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Economic forecasts and sovereign yields ☆

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ABSTRACT

We assess whether the corrections made to the EC macro and fiscal forecasts (GDP growth rate, inflation, budget balance, debt ratio, current account) have an impact in sovereign yields. We perform a panel analysis of 15 EU countries (Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Sweden), for the period from 1999:1 until 2012:1, and we also analyse each country individually, on the basis of a SUR estimation. We find that corrections in the EC's forecasts impinge on 10-year sovereign bond yields, particularly corrections in fiscal variables, being more pronounced in countries with less favourable economic conditions. The penalization for the yields is higher in corrections for the current and next years than for previous years.

1. Introduction

Since 1998 the European Commission (EC) releases in a regular basis twice a year, in the spring and in autumn, short-term economic forecasts for the member states of the Economic and Monetary Union (EMU), candidate countries and other important economies, as the United States, Japan and the United Kingdom.

Since the forecasts are publicly available, investors may use this information to decide their investment portfolio, notably their investment in the sovereign bonds. Therefore, the release of these forecasts should, theoretically, have an impact on sovereign spreads. Indeed, we may argue that rational investors use all the available information; thus, a release of new information will cause a rearrangement in their investment portfolio. However, it is not obvious that this happens in reality.

Hence, we are interested in assessing what is the impact of releasing economic forecasts on the sovereign yields. If, as expected, the impact on sovereign yields is significant, the institutions which release these forecasts (EC, Organization for Economic and Co-operation Development (OECD), European Central Bank (ECB), and others) and in particular the governments, want to be aware of the consequences of forecast accuracy. That is particularly relevant regarding forecasts for current and next years (the ones with most obvious possible influence), but also for past years, as there are often corrections to past data.

Moreover, there is also an interest for private agents to know the impact of macro and fiscal forecasts, especially traders, as every anticipation of future movements in bond's prices may bring profit. Therefore, knowing if and how the bond market reacts to the release of these forecasts is paramount.

The present research will try to provide an answer for this problem, and it is a contribution to the literature since these linkages have not been much explored, at least to our knowledge, after reading the existing related literature. In fact, there are only a few studies for the USA,[2] and some were made 15 or more years ago.[3] On the contrary, there are numerous studies on sovereign spreads' determinants, on forecasts' accuracy, and on the causes of forecast errors (notably, Jonung and Martin, 2006; Martins and Mora, 2007; Merola and Pérez, 2012; Moulin and Wierts, 2006).

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[2] See Canzoneri et al. (2003).
[3] See Porter-Hudak and Quigley (1994).

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We perform an econometric analysis of the linkages between different economic forecasts and sovereign yield spreads, using a panel of 15 EU countries (Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Sweden), covering the period from 1999:1 until 2012:1. First we do the analysis for the entire panel, and afterwards we study each country individually, specifically on the basis of a SUR analysis. Notice that we use as variables the difference between the forecasts of two consecutive semesters, and not the forecast itself. This has as purpose to identify not only the impact of the forecasts' corrections in the yields, but also the credibility of the previsions.

In a nutshell, we can draw an important conclusion from our study: corrections in the EC's forecasts do impinge on the 10-year sovereign bond yield spreads, particularly the corrections in fiscal variables (public debt and budget balance), but this impact is different across countries, being more pronounced in countries with less favourable economic conditions. The penalization for the yields is higher in corrections for the current and next years than for previous years. The fact that markets react to this information on macro and fiscal forecasts could be consistent with the semi-strong form of efficient market hypothesis.

This paper is organized as follows. Section two covers the related literature. Section three explains and discusses the data and the construction of the variables. Section four presents the empirical strategy and the results. Section five summarizes the conclusions.

2. Literature review

2.1. Literature on sovereign spreads' determinants

To perform our analysis, we need to know the main determinants of sovereign bond yield spreads. There is a great amount of literature on this subject, but there are still some conflicting results, as there are many factors which may influence sovereign spreads.

However, there are some conclusions that are common to the majority of the studies. The variables which more often appear as significant are the level of GDP, GDP *per capita* or GDP growth rate (Afonso, 2010; Hischer and Nosbusch, 2010), fiscal performance, through public debt and budget balance (Afonso, 2010; Afonso et al., 2012; Akitoby and Stratmann, 2006; Amira, 2004; Baldacci and Kumar, 2010; Dell'Erba and Sola, 2011; Gruber and Kamin, 2010; Laubach, 2009), current account balance (Amira, 2004) and monetary policy (Gruber and Kamin, 2010).

The literature also presents several interesting conclusions. For example, the impact of the level of public debt is quantitatively lower than the one of public deficits (Faini, 2006; Laubach, 2009), and worst fiscal behaviour lowers the ratings of sovereign debt (Afonso and Gomes, 2010), which may induce a rise in the yields demanded by market participants. Indeed, government balance and the debt-to-GDP ratios could convey relevant information regarding credit risk or liquidity risk and help in explaining cross-country financial risk premia.

Dell'Erba and Sola (2011), using a panel of 17 OECD countries from 1989 to 2009, conclude that a budget deficit increase has a greater impact in small peripheral countries or in countries with low financial integration. Baldacci and Kumar (2010), with data from 31 developed and in developing countries, between 1980 and 2008, report that higher deficits and levels of public debt lead to a significant increase in long-term interest rates, and that the magnitude of such increase depends on the initial fiscal, institutional and structural conditions, and on the spillovers of the global financial markets.

A study by the EC (2011) finds a negative relationship between the strength of rules-based fiscal governance and sovereign spreads, using the Fiscal Rules Index as a measure of the quality of the fiscal institutions. Alexopoulou et al. (2009) conclude that the current account and budget balance, inflation, exchange and short-term interest rates, among other factors, influence the cost of long-term finance of new EU countries, while Afonso and Rault (2010) conclude that the inflation rate, budget and external imbalances have an impact on OECD countries sovereign spreads.

