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The determinants of government bond yield spreads in the EMU area: a panel data analysis

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II.

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TABLE OF CONTENTS

ABSTRACT

With the European Monetary Union (EMU), EU policymakers seemed to have achieved their goal of creating a standardized European public debt market. Indeed, euro-area governments have witnessed a considerable narrowing in their borrowing costs following the introduction of the single currency. However, the financial crisis has marked the beginning of a turnaround in the EMU government bond market, with market participants starting to discriminate between sovereign issuers. By means of Feasible Generalized Least Square (FGLS) panel estimation, this master thesis aims to identify the reasons behind this widening in EMU bond yield spreads relative to Germany. More particularly, it will study to what extent those differentials are driven by idiosyncratic factors (credit and/or liquidity risk) or global risk factors. The paper finds evidence of an alteration in market prices vis-à-vis default risk factors, with deteriorating fiscal positions being more heavily punished since the global credit crunch. Moreover, our results support that the amount and price of general investors' risk aversion has also a significant impact on interest differentials, highlighting the save-haven status enjoyed by German bonds. Interestingly, we can also argue that investors became concerned about growth perspectives in the EMU periphery, indicating the need of growth packages stimuli. Finally, the transmission of monetary policy seems to have been impaired during the crisis episode. All in all, these dynamic properties of yield spread determinants call for models taking into account this time-varying relationship between interest differentials and sovereign risk factors.

INTRODUCTION

In his 1997 column entitled "*The Euro: Monetary unity to political disunity"*, Milton Friedman has warned European policymakers about the dramatic effects of a monetary unity imposed under unfavorable conditions. Nonetheless, European institutions have disregarded these concerns by materializing the idea of a common currency on the 1st of January 1999. A clear rationale for the Economic and Monetary Union (EMU) was to create a more integrated public debt market in Europe. However, sixteen years later, Friedman's paper has turned out to be somewhat prophetic if we look at the hardships faced by EMU government bond markets during the recent financial crisis.

By looking at *Graph 1* (see appendix 1), we can observe that financial markets barely discriminated EMU sovereigns following the inception of the euro. Indeed, 10-year government bond yield spreads across the Eurozone were minimal during that period, indicating countries were perceived as close 'substitutes'. While this stability period may offer the image of a better-integrated bond market, the 2008 global credit crunch and its contagion to EMU sovereign debt markets has somewhat undermined this conviction. In effect, countries with deteriorating fiscal positions have seen their yield differentials skyrocket with the financial crisis, as market participants became more risk averse and started to reappraise country-specific credit risk. Regrettably, this reversal in EMU government bond markets has taken some dramatic proportions for several EMU countries (see e.g. Greece, Ireland and Portugal), which has obliged European policymakers to implement unconventional measures to avoid a complete reverberation of these fresh financial vulnerabilities on the real-sector of the affected countries.

In response to the Eurozone sovereign debt crisis, empirical literature has stepped up its efforts to disentangle the factors driving EMU government bonds. Their mapping of yield spread determinants, reviewed in section 2, greatly improves our understanding of the EMU sovereign debt crisis. But above all, it represents a valuable input for policymakers responsible for adopting adequate measures in EMU government bond markets. Findings asserting the existence of market discipline vis-à-vis fiscal imbalances (signaled by a high

credit risk premium) would indeed point out the inefficiencies of the current institutional framework[1] and call for reforms that help deleveraging to safer fiscal positions. Differently, a significant liquidity premium suggests an incomplete convergence in markets microstructure and encourages debt management policies that enhance market integration. Finally, prospects of EMU government bond markets are also crucial since government papers are frequently used for valuation purposes. Significant volatility in sovereign bond yields may harm investors' in the calculation of the cost of capital.

Our research aims to produce an updated analysis of the drivers of EMU sovereign bond yield spreads for the period between 2002 and 2013. Our analysis' input to the existing literature can be summarized as follows: First, the specificity of our data timeframe, which offers a complete picture of the EMU sovereign debt crisis, permits to highlight the effects on yield spreads of various adjustment mechanisms implemented in the aftermath of the financial crisis. A second contribution concerns the market-based distinction we made between EMU central and peripheral countries. This latest offers the possibility to control for the heterogeneity of our sample and to distinguish between yield trends within the euro area. Finally, we account for a possible shift in markets' sensitivity vis-à-vis our different determinants with the outburst of the crisis. In line with recent literature (see e.g. Afonso *et al*, 2015, Arghyrou and Kontonikas, 2012), we will implement this idea by generating an exogenous break in our model specification.

The empirical findings of our study are globally in line with the existing literature, which finds that government bond yield spreads are impacted by both investors' risk aversion and idiosyncratic factors. More specifically, our results argue that the amount and price of global risk aversion has been a major driver of the rise in yield differentials during the credit crunch period (see e.g., Attinasi *et al*, 2009, Sgherri and Zoli, 2009). Furthermore, we provide new evidence that an alteration in market prices vis-à-vis default risk factors is observed, with fiscal imbalances being especially punished in the aftermath of the crisis (see e.g. Afonso *et al*, 2015, Bernoth *et al*, 2012, Schuknecht *et al*, 2010). But above all, we can argue that monetary policy transmission has been impaired during the economic slowdown, displaying a

[1] In the EMU, the Stability and Growth Pact as well as the Maastricht Treaty fulfill this role.

counter-intuitive negative correlation with yield differentials. Finally, one can also conclude that investors have become more concerned about growth prospects of the more vulnerable EMU periphery.

The remainder of this study is organized as follows. Part 1 reviews the relevant literature on determinants of EMU sovereign bonds as well as the institutional framework of EMU public debt markets. Part 2 offers a detailed description of our data and discusses both the empirical model as well as the econometric estimation method. The empirical results are discussed in Part 3 while a robustness check is outlined in Part 4. Finally, Part 5 concludes and offers some policy implications.

6.

Part 1. LITERATURE REVIEW

1.1. Government bond yield spreads: A twenty-year time overview

In this section, we start by reviewing the bond yield developments in number of countries of the European and Monetary Union (EMU)[2]. As depicted in *Graph 1* the yield dynamics among EMU government bonds have been subject to striking developments for the last 20 years. In brief, three 'phases' characterized by medium term trends can be identified. The next three sub-sections will be devoted to a more thorough analysis of each phase.

1.1.1. The EMU implementation: Convergence in the candidates' sovereign bond yield spreads

Signed on the 7 February 1992, the Maastricht Treaty paved the way for the inception of the institutional framework named the European Monetary Union (EMU). Among the Treaty's numerous articles, it is worth noticing to mention the following features: the establishment of rules and proceedings to conduct economic policy (Art. 104), known as the 'Maastricht convergence criteria', and the implementation of a supranational body to conduct monetary policy, namely the European System of Central Banks (ESCB) (Art. 105) (Maastricht Treaty, 1992)[3]. Having agreed on the goal and the conditions to be met, the European Union could now move forward to the tree-stage transition, road designed to the EMU's introduction (ec.europa.eu).

With the idea to strengthen the surveillance of national public finances and clarify the excessive deficit procedure into the EMU period, the European Council adopted in June 1997 the Stability and Growth Pact (SGP), the one post-Maastricht element (Buti *et al*, 1998)[4].

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[2] We illustrate the founding countries (except Luxembourg), which joined EMU in 1999, plus Greece that entered in 2001. Those choices were made for consistency purpose. Indeed, distortions would have appeared with the introduction of later entrants because of varying convergence timings.

[3] A more detailed analysis of the Maastricht Treaty can be found in appendix 2.

[4] A more detailed analysis of the Stability and Growth Pact can be found in appendix 2.

All in all, the more restrictive set of provisions of the SGP can be seen as a further reinforcement of the budgetary discipline of the Maastricht Treaty, plus a way to underpin the credibility of his no-bailout clause (Eichengreen and Wyplosz, 1998). According to the authors, the most compelling argument in favor of the SGP was to prevent high indebted countries to pressure the ECB for an inflationary debt bailout. Indeed, the hypothesis of a debt monetization by the ECB may encourage governments to embark in riskier policies (c.f.: excessive debt accumulation). In this view, the SGP's role is to tackle the problem of moral hazard.

The Maastricht Treaty, together with the SGP, largely explains the evolution of the yield spreads in regard to the EMU implementation period.

As the introduction of the single currency approached[5], bond spreads among future EMU members converged sharply, especially during the second half of the 1990's. With the exception of Greece, all yield spreads relative to Germany had vanished as of early 1998 (see *Figure 1* and *Table 1* in appendix 1).

