



# A macro-financial analysis of the euro area sovereign bond market<sup>☆</sup>



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## ABSTRACT

We estimate the 'fundamental' component of euro area sovereign bond yield spreads, i.e. the part of bond spreads that can be justified by country-specific economic factors, euro area economic fundamentals, and international influences. The yield spread decomposition is achieved using a multi-market, no-arbitrage affine term structure model with a unique pricing kernel. More specifically, we use the canonical representation proposed by Joslin et al. (2011) and introduce next to standard spanned factors a set of unspanned macro factors, as in Joslin et al. (forthcoming). The model is applied to yield curve data from Belgium, France, Germany, Italy, and Spain over the period 2005–2013. Overall, our results show that economic fundamentals are the dominant drivers behind sovereign bond spreads. Nevertheless, shocks unrelated to the fundamental component of the spread have played an important role in the dynamics of bond spreads since the intensification of the sovereign debt crisis in the summer of 2011.

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## 1. Introduction

The creation of the European Economic and Monetary Union (EMU) in January 1999 led to an unprecedented convergence of government bond yields of eurozone countries,<sup>1</sup> with remaining yield differentials being mainly attributed to differences in the levels of credit and liquidity risks among countries. The surge in the spreads between euro area sovereign bond yields and market risk-free rates, particularly since 2011, has raised questions about

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<sup>1</sup> See Pagano and von Thadden (2004) for a detailed description of this process.

the underlying drivers of bond spreads and whether economic fundamentals (country-specific and international) alone are able to explain such dynamics. In this paper, we extend the approach proposed by Joslin et al. (2011) to a multi-market setting in order to decompose yield spreads of a set of euro area countries into a fundamental and a non-fundamental component. The fundamental component can be justified by a set of country-specific factors, euro area economic fundamentals, and international factors. The non-fundamental part incorporates liquidity and political uncertainty effects, in addition to remaining common factors which might be proxying for redenomination risk, i.e. the fear by investors that at least one country would abandon the euro area.<sup>2</sup>

Our paper is part of a broad literature that studies the determinants of bond yield differentials in the eurozone. Despite its various approaches, we view this literature as divided in two main strands. The first one relies mainly on regressions of yield spreads on a number of fundamental variables representing credit, liquidity, and international risks (see, for instance, Favero et al.

<sup>2</sup> The term *mispricing* has been used to designate the non-fundamental component of sovereign bond spreads, i.e. the part of bond spreads not explained by differences in fiscal and macroeconomic fundamentals. See, for example, De Grauwe and Ji (2012) and Di Cesare et al. (2012).

(2010)). Although there does not seem to be a clear consensus on the relative weight of each component, most studies in this strand of the literature point to the importance of both credit and liquidity risks in explaining differences in euro area bond spreads for the period before the start of the sovereign debt crisis in late 2009. Among the most recent studies, and particularly those focused on the sovereign debt crisis in the euro area, different approaches have been used to identify the extent to which bond spreads are justified by macroeconomic and financial fundamentals. Several papers have found evidence of the importance of a country's macroeconomic situation in determining its sovereign bond yields, as these depend on its fiscal position and ability to honor its commitments. Bayoumi et al. (1995) find evidence of the impact of the debt level on bond spreads for the U.S., while later studies reach similar conclusions for euro area countries (Hallerberg and Wolff (2006), Faini (2006), and others). Thus, the fundamental part (i.e. related to a country's creditworthiness) of bond yields may be estimated using mainly country-specific indicators. Aizenman et al. (2011) develop a model of pricing of sovereign risk for a number of European and non-European countries where sovereign credit default swap (CDS) spreads are regressed on fiscal position indicators and other macroeconomic variables. According to their results, CDSs have been mispriced in euro area periphery countries, being excessively low in tranquil periods and too high during the recent sovereign debt crisis.

Nevertheless, other factors may be behind movements in sovereign bond spreads, including the level of international risk aversion and financial contagion, the latter being of particular relevance within a currency union. In the case of the euro area, market liquidity, cyclical conditions and risk appetite, which are related to the level of short-term rates, have been identified as important factors behind the level of bond spreads (Manganelli and Wolswijk, 2009). Attinasi et al. (2011), for example, control for the effect of such factors on euro area sovereign bond spreads vis-à-vis German sovereign bonds. De Santis (forthcoming), on the other hand, considers the impact of contagion from events in Greece to other eurozone countries. He concludes that both sovereign solvency risk and contagion have played an important role in the increase of bond spreads in eurozone countries during the recent debt crisis. Giordano et al. (2013), in turn, distinguish between three types of contagion, with a 'pure contagion' not being justified by fundamentals. They do not find evidence of this kind of contagion during the debt crisis in the euro area. Finally, Caceres et al. (2010) also find evidence of contagion originating in the most affected countries in the eurozone.