Thus, our empirical analysis will consider as determinants of the 10-year government bond yields the GDP real growth rate, the public debt-to-GDP ratio, the budget balance ratio, the inflation rate, given by the harmonized index of consumer prices (HICP), the real effective exchange rate (more specifically, the percentage change to the preceding year), the current account balance, also as a percentage of GDP (all of these sourced as EC forecasts), the international risk (represented by the VIX—the S&P 500 implied stock market volatility index), and monetary policy (represented by the short-term interest rates defined by the monetary authority). We also control for the existence and strength of fiscal rules, including as a variable the Fiscal Rude Index, calculated by the EC.

There is a theoretic economic relation between all the variables aforementioned and the 10-year government bond yields. For instance, with high inflation a government tends to unilaterally and partially inflate away from its fiscal indebtedness, and the need for a higher nominal and real long-term bond yield cannot be discarded. Moreover, expected inflation is also seen as an indicator of macroeconomic stability, implying higher sovereign risk. Deviations from past inflation can be assumed from the actual inflation rate, or taken as an average of past observations.

In addition, the current account balance-to-GDP ratio can convey the existence of a gap between saving and investment and provide expectations of a future depreciation of the domestic currency. Under those circumstances the risk premia demanded by the markets on sovereign debt may also increase.

2.2. Literature on forecast errors

Regarding forecast errors, there are two different topics usually explored: errors in government's forecasts and their causes, and errors in independent agencies' forecasts and their causes. Both are important for our work due to the dependency of the EC's forecasts on governments' forecasts, since they are based on the information provided by the country's government.

Concerning governments' forecasts, three main conclusions appear in the literature:

1) preliminary data releases are biased and non-efficient predictors of the true values, especially for GDP and public deficit, and several corrections occur over the subsequent vintages (Castro et al., 2011; Frankel, 2011; Jonung and Martin, 2006; Martins and Mora, 2007; Merola and Pérez, 2012; Moulin and Wierts, 2006);
2) the economic cycle is not fully included in the GDP forecast, making GDP forecast errors an important cause of budget deficit errors (Castro et al., 2011; Frankel, 2011; Jonung and Martin, 2006; Merola and Pérez, 2012; Moulin and Wierts, 2006);
3) being subject to a fiscal rule, without having strong and independent supervision, leads to an increase in GDP and budget deficit errors, possibly due to creative accounting (Frankel, 2011; von Hagen and Wolff, 2006).

Bernoth and Wolff (2008), and von Hagen and Wolff (2006) mention that most European Union's members incur in stock flow adjustments (i.e., the change in their government debt is higher than the budget deficit), which increases the yields demanded by financial markets. This increase is higher when the events of creative accounting are reported in the media. On the other hand, Castro et al. (2011) argue that modifications in Eurostat budget rules also explain a significant part of forecast errors, and forecasts may be considered rational after 2 years (i.e., forecast for year t may be considered correct in year $t+2$). This conclusion was the reason for the use in our study of forecast's corrections till 2 years ago as regressors.

Concerning independent agencies' forecasts, two main conclusions are possible:

1) they seem to be unbiased and efficient, either for the EU and for the non-EU countries (Melander et al., 2007);
2) however, they appear to be correlated with the electoral cycles, though less than those from the government, and do not include all the available information, though they consider more information than governments (Merola and Pérez, 2012).

Thus, according to the available empirical evidence, it appears that independent agencies' forecasts are more reliable than governments', which might notably be linked to the fact that governments have sometimes to accommodate the political cycle. Melander et al. (2007) show that the forecasts for GDP, inflation, current account balance and public budgets are the most accurate ones, though not totally correct. Indeed, the authors report that real growth and budget balance forecasts do not show persistent errors (the study covers the 1970–1995 period).

In our analysis we will consider EC's forecasts, as they are part of the basis of budgetary surveillance in the context of the application of the Excessive Deficits Procedure, and are considered more reliable than the government's, being a major reference for investors, economists and managers.

3. Data and variables

As already mentioned, in our study we use a panel of 15 countries: Austria (AT), Belgium (BE), Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), United Kingdom (GB), Greece (GR), Ireland (IE), Italy (IT), Luxemburg (LU), Netherlands (NL), Portugal (PT) and Sweden (SE).

The EC's forecasts of budget balance-to-GDP ratio (BAL), public debt-to-GDP ratio (DEBT), GDP real growth rate (YR), current account balance (CA), inflation (INF) and real effective exchange rate (REER) were retrieved from the EC's website, as well as the short-term interest rates (I), the 10-year government bond yields (YIELDS) and the fiscal rule index (FRI). The VIX was obtained from Bloomberg's.

The forecasts are released twice a year, typically around March–April (the spring forecast) and October–November (the autumn forecast); therefore, our data will be bi-annual. As the first forecasts were made in the second semester of 1998, our analysis covers the period from 1999:1 till 2012:1. The short-term interest rates, the yields and the VIX used relate to the month of the release of the forecast. We use monthly yields instead of daily ones in order to try to capture some market anticipation of the forecast's release.

It is important to understand correctly the meaning of all variables. We will include forecasts made in year t for year t, year $t+1$, and also for years $t-1$ and $t-2$. This choice was based on Castro et al. (2011), as mentioned above. If forecasts may be considered rational after 2 years, investors will not pay much attention to corrections made after that (except if those corrections are truly significant, but it is not a frequent occurrence). Moreover, as already said, we will use forecasts' corrections as variables, and not the forecast itself.