According to Adjaouté and Danthine (2003), this convergence phase is explained to a large extent by the convergence of the fundamentals (inflation and fiscal accounts) and the elimination of exchange rate risk. Baele *et al.* (2004) support this assumption. Following the authors, competitive monetary devaluation among countries substantially decreased and finally disappeared with the advent of the euro. Hence, the exchange rate risk premium was not considered anymore as a determinant of the yield differentials. Second, fiscal discipline, as outlined by the SGP, helped to keep budget fundamentals on track to reach the treaty's targets (Baele *et al.*, 2004). Finally, they argue that the yield convergence in the run-up to the single currency was also buttressed by falling discrepancies in the inflation expectations across countries.

[5] By January 1999

1.1.2. The inception of the EMU: A stabilizing phase

The start of the EMU, which *de facto* induced the disappearance of the exchange rate risk and inflation, created the conditions for more integrated European financial markets[6]. From 1999 until 2007, intra euro zone yields fluctuated at a very low level by historical comparison. Pepino (2012) recorded an average yield of 4.4% for the considered period. Moreover, *Graph 1* shows that the general convergence trend observed in the 1990's have been reinforced, so that yield differentials became minimal.

However, spreads did not completely disappear. Even government bonds with similar credit risk and maturity characteristics were still not treated as perfect substitutes in the beginning of the decade. Baele *et al.* (2004) take the cases of Austria, France and the Netherlands. In 2002, they were all rated triple AAA by the three major credit rating agencies (cf. Moody's, Standards & Poor's, Fitch). Despite this, their governments had to pay on average 16.8, 8.4 and 11.1 basis points more than Germany, which shared the same credit rating[7]. According to Codogno *et al. (*2003), albeit these gaps seem very small, their impact on budgetary finances is not negligible. For the period Jan. 1999/ Dec. 2002, the authors recorded a yield differential of 32.5 basis points for the Italian 10-year government bond relative to Germany. If applied to the entire outstanding debt of Italy, this would count for additional expenditures of 0.3% of GDP for the government.

As regards markets global risk aversion, an exceptionally low risk premium environment prevailed during this period. This was already the case during the pre-EMU convergence phase (point1.1.1.). Indeed, the correlation between risk and required return seemed to have vanished, as abundant savings flooded into financial markets in search of investment opportunities (Pepino, 2012).

On the whole, the ambiguity of developments opened the way for contrasting interpretations. However, understanding the sources of relative risks in euro-denominated sovereign bond markets is crucial in order to assess the prospects of these markets.

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[6] Market discipline and financial integration will be treated in section 2.2.
[7] See Table 1.

At that time, debt managers and market participants assessed liquidity factors to be the most relevant sources in explaining the small movements in yield spreads (Codogno et al., 2003). One of the reason underlying this intuition stems from the mild reaction of markets towards the general deterioration of public finances occurred in the five first years of the EMU (Abreu, 2014). Indeed, yields were not impacted (an upward trend was expected) by this period of fiscal turbulence, mainly driven by a prolonged slowdown of the European economy (Fitoussi, 2005). Fitoussi (2005) named this set of findings "*the puzzle of interest rate inertia*"[8].

Other academics have argued that this mispricing of credit risk may be explained by the nature of the entities being analyzed. For example, the IMF (1997) supports the idea that market participants will unlikely price government debt as if it were corporate debt, even with the Maastricht Treaty ruling out EU direct assistance to member states. In effect, a weak credibility of the non-bailout clause might lead government to get on debt accumulation and financial markets to incorrectly estimate the risk of default.

1.1.3. The global financial crisis and Eurozone sovereign debt crisis: The end of an ephemeral convergence

However, the financial turmoil triggered by the U.S. subprime mortgage crisis has caused spreads within the EMU to widen again. Indeed, rapid contagion effects, fostered by financial globalization, have affected European financial assets including the Eurozone sovereign bond markets (Matei and Cheptea, 2013).

Following the onset of this crisis, macroeconomic and fiscal imbalances within the EMU countries were brought to light (Gomez Puig *et al.*, 2014). The mix of deteriorating fiscal prospects, a surge in global risk aversion and budgetary costly measures to contain the spillover from the credit crisis, raised the concern about the possibility that governments

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[8] Fitoussi (2005) contends that markets do not only focus on fiscal imbalances when pricing long-term sustainability, but also enlarge the scope to investments and savings. In this general perspective, the observed inertia in long-term rates is not surprising. His opinion takes a stance opposite to Eurozone SGP's view, which focus on short-term quantitative caps to assess countries' creditworthiness. So, the author assigns markets' lack of reaction to the inappropriate design of the current fiscal framework in the EMU.

might default[9]. These developments turned into the euro sovereign debt crisis, which first hit Greece during the third quarter of 2009 and gradually impinged to the EMU most vulnerable countries (Ireland, Portugal). This dramatic move, resulting in several credit rating downgrades and exploding yields, forced Greece, Ireland and Portugal to request in 2010-11 a financial rescue scheme, namely the European Financial Stability Facility[10] (Afonso *et al*., 2015, Matei and Cheptea, 2013). Although they kept afloat the above-mentioned countries, these packages have not prevented the Italian and Spanish government bonds to suffer from contagion effects and thus be under market pressure from the second part of 2011 (Afonso *et al*., 2015).

So, the picture changed completely since Greece was cut off from international bond markets in 2010, with sovereign risk differentials taking problematic directions in the euro zone (Gomez Puig *et al.*, 2014).

1.2. Market discipline in the EMU government bond market

Financial markets operate in a given institutional structure. To correctly assess the determinants of government bonds dynamics, it's paramount to understand this set-up.

So, the two sub-sections will be devoted to frame the structure's characteristics, i.e. financial integration and fiscal rules. The aim of the process is to link yield differentials with issues concerning market discipline (Manganelli and Wolswijk, 2009). Finally, we will discuss about the debate surrounding market discipline within the EMU.

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[9] We observed a widening in the spreads across private (and public) credit markets. This is partly due to a sudden increase, among the investors community, of the perceived riskiness of most financial assets. Indeed, market participants start to flight to safe assets ("flight-to-quality phenomena").

[10] The European Financial Stability Facility (EFSF) mechanism is a common rescue facility, set up by European policymakers, in order to financially assist EMU members facing difficulties. It is backed by a system of guarantees of EMU member states.

1.2.1.Fiscal rules

In the case of sovereigns, market discipline could be defined as " *The onus on sovereigns to conduct business while considering the risks to their stakeholders*"[11]. To put it another way, it's how market participants can discipline irresponsible sovereign borrowers by pricing default risk premium and constraint their access to credit. According to Bishop et al. (1989), countries running unsound fiscal policies would be punished by higher yields. Without a correction of their fiscal behavior, they will see their cost of borrowing increase further. Eventually, this could result into a denied access to credit markets. So, market discipline offers a deterrent against fiscal policy adventurism and hence supports fiscal discipline (Manganelli and Wolswijk, 2009). This market-based approach, namely "the market disciplining hypothesis", is quite optimistic in view of the interest rate developments observed within the EMU (see sub-section 1.1.2 above).

Nevertheless, to counter a possible un-ability of markets to assess countries fiscal sustainability, The Maastricht Treaty and the Stability and Growth Pact introduced binding rules concerning fiscal stance. The ceilings on ratios[12] aim to support investors in the monitoring of countries fiscal developments. According to Manganelli and Wolswijk (2009), these upper limits could have an ambivalent effect on market attitude. Indeed, infringements of the rules may generate two opposite behaviors. On the one hand, investors who mistrust the workings of the current formal fiscal framework will not focus on fiscal rules transgressions. Thus, recommendations on national public finances will not alter their posture towards sovereign yields. On the other hand, we have market participants who believe that any excess will directly be punished thanks to the relevance of the SGP. In this case, recommendations, which are judged credible, have an immediate effect on the monitoring behavior of markets. Thus, fiscal rules here re-enforce the market disciplining mechanism.

1.2.2. Financial integration

European financial integration is a major area of concern to the extent that investors can benefit from integrated financial markets through several channels. Indeed, opportunities of

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[11] Investopedia

[12] See appendix 2: The Maastricht Treaty and the Stability and Growth Pact

risk sharing/diversification, as well as a more efficient allocation of capital, are facilitated by the elimination of barriers to trading, clearing and settlements platforms (Baele *et al.,* 2004). This improvement of welfare explains the multiple initiatives undertaken throughout the European community to promote integration of European financial markets. The most noteworthy was the Financial Services Action Plan (FSAP)[13], which aimed to revise the former EU landscape of financial services.

