the non-core country group. Interestingly, that effect seems to be absent for the case of the core country group. Moreover, the one year-ahead forecasts announcements of public debt contribute to increase sovereign bond spreads also for the case of the non-core EU countries. Therefore, one can perceive some different capital market responses that discriminate fiscal events across core and non-core EUR countries.

The second issue for which we assess the sensitivity of the results is a time-span split related to two distinct but related global events, where higher financial instability can increase the impact of fiscal conditions on sovereign bonds risk and yields (see, Caggiano and Greco, 2012). The first is the beginning of the GFC (marked by the NBER to be in December 2007) which was the fuse for the Great Recession globally. The second event was the sovereign debt crisis in Europe alone which was timed to have started at the end of 2009, and which typically spanned until 2016. We redo the empirical analysis (in Tables 7 and 8, respectively for the GFC and for the European debt crisis) taking into account the potential structural breaks caused by these two big events.

In Table 7 we observe that the LTRO contributes to lower sovereign spreads in the period after the GCF (a result in line notably with Afonso and Leite, 2019), and the same is true for the first covered bond purchase programme (CBPP1). Likewise, the EC one year-ahead forecasts announcements of public debt (vis-à-vis the German case) contribute to increase sovereign bond spreads after the GFC. It is important to notice that this effect seems to be statistically insignificant before the GFC, which is also in line with the idea of some previous capital markets mispricing of the sovereign risk in the euro area up to that event.

Regarding the so-called European sovereign-debt crisis event, we find in Table 8 rather similar results. Nevertheless, regarding the fiscal events, now the EC one year-ahead forecasts announcements of budget balances only contributed to decrease sovereign bond spreads before 2009. Hence, once the crisis is upon the markets, annual fiscal improvements tended to be more heavily discounted.

Table 7
Sensitivity: before and after Global Financial Crisis – fixed effects IV.

Specification combinations	(1) baseline	(2) MP type 1	(3) MP type 2	(4) FP type 1	(5) FP type 2	(6) Both FP	(7) baseline	(8) MP type 1	(9) MP type 2	(10) FP type 1	(11) FP type 2	(12) Both FP
Time span	Before GFC (until end 2007)						after GFC (after early 2008)					
IP_PCH_DEU	−0.0010	−0.0019	−0.0009	−0.0010	−0.0018	−0.0017	−0.1174***	−0.1407***	−0.0376	−0.1177***	−0.0939**	−0.0929**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.027)	(0.028)	(0.090)	(0.027)	(0.029)	(0.030)
VIX	0.0047***	0.0038***	0.0048***	0.0047***	0.0036***	0.0036***	−0.0063	−0.0106	0.0304	−0.0064	0.0333***	0.0334***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.010)	(0.012)	(0.018)	(0.010)	(0.009)	(0.009)
REER	−0.0078**	0.0007	−0.0079**	−0.0077**	−0.0066*	−0.0066*	−0.0634*	−0.0691*	0.0801**	−0.0637*	0.0395	0.0400
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.031)	(0.034)	(0.028)	(0.031)	(0.026)	(0.027)
bid_ask	7.8391***	0.8287	7.8602***	7.8297***	7.2807***	7.2799***	4.8563***	4.8407***	3.6278***	4.8505***	4.0154***	4.0175***
	(1.524)	(1.561)	(1.524)	(1.525)	(1.742)	(1.741)	(0.658)	(0.622)	(0.510)	(0.654)	(0.892)	(0.890)
D.DF		0.0327						1.0898				
		(0.026)						(0.627)				
oD.MLF		0.0000										
		(0.000)										
oD.MRO		0.0000										
		(0.000)										
D.LTRO		0.0008***	0.0005					−0.0005	−0.0066**			
		(0.000)	(0.000)					(0.001)	(0.002)			
D.CMRO		0.0000**						−0.0000				
		(0.000)						(0.000)				
oD.Net_LTRO			0.0000									
			(0.000)									
EDP				−0.0174		−0.0027				0.1833		−0.1896
				(0.026)		(0.023)				(0.194)		(0.379)
f1_debt					0.0019	0.0019					0.0548**	0.0550**
					(0.002)	(0.002)					(0.021)	(0.022)
f1_OB					0.0210**	0.0209**					−0.0698	−0.0727
					(0.007)	(0.007)					(0.050)	(0.054)
D.MLF								1.9695**				
								(0.688)				
D.MRO								−3.3171**				
								(1.163)				
D.Net_LTRO									0.0081***			
									(0.002)			
D.SMP_p									0.0060			
									(0.011)			
D.CBPP1_p									−0.1289**			
									(0.045)			
Observations	946	458	946	946	946	946	994	846	704	994	994	994
R-squared	0.7150	0.7609	0.7162	0.7152	0.7303	0.7303	0.7416	0.7342	0.8317	0.7417	0.7742	0.7743

