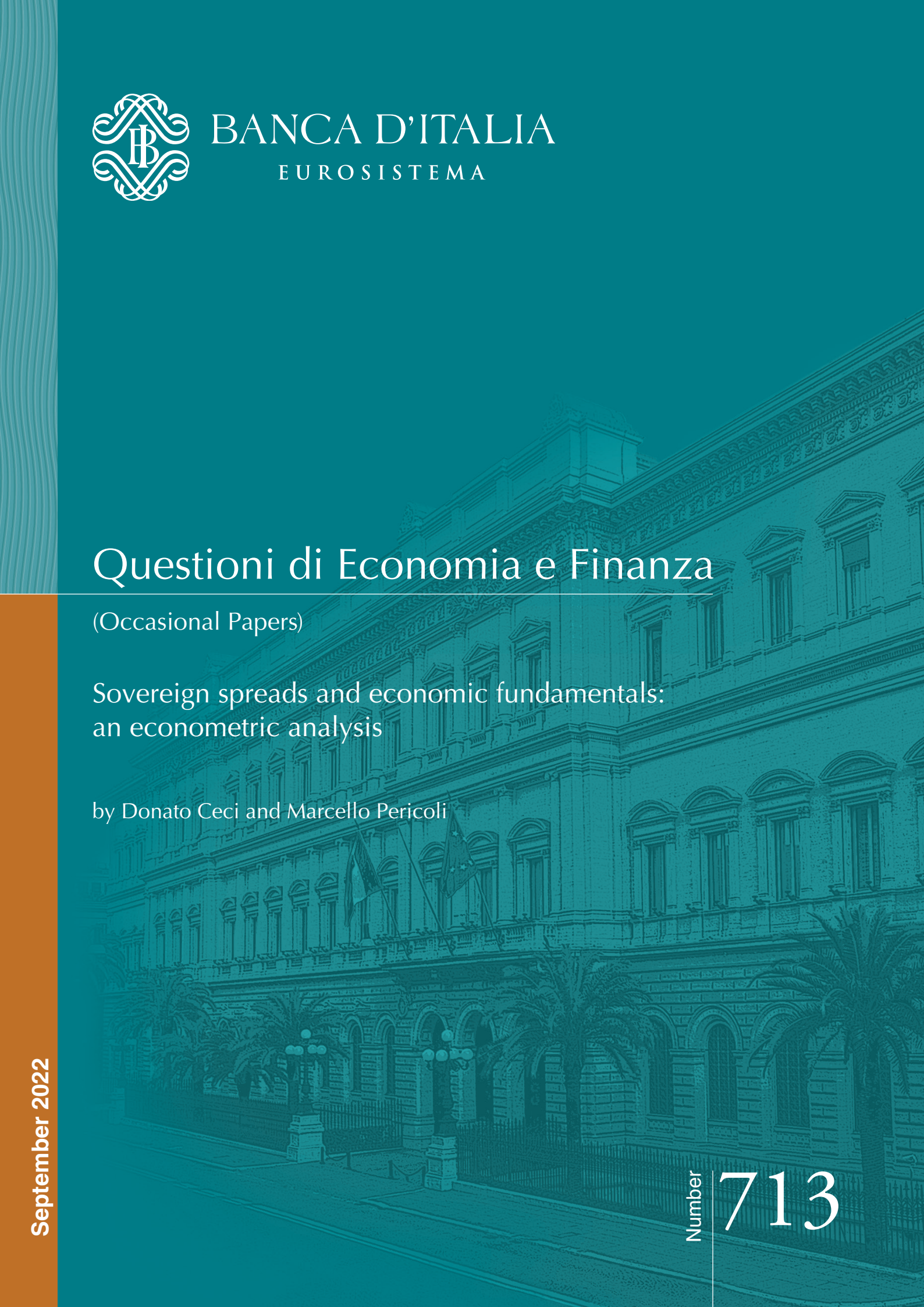

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SOVEREIGN SPREADS AND ECONOMIC FUNDAMENTALS: AN ECONOMETRIC ANALYSIS

by Donato Ceci* and Marcello Pericoli*

Abstract

This paper provides an estimate of the fair value of the Italian ten-year sovereign spread, defined as a value consistent with the country's macroeconomic fundamentals. It uses a multi-country model in which the spreads of the government bond yields of Italy, France and Spain with respect to the German bond yield are regressed on a set of fundamental macroeconomic variables and a set of variables approximating the risk perception of investors, for the period January 2007 – June 2022. The results show that, in the last ten years, the observed level has often been above the fair value, with significant upward deviations during periods of market tensions and/or political uncertainty. The dynamics of the debt-to-GDP ratio and those of expected growth show, respectively, a positive and a negative relationship with the trend of the fair value. In the last two years, expected inflation has also played an important role: while its decline exerted a downward effect on the fair value in 2020 and for part of 2021, the increase observed since the last quarter of 2021 has led to a rise in the fair value.

JEL Classification: E44, G15, H63.
Keywords: sovereign bond spread, macroeconomic fundamentals, risk aversion.
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Contents

* Bank of Italy, Economic Outlook and Monetary Policy Directorate.

1. Introduction[1]

This paper provides an estimate of the fair value of the Italian ten-year sovereign spread, defined as a value consistent with the country's macroeconomic fundamentals. It uses a multi-country model in which the spreads of the government bond yields of Italy, France and Spain with respect to the German bond yield are regressed on a set of fundamental macroeconomic variables and a set of variables approximating the risk attitude of investors, for the period January 2007 – June 2022. A multi-country model is the most appropriate approach for countries belonging to a highly integrated economic and financial area with assets denominated in the same currency, such as the euro area. In this context, investors are likely to respond in a similar way to the evolution of the variables that determine the prices of comparable assets. In any case, we also present estimates obtained with single-country models, and we carry out various robustness checks.

The results provide indications on the deviations of sovereign bond spreads from their fundamental-based values and on the contributions of the possible drivers. Point estimates of fair values, however, need to be used with extreme caution, especially those for the last two years, as the models incorporate the large swings in GDP growth and the inflation observed since the outbreak of the pandemic.

The rationale for identifying a fair value for the sovereign spread, which had gained relevance following the financial crisis and especially during the sovereign debt crisis in the euro area, has raised renewed interest in connection with the increase in sovereign credit risk among euro-area countries between the second half of 2021 and the first half of 2022.

The main results are the following. First, in the last ten years, the value of the spread implied by macroeconomic fundamentals has often been below the observed level, with significant upward deviations during periods of market tensions and political uncertainty (i.e. the sovereign debt crisis in 2011-2012, the political uncertainty in mid-2018 and the onset of the pandemic in March 2020). Second, the public debt-to-GDP ratio contributed positively to the spread and its contribution has remained broadly stable during the pandemic.

Third, over the last two years, swings in expected growth, both in the short and medium term, have had a strong impact on the dynamics of the fair spread; in particular, the large increase in expected growth at the beginning of 2021 induced a sharp temporary fall in the fair value, while a downward revision contributed to its recent rise.

Finally, over the last two years, expected inflation has also played an important role. While its decline exerted a downward effect on the fair value in 2020 and for part of 2021, the increase observed since the last quarter of 2021 has led to a rise in the fair value. This latter effect could be related to investors' expectations of a faster-than-anticipated monetary policy normalization in the euro area as a reaction to accelerating price dynamics.

Estimates of the fair spreads are less volatile than market values and never reach the peaks observed for the latter during bond market tensions. At the end of June 2022, the fair values were around 135bp for Italy, 65bp for Spain and 40bp for France; the observed values were 200bp, 111bp and 50bp, respectively.

[1]The opinions expressed are those of the authors and do not necessarily reflect those of Banca d'Italia. The authors would like to thank – without in any way implicating – Paolo del Giovane, Antonio Di Cesare, Stefano Neri, Marco Taboga and Pietro Tommasino for their comments. Any errors are of course ours.