The surge in cross-border trading activities that accompanied the ongoing integration process gave rise to the question; May financial integration hinder the disciplinary faculty of markets? An affirmative answer would imply that policy-makers are pursuing conflicting strategies, with financial integration effects counterbalancing the 'possible' discipline enhancement offered by the SGP rules (Manganelli and Wolswijk, 2009). Contrariwise, the authors state that financial integration is a prerequisite for markets to correctly discriminate between the different sovereign entities afterwards.

However, two conditions must be fulfilled for market discipline to work in this financially integrated environment. The first is that "all potential market participants with the same relevant characteristics (1) face a single set of rules when they decide do deal with financial instruments and/or services (2) have equal access to the above-mentioned set of financial instruments and/or services (3) are treated equally when they are active in the market" (Baele *et al.,* 2004). This formal definition of fully integrated markets is based on the 'law of one price'[14]. This 'law" excludes arbitrage opportunities that could benefit investors, helping to a proper evaluation of the risk/return profile of each security (in our case, sovereign bonds). This correct valuation of a security's payoff is essential for an efficient allocation of capital (Baele *et al.,* 2004, Manganelli and Wolswijk, 2009). The second condition is specifically intended to government bonds. In effect, sovereigns cannot enjoy preferential rights or positions in markets, compared to different borrowers. More precisely, no pledge-implicit or

[13] Launched in 1999 by the European Commission.

[14] 'The law of one price' is the most commonly used definition of financial integration. This economic rule states that a given security must have the same price no matter how the security is created (see www.nasdaq.com)

explicit- to rescue troubled sovereign bonds is authorized. Markets must be convinced that the Maastricht non-bail-out clause is credible (Bayoumi, 1995).

All in all, the integration process ensures that financial markets are more efficient and well functioning, approaching what Manganelli and Wolswijk (2009) name "*the ideal benchmark of perfect competition"*. Following this, financial integration should reinforce the market discipline mechanism.

1.2.3. Debate surrounding the market discipline within the EMU

1.2.3.1. Pre-EMU period

Issues about government bond valuations fostered with the signature of the Maastricht Treaty. During the pre-EMU period, considerable attention has been devoted to how markets would possibly exert their disciplinary power with the introduction of the single currency.

During the 1990's, the area of contention concerned the possible evolution of outright default pricing with the onset of the EMU. Part of the academics considers that we should see an increase of the default risk premium[15] with the appearance of the EMU whereas others make the point to the contrary with a steady default risk premium (Pepino, 2012).

In order to correctly structure the future institutional framework, policymakers needed to rule on this question of market disciplining mechanism. A recurrent concern was the necessity to constrain, or not, national fiscal fundamentals within the future EMU? One view, supported by the Delors' Report, got the upper hand and established itself as the preferred solution. It is one that puts emphasis on binding fiscal rules (Bayoumi, 1995)[16]. In this connection, the Maastricht Treaty devoted two of his five rules to fiscal stance and prohibits any monetary financing or bail out. Furthermore, the SGP subsequently 'sanctified' the rules by extending them into the EMU period. As pointed out by Pepino (2012), the EMU's founding fathers did

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[15] Lemmen and Goodhart (1998) argue that sovereign bonds will be discriminated on the basis of default risk instead of currency risk as soon as EMU governments lose their monetary sovereignty and the ability to perform devaluation of exchange risk.

[16] The Delors report was summited in 1989.

not entrust this disciplining role to private market players. They were indeed not convinced about the ability of financial markets to prevent member states from running unsound fiscal policies and thus from excessive indebtedness. In other words, they didn't fully believe in the 'Market disciplining hypothesis'

1.2.3.2. The first years of EMU

The behavior of government bonds following the EMU implementation didn't help to settle the debate surrounding the "market-disciplining hypothesis" (Pepino, 2012).

As pointed in sub-section 1.1.2, sovereign bond spreads stood at very low levels until 2007, reinforcing the convergence momentum observed during the 1990's. Nonetheless, the differentials didn't fully fade away, even inside the AAA-rated basket of countries. As a result of this 'anomaly', mixed interpretations about market discipline effectiveness arose in the academic community. Two main lines emerged during that period[17], with respectively the following postulates (1) Financial markets correctly price the default risk premium within the EMU (Bernoth *et al*., 2004) (2) There's a failure in the markets' ability to discipline fiscal laxity (Fitoussi, 2005).

1.3. Determinants of EMU bond spreads

EMU government bond spreads is a topic that gained in popularity since the inception of the EMU. Indeed, there has been a proliferation of econometric studies that aim to determine the drivers of the EMU sovereign bond yield spreads. But the conclusions of this extensive literature are disputed. Reasons include, among others, the choice of the empirical methods (model definition and estimation techniques), the length of the times series, the partial sample of countries and the nature of proxies/variables measuring the different risk factors (Pepino, 2012).

[17]The period encompasses the 1999-2007 times span.

Before going specifically trough some relevant literature and review the current state of academic research, it's useful to review the theoretical risks associated with investing in government bonds[18]. The key risk factors driving the total risk premium (or yield spreads) of European sovereign bonds are:

(1) Exchange or Currency risk
(2) Credit risk
(3) Liquidity risk
(4) International risk (aversion)

The exchange risk is the risk incurred by a bond portfolio manager due to an insecure exchange rate environment. When investing in bonds with payments in a foreign currency, a portfolio manager bears the risks of an unknown cash flow in his domestic currency (Fabozzi, 2007). As mentioned in sub-section 1.1.2, the currency factor disappeared in January 1999 for intra-EMU countries.

Following Fabozzi (2007), the credit risk can take three types of forms: The default risk, the credit spread risk and the downgrade risk. The author clarifies it as follow: The default risk concerns the possibility that the issuer will fail to honor, in part or in full, its obligations vis-à-vis interest and principal payments. Credit spread is the part of the yield spread (or total risk premium) attributable to this default risk. It numerically quantifies the default risk, even in absence of an outright default. Over the time period of the bond, investors face the risk of an increase in the credit spread (and thus the total risk premium), which will consequently depress the price of the issuer's bond[19]. Generally, credit spread is approximated thanks past or future fiscal performance. Finally, the downgrade risk is defined as the risk of an unanticipated downgrade of an issuer by a rating agency. This inferior credit rating adversely affects the issuer because the downgrade increase the credit spread of the issuer's bond and thus decrease its market price (Fabozzi, 2007)

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[18] In our case, risks associated with government bonds are a restricted version of the risks supported by the fixed-income markets. For a complete overview of risks related to bonds, see the academic book of Franck J. Fabozzi (2007).

[19] In the next sections, we will deliberately focus on this type of credit risk rather than the downgrade risk.

In addition, the total premium investors require is linked to liquidity risk. Market participants bear the risk of selling a bond below its indicated value, which is determined by a recent transaction. This may be due to early liquidation and/or to substantive price reduction resulting from a small number of transactions (Fabozzi, 2007, Afonso *et al.,* 2015). Liquidity refers to the size and depth of government bond markets, the efficiency of secondary market makers and market segmentation (see e.g. Codogno *et al*., 2003, Gomez-Puig, 2008).

Lastly, the international risk factor constitutes another main determinant of yield differentials, as it gauges markets' feeling vis-à-vis global financial risk (Afonso *et al*., 2015). In order to capture the perceived level of financial risk, market implied volatility or/and corporate bond spreads are usually used.

Please note that these principal sources of relative risk may be competing, complementary or interacted.

1.3.1. Some relevant literature research with emphasis on methodology and results[20]

1.3.1.1. Pre-EMU period

Alesina *et al*. (1992) found statistical evidence that markets charge a default risk premium on highly indebted countries. The authors used the difference between returns on public debt and 'safe' private debt to price the default risk.

For a sample of 12 OECD countries from 1974 to 1989, the return on private debt was found to be higher on average than the one on sovereign bonds, making private assets riskier to hold until maturity. Nevertheless, Alesina *et al*. (1992) found that, for countries presenting high stocks of debt, public debt and the interest rates charged on it are positively correlated.

[20] The selection was made according to the academic visibility of the publications. Nevertheless, we are aware not having covered in detail the entire array of research. This shortcoming is corrected in the next sub-section with an extensive review of the literature.

Moreover, the authors alert us that, even if significant, the scale of these results is quantitatively small.

Consideration should be given to Favero *et al.* (1997) paper for a number of reasons: (1) It is the first trial to understand the fluctuations of the spreads of high yielders' government bonds over German Bunds (2) For the first time, a measure of yield differentials based on interest rate swaps is introduced[21] (3) In the case of weaker countries, the authors question the causality running from the European Exchange Rate Mechanism (ERM) membership to exchange rate stability.

