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Rules and risk in the Euro area ☆

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ABSTRACT

We show that stronger fiscal rules in Euro area members reduce sovereign risk premia, in particular in times of market stress. Using a unique data set of rules-based fiscal governance in EU member states, we estimate a model of sovereign spreads that are determined by the probability of default in interaction with the level of risk aversion. The legal base of the rules and their enforcement mechanisms are the most important dimensions of rules-based fiscal governance.

1. Introduction

Differences in government bond yields have sharply increased in the Euro area in the course of the sovereign debt crisis. Part of this increase can be attributed to developments in public debt (von Hagen et al., 2011) and contingent liabilities related to the banking sector (Gerlach et al., 2010; Ejsing and Lemke, 2011). Beyond these factors, the price of government bonds also reflects market confidence in governments' commitment towards sustainable fiscal policies. The trust of investors in such commitment may be enhanced by a strong fiscal framework (Fatás, 2010), which may help anchor fiscal policy expectations (Leeper, 2010). Indeed, strengthening national fiscal governance has been an important item both of national reforms in the Euro area[2] and the economic governance reform at the EU level (Council of the European Union, 2011).

We investigate whether national fiscal governance and numerical fiscal rules in particular help reduce the interest required on government bonds, specifically accounting for different levels of risk aversion over time. We argue that fiscal governance has an impact on the sovereign yield spreads by reducing the probability of default, and that this in turn has a twofold effect on the sovereign spreads. First, a lower probability of default will reduce the risk premium that compensates for the possibility of default no matter

☆ The views expressed in this paper are those of the authors and do not necessarily represent those of the European Commission.

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[2] Germany adopted a constitutional rule to limit government debt in 2009; Hungary and Spain have followed suit. After initially embracing this idea, the introduction of a constitutional debt brake has been postponed in France, but has now been implemented with the Fiscal Compact.

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what the extent of risk aversion is. Second, it will also reduce the variance of the payments from the risky bond. Markets will ask for a compensation for assuming the risk associated with this variance; this second component is amplified with risk aversion. Using a unique dataset on fiscal governance in EU member states, we test the effects of fiscal governance on sovereign spreads and provide empirical support to our predictions. We find strong and economically sizeable effects of the quality of national rules-based fiscal governance on sovereign spreads. We further show that the legal base of the rules appears to be the most important dimension of their effectiveness in containing sovereign risk premia, while the mechanisms to enforce compliance are highly important as well. The type of the bodies in charge of supervising compliance with the fiscal rules, in turn, appears to matter less.

Numerical fiscal rules are defined as permanent constraints on summary indicators of fiscal performance, such as the budget deficit, debt, or a major component thereof (Kopits and Symansky, 1998). They are aimed at reducing the policy failures due to which budget process outcomes tend to be biased towards deficits: namely, the common pool problem of governments without centralised spending powers, the short-term orientation of governments due to short electoral cycles, and the possible short-term orientation of voters. In the EU, fiscal rules further aim at mitigating the incentives for deficits resulting from a common currency.

Empirical research in the past two decades has shed light on the role of numerical fiscal rules for sound public finance. While earlier research concentrated on the experience of the US states, sometimes in view of deducting insights for the nascent EMU (von Hagen, 1991; Bayoumi and Eichengreen, 1995; Alesina and Bayoumi, 1996; Bohn and Inman, 1996), the focus of analysis then shifted to Europe. The effectiveness of national fiscal rules with respect to fiscal performance has been shown to depend on the mechanisms established to enforce compliance with the rule (Inman, 1998; Ayuso-i-Casals et al., 2009), as well as on the type of the rule, where budget balance and debt rules appear to outperform expenditure rules (Debrun et al., 2008). Fiscal rules have also been found supportive to the adherence to medium-term fiscal plans presented in the Stability and Convergence Programmes of EU members, which is a central plank of EU budgetary surveillance (von Hagen, 2010). The role of fiscal rules in the budgetary process has been scrutinised as well: empirical evidence is not fully conclusive whether fiscal rules serve as commitment devices to effectively tie the hands of governments, or whether they merely have a signalling role and remove information asymmetries between governments and the electorate, without changing the behaviour of policy-makers (Debrun and Kumar, 2007b,a; Debrun, 2006; Debrun et al., 2008). Budgetary rules enshrined in national constitutions specifically have been found to be correlated with lower government expenditure (Blume and Voigt, 2013). On the EU level, fiscal rules have been shown to be effective, but to lead to significant creative accounting aimed at their circumvention (von Hagen and Wolff, 2006; Buti et al., 2007). Theoretically, it has been elaborated that supra-national rules are welfare improving relative to merely national regimes, but that they cannot fully eliminate the deficit bias: therefore, strong national rules should complement a supra-national framework (Krogstrup and Wyplosz, 2010).

The past several years witnessed a surge of research on the impact of fiscal variables on spreads in government bond yields as well. In an international context, a positive relationship between public debt and interest rates has been consistently confirmed (Edwards, 1986; Alexander and Anker, 1997; Lemmen and Goodhart, 1999; Lonning, 2000; Copeland and Jones, 2001; Codogno et al., 2003). In the Euro area, sovereign spreads are found to be determined by debt, deficits, and debt-service ratios (Bernoth et al., 2012) as well as by hidden fiscal policy activity, creative accounting practices, and transparency of government budgeting (Bernoth and Wolff, 2008). On the sub-national level, the price of public debt is confirmed to reflect fiscal fundamentals (Schuknecht et al., 2009; Heppke-Falk and Wolff, 2008; Schulz and Wolff, 2009). The impact of risk perceptions has also received significant attention in recent research (Codogno et al., 2003; Favero et al., 1997; Barrios et al., 2009); variations over time of the importance of various determinants have been analysed most recently as well (Bernoth and Erdogan, 2012).

The impact of fiscal restraints on the cost of public borrowing has been studied by looking at US states. Bayoumi et al. (1995) show that the impact of constitutional controls on the cost of debt depends on the level of debt: at average levels, the presence of such controls is found to be associated with a reduction of the interest cost by 50 basis points. Eichengreen and Bayoumi (1994) confirm the negative impact of fiscal rules on the cost of government borrowing. Poterba and Rueben (1999) uncover that expenditure, deficit, and debt rules (negatively) as well as tax limitations (positively) impact on state bond yield differentials; debt rules appear to be the least effective. Differentiating this result, Johnson and Kriz (2005) show that revenue limits have a direct impact on state borrowing, while the effect of numerical fiscal rules is indirect via improved credit ratings. For the Euro area, Hallerberg and Wolff (2008) reveal that government bond yields are also determined by institutional characteristics of the fiscal process.

Our analysis adds to the body of research in several ways: it is the first to empirically investigate the role of numerical fiscal rules on sovereign bond spreads in the Euro area, and it uses a rich dataset maintained by the European Commission. It adopts an approach that allows for an amplifying effect of risk aversion on the impact of fiscal rules on sovereigns spreads. Finally, it focuses on five dimensions of rules-based fiscal governance.

The remainder of the paper is structured as follows. Section 2 outlines our analytical approach and the empirical strategy adopted. Section 3 describes our dataset and the construction of the fiscal rule index in particular. Section 4 presents the panel data estimations and a set of robustness checks. Section 5 concludes.

2. Analytical framework

We investigate the impact of rules-based fiscal governance on risk premia in Euro area government bond markets in a simple framework accounting for risk aversion.