Therefore, every semester s we have a forecast for variable X, for country i and year t, $X^t_{i,s}$. Our variable of interest will then be $\Delta X^t_{i,s} = X^t_{i,s} - X^t_{i,s-1}$, the difference between forecasts made for year t in two consecutive semesters. We are not interested in knowing if the release of the forecast itself has an impact on the yield, but whether if the corrections made in the forecasts are significant enough to alter the yields. This way, we can evaluate if the EC's and government forecasts have credibility.

4. Empirical strategy and results

4.1. Panel estimation results

We will start by using a panel data approach, to obtain the aggregate effect of forecasts' corrections on the sovereign yields. The baseline specification is

$$YIELD_s = \beta_0 + \beta_{1.} * \Delta\overline{X}^T_{i,s} + \beta_2 * I_{i,s} + \beta_3 * VIX_{i,s} + \beta_4 * FRI_{i,s} \quad (1)$$

where $T = \{t, t+1, t-1, t-2\}$ refers to the year of the forecast, and $\overline{X} = \{BAL, CA, DEBT, INF, REER, YR\}$ is the forecasts' vector, and varies from regression to regression, depending on the variables we want to study.

Due to the correlation between ΔDEBT and ΔBAL, we never include them in the same regression. We excluded $\Delta REER^{t+1}$ as a regressor because it had too few observations. In addition, we perform the analysis separately for the years when the forecasts are made for, which means we have a different table with the eight regressions for forecasts for years t, $t+1$, $t-1$ and $t-2$. We do this due to the correlation of the majority of the variables from one year to another. VIX, FRI and the short-term interest rate are present in all regressions, since they are control variables, and some forecast variables are repeated in different regressions in order to test their impact in more than one way. Non-linear effects were not accounted for since the focus of the study was specifically to check the effect of the corrections in the EC forecasts. In order to admit residual heteroscedasticity, we always use the White diagonal covariance matrix.

We use instrumental variables for ΔDEBT and ΔBAL, regarding forecasts for year t and $t+1$, since they are correlated with the YIELDS. Every year, governments have to make interest payments to bond owners, an expense that it is accounted for in the budget balance and, consequently, in public debt. Therefore, the higher the interest rate demanded by investors in the bond's auction, the higher will be the budget deficit and consequently the stock of future debt. Moreover, forecasts for the fiscal variables for t and for $t+1$ are also likely to be influenced by the current 10-year secondary market bond yields.

Additionally, we have performed the Wu–Hausman's endogeneity test for ΔYR, also for the forecasts for year t and $t+1$, to exclude a possible effect of the 10-year sovereign yields on the country's economic growth. Indeed, higher yields may push public balances to critical values, forcing governments to adopt somewhat more austere programs, reducing their expenses or increasing their revenues, mostly through higher taxation. Either way, these are negative stimulus to the economy, and may have a contractionary effect on real GDP. Finally, we also perform the Hausman's test, to verify if it is more appropriate to use fixed or random effects. [4]

For forecasts concerning the year of their release, we have public debt and the budget balance corrections as significant. GDP growth rate corrections have statistical significance in two of the seven regressions where they are included, having a positive effect on yields, and real effective exchange rate in one of the four regressions, having a negative coefficient. The constant term, short-term interest rate and FRI also have an impact on the yields.

Regarding the forecasts for the next year, fiscal variables remain statistically significant. Current account balance corrections appear as significant in one of the regressions, having a positive but smaller impact than the fiscal variables. The constant term, short-term interest rate and FRI are significant again.

In the results obtained with forecasts for year $t-1$, only budget balance is significant. Public debt no longer has an impact, probably because it is difficult to hide the true value of this ratio, when comparing

[4] We report the results for years t and $t+1$, the most significant ones; for more results see the working paper version.

Table 1
Estimation results for 10-year yields: forecasts for year *t*.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
$C_{i,t}$	3.526***	3.494***	3.555***	3.662***	3.523***	3.460***	3.580***	3.639***
	(0.159)	(0.166)	(0.169)	(0.177)	(0.254)	(0.262)	(0.267)	(0.174)
$\Delta BAL_{i,t}$					−0.398*	−0.409*	−0.442*	
					(0.210)	(0.222)	(0.228)	
$\Delta CA_{i,t}$				0.019		−0.027		0.013
				(0.020)		(0.037)		(0.026)
$\Delta DEBT_{i,t}$	0.135**	0.132**	0.150*	0.077				
	(0.062)	(0.066)	(0.078)	(0.077)				
$\Delta INF_{i,t}$	0.299		0.243				0.364	0.111
	(0.206)		(0.189)				(0.246)	(0.141)
$\Delta REER_{i,t}$	−0.017	−0.020				−0.031		−0.041*
	(0.027)	(0.028)				(0.034)		(0.022)
$\Delta YR_{i,t}$	0.114	0.178	0.152*	−0.166	0.194*	0.157	0.131	
	(0.088)	(0.112)	(0.090)	(0.207)	(0.108)	(0.119)	(0.099)	
$I_{i,t}$	0.298***	0.328***	0.314***	0.342***	0.337***	0.352***	0.310***	0.223***
	(0.038)	(0.039)	(0.039)	(0.040)	(0.045)	(0.049)	(0.046)	(0.058)
$VIX_{i,t}$	−0.003	−0.002	−0.001	−0.011	0.001	−0.004	−0.001	0.007*
	(0.006)	(0.005)	(0.007)	(0.008)	(0.006)	(0.006)	(0.007)	(0.003)
$FRI_{i,t}$	−0.020	−0.084	−0.172***	−0.189***	−0.164	−0.105	−0.129	−0.053
	(0.140)	(0.142)	(0.054)	(0.054)	(0.103)	(0.099)	(0.095)	(0.112)
R-square	0.357	0.329	−0.097	0.185	−0.057	−0.048	−0.077	0.315
N	15	15	15	15	15	15	15	15
Obs	303	303	349	314	349	302	349	302
Endogeneity	0.396	0.493	0.204	0.099	0.802	0.879	0.794	
Hausman	0.005	0.003	0.539	0.600	0.763	0.191	0.825	0.070

