Recent estimates of sovereign risk premia for euro-area countries

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Abstract

This paper examines the recent behavior of sovereign interest rates in the euro area, focusing on the 10 year yield spreads relative to Germany for Italy and other euro area countries. Both previous analyses and the new evidence presented in the paper suggest that, in recent months, for several countries the spread has increased to levels that are well above those that could be justified on the basis of fiscal and macroeconomic fundamentals. Among the possible reasons for this gap, the analysis focuses on the perceived risk of a break up of the euro area.

JEL Classification: G12, E43, E62, H63.

Keywords: interest rates, government yield spreads, sovereign risk premia, government debt, financial crisis, sovereign debt crisis, financial contagion, euro break up, convertibility risk.

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1. Introduction and executive summary[1]

This paper examines the recent behaviour of sovereign risk premia in a number of euro-area countries, with a particular focus on the 10-year yield spreads relative to Germany.

Using different estimation techniques and explanatory variables, the previous literature finds a statistically and economically significant relationship between sovereign risk premia and country-specific fundamentals such as the debt-to-GDP ratio, the government budget deficit and GDP growth. However, studies on the most recent period – i.e. since the onset of the Greek sovereign debt crisis at the end of 2009 – generally find that the surge in sovereign spreads experienced in several euro-area countries cannot be fully explained by changes in macroeconomic fundamentals.

The analyses presented in this paper – which in some cases are obtained building on previous studies – are broadly consistent with those of the extant literature. Our results suggest that in recent months the spectacular reduction of long-term German sovereign yields (standing at around 1.3 per cent as of end-August 2012) is to a large extent due to safe-haven flows (see Section 4.1). Moreover, for several countries we find that in the most recent period the sovereign spread vis-à-vis the German Bund has risen well above the value consistent with country-specific fiscal and macroeconomic fundamentals (see Sections 4.2-4.5).[2] For Italian government bonds, most estimates of the 10-year spread fall around 200 basis points, as opposed to a market value of almost 450 points (at end-August 2012). Furthermore, large differences between the market spreads and those warranted by fundamentals are also found on shorter maturities (2 and 5 years – see a summary of the estimates in Table 1).

These results are likely due to the fact that the models used so far do not take into account the new risks which have recently emerged in euro-area sovereign debt markets. In fact, several reasons suggest that euro-area sovereign spreads are increasingly affected by investors' concerns of a break-up of the Economic and Monetary Union (EMU – see Section 5). First, the fact that the deviation of sovereign yields from their model-based value is negative for some "core" countries and positive for "non-core" countries likely reflects the expectation that a break-up of the euro would entail an appreciation of the new national currencies for the former countries and a depreciation for the latter (compared with the parities enshrined in the single currency). Second, the divergence between sovereign spreads and their model-based values has emerged in a phase of

[1] The first version of this paper was published in September 2012, as Bank of Italy Occasional Paper No. 128. Most of the analyses presented in the paper refer to the data available at the date of its first publication.

[2] For the sake of conciseness, in this paper the value of the yield spread consistent with fundamentals is in some cases referred to as the 'fair value', as it is sometimes called in the literature.

exceptionally high volatility in financial markets, when the risk of a break-up of the euro is mentioned more and more frequently by market participants.

Other explanations are possible. These include: concerns of a further, significant deterioration of the medium-term fiscal outlook of the weaker sovereigns not captured by the available indicators; a re-pricing of sovereign risk that increases the compensation required by investors for bearing it; difficulties in assessing sovereign risk that may induce investors to make oversimplifying assumptions and take into consideration only pessimistic or worst-case scenarios. More generally, spreads may reflect the interaction between these different factors, with the possible emergence of a negative spiral between rising risk premia, deteriorating public finances, problems with banking systems, and low growth.

In future work we will assess the contribution of these alternative factors. Nonetheless, as already mentioned, the timing of the increase of sovereign yields in fiscally weak countries and the concurrent, spectacular fall of sovereign yields in fiscally sound countries seems to suggest that recent developments in sovereign euro-area debt markets can be largely traced back to concerns of a break-up of the EMU.

Table 1

Estimates of the Italian yield spreads vis-à-vis Germany consistent with fundamentals: Summary of the results (1)

(basis points)

Main determinants of the spread	Frequency of the data	Time horizon		
		2 years	5 years	10 years
Debt-to-GDP ratio	Daily	91	109	122
Debt-to-GDP ratio (nonlinear)	Quarterly	164	203	212
Fiscal/macro indicators (CDS model)	Daily	124	143	155
Fiscal/macro consensus expectations	Monthly	116	215	260
Fiscal/macro indicators ("wake-up call" model)	Monthly	–	–	80-270 (2)
Financial indicators (average value)	Daily	168	193	215
Fiscal/macro consensus expectations and financial indicators	Monthly	182	272	272
Fiscal/macro indicators and financial accounts	Yearly	–	–	112-301 (3)
Fiscal/macro indicators and contagion	Annual	–	–	80-408 (4)
Memo:				
Actual BTP-Bund spread (21 August 2012)	Daily	300	413	410
Actual BTP-Bund spread (June 2012)	Monthly	414	493	449
Actual BTP-Bund spread (2012 Q1)	Quarterly	289	371	382

(1) Unless otherwise stated, daily estimates refer to the value of the spread on 21 August 2012, monthly estimates refer to its average value in June 2012, and quarterly estimates refer to its average value in the first quarter of 2012. – (2) Data as of December 2011. – (3) Average value for 2012, as of early July. – (4) As of mid-July 2012. The lower value refers to a specification based only on fundamentals, the upper value to one including also a proxy for euro-area systemic risks; the difference between the two values cannot be ascribed to country-specific factors.

This paper is organised as follows. The second section provides an overview of recent trends in the long-term interest rates of the euro area. The third section briefly reviews recent studies. The

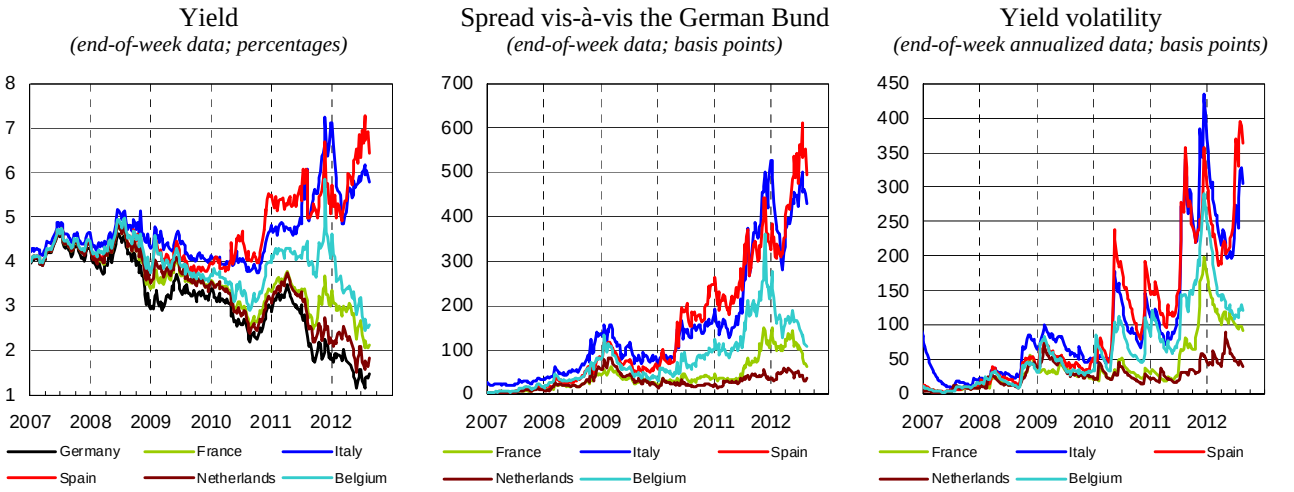
fourth section shows alternative estimates of the values of the yield spreads vis-à-vis Germany consistent with fundamentals for a number of euro-area countries, with a focus on the 10-year maturity. The fifth section presents evidence on the ongoing concerns of a break-up of the euro area and their role in widening the dispersion of interest rates across euro-area countries. The sixth section concludes and highlights some topics for future research.

2. The rising dispersion of long-term interest rates within the euro area

Since the onset of the global financial crisis in the summer of 2007 the dispersion of the long-term government bond yields of the main euro-area countries has risen significantly (Figure 1, left-hand panel). In particular, long-term rates have considerably increased in Italy and Spain, while they have declined in Belgium, France and, above all, the Netherlands and Germany.

Figure 1

Ten-year government bonds



Source: based on Bloomberg data.

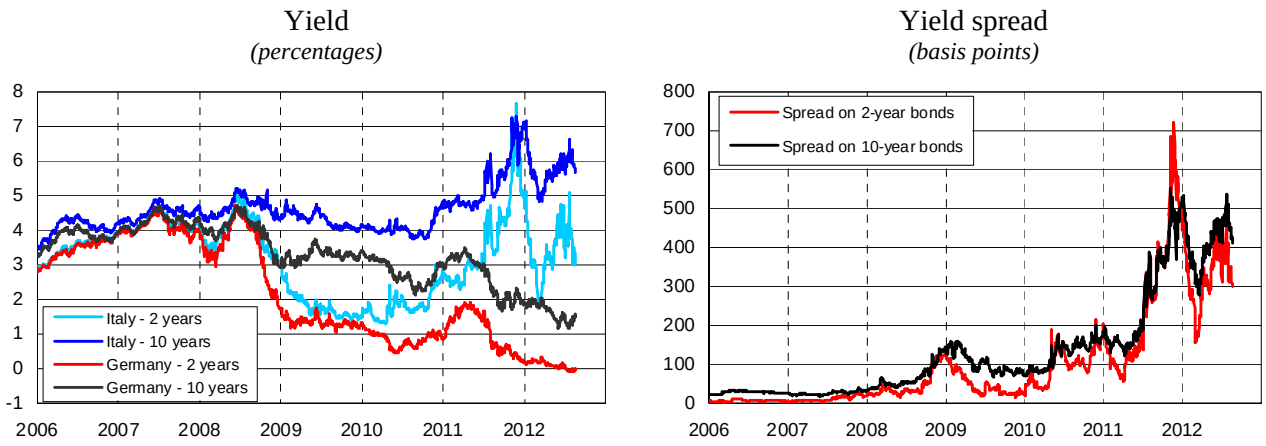
Similarly, yield spreads relative to the German Bund have recorded a significant increase in Spain and Italy, while they have risen much less in the other main euro-area countries (Figure 1, middle panel). Yield volatility has soared across the board, reaching particularly high levels for Spanish and Italian government bonds (Figure 1, right-hand panel).

The dynamics of the spread between Italian and German 10-year sovereign rates has been characterized by three different periods (Figure 2). Between mid-2009 and April 2010, the spread hovered around 85 basis points.

Figure 2

Italian and German 2- and 10-year government bonds

(daily data)



Source: based on Bloomberg data.

Subsequently, after the start of the first wave of sovereign debt tensions in May 2010 and up to June 2011, the spread was still relatively stable, although at a higher level (about 150 basis points on average).

In the third period, starting in July 2011 (after the announcement of the so-called private sector involvement in the second assistance package for Greece), the Italian 10-year yield spread has increased substantially and has become much more volatile. The tensions have involved the entire euro area, leading to a widespread increase in market volatility and to a sharp depreciation of the euro. During this period, the sources of the tensions changed. Until November 2011, the turbulence was concentrated on Italy, as shown by the widening spread of Italian sovereign bonds vis-à-vis other non-core countries, such as Spain. It was fuelled by the deterioration of macroeconomic conditions and political instability in Italy; in November 2011, the Italian 10-year sovereign rate and spread vis-à-vis Germany reached record highs of 7.3 per cent and 5.5 percentage points, respectively. In contrast, in the first half of 2012 the instability was largely driven by the deterioration of macroeconomic conditions in Greece and the difficulties of the Spanish banking sector. In this phase, Italian sovereign rates remained well below the previous peaks, hovering below 6 per cent; in contrast, Spanish yields increased significantly, with the spread between Spain and Italy turning positive (up to 1.2 percentage points in the second half of July 2012).

3. Sovereign risk premia for euro-area countries: recent literature

Ardagna, Caselli and Lane (2007) describe the three main channels through which a worsening of the public finances can affect medium- and long-term yields.[3] First, if the supply of savings is not perfectly elastic, financing the public deficit has to compete for resources with the private sector, causing real interest rates to rise.[4] Second, increases in public debt may cause fears that even sovereign borrowers may default, leading to an increase in the credit risk premia on government bonds. Third, larger public deficits may fuel expectations of inflation or exchange-rate depreciation, with repercussions on interest rates.

Most of the extensive empirical literature on the effects of fiscal imbalances on long-term interest rates does not distinguish among the three aforementioned channels and resorts to reduced-form regressions. Estimates vary greatly from country to country and depending on the method used (see the table in Annex 1, reproduced from Haugh, Ollivaud and Turner, 2009). It is widely agreed that the effects are generally small (see, among others, Balassone, Franco and Giordano, 2004), despite their being larger where the deterioration in the budget balance persists over time. Estimates for the United States indicate that a permanent increase in the debt-to-GDP ratio of 1 percentage point would raise real long-term interest rates by 3 to 5 basis points, while a permanent increase in the budget deficit would produce far larger results. Estimates for European countries, although not uniform, tend to show larger effects.

In recent years, the global financial crisis of 2007-9 and the ensuing sovereign debt crisis in the euro area have spurred a new wave of studies on the relationship between fiscal conditions and long-term interest rates. Unlike previous studies, most of these analyses relax the assumption that public debt is always honoured and allow for the possibility that interest rates on government bonds contain a default risk premium.[5] Attinasi, Checherita and Nickel (2009) estimate a dynamic panel for the 10-year spreads vis-à-vis Germany of ten euro-area countries and find that they are mainly driven by expected public debt and market liquidity, while risk aversion is not significant. Barrios,

[3] See also the box "The effects of the public debt on long-term interest rates" in Banca d'Italia (2010).

[4] As pointed out by Ardagna, Caselli and Lane (2007), it is useful to distinguish between short- and long-run effects. In an economy with a certain degree of short-run nominal stickiness, a weakening in the primary fiscal balance adds to aggregate demand and leads to an increase in nominal and real short-term rates. Insofar as price adjustment is gradual and the weakening in the primary balance is perceived to be persistent, long-term interest rates are also affected. In the longer run, to the extent that fiscal expansion crowds out private investment and results in a lower steady-state capital stock, it will be associated with a higher marginal product of capital and thus a higher real interest rate. For an analysis of the long-run implications of rising public debt for interest rates, see Engen and Hubbard (2005). An important point is made by Krugman (2012), who argues that, in a depressed economy, budget deficits do not compete with the private sector for funds, and hence do not lead to soaring interest rates.