We start from the standard case of risk neutrality. Specifically, we consider an investor who can buy a risk-free bond that pays interest r^*, or a risky bond of country i that delivers repayment with the same interest plus an interest spread s_i^0 to compensate for the possibility of default. The probability of default is $\theta_i \in [0;1]$, and we assume that there is no re-payment of principal if the sovereign defaults. $\tau_i = (\theta_i)/(1 - \theta_i)$ is the odds of default.

Under risk neutrality, the standard arbitrage condition equalises the expected returns of the two bonds

$$(1+r^*) = \left(1+r^*+s_i^0\right)(1-\theta_i), \tag{1}$$

so that

$$s_i^0 = (1+r^*)\tau_i. \tag{2}$$

Next, we consider risk-averse investors. Their utility functions are not only twice differentiable and strictly increasing as with risk neutrality, but also concave. If they hold a risky bond, they need to be compensated for the possibility of default, just like risk-neutral investors. Besides they require compensation for their readiness to bear risk as well. The compensation for the assumption of risk is naturally provided by the Arrow–Pratt risk premium π_i derived from the condition of indifference between purchasing bonds of country i and the certainty equivalent to such activity[3]:

$$\pi_i = 0.5\sigma_i^2\rho, \tag{3}$$

where ρ is the coefficient of absolute risk aversion, and σ_i^2 is the variance of outcomes from holding country i's sovereign bonds instead of investing into the risk-free asset, defined for the random variable I_i denoting the differential income from the risky investment as compared to the risk-free benchmark:

$$\sigma_i^2 \equiv E\left(I_i^2\right) - E^2(I_i) = \tau_i\left(-(1+r^*)\right)^2 + (1-\tau_i)\left(s_i^0\right)^2 = (1+r^*)^2\tau_i. \tag{4}$$

We assume that this latter part of the compensation additively comes on top of the compensation s_i^0 that investors would get under risk neutrality. Thus, if financial market participants are risk averse, the spread between the risk free and the risky asset will be[4]

$$s_i^+ = s_i^0 + \pi_i = (1+r^*)\tau_i\left[1+0.5\rho(1+r^*)\right]. \tag{5}$$

Eq. (5) shows how the excess yield that country i's sovereign bond offers over the risk-free return r^* depends on the odds of default, τ_i. In particular, τ_i has an immediate effect via the compensation for the possibility of default, s_i^0, but also an effect via the Arrow–Pratt risk premium, π_i. This latter effect is amplified by the level of risk aversion, ρ, as well as by the size of the risk-free return, r^*.

As concerns the first effect – the interplay between θ_i and ρ – $\partial^2 s_i^+/\partial\theta_i\partial\rho = 0.5(1-\theta_i)^2 > 0$: in times of elevated risk aversion in financial markets, the yield spread over the risk free bond will be higher especially in countries with higher default probabilities. For risk neutrality, Eq. (5) simplifies to allow the standard approximation equalising the yield spread with the country-specific probability of default: $s_i^+ = s_i^0 \approx \tau_i$.

To arrive at our estimating equation, we resort to the standard assumption (Edwards, 1986; Bayoumi et al., 1995) that θ_i is a logistic function of a measure Y_i that in turn linearly depends on a set of exogenous regressors X_i, parameters β, and a stochastic error term $\epsilon \sim$ i.i.d.:

$$\theta_i = P(I = (-(1+r^*))|Y_i) = e^{Y_i}/\left(1+e^{Y_i}\right) \tag{6}$$

with $Y_i = X_i'\beta + \varepsilon_i$.

Inserting Eq. (6) into Eq. (5), taking logs, and rearranging terms results in

$$ln\left(s_i^+\right) = r^* + X_i'\beta + ln(1+0.5\rho(1+r^*)) + \varepsilon_i'. \tag{7}$$

As concerns the determinants of the risk of country i's default, these will include the standard determinants of the sovereign debtor's solvency, specifically, the actual levels of debt B_i and the budget balance b_i, as well as institutional characteristics of the country $(C_i, Z_{i,t})$, where C_i summarises such characteristics that are constant over time, and $Z_{i,t}$ is a vector of time-varying characteristics. The solvency of the country will be determined by the future realisations of the budget balance above all; but any systematic bias (such as the deficit bias) of the future fiscal position will be already absorbed by C_i (specifically, $E_t(b_{t+1}|c_i) = \gamma c_i + \nu_{i,t}$ with $E(\nu_i) = 0$, where c_i is part of C_i and cannot be separately identified econometrically). Hence, the set of determinants of the default probability is

$$X_{i,t} = \left(B_{i,t}, b_{i,t}, C_i, Z_{i,t}\right). \tag{8}$$

[3] We disregard heterogeneity among investors. Therefore the dependence of our measure of risk aversion on the amount to invest does not impair the analysis.

[4] This approach implies that the compensation for assuming risk is certain i.e. if in case of default, only the principal in excess to the Arrow–Pratt risk premium is lost. The simplifying assumption of additionality between the compensation for risk and default respectively is applied to avoid complicated non-linearities. A qualitatively similar relationship between the spread, determinants of default and risk aversion would result from the mean–variance analysis approach to the choice of a risk-averse investor between a risky and a risk-free asset respectively.

In our approach, rules-based fiscal governance has an impact on sovereign spreads as part of the time-varying institutional characteristics $Z_{i,t}$, and specifically by its impact on the expected probability of default.

Numerical fiscal constraints are part of the institutional characteristics of a country; they can be expected to have an impact on the expected probability of default in two ways: first, their very role is to correct for persistent deficit bias, thereby improving the expected value of the fiscal balance. Second, they will also reduce the variance of future deficits. This, in turn, diminishes the probability of default, as sustainability-threatening deficits become less frequent. In our analytical approach, the determinants of the default probability have a non-linear impact on the sovereign bond spreads. According to the log-linear Eq. (7), the impact of fiscal rules on the probability of default is amplified by the level of risk aversion ρ. Differences in the quality of rules-based fiscal governance translate into relatively higher differences in sovereign spreads when risk aversion is high, while at low levels of risk aversion, better rules-based fiscal governance will result in smaller improvements in sovereign spreads.

In line with the approach sketched above, in our empirical analysis we regress the logarithm of the Euro area countries' sovereign bond spreads against Germany, *ln_spread*, on the levels of the German Bunds' interest (*yield_de*), the budget balance (*balance*), debt (*debt*), a measure of the quality of rules-based fiscal governance (*fri*), and the logarithm of the composite term $(1 + 0.5(1 + r^*))$ as implied in Eq. (7), where ρ is proxied either by the spread between US low grade corporate and government bonds (*ln_riskav*) or by the Chicago Board Options Exchange Market volatility index known as VIX (*ln_riskav_vix*). These measures are driven by global shocks and can be considered exogenous to Euro area bond spreads. We describe the fiscal rules index *fri* in detail in the next section. Our baseline estimating equation is

$$ln\left(spread_{i,t}\right) = \beta_1 yield\_de_t + \beta_2 balance_{i,t} + \beta_3 debt_{i,t} + \beta_4 fri_{i,t} + \beta_5 ln\left(1 + 0.5\rho_t\left(1 + yield\_de_t\right)\right) + C_i + u_{i,t}. \quad (9)$$

Note that our approach implies that $\beta_1 = \beta_5 = 1$ (see Eq. (7)).