Note: the asterisks *, ** and *** represent significance at 10, 5 and 1% level, respectively. The values present between parentheses are the standard error. *IV* indicates if instrumental variables were used in the regression, *N* is the number of countries included in the sample, *Obs* is the number of observations, *Endogeneity* is the *p*-value obtained by performing the Wu–Hausman endogeneity test for ΔYR, and *Hausman* is the p-value for the Hausman's random effect test.

to budget balance. The constant term, short-term interest rate and VIX remain significant, and VIX starts to appear as well.

Finally, in the case of forecasts for year $t-2$, none of the fiscal variables is significant. We find once more that the constant term, short-term interest rate and FRI are significant, as in all the tables above. Moreover, in this case VIX is also significant in all regressions, probably because investors do not pay attention to corrections in forecasts of so far back; thus, VIX gains significance.

Overall, we observe that the constant term, ΔBAL, ΔDEBT, I and FRI are significant in most of the specifications. The fiscal variables, ΔBAL and ΔDEBT, are the two forecasts' corrections in which investors focus on. Hence, we may say that investors pay attention to countries' fiscal behaviour, demanding higher yields when the public debt ratio increases and the budget balance decreases, meaning investors penalize countries which engage in an expansionary fiscal policy financed by debt issuance.

Table 2
Estimation results for 10-year yields: forecasts for year $t+1$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IV	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
$Ci_{,t}$	3.581***	3.664***	3.633***	3.681***	3.881***	3.843***	3.795***	3.629***
	(0.207)	(0.224)	(0.203)	(0.202)	(0.378)	(0.405)	(0.314)	(0.166)
$\Delta BAL_{i,t+1}$					−0.456*	−0.334*	−0.373*	
					(0.259)	(0.198)	(0.209)	
$\Delta CA_{i,t+1}$				0.028		0.061		0.056**
				(0.018)		(0.038)		(0.027)
$\Delta DEBT_{i,t+1}$	0.099*	0.085*	0.094*	0.085*				
	(0.053)	(0.052)	(0.050)	(0.051)				
$\Delta INF_{i,t+1}$	0.200		0.190				0.207	−0.024
	(0.164)		(0.140)				(0.170)	(0.063)
$\Delta REER_{i,t}$	−0.036	−0.038				−0.047		−0.039*
	(0.029)	(0.031)				(0.037)		(0.021)
$\Delta YR_{i,t+1}$	0.048	0.020	0.098	−0.004	0.185	−0.017	0.106	
	(0.101)	(0.106)	(0.092)	(0.097)	(0.178)	(0.179)	(0.168)	
$I_{i,t}$	0.335***	0.342***	0.323***	0.334***	0.328***	0.310***	0.293***	0.244***
	(0.048)	(0.048)	(0.047)	(0.046)	(0.051)	(0.050)	(0.054)	(0.043)
$VIX_{i,t}$	−0.011	−0.011	−0.004	−0.010	−0.013	−0.016	−0.008	0.006*
	(0.009)	(0.010)	(0.008)	(0.010)	(0.014)	(0.013)	(0.010)	(0.003)
$FRI_{i,t}$	−0.006	−0.173**	−0.157	−0.177***	−0.225**	−0.150	−0.130	−0.076
	(0.192)	(0.069)	(0.171)	(0.051)	(0.089)	(0.120)	(0.206)	(0.106)
R-square	0.302	0.197	0.234	0.215	−0.412	−0.186	−0.131	0.319
N	15	15	15	15	15	15	15	15
T	303	303	349	314	349	302	349	302
Endogeneity	0.945	0.924	0.728	0.295	0.466	0.628	0.697	
Hausman	0.001	0.103	0.089	0.231	0.101	0.169	0.028	0.000

Note: the asterisks *, ** and *** represent significance at 10, 5 and 1% level, respectively. The values present between parentheses are the standard error. *IV* indicates if instrumental variables were used in the regression, *N* is the number of countries included in the sample, *Obs* is the number of observations, *Endogeneity* is the *p*-value obtained by performing the Wu–Hausman endogeneity test for ΔYR, and *Hausman* is the *p*-value for the Hausman's random effect test.

Table 3
Individual results of estimations of forecasts for year *t*, regression (2).