[5] For an earlier analysis of yield spreads in the euro area, see Codogno, Favero and Missale (2005).

Iversen, Lewandowska and Setzer (2009) find a limited impact of deteriorated fiscal balances: on average an increase of 1 percentage point in the budget deficit (vis-à-vis Germany) implies a rise of only 2.4 basis points in the government bond yield spread (vis-à-vis Germany). Bernoth, von Hagen and Schuknecht (2012) show that yield spreads responded significantly to measures of government indebtedness both before and after the start of the EMU. They also find that, since the start of the EMU, markets have paid less attention to government debt levels than they did before; on the contrary, deficits and debt service ratios have been more closely monitored. Bernoth and Erdogan (2012) detect some instability in the pricing of risk between 1999 and the first quarter of 2010 and advocate for the need of time-varying coefficient models in this context.

An increasing number of papers specifically deal with the euro-area sovereign debt crisis and try to analyse its determinants. Borgy, Laubach, Mésonnier and Renne (2011) develop an arbitrage-free affine term structure model to price defaultable sovereign bonds and apply it to a panel of eight euro-area government bond yield curves. They use expected changes in debt-to-GDP ratios as a proxy of fiscal sustainability. According to their estimates (which only include the first period of the sovereign debt crisis), the conditions of the public finances were the major drivers of the increase in spreads that occurred between 2008 and mid-2011.

Other papers find that fundamentals cannot explain a significant portion of the movements of sovereign risk premia registered since the spring of 2010. Aizenman, Hutchison and Jinjarak (2011) estimate a panel model of the premia on 5-year sovereign CDSs. Their sample covers 60 countries (advanced and emerging) from 2005 to 2010 and their explanatory variables include two measures of fiscal laxity (the ratio of government debt to tax revenue and the ratio of the fiscal deficit to tax revenue) and other economic fundamentals. For the euro-area countries most exposed to sovereign tensions (Greece, Ireland, Italy, Portugal and Spain), they find that sovereign credit risk was somewhat underpriced relative to international norms in the period prior to the global financial crisis and substantially overpriced during and after the crisis. According to the authors, this could be due either to mispricing or to pricing based on future fundamentals, incorporating expectations that the fiscal outlook will deteriorate markedly in the euro-area periphery and will pose a high risk of debt restructuring.

Ardagna, Burgi, Cole and Garzarelli (2012) model the 10-year asset swap spreads relative to Germany of France, Italy and Spain as a function of fundamentals (public debt, primary deficit, expected nominal GDP growth and expected 3-month rates) and time dummies. The basic specification of the model uses only the macro fundamental variables and predicts a value of the spreads of about 40, 130 and 200 basis points for France, Italy and Spain, respectively (Table 2).

The higher spreads prevailing in recent years are accounted for by augmenting the model with time dummies that capture changes in the spreads that took place in specific periods and unrelated to country fundamentals. In particular, the very high values reached by sovereign spreads after July 2011 can only be captured by introducing a dummy for that period.

Table 2

Ten-year sovereign spreads vis-à-vis Germany: A fundamental model augmented by time dummies (1)

(basis points)

	France	Italy	Spain
Actual 10-year spread with respect to Germany (2)	107	431	491
Fitted values of spreads			
1. Fundamentals and EMU dummy (post Jan-99)	43	129	202
2. As sub 1 + Financial Crisis dummy (post Sep-08)	58	180	204
3. As sub 2 + EMU sovereign crisis dummy (post May-10)	50	259	365
4. As sub 3 + PSI dummy (post Jul-11)	140	630	384

Source: Ardagna, Burgi, Cole and Garzarelli (2012).
(1) Fitted values of 10-year asset swap spreads with respect to Germany are obtained from a panel model estimated on monthly data from January 1990. The first estimate shown in the table is based only on macro fundamentals and a post-January 1999 dummy. The other estimates make the additional hypothesis that the events flagged by the time dummies indicated in the table have had a significant impact on sovereign yield spreads. – (2) Data as of 29 March 2012.

On the basis of a panel model of the 10-year interest rates of 21 advanced economies estimated over the period 1980-2010, the IMF finds that the current sovereign spreads with respect to Germany of some euro-area countries are well above what could be justified on the basis of fiscal and other long-term fundamentals (IMF, 2012). For Italy and Spain, in the first half of 2012 the model-based values of the spreads with respect to Germany were around 200 basis points, about half their market value.

Several studies argue that deviations of the spreads from the levels justified by fundamentals are partly due to contagion effects. Metiu (2012) finds that, between January 2008 and February 2012, Italy was hit by contagion from Spain and Portugal while these two countries, in turn, were "importers of risk" from Greece. Moreover, he finds that contagion from Spain to Italy is significant both statistically and economically: more than half of the unexpected increases in the Spanish spread are transmitted to the Italian spread, even if they are unrelated to Italian fundamentals. Similar contagion effects are found by De Santis (2012), who also finds evidence that common upward movements in the spreads are often due to safe haven phenomena that contribute to reducing the yield of the Bund. The results of Caceres, Guzzo and Segoviano (2010) and Beber, Brandt and Kavajecz (2009) are consistent with this finding; in particular, the latter authors argue that safe haven phenomena are often linked to increased demand for very liquid assets.

While a consensus is forming around the idea that contagion is an important determinant of the increase in sovereign risk premia in some countries, the economics profession still lacks a rigorous theoretical framework to understand contagion and identify policy actions that might prevent it. Moving from the empirical observation that contagion has been spreading, mainly but not only, within the euro zone, De Grauwe and Ji (2012) argue that contagion might come from self-fulfilling liquidity crises that propagate within the euro area (but not outside of it) because of the disconnect between monetary and fiscal authorities. The policy implication is that only a better integration of the two policies can prevent contagion.

4. Estimates of the values of the yield spreads vis-à-vis Germany consistent with fundamentals

In this section we present new estimates of the yield spreads vis-à-vis Germany consistent with domestic fundamentals for selected euro-area countries. Some of these estimates are based upon new approaches, while others build upon results of previous studies.

To streamline the exposition, only estimates referring to 10-year spreads are presented in the main text, while Table 1 and the graphs in Annex 2 summarize some of the empirical findings concerning the 2- and 5-year maturities for Italy. The results obtained with shorter maturities are qualitatively similar to those obtained with the 10-year maturity. For the sake of brevity, the coefficient estimates are not shown in the main text and are reported in Annex 3 only for some of the most representative models.

We start by pointing out that analyses of the spreads vis-à-vis Germany should start from an assessment of the level of the German yield. We then present different estimates of the values of sovereign yield spreads consistent with fundamentals, moving from simple models (whose regressors include only the debt-to-GDP ratio) to models that also include other fiscal variables, economic fundamentals and financial risks.

Most of the empirical models are estimated over sample periods that do not extend beyond the first half of 2011. This is due to the fact that since July 2011 the conditions of euro-area government bond markets have rapidly deteriorated (as discussed in Section 2) and have likely been increasingly affected by contagion effects and fears of a break-up of the euro area (as will be discussed in Section 5). In estimating the determinants of the sovereign risk premia, it thus seems preferable to drop the observations that refer to this last phase of exceptional instability, which has led the market prices of the government bonds of the euro area to move away from the levels

justified by fundamentals. In any case, the robustness of our results to different sample periods is assessed in a number of ways.[6]

4.1 Safe haven flows and the level of the German 10-year rate

It is commonly argued that, in times of financial stress, safe haven phenomena tend to push German yields below the levels that are consistent with the perceived creditworthiness of the German sovereign. To examine this issue, the left-hand panel of Figure 3 reports the difference between the 10-year German government bond yield and the premium on the 10-year CDS on Germany (red line). This indicator, being broadly equivalent to the return of a credit-risk-free asset, should be comparable to the 10-year Eonia swap rate, which represents a proxy of the risk-free rate (black line). Until April 2010 the difference between the Eonia swap rate and the German government bond-CDS spread (blue line) was in fact very low, with the notable exception of the aftermath of Lehman's default, when it increased substantially reaching one percentage point at the end of 2008 and in early 2009. This spread started to widen again in May 2010, when there was a first phase of strong tensions in euro-area fixed income markets. Subsequently, it increased considerably and since August 2011 it has consistently remained way above the maximum level reached during the global financial crisis of 2007-9. This indicator signals that, over recent months, safe haven effects on 10-year German yields might have been as large as 130 basis points.[7] Similar patterns are also evident for the 2- and 5-year maturities (see Figure A.4 in Annex 2).

The right-hand panel of Figure 3 shows similar indicators for the US, Italy and Spain. For the latter two countries, the differential tends to be more erratic and since mid-March 2012 it has declined considerably (even becoming negative recently), because government bond yields have increased much more than the premia on sovereign CDSs.

[6] In particular, in Section 4.4 we carry out rolling regressions, while in Section 4.5.1 we run the model on shorter-sample periods.

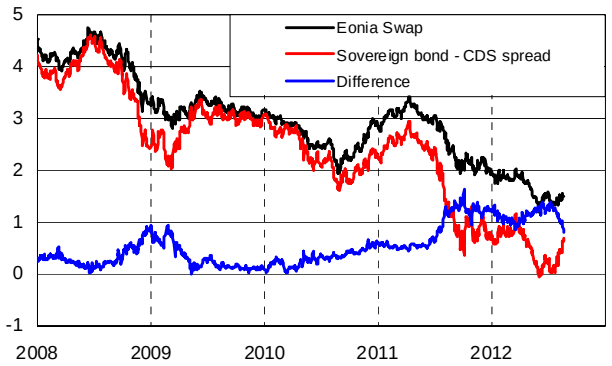
[7] It is worth noting that the CDS premium also reflects counterparty risk, which is the risk that the protection seller is not able to meet its obligation when a default event occurs. The presence of counterparty risk lowers the CDS premium because the protection buyer knows that the protection offered by the contract is not actually full. As the counterparty risk should increase during periods of stress, it seems safe to say that since mid-2011 the premium on the German CDS has actually been lower than it would otherwise have been. Thus, the presence of counterparty risk has probably increased the bond-CDS differential and lowered the difference with the Eonia swap rate. In this respect, therefore, our estimates of the safe haven effects on 10-year German yields are probably conservative.

Figure 3

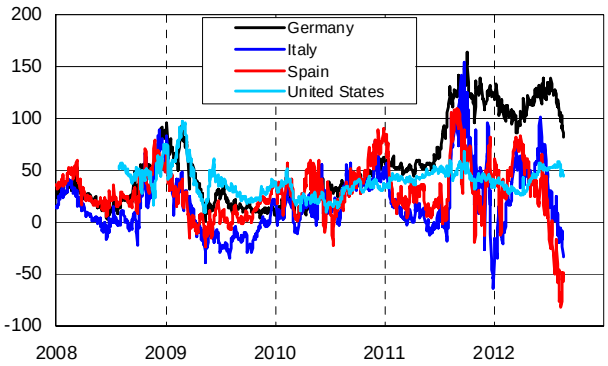
Differential between the 10-year Eonia swap rate and the 10-year sovereign bond-CDS spread (1)

(daily data)

Germany
(percentages)



Germany, Italy, Spain and United States
(basis points)



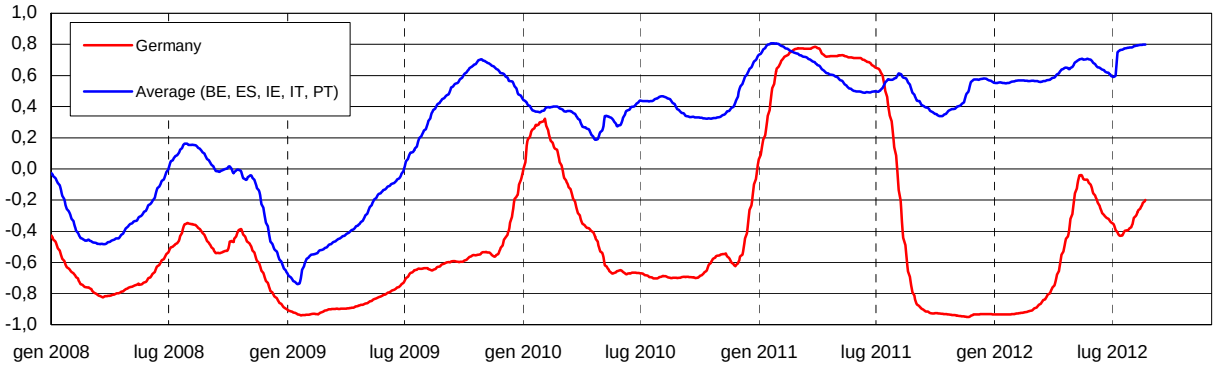
Source: based on Bloomberg data.
(1) The sovereign bond-CDS spread is the difference between the 10-year government bond yield and the premium on the 10-year sovereign CDS.

Further evidence of safe haven phenomena is provided by the co-movement between CDS premia and bond yields. In principle, there should be a positive relationship: a higher CDS spread should be associated with a higher bond yield. While this has been the case for countries with a high debt or deficit (Belgium, Ireland, Italy, Portugal, Spain; Figure 4), for Germany the correlation between the 10-year bond yield and the 10-year CDS spread has been negative both in recent months and over longer time spans. This could be interpreted as evidence of the fact that spikes in risk aversion have triggered both upward revisions of the German sovereign risk premium and safe haven phenomena, but with the effect of the latter on the Bund yield prevailing.[8]

Figure 4

Correlation between 10-year bond yield and 10-year CDS premium

(daily data; 200-day rolling correlations)



Source: based on Bloomberg and Thomson Reuters Datastream data.

[8] There could be also a role for the liquidity risk premium on German bonds that may tend to decrease significantly during periods of financial stress.

4.2 Sovereign spreads and the public debt-to-GDP ratio

A preliminary assessment of the level of the sovereign bond spread vis-à-vis the corresponding German Bund can be obtained from a simple bivariate regression model, where for each country the spread itself is regressed on a constant and the ratio of public debt to GDP (a common indicator of country risk):[9]

$$s_t = \beta_1 + \beta_2 \left(\frac{debt}{GDP} \right)_t + \varepsilon_t , \qquad (1)$$

where s_t is the 10-year spread at day t and $(debt/GDP)_t$ is the debt-to-GDP ratio (kept constant within the quarter). The fitted values from this regression are used as an estimate of the fair value of the spread, while the residuals are interpreted as the portion of the spread not explained by country risk. The model is estimated using daily data from October 2000 to June 2011.