Using daily data from 1992 until 1995, Favero *et al.* (1997) try to understand what drives the yields differentials for Sweden, Spain and Italy. They have identified three components: the expectation of exchange rate depreciation, the different taxation treatments and a default risk factor. With the intent to study how total spreads respond to structural shocks, they found "*evidence of uni-directional causality running from the exchange rate factor to the yield differential*"[22].Nonetheless, the exchange rate as explaining factor only holds for Spain and Italy in the long run. Globally, their findings support the existence of a co-integrating vector for Spanish and Italian spreads. This common trend is independent of country specific shocks, which are only relevant to explain short-run dynamics.

1.3.1.2. EMU period

With the advent of the single currency, the focus of part of the literature shifted toward the EMU government bonds dynamics. In this context, using the German Bund as the 'risk-free' asset became the accepted standard.

To estimate the relative importance of credit and liquidity premium in yield spreads, Codogno *et al*. (2003) used a data sample from 1991 to 2002 for 10 EMU countries. The authors started

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[21] This methodology is of great relevance within the academic literature (see Codogno *et al*, 2003, Gomez-Puig, 2006).

[22] Favero, C. A., Giavazzi, F. & Spaventa, L. (1997). High Yields: The Spread on German Interest Rates. *The Economic Journal*, 107(443), p.979

with monthly observation in order to focus on the effect of fiscal fundamentals and subsequently moved on to daily series to account for the liquidity factor. Like Favero *et al*. (1997), Codogno *et al.* (2003) define relative assets swap spread as the dependent variable in order to remove the exchange rate fluctuations of the pre-EMU period. Thanks to this, a pooled analysis of the Pre-EMU and Post-EMU observations was made possible.

The model defines credit risk and international risk-related factors as the relevant drivers of yield spreads[23]. Both affect the spread linearly, or when interacted. International risk, when interacted with the deviation of country i debt-to-GDP ratio from the German ratio, prove to be significant. According to the authors, this is explained by a change in the assessment of countries' default risk. For its part, liquidity plays a smaller role, due to a lack of data availability for this variable.

Bernoth *et al*. (2004) dissociated themselves from other academics by the unique data set used, namely Deutsch Mark/Euro and US dollar denominated bonds[24]. Their approach has positively contributed to the research on sovereign risk premia: First, they found another way to get through the exchange rate complications. Second, using data from Pre-EMU and Post-EMU offers the possibility to directly estimate the effects of the monetary union on bond pricing.

To examine sovereign bond yield fluctuations, Bernoth *et al*. (2004,2012) empirically tested a reduced-form equation of their portfolio model of bond yield differentials. The estimation results reflect a positive default risk premium, driven by debt and debt-services payments. It's especially the case when these fiscal fundamentals are interacted with global investors attitude. With the start of the EMU, markets have shifted attention to the debt-services ratio as a proxy of fiscal soundness. In contrast, the liquidity premium seems to have vanished after the beginning of the EMU (Bernoth *et al*, 2004).

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[23] International risk factors are proxied by the US' interest rate swap and Moody's Seasoned AAA US corporate bonds spreads relative to US treasury yields.

[24] Prior to the 1999, bonds denominated in Deutsche Mark (DM) were used instead of euro ones. This denominantion will be used in ulterior papers, notably Schuknecht *et al*. (2010).

All in all, Bernoth *et al*. (2004) points that the EMU has increased financial markets integration without having withdrawn their disciplinary function vis-à-vis countries risky fiscal developments. In 2012, Bernoth *et al*. applied the same methodology for a data set of bonds issued between 1993 and 2009. As for the previous paper (see Bernoth et *al.,* 2004), this extension emphasizes fiscal imbalances as a key driver of interest differentials and confirms the elimination of liquidity premiums. Moreover, the results indicate that market discipline has significantly increased with the emergence of the financial crisis.

Gomez-Puig (2006)'s contribution to the government bond spreads literature lies first and foremost in the data specification used. Indeed, it's the first empirical framework that uses daily observations for one of the most important liquidity measures, namely the bid/ask spread[25].

In order to disentangle the effects on yield spreads of the main domestic risk components, Gomez-Puig (2006) carries out a panel-estimation including all EMU countries except Luxembourg and Greece. Covering the 1996-2001 time-period, the results conclude that liquidity, rather than credit risk, is the main determinant of government bond yield differentials. Interestingly, government bond spreads have incurred an increase in their relative cost of borrowing vis-à-vis Germany after the EMU introduction (+11.98 bps on average). Following the estimations, this rise could be attributed to a change in the market perception of liquidity, measured by market size (Gomez-Puig, 2006). More precisely, the results find evidence for a negative quadratic relation between yield spreads and the relative amount of outstanding debt, whose impact was exacerbated with the introduction of the single currency. Therefore, countries with larger debt market sizes as Spain, Italy or France benefit from a lower liquidity premium and thus from lower rises in yield spreads.

In order to explore the time-series behavior of Euro sovereign yield spreads, Favero *et al.* (2007) develop a model for the interaction between aggregate risk and liquidity.

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[25] Gomez-Puig (2006) used two proxy variables to measure the liquidity premium: The bid/ask spread and the amount of outstanding debt. The former intents to measure market tightness while the latter reflects market size/depth.

One of his distinctive features lies in the assumption on how liquidity interacts with aggregate risk. The authors' theoretical model predicts that liquidity, when statistically significant, requires a premium (as in any pricing model) but that its effects are dampen when interacted with aggregate risk factors. Indeed, Favero *et al*. (2007) assume that the demand for liquidity (= liquidity risk premium) is elastic, with a premium that decreases if aggregate market risk increase[26]. This takes a stance opposite vis-à-vis standard asset pricing models, which assume a price-inelastic demand and thus that the impact of liquidity is amplified by market risk perceptions (see Acharya and Pederson, 2005).

As a confirmation, the authors tested the model predictions using daily observations for the time-period 2002-2003. The results show that the proxy for aggregate risk[27] is the most consistent variable to explain the co-movements in spread differentials. Moreover, although liquidity differentials are priced for only a subset of countries, their co-variation with aggregate risk confirms the model's prediction. Those findings support the results of Favero, Pagano and Von Thadden (2005) previous paper. Moreover, Favero *et al.* (2007) incremental contribution lies in the negative sign affected to the interaction between liquidity differentials and the aggregate risk factor. This latest was not detected in the previous paper.

Manganelli and Wolswijk (2009)'s research aims to study the relationship between short-term interest rates, as determined by the ECB, and government bond spreads.

In the view of many academics, risk aversion is identified as the common factor explaining yield differentials (see Codogno *et al.,* 2003, Bernoth *et al.*, 2004,2012, Favero *et al.*, 2007). Nevertheless, little has been done to investigate what economic forces drive this time-varying risk aversion. Manganelli and Wolswijk (2009) address this shortcoming by arguing that developments in investors' risk perception are related to the level of short-term interest

[26] For the complete intuition behind this assumption, see Favero et al. (2007)

[27] In this case, aggregate risk is proxied by the yield difference between U.S. corporate bonds and U.S. government bonds.

rates[28]. In theory, a tightening of monetary policy decreases the willingness of investors to bear risk. This higher degree of risk aversion subsequently widens bond spreads.

Their empirical results indicate that short-term interest rates are positively related with EMU sovereign bond spreads, confirming the theoretical framework[29]. Moreover, they noticed this transmission mechanism is particularly effective for countries facing a higher default risk. The second input of the paper concerns the credit and liquidity premiums. Although shadows were casted over these latters, especially when sovereign bond spreads reached very low levels, the authors found statistical significance for both credit risk and liquidity risk being priced within the EMU.

1.3.1.3. Financial crisis period

The spillover of Lehman Brother's bankruptcy to the European economies and, most importantly, the discovery of Greece's dramatic public finances in October 2009 shed light on the growing imbalances within the EMU. Market participants, who became much more reluctant to bear risk, started to revise their assessment on sovereign issuers' creditworthiness (ECB, 2014) [30]. These events led to an increase in EMU government bond yield differentials vis-à-vis the German Bund.

The academic literature has been revived by the outbreak of the euro sovereign debt crisis, with authors trying to understand the drivers of spreads in this new market environment. We will present some of their meaningful results in this subsection.

Schuknecht *et al*. (2010) revisit the valuation of EMU sovereign risk in order to account for the impact of the financial crisis. Via a panel analysis with time fixed effects, the authors studied to what extend drivers of government yield spreads have evolved with the collapse of

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[28] According to the authors, the relation is made possible via at least two channels (direct and indirect). A more precise explanation will be given in section 2.1 Data description

[29] These results stem from the authors' econometric model that runs panel regressions on monthly data between 1999 and 2008.