	$Ci_{,t}$	$DEBT_{i,t}$	$INF_{i,t}$	$REER_{i,t}$	$YR_{i,t}$	$I_{i,t}$	$VIX_{i,t}$	R-square	Obs
AT	3.120***	−0.008	−0.127*	−0.043	−0.095	0.415***	0.000	0.700	24
	(0.198)	(0.015)	(0.067)	(0.031)	(0.058)	(0.044)	(0.007)		
BE	3.312***	−0.047***	0.006	−0.080***	−0.141**	0.302***	0.012	0.599	25
	(0.208)	(0.016)	(0.046)	(0.023)	(0.057)	(0.049)	(0.007)		
DE	2.801***	0.018	−0.038	0.014	0.032	0.550***	−0.013	0.678	25
	(0.273)	(0.017)	(0.074)	(0.011)	(0.040)	(0.064)	(0.010)		
DK	3.568***	−0.036***	0.343	−0.102	−0.146	0.313**	0.003	0.771	13
	(0.352)	(0.013)	(0.323)	(0.105)	(0.220)	(0.147)	(0.031)		
ES	4.013***	0.018	0.230**	−0.102**	−0.194	0.117	0.005	0.283	25
	(0.298)	(0.047)	(0.110)	(0.040)	(0.141)	(0.078)	(0.011)		
FI	2.852***	0.119***	0.052	−0.052**	0.010	0.520***	−0.005	0.817	25
	(0.189)	(0.016)	(0.068)	(0.025)	(0.035)	(0.046)	(0.007)		
FR	3.143***	0.038*	−0.030	−0.008	0.128*	0.413***	−0.001	0.686	25
	(0.199)	(0.020)	(0.064)	(0.019)	(0.070)	(0.046)	(0.007)		
GB	3.287***	0.056**	0.039	0.066***	0.073	0.355***	−0.005	0.763	25
	(0.242)	(0.027)	(0.086)	(0.012)	(0.097)	(0.034)	(0.009)		
GR	9.080***	−0.256***	0.436	−0.322	−1.082**	−1.431***	0.041	0.612	25
	(1.895)	(0.041)	(0.420)	(0.212)	(0.431)	(0.519)	(0.066)		
IE	5.799***	0.080***	0.571***	−0.069	0.027	−0.526***	0.022	0.474	25
	(0.658)	(0.020)	(0.209)	(0.055)	(0.111)	(0.178)	(0.024)		
IT	3.995***	−0.016	0.208	−0.066**	−0.089	0.085	0.017*	0.247	25
	(0.277)	(0.032)	(0.127)	(0.033)	(0.105)	(0.072)	(0.010)		
NL	2.970***	0.008	−0.041	0.013	−0.004	0.474***	−0.004	0.643	25
	(0.256)	(0.015)	(0.059)	(0.024)	(0.045)	(0.059)	(0.009)		
PT	5.823***	0.035	0.959***	−0.277***	−0.063	−0.711***	0.052*	0.492	25
	(0.798)	(0.048)	(0.256)	(0.076)	(0.225)	(0.207)	(0.028)		
SE	2.671***	0.039	0.156	−0.013	0.350***	0.632***	0.000	0.838	20
	(0.210)	(0.034)	(0.136)	(0.024)	(0.095)	(0.062)	(0.007)		

Note: the asterisks *, ** and *** represent significance at 10, 5 and 1% level, respectively. The values present between parentheses are the standard error. *Obs* is the number of observations.

Looking at the results, we can conclude that investors pay more attention to corrections made in forecasts for current and next year than to corrections made in forecasts for 1 and 2 years back. This may occur due to investor's confidence in EC's forecast accuracy (in fact, corrections for previous years tend to be smaller), or a higher investor's preference for values of fiscal variables for current and next years. In terms of policy implication, if the more accurate values are only obtained afterwards, there will only be a penalization for worst budget balances, and it will be lower than if budget balances' data were corrected before.

The coefficient for the short-term interest rate is positive. When a central bank increases these rates, it is engaging in contractionary monetary policy; thus, one can expect a deceleration in economic activity, which may worsen budget balances and compromise the country's ability to pay the debt, thus bringing the yields up. The coefficient for the FRI is negative. The FRI is calculated based on the Fiscal Rule Strength Index, which evaluates the quality and visibility of a country's institutional features, essential to the correct application of the fiscal rule. The higher their quality and visibility, the higher is the probability and credibility of following the rule, thus the lower are the yields demanded. If investors believe that the government will oblige to the limits imposed, then there is higher credibility that fiscal imbalances will be quickly corrected.

The constant term may be interpreted as a risk premium demanded by investors, related to the probability of default. At the aggregate level, it is, on average, 3.635, but as we will see ahead it differs quite a lot across countries, depending on the perceived risk attributed to each one.

Finally, real GDP growth rate forecast's corrections are also significant for years t and $t-2$. It could be expected that this variable would be as meaningful as the fiscal variables, as it is a vital indicator of a country's economic viability and debt sustainability. In spite of its relevant value as an indicator of the state of the economy, real GDP growth rates forecasts are the most volatile,[5] as they depend on external and non-controllable factors, among others. Hence, investors may not always react to small corrections in this variable's forecast, as they are very frequent, or may actually anticipate some errors (for example, they may anticipate that forecasts are too optimistic). Another possible explication will be given ahead, after performing the SUR analysis. Indeed, if corrections in GDP growth rate forecasts have opposite effects in the countries' yields, then when we estimate for the entire panel these effects may cancel each other, leading to the statistic insignificance of these corrections. On the one hand, higher growth increases firm's profits, investment returns and, consequently, stock dividends, which makes the stock market more profitable and attractive, leading to bond selling, decrease in bond's prices and increase in bond's yields, in order to attract investors again (a positively sloped yield curve also tends to reflect growth expectations). On the other hand, higher growth can suggest lower debt and budget balance ratios to GDP, implying a lower probability of default, which makes the country's sovereign bonds safer investments and, as a consequence, the yields demanded are lower.

4.2. Robustness tests

Although there are EC's forecasts until 2012:1, the FRI only has data until 2010:2. Consequently, in the results shown above, three forecast's releases were not included (spring and autumn of 2011, and spring of 2012). In order to overcome this problem, we did two robustness tests, to see if the results obtained were still valid: first, we added one observation to the FRI, making the value for this variable in 2011 equal to the one verified in 2010; second, we removed the FRI from the sample. All econometric details (instrumental variables, random or fixed effects, YR endogeneity and White covariance matrix) remain valid (results are available on request).

Comparing the results with one extra FRI observation with the initial baseline specification, we observe that fiscal variables still remain the most important variables among the forecasts. However, public debt increases its importance, being significant for all years (before it was only significant for years t and $t+1$), and the magnitude of the budget balance coefficient is lower; it only

[5] See, for example, Castro et al. (2011), Merola and Pérez (2012) and Martins and Mora (2007).