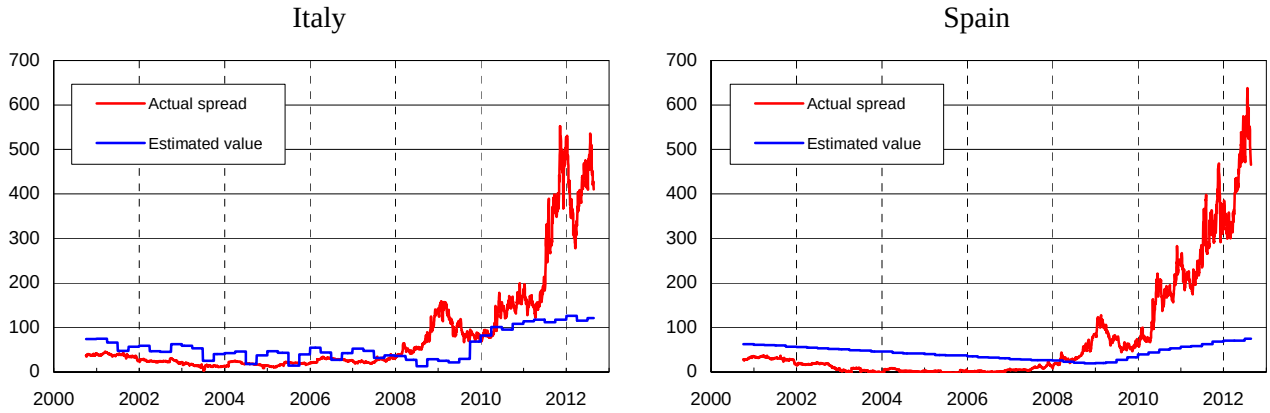
According to this simple indicator, the recent increases of both Spanish and Italian spreads with respect to Germany are much larger than would be justified by the trends in the debt-to-GDP ratios (Figure 5). In particular, the level of the Italian spread consistent with the debt-to-GDP ratio in the second half of 2012 is estimated to be around 120 basis points, against an actual value of the spread of 410 basis points (see Figure A.5 in Annex 2 for the results for 2- and 5-year maturity Italian bonds).

[9] Tests of the null hypothesis of non-stationarity for many of the time series used in this paper are not able to reject it. However, such tests are reckoned to have limited power in datasets of moderate size like ours (Nelson and Plosser, 1982, and Kwiatkowski et al., 1992). Moreover, these tests provide valid inferences only if structural breaks are absent (Perron, 1989) and if errors are reasonably homoskedastic (Kim and Schmidt, 1993). As these conditions are probably not met by our data (especially homoskedasticity), one should be very careful in interpreting the results from unit root tests. In addition, even in the presence of unit roots, OLS estimates such as those presented in this paper remain consistent (actually super-consistent, hence with smaller standard errors) if the series are also cointegrated (Phillips and Durlauf, 1986). Thus, the case remains open only if the variables are I(1) but not cointegrated. Our a priori is that this possibility is economically implausible: theory indicates that the variables under examination are strongly related in an economic equilibrium.

Figure 5

Ten-year sovereign spreads with respect to Germany as a function of debt-to-GDP ratios

(daily data; basis points)



Source: based on Bloomberg and Thomson Reuters Datastream data.

This simple regression model does not take into account possible non-linearities in the relationship between sovereign spreads and public debt-to-GDP ratios. Non-linear effects might be sizable for countries with a high public debt relative to the size of the economy (e.g., Italy, Ireland and Portugal). To account for non-linearities, we follow De Grauwe and Ji (2012). The fair value of the spread is obtained by regressing bond spreads on debt-to-GDP ratios, debt-to-GDP ratios squared, country specific dummies and interactions between these country dummies and debt-to-GDP ratios (simple and squared):

$$s_{i,t} = \beta_1 + \beta_2\left(\frac{debt}{GDP}\right)_{i,t} + \beta_3\left[\left(\frac{debt}{GDP}\right)_{i,t}\right]^2 + \beta_4 D_i + \beta_5 D_i\left(\frac{debt}{GDP}\right)_{i,t} + \beta_6 D_i\left[\left(\frac{debt}{GDP}\right)_{i,t}\right]^2 + \varepsilon_{i,t}, \quad (2)$$

where $s_{i,t}$ is the spread of country *i* in quarter *t*, $(debt/GDP)_{i,t}$ is the debt-to-GDP ratio and D_i is a country dummy.[10]

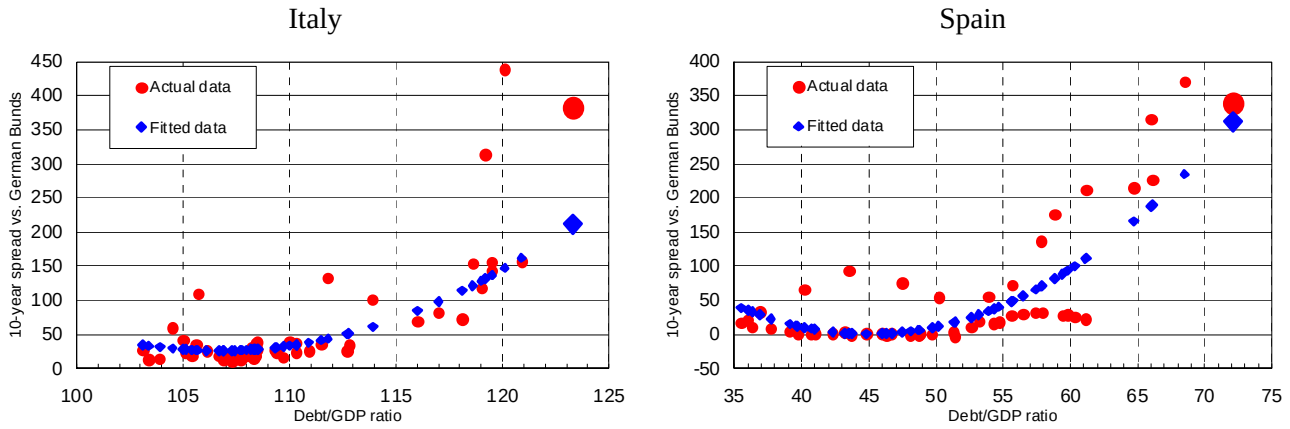
Figure 6 and Figure A.1 in Annex 2 show actual and fitted data for 10-year spreads relative to the German Bund for Belgium, France, Ireland, Italy, Portugal and Spain. The estimates are based on quarterly data of the debt-to-GDP ratio from 2000Q1 to 2011Q2. The data on spreads are quarterly averages. Fitted data from 2011Q3 to 2012Q1 are out-of-sample estimates.

[10] De Grauwe and Ji (2012) also include the ratio of the current account to GDP among the regressors, but its effect on the spread is never statistically significant. They also do not include the interaction terms between the country dummies and the debt-to-GDP ratios (simple and squared), so that the impact of the debt-to-GDP ratio is the same for all the countries in their sample.

Figure 6

Ten-year sovereign spreads with respect to Germany as a non-linear function of debt-to-GDP ratios (1)

(quarterly data; percentages and basis points)



Source: based on Bloomberg and Thomson Reuters Datastream data.
(1) The larger markers denote the latest observations (2012 Q1).

Two results stand out. First, in every country except Belgium, the relationship between the public debt-to-GDP ratio and the sovereign yield spread is non-linear and convex (the larger the debt, the higher the impact on the spread of a one percentage point increase in the debt-to-GDP ratio).[11] Second, in the first quarter of 2012 (the latest available data) the actual level of the spread is much higher than the predicted value in every country except Ireland. In Italy, the fair value of the spread is equal to about 210 basis points, as against an observed value of 380 basis points (see Figure A.6 in Annex 2 for analogous results for 2- and 5-year maturities).

4.3 Sovereign spreads, fiscal sustainability indicators and other fundamentals

Another estimate of the fair value of the sovereign spreads takes into account both fiscal sustainability and macroeconomic indicators and uses some empirical results by Aizenman, Hutchison and Jinjarak (2011). These authors estimate equilibrium sovereign CDS premia as a function of the current values of fiscal sustainability indicators (such as the ratio of public debt to GDP or the ratio of public debt to the realized tax collection) and other fundamental variables (such as inflation and the ratio of total foreign liabilities to GDP). For the euro-area countries most exposed to the tensions on government bond markets, Aizenman, Hutchison and Jinjarak (2011) calculate the ratios between the actual and the predicted values of the sovereign CDS premia for the years 2008-10. We use these ratios to get an estimate of the fair values of the 10-year yield spreads

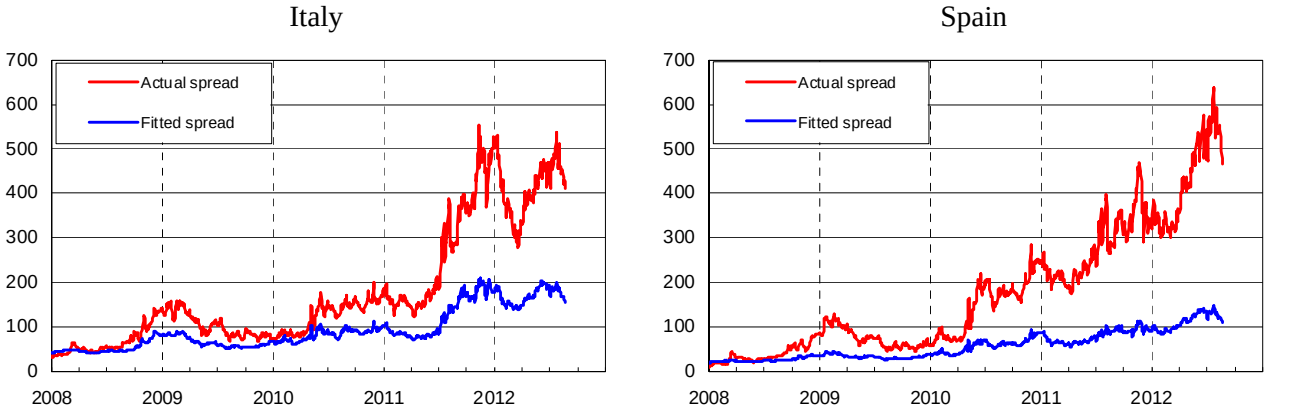
[11] In the case of Belgium, the atypical concave pattern of the fitted curve is due to the fact that in the last few quarters Belgian spreads have recorded historically high levels notwithstanding the debt-to-GDP ratio being well below its historical maxima.

with respect to Germany for Ireland, Italy, Portugal and Spain.[12] Figure 7 and Figure A.2 in Annex 2 show these estimates. Since 2012, the fitted values of the sovereign spreads with respect to Germany have hovered around 390, 180, 290 and 110 basis points for Ireland, Italy, Portugal and Spain respectively (see Figure A.7 in Annex 2 for the results for 2- and 5-year maturity Italian bonds).

Figure 7

Estimates of the 10-year sovereign spreads with respect to Germany based on the results reported by Ainzenman et al. (2011) for sovereign CDSs (1)

(daily data; basis points)



(1) Fitted values are generated on the basis of Ainzenman, Hutchison and Jinjarak (2011)'s estimates of the value of the premia on sovereign 5-year CDSs that are consistent with current fundamentals.

We then take an alternative approach, in which we estimate a model for the 10-year government bond yields of Italy and Germany and then compute the model-implied value of the spread as the difference of the fitted values of the yields. To better account for the forward-looking nature of interest rates, we use the monthly forecasts of yearly macroeconomic variables provided by Consensus Economics (based on a survey of professional forecasters) as proxies for fundamentals. For the Italian and German interest rates,[13] we estimate the following equation:

$$r_t = \alpha + \beta' \overline{EXPFUND}_t + \varepsilon_t \,, \qquad (3)$$

[12] We use a three-step procedure. First, for each country the relationship between sovereign bond spreads and premia on sovereign CDSs (both calculated with respect to Germany) is derived through a linear regression estimated on daily data for the period 2008-10. Second, for each country an estimate of the level of CDS premia consistent with fundamentals ("fundamental-adjusted" CDS premia) is obtained by applying the correction terms reported in Table 4 by Aizenman, Hutchison and Jinjarak (2011) to the actual values of the CDS premia. To err on the side of caution, we use the lowest estimate of the correction term for Germany and the highest for the other countries; moreover, in order to smooth the time variation, we use the average values of the correction terms over the three-year period 2008-10. In the third and last step, the fundamental-adjusted bond spreads are computed by using the equation estimated in the first step and replacing the actual values of the CDS premia with their fundamental-adjusted values.

[13] Long time series of consensus forecasts data are only available for G7 countries.

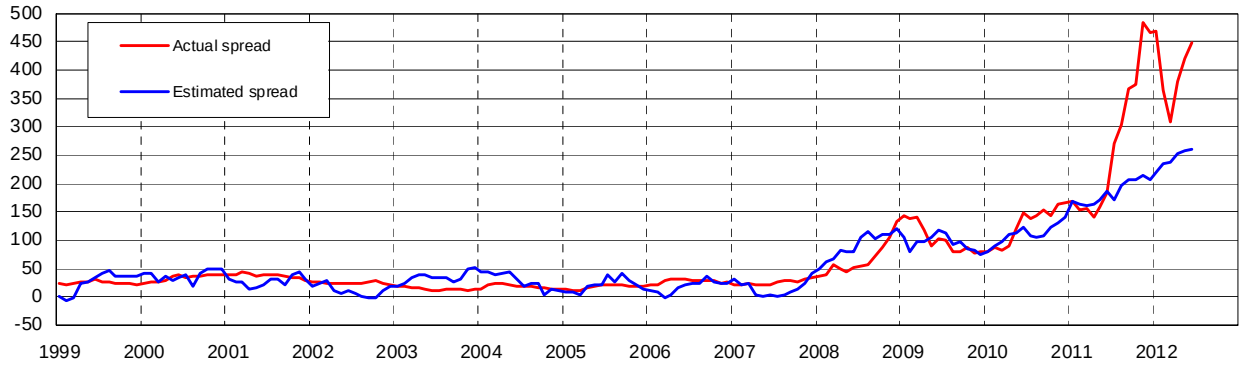
where r_t is the nominal interest rate and $\overline{EXPFUND_t}$ is a vector of variables including the 12-month-ahead forecasts at month t of one fiscal fundamental (the budget balance-to-GDP ratio) and a stream of other macroeconomic variables (three-month interest rates, GDP growth rate, consumer price inflation, unemployment rate and the current account-to-GDP ratio).[14] Regressions are estimated over the period January 1999-June 2011.