A second strand of the literature includes papers that estimate multi-issuer, no-arbitrage, affine term structure models. For example, in order to analyze the dynamics of bond spreads of EMU countries, Düllmann and Windfuhr (2000) employ standard interest rate models using the short rate and the spread between risky and risk-free bonds as factors, while Geyer et al. (2004) rely on the estimation of purely latent factor models. Borgy et al. (2011), on the other hand, employ a multi-country affine term structure model making use of macroeconomic variables as factors.<sup>3</sup> They estimate the joint dynamics of eight euro area government bond yield curves making use of three common euro area macro factors and one latent fiscal factor for each country. They focus on the effect of fiscal policy on the perceived sovereign default probabilities for each country and conclude that fiscal factors are the main determinants in the increase of yield spreads since 2008. Ang and Longstaff (2013) use a multi-factor affine framework to disentangle the systemic and country-specific shocks on CDS spreads of government

bonds for the U.S., individual U.S. states, and eleven euro area countries. Their findings point to a stronger impact of systemic risk among European sovereigns than among individual U.S. states. This is interpreted by Battistini et al. (2013) as evidence of a possible breakup of the currency union. These authors estimate a dynamic latent factor model to identify the shocks driving the sovereign yields of each euro area issuer. They distinguish between a common (systemic) factor, capturing the perceived risk of a collapse of the euro system, and a country-specific factor, capturing each country's credit risk. Using euro area data from 2008 to 2012, they conclude that yield differentials are mainly driven by country risk, particularly for eurozone periphery countries.

The economic literature, therefore, finds evidence that both country-specific credit risk, contagion risk, and international risk factors are important in the determination of euro area sovereign bond spreads. Nevertheless, depending on the specific country under study, the effect of common risk factors not only is significantly different in magnitude but also has opposite effects on bond spreads.

Our model is part of the *multi-issuer*, no-arbitrage, *affine term structure model* literature and it differs from the extant papers in at least two points. First, we attempt to determine the fundamental component of bond spreads by using a relatively large set of observable macroeconomic factors. Our model therefore allows one to link the development of yield spreads with the evolution of the economic situation. Second, from an econometric setting, we adopt a relatively flexible and simple methodology that overcomes most of the drawbacks related to existing affine term structure models. These shortcomings are related to the significant amount of time necessary for the convergence of standard maximum likelihood algorithms<sup>4</sup> and, more importantly, to the fact that the standard formulation implies that the macroeconomic risk factors are spanned by – i.e. can be expressed as a linear combination of – bond yields. This spanning condition is however overwhelmingly rejected by standard regression analysis, which shows that there is no perfect linear relation between yields and macroeconomic variables (see Joslin et al. (forthcoming)).

To overcome these issues, we use the approach proposed by Joslin et al. (2011, forthcoming), extending it to a multi-issuer setting. We propose a *multi-country*, no-arbitrage, affine term structure model in which the countries share a common currency.<sup>5</sup> Our goal is to identify the fundamental component of eurozone sovereign bond yield differentials. To this end, we estimate separately five *two-market* models for Belgium, France, Germany, Italy, and Spain in which the Overnight Indexed Swap (OIS) rate is used as the reference rate, i.e. it serves as our benchmark market. We proceed as follows. We estimate the dynamics of a single risk-neutral measure in order to fit the OIS yield curve and the yield curve of the respective country. This is achieved with the use of four spanned pricing factors computed as linear combinations of yields. Two of these factors are used to fit the OIS yield curve and the other two to fit the country's bond yield differentials. In order to determine the effect of specific macroeconomic and financial variables in the dynamics of bond spreads, we estimate a vector autoregressive (VAR) model combining the spanned factors with nine unspanned factors. Five of them represent country-specific fundamental factors, euro area economic measures, and other international influences. The other four factors capture the non-fundamental component of the sovereign spread, such as liquidity premia, political uncertainty,

<sup>3</sup> Amato and Luisi (2006) use a combination of macroeconomic and latent variables in an affine term structure model of defaultable bonds but their model is applied to U.S. corporate bond spreads.

<sup>4</sup> For a description of the usual computational challenges faced by affine term structure models, see Duffee and Stanton (2008), among others.

<sup>5</sup> Bauer and Diez de los Rios (2012) combine the methodology of Joslin et al. (2011, forthcoming) in a multi-country affine term structure model which includes unspanned macroeconomic risks. Their model, however, also includes foreign exchange risk.

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