[30] Rougly, this spillover can be attributed to the exposure of European banks to the US subprime mortgage market. Indeed, European banks were massively involved in highly leveraged purchases of US mortgage-backed securities (Cafruny & Schwartz, 2013). These vulnerable banks were subsequently rescued by their national governments at a substantial financial cost.

Lehman Brother's. First, the results suggest that sovereign issuers were still priced on the basis of macroeconomic variables during the crisis. This confirms that market rationality subsisted in these times of financial stress (Schuknecht *et al*., 2010). Second, markets punish unsustainable fiscal strategies more heavily since the global financial crisis, highlighting the shift operated in the pricing of credit risk. In addition to fiscal criteria, evidence was found in favor of global risk sentiment as driver of yield differentials. Finally, the authors pointed out that Germany was characterized as a safe-haven investment, which was not true before the financial turmoil. This study is an extension of the authors' previous paper (see Schuknecht *et al.,* 2009). While it applies the same approach as in the former note, the database is here extended to account for the financial crisis period.

Attinasi *et al*. (2009)'s focus goes to the rescue packages announced by EMU governments in order to shore up troubled banks. Using a dynamic panel model for the period running from end-July 2007 to end-March 2009, they conclude that the announcements of stimuli packages has re-assessed the market perception towards government credit risk. The cause of this finding is the shift of risk from the private sector to the public sector. Interestingly, the authors also found that the size of this public support doesn't prove to be significant, which make them believe that only the credibility of the commitment is at stake for markets. Finally, their findings support that favorable fiscal fundamentals, approached by expected budget debt/deficit relative to Germany, allows countries to benefit from lower borrowing costs. This is in line with other academics supporting market discipline.

The dynamics of yield spreads in the EMU government bonds since 1999 raise the question of a possible mispricing of risks on behalf of investors. De Grauwe and Ji (2012) share these disconcerting developments in bonds and try, thanks to a fixed effect model, to answer this question[31].

[31] This fixed-effect model will be applied to a dataset covering a time period between the 2nd quarter of 2000 and the 2nd quarter of 2011

The paper's first evidence shows that, during 2010-2011, an important part in the increase of the PIGS[32]' spreads is dissociated from their underlying fundamentals. This confirms the authors' hypothesis that "*spreads can be subject to bubbles*"[33]. Indeed, this systematic overpricing of risk since 2010 have driven already fragile countries into a bad equilibrium characterized by solvency crises and deep recessions (De Grauwe and Ji, 2012). Following the authors, investors have long ignored differences in the level of indebtedness by pricing the same risk premium for EMU member states[34]. With the outbreak of the financial crisis, markets suddenly started to worry about their high debt-to-GDP ratios but subsequently overpriced risk (as seen above). This is challenging to the extent that the authors did not observed the same mispricing behavior concerning stand-alone countries with equally high and increasing debt-to-GDP ratios.

1.3.2. Empirical studies on government bond spreads in the EMU: A summary

As a confirmation of the theoretical factors mentioned in the preface of section 1.3, the existing literature mostly models government bond spreads on three main variables: credit risk, liquidity risk and the international risk factor. Even though results are not unanimous, we can go through the mix of evidence provided and draw some interesting conclusions. This being said, we will start with the period preceding the global financial turmoil.

(1) Credit risk premium: A number of papers highlight the role played by the 'fiscal performance' of EMU central governments in explaining the yield spread of bonds. Alesina *et al*. (1992) first bring to light the role of public debt in the determination of interest rates, which seems to matter for highly indebted countries. Similarly, Gomez-Puig (2008) finds evidence that yield differentials are positively correlated to an increase in debt vis-à-vis Germany. Meanwhile, Schuknecht *et al*. (2009), Hallerberg and Wolff (2008), Manganelli and Wolswijk (2009), and Gerlach *et al*. (2010) shows that fluctuations in spreads among the EMU countries are connected to their debt and deficit ratios. Differently, Bernoth *et al*. (2004) find that, with the advent of the EMU, markets now capture fiscal soundness thanks to the debt service ratio rather than overall debt or deficit levels. Heppke-Falk and Hüfner

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[32] PIGS is a jargonistic acronym that refers to the economies of Portugal, Ireland, Greece and Spain.

[33] De Grauwe, P., Ji, Y. (2012). Mispricing of sovereign risk and multiple equilibria in the Eurozone. *Centre for European Policy Working Paper*, (361), p.1

[34] During 1999-2008, yield spreads were almost equal to zero despite widly differences in underlying fundamentals.

(2004)'s estimation results suggest that the expected deficit ratio has a positive impact on France and Germany yield differentials, rather than realized deficits. Finally, Codogno *et al*. (2003) find default risk (especially debt ratios) to be a relevant determinant for Spain and Italy.

(2) Liquidity risk premium: Statistical evidence concerning the liquidity premium is far from consensual. For example, Gomez-Puig (2006), Manganelli and Wolswijk (2009) and Gerlach *et al*. (2010) find liquidity proxies to be important drivers of yield differentials among EMU bonds[35]. On the contrary, Bernoth *et al*. (2004) point out that the liquidity premium has vanished with the introduction of the EMU. In between, Beber *et al*. (2009) conclude that a flight-to-liquidity phenomenon emerges in times of market stress. According to their results, investors chase liquidity in period of economic distress. For their part, Favero *et al*. (2007) find liquidity differentials to be priced only for a subset of countries. Finally, Codogno *et al*. (2003) find that liquidity plays at most a small role in yield spreads.

(3) International risk factor: Several studies confirm the hypothesis that interest rates differentials among EMU bonds are partly determined by global risk factors. Indeed, Codogno *et al*. (2003), Geyer *et al*. (2004) and Favero *et al*. (2007) underscore that the (co) movement of yields and spreads are mainly driven by a common factor, mimicking the perceived risk of financial assets. Similarly, Maganelli and Wolswijk (2009) and Sgherri and Zoli (2009) confirm that this exogenous pricing of global risk over time (=shifts in international risk sentiment) affects the yield spreads across EMU member states.

Up to now, all the papers mentioned in this summary handle datasets with time periods up to 2008[36]. So they fail to capture the evolution of government bond yield differentials following the global financial crisis. Since then, a more recent literature has fortunately re-examined the menu of risks priced by markets, as well as their accountability in the widening of spreads among EMU members. We will focus on these researches in the remainder of this section.

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[35] In the broadest terms, academic literature provides the following proxies to measure the liquidity premium: amount of outstanding bonds, volumes at issuance, trading volumes or bid-ask spreads.

[36] With the exception of Sgherri and Zoli (2009) and Gerlach et al. (2010).

With regard to the early stage of the crisis, domestic banking sectors were found to be a significant driver of national yield spreads. However, the impact is heterogeneous across EMU members, depending upon national banks' exposure to international financial conditions (see e.g. Attinasi *et al*., 2009, Sgherri and Zoli, 2009, Gerlach *et al*., 2010, Acharya *et al*., 2011). In effect, troubled financial institutions were recapitalized through public bailout programs, which *de facto* exposed the governments to the weaknesses of their financial sector. According to Acharya *et al*. (2011), this provision of state aid has been converted into sovereign risk due to the financing mechanisms adopted. Indeed, increased taxation and dilution of existing sovereign debt-holders are both costly channels: Future taxation will depress the investments of the non-financial sector, consequently hurting growth and thus future public revenues. For its part, anticipated dilution will lead to a deterioration of government creditworthiness.

Furthermore, academics also started to question the structural inertia that prevailed in the different model specifications. By testing for discrete shifts in the estimation coefficients, several papers found that the sensitivity of sovereign bond yields towards idiosyncratic fundamentals increased since August 2008. Indeed, fiscal unsoundness and other macro-economic imbalances are now more heavily punished than in the pre-crisis period (see e.g. Bernoth *et al*., 2012, Schuknecht *et al*., 2010, Barbosa and Costa, 2010, Arghyrou and Kontonikas, 2011, Sgherri and Zoli, 2009, Afonso *et al*, 2015). On the contrary, the liquidity factor, although being statistically significant, is still a bipartisan topic. Some academics (Barbosa and Costa, 2010) argue that the role of liquidity has increased with the crisis while others (Sgherri and Zoli, 2009, De Santis, 2012) suggest a rather limited incidence of liquidity on spreads.