The multi-country model is estimated using a panel regression model with country fixed effects, suited to capturing both country-specific characteristics and broader common relationships, given that we consider countries belonging to a highly integrated economic and financial area with assets denominated in the same currency. In addition, we estimate alternative specifications of the model to test its robustness. In particular, we estimate the model for each individual country and we estimate the multi-country model by using different regressors or applying different techniques. The alternative models produce (as of June 2022) a 70-190bp range for the fair value of the Italian spread, with a median of 134, suggesting the presence of uncertainty in the point estimates.

The paper is structured as follows. Section 2 presents a brief survey on the literature and the model. Section 3 describes the data and Section 4 documents the results. Section 5 shows some robustness checks and Section 6 concludes.

2. Literature and methodology

The literature on the determinants of sovereign spreads in EMU expanded following the global financial crisis and flourished further during the sovereign debt crisis in the euro area.

A number of papers (Hallerberg and Wolff 2008; Attinasi et al. 2009; Beber et al. 2009; Schuknecht et al. 2009; Sgherri and Zoli 2009; Favero et al. 2010) use models that typically explore the role of country-specific factors, namely fiscal fundamentals and market liquidity, and common factors, such as the market appetite for risk.

Another stream of studies analyzed the role of contagion in inducing unjustified increases in spreads during periods of tension within EMU by introducing a variable capturing developments in other countries. Caceres et al. (2010) employ a measure of 'distress dependence' from credit default swaps while Hondroyiannis et al. (2012) add a 'contagion variable', defined as a weighted combination of other countries' spreads. Giordano et al. (2013) use a more precise and circumscribed definition of contagion in the spirit of Eichengreen et al. (1996), Masson (1998) and Goldstein et al. (2000), who distinguish between wake-up-call contagion, shift contagion and pure contagion. Analogously to Giordano et al. (2013), Bernoth et al. (2012) find that the Lehman's bankruptcy increased the sensitivity of spreads to country-specific fundamentals and global factors.

Very few studies present estimates of sovereign spreads consistent with fundamentals. Among these, De Grauwe and Li (2012) show that a significant part of the surge in the spreads of Portugal, Ireland, Italy, Greece and Spain in the euro area during 2010–11 was disconnected from underlying increases in the debt-to-GDP ratios, and was the result of negative market sentiments that became very strong since the end of 2010. They argued that the systematic mispricing of sovereign risk in the euro area intensifies macroeconomic instability, leading to bubbles in good years and excessive austerity in bad years. In the same spirit, Di Cesare et al. (2012) document that during the euro area debt crisis the spread has increased to levels that were well above those that could be justified on the basis of fiscal and macroeconomic fundamentals because the investors' perceived risk of a breakup of the euro area. Favero (2013) follows the setup of Favero and Missale (2012) and using a Global Vector Autoregressive model studies the dynamics of euro-area spreads, with the introduction of local factors, fiscal fundamentals and growth, a global world factor, market's appetite for risk, and a third factor, expectations of exchange rate devaluation. Results show that spreads capture the time-varying 'distance' between countries' fiscal fundamentals. More recently, Dewachter et al. (2015) estimate the 'fundamental' component of euro area sovereign bond yield spreads, as the part of bond spreads that can be justified by country-specific economic factors, euro area economic fundamentals, and

international influences. The decomposition is achieved using a multi-market no-arbitrage affine term structure model, with a unique pricing kernel. They show that, albeit economic fundamentals are the dominant drivers behind yield differentials, non-fundamental risk have had a significant impact on bond spreads since September 2011 in particular in the short term. Barclays (2022) uses a panel quarterly dataset of twelve major euro area countries for modelling the 10-year government bond spreads versus the 10-year German bond yield; domestic variables are in difference with the corresponding German variables and the fair value is defined by the fitted value from the panel regression.

This paper follows in spirit the work by De Grauwe and Li (2012) and Giordano et al. (2013) to provide estimates of the fair value of sovereign spreads for Italy, France and Spain. Fair value is defined as the value consistent with the country's macroeconomic fundamentals, which are relevant in shaping its creditworthiness. We adopt a multi-country model, since we consider it appropriate for countries belonging to a highly integrated economic and financial area with assets denominated in the same currency, such as the euro area. In this context, investors are likely to respond in a similar way to the evolution of the variables that determine the prices of comparable assets. The three countries included in the model represent the largest economies in the euro-area, excluding Germany. Furthermore, the choice to analyse them jointly reflects the fact that France is considered a safe country, not too dissimilar to Germany, while the latter two countries are more vulnerable, due to high levels of public debt, and show a similar sensitivity of bond yields to macroeconomic developments.[2]

The econometric estimation of fair values of yields and the respective spreads is a difficult task, which may be carried out with different approaches and produce varying results depending on the adopted methodology. Therefore, results must be interpreted with caution (see Section 5 for some robustness checks).

We estimate with Ordinary Least Squares the following panel model with fixed-effects:

$$s_{it} = \alpha + \delta_i + \beta_0 Z_{it} + \beta_1 X_{it} + \beta_2 F_t + \epsilon_{it} , \quad (1)$$

where s_{it} is the end-of-period spread observed for country *i* at time *t* measured as the difference between the 10-year government bond yield of country *i* and the corresponding 10-year German bond yield; δ_i represents country fixed effects; Z_{it} includes country specific macroeconomic variables; X_{it} and F_t represent variables related to the risk attitude of investors which are, respectively, country specific and common to all countries. All covariates in the model enter the regression with no lags. Following De Grauwe and Ji (2012), the "fair value" of the spread is determined exclusively by the macroeconomic fundamentals, observed or expected in the near future. Accordingly, the fair value $\hat{s}_{it}$ of the spread of country *i* in month *t* is defined as the fitted value obtained as:

$$\hat{s}_{it} = \hat{\alpha} + \hat{\delta}_i + \hat{\beta}_0 Z_{it} , \quad (2)$$

where the parameters with the symbol ^ are those estimated with the panel regression in (1).

The use of multi-country models is generally appropriate for countries belonging to a highly integrated economic and financial area with assets denominated in the same currency, such as the

[2] The spread between Italian and German 10-year government bond yields increased by 40bp during the second half of 2021 and by 60bp in the first six months of 2022 exceeding 200bp in May 2022. The corresponding increases were 5bp and 20bp for France, and 10bp and 35bp for Spain.

euro area. In this context, investors are likely to respond in a similar way to the evolution of the variables that determine the prices of comparable assets.

3. Data

We use monthly data from January 2007 to June 2022 for a panel model that includes France, Italy and Spain.[3] The variables are selected according to their relevance in terms of public debt sustainability, macroeconomic outlook and risk aversion of global investors (see Giordano et al., 2013). The country-specific macroeconomic variables are as follows: (*i*) the debt-to-GDP ratio; (*ii*) the expected average inflation over the next five years surveyed by Consensus Forecast; (*iii*) the average real GDP growth rate expected over the next twelve months surveyed by Consensus Forecast; (iv) the average real GDP growth expected over the next five years surveyed by Consensus Forecast; and (v) the unemployment rate.[4] We use constant monthly data within the quarter for the debt-to-GDP ratio, for the expected average real GDP growth and inflation over the next five years.[5]

The model includes also indicators of risk aversion and re-denomination risk, i.e. the risk that the country's debt may be redenominated into a different currency because the country exits the euro area. Specifically, we consider the country-specific ISDA basis as a non-fundamental explanatory factor in the X_{it} vector to capture domestic risk.[6] As regards the risk of a break-up of the euro, we follow Di Cesare et al. (2012) and consider as a common factor (F_t) the search volume of "euro break-up" or similar keywords using the Google search engine (Google Index).[7] As opposed to the ISDA basis, this variable is more related to the euro area risk rather than to domestic risk. Both variables are taken as the average over the month. Finally, in our analysis we consider the political risk as a "non fundamental" factor, although admittedly this is a controversial issue, given that the political variables may have implications on the sustainability of public finance. Our approach corresponds to the idea that, from a policy point of view, political factors matter when they actually affect fundamentals, not simply because markets expect them to have an effect, which might or might not materialize.