Table 4
Individual results of estimations of forecasts for year $t + 1$, regression (2).

	$Ci_{,t}$	$DEBT_{i,t+1}$	$INF_{i,t+1}$	$REER_{i,t}$	$YR_{i,t+1}$	$I_{i,t}$	$VIX_{i,t}$	R-square	Obs
AT	2.971***	0.011	−0.331***	−0.037	0.174*	0.444***	0.006	0.686	24
	(0.207)	(0.012)	(0.118)	(0.036)	(0.093)	(0.047)	(0.008)		
BE	3.318***	−0.019	0.008	−0.056***	−0.103	0.309***	0.010	0.584	25
	(0.211)	(0.012)	(0.088)	(0.020)	(0.084)	(0.051)	(0.008)		
DE	2.269***	0.024*	0.238**	0.029**	0.155*	0.574***	−0.008	0.702	25
	(0.276)	(0.013)	(0.100)	(0.013)	(0.091)	(0.066)	(0.010)		
DK	2.658***	0.091**	−1.442***	−0.150**	1.600***	0.519***	0.025	0.847	13
	(0.265)	(0.037)	(0.440)	(0.064)	(0.467)	(0.123)	(0.022)		
ES	4.037***	−0.011	0.222	−0.095**	−0.200	0.054	0.011	0.192	25
	(0.336)	(0.021)	(0.156)	(0.037)	(0.130)	(0.088)	(0.013)		
FI	2.669***	0.073***	−0.220*	−0.024	0.299***	0.527***	0.004	0.810	25
	(0.203)	(0.014)	(0.124)	(0.023)	(0.089)	(0.046)	(0.007)		
FR	3.029***	0.043***	0.260	−0.037*	0.207***	0.436***	0.000	0.741	25
	(0.185)	(0.011)	(0.109)	(0.019)	(0.069)	(0.044)	(0.007)		
GB	3.030***	0.024	−0.152	0.073***	0.209*	0.381***	0.004	0.781	25
	(0.288)	(0.016)	(0.147)	(0.015)	(0.117)	(0.038)	(0.010)		
GR	9.761***	−0.119***	0.269	−0.630***	−1.037**	−1.692***	0.036	0.535	25
	(1.983)	(0.041)	(0.949)	(0.214)	(0.499)	(0.554)	(0.071)		
IE	5.162***	0.098***	1.562***	−0.020	0.197	−0.748***	0.032	0.453	25
	(0.707)	(0.027)	(0.474)	(0.061)	(0.168)	(0.211)	(0.026)		
IT	3.790***	0.022	1.235***	−0.053*	−0.191	0.066	0.024**	0.385	25
	(0.269)	(0.020)	(0.250)	(0.030)	(0.130)	(0.068)	(0.010)		
NL	2.874***	0.016	0.005	0.006	0.169***	0.499***	0.000	0.658	25
	(0.253)	(0.010)	(0.015)	(0.020)	(0.062)	(0.059)	(0.009)		
PT	5.044***	0.162***	2.318***	−0.311***	0.671**	−0.466**	0.049	0.518	25
	(0.811)	(0.042)	(0.532)	(0.085)	(0.323)	(0.206)	(0.029)		
SE	2.792***	−0.055**	−0.249	0.005	−0.298**	0.694***	−0.020**	0.810	20
	(0.239)	(0.027)	(0.173)	(0.028)	(0.141)	(0.071)	(0.008)		

Note: the asterisks *, ** and *** represent significance at 10, 5 and 1% level, respectively. The values present between parentheses are the standard error. *Obs* is the number of observations.

appears significant in forecasts for year $t - 1$, and before it was also for years t and $t + 1$. The real GDP growth rate never appears as significant, as well as the current account balance. On the contrary, inflation now appears as significant for years t, $t + 1$ and $t - 2$, when it used to be significant only for $t - 2$, and real effective exchange rate has a significant impact, regarding forecasts for years t and $t + 1$, like current account balance, in forecasts for year $t + 1$.

Hence, adding the year 2011 to our sample allows keeping the main conclusions, but changes some of the results. This may happen due to instability and uncertainty of this year (in 2011 Portugal asked for a financial assistance, implementing the EC/ECB/IMF Economic Adjustment Programme, Greece asked for a second financial loan, Italian and Spanish bonds started to be under pressure), which leads to a bigger suspicion by the investors, not relying so much on public balance and GDP growth rate forecasts, as they tend to undergo several ex-post corrections.

As stated above, we also tested the same regressions without the FRI data, which allows for three more time series observations per country. The results (available on request) go in the same direction than those of the first robustness test.

These results seem to confirm the idea that the instability and uncertainty of 2011 and 2012 may alter somehow the results obtained in the initial panel. The disbelief in government's accounts could have led investors to overlook the budget balance corrections, as they did not see them as very credible in that context, and they started to give more importance to government debt. In addition, countries began to rely on exportations to grow, as their internal demand was sluggish; thus, the real effective exchange rate increased its importance as an indicator of the country's economic evolution. Also, the constant term increased, indicating that investors demanded a higher risk premium, due to higher risk and uncertainty in the bond market.

4.3. Country estimation—SUR

In addition to our panel analysis, we have performed an individual analysis for the countries. Investors may react differently to corrections in forecasts, as they give different credibility to each country, once they have different characteristics.