In the same vein as the idiosyncratic factors, Sgherri and Zoli (2009) and Schuknecht *et al* (2010) show that the increase in yield differentials mirrors a revised assessment of global financial market factors. Barrios *et al*. (2009) and Haugh *et al*. (2009) partly confirm this finding, with international risk aversion being responsible for nonlinearities in the coefficients of other explanatory variables. Indeed, Barrios *et al*. (2009) rule that the coefficient of public debt heightened with the shift in markets' global sentiment while Haugh *et al*. (2009) shows that the penalization of fiscal imbalances is magnified by the increase in market stress.

So far, the above studies use at best exogenous breakpoints to account for the altering in the coefficients of the different risks. According to Bernoth and Erdogan (2012), these models are not a good way to correctly assess the structural instability of the explanatory variables. Indeed, the authors argue that the change over time in the pricing of risks requires time-varying slope coefficients. By applying a time-varying coefficient panel model, Bernoth and Erdogan (2012) found that the incidence of domestic fundamentals and international risk aversion differ over time. This is expressed by a shift in the model' estimated coefficients. In line with Bernoth and Erdogan (2012), Afonso *et al.* (2015) also criticize the choice to reduce the time span to a pre versus post-crisis distinction, where a discrete structural break differentiate the two sub-samples. The authors' incremental contribution lies in the testing of this time-varying relationship on a country-specific basis. The time-series results suggest the presence of significant heterogeneity across member states, with spread drivers varying in nature and magnitude over time. Furthermore, Afonso et al. (2015) results confirm Bernoth and Erdogan (2012) work, which support the existence of a time-varying relationship between the explanatory variables and yield spreads of government bonds.

In addition, some literature found out contagion effects among less well-rated governments during the Eurozone sovereign debt crisis (Caceres *et al.*, 2010, De Santis, 2012). Indeed, De Santis suggests that Greece's woes (several rating downgrades) have spilled over to EMU members with weaker fundamentals: Ireland, Italy, Portugal, Spain, Belgium and France.

Finally, De Grauwe and Ji (2012) shed a new light on the topic of sovereign risk, suggesting a mispricing of risk following the onset of the euro sovereign debt crisis. This can drive countries to multiple equilibria, characterize by solvency crises and recession in bad times. In their view, this phenomenon is amplified for the EMU countries because they lost their monetary autonomy with the currency union.

1.4. Market-based measurement of sovereign risk

In this section, we will elaborate further on government creditworthiness and how it expresses in financial markets. In effect, a range of financial securities (stocks, bonds, options and other

derivatives) reflects investors' perceptions towards the credit quality of sovereign borrowers. While we mostly have expanded on bond yield spreads in the preceding sections, it's worth taking the time to examine another instrument that proxy our variable under study; sovereign credit default swaps (SCDS) (Pepino, 2012).

According to the International Monetary Fund (2013), the analysis of countries' relative riskiness is made possible thanks to bond and SCDS spreads. Indeed, both spreads market-measure the different risks underlying a given national entity (Arce *et al*., 2011). In an environment without market frictions, a theoretical equivalence prevails between a sovereign bond yield differential and the corresponding SCDS spread (Arce *et al.*, 2011, 2012). Thus, both markets should reflect in a similar fashion the information regarding credit risk factors of the reference entity. Lastly, with regard to the price discovery process, both spreads should reveal as quickly and efficiently all information related to sovereign risk (Arce *et al*., 2011)[37].

The two financial instruments, including their linkages with government riskiness perceptions, are outlined in the following two sub-sections. To finish, a comparison about their reliability/usefulness will close this chapter about the market pricing of "sovereigns".

1.4.1. Government bond yield spreads

As a reminder, let us start with some basic features of fixed income analysis, especially the understanding of bond yield spreads. In line with the risk-return tradeoff definition, an issuer has to reward investors for the risks incurred in engaging a bond purchase. Specifically, this interest rate paid by the bond issuer is made of two elements (1) the yield requested on 'risk-free' instruments and (2) the additional yield requested for bearing the perceived risks related to the issue (Fabozzi *et al*., 2007). Thus, it's this second item that determines bond yield differentials.

[37] The hypotheses retained in this paragraph will be debated in the sub-section 1.4.3.

According to Fabozzi *et al*. (2007), the absolute yield spread between two bonds is defined as:

$$yield\ spread\ =\ yield\ on\ bond\ X\ -\ yield\ on\ bond\ Y$$

Where a reference (or benchmark) bond Y is subtracted from the bond X under study.

Yield spreads provide a useful support in the valuation process of individual securities within a bond sector. By construction (see equation above), the yield spread estimates "the relative value" of a bond towards a chosen benchmark. Interestingly, this type of data opens the door for a comparative analysis of returns/borrowing costs across a specific market, in this case the government bond market (Fabozzi *et al*., 2007 and Wooldridge, 2001).

Within the context of EMU government bonds, German yields can be used as the interest rate benchmarks against which other EMU members will be priced. According to investors, German bunds are one of the best instruments to proxy the "risk-free" rate for European bond markets. However, other assets/securities compete for this benchmark status. As mentioned by several authors (see e.g. the IMF, 2013, Van Landschoot, 2004 and Wooldridge, 2001), swap contracts are an alternative riskless yield curve. In effect, interest rate swaps are particularly used due to the lack of any counterparty risk, as capital is not engaged[38]. Even though the range of users is growing (especially the dealer-customer segment), these derivative instruments are mostly used as reference by traders of commercial and investment banks (Van Landschoot, 2004, Wooldridge, 2001)[39]. Moreover, interest swap rates remain exposed to reversals in the interbank deposit rate and are more related to the short end of the interest rates term structure (Wooldridge, 2001). Accordingly, we will opt for the German Bund term structure as the nub in our interest rates analysis, as is also the case for most of the quantitative studies mentioned in section 1.3.

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[38] Interest rate swaps are private agreements between financial institutions to exchange future streams of interest payments (i.e. fixed rate for floating rate). These OTC derivatives instruments are virtually default-free as risk is limited to interest rate differences (for an entire explanation of interest rate swaps see Credit Suisse website).

[39] As the floating rate of the swap contract is indexed to a reference rate like the LIBOR (or EURIBOR), this benchmark corresponds more to the cost of financial institutions liabilities. For this reason, banks assess prices against the swap curve, which is not adequate for our future work on sovereign financing costs.

As regards the time horizon, reference is often made to the 10-year maturity of the term structure of interest rates. According to Codogno *et al.* (2003), the 10-year government bond is the most actively traded maturity in the EMU sovereign securities market. Moreover, it is the maturity along the yield curve that best reflects medium/long term creditworthiness (Mosley, 2003). Nevertheless, we are aware that the concept of maturity is not reduced solely to this latest aspect. Maturity is involved in a wide range of risks faced by bonds. The most important might be the interest rate risk, which all fixed income instruments (including sovereign bonds) are exposed to (Bodie *et al.*, 2013, Fabozzi, 2007)[40]. Although the interest rate sensitivity of bonds is of great concern for market participants, it falls out of scope for our study since we are interested in yield spreads rather than the subsequent changes in bond prices. The same remark applies to the yield curve risk, which is the risk of experiencing an adverse shift in the yield curve (Fabozzi, 2007, Investopedia). Indeed, a bond's price reaction to movements in the yield curve (steeping or flattening) depends on his exposure along the curve (cf. maturity). Putting aside the term structure theories that interpret these changes in the yield curve, we can rule out this issue concerning maturity as we calculate bond spreads for bonds with an identical term to maturity.

1.4.2.Sovereign Credit default swaps spreads

A credit default swap (CDS) is a derivative instrument conceived to transfer the credit risk of debt obligations of reference entities (Fabozzi, 2007). Analogous to insurance policies, a CDS is a documented contract where the purchaser of the swap makes periodic payments (= swap spread or premium) to the credit protection seller until maturity of the contract. In return of this periodic fee, the buyer is protected from any potential losses on the underlying debt arising from so-called "credit events" (Gonzalez-Hermosillo, 2013)[41]. If such an event occurs, the contract terminates and the protection seller settles the amount of the compensation payment, which is usually equal to the difference between the contract notional value and the

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[40] Indeed, bonds core features affect the price sensitivity of a bond to changes in interest rates. So, the determinants of interest rate risk include the term to maturity, the coupon rate, embedded options and the yield level of the bond. For their general properties, also known as Malkiel's (1962) bond pricing relationships, see the academic book of Bodie *et al*. (2013), Essentials of Investments.

[41] The documentation of a CDS includes the identification of the reference entity/obligation, the settlement method retained, the determination of the payment obligation and the definition of "credit events". These swaps are usually documented under a standard set of forms published by the International Swap and Derivatives Association (ISDA).

recovery value of the reference obligation (Codogno *et al*., 2003). In a different register, CDS can be seen as a market-based indicator of credit risk. Indeed, the premium paid for the protection can be used to quantify the perceived riskiness of the third party/ reference entity since the risk structure of interest rates and the CDS prices ought to be aligned (Bodie *et al.*, 2013, Gonzalez-Hermosillo, 2013).