4. Results

Figure 1 shows the observed spread and the fair value of the spread given by equation (2) for Italy, estimated with the panel methodology and fixed effects. Alternative estimation methods yield similar results.[8] Table A1 in the Appendix reports the panel regression results and Figures A2 and A4 in the Appendix show the observed and fair spreads for Spain and France.

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[3] In addition, model (1) is estimated with country-specific equations, as in Di Cesare et al. (2012) and Dewachter et al. (2015). See Section 5 for a discussion of the single-country results.

[4] These variables are selected using a general-to-specific methodology based on the variables suggested by the literature. A LASSO panel regression confirms our choice of variables.

[5] Due to data availability, the unemployment rate in June 2022 is fixed at the value observed in May 2022.

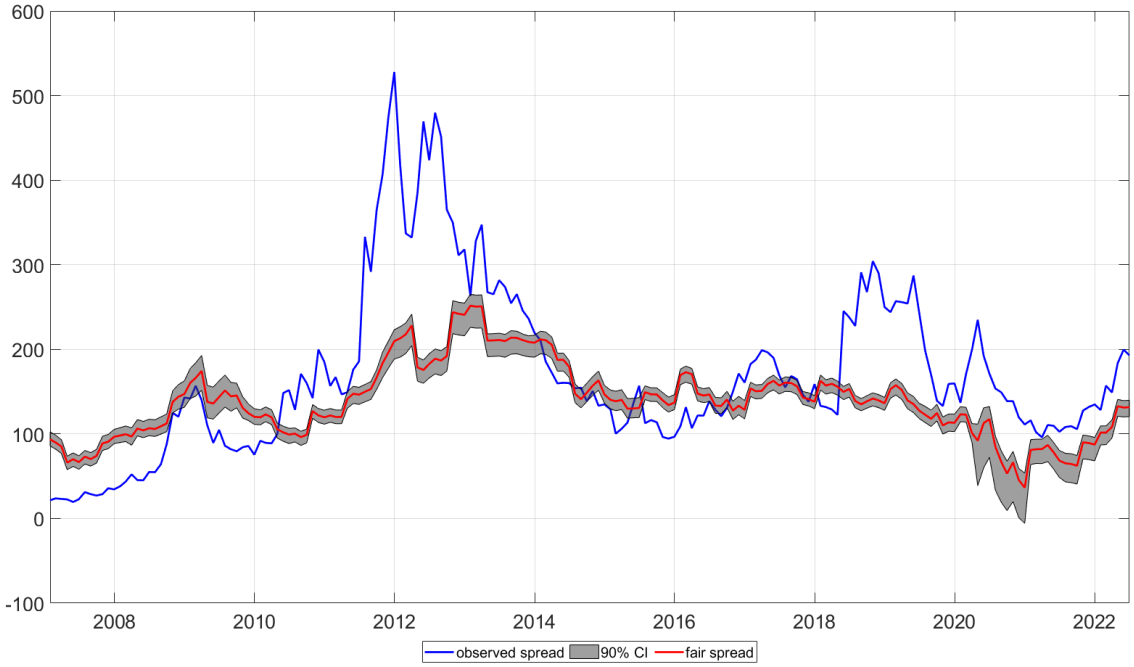
[6] The so-called ISDA basis is the difference between the CDS premia defined by the 2003 ISDA protocol and those defined by the 2014 ISDA protocol where the latter explicitly considers the redenomination of the debt in a different currency as a credit event which triggers a settlement under the CDS contract. Therefore, ISDA basis is widely retained as an indicator of re-denomination risk.

[7] Following Giordano et al. (2013), Dewachter et al. (2015) and De Grauwe and Li (2012), the regression model does not include information on sovereign bond market liquidity, which could be a relevant factor when dealing with high frequency data (our model is estimated on a monthly frequency).

[8] We also estimated model (1) with pooled OLS, the Robust Least Squares, the Generalized Method of Moments and the Quantile Regression. The results are similar to those presented in Figure 1.

Since the second half of 2010, the fair value has often been lower than the observed spread, with significant differences in periods of market tension and political uncertainty, such as during the sovereign debt crisis in 2011-2012, political uncertainty in mid-2018, and the onset of the pandemic in March 2020. In particular, in the period 2015-2019 the fair value remained almost stable, recording an average value of about 145bp, while the observed spread rose sharply since the spring of 2018 (up to 300bp), driven by political uncertainty, a factor captured by the risk component included in the regression model, and remained elevated until the first part of 2019. As to the pandemic period, the fair value remained relatively stable in the initial phase of the emergency, and then dropped drastically between the second half of 2020 and the beginning of 2021, driven by expectations of a strong recovery in GDP growth. Since the last quarter of 2021, however, it has grown roughly at the same pace of the observed spread, due to a slowdown in expected growth and an increase in expected inflation, returning to the levels reached in the first part of 2020 but still below the observed spread. As of June 2022, the fair value was around 130bp, 60bp below the end-of-month observed spread.

Figure 1. Italian spread: observed and fair values from January 2007 to June 2022
(*monthly data; basis points*)



Note: The figure shows the end-of-month current level of the spread (blue line) and the fair value of the spread estimated with a panel model with fixed effects (red line) computed from the subset of regressors in equation (2). The grey shaded area represents the 90% confidence interval (90% CI). Using a block-bootstrap algorithm, the interval is obtained estimating different regressions excluding each time a twelve months overlapping rolling window of consecutive observations over the entire sample.

The fluctuations in fair value in recent years, indicate that point estimates should be taken with extreme caution, as they reflect exceptionally large swings in expected GDP growth and inflation (see Figure A1 in the Appendix), as also suggested by the values of the estimated fair values for France and Spain at the beginning of 2021, which were respectively slightly and largely negative (see Figures A2 and A4 in the Appendix). This consideration also holds in perspective, given the new, exceptional increase in uncertainty on the macroeconomic outlook caused by the war in Ukraine.

Figure 2 illustrates the cumulated contributions of each variable in model (1) to the observed spread since January 2018; Figures A3 and A5 in the Appendix show the corresponding results for Spain and France.[9] In particular, the "growth" label refers to the sum of the contributions of the real GDP growth rate expected over the next twelve months and that expected over the next five years; the "risk" label refers to the contribution from both the ISDA basis and the Google Index; finally, the "residuals" label represents the amount of spread that is not explained by the regression model (1).