We have estimated a system of equations, one for each country, to find the individual coefficients. For that purpose, we used the Seemingly Unrelated Regressions (SUR) model. We will use this model in two different specifications, due to the correlation between public debt and budget balance, as mentioned above:

$$YIELD_s = \beta_0 + \beta_1 * \Delta DEBT^T_{i,s} + \beta_2 * \Delta INF^T_{i,s} + \beta_3 * \Delta REER^T_{i,s} + \beta_4 * \Delta YR^T_{i,s} + \beta_5 * I_{i,s} + \beta_6 * VIX_{i,s} \quad (2)$$

$$YIELD_s = \beta_0 + \beta_1 * \Delta BAL^T_{i,s} + \beta_2 * \Delta CA^T_{i,s} + \beta_3 * \Delta REER^T_{i,s} + \beta_4 * \Delta YR^T_{i,s} + \beta_5 * I_{i,s} + \beta_6 * VIX_{i,s} \quad (3)$$

where $T = \{t, t + 1, t - 1, t - 2\}$ refers to the year of the forecast. From Eq. (2) we will create a system of fourteen regressions, one for each country (Luxembourg is excluded, because it has very few observations), and we do the same with Eq. (3). Once again, we separate the regressions through year of forecast, so we will have eight systems, regarding forecasts for year t, $t + 1$, $t - 1$ and $t - 2$ for both regressions. Notice that we remove the FRI as a regressor, although it was significant in the panel. We need to do this because the FRI is a constant for Greece, and almost a constant for Belgium and Netherlands, which causes collinearity problems.

The results of the estimations for years t and $t + 1$ for regression (2) and (3) are reported in Tables 3, 4, 5, and 6. [6] (See Tables 1 and 2.)

Looking at the results, we observe that the coefficients and the significant variables naturally vary across countries. In addition, while in the initial result corrections to public debt and budget balance, the short-term interest rate and the constant term were the variables which stood out, now corrections in the real effective exchange rate and real GDP growth rate are also important determinants of the

[6] The results of forecasts for years $t - 1$ and $t - 2$ are also available from the authors.

Table 5
Individual results of estimations of forecasts for year *t*, for regression (3).

	$Ci_{,t}$	$BAL_{i,t}$	$CA_{i,t}$	$REER_{i,t}$	$YR_{i,t}$	$I_{i,t}$	$VIX_{i,t}$	R-square	Obs
AT	3.108***	−0.114	0.032	−0.032	−0.034	0.390***	0.002	0.707	24
	(0.202)	(0.076)	(0.035)	(0.040)	(0.060)	(0.044)	(0.007)		
BE	3.452***	−0.036	0.002	−0.077***	−0.068	0.290***	0.006	0.574	25
	(0.206)	(0.045)	(0.021)	(0.025)	(0.047)	(0.049)	(0.007)		
DE	2.840***	−0.171*	0.054	0.027	0.090	0.506***	−0.011	0.703	25
	(0.262)	(0.091)	(0.048)	(0.019)	(0.077)	(0.062)	(0.009)		
DK	3.282***	−0.260	−0.150	−0.114*	0.006	0.305**	0.020	0.759	13
	(0.310)	(0.163)	(0.116)	(0.079)	(0.258)	(0.134)	(0.026)		
ES	4.026***	0.213***	0.013	−0.117***	−0.357***	0.071	0.013	0.336	25
	(0.283)	(0.055)	(0.016)	(0.031)	(0.086)	(0.073)	(0.010)		
FI	2.858***	−0.177**	−0.046	−0.081***	0.020	0.526***	−0.003	0.746	25
	(0.215)	(0.069)	(0.035)	(0.028)	(0.056)	(0.052)	(0.008)		
FR	3.214***	−0.168***	−0.041	−0.057***	0.059	0.392***	−0.005	0.729	25
	(0.181)	(0.050)	(0.031)	(0.019)	(0.053)	(0.042)	(0.007)		
GB	3.372***	−0.145***	0.033	0.041***	0.215**	0.324***	−0.004	0.783	25
	(0.217)	(0.054)	(0.056)	(0.010)	(0.101)	(0.028)	(0.008)		
GR	8.554***	0.219	−0.456**	−0.851***	−0.623	−1.576***	0.065	0.529	25
	(2.051)	(0.188)	(0.222)	(0.192)	(0.500)	(0.561)	(0.075)		
IE	5.595***	−0.095***	0.105	−0.079	0.139*	−0.440**	0.027	0.350	25
	(0.742)	(0.022)	(0.140)	(0.053)	(0.076)	(0.194)	(0.027)		
IT	4.048***	0.301**	0.187***	−0.050	−0.169*	0.091	0.018*	0.319	25
	(0.264)	(0.131)	(0.069)	(0.036)	(0.099)	(0.069)	(0.009)		
NL	3.003***	−0.049	−0.039	−0.008	−0.033	0.469***	−0.007	0.672	25
	(0.244)	(0.060)	(0.028)	(0.038)	(0.070)	(0.057)	(0.009)		
PT	5.779***	0.116	0.167	−0.321***	0.175	−0.575**	0.051	0.387	25
	(0.939)	(0.219)	(0.119)	(0.091)	(0.245)	(0.239)	(0.033)		
SE	2.707***	−0.149	−0.097	−0.021	0.279***	0.677***	−0.006	0.861	20
	(0.190)	(0.097)	(0.066)	(0.021)	(0.082)	(0.057)	(0.006)		

Note: the asterisks *, ** and *** represent significance at 10, 5 and 1% level, respectively. The values present between parentheses are the standard error. *Obs* is the number of observations.

10-year bond yields. In some countries, current account balance and inflation corrections also have a significant impact on yields.

As it might be expected, the estimated coefficients in Greece, Ireland and Portugal tend to be higher than in other countries. We seem to confirm that a country's credibility is an essential factor in determining its funding costs, due to the risk premium demanded, but also because countries with lower credibility tend to have yields that are more reactive to forecasts' corrections.

After making the individual analysis, it is visible that the real effective exchange rate and real GDP growth rate corrections are not so important in the panel results because they have opposite effects in some countries.