In principle, concerns might arise that the adoption or improvement of fiscal rules is influenced by developments of sovereign spreads. The endogeneity of fiscal rules with respect to fiscal policy outcomes was explored in past empirical research (e.g., Debrun and Kumar, 2007a,b), with inconclusive results though. Immediate simultaneity between fiscal rules and sovereign spreads can be ruled out because of the usual adoption lags of political reform, but the possibility of predetermined fiscal rules has to be taken into account in empirical research. Indeed in the most recent period, national fiscal framework reforms have been driven by consolidation pressures and high sovereign bond spreads. Changes in fiscal governance prior to the sovereign debt crisis were unconnected with bond markets though, as government bond spreads in the Euro area had been too low to fuel institutional debates. Fiscal framework reforms were enacted because of domestic and EU level pressure instead, and endogeneity should thus not be a matter of concern. Still, to be sure that our findings are not impaired by endogeneity, we investigate the robustness of our results by excluding the 2009 and 2008 data where the strength of numerical fiscal rules might have been determined by the fanning out of the government bonds yields in the previous year. We also present estimation results using a sample that includes the year 2010, and results from estimations where the fiscal rule index is technically considered predetermined.

It has been hypothesised that fiscal rules might only be a signal of pre-existing commitment instead of providing genuine constraints to fiscal behaviour. Indeed, our fiscal rule index might not measure the effect of rules-based fiscal governance on probabilities of sovereign default by directly constraining fiscal activity, but rather reflect the effects of an omitted variable measuring pre-existing commitment to sound fiscal policy. As we control for country fixed effects, any omitted variable bias can only stem from time-varying commitment to fiscal rectitude that is correlated with changes in rules-based fiscal governance. In the presence of such omitted variable bias, changes in fiscal rules would reflect changes in underlying preferences. Empirically, we cannot exclude this possibility but it appears to be of comparatively minor relevance as preferences typically shift only slowly.

Our baseline regressions are augmented by further analysis. We do not only consider the global impact of rules-based fiscal governance on sovereign risk premia but study the impact of its different dimensions, such as the legal basis, enforcement etc. as well. Besides we provide robustness analyses with regard to the time period covered, the crisis, and the role of liabilities stemming from bank rescue operations.

3. The dataset

Our empirical analysis is based on a dataset covering 11 Euro area countries in the time period of 1999 to 2009. In our baseline estimations, we disregard the most recent years as since 2010 reform debates and initiatives concerning rules-based fiscal governance have intensified across the Euro area; what is more, as of 2011, three countries from our sample received international assistance to refinance their sovereign debt. By leaving data of 2010 and 2011 aside, we reduce concerns about the endogeneity of fiscal rules. Luxembourg – with very little public debt until recently – as well as the latest Euro area entrants Cyprus, Estonia, Malta, Slovenia, and the Slovak Republic are not included either. The sovereign bond spreads are expressed in differences to German data, which leaves us with a panel dataset of 10 countries. Germany is chosen as the benchmark country as the Bund is considered the benchmark bond in the respective bond market (see e.g. Dunne et al., 2007).

Our dependent variable *ln_spread* is the log of government bond spread against the German Bund based on the yield of their 10-year on-the-run fixed coupon bonds obtained from Bloomberg. As indicators of the debtors' repayment capacity–*balance* and *debt*–data on government deficits and debt from Eurostat are employed. The data are measured in per cent of GDP. Annual averages of the seven-to-ten year US corporate bond spread for the rating category BBB from Merrill Lynch against US treasuries is employed as a proxy for the average coefficient of absolute risk aversion among investors.

The index of the strength of national numerical fiscal rules *fri* has been constructed by the fiscal governance unit of the European Commission's Directorate-General for Economic and Financial Affairs from information on fiscal governance obtained from the EU member states via the Economic Policy Committee of the Ecofin Council of the EU.[5] The fiscal rule index is based on information on five dimensions describing each fiscal rule in force at the local, sub-national or national level in an EU member state: (1) the statutory base of the rule, (2) room for revising objectives, (3) mechanisms of monitoring compliance with and enforcement of the rule, (4) the existence of pre-defined enforcement mechanisms, and (5) media visibility of the rule. Scores are attributed to each of the dimensions for each fiscal rule as shown in Appendix A. To construct the fiscal rule index, these scores are aggregated using weights obtained as averages of 10,000 randomly drawn numbers from a uniform distribution, following the method used by Sutherland et al. (2005). The random weights technique is applied because of the absence of theoretical guidance on the importance of each criterion in the composite index of the strength of fiscal rules. Finally, the indices of the strength of a fiscal rule obtained for each single rule are aggregated to a single comprehensive score per country per year by adding up the indices calculated for each fiscal rule separately, adjusted by the coverage of general government finances by that rule. In the presence of more than one rule covering the same government sub-sector, the second and third rules obtain weights 1/2 and 1/3 to reflect decreasing marginal benefit of multiple rules applying to the same sub-sector of general government. The design of the index is inspired by Deroose et al. (2006). The index is re-scaled to assume values between 0 (minimum) and 10 (maximum). An improvement of the index is achieved by strengthening one or several existing numerical fiscal rules along either of the above dimensions, by introducing new numerical fiscal rules, or by extending the coverage of general government by existing or new rules. Note that the fiscal rule index only considers if there is a numerical constraint to a budgetary aggregate: it does not take into account however if this constraint is realistically binding in reality (e.g., debt rules allowing for a comparatively high debt level are not binding in low-debt countries).

We also analyse the impact of numerical fiscal rules on sovereign bond spreads considering the five components separately. Table A in Appendix B shows the unconditional correlation between the components of the global fiscal rule index: correlations between pairs of components are typically high. Country sets of rules that are strong by one dimension tend to be strong along other dimensions as well. The correlation between components 1 and 3 of the overall index (referring to the legal base and the body in charge of monitoring and enforcing compliance with the rule respectively) appear to be particular strong. Components 4 and 5 of the overall index (referring to its enforcement mechanisms and media visibility) appear to be less connected to the overall index than components 1 and 2.

Fig. 1 shows the development of rules based fiscal governance in the eleven Euro area members of our sample, as measured by the fiscal rules index, 1999 to 2009. The strength of the fiscal rules in force in our country of reference, Germany, has been above average and constant at around 7 throughout the period considered.[6]

The strength of the numerical fiscal rules in force in the other Euro area countries ranged between zero (for Greece, that has had no such rule in force) and 9.5 (the Netherlands,[7] unchanged, and Spain as from 2006) and 9.7 (Spain[8] 2003–2005) respectively. Countries with below-average fiscal rule index scores were Ireland, Portugal, and Italy, while the scores of France, Austria, Belgium, and Finland qualified these countries as having stronger fiscal rules than on average. Remarkable changes to the better occurred in the case of France 2006 and 2008 to 2009,[9] as well as Ireland 2004, while the strength of the fiscal rules deteriorated in Finland after 2007 and in Austria in 2009,[10] in particular due to the suspension of rules in force in the course of the economic and financial crisis.

As any index, the index of rules-based fiscal governance applied in our analysis constitutes a simplification of complex reality. Despite measurement errors of which an index of this type will inevitably suffer, we argue that it is a useful approximation of reality. Measurement errors affecting the index should be randomly distributed and therefore not affect the basic estimation results. If anything, attenuation due to measurement errors biases coefficients towards zero. Therefore, any significant result can be confidently regarded to corroborate our hypothesis and provide a lower bound of the true effect.

Turning now to the development of the government bond spreads as compared to German Bund yields in the period under review, these spreads were below 30 basis points for most Euro area members, with a slight increase until 2001 and decreasing in the period between 2001 and 2006. Sovereign bond spreads mounted and fanned out in the wake of the economic and financial crisis, with particularly high values of 190 basis points reached on average by Greece and Ireland and values between 40 and 100 basis points for the other Euro area members during 2009 (see Fig. 2). The ranking of the Euro area members by the size of the

[5] This dataset is updated annually; it is accessible to the public at http://ec.europa.eu/economy_finance/db_indicators/fiscal_governance/index_en.htm.