Note: Dependent variable is the 10-year bond yield spread (relative to Germany). Robust standard errors clustered at the country level are in parenthesis below each coefficient estimate. Prefix "f1″ and "f2″ denote one or two years-ahead forecasts of a given variable, respectively. Country and time effects were estimated but omitted for reasons of parsimony. A constant term was also estimated but omitted.

Table 8
Sensitivity: before and after the European Debt Crisis – fixed effects IV.

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
combinations	baseline	MP type 1	MP type 2	FP type 1	FP type 2	Both FP	baseline	MP type 1	MP type 2	FP type 1	FP type 2	Both FP
Time span	Before debt crisis (until end 2009)						after debt crisis (after early 2010)					
IP_PCH_DEU	0.0400***	0.0544***	0.0402***	0.0394***	0.0292***	0.0292***	−0.0622	−0.0680	−0.0376	−0.0584	−0.0546	−0.0481
	(0.008)	(0.011)	(0.008)	(0.008)	(0.008)	(0.008)	(0.074)	(0.083)	(0.090)	(0.078)	(0.076)	(0.081)
VIX	0.0174***	0.0255***	0.0173***	0.0174***	0.0169***	0.0169***	0.0180**	0.0204**	0.0304	0.0191**	0.0176*	0.0177*
	(0.003)	(0.005)	(0.003)	(0.003)	(0.002)	(0.002)	(0.006)	(0.007)	(0.018)	(0.007)	(0.008)	(0.008)
REER	0.0044	−0.0007	0.0043	0.0044	−0.0008	−0.0008	0.0133	0.0121	0.0801**	0.0183	0.0020	0.0038
	(0.003)	(0.012)	(0.003)	(0.003)	(0.004)	(0.004)	(0.016)	(0.020)	(0.028)	(0.021)	(0.045)	(0.044)
bid_ask	8.1829**	1.4150	8.1765**	8.2833**	8.6408***	8.6290***	4.1207***	4.1007***	3.6278***	4.1236***	3.9479***	3.9510***
	(3.134)	(3.712)	(3.127)	(3.062)	(2.218)	(2.219)	(0.617)	(0.573)	(0.510)	(0.613)	(0.707)	(0.704)
D.DF		−0.3159***						0.8344				
		(0.069)						(0.904)				
D.MLF		0.3399***						2.2393				
		(0.073)						(1.479)				
oD.MRO		0.0000										
		(0.000)										
D.LTRO		0.0004***	0.0001					−0.0001	−0.0066**			
		(0.000)	(0.000)					(0.001)	(0.002)			
D.CMRO		−0.0000						−0.0000				
		(0.000)						(0.000)				
oD.Net_LTRO			0.0000									
			(0.000)									
EDP				0.1024		−0.0126				−0.5456		−0.6717
				(0.071)		(0.033)				(0.529)		(0.629)
f1_debt					−0.0028	−0.0028					0.0165	0.0165
					(0.004)	(0.004)					(0.011)	(0.011)
f1_OB					−0.0691**	−0.0692**					−0.1246	−0.1403
					(0.021)	(0.021)					(0.165)	(0.174)
D.MRO								−3.7154*				
								(1.791)				
D.Net_LTRO									0.0081***			
									(0.002)			
D.SMP_p									0.0060			
									(0.011)			
D.CBPP1_p									−0.1289**			
									(0.045)			
Observations	1,176	642	1,176	1,176	1,176	1,176	764	662	704	764	764	764
R-squared	0.5354	0.6584	0.5357	0.5367	0.6579	0.6579	0.8038	0.7954	0.8317	0.8047	0.8066	0.8079

Note: Dependent variable is the 10-year bond yield spread (relative to Germany). Robust standard errors clustered at the country level are in parenthesis below each coefficient estimate. Prefix "f1″ and "f2″ denote one or two years-ahead forecasts of a given variable, respectively. Country and time effects were estimated but omitted for reasons of parsimony. A constant term was also estimated but omitted.