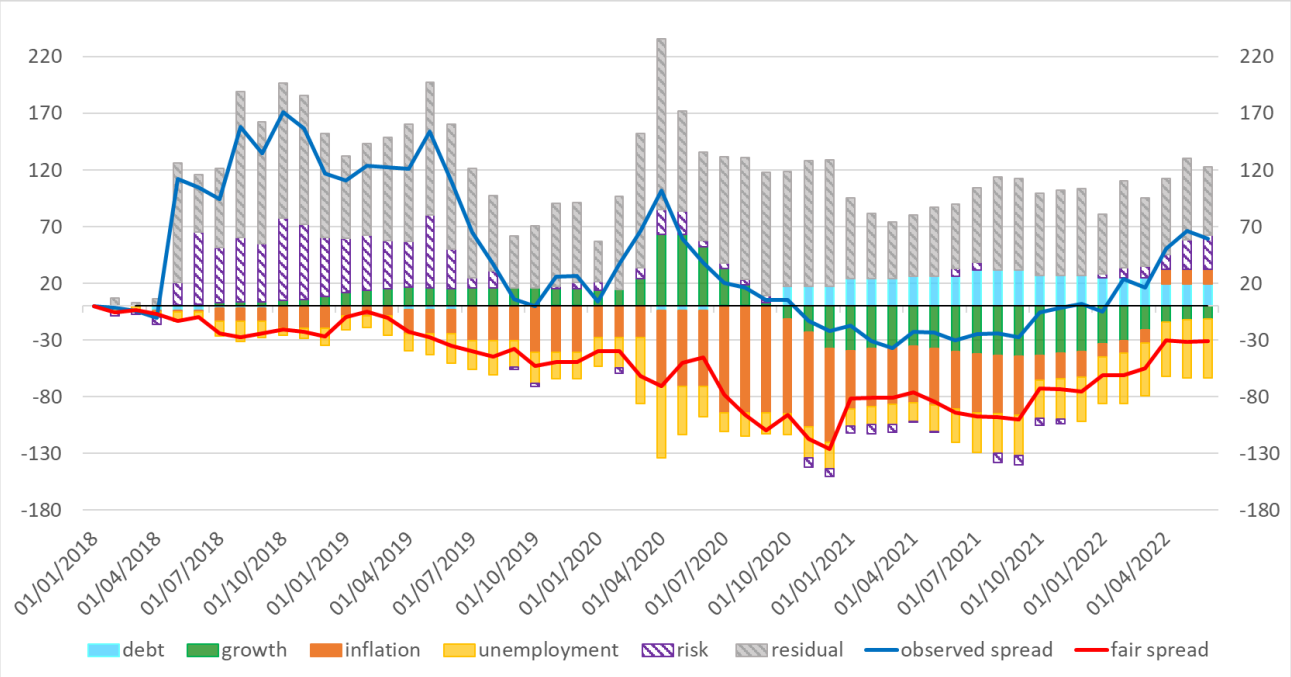
Since the onset of the pandemic, expected growth and inflation have been the main factors driving the dynamics of both observed and fair spreads. In particular, the expected growth – strongly influenced by the evolution of the pandemic and the consequent containment measures – contributes to the increase in the observed and fair spreads during the first half of 2020 and represents the main driver of their rapid decrease in the last quarter of the same year. The contribution of inflation expectations increases throughout 2021 with a growing impact from the fourth quarter of the year, likely also reflecting related expectations of a faster-than-expected normalization of the monetary policy stance.

With regard to the other factors and focusing on the recent period, the cumulative contribution of the risk component to the observed spread is limited, unlike in the 2018-2019 period, although increasing since the last quarter of 2021, following the rise in the Italian ISDA basis (see Figure A1 in the Appendix).[10] Its contribution increased rapidly from May 2022 signalling the relevance of the country-specific risk linked to higher interest rates on government debt and (low but rising) political uncertainty.

[9] Each contribution at time t is obtained by cumulating from January 2018 the products of the estimated regression coefficient for the value of each variable in month t. The vertical sum of the histograms corresponds to the value of the cumulative difference in the observed spread (blue line). The vertical sum of the histograms with solid colours corresponds to the cumulative difference in fair spread (red line).

[10] The main driver of the "risk" component is the ISDA basis, while the contribution of the Google Index is minimal (see Figure A1 in the Appendix).

Figure 2. Cumulated contribution to the dynamics of the spread from January 2018
(*monthly data; basis points*)



Note: The figure shows the cumulated changes from January 2018 to June 2022 in the observed spread (blue line), the fair spread (red line) and the cumulated contribution of the variables as specified in model (1). In each period, the height of a coloured bar of the histogram is given by the product of the estimated coefficient presented in Table A1 in the Appendix and the corresponding variable indicated in the legend. The vertical sum of the histograms corresponds to the value of the observed spread, the sum of the histograms with solid colours to the value of the fair spread.

5. Robustness checks and other controls

We estimate alternative model specifications to test the robustness of the estimates of model (1). In particular, we estimate model (1) for each country separately and either using different regressors or applying different techniques. The estimate of the fair value with the single-country model tends to be higher than that of the multi-country model when the spread increases. Overall, the estimates of the alternative multi-country models fall within the 90% confidence interval of the fair value of model (1), with some exceptions over short periods for two models. Below is a list of the alternative estimated models.

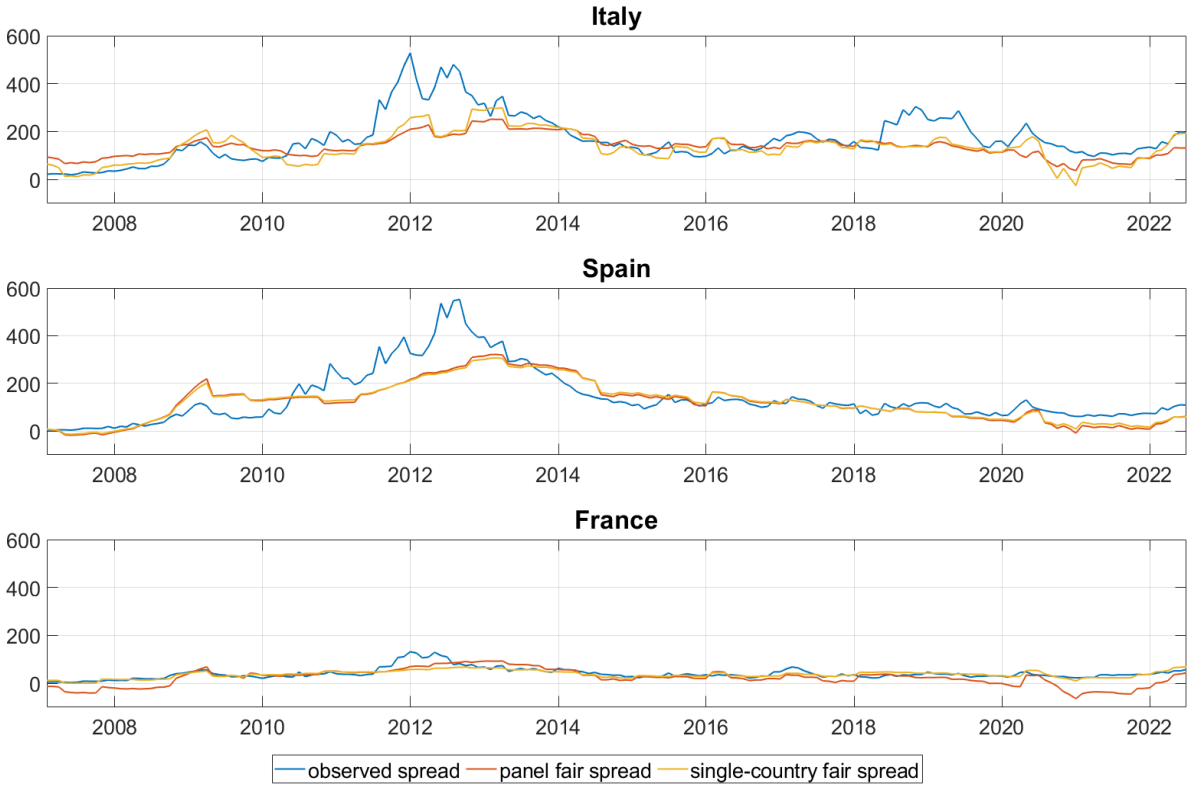
Single-country model

Following Di Cesare et al. (2012), model (1) is estimated separately for each country, using the same set of explanatory variables. As expected, the significance of the variables varies across countries. In general, while a single-country model might better capture the impact of idiosyncratic factors and the possibility that financial markets react differently to similar changes in fundamental variables, depending on the country where they occur, fewer observations make the estimates more volatile.

The results indicate dynamics of the fair spread that are similar to those obtained with the multi-country model for most of the period considered, but significant discrepancies in the pricing of

fundamentals are observed at specific times since the estimated coefficients are not averaged-out across countries (see Figure 3 and Table A2 in the Appendix). In particular, by comparing the regression coefficients for the three countries, we see that the Italian single-country fair value is relatively more sensitive to the main drivers.

Figure 3. Comparison between fair values from panel model and single-country model (*monthly data; basis points*)



Note: The figure shows the observed, the panel fair value and the single-country fair value of the spread for each of the three countries in the model (1).