[6] In the period covered by our sample, Germany has operated "golden" budget balance rules and rules limiting nominal expenditure growth for both the federal government; local governments' budgets have been constrained by debt ceilings and a balance budget rule. In the period considered, the target of the nominal expenditure rule was reformulated, that had no impact on the score of the fiscal rule index, though. Note that the much-debated "debt brake" for the federal government and the Länder has been phased in only from 2011, so the score of the index is unaffected by it in our sample.

[7] The Netherlands have been operating a real expenditure ceiling and a rule to allocate windfall revenues applying to all general government.

[8] Until 2002, Spain has operated debt ceilings to local and regional governments. In 2002, a budget-balance rule covering all general government was introduced, which was slightly modified in 2006. In 2003, the rules-based framework was extended by further restrictions on debt applied to regional governments.

[9] In 2006, France introduced a rule to the central government to pre-commit unexpected revenues, and a ceiling to the growth of health expenditure to be established by the parliament. In 2008 the increase of social security debt was made conditional upon an increase in revenues. Finally, since 2009, unexpected revenues were automatically assigned to deficit reduction.

[10] In Finland, a debt rule and budget balance rule applied to the central government were no longer in force after 2007 and 2008, respectively. In Austria, the budget balance rule laid down in the National Stability Pact was replaced in 2009 by a nominal expenditure ceiling for five headings of the general government budget. The main difference between the two approaches is that the more recent nominal expenditure ceiling only covers a fraction of parts of the budget previously covered by the National Stability Pact.

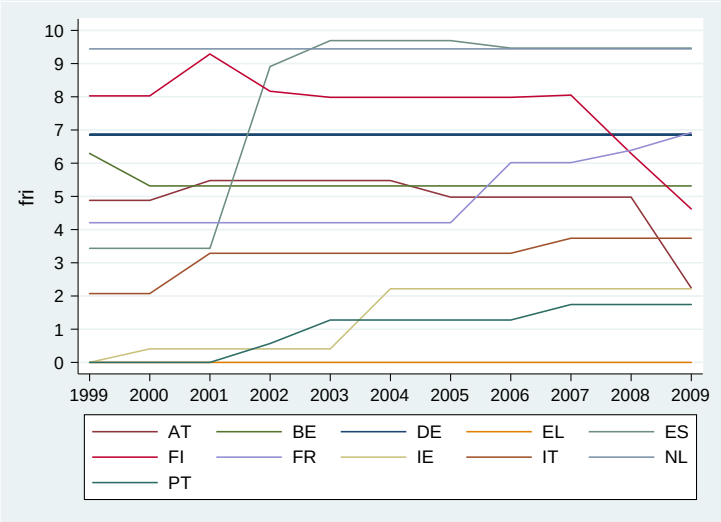

Fig. 1. The fiscal rule index in 11 Euro area members, 1999 to 2009.

spread of their bond yields against Germany was broadly constant in the period considered, with France, the Netherlands, and Finland being closer to the benchmark and Greece, Italy, Portugal and Spain being at the higher end of the distribution.

In Fig. 3 we look at the development of international risk aversion as measured by the spread between low-grade US corporate and government bonds. As can be seen by comparison with Fig. 2, Euro area government bond spreads have moved in parallel with international risk aversion. In fact, international risk aversion was particularly low in the mid-2000s, when Euro area sovereign bond spreads were historically low as well. With the rise of international risk aversion during the economic and financial crisis, sovereign bond spreads increased markedly, too.

Table B in Appendix B provides the simple correlations of the main variables applied in our analysis. The unconditional correlation between the quality of fiscal rules and the sovereign bond spreads in our sample is negative.

4. Estimation results

We carry out the empirical estimation of the model outlined in Section 2 in a dynamic framework using the Arellano–Bond GMM estimator. As we find significant error autocorrelation when using a static approach, we prefer to show this dynamic estimator. A dynamic model with two lags is found most appropriate according to the standard tests. The lags of the dependent variable are indicated *L.ln_spread* and *L2.ln_spread* in the tables reporting the results. The chosen GMM estimator accounts for the potential endogeneity in the level of general government debt, the budget balance, and the level of risk aversion, i.e. the estimation of the model in differences does not use their contemporary levels and first lags among the instruments. In the regressions, the unit of the variables measured in per cent is a percentage point.

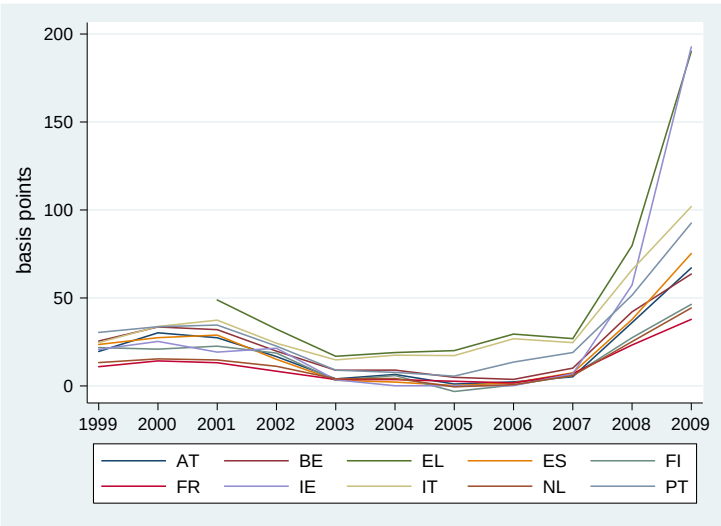

Fig. 2. Sovereign spreads against Bunds in 10 Euro area members, 1999 to 2009.

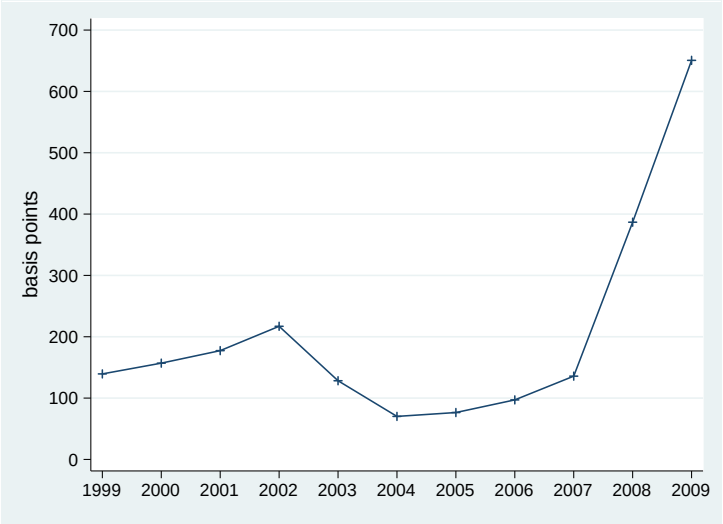

Fig. 3. Merrill Lynch US corporate BBB spread, 1999 to 2009.

Table 1 presents the main results of the estimation of our model. Regression A presents the estimation of our model according to Eq. (10) above (see Section 2). The negative effect of the strength of rules-based fiscal governance on sovereign spreads is clearly confirmed. An increase in the index is thus associated with a reduction of the sovereign spread relative to Germany.