Besides being valuable hedging instruments and important tools in the management/trade of credit risk, CDS can be used to speculate on an entity's future creditworthiness. By taking an unfunded short (or long) position in the reference obligation, investors deliver a negative (positive) recommendation about the default risk of the issuer without having any offsetting position in the underlying debt (Gonzalez-Hermosillo, 2013). The hypothetic nuisance of this process on the stability of markets is subject of debate and will be discussed in the next section.

Moreover, the last purpose of this type of swaps is the disclosure of arbitrage opportunities. Indeed, pricing differences between CDS and the underlying debt might occur and traders try to benefit from them by implementing specific trading strategies, called "basis trading" (Gonzalez-Hermosillo, 2013).

CDS also trade on sovereign debt and are known as sovereign credit default swaps (SCDS) (Bodie *et al*., 2013). The SCDS spread (or premium), expressed as a percentage of the face value of the government bond, reflects the perceived creditworthiness of individual sovereign debt (Pepino, 2012).

1.4.3.Debate surrounding the two approaches

In this closing section, we will first quote some of the substantial differences that may exist between government bond and SCDS spreads before going through the analysis of the theoretical equivalence and the price discovery process mentioned in 1.4.

As for government bond, market microstructure characteristics (including liquidity) also affect SCDS spreads. Although the trading volume of SCDS has expanded significantly since

2008, it does not carry much weight towards the volumes observed in the sovereign debt market (Arce *et al.*, 2011, Codogno *et al*., 2003). So, sovereign bonds seem to benefit form higher market liquidity as we accept market size to be a rational proxy. The latest available figures from the Bank of International Settlements (BIS) support this postulate. Indeed, the $2,5 trillion gross notional amount of outstanding SCDS (by end-June 2014) sound to be small relative to the total government outstanding debt, which amounted to $38 trillion in March 2015[42]. Other proxies traditionally used confirm the superiority of government bonds regarding liquidity; for example, the number of 'zero changes' in spreads per week is higher for the CDS market than the government bond market (Fontana and Scheicher, 2010).

Moreover, SCDS spreads slightly differ from government bonds spreads since SCDS include counterparty risk (Favero *et al.*, 2007). In effect, theses latest are exposed to the solvency of swap dealers, a feature not shared by government bonds. A lower quality of protection increases the counterparty risk faced, which subsequently implies a fall in the SCDS price (=spread). Unfortunately, counterparty risk might be the scene of worrying developments; the 2008's case of the American Insurance Group (AIG), one of the biggest credit protection sellers, dramatically illustrates this additional risk incurred by the protection buyers.

Despite the efforts made by the International Swap and Derivatives Association (ISDA) to standardize documentation, SCDS's remains customized transactions including some discrete contract terms and provisions (Fabozzi , 2007). According to Pepino (2012), it makes from swaps a less transparent instrument than government bonds and compels investors to be more careful vis-à-vis price signals in CDS markets.

A last differentiation between the two securities concerns the 'optionality' feature carried by CDS (Codogno *et al.*, 2003). Following the authors, *CDS spreads cannot decrease below zero*

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42 The digits are based on the latest BIS statistical bulletin, issued in September 2015. In this case, the gross notional amount of outstanding SCDS covers the global OTC derivatives market while government outstanding debt equals the aggregate of the general government debt of the countries listed in the table. Our first purpose was to illustrate the discrepancies in trading volumes with the SCDS net notional value ratio released by the Deposit Trust and Clearing Corporation (DTCC). Nevertheless, we were unable to collect the data from this source.

while asset swap spreads (=government bond spreads) *may go deeply negative* [43]. Embedded options make it difficult to properly study governments' relative creditworthiness.

The EMU sovereign debt crisis has putted into question the theoretical equivalence between government bonds and SCDS. In their papers, Arce *et al*. (2011,2012) refuted this equivalence as they found some significant pricing differences between the two spreads. Indeed, the authors found evidence for non-zero "bases" during this latest period of financial stress and that this persistent deflections are due to the following explanatory factors[44]; counterparty risk, funding costs and flight-to-liquidity negatively affect the basis whereas liquidity and the common volatility of EMU equity markets (=regional systemic risk) have a positive effect on the basis (Arce *et al.*, 2012). For their part, Fontana and Scheicher (2010) found country-specific and global risk factors to be linked to sovereign "bases". On the contrary, the International Monetary Fund (2013) have documented that SCDS are a perfect tool to eliminate government credit risk. Indeed, their results state that SCDS spreads display the same economic fundamentals and market risk factors as the underlying sovereign bonds.

What concerns the possible divergence in the markets' informational efficiency (=credit risk price-discovery), it is difficult to retrieve recurrent findings from the literature. For instance, Delatte *et al*. (2012) find that in period of market turmoil SCDS markets tend to incorporate new information faster than in government bond markets. On the contrary, Arce *et al*. (2012) argue that sovereign bond markets tend to adjust more rapidly and thus lead the price-discovery process in period of acute stress. Finally, Fontana and Scheicher (2010) results point differences across EMU countries since the outbreak of the crisis.

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[43] Codogno, L., Favero, C., Missale, A. (2003). Yield spreads on EMU government bonds. *Economic Policy*, 18(37), p. 519.

44 The "basis" is defined as the difference between the CDS spread and the corresponding bond spread. In equilibrium, it should be equal to zero as s= ytm-r, where s is the CDS spread and ytm-r is the bond spread (Arce *et al.*, 2011, 2012).

Part 2. DATA AND ECONOMETRIC METHODOLOGY

2.1. Data description

To define the factors driving government yield spreads, I carry out an empirical analysis on a data-sample comprising quarterly observations of nine EMU countries from January 2002 to December 2013.

Our sample comprises both central (Belgium, Finland, France and the Netherlands) and peripheral countries (Greece, Ireland, Italy, Portugal and Spain) of the EMU. The time span includes the ephemeral stability in sovereign bond yields that followed the inception of the single currency as well as their widespread increase in the aftermath of the financial crisis. Unlike most studies (see e.g. Bernoth *et al*., 2012, Schuknecht *et al*., 2010), our data-sample has the advantage to fully cover the recent Eurozone sovereign debt crisis during which fragile member states faced enormous pressure to finance their debt, leading for the most severe cases to trigger financial rescue packages.

For our dependent variable, we use government bond yield spreads measured as: $YD_{i,t} = \left(Y_{i,t} - Y_{GER,t}\right)$

Where $Y_{i,t}$ and $Y_{GER,t}$ are the yields to maturity of 10-year bonds issued by country *i* and by Germany respectively (Codogno *et al.*, 2003)[45]. The data is collected from Bloomberg terminal. Importantly, we gathered daily yields of generic 10y-government bonds without coupon. What concerns the method of frequency conversion, we decided to use the last period observation for each quarter.

With reference to the explanatory variables, we explain yield differentials in terms of fundamental-based and investor behavior-based variables (Dornbusch *et al*., 2000). More specifically, we use instruments that could be gathered following the next group of regressors:

[45] As mentioned in section 1.4.1, the literature often takes German bund yields as interest rate benchmark in the context of EMU government bonds.

macroeconomic fundamentals, market microstructure, global market sentiment, policy actions and control variables.

To account for *credit risk*, we decide to use countries' fiscal fundamental variables, namely the historical government debt-to-GDP and budget balance-to-GDP[46] (see e.g. Bernoth *et al*, 2004, Beber *et al*, 2009, Geyer *et al*, 2004, Schuknecht *et al*., 2010). Our choice is motivated by theirs widely usage in budget policies and the Maastricht treaty. A worsening in a country's fiscal position (higher debt or lower budget balance ratio) can alter investors' opinion about the sustainability of its fiscal policy. So, a higher debt ratio is expected to increase spreads, as highly indebted countries are more likely to bear default risk. On the contrary, the budget balance ratio should negatively influence yield differentials because government budget surplus tends to improve the country's credit risk[47]. The data concerning government debt-to-GDP of EMU countries are quarterly observations sourced from Eurostat database while government budget balance-to-GDP data is taken from European Central Bank data warehouse. In our case, we do not include credit ratings as a proxy of credit risk for the following reason that it is considered an ex-post measure of fiscal sustainability (Gomez-Puig *et al.*, 2014).

Besides these two standard fundamental variables, we also use other instruments to assess countries' credit risk: the current account balance-to-GDP and the debt service ratio.