For Italy the single-country fair spread (yellow line) increases more than the multi-country fair spread (orange line) starting from the end of 2021 up to the level of the observed value at the end of June 2022 (at about 190bp), reaching levels seen at the start of the pandemic in 2020. The single-country model, being more sensitive to idiosyncratic developments, can indeed produce more extreme estimates. The recent differences from the multi-country fair spread are due to the stronger response to expected growth and inflation, which have worsened in recent months.

For Spain, the single-country and multi-country estimates are nearly identical, showing that Spain approximates the average country of those in the panel model. On the other hand, the single-country estimate for France is higher than the multi-country fair value for most of the sample and it shows small deviations from the observed spread, indicating a small role for financial risk.

Domestic variables in difference with respect to Germany

Following Barclays (2022), we estimate model (1) with domestic variables in differences with the corresponding German variables. Compared to Barclays (2022), we use survey-based expected growth, inflation and government budget, the government debt as a share of GDP while the VIX replaces the ISDA basis and the Google breakup index.

No fixed effects

In the panel regression model (1) we introduced fixed effect (FE) to capture heterogeneities between the countries that are fixed over time and do not depend on the other variables of the model. A different approach would be to consider a model without FE (also called pooled OLS) in which the macroeconomic and financial variables in the model are assumed to capture the heterogeneity between the countries in the panel.

Monetary policy

Over the time span of the sample (Jan 2007 – June 2022) the ECB introduced unconventional monetary policies (UMP) such as asset purchases in the secondary market and special longer-term refinancing operations to increase liquidity and encourage lending. These instruments may have altered the perception of risk of the investors and their attention to macroeconomic conditions when pricing sovereign bonds. To take into account the changing environment, model (1) is augmented with two alternative measures of UMP. The first includes the month-on-month changes in APP holdings by the Eurosystem from October 2014 to date. The second includes a time-dummy which takes value equal to one from October 2014 to date and zero otherwise. Both variables are not included among the fundamental variables.

As alternative, we included in the model the so-called "near-term forward rate", which following the Federal Reserve we define as the 18-month forward 3-month OIS rate, to capture expectations on future policy rates.

Alternative model specification

Public debt sustainability can be valued in terms of the difference between the growth rate of the GDP and the government bond yield, as a measure of cost of debt service. While the former is already included in the model, the latter can be added using as a proxy the 10-year government bond yield. The bond yield is included among the fundamental variables.

In addition to public debt, we also include the expected government budget balance (from Consensus Economics) as an indicator of fiscal policies and therefore future public debt sustainability.

Global risk aversion can be measured by the VIX, an index that measure the option-implied volatility of the US stock market. With this aim, in the panel, the VIX takes the place of the Google break-up risk.[11]

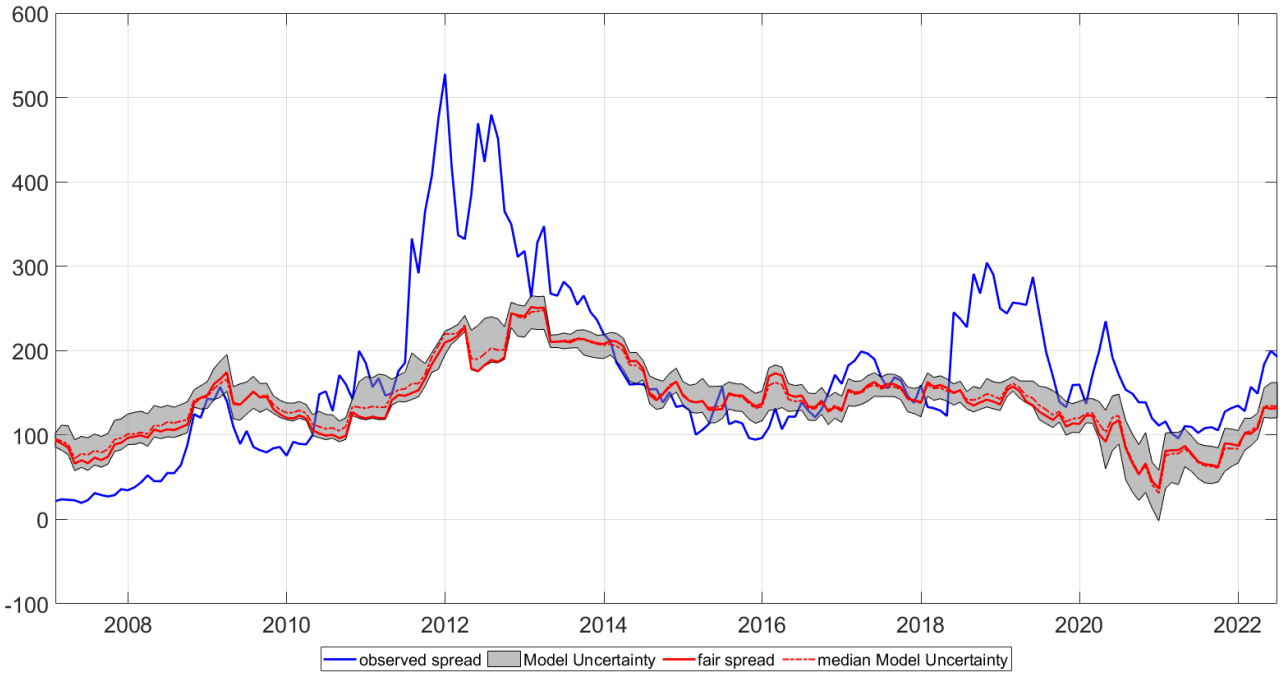
[11] The empirical finance literature often jointly models sovereign and corporate bond yields given their interconnection and the latter may be considered as a proxy of market appetite for risk. However, including such a variable in the model may be misleading since it is recognized that sovereign bond yields play an important role in pricing corporate bonds instead of the opposite. Conventional wisdom holds that the sovereign has the ability to divert resources from the corporate sector to cover its fiscal needs, which implies that corporate borrowers can only be as safe as their sovereign.

Moreover, following Barclays (2022), we stop the estimation of the regression coefficients on December 2019 to avoid the large swings seen during the pandemic and the conflict in Ukraine in the variables and compute the fair value after 2019 with those coefficients.

The comparison of the ten alternative multi-country specifications is shown in Figure 4 and in Figure A6 in the Appendix. The light grey area represents for each period the range of values between the 10th and 90th percentiles, which measures the models' uncertainty, and the dotted red line represent the median of the ten models, respectively. The median of the ten multi-country models is almost identical to the fair value obtained with model (1).

Analyzing each multi-country model per time, we see that most of the fair values are close to the fair value obtained with model (1) (Figure A6). The exceptions are the model with variables in difference with Germany (line with orange diamonds) and the model with the 10-year bond yield (line with green squares). All of the other model estimates fall in the 90% confidence grey area. All in all, as of June 2022, all the estimated fair values are below the observed spread; the highest value (190bp) comes from the model with the 10-years bond yield, while the lowest value (about 70bp) is obtained from the model with variables taken in difference with the corresponding German variable.

Figure 4. Italian spread: observed and fair values
(*monthly data; basis points*)



Note: The figure shows the end-of-month current level of the spread (blue line), the fair value of the spread estimated with a panel model with fixed effects (red line), the median of the ten models, defined median Model Uncertainty (red dotted line), the area between the 10th and 90th percentile, defined Model Uncertainty (grey area).

6. Conclusions

We provide an estimate of the fair value of the Italian ten-year sovereign spread, defined as a value consistent with the country's macroeconomic fundamentals, using a multi-country model in which the sovereign spreads vis-à-vis the German Bund are regressed on a set of fundamental macroeconomic variables and a set of variables approximating the risk attitude of investors. The results provide indications on the deviations of sovereign bond yields from their fundamental-based values and on the contributions of the possible drivers.