A unit improvement of the rules-based framework lowers the risk premium by around 23%. Due to the log-linearity of our model, the effect on absolute spreads of a change in one determinant depends on the level of the other variables. When the level of risk aversion is high, improving national rules-based fiscal governance will have a much stronger effect on sovereign spreads than in times of lower risk aversion. Likewise, a unit increase in the quality of fiscal governance induces a larger decrease of the sovereign spread in a country with higher deficits and public debt. Fig. 4 illustrates this dependency: the higher the level of risk aversion, the steeper the slope of the curve relating the sovereign spread to the quality of rules-based fiscal governance (left panel). At the same time, initial spreads are higher and their decline is consequently higher if deficit and debt are high (right panel). In sum, the benefit from improving rules-based fiscal governance will be highest for countries with weaker budgetary positions and in times of higher risk aversion.

The effects of the other variables are as expected as well. Sovereign spreads of the Euro area countries in the 2000–2009 decade are above all determined by the risk-free interest rate and the level of global risk aversion. Increasing the benchmark interest rate by one unit equalling 100 basis points has an effect of increasing the spread by at least 1%. The full effect is higher (as the benchmark yield is part of the composite term *ln_riskav*), but its magnitude depends on the prevailing level of risk aversion. A reduction in the general government budget deficit by one unit of a percentage point results in a decrease of the spread by around 20%, while each unit of additional general government debt increases the spread by around two per cent. Our estimation results confirm the restrictions implied in our approach: specifically, the coefficient of unity to *ln_riskav* and *yield_de* cannot be rejected.[11] The model thus appears to be in line with the data generating process.

In regressions B to D reported in Table 1 we add further control variables to our basic specification. Regression B adds the bank assets to GDP ratio, *banksector*, as a further control variable, specifically to account for possible contingent liabilities incurred by the public purse. The regression reveals that countries with larger banking sectors typically see larger spreads, confirming the findings of Gerlach et al. (2010). In regression C we include the net borrowing of the entire economy, *borrowing*, as well as the total net financial liability position of the economy, *finliabilities*, both in per cent of GDP respectively. We find that larger liability positions are associated with higher spreads but net borrowing is not found to be significant. This result holds up in regression D, in which all variables are included simultaneously.

In regressions E to G reported in Table 1, we investigate the robustness of our findings to the time period. Specifically, we shorten the sample by one and two years respectively (regressions E and F) to exclude the crisis years. Thereby we can avoid our results being purely driven by the last couple of crisis years. The shortened sample is also a way of addressing potential endogeneity concerns, given our argument that prior to the crisis, fiscal governance was not shaped by concerns about sovereign spreads. To be sure, on the other hand, we also add results from a sample that includes the year 2010 (regression G), irrespective of these concerns. The regressions presented document the substantial robustness of our results. The coefficient on our fiscal rule index is highly significant in the pre-crisis years as well, and its magnitude is very similar to that found with the full sample. What is more, our results remain stable even when data from 2010 are included. We are thus confident that our results are neither altered by recent crisis specific effects nor are they impaired by the endogeneity of rules-based fiscal governance quality with respect to sovereign spreads.

[11] Arguably, our risk aversion measure could be picking up other common factors such as the international business cycle and thereby attenuate the coefficient of *ln_riskav* downward. A small downward bias in that coefficient would still well support the restriction derived from our approach.

Table 1
Main estimation results.

	A	B	C	D	E	F	G	H	I	J	K	L
debt	0.02*	0.03***	0.02	0.03*	0.03	0.02	0.07***	0.02	0.03**	0.03*	0.02**	0.03
(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	
balance	−0.18***	−0.14***	−0.18***	−0.15***	−0.17**	−0.11	−0.09	−0.16***	−0.19***	−0.12***	−0.10*	−0.12*
	(0.05)	(0.05)	(0.04)	(0.05)	(0.07)	(0.10)	(0.06)	(0.05)	(0.05)	(0.02)	(0.04)	(0.06)
ln_riskav	0.90***	0.80***	0.96***	0.88***	0.96***	0.16	0.87***	1.03***		1.22***	1.18***	0.79***
	(0.13)	(0.15)	(0.13)	(0.13)	(0.11)	(0.34)	(0.10)	(0.11)		(0.14)	(0.11)	(0.15)
yield_de	1.01***	1.08***	1.01***	1.04***	0.98***	1.41***	0.61**	0.91***	0.94***	0.84***	0.71**	1.33*
	(0.26)	(0.26)	(0.26)	(0.25)	(0.28)	(0.32)	(0.30)	(0.27)	(0.26)	(0.21)	(0.26)	(0.58)
fri	−0.23**	−0.13***	−0.31**	−0.20***	−0.26*	−0.30*	−0.19**	−0.34*	−0.22**	−0.12**	−0.10***	−0.22**
	(0.10)	(0.03)	(0.13)	(0.05)	(0.15)	(0.17)	(0.10)	(0.18)	(0.09)	(0.05)	(0.03)	(0.09)
banksector		0.00**		0.00							0.00	0.00
		(0.00)		(0.00)							(0.00)	(0.00)
borrowing			0.06	0.04								
			(0.07)	(0.06)								
finliabilities			0.01**	0.01*								
			(0.00)	(0.00)								
ln_riskav_vix									1.57***			
									(0.40)			
baspread												0.03**
												−0.01
L.ln_spread	0.20	0.20	0.13	0.12	0.17	0.28	0.36**	0.11	0.22			
	(0.16)	(0.13)	(0.14)	(0.13)	(0.18)	(0.24)	(0.15)	(0.09)	(0.22)			
L2.ln_spread	−0.39***	−0.33***	−0.37***	−0.31***	−0.42***	−0.42***	−0.34***	−0.34***	−0.53***			
	(0.08)	(0.06)	(0.08)	(0.07)	(0.10)	(0.15)	(0.04)	(0.07)	(0.09)			
N	66	62	66	62	56	49	76	66	66	105	95	61
FE										yes	yes	yes
Years	1999–2009	1999–2009	1999–2009	1999–2009	1999–2008	1999–2007	1999–2010	1999–2009	1999–2009	1999–2009	1999–2009	2003–2009

Standard errors in parentheses. *fri* is considered predetermined in regression H.
* Denotes significance at 10%.
** Denotes significance at 5%.
*** Denote significance at 1%.

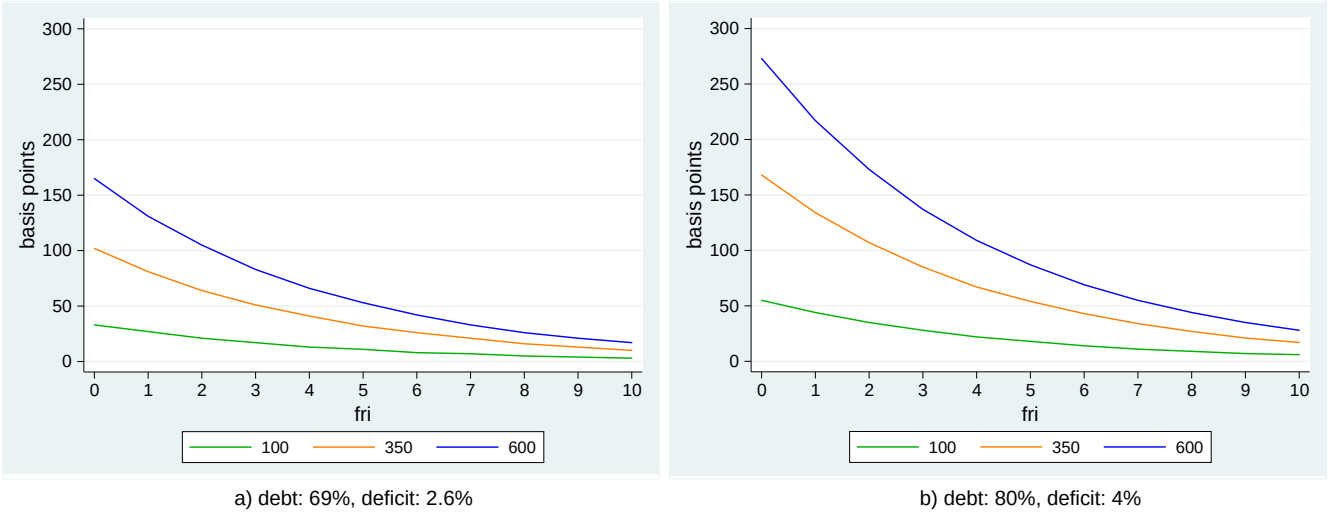

Fig. 4. Sovereign spreads at different values of the fiscal rule index and risk aversion, (a) sample average and (b) high-deficit, high-debt example.