Table 6
Individual results of estimations of forecasts, year $t + 1$, regression (3).

	$Ci_{,t}$	$BAL_{i,t+1}$	$CA_{i,t+1}$	$REER_{i,t}$	$YR_{i,t+1}$	$I_{i,t}$	$VIX_{i,t}$	R-square	Obs
AT	2.874***	−0.138***	0.059*	−0.025	0.237**	0.411***	0.011	0.750	24
	(0.197)	(0.049)	(0.030)	(0.039)	(0.100)	(0.044)	(0.007)		
BE	3.385***	−0.032	0.014	−0.061***	−0.047	0.308***	0.006	0.587	25
	(0.210)	(0.031)	(0.018)	(0.017)	(0.062)	(0.051)	(0.007)		
DE	2.694***	−0.063	0.094**	0.024	0.108	0.537***	−0.009	0.705	25
	(0.265)	(0.043)	(0.040)	(0.020)	(0.101)	(0.064)	(0.009)		
DK	3.079***	−0.266	−0.109	−0.148*	0.527	0.325**	0.024	0.696	13
	(0.337)	(0.220)	(0.113)	(0.082)	(0.537)	(0.148)	(0.031)		
ES	3.975***	0.118***	0.005	−0.074**	−0.242**	0.083	0.012	0.233	25
	(0.318)	(0.038)	(0.014)	(0.034)	(0.100)	(0.080)	(0.012)		
FI	2.756***	−0.180***	−0.023	−0.074***	0.224**	0.515***	0.001	0.753	25
	(0.220)	(0.040)	(0.030)	(0.025)	(0.089)	(0.050)	(0.008)		
FR	3.148***	−0.078***	−0.030	−0.050***	0.121*	0.398***	−0.002	0.735	25
	(0.180)	(0.029)	(0.027)	(0.017)	(0.065)	(0.042)	(0.007)		
GB	3.039***	−0.049	−0.050	0.051***	0.175*	0.370***	0.003	0.778	25
	(0.249)	(0.042)	(0.061)	(0.012)	(0.101)	(0.032)	(0.009)		
GR	9.165***	−0.024	−0.791***	−1.134***	0.297	−2.132***	0.110	0.549	25
	(1.980)	(0.226)	(0.206)	(0.219)	(0.437)	(0.551)	(0.073)		
IE	5.315***	0.202*	−0.062	−0.061	−0.071	−0.466**	0.047	0.276	25
	(0.819)	(0.115)	(0.143)	(0.064)	(0.138)	(0.205)	(0.030)		
IT	4.028***	0.033	0.064	−0.051**	−0.107	0.085	0.018*	0.202	25
	(0.300)	(0.052)	(0.043)	(0.025)	(0.102)	(0.075)	(0.011)		
NL	2.942***	−0.051	−0.036	−0.011	0.130*	0.473***	−0.003	0.683	25
	(0.239)	(0.034)	(0.028)	(0.029)	(0.072)	(0.054)	(0.009)		
PT	5.670***	0.178	0.090	−0.155	−0.588**	−0.495**	0.026	0.404	25
	(0.899)	(0.205)	(0.136)	(0.097)	(0.258)	(0.226)	(0.033)		
SE	2.799***	0.242*	0.060	−0.016	−0.423**	0.690***	−0.018**	0.816	20
	(0.224)	(0.135)	(0.073)	(0.026)	(0.213)	(0.065)	(0.008)		

Note: the asterisks *, ** and *** represent significance at 10, 5 and 1% level, respectively. The values present between parentheses are the standard error. *Obs* is the number of observations.

5. Conclusion

In our study we have assessed the relevance of macro and fiscal forecast vintages for the explanation of sovereign yield developments in a panel of 15 EU countries. Our analysis covers the period from 1999:1 till 2012:1.

We show that we can draw an important conclusion: corrections in the EC's forecasts do impinge on the 10-year sovereign bond yield spreads, particularly the corrections in fiscal variables (public debt and budget balance), but this impact is different across countries, being more pronounced in countries with less favourable economic conditions.

It seems that whether or not macro and fiscal forecasts are consistently seen as credible by the markets plays a relevant work. On the one hand, the credibility that investors give to EC's forecasts is relevant, and on the other hand the credibility that they give to the country and, consequently, to governments' forecasts is also paramount.

As we have seen, higher credibility means yields will react less to changes in forecasts. Hence, in spite of the incentive that governments have to report less accurate forecasts, as the penalization is higher in corrections for the current and next years than for previous years, if it lowers its credibility, it may be worse than revealing the right way the true results.

A relevant policy implication is that if more accurate values are only known afterwards, the market penalization for worst budget balances will be lower than if budget balances' data was corrected ex-ante. This implies the need for a better perception of the forecast errors by market participants, which could imply additional scepticism regarding the initial vintage forecasts, and already an increase in the yields at the time of probably too optimistic 1st year vintage forecasts.

We also saw evidences that the sovereign debt crisis altered the variables to which investors pay attention. After including 2011 and 2012 forecasts, the budget balance lost statistical significance, public debt became a more relevant determinant, and the real effective exchange rate started to be significant as well. Also, the constant term increased, indicating that investors demanded a higher risk premium, due to higher risk and uncertainty in the bond market.

However, it is important to notice that there are some limitations in our analysis. In fact, the number of observations is not very large, which may bias our results, especially when we perform the SUR analysis. In addition, the period under analysis is very typical, since half of the years considered encompass the subprime and subsequent sovereign crisis. As follow up work it would be useful to separate the data during the sovereign crisis, in order to understand its consequences on investors' reactions. However, that is not possible, due to the yet low number of forecasts made after the beginning of the crisis, but it stays as a possible future research development.

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