We show that the fair value has often been below the observed level, with significant upward deviations during periods of market tensions and political uncertainty. Moreover, the public debt-to-GDP ratio contributed positively to the spread and its contribution has remained broadly stable during the pandemic. With a focus on the last two years, we document that the large increase in expected growth at the beginning of 2021 induced a sharp temporary fall in the fair value, while a downward revision has contributed to its recent rise. Moreover, the decline in expected inflation exerted a downward effect on the fair value in 2020 and for part of 2021, while the increase observed since the last quarter of 2021 has led to a rise in the fair value.

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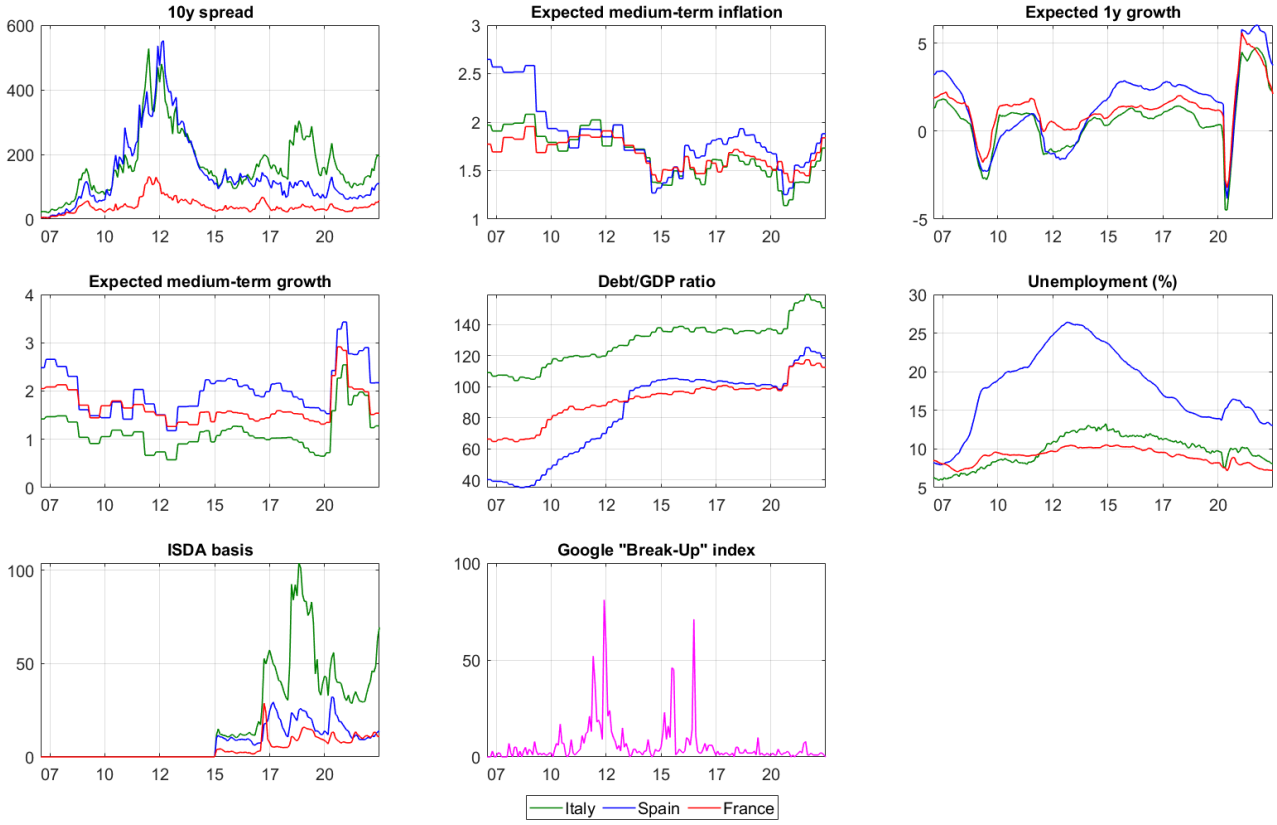
Appendix

Figure A1. Variables used in model (1)



Note: The figure shows the monthly variables used in model (1) for Spain, France and Italy. '10y spread' is the difference between the sovereign 10-year bond yield and the corresponding German bond yield; 'Expected medium-term inflation' is the average expected inflation over the coming 1 to 5 years surveyed by Consensus Economics; 'Expected 1yr growth' is the expected GDP growth over the coming 12 months surveyed by Consensus Economics; 'Expected medium-term growth' is the average expected GDP growth over the coming 1 to 5 years surveyed by Consensus Economics; 'Debt/GDP ratio' is the ratio between the nominal government debt and the nominal GDP; 'Unemployment %' is the rate of unemployment; 'ISDA basis' is the difference between the CDS premium under the 2003 ISDA protocol and that under the 2014 ISDA protocol (it is fixed to nil before September 2014); 'Google "Break-Up" index' is the search volume of "euro break-up" or similar keywords using the Google search engine.

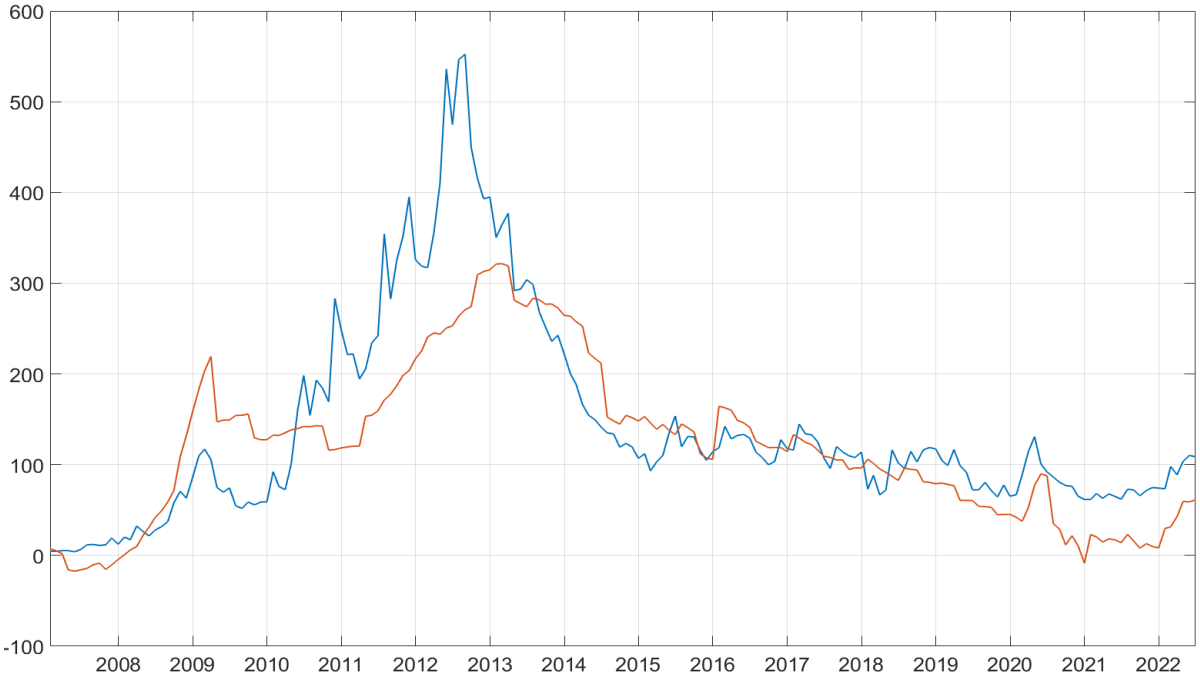
Table A1. Panel estimates of model (1)

	Estimate	SE	tStat	pValue
constant	-538.86	57.81	-9.32	0.00
Debt/GDP ratio	1.42	0.23	6.19	0.00
Expected 1y growth	-11.38	2.02	-5.64	0.00
Expected medium-term growth	-6.99	7.84	-0.89	0.37
Expected medium-term inflation	179.85	18.29	9.84	0.00
Unemployment	17.59	1.17	15.08	0.00
ISDA basis	1.01	0.17	5.98	0.00
Google "Break-up" Index	2.08	0.22	9.48	0.00