Finally, we tried to include combinations of the several dummy variables, and checked which survived. However, and the series for fiscal and monetary events are unbalanced and not everywhere present. For instance, some unconventional monetary events only began after the GFC (while the time span covered starts in 1999). This means that depending on the policy instrument considered and under evaluation the degrees of freedom available may change. For this reason, it is not deal to include all variables or dummies together as we would shrink the total sample of available observations to a much smaller number (in some cases around 1/3 of the total number of observations in the baseline. Ultimately, more time needs to elapse to fully understand the impact of some of the most recent policy measures. This should be the object of future work.

5. Conclusion

In this paper, we have studied the impact of macroeconomic, fiscal and monetary developments and well-defined policy events on sovereign bond yield spreads in 10 EMU countries for the period 01:1999 – 07.2016 implementing fixed effects OLS and IV regressions.

We modelled spreads on a fixed block of determinants that deal with international risk conditions, liquidity risk, credit risk and economic growth. In addition, we added to the model four different types of fiscal and monetary policy event variables. Our fiscal events data include the EC releases of the short-term economic forecasts as well as the Excessive Deficit Procedures (EDP). Monetary policy events data include the announcements of the ECB's main interest rates and the unconventional monetary policies, which, as mentioned above, were ruled by the ECJ as being legal under the ECB's remit.

Our results showed that the announcement of a negative fiscal forecast by EC (e.g. upward revision in the debt-to-GDP ratio) contributed to the increase in sovereign bond yield spreads while a positive fiscal announcement (e.g. downward revision in the debt-to-GDP ratio) contributed to the decrease in spreads. We also found that noncomplying with the EDP, tends to increase sovereign yield spreads. These results imply that the investors associate higher risk of default to the sovereign bonds of countries that are not characterized by positive economic prospects. Interestingly, there is also some evidence of capital markets mispricing of the sovereign risk in the euro area before the GFC, notably regarding the government debt forecasts.

Regarding the monetary policy events, we found that the announcements of the ECB's interest rates contributed to decreasing the spreads. Moreover, we found that the announcements of the longer-term refinancing operations (LTROs), and the first covered bond purchase programme (CBPP1) contributed to decreases the sovereign yield spreads of the euro area sample countries. To some extent, and addition to the natural higher demand effect of the lowering of the yields, one could also discuss the relevance of central banks as bondholders.

Further work could consider the effects of the gradual phasing out of the non-conventional monetary policy measures of the ECB, once they have played out in the markets. Another possible avenue of research could focus on the EC announcements related not only to the EDP events, but also the more recent ones linked to the Macroeconomic Imbalance Procedure. However, to conduct such analyses empirically more time needs to elapse to allow sufficient degrees of freedom.

CRediT authorship contribution statement

António Afonso: Conceptualization, Methodology, Validation, Writing - review & editing. **João Tovar Jalles:** Conceptualization, Methodology, Validation, Writing - review & editing. **Mina Kazemi:** Data curation, Software.

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Appendix A

Table A1
Summary Statistics.

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Bond_Spread	2,110	1.117	2.528	−0.050	27.390
VIX	2,100	20.811	7.940	10.420	59.890
BAS	2,048	0.042	0.245	−0.004	5.886
REER	2,090	98.900	11.102	70.125	144.533
IP_PCH_DEU	1,990	−0.403	2.763	−10.776	20.385
DF	2,110	1.2431	1.2197	−0.400	3.750
MLF	2,110	2.873	1.633	0.250	5.750
MRO_F	1,120	1.115	1.049	0.000	4.250
MRO_V	1,000	3.125	0.953	2.000	4.750
LTRO	2,110	309.945	284.072	45.000	1092.400
Net_LTRO	2,110	274.114	287.771	20.800	1092.400
TLTRO_I	230	311.348	126.833	63.900	425.100
TLTRO_II	10	399.300	0.000	399.300	399.300
SMP	750	147.576	51.632	35.000	219.500
CBPP1	850	41.167	16.045	4.200	61.100

Source: authors' computations.

Table A2
Data Description and Sources.