Regression H adds further to the investigation of endogeneity: here we consider *fri* to be predetermined.[12] These results confirm our earlier findings; we obtain a stronger effect of the fiscal rule index.

Regression I investigates the robustness of our results against the indicator of risk aversion. Specifically, results are shown for the same specification as model A, but the composite term controlling for risk aversion is built using the Chicago Board Options Exchange Market volatility index VIX instead of the US corporate bond spread (*ln_riskav_vix*). The results found in specification A remain remarkably stable using this indicator as well.

The final columns of Table 1 present regressions where we depart from the dynamic model, in order to document the robustness of our results to different estimation approaches (regressions J to L). Our central results are again confirmed; all variables keep their sign and their significance. The static approach is also better suited to testing the robustness of our results to potential liquidity effects that might affect sovereign spreads. To proxy liquidity in sovereign bond markets, we only have data as of 2003 at our disposal: this restricted dataset is unsuited to the estimation of a dynamic model with several lags of the dependent variable. Regression L shows that higher bid-ask spreads included via the variable *baspread*, that are a sign of low liquidity, are associated with higher sovereign spreads.

The Euro area countries where the strength of rules-based fiscal governance was below the average of 5 in 2009 were Finland, Greece, Ireland, Italy, and Portugal; of these, the last four are facing particularly high consolidation pressures. According to the predictions of our model, these countries would have profited most from improving their rules-based fiscal governance. The results from regression A presented in Table 1 for the year 2009 imply the following: in the case of Greece – with a budget deficit of 13.5% and a public debt burden of 115% of GDP in that year – the establishment of a rules-based fiscal governance framework of average quality would have implied a reduction of the sovereign spread by around 130 basis points. Ireland also had a budget deficit of 14% in 2009 but public debt only amounted to 63% of GDP, while its rules based fiscal governance framework was rather weak, with a fiscal rule index value of around 2. According to our predictions, the strengthening of their fiscal governance framework to the average level would have allowed a decline in the risk premium for Irish sovereign bonds by almost 100 basis points. Italy in turn had a rules-based fiscal governance framework in place that was assigned a fiscal rule index value of 3.7, relatively close to the average of 5, but it had a deficit of 5.3% and a public debt level of 115% of GDP in 2009. The improvement of its rules-based fiscal governance framework to the average level would still have yielded a reduction of its sovereign risk premium by about 30 basis points. Finally, the gain from such institutional improvement for Portugal – with a deficit of 9.4% and public debt of 77% in 2009 – would have been 50 basis points. In Fig. 5 we show predictions of sovereign bond yields in these countries in the hypothetical case that their rules-based fiscal governance frameworks had average quality, as well as the difference to the spreads actually observed, in 2009 to 2009.

Our dataset permits us to study the impact of specific characteristics of rules-based fiscal governance on sovereign spreads as well. As described in Section 3, the fiscal rules index is a composite of 5 different dimensions of rules capturing (1) their legal base, (2) the room for setting or revising objectives, (3) the nature of the body that is monitoring compliance with the rule, (4) the enforcement mechanisms and (5) the media visibility of the rule. We study the relevance of these dimensions by performing separate regressions for each of the different sub-indices of the rule in turn, also presenting a regression with all sub-indices included simultaneously.

Table 2 shows these estimation results. Only for three sub-indices do we find a significant effect. The largest effect is found for the legal base of the national fiscal rule. A rule that is enshrined in the constitution will be perceived by markets to be highly effective; strengthening the legal dimension will thus have a strong and highly significant effect on sovereign bond spreads. We

[12] I.e., when estimating the model in differences, contemporary values of *fri* in levels are discarded from the instruments.

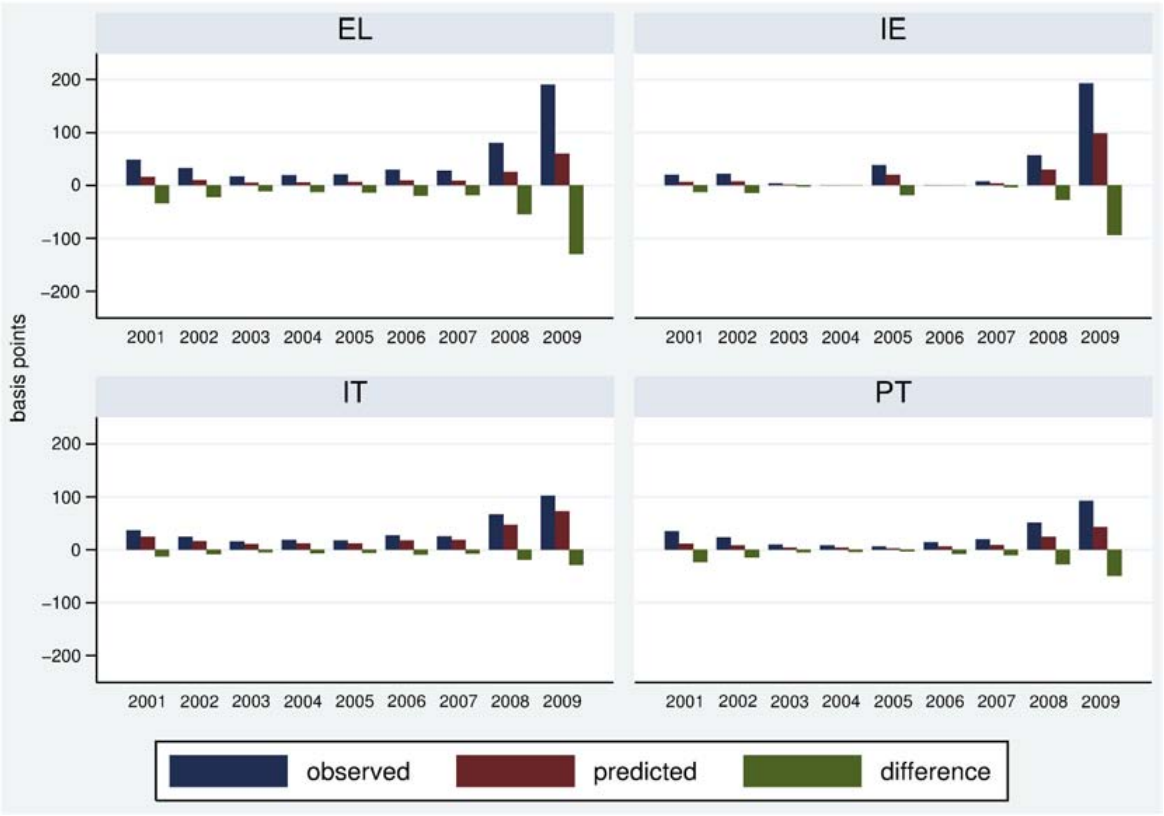

Fig. 5. Predicted impact of improved fiscal governance on sovereign risk premia in some Euro area members.

also find a highly significant and strong effect of the legal enforcement possibilities attached to the rules. Finally, we also find a significant and strong effect of the media visibility of the rule. In contrast, the nature of the body in charge of monitoring compliance with the rules as well as the room for setting or revising objectives are not found to be significant determinants of the

Table 2
Estimation results: fiscal rule sub-indices.