Number of observations: 558, Error degrees of freedom: 548
R-squared: 0.72, Adjusted R-Squared: 0.715
F-statistic vs. constant model: 156, p-value = 0.00

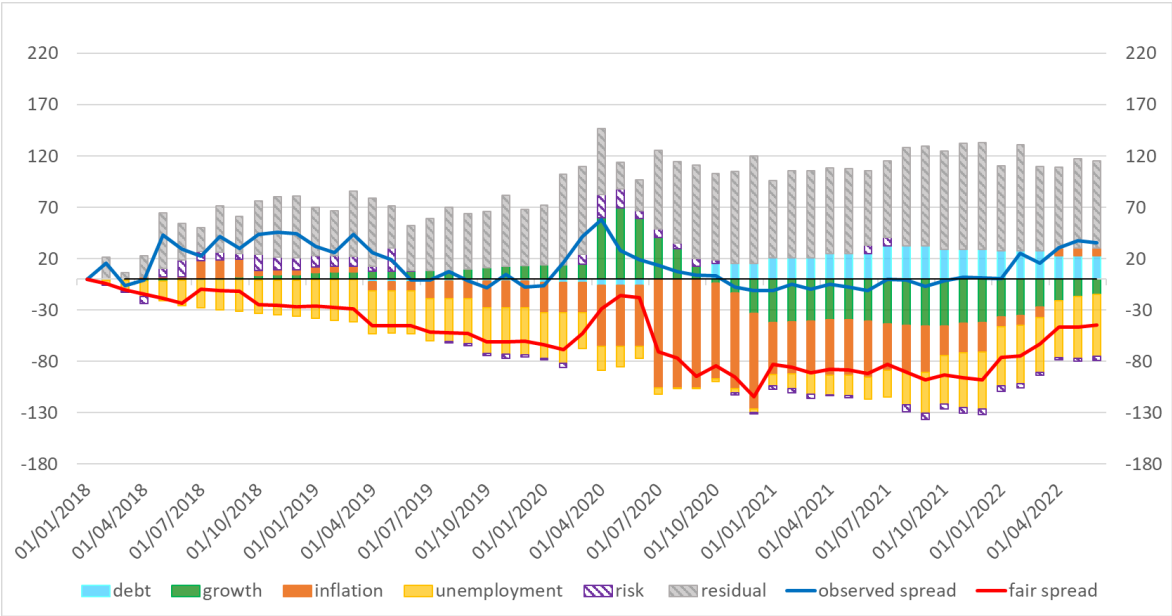
Source: authors' computation based on data from Bloomberg, Refinitiv, SDW National financial accounts and Consensus Economics. Panel estimates of equation (1) with country fixed effects. Sample period January 2007 – June 2022.

Figure A2: Spain: observed and fair spreads from January 2007 to June 2022
(*monthly data; basis points*)



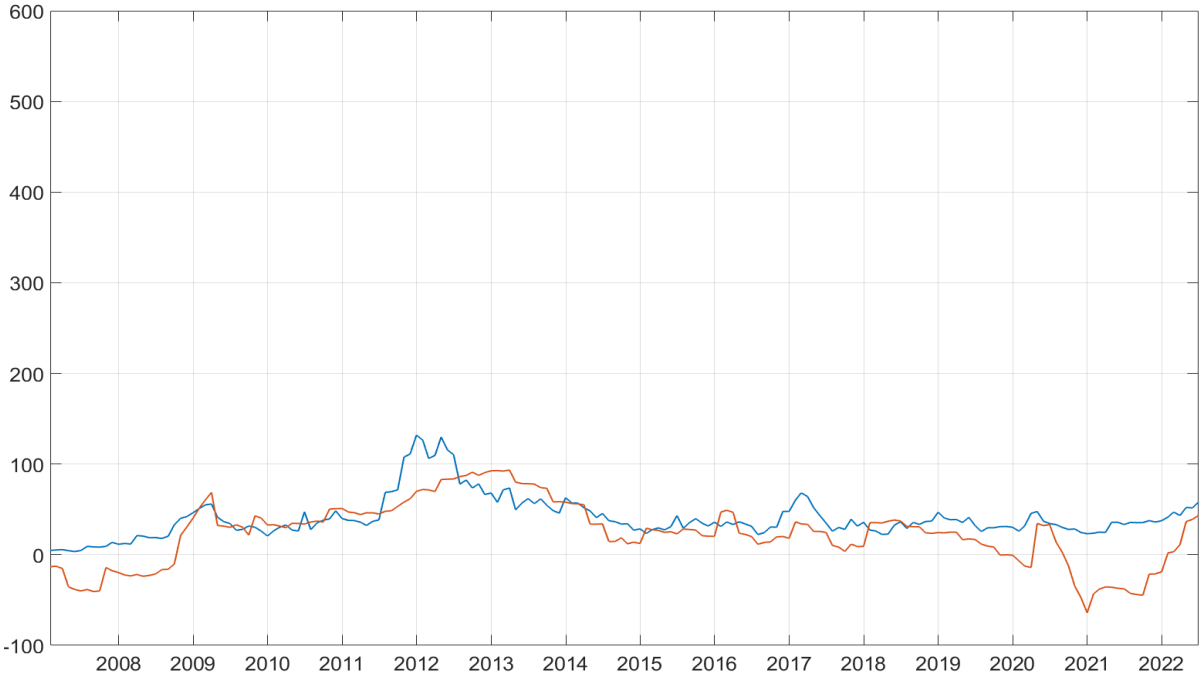
Note: The figure shows the end-of-month current level of the spread (blue line) and the fair value of the spread estimated with a panel model with fixed effects (red line).

Figure A3: Spain: cumulated contribution to the dynamics of the spread from January 2018
(*monthly data; basis points*)



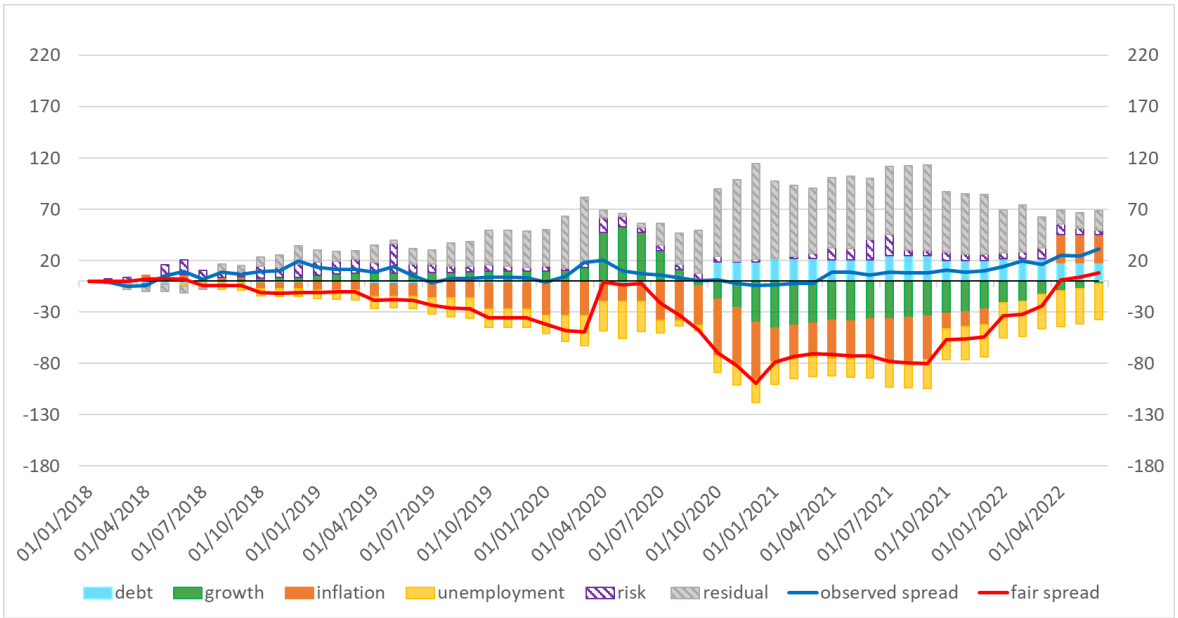
Note: The figure shows the cumulated changes from January 2018 to June 2022 in the observed spread (blue line), the fair spread (red line) and the cumulated contribution of the variables as specified in model (1). In each period, the height of a coloured bar of the histogram is given by the product of the estimated coefficient presented in Table A1 in the Appendix and the corresponding variable indicated in the legend. The vertical sum of the histograms corresponds to the value of the observed spread, the sum of the histograms with solid colours to the value of the fair spread.