At mid-2012 the estimated value of the 10-year Italian spread with respect to Germany was equal to 260 basis points, almost 2 percentage points lower than its actual value (Figure 8). For the 2- and 5-year maturities, the gaps between the actual and estimated values of the spread were even higher (around 3 percentage points; see Figure A.8 in Annex 2).

Figure 8

Italian 10-year sovereign spread with respect to Germany as a function of consensus expectations on fiscal and other economic fundamentals (1)

(monthly data; basis points)



Source: based on Bloomberg, Thomson Reuters Datastream and Consensus Forecasts data.
(1) The estimated spread is the difference between the fitted values of the Italian and German interest rates. Interest rates are modelled as a function of the expected deficit/GDP ratio over the next 12 months and the 12-month-ahead forecasts of other macroeconomic variables (expected three-month interest rates, GDP growth rate, consumer price inflation, unemployment rate and the current account/GDP ratio). Since July 2011 the estimated spread is based on out-of-sample forecasts.

A possible weakness of our results is that the models used so far ignore the possibility that since the onset of the Greek crisis in November 2009 sovereign risk premia within the euro area may have become much more sensitive to fundamentals. This "wake-up call" hypothesis is examined by Giordano, Pericoli and Tommasino (2012), who estimate the following panel model of the 10-year spreads with respect to Germany:

$$s_{it} = \alpha_{i0} + \alpha_{i1} s_{it-1} + \beta_0 Z_{it} + \beta_1 F_t + \gamma_0 D_t + \gamma_1 D_t Z_{it} + \gamma_2 D_t F_t + \varepsilon_{it}, \qquad (4)$$

[14] Rolling 12-months-ahead forecasts are computed as a weighted average of the forecasts for the current and next calendar years, in which the weights are given by the fractions of the two calendar years included in the computation window.

where D_t is a dummy variable equal to one after the outbreak of the Greek crisis in October 2009, F_t is the VIX index (regarded as a measure of global risk aversion) and $Z_{i,t}$ includes country-specific variables, such as GDP growth and the ratios of public debt, private debt and the current account to GDP (all these ratios are computed as differences with respect to those of Germany). The dataset covers nine euro-area countries (Austria, Belgium, Finland, France, Ireland, Italy, the Netherlands, Portugal and Spain) and runs from January 2000 to December 2011. Giordano, Pericoli and Tommasino (2012) find that after October 2009 financial market participants became more responsive to country-specific fundamentals than before (with countries with sounder fiscal conditions and better external positions benefiting from lower spread levels). However, even using this "wake-up-call" model, the unexplained portions of the actual yield spreads with respect to Germany remain large. In the case of Italy, the predicted value of the 10-year spread with respect to Germany ranges between 80 and 270 basis points (depending on whether investors' average sensitivity to country-specific factors is set to its pre- or post-Greek-crisis level).

4.4 Financial factors

Besides economic and fiscal fundamentals, sovereign risk premia may be affected by risks stemming from financial markets. Three factors can be singled out: 1) the surge in sovereign spread volatility has reportedly discouraged investors from holding the government bonds of some euro-area countries; 2) sovereign spreads have also been affected by strains in domestic banking systems; 3) the recent wave of sovereign debt rating downgrades might also have contributed to widen government bond spreads, due to the pervasive role of ratings in the financial industry.[15]

A preliminary assessment of the impact of these three financial factors on recent trends in euro-area sovereign yield spreads can be obtained from simple bivariate regression models, where the spread is regressed on a constant and an indicator of financial risks:

$$s_t = \beta_1 + \beta_2 \, financial\_indicator_t + \varepsilon_t \,, \qquad (5)$$

where s_t is the spread at time t of the country considered and $financial\_indicator_t$ is the given indicator of financial risks. As for equation (1), the fitted values from this regression are interpreted as an estimate of the fair value of the spread, while the residuals are interpreted as the portion of the spread not explained by country risk.

[15] It should be borne in mind that using financial market variables as explanatory variables of sovereign spreads may entail serious reverse causality issues. This could be particularly relevant over the last year, when developments in euro-area government bond markets have been a source of systemic risks.

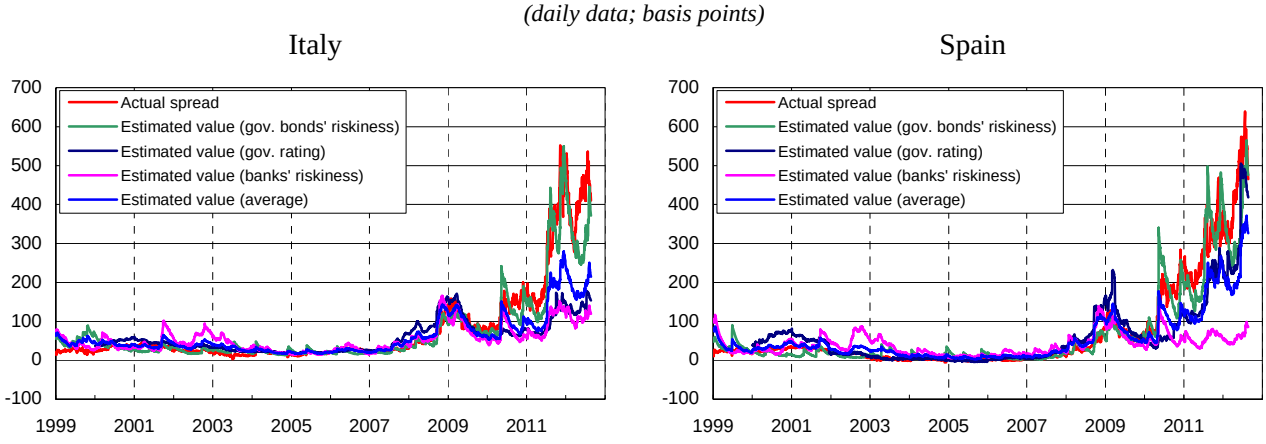
For each of the six countries considered in Section 4.2, we use three different proxies of country-level financial risks, giving rise to three alternative estimates:

- *volatility of the sovereign spread*: this is motivated by the observation that the risk premium required to hold a given bond could be proportional to its financial riskiness, as measured by its price volatility in excess of the volatility of a safe bond. The indicator is computed as an exponentially weighted moving average (EWMA) of squared day-on-day changes in the 10-year government bond spread;[16]
- *volatility of bank stocks*: given investors' concerns about banks' conditions in the euro area, this measure takes into account the possibility that the sovereign spread of a given country might reflect the vulnerability of its banking sector, as proxied by the stock price volatility of the major banks. The indicator is calculated by applying the EWMA methodology to country indices of bank share prices;[17]
- *spread on corporate bonds having the same rating*: under the assumption that credit ratings are reliable measures of credit risk, there should be a close relationship between the spreads on sovereign and corporate bonds having the same rating. For each sovereign, this indicator is computed from the Merrill Lynch index of the corporate bonds having the same rating as the sovereign's government bonds.

Figure 9

Ten-year sovereign spreads with respect to Germany as a function of financial indicators of country risk

(daily data; basis points)



Source: based on Bloomberg and Thomson Reuters Datastream data.

We run equation (5) on daily data from January 1999 to June 2011. The fitted values from these regressions are plotted in Figure 9 for Italy and Spain and Figure A.3 in Annex 2 for the other

[16] We used the standard RiskMetrics framework for daily data, assuming null mean and a decay factor equal to 0.96.

[17] We used the Datastream indices for national banking sectors.

four countries (see Figure A.9 in Annex 2 for the results for 2- and 5- year maturity Italian bonds). The figures also show the series obtained by averaging the estimates from the three models.

The main results that emerge from the analysis can be summarized as follows:

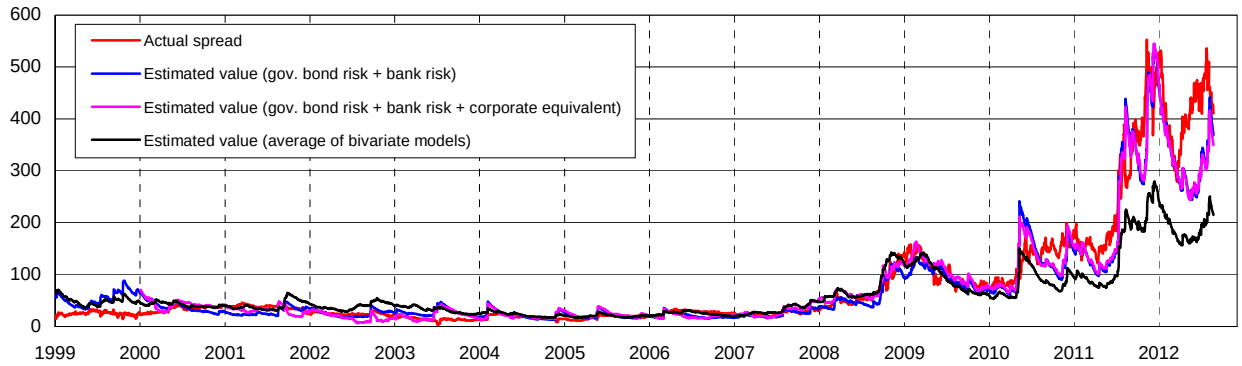
- All the proxies of country risk have significant explanatory power, particularly the volatility of the sovereign spread; the latter finding signals that financial risks stemming from short-term bond price volatility is one of the main drivers of sovereign spreads;
- Since the summer of 2011, there has been an increasing gap between the market values of sovereign spreads and their model-based values; this is true for all countries in the panel, albeit to different extents;
- Italy seems to be the most severely penalized country. On 21 August 2012 (the last day in our sample) the spread stood at 410 basis points, against an average estimated value of 215 points. On the same day, the most conservative estimate was about 370 basis points (based on the volatility of the sovereign spread), while the other estimates stood at 120 and 150 basis points (based on the volatility of bank stocks and the spread of equivalent corporate bonds, respectively).

As a robustness check, we also run multiple regressions: one including all three proxies of risk and one including only the two volatility variables. These regressions also provide evidence of a gap between the actual and the model-based value of the spreads. In particular, despite producing a remarkably good fit of the dynamics of the Italian spread until the end of March 2012 they fail to explain the surge that occurred subsequently (Figure 10).

Figure 10

Multiple regressions of the Italian 10-year sovereign spread with respect to Germany on financial indicators of country risk

(daily data; basis points)



Source: based on Bloomberg and Thomson Reuters Datastream data.

A possible concern about these estimates is that they do not take into account the possible time-variation in investors' risk aversion and the price of risk. One may interpret the explanatory variables as proxies of the quantity of risk and their regression coefficients as the price of risk (their product being the risk premium). Along these lines, it is possible to estimate how the price of risk evolved through time by running rolling regressions over shorter sub-samples. Using 2-year rolling windows, we find that in 2012 the estimated prices of risk are very close to their sample averages; even with time-varying coefficients, the estimated value of the spread is only a few basis points above the level found with the baseline model described above. Furthermore, estimates of the fair value remain virtually unchanged by adding to the regressors the level of the VIX index, which is sometimes regarded as a proxy of risk aversion.[18]

4.5 Financial factors and other fundamentals

Sovereign risk premia are likely to be a function of both financial factors and economic and fiscal fundamentals. In this section we follow two different approaches that try to take all these determinants into account.

4.5.1 Indicators of financial risks and other fundamentals

In Section 4.3 we have modelled Italian spreads with respect to Germany as a function of the consensus forecasts of macroeconomic variables. We now augment model (3) to include the three indicators of financial risks described in Section 4.4. For the Italian and German interest rates, we run the following equation:

$$r_t = \alpha + \beta' \overline{EXPFUND}_t + \gamma' \overline{FINFACT}_t + \varepsilon_t \,, \qquad (6)$$

where r_t is the nominal interest rate of the country considered, $\overline{EXPFUND}_t$ is the vector of 12-month-ahead forecasts of fundamentals described in Section 4.3 and $\overline{FINFACT}_t$ is a vector including the volatility of r_t, the volatility of the share prices of the banks of the given country, and the yield on corporate bonds having the same rating as the sovereign of the given country. In an extended version of (6) the regressors also include the current level of the public debt/GDP ratio

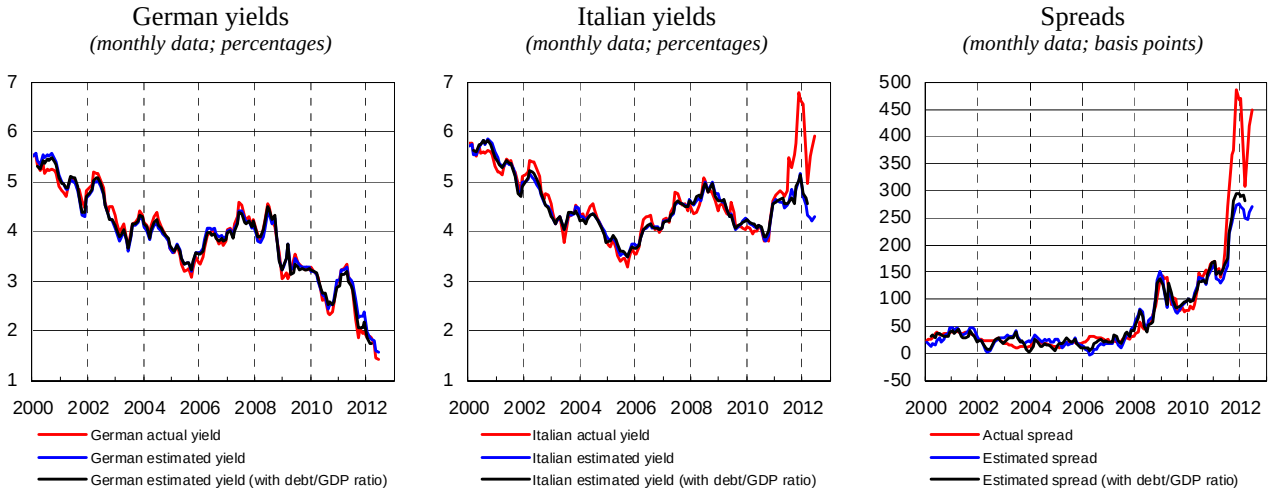
[18] These results apparently provide little support for the hypothesis that the compensation required by investors to bear sovereign risk in the euro area has significantly increased since the second quarter of 2010. However, our proxies of risk (in particular, corporate spreads) are themselves affected by the price of risk and thus may already reflect, at least in part, its possible changes over time.