Variable	Description	Source
Bond_Spread	10 year bond yield spread against German bond	ECB; Own calculations
VIX	Chicago Board of Exchange Volatility Index	Bloomberg
BAS	10-year bond yield bid-ask Spread	Bloomberg; ECB
REER	Real Effective Exchange Rate, CPI based	IFS
IP_PCH_DEU	Annual growth rate differentials of IP(seas adjusted) vs Germany	IMF
DF	Deposit Facility, percent per annum	ECB
MLF	Marginal Lending Facility, percent per annum	ECB
MRO_F	Main Refinancing Operations-fixed rate tenders, percent per annum	ECB
MRO_V	Main Refinancing Operations-variable rate tenders, percent per annum	ECB
LTRO	Longer-term Refinancing Operation (includes TLTRO_I and TLTRO_II), Holdings	ECB
Net_LTRO	Longer-term Refinancing Operation, Holdings	ECB and own calculations
TLTRO_I	First Targeted Longer-term Refinancing Operation, Holdings	ECB and own calculations
TLTRO_II	Second Targeted Longer-term Refinancing Operation, Holdings	ECB
SMP	Securities Market Programme, Holdings	ECB
CBPP1	Covered bond purchase programme 1, Holdings	ECB
F1_debt	General Government Gross Debt – one year ahead forecasts	EC
F1_OB	General Government Balance – one year ahead forecasts	EC
F1_CAB	Current Account Balance – one year ahead forecasts	EC

Table A2 (*Continued*)

Variable	Description	Source
F2_debt	General Government Gross Debt – two years ahead forecasts	EC
F2_OB	General Government Balance – two years ahead forecasts	EC
F2_CAB	Current Account Balance – two years ahead forecasts	EC

Notes: Expected budget balances and government debt are the differences vis-à-vis Germany of the European Commission vintage forecasts, taking the same value in the months between each forecast vintage. The volumes securities purchases are for the overall euro area.

Table A3
Type 2 Fiscal events (Excessive Deficit Procedures (EDP)).

country	date	event	country	date	event
Austria	02.12.2009	+1	Ireland	27.04.2009	+1
	20.06.2014	−1		02.12.2009	+1
Belgium	02.12.2009	+1		07.12.2010	+1
	21.06.2013	+1		17.06.2016	−1
	20.06.2014	−1	Italy	05.07.2004	−1
Finland	13.07.2010	+1		28.07.2005	+1
	12.07.2011	−1		03.06.2008	−1
France	21.01.2003	+1		02.12.2009	+1
	03.06.2003	+1		21.06.2013	−1
	30.01.2007	−1	The Netherlands	02.06.2004	+1
	27.04.2009	+1		07.06.2005	−1
	02.12.2009	+1		02.12.2009	+1
	21.06.2013	+1		21.06.2013	+1
	27.02.2015	+1		20.06.2014	−1
	10.03.2015	+1	Portugal	12.02.2002	−1
Greece	05.07.2004	+1		20.09.2005	+1
	18.01.2005	+1		03.06.2008	−1
	17.02.2005	+1		02.12.2009	+1
	05.06.2007	−1		09.10.2010	+1
	27.04.2009	+1		21.06.2013	+1
	02.12.2009	+1		12.07.2016	+1
	16.02.2010	+1	Spain	27.04.2009	+1
	10.05.2010	+1		02.12.2009	+1
	07.09.2010	+1		10.07.2012	+1
	07.03.2011	+1		21.06.2013	+1
	12.07.2011	+1		12.07.2016	+1
	08.11.2011	+1			
	13.03.2012	+1			
	04.12.2012	+1			
	20.08.2015	+1			

Note: Events that have negative impact are flagged by +1 (increasing the spreads) and events that have positive are flagged by -1 (decreasing the spreads). For instance, on 02.12.2009 EC reports the council decision on the existence of an excessive deficit for Austria, which is considered as a negative effect, that increases the yield, spreads so it is flagged by +1. On 20.06.2014 EC reports council decision abrogating the decision on the existence of an excessive deficit for Austria where it is flagged by −1 as it has a positive effect and decreases the yield spreads. Source: EC.

Table A4
Type 1 Monetary events (Key ECB interest rates).