	A	B	C	D	E	F
debt	0.02**	0.02*	0.02*	0.02*	0.02*	0.01
	−(0.01)	−(0.01)	−(0.01)	−(0.01)	−(0.01)	−(0.01)
balance	−0.18***	−0.18***	−0.19***	−0.16***	−0.19***	−0.17***
	−(0.05)	−(0.05)	−(0.05)	−(0.05)	−(0.04)	−(0.05)
ln_riskav	0.91***	0.86***	0.90***	0.85***	0.88***	0.82***
	−(0.14)	−(0.14)	−(0.14)	−(0.12)	−(0.15)	−(0.16)
yield_de	1.02***	1.04***	1.05***	0.99***	1.01***	0.94***
	−(0.25)	−(0.27)	−(0.26)	−(0.27)	−(0.22)	−(0.21)
fri_1	−0.23**					−0.11
	−(0.09)					−(0.43)
fri_2		−0.13				0.06
		−(0.12)				−(0.19)
fri_3			−0.12			0.20
			−(0.10)			−(0.38)
fri_4				−0.18***		−0.14
				−(0.05)		−(0.18)
fri_5					−0.20**	−0.24*
					−(0.09)	−(0.13)
L.ln_spread	0.19	0.26	0.22	0.22	0.24	0.26
	−(0.16)	−(0.18)	−(0.16)	−(0.17)	−(0.18)	−(0.18)
L2.ln_spread	−0.40***	−0.38***	−0.43***	−0.32***	−0.42***	−0.32***
	−(0.08)	−(0.07)	−(0.08)	−(0.08)	−(0.10)	−(0.12)
N = 66						
Years: 1999–2009						

Standard errors in parentheses.
* Denotes significance at 10%.
** Denotes significance at 5%.
*** Denote significance at 1%.

sovereign bond spread. Moreover, we perform a regression in which we include all five sub-indices simultaneously. This regression suffers from the problem of a very high correlation of the sub-indices. In this regression, only the media visibility of the rules remains a significant determinant of sovereign spreads.

Most available empirical analyses of sovereigns spreads have estimated a simple linear relationship between the spreads and their determinants. For comparability, we also present estimation results following this approach. This also serves as a confirmation of our results presented above. We specifically estimate the following equation and its variants with further control variables:

$$\begin{aligned} spread'_{i,t} = {} & \beta_1 risk_t + \beta_2 balance'_{i,t} + \beta_3 risk_t balance'_{i,t} + \beta_4 debt'_{i,t} \\ & + \beta_5 risk_t debt'_{i,t} + \beta_6 fri'_{i,t} + \beta_7 risk_t fri'_{i,t} + C'_i + u'_{i,t}, \end{aligned} \tag{10}$$

where *debt′*, *balance′* and *fri′* are considered to determine the probability of default in deviation to the benchmark country, Germany, and *risk* – the US corporate bond spread – measures investors' risk aversion. The spread is considered to be determined by the risk of default as well as interaction terms between risk aversion and the other variables, to allow for the possibility that spreads react differently to fundamentals depending on the state of risk aversion. The estimating equation contains country fixed effects C' that capture the effect of time-invariant institutional factors, while $u'_{i,t}$ is an error term with standard properties. Variables employed in additional specifications are bid-ask spreads of the respective government bonds to control for the risk that assets cannot be sold quickly, *baspread′*, the size of the banking sector in the economy, *banksector′*, relative to GDP to account for contingent liabilities, and the three-year projection of deficits obtained from the Stability and Convergence Programmes of the EU members, *E*(*F*3.*balance*)′ to consider the role that fiscal policy expectations might play separately from the room for manoeuvre allowed for by the rules-based governance framework.

Table 3 shows the results of our reduced form regression analysis of the determinants of government bond spreads in the Euro area. The results confirm the important role of fiscal rules for sovereign risk premia in the Euro area. Fiscal rules do not have a significant explanatory role regarding sovereign bond yields as such (regression A). However, they are highly relevant when investors become risk averse (regressions B to E). When global risk aversion increases, countries with better fiscal rules witness lower increases of sovereign bond yields relative to Germany. Also quantitatively, the results show a similar order of magnitude as in the model-based estimations shown above, as illustrated by Fig. 6 depicting the reduction in sovereign spreads upon a unit improvement of rules-based fiscal governance at different levels of international risk aversion. We also find that a higher ratio of general government debt to GDP significantly increases sovereign bond yields, as do higher general government budget deficits.

In line with previous research, we find that international risk aversion is an important driver of sovereign bond spreads in the Euro area itself. When controlling for differences in liquidity across bond markets by including bid-ask spreads (available as of 2003) among the regressors, we continue to find that fiscal rules play a significant role (regressions F and G). Regression H addresses the fact that in many countries the quality of fiscal rules does not change often: the fiscal rule index might pick up other non-observable time-constant factors in these cases. Therefore, in this regression we control for unobservable time-invariant factors that are evaluated differently at different levels of risk aversion with country fixed effects in interaction with risk along with the country effects in levels. Our findings on fiscal rules are preserved in this highly flexible specification.

Regressions I and J omit the year 2009, thereby rendering the regression robust to special effects related to the economic and financial crisis. As argued above, here we can safely consider the quality of rules-based fiscal governance exogenous with respect to government bond yields and their spreads. Qualitatively, the difference to the main specifications presented above is that deficits and debt do not have different impacts on sovereign spreads at different levels of risk aversion. Regression K addresses the role of the banking sector and its potential liabilities to public budgets in the economic and financial crisis by controlling for the size of the aggregate bank assets as a proportion of GDP (relative to Germany). This variable is insignificant; our central results regarding the importance of national fiscal rules for containing sovereign bond yields are again confirmed.

Finally, to rule out the possibility that our fiscal rule index is just a proxy of expectations on the fiscal policy stance but does not shape these, we control for the three year projection of deficits obtained from the Stability and Convergence Programmes of the EU members (regression L). Deficit forecasts are found to be a significant and quantitatively important determinant of government bond spreads, while our main results remain in place. This implies that rules-based fiscal governance has an important role for the formation of fiscal policy expectations by financial markets beyond short-term expectations embodied in forecasts.

5. Conclusion

The present paper shows the importance of rules-based national fiscal governance for the assessment of sovereign risk by financial markets in the Euro area. Stronger fiscal rules turn out to be of great importance to contain sovereign bond spreads in times of elevated market uncertainty in particular. The strength of the legal base of the fiscal rules in force as well as the enforcement mechanisms are found to be especially relevant. Our results are robust to the length of the time period and the measurement of international risk aversion.

Overall, our results lend strong empirical support for the strengthening of national rules-based fiscal governance as part of the European economic governance reform process. Ultimately it is clear, however, that numerical fiscal rules can operate as constraints to fiscal policy only to the extent that there is commitment to comply with them. Thus, our research confirms that the

Table 3
Results from reduced-form estimation.