(for which no consensus forecast is available), which might be an important factor for Italian sovereign risk premia. Regressions are estimated over the period January 2000-June 2011.[19]

Results for the 10-year maturity are shown in Figure 11. While the equation tracks the German 10-year yield quite well, the Italian 10-year yield turns out to be significantly higher than the fitted value (by 160 basis points at mid-2012). The fitted value of the spread at June 2012 stands at 270 basis points, almost 180 basis points lower than its actual value. For the 2- and 5-year maturities, the gaps between actual and fitted values are even larger for the Italian interest rates (about 220-230 basis points), while they are nil for the German ones (see Figure A.10 in Annex 2).

Figure 11

Ten-year government bond yields and spreads as a function of fundamentals and financial factors



Source: based on Bloomberg, Thomson Reuters Datastream and Consensus Forecast data.
(1) Yields are modelled as a function of three financial risk indicators (yield volatility, bank share price volatility and yield of corporate bonds with the same rating as the sovereign), the expected deficit/GDP ratio over the next 12 months and the 12-month-ahead forecasts of other macroeconomic variables (expected three-month interest rates, GDP growth rate, consumer price inflation, unemployment rate and the current account/GDP ratio). An extended specification also includes the current level of the debt-to-GDP ratio among the regressors. Since July 2011 fitted values are based on out-of-sample forecasts.

4.5.2 Fundamentals and the financial position of the main sectors of the economy

Grande, Masciantonio and Tiseno (2012) explain sovereign yields in terms of fundamentals and the financial position of the main sectors of the economy. For the 10-year interest rates of 18 major advanced countries, the authors estimate the following panel model:

$$r_{i,t} = \alpha_i + \beta' F_{i,t} + \gamma' B_{i,t} + \varepsilon_{i,t}\,, \qquad (7)$$

[19] The stability of the econometric estimates is assessed by running the model on two shorter sample periods: (*i*) from 2007 to June 2011, in order to exclude the first half of the 2000s (a period of very low sovereign risk premia) from the sample period; (*ii*) from 2007 to November 2012, in order to assess how much the results are affected by the recent wave of massive instability. The results are remarkably stable across the three sample periods: the coefficients do not change sign and vary in magnitude and significance levels only for a restricted number of variables (see Annex 3).

where $F_{i,t}$ is a vector of economic and fiscal variables of country i at time t and $B_{i,t}$ is a vector of variables taken from the country's financial accounts. The latter includes the net asset holdings (defined as the balance between the stock of financial assets and that of financial liabilities) of the sectors of the economy that are the main providers or users of savings – households, non-financial corporations, the public sector, and the foreign sector. As for the fundamentals, the authors use two different specifications with and without rating dummies.[20] Rating dummies are based on end-of-year data and refer to the best rating across the three major rating agencies.[21] The model is estimated using yearly averages over the period 1995-2010 and is used to predict the average yields for 2011 and 2012.

Table 3 reports out-of-sample predictions for Italian and German interest rates for 2011 and 2012, and their actual values. Both the models with and without sovereign ratings are included. For 2011 the predicted value of the 10-year BTP-Bund spread ranges between 150 and 210 basis points, compared with an actual level of 280. The two-notch decline in Italian government bonds' best rating occurred in the last months of 2011 accounts for an increase in the fitted value of the Italian 10-year rate of more than 50 basis points.

For 2012, three different scenarios are envisaged depending on the hypotheses about the net asset holdings of households and non residents, and the other financial account variables. In the middle scenario, dubbed "Stabilization", the net asset holdings are assumed to remain broadly unchanged at the levels reached at the end of 2011. In that case, the predicted value of the 10-year BTP-Bund spread ranges between about 160 and 280 basis points, compared with an average level of the spread of nearly 400 basis points in the first half of 2012. The other two scenarios, dubbed "Recovery" and "Deterioration", assume that the changes in the net asset holdings observed in 2011 will revert or occur again in 2012, respectively. Fitted values range between about 110 and 230 basis points in the "Recovery" scenario and between about 190 and 300 basis points in the "Deterioration" scenario.

[20] With regard to fundamentals, the explanatory variables include real short-term rates, inflation, the average residual maturity of marketable public debt, and the ratio of public debt to GDP.

[21] The rating dummies are defined as follows: (*i*) for each country, the end-of-year ratings provided by the three major rating agencies are converted into a common numerical scale; (*ii*) each country is given the rating score which corresponds to the highest level of creditworthiness across the three rating agencies.

Table 3

Interest rates on Italian and German 10-year government bonds: A model of fundamentals, credit ratings, and capital availability (1)

(average data; percentages and basis points)

Year	Scenario		Model without ratings (2)		Model with ratings (2) (3)		Observed rates (4)	
			Italy	Germany	Italy	Germany	Italy	Germany
2011	Actual data	Yield	4.19	2.72	4.81	2.68	5.42	2.61
		S.E.	(0.47)	(0.29)	(0.45)	(0.31)		
		Spread	*147*		*213*		*281*	
	Recovery (back at end-2010 levels)	Yield	3.54	2.42	4.71	2.38		
		S.E.	(0.54)	(0.29)	(0.58)	(0.31)		
		Spread	*112*		*233*			
2012	Stabilization (as at end-2011)	Yield	3.92	2.34	5.06	2.31	5.70	1.71
		S.E.	(0.50)	(0.28)	(0.54)	(0.30)		
		Spread	*158*		*275*		*399*	
	Deterioration (2011 trends continue in 2012)	Yield	4.21	2.35	5.33	2.32		
		S.E.	(0.48)	(0.28)	(0.52)	(0.30)		
		Spread	*186*		*301*			

Source: based on Grande, Masciantonio and Tiseno (2012).

(1) Yields and standard errors (S.E.) are in percentages, while spreads are in basis points. Fitted values of 10-year yields are out-of-sample predictions obtained by a panel model estimated on annual data from 1995 to 2010 for a sample of 18 major advanced countries. – (2) Fundamentals include real short-term rates, inflation, the debt-to-GDP ratio, and the average residual maturity of the public debt. – (3) Rating dummies are based on end-of-year data and refer to the best rating across the three major rating agencies. For 2012, best rating as of mid-July 2012. – (4) For 2012, average values from January to early July.

5. The perceived risk of a break-up of the euro area

The existence of large and persistent gaps between the actual levels of interest rates and what could be justified on the basis of fiscal and other macroeconomic fundamentals for several countries suggests that some common new risk factor is currently at play in the euro area.

One factor driving these gaps may be the risk of a break-up of the euro area and its systemic consequences. Doubts about the irreversibility of the euro led market participants to start guessing about the likelihood and consequences of a euro break-up and about investors' willingness to bear that risk. Fears of the reversibility of the euro can thus explain the current high dispersion of interest rates within the euro area and be a major source of uncertainty and systemic risk.

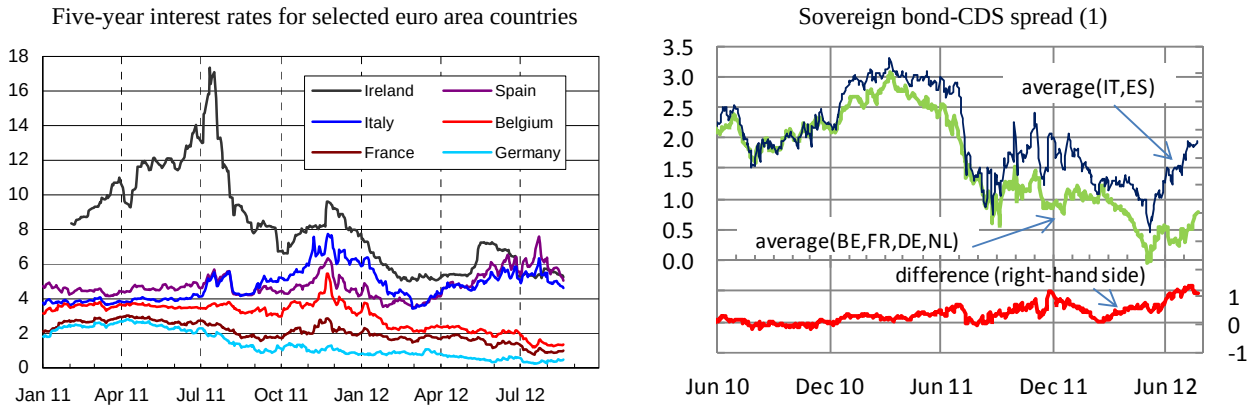
There is sound evidence that over the last year euro-area government bond markets have been increasingly affected by stories of a break-up of the euro area. Besides the abnormal levels reached in the euro area by sovereign yields and yield volatilities since the second half of 2011 (see

Section 2), some recent discontinuities in the patterns of sovereign yields call for attention. Until early March 2012, Belgian interest rates had oscillations rather similar to those of Italian and Spanish interest rates, likely due to changes in risk premia related to investors' assessments of the sustainability of the public debt in Belgium (Figure 12, left-hand panel). Subsequently, there has been a growing divergence between Belgian rates and Italian and Spanish rates, with the former becoming closer to French and German rates. This suggests a clustering of interest rates along geo-economic patterns that were discernible before the introduction of the single currency and is consistent with a progressive loss of confidence in the integrity of the euro area.

Figure 12

Interest rates within the euro area and sovereign bond-CDS spread

(daily data; percentages)



Source: based on Bloomberg and Thomson Reuters Datastream data.
(1) Average values of the sovereign bond-CDS spread for two groups of euro-area countries (Italy and Spain, on the one hand, and Belgium, France, Germany and the Netherlands, on the other). The lower panel of the graph shows the difference between the two average spreads. The sovereign bond-CDS spread is the difference between the 10-year government bond yield and the premium on the 10-year sovereign CDS.

A structural break can be observed also in the sovereign bond-CDS spread, i.e. the differential between government bond yields and the premia on sovereign CDSs. As mentioned in Section 4.1, this spread contains the risk-free rate and premia on risk factors other than sovereign default (e.g., liquidity risk). The right-hand panel of Figure 12 shows the average values of the spread for two groups of euro-area countries: the two main countries most exposed to tensions (Italy and Spain) and the other four main countries (Belgium, France, Germany and the Netherlands). The lower half of the graph also shows the difference between the two average spreads. Since July 2011 this spread has become much more volatile and dispersed across euro-area countries. More importantly, since mid-March 2012 the gap between the average spreads of the two groups of countries has consistently increased, because over the whole period bond yields have risen much more than sovereign CDS premia in Italy and Spain, and they have declined much more than

sovereign CDS premia in the other main euro-area countries. The formation of such a wide gap between the average spreads of the two group of countries is consistent with the hypothesis that over recent months the huge increase in the dispersion of interest rates across euro-area countries has been due to a new common factor, namely the risk of a break-up of the euro area.

A scenario of some countries leaving the euro area has been gathering momentum for some time among financial market participants. In June 2012, the Swiss bank UBS conducted a poll of 80 central bank reserve managers who collectively control more than 8 trillion US dollars. The respondents said that a break-up of the euro area was the greatest risk to the global economy over the next 12 months (Financial Times, 2012). Nearly three quarters of them said at least one country would leave the euro area within five years. Of those, roughly a quarter said that more than one country would drop the euro.

Concerns about a possible break-up of the euro area have also become widespread in the non-financial media and the online world. The volume of searches of "euro break-up" or similar keywords using Google peaked in early December 2011 and in May and June 2012 (Figure 13, left-hand panel). As unlikely as it may be, the possibility that the interest rates of euro-area countries have been including a convertibility risk premium has recently been mentioned by the President of the ECB (Draghi, 2012).[22]

Our own quantitative analysis provides some indications that since July 2011 euro break-up risks have been a main driver of the instability of euro-area government bond markets (see also Favero, 2012, for econometric evidence of non-default components linked to break-up risks). The very fact that the deviation of sovereign yields from their estimated value has recently tended to be negative for Germany and positive for "non-core" countries likely reflects the expectation that a break-up of the euro area would entail an appreciation of the new German currency and a depreciation of the currencies of "non-core" countries (compared with the parities enshrined in the single currency). This explanation is supported by the comparison of the Google-based indicator of euro break-up risks shown in the left-hand panel of Figure 13 with the residuals from the interest rate models with macroeconomic variables and financial factors presented in Section 4.5.1 (Figure 13, right-hand panel). Model residuals are a measure of the gap between the actual level of the

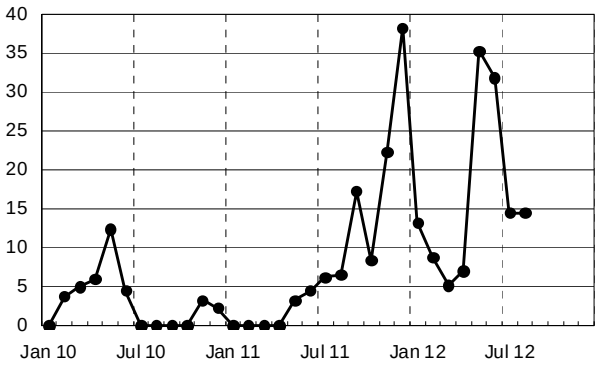
[22] A straightforward way to check for the presence of a convertibility risk premium is the comparison of the yields of Italian government bonds denominated in euro and the yields of similar government bonds denominated in, say, US dollars, which are immune of the risk of redenomination. However, the two types of bonds typically do not differ only for the currency of denomination but also for a number of other factors (e.g., law to which the issuance is subject, eligibility towards central bank refinancing, liquidity of the underlying market) that may make the use of this approach extremely difficult in practice.

interest rate and the level that would be justified by fundamentals. Since the second half of 2011 the positive correlation between the euro break-up indicator and the portion of the Italian 10-year interest rate not justified by fundamentals is striking. For the German 10-year rate, the correlation with the euro break-up indicator is remarkable as well, although it is slightly lower than for the Italian rate (over the period January 2010-June 2012, the correlation is 0.77 and 0.56 for the Italian and the German unexplained rate, respectively).