Figure A4: France: observed and fair spreads from January 2007 to June 2022
(*monthly data; basis points*)



Note: The figure shows the end-of-month current level of the spread (blue line) and the fair value of the spread estimated with a panel model with fixed effects (red line).

Figure A5: France: cumulated contribution to the dynamics of the spread from January 2018
(*monthly data; basis points*)



Note: The figure shows the cumulated changes from January 2018 to June 2022 in the observed spread (blue line), the fair spread (red line) and the cumulated contribution of the variables as specified in model (1). In each period, the height of a coloured bar of the histogram is given by the product of the estimated coefficient presented in Table A1 in the Appendix and the corresponding variable indicated in the legend. The vertical sum of the histograms corresponds to the value of the observed spread, the sum of the histograms with solid colours to the value of the fair spread.

Table A2. Single-country estimates of model (1)

Italy

	Estimate	SE	tStat	pValue
constant	-1131.10	141.73	-7.98	0.00
Debt/GDP ratio	5.04	0.77	6.58	0.00
Expected 1y growth	-30.68	4.10	-7.48	0.00
Expected medium-term growth	-11.35	17.85	-0.64	0.52
Expected medium-term inflation	316.91	36.74	8.63	0.00
Unemployment	12.04	3.97	3.04	0.00
ISDA basis	0.89	0.24	3.77	0.00
Google "Break-up" Index	3.26	0.40	8.11	0.00
Number of observations: 186, Error degrees of freedom: 178				
R-squared: 0.668, Adjusted R-Squared: 0.655				
F-statistic vs. constant model: 51.2, p-value = 0.00				

Spain

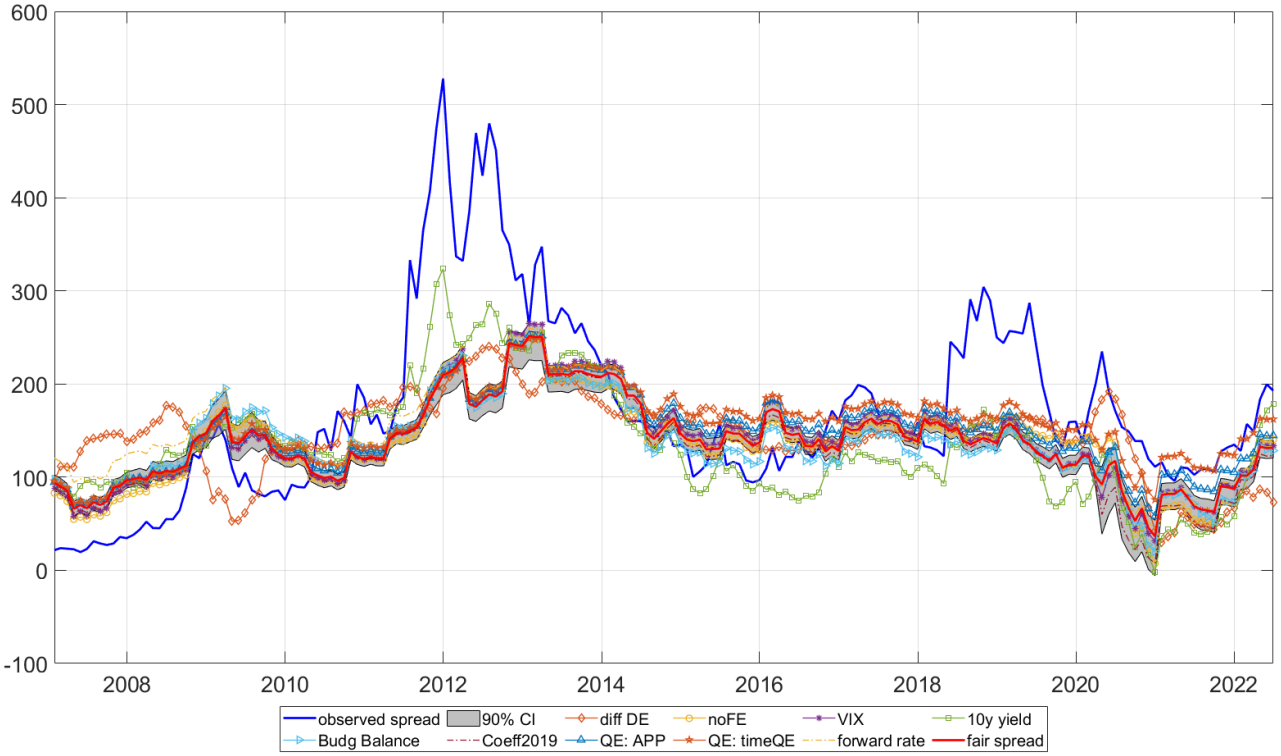
	Estimate	SE	tStat	pValue
constant	-516.61	113.33	-4.55	0.00
Debt/GDP ratio	1.081	0.48	2.21	0.02
Expected 1y growth	-8.23	4.45	-1.84	0.06
Expected medium-term growth	-8.50	13.74	-0.61	0.53
Expected medium-term inflation	146.97	31.01	4.73	0.00
Unemployment	16.92	2.32	7.28	0.00
ISDA basis	0.38	1.03	0.37	0.70
Google "Break-up" Index	2.62	0.43	5.98	0.00
Number of observations: 186, Error degrees of freedom: 178				
R-squared: 0.71, Adjusted R-Squared: 0.699				
F-statistic vs. constant model: 62.3, p-value = 0.00				

France

	Estimate	SE	tStat	pValue
constant	-251.21	33.03	-7.60	0.00
Debt/GDP ratio	1.17	0.13	8.94	0.00
Expected 1y growth	-5.41	0.95	-5.65	0.00
Expected medium-term growth	-2.01	3.97	-0.50	0.62
Expected medium-term inflation	99.08	9.50	10.42	0.00
Unemployment	2.89	1.71	1.68	0.09
ISDA basis	-0.21	0.31	-0.68	0.50
Google "Break-up" Index	0.64	0.09	6.62	0.00
Number of observations: 186, Error degrees of freedom: 178				
R-squared: 0.652, Adjusted R-Squared: 0.639				
F-statistic vs. constant model: 47.7, p-value = 0.00				

Source: authors' computation based on data from Bloomberg, Refinitiv, SDW National financial accounts and Consensus Economics. Single-country estimates of equation (1). Sample period January 2007 – June 2022.

Figure A6. Italian spread: observed and fair values of multi-country specifications (*monthly data; basis points*)



Note: The figure shows the end-of-month current level of the spread (blue line) and the fair value of the spread estimated with a panel model with fixed effects (red line). The figure include: the 90% confidence interval obtained by means of a block-bootstrap algorithm; the model taking variables in difference from the Germany (diff DE); the model without fixed effects (noFE); the model including VIX, the 10-year bond yield and the expected government budget balance as regressors (VIX, 10y yield and Budg Balance respectively); the model where the regression coefficients are estimated up to December 2019 (Coeff2019); the models taking into account the role of the UMP (QE:APP and QE:timeQE) and the expectations about monetary policies (forward rate).