	A	B	C	D	E	F	G	H	I	J	K	L
risk	0.18***	0.14***	0.08***	0.08***	0.08***	0.07***	0.05**	−0.44***	0.08***	0.09***	0.08***	0.10***
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.12)	(0.01)	(0.01)	(0.02)	(0.01)
debt′	0.93***	0.81***	0.75***	0.56***	0.57***	1.40***	0.97**	−1.24***	0.50***	0.45***	0.73***	0.46***
	(0.24)	(0.22)	(0.18)	(0.20)	(0.18)	(0.44)	(0.39)	(0.41)	(0.09)	(0.10)	(0.19)	(0.11)
risk ∗ debt′				0.001**	0.001		0.002**	0.012***		0.00		0.00
				(0.001)	(0.001)		(0.001)	(0.002)		(0.00)		(0.00)
balance′			−4.04***	−4.39***	0.69	−3.64***	−1.35	0.82	−1.54***	−1.21*	−4.20***	
			(0.61)	(0.62)	(1.22)	(1.02)	(1.62)	(1.13)	(0.31)	(0.66)	(0.74)	
risk ∗ balance′					−0.02***		−0.01**	−0.02***		0.00		
					(0.00)		(0.01)	(0.00)		(0.00)		
fri′	0.75	4.37***	3.90***	2.66*	−0.88	−0.48	−9.32***	1.91	0.41	−0.15	4.07***	0.04
	(1.57)	(1.59)	(1.32)	(1.41)	(1.48)	(2.93)	(3.19)	(2.47)	(0.66)	(0.79)	(1.40)	(0.78)
risk ∗ fri′		−0.02***	−0.02***	−0.02***	−0.01**	−0.02***	−0.01	−0.02*	−0.01***	−0.01**	−0.02***	−0.01***
		(0.00)	(0.00)	(0.00)	(0.00)	0.00	0.01	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
baspread′						−357.18**	−193.61					
						(148.26)	(134.16)					
risk ∗ baspread′						0.88**	0.54					
						(0.37)	(0.34)					
banksector′											−0.01	
											(0.03)	
E(F3.balance)′												−0.99*
												(0.59)
N	107	107	107	107	107	69	69	107	97	97	107	97
Years	1999–2009	1999–2009	1999–2009	1999–2009	1999–2009	2003–2009	2003–2009	1999–2009	1999–2008	1999–2008	1999–2009	1999–2008
R^2	0.66	0.73	0.82	0.82	0.86	0.87	0.91	0.93	0.85	0.85	0.82	0.81

Standard errors in parentheses.
* Denotes significance at 10%.
** Denotes significance at 5%.
*** Denote significance at 1%.

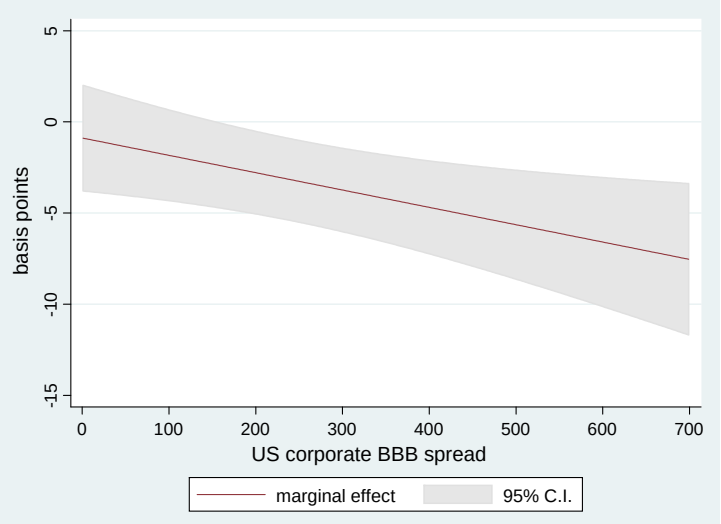

Fig. 6. Marginal effect on fiscal rules on sovereign spreads.

existing rules have been regarded as effective safeguards of stability oriented fiscal policy. Fiscal rules introduced most recently, in some instances under external pressure, will certainly be the more effective the stronger the political determination and broader support of society are for the pursuit of fiscal discipline.

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Appendix A. Scores assigned to characteristics of fiscal rules

Dimension 1 (fri_1) Legal base of the rule
4 the rule is established by the constitution
3 the rule is based on a legal act (e.g. public finance act, fiscal responsibility law)
2 the rule is based on a coalition agreement or an agreement reached by different general government tiers, but not enshrined in a legal act
1 political commitment by a given authority (central/local government, minister of finance).

Dimension 2 (fri_2) Room for setting or revising objectives
3 there is no margin for adjusting objectives: they are encapsulated in the document underpinning the rule
2 there is some but constrained margin in setting or adjusting objectives
1 there is complete freedom in setting objectives: the statutory base of the rule merely contains broad principles or the obligation for the government or the relevant authority to set targets.

Dimension 3 (fri_3) Nature of the body in charge of monitoring respect and enforcement of the rule
The score of this criterion is constructed as a simple average of the two elements below:
Nature of the body in charge of monitoring respect of the rule
3 monitoring by an independent authority (fiscal council, court of auditors, or any other court) or the parliament.
2 monitoring by the ministry of finance or any other government body
1 no regular public monitoring of the rule (no report systematically assessing compliance)
The score of this sub-criterion is augmented by 1 if there is real time monitoring of compliance with the rule, i.e. if alert mechanisms of risk of non-respect exist.
Nature of the body in charge of enforcing compliance with the rule
3 enforcement by an independent authority (fiscal council or court) or the parliament
2 enforcement by the ministry of finance or other government body
1 no specific body in charge of enforcement.

Dimension 4 (fri_4) Enforcement mechanisms of the rule
4 there are automatic correction and sanction mechanisms in case of non-compliance
3 there is an automatic correction mechanism in case of non-compliance and the possibility of imposing sanctions
2 the authority responsible is obliged to take corrective measures in case of non-compliance or is obliged to present corrective proposals to the parliament or the relevant authority
1 there is no ex-ante defined actions in case of non-compliance.
The score of this dimension is augmented by 1 if escape clauses are foreseen and clearly specified.

Dimension 5 (fri_5) Media visibility of the rule
3 observance of the rule is closely monitored by the media, non-compliance is likely to trigger public debate
2 high media interest in compliance, but non-compliance is unlikely to invoke public debate
1 no or modest interest of the media.

Appendix B. Additional tables

Table A
Correlation across the components of the fiscal rule index.

	fri	*fri_1*	*fri_2*	*fri_3*	*fri_4*
fri_1	0.95	1.00			
fri_2	0.97	0.91	1.00		
fri_3	0.97	0.90	0.95	1.00	
fri_4	0.93	0.90	0.90	0.84	1.00
fri_5	0.93	0.84	0.86	0.93	0.80

Table B
Correlation across variables employed in the analysis, 1999 to 2009.

	ln_spread	*yield_de*	*debt*	*balance*	*fri*
yield_de	0.10 (0.29)	1.00			
debt	0.43 (0.00)	−0.07 (0.48)	1.00		
balance	−0.52 (0.00)	0.42 (0.00)	−0.46 (0.00)	1.00	
fri	−0.37 (0.00)	−0.07 (0.45)	−0.34 (0.00)	0.40 (0.00)	1.00
ln_riskav	0.79 (0.00)	0.02 (0.84)	0.09 (0.38)	−0.34 (0.00)	−0.04 (0.69)

p-Values in parentheses.

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