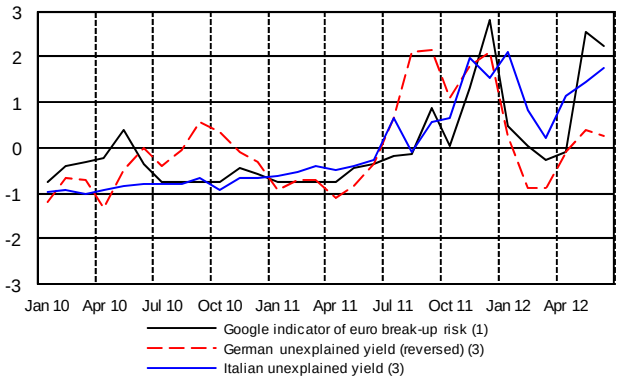
Figure 13

Euro break-up risk and the gap between market yields and the yields consistent with fundamentals

Frequency of internet searches of euro break-up keywords (1)



Unexplained portions of sovereign German and Italian 10-year yields and euro break-up risk (2)



Source: based on Bloomberg, Thomson Reuters Datastream, Consensus Forecasts and Google data.
(1) Monthly data. Index of search volume of euro break-up keywords ("end of euro", "end of the euro", "euro break-up", "euro break up", "euro breakup" and "euro exit") typed into Google's web search engine. Data is monthly averages of weekly data: weekly data is an index which varies between 0 and 100 and is equal to 100 when the ratio "number of query X"/"total number of queries" reaches its maximum value over the period for which data are extracted. The data extraction period was January 2004-August 2012. Data downloaded on 23 August 2012. – (2) The time series are normalized to have zero mean and unit variance. – (3) Difference between the actual and fitted values of the 10-year government bond yield. Fitted values are obtained by a model that controls for both macroeconomic fundamentals and financial factors. Since July 2011 fitted values are out-of-sample forecasts.

Indicators of a generalised euro-area risk can also be computed by looking at measures of comovements of sovereign risk premia. Bufano and Manna (2012) carry out a principal component analysis of the 10-year swap spreads for the ten leading euro-area sovereign issuers.[23] They find that the first principal component explains 95% of the overall variance of sovereign swap spreads and its trend closely tracks the main phases of the sovereign debt crisis (Figure 14, left-hand panel): it is virtually unchanged until the third quarter of 2008, picks up in late 2008-early 2009, starts rising in the second quarter of 2010, reaches a maximum in the summer 2012, and sharply declines afterwards.

[23] The countries included in the sample are: Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain. The swap spread is the difference between the yield of the benchmark bond on a given maturity and the swap rate for that maturity. This measure was preferred to the perhaps more conventional yield spread with respect to the German Bund to allow the model also to provide an estimate of the fair value for the sovereign risk premium for Germany.

Using that indicator as a proxy of systemic euro-area risk, and building upon Bufano and Manna (2012), we estimate the following panel model for sovereign 10-year swap spreads:

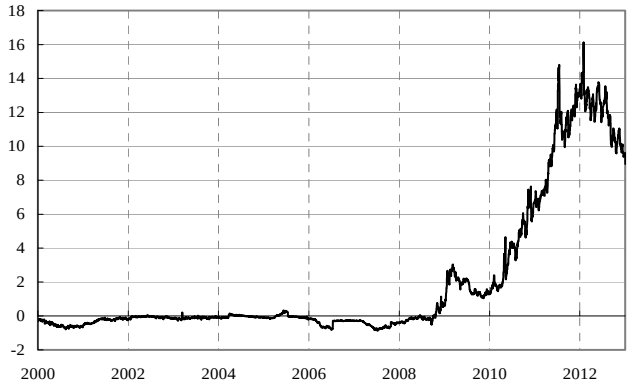
$$s_{i,t} = \beta_0 + \beta_{1,i} C1_t + \beta_2 \left(\frac{debt}{GDP} \right)_{i,t} + \beta_3 \left(\frac{deficit}{GDP} \right)_{i,t} + \beta_4 E_{t,t+5} \left(\frac{\Delta GDP}{GDP} \right)_{i,t} + \varepsilon_{i,t} \,, \tag{8}$$

where *C1* is the first principal component and the expected growth in real GDP refers to a five-year horizon.[24] The right-hand panel of Figure 14 shows the fitted values of the sovereign spread of Italy relative to Germany for two different specifications. According to the specification that only includes fundamentals among the explanatory variables – model (8) without the systemic risk indicator *C1* – the predicted value of the 10-year yield spread between Italy and Germany for October 2012 is equal to 90 basis points. This number is more than 250 basis points lower than its actual value at that time and broadly unchanged from the fitted value for 2011. If one also includes the systemic risk indicator *C1* on the right-hand side of model (8), the forecast for the Italian swap spread increases considerably while that for the German swap spread declines somewhat. In this case the predicted level of the spread of Italy with respect to Germany reaches 370 basis points, close to the actual value.

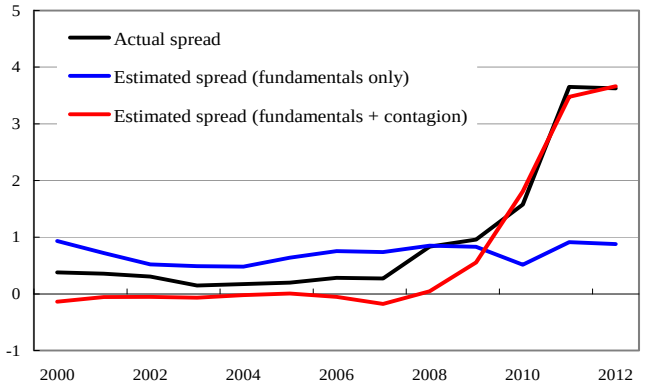
Figure 14

Sovereign risk premia of euro-area countries:
A model of generalised euro-area risk

First principal component of euro-area sovereign 10-year swap spreads (1)



Actual and fitted values of the 10-year swap spread of Italy relative to Germany (2)



Source: based on Bufano and Manna (2012).
(1) Daily data. The principal component analysis is carried out from 2000 to2012. – (2) Annual data, in percentages. Data as of 1st October of each year. Fitted values for 2012 are out-of-sample fits.

[24] The model is estimated on data from 2000 to 2011. The estimated coefficients turn out to have the expected sign and are in line with the results found in previous studies. For details, see Bufano and Manna (2012), where a slightly different specification of model (8) is analysed, over an extended sample.

6. Conclusions

The analyses presented in this paper – which in some cases are obtained by building on the results of other studies – are broadly consistent with those of the earlier literature. In particular, financial market indicators and econometric results suggest that:

(i) In recent months the spectacular reduction of long-term German yields (standing at around 1.3 per cent as of end-August 2012) is to a large extent due to safe haven flows;

(ii) For several countries, we find robust evidence that in the most recent period the spreads vis-à-vis the German Bund have risen to levels that are significantly higher than what could be justified by fundamentals;

(iii) For Italian government bonds, most estimates of the value of the 10-year spread consistent with fundamentals are around 200 basis points, against its market value of about 450 points (at end-August 2012). The values estimated on the basis of fundamentals are markedly lower than the actual values also for the 2- and 5-year spreads.

The large gap between the market and model-based values of sovereign spreads needs to be explained. Possible alternative hypotheses are the following:

- One cannot completely rule out the possibility that financial market participants' expectations about the fiscal outlook are much more negative than one can gauge on the basis of past trends or consensus forecasts. However, given the relatively small magnitude of the estimated effects of these variables on interest rates (as explained in Section 3), it is worth observing that these pessimistic scenarios should imply a massive and persistent increase in public deficits and debts, much larger than is usually discussed anecdotally by market participants.
- Another possibility is that market participants have a biased perception of the risks associated with sovereign bonds. This might come from the difficulty of exactly measuring and quantifying these risks, which might lead investors to make oversimplifying assumptions (e.g. rule-of-thumb assessments) and take into consideration only very pessimistic or worst-case scenarios.
- Even under the hypothesis that risks are correctly measured, there may have been a surge in the price required by investors to bear these risks. Re-pricings of risk of this kind are inherently difficult to measure as they are intimately related to unobservable changes in investors' preferences and non-diversifiable risks. However, some of the regressions presented in this

paper suggest that the large discrepancies between the actual and model-based values of the spreads persist even when changes in the price of risk are controlled for by considering time-varying coefficients or commonly used proxies of investors' risk aversion.

While we plan to assess the contribution of these alternative explanations in future work, the size and persistence of the recent dynamics of interest rates that is not explained by fundamentals suggest that some common new risk factor is at play, clearly not accounted for by the models used so far.

Given the timing of the increase of sovereign yields in the countries most exposed to tensions and the concurrent, spectacular fall of sovereign yields in fiscally sounder countries, the natural and most likely candidate for the large gap between the market and model-based values of sovereign spreads is the perceived risk of a break-up of the euro area. Concerns about the fragility of the euro are increasingly and widely mentioned by a number of market observers and have apparently caught the attention of the public at large. The assumption of a prominent role of euro break-up risks is also corroborated by some new findings presented in this paper. For the bonds issued by some "core" and "non-core" countries the deviations of the yields from the values justified by fundamentals are in opposite directions. Moreover, those deviations turn out to be strongly correlated with an indicator of euro break-up risks. In conclusion, fears of the reversibility of the euro have likely played a key role in the recent huge widening of the dispersion of government bond yields across euro-area countries.

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Annex 1: The literature on the impact of fiscal variables on interest rates: A synoptic table

Summary of selected empirical works on the impact of fiscal variables on sovereign bonds, reprint from Haugh, Ollivaud and Turner (2009)

Reference	Countries	Fiscal variables (1)	Estimated effects on long-term interest rates in basis points (bps)
		Studies that focus on flow fiscal variables	
Thomas and Wu (2009)	United States	A 1% point increase in projected fiscal deficit in 5 years	30-60 bps
Bernoth et al (2006)	14 EU countries	A debt -service ratio 5% above Germany's	32 bps (spread vs. Germany, post-EMU period, some non-linear effects)
Dai and Philippon (2005)	United States	A 1% point increase in fiscal deficit lasting 3 years	20-60bp
Ardagna et al (2007)	16 OECD countries	A 1% point deterioration in primary balance	10 bps
Laubach (2003)	United States	A 1% point increase in projected fiscal deficit	25 bps
Literature review by Gale and Orzag (2003)	United States	A 1% point increase in projected fiscal deficit	40-50 bps
Literature review by Gale and Orzag (2002)	United States	A 1% point increase in projected fiscal deficit	50-100 bps (macro models) 50 bps (others)
Canzeroni, Cumby and Diba (2002)	United States	A 1% deterioration in projected fiscal balance, 5 to 10 year ahead	41-60 bps (Spread of 10-year yield over 3-month)
Linde (2001)	Sweden	A 1% deterioration in fiscal balance	25 bps after 2 years (Domestic-foreign long-term interest differential)
Reinhart and Sack (2000)	19 OECD countries G7	A 1% deterioration in fiscal balance in current and next years	9 bps (yield) 12 bps (yield)
Orr, Edey and Kennedy (1995)	17 OECD countries	A 1% point deterioration in fiscal balances	15 bps
		Studies that focus on stock fiscal variable	
Chinn and Frankel (2005)	Germany, France, Italy, UK and Spain USA	A 1% increase in current net debt A 1% increase in net public debt ratio projected 2 years ahead A 1% increase in current or projected net debt	5-8 bps 10-16 bps 5 bps over period 1998-2002, but obscured when extended to 2004
Ardagna et al (2007)	16 OECD countries	Public debt	non-linear
Engen and Hubbard (2004)	United States	A 1% point increase in debt ratio	3 bps (with ranges)
Laubach (2003)	United States	A 1% point increase in projected debt ratio	4 bps
Chinn and Frankel (2003)	Germany, France, Italy, Japan, Spain UK and USA	A 1% increase in net public debt ratio projected 2 years ahead	3-32 bps (individual country) 7-12 bps (European interest rates)
Codogno et al (2003)	9 EMU countries	Debt-to-GDP ratio	Small and significant effects on spreads for Austria, Italy and Spain
Conway and Orr (2002)	7 OECD countries	A 1% point increase in net public debt	Less than 1 bps (Real 10-year bond yields, starting from zero net debt) 1.5 bps (Real 10-year bond yields, starting from 100% net debt)
O'Donovan, Orr and Rae (1996)	7 OECD countries	A 1% point increase in net public debt	Less than 1 bps (Real 10-year bond yields, starting from zero net debt) 2 bps (Real 10-year bond yields, starting from 100% net debt)
Ford and Laxton (1995)	9 countries World	A 1% point increase in world net public debt	14 - 49 bps (Real 1-year bond yields) 15 -27 bps (Real 1-year bond yields)

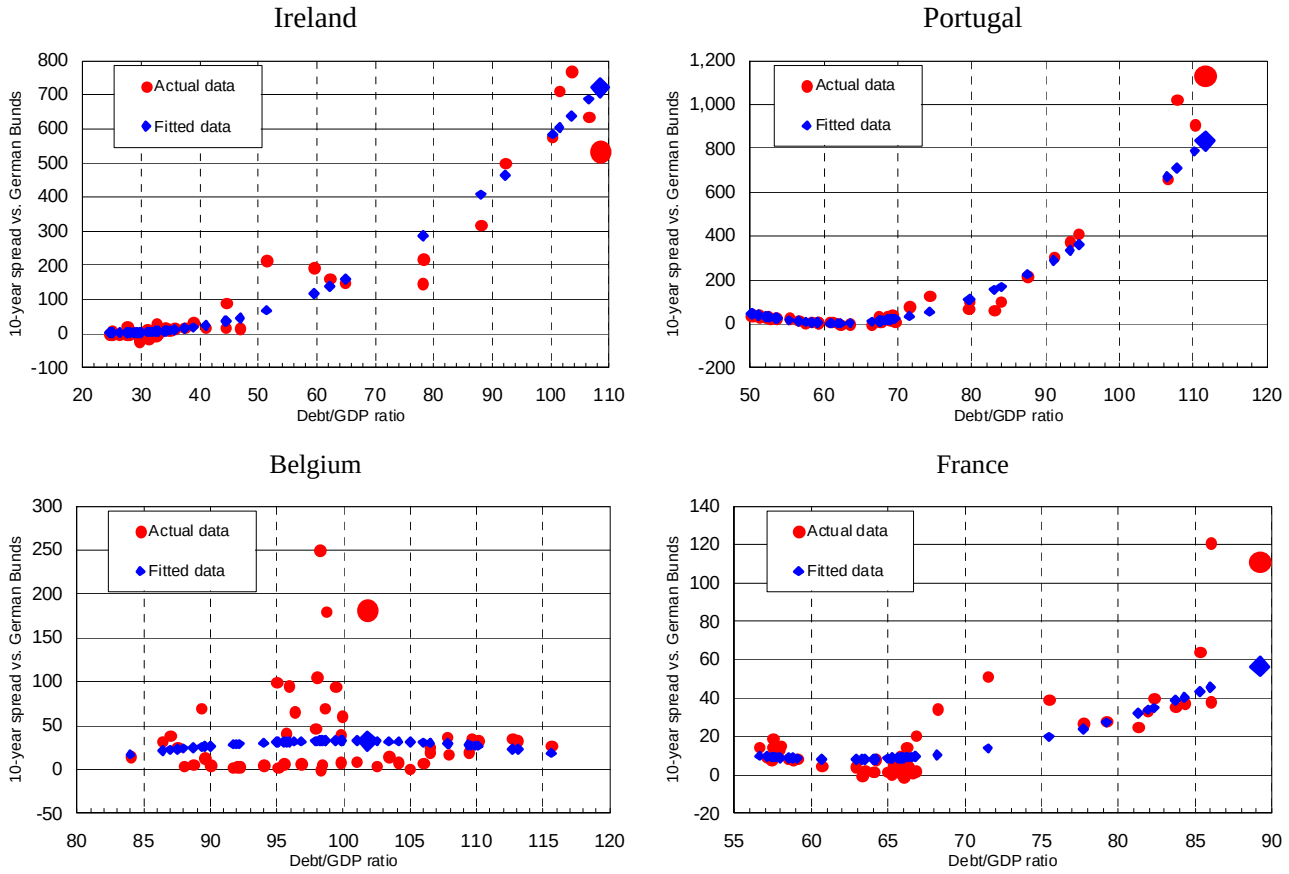
Source: Haugh, Ollivaud and Turner (2009).
(1) All changes are expressed in relation to GDP unless otherwise specified.