Date		DF	MRO (fixed and variable rates)	MLF
1999	01 January	2.00	3.00	4.50
	04 January	2.75	3.00	3.25
	22 January	2.00	3.00	4.50
	09 April	1.50	2.50	3.50
	05 November	2.00	3.00	4.00
2000	04 February	2.25	3.25	4.25
	17 March	2.50	3.50	4.50
	28 April	2.75	3.75	4.75
	28 June	3.25	4.25	5.25
	01 September	3.50	4.50	5.50
	06 October	3.75	4.75	5.75

Table A4 (*Continued*)

Date		DF	MRO (fixed and variable rates)	MLF
2001	11 May	3.50	4.50	5.50
	31 August	3.25	4.25	5.25
	18 September	2.75	3.75	4.75
	09 November	2.25	3.25	4.25
2002	06 December	1.75	2.75	3.75
2003	07 March	1.50	2.50	3.50
	06 June	1.00	2.00	3.00
2005	06 December	1.25	2.25	3.25
2006	08 March	1.50	2.50	3.50
	15 June	1.75	2.75	3.75
	09 September	2.00	3.00	4.00
	11 October	2.25	3.25	4.25
	13 December	2.50	3.50	4.50
2007	14 March	2.75	3.75	4.75
	13 July	3.00	4.00	5.00
2008	09 July	3.25	4.25	5.25
	08 October	2.75	–	4.75
	09 October	3.25	–	4.25
	15 October	3.25	3.75	4.25
	12 November	2.75	3.25	3.75
	10 December	2.00	2.50	3.00
2009	21 January	1.00	2.00	3.00
	11 March	0.50	1.50	2.50
	08 April	0.25	1.25	2.25
	13 May	0.25	1.00	1.75
2011	13 April	0.50	1.25	2.00
	13 July	0.75	1.50	2.25
	09 November	0.50	1.25	2.00
	14 December	0.25	1.00	1.75
2012	11 July	0.00	0.75	1.50
2013	08 May	0.00	0.50	1.00
	13 November	0.00	0.25	0.75
2014	11 June	−0.10	0.15	0.40
	10 September	−0.20	0.05	0.30
2015	09 December	−0.30	0.05	0.30
2016	16 March	−0.40	0.00	0.25

Notes: DF - The interest rate on the deposit facility; MLF – The interest rate on the marginal lending facility; MRO – The interest rate on the marginal refinancing operations. We merged the fixed and variable rate tenders to a single column. On 08.06.2000 the ECB announced that, starting from the operations to be settled on 28.06.2006 the MROs of the Eurosystem would be conducted as variable rate tenders. On 08.10.2008 the ECB announced that starting from the operations to be settled on 15.10.2008, the weekly MROs would be carried out through a fixed rate tender procedure. As we used monthly data in our study, we only considered the last rate announced in a given month.

Table A5
Type 2 Monetary events (Conventional and Unconventional monetary policy).

Instruments	Monetary policy measures	Conventional instrument?	Announcement and implementation
Open market operations	Longer-term refinancing operations (LTRO)	Yes	–
	Targeted longer-term refinancing operations I (TLTRO I)	No	5 June 2014 June 2014 – May 2016
	Targeted longer-term refinancing operations II (TLTRO II)	No	10 March 2016 Since June 2016
Asset purchase programmes	Covered bond purchase programme (CBPP1)	No	7 May 2009 July 2009 – June 2010
	Securities Markets Programme (SMP)	No	10 May 2010 May 2010 - September 2012

Table A6
Baseline Pooled OLS, Country Fixed Effects and Random Effects Estimations.

Specification Estimator	(1) Pooled	(2) Country fixed effects	(3) Random effects
IP_PCH_DEU	−0.0177*	−0.0886*	−0.0177*
	(0.009)	(0.047)	(0.009)
VIX	0.0051***	0.0029	0.0051***
	(0.001)	(0.005)	(0.001)
REER	0.0004	−0.0288	0.0004
	(0.001)	(0.025)	(0.001)
bid_ask	0.7079***	6.9975***	0.7079***
	(0.031)	(0.886)	(0.031)
Observations	1,940	1,940	1,940
R-squared	0.9751	0.5132	
Hausman test with respect to country fixed effects	27.28 (0.0001)		27.28 (0.000)

Note: Ho – null hypothesis - of the Hausman test is that the difference in coefficients is not systematic. If this is < 0.01 (i.e. significant at the 10 percent level) we use fixed effects.

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at https://doi.org/10.1016/j.irle.2020.105924.

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