Annex 2: Graphs

Figure A.1

Ten-year sovereign spreads with respect to Germany as a non-linear function of debt-to-GDP ratios (1)

(quarterly data; percentages and basis points)

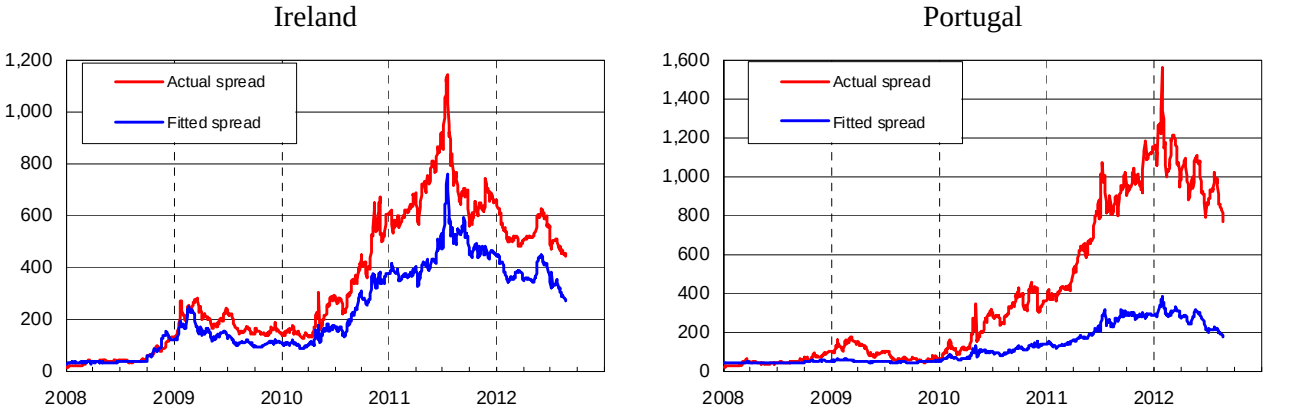


Source: based on Bloomberg and Thomson Reuters Datastream data.
(1) The larger markers denote the latest observations (2012 Q1).

Figure A.2

Ten-year sovereign spreads with respect to Germany based on the results by Ainzenman et al. (2011) for sovereign CDSs (1)

(daily data; basis points)



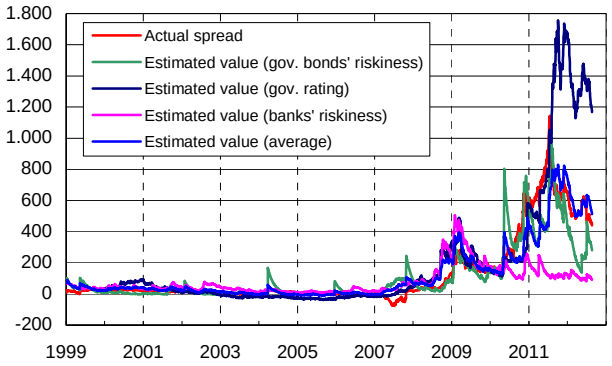
(1) Fitted values are generated by using the estimates by Ainzenman, Hutchison and Jinjarak (2011) of the value of the premia on sovereign 5-year CDSs consistent with fundamentals.

Figure A.3

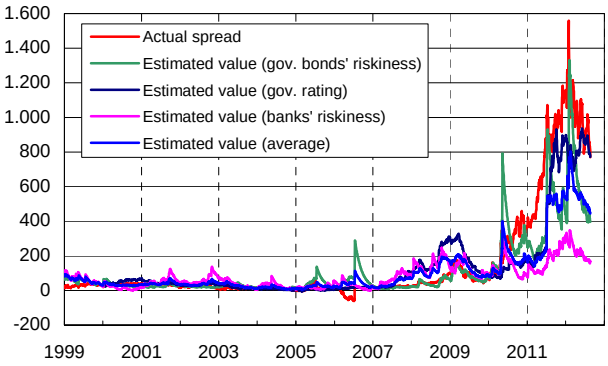
Ten-year sovereign spreads with respect to Germany as a function of financial indicators of country risk

(daily data; basis points)

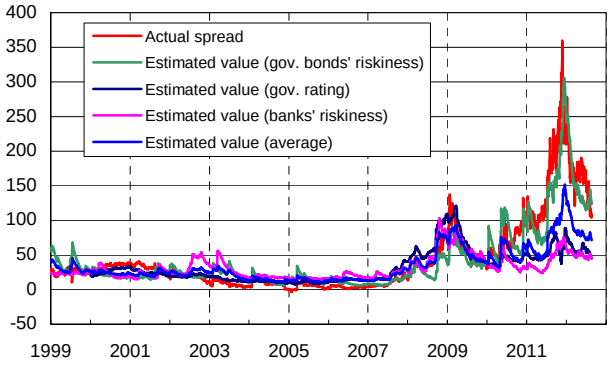
Ireland



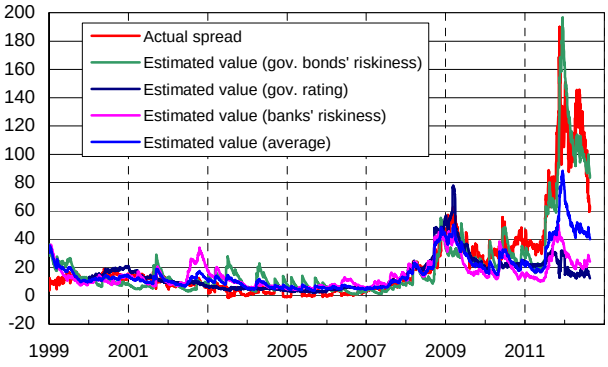
Portugal



Belgium



France



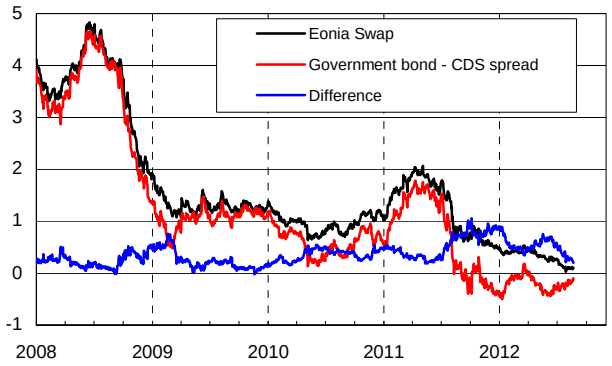
Source: based on Bloomberg and Thomson Reuters Datastream data.

Figure A.4

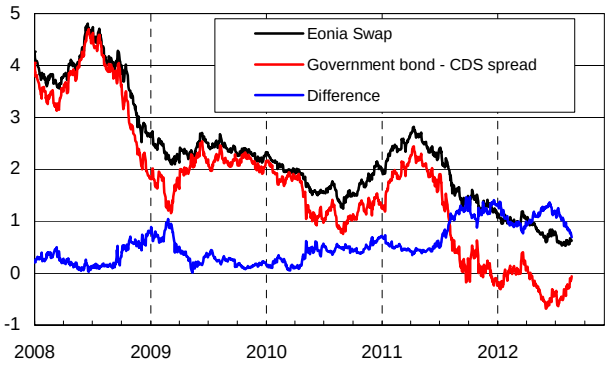
Differential between the Eonia swap rate and the sovereign bond-CDS spread for Germany at the 2- and 5-year maturities

(daily data; percentages)

2 years



5 years



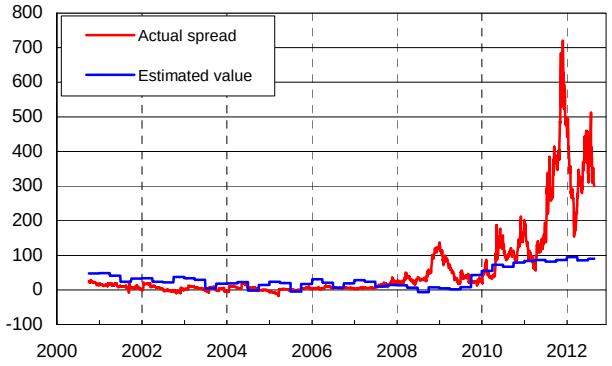
Source: based on Bloomberg data.

Figure A.5

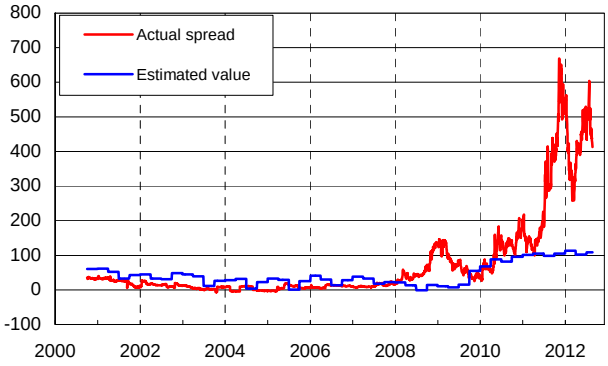
Italian 2- and 5-year sovereign spreads with respect to Germany as a function of debt-to-GDP ratios

(daily data; basis points)

2 years



5 years

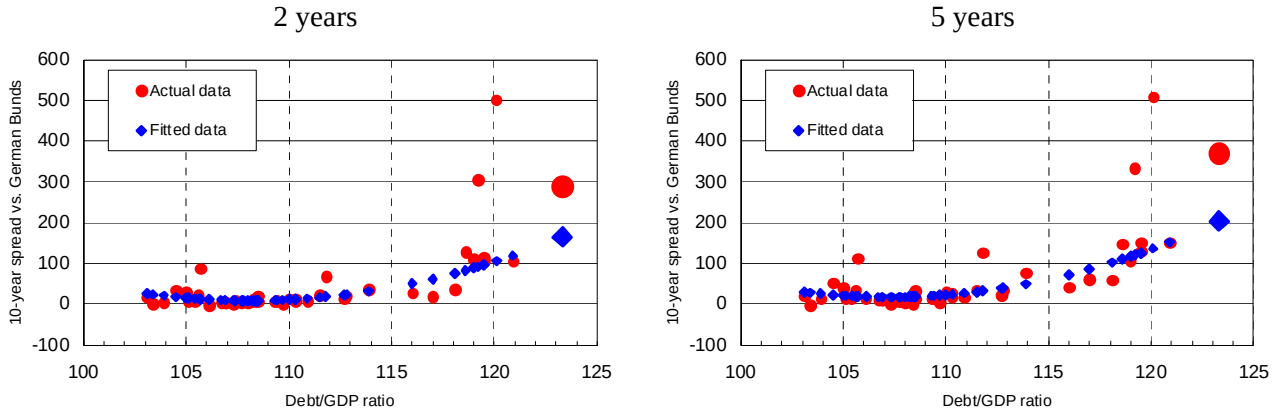


Source: based on Bloomberg and Thomson Reuters Datastream data.

Figure A.6

Italian 2- and 5-year sovereign spreads with respect to Germany as a non-linear function of debt-to-GDP ratios (1)

(quarterly data; percentages and basis points)

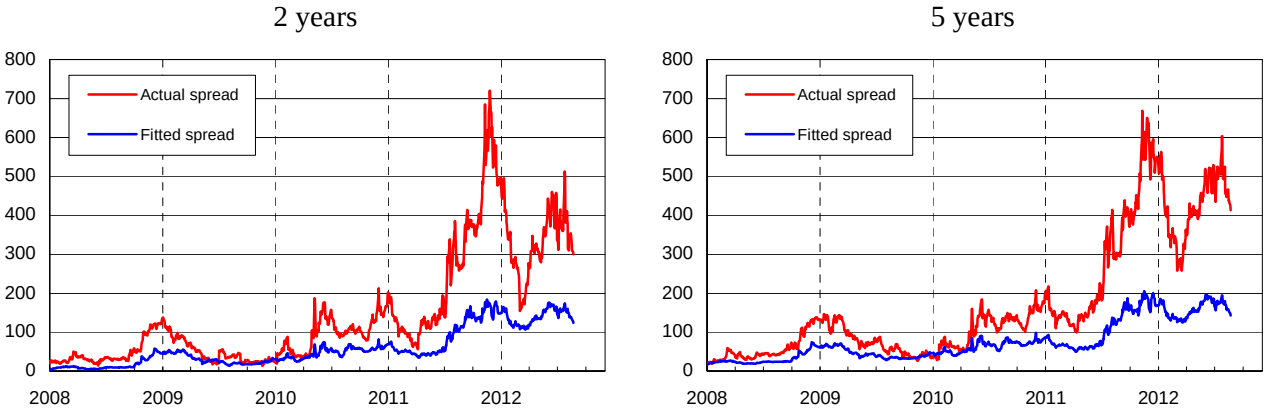


Source: based on Bloomberg and Thomson Reuters Datastream data.
(1) The larger markers denote the latest observations (2012 Q1).

Figure A.7

Estimates of the Italian 2- and 5-year sovereign spreads with respect to Germany based on the results by Ainzenman et al. (2011) for sovereign CDSs (1)

(daily data; basis points)

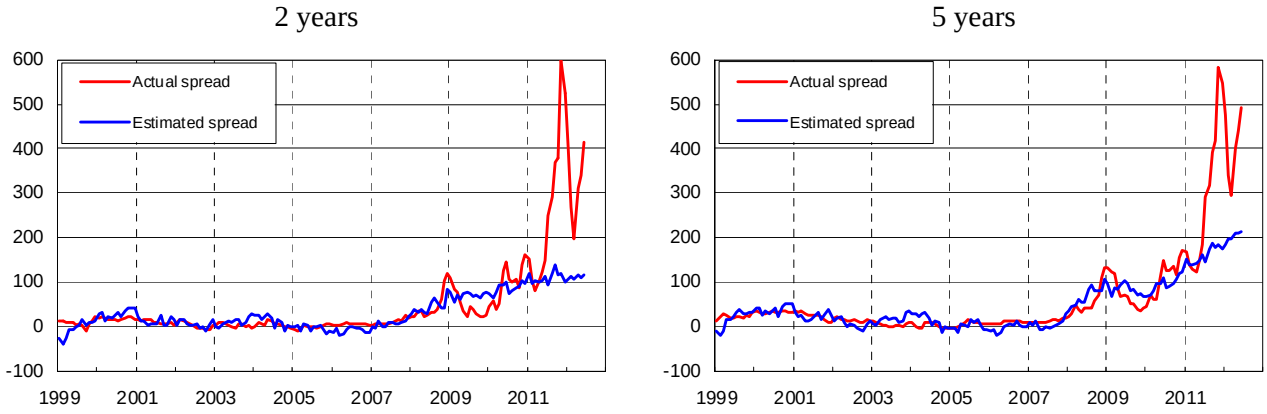


(1) Fitted values are generated on the basis of Ainzenman, Hutchison and Jinjarak (2011)'s estimates of the value of the premia on sovereign 5-year CDSs that are consistent with current fundamentals.

Figure A.8

Italian 2- and 5-year sovereign spreads with respect to Germany as a function of consensus expectations on fiscal and other economic fundamentals (1)

(monthly data; basis points)



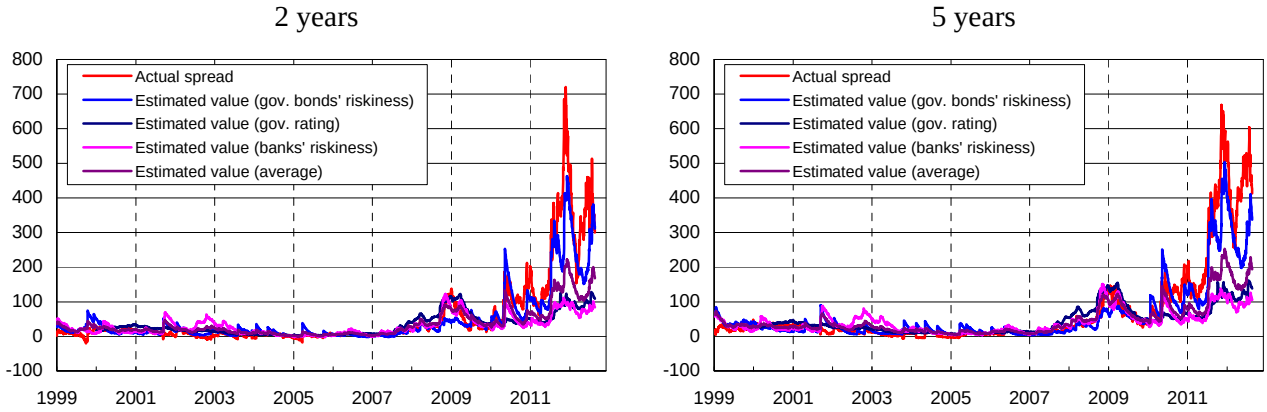
Source: based on Bloomberg, Thomson Reuters Datastream and Consensus Forecasts data.

(1) The estimated spread is the difference between the fitted values of the Italian and German interest rates. Interest rates are modelled as a function of the expected deficit/GDP ratio over the next 12 months and the 12-month-ahead forecasts of other macroeconomic variables (expected three-month interest rates, GDP growth rate, consumer price inflation, unemployment rate and the current account/GDP ratio). Since July 2011 the estimated spread is based on out-of-sample forecasts.

Figure A.9

Italian 2- and 5-year sovereign spreads with respect to Germany as a function of financial indicators of country risk

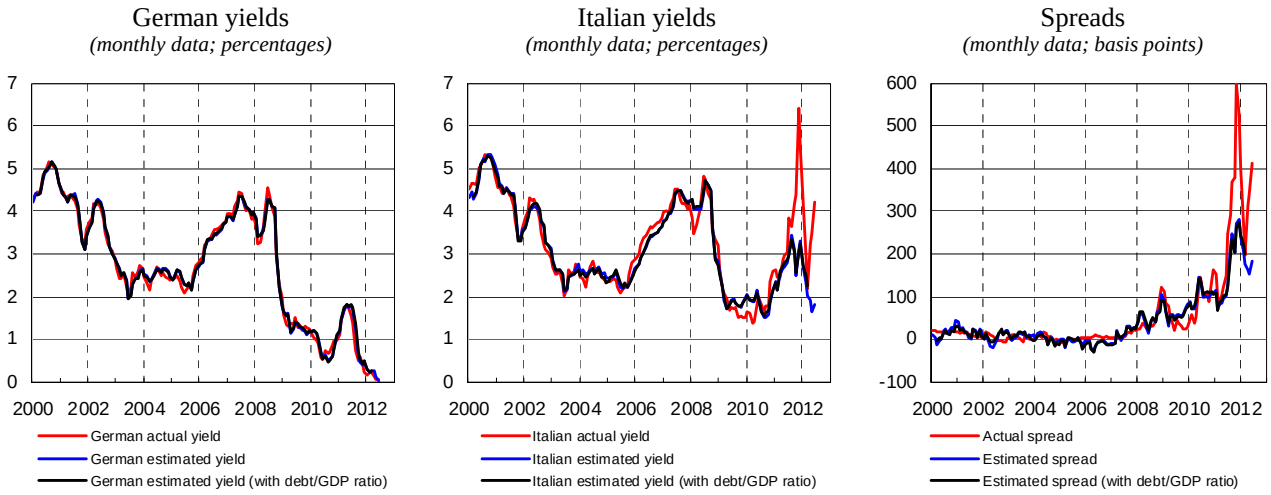
(daily data; basis points)



Source: based on Bloomberg, Thomson Reuters Datastream and Consensus Forecasts data.

Figure A.10a

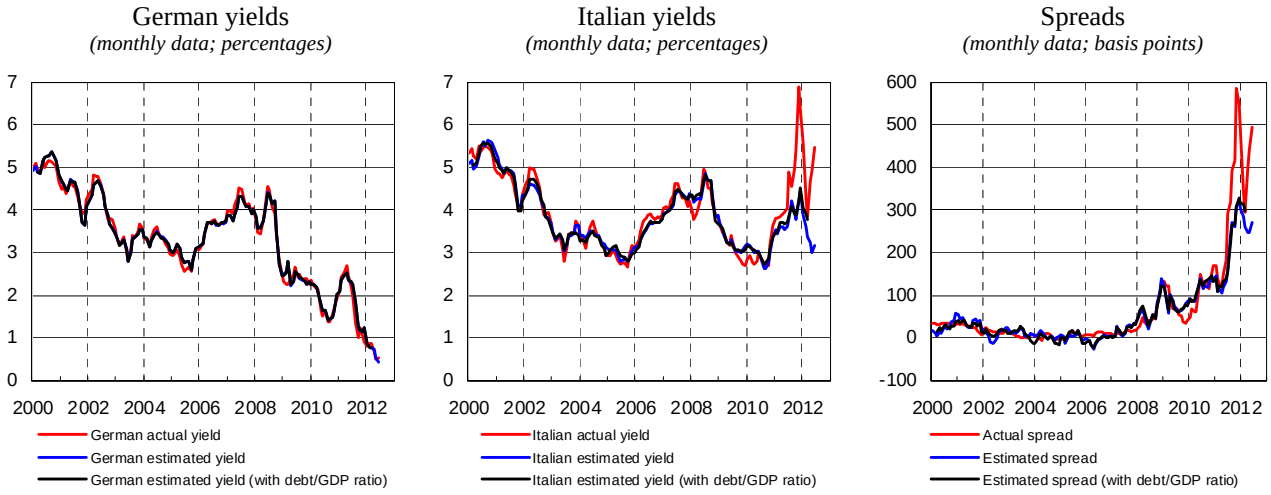
German and Italian 2-year government bond yields and spreads as a function of fundamentals and financial factors



Source: based on Bloomberg, Thomson Reuters Datastream and Consensus Forecasts data.
(1) Yields are modelled as a function of three financial risk indicators (yield volatility, bank share price volatility and yield of corporate bonds with the same rating as the sovereign), the expected deficit/GDP ratio over the next 12 months and the 12-month-ahead forecasts of other macroeconomic variables (expected three-month interest rates, GDP growth rate, consumer price inflation, unemployment rate and the current account/GDP ratio). An extended specification also includes the current level of the debt-to-GDP ratio among the regressors. Since July 2011 fitted values are based on out-of-sample forecasts.

Figure A.10b

German and Italian 5-year government bond yields and spreads as a function of fundamentals and financial factors



Source: based on Bloomberg, Thomson Reuters Datastream and Consensus Forecasts data.
(1) Yields are modelled as a function of three financial risk indicators (yield volatility, bank share price volatility and yield of corporate bonds with the same rating as the sovereign), the expected deficit/GDP ratio over the next 12 months and the 12-month-ahead forecasts of other macroeconomic variables (expected three-month interest rates, GDP growth rate, consumer price inflation, unemployment rate and the current account/GDP ratio). An extended specification also includes the current level of the debt-to-GDP ratio among the regressors. Since July 2011 fitted values are based on out-of-sample forecasts.

Annex 3: Econometric results

Table A – Econometric results of selected models

The table shows coefficient estimates and associated p-values for some of the models presented in Section 4 (the sub-section is indicated in the first row of the table). Standard errors are corrected for autocorrelation and heteroskedasticity with the Newey-West algorithm.Country codes: DE=Germany, IT=Italy.

Reference section	4.5.1		4.3		4.5.1		4.3		4.4		4.4		4.4		4.4	
Dependent variable	10-year IT yield		10-year IT yield		10-year DE yield		10-year DE yield		10-year IT-DE spread		10-year IT-DE spread		10-year IT-DE spread		10-year IT-DE spread	
	coef.	p-value	coef.	p-value	coef.	p-value	coef.	p-value	coef.	p-value	coef.	p-value	coef.	p-value	coef.	p-value
Constant	0.21	[0.65]	0.92	[0.14]	-1.16	[0.02]	3.67	[0.00]	9.21	[0.00]	-1.26	[0.78]	4.99	[0.13]	12.30	[0.00]
3-month rate	0.05	[0.43]	0.37	[0.00]	0.11	[0.24]	0.46	[0.00]								
GDP	0.19	[0.00]	-0.12	[0.00]	0.10	[0.00]	0.00	[0.95]								
CPI	-0.14	[0.02]	-0.36	[0.35]	-0.08	[0.29]	-0.39	[0.00]								
Unemployment	0.19	[0.00]	0.39	[0.00]	0.17	[0.00]	0.01	[0.88]								
Budget balance	0.06	[0.21]	0.30	[0.00]	0.01	[0.86]	0.08	[0.25]								
Current account	-0.19	[0.01]	-0.36	[0.00]	-0.03	[0.08]	-0.12	[0.00]								
Yield volatility	5.04	[0.05]			4.15	[0.28]										
Spread volatility									19.60	[0.00]					18.90	[0.00]
Banks volatility	-0.11	[0.01]			-0.10	[0.00]					33.50	[0.00]			-13.30	[0.00]
Corporate spread	0.53	[0.00]			0.74	[0.00]							0.52	[0.00]	3.90	[0.00]
R-square	0.94		0.84		0.96		0.84		0.80		0.38		0.52		0.88	
Sample period	2000:M1-2011:M6		1999:M1-2011:M6		2000:M1-2011:M6		1999:M1-2011:M6		4 Jan. 99-30 June 11		4 Jan. 99-30 June 11		4 Jan. 99-30 June 11		4 Jan. 99-30 June 11	

Table B – Robustness of the estimates of the 10-year Italian yield

The table shows the equation of the 10-year Italian yield presented in Section 4.5 estimated on three different sample periods: 2000:M1-2011:M6 (as in Section 4.5.1); 2007:M1-2011:M6; 2007:M1-2012:M11. Standard errors are corrected for autocorrelation and heteroskedasticity with the Newey-West algorithm.

Dependent variable	10-year IT yield		10-year IT yield		10-year IT yield	
	coef.	p-value	coef.	p-value	coef.	p-value
Constant	0.21	[0.65]	-1.08	[0.20]	1.06	[0.30]
3-month rate	0.05	[0.43]	0.21	[0.01]	0.05	[0.73]
GDP	0.19	[0.00]	0.12	[0.02]	0.10	[0.20]
CPI	-0.14	[0.02]	-0.23	[0.02]	-0.29	[0.02]
Unemployment	0.19	[0.00]	0.43	[0.00]	0.27	[0.00]
Budget balance	0.06	[0.21]	0.22	[0.00]	0.32	[0.00]
Current account	-0.19	[0.01]	-0.28	[0.00]	-0.37	[0.00]
Yield volatility	5.04	[0.05]	7.06	[0.00]	11.61	[0.00]
Spread volatility						
Banks volatility	-0.11	[0.01]	-0.20	[0.00]	-0.21	[0.00]
Corporate spread	0.53	[0.00]	0.46	[0.00]	0.38	[0.00]
R-square	0.94		0.90		0.89	
Sample period	2000:M1-2011:M6		2007:M1-2011:M6		2007:M1-2012:M11	