The current account balance is an indicator of countries' competitiveness as well as countries' ability to raise funds for debt servicing (Giordano *et al*, 2012)[48]. Consequently, a current account surplus should pressure sovereign credit risk downward whereas a deficit should

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[46] An alternative option is to make use of expected fiscal variables (see e.g. Attinasi *et al*, 2009, Barrios *et al*, 2009, Sgherri and Zoli, 2009). Even though these authors assume investors use reliable sources of information (e.g. European Commission's forecasts and OECD Economic Outlooks) to form their expectations, we do not support such a strong assumption about investors' farsightedness. Moreover, their low frequency of updates (bi-annual) is a potential drawback.

[47] Government budget balance, also referred to as public fiscal balance, is the overall difference between government revenues and spending. A positive difference is called a budget surplus while a negative difference is called a budget deficit (see Investopedia).

[48] As the current account balance is measured by the difference between exports and imports, it determines the country's net position towards the rest of the world/net foreign debt (Eurostat).

increase it. However, the mechanisms underlying this causality are diverse. Following De Grauwe and Ji (2012), an increase in a country's net foreign debt, whether driven by private or public overspending, has a negative incidence on its government budgets. The authors point that private default risk arising out private sector overspending negatively affect the strength of the economy, which subsequently induces a decline in government revenues and thus an increase in its budget deficit. Differently, Barrios *et al*. (2009) argue that governments may take over private debts in some severe cases, leading to a worsening of its budget positions. So, current account imbalances may add difficulties to countries' fiscal management and are taken into account by investors[49]. The data concerning current account balances of EMU countries are quarterly observations taken from OECD database.

The debt service ratio, which gives us the debt interest payments over total government revenues, is another measure to capture borrower's credit quality. Initially developed in Bernoth *et al*. (2004) paper, it emphasizes on the degree to which government budgetary flows may be harmed by debt service payments. Furthermore, the variable takes into account the leeway for governments to raise the tax burden on domestic taxpayers for a given level of GDP (Bernoth *et al*., 2004). The ratio is constructed with quarterly observations obtained from Eurostat.

Regarding the *liquidity premium,* we follow a widespread approach of the literature (see e.g. Beber *et al*., 2009, Codogno *et al*., 2003, Gomez-Puig, 2006 and 2014), which uses the total amount of outstanding government debt to proxy differences in market liquidity[50]. According to Gomez-Puig (2006, 2014), the total volume of supply of a security can be considered a measure of market depth because larger markets benefit from lower information costs and the presence of numerous traders. This suggests that the overall volume outstanding has a positive effect on the liquidity premium, meaning that our variable has a negative impact on sovereign yield spreads. Technically, our liquidity measure is constructed as the ratio of the total amount

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[49] Barrios *et al* (2009) note these difficulties are more pronounced in currency areas (e.g. the EMU). Since competitive devaluation is no longer possible (=inhibit an export-led recovery), adjustment of current account deficits harm even more the government budget positions

[50] Liquidity may also vary across sovereign issuers due to trading volumes, activity of market markers and the efficiency of secondary markets (Codogno *et al*, 2003). Since these variables are hardly available, we have decided to exclude them of our empirical analysis.

of outstanding government debt in country *i* to the total amount in Germany. The quarterly observations for our data were extracted from the database of Bank of International Settlements.

In order to capture the effects of *investors' risk aversion* on government yield spreads, we first consider the yield spread between Moody's Seasoned AAA US corporate bonds and 10-year US Treasury bonds (see e.g. Attinasi *et al*., 2009, Barrios *et al*., 2009, Codogno *et al*., 2003, Geyer *et al*. (2004))[51]. Empirical evidence for government bond spreads in emerging markets has motivated our choice to use US corporate bond spreads as proxy for international risk factors (Kamin *et al*, 1999, Eichengreen *et al*, 2000). Indeed, these latest were found to drive upward the interest rates differentials. The data are available on the Federal Reserve Bank of St. Louis database. For this instrument, averaging daily observations create our quarterly times-series. To robustness check this variable, we use an additional variable to gauge the role of global market sentiment in sovereign yield spreads, namely the VIX index (see e.g. Afonso *et al*., 2015, Arghyrou and Kontonikas, 2011, Beber *et al.,* 2009). The Chicago Board Options Exchange Volatility Index (VIX) is a measure of the perceived risk in US equity markets, constructed using implied volatilities from the S&P 500 index options[52]. So, this forward-looking index depicts investors' expectations about stocks volatility over the next 30-day period (Whaley, 2008). Like Rankin and Idil (2014) who have shown that U.S. Treasury yields and the VIX index recently displayed a strong negative correlation, we expect high levels of markets' uncertainty to coincide with strong demands for 'safe-haven' assets like German bonds. In consequence, this 'flight-to-quality' phenomenon (i.e. capital inflow into German bonds) should cause an increase in yield differentials of other EMU government bonds. The data for the VIX index is available on Bloomberg Terminal. As for the US corporate spread, we calculated quarterly averages from daily observations.

In addition, we investigate the impact of ECB *monetary policy* on EMU government bond yield spreads. According to Manganelli and Wolswijk (2009), a positive theoretical link

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[51] We should note that some research papers instead use BBB US corporate spreads (see e.g. Bernoth *et al*., 2004, Gerlach *et al*., 2010)

[52] Definition based on Bloomberg and Investopedia.

prevails between ECB key interest rates and sovereign yield spreads: Indeed, a tightening of monetary policy is related to an increase in spreads and vice versa, a loosening in short term interest is associated with a downward movement in spreads. The rationale behind this causality is explained by the mean of two channels (Manganelli and Wolswijk, 2009). The first channel rephrases the incentives structure of investment managers developed in Rajan's (2005) paper whereas the second (indirect) channel is based on the impact of interest rates on the state of the economy[53]. Unlike Manganelli and Wolswijk (2009), we do not use the ECB main refinancing operation (MRO) rate to proxy short-term interest rates but the European Overnight Index Average (EONIA) reference rate. Obtained from the ECB data warehouse, our daily observations were average on a quarterly basis.

Following the academic literature (see e.g., Bernoth *et al*., 2004, Klepsch, 2011), we also include the GDP growth rate as *control variable* for cyclical fluctuations. Consideration to this variable has first been indicated by Alesina *et al* (1992), for which the health of the overall economy has an incidence on a country's default risk. Indeed, an economic slowdown entails a reduction in government revenues, which is likely to increase budget deficits and thus credit risk. We collected quarterly observations of each country's GDP growth rate from OECD database.

As our dependent variable is the yield spread of each EMU country over Germany, all variables included in our model are in relative terms of German ones, except for proxies that capture global risk aversion and ECB monetary policy.

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[53] Following Rajan (2005), a loose monetary policy incites investors to take on more risks because they can boost their compensation by increasing the expected return of their investments. On the contrary, in a tightened monetary environment, it can be sufficient for investors to invest in safer assets to achieve the desired return. So, Rajan (2005) claims it is rather a question of shifts in investors' incentives than their willingness to bear risks that drives bond spreads.For its part, the second channel mechanism builds on habit formation models wherein risk aversion increases in economic slowdowns and vice versa. In such a framework, an increase in short-term key interest rates should wind down economic activity. The economic deterioration is accompagnied by a rise in investors' risk aversion, increasing in this way the premium required on riskier bonds.

2.2. Modeling government bond yield spread

In order to combine cross-sectional data on N spatial units and T time periods, we will use panel-data econometrics for our modeling process (Wooldridge, 2012). The primary interest of using such models is to benefit from larger data samples (NxT observations) than those typically encountered in single cross-section (N observations) or times-series data (T observations). According to Baltagi (2005), large datasets offer more variability and less co-linearity among variables. This additional informative data yields more accurate parameters estimates and a better statistical inference[54]. Furthermore, large samples imply higher degree of freedoms, which allow relaxing the restriction on the number of explanatory variables (Podestà, 2002). A second precious benefit is the ability of panel-data models to control for individual or time heterogeneity, a characteristic not shared by pure cross-section or time series studies (Baltagi, 2005).[55] Furthermore, a growing part of the literature tackles EMU sovereign bond spread with a panel data methodology, confirming our choice to use this modeling process (see, e.g. De Grauwe and Ji (2012), Gomez-Puig (2006, 2008 and 2014), Haugh *et al*. (2009), Klepsh (2011), Schuknecht *et al*. (2010)).

So, our baseline specification is a static panel model regressing 10-year government bond yield spread on the different variables identified in the data description. More precisely, we have chosen to make use a least square dummy variable model (LSDV) to account for the individual fixed effects[56]:

$$YD_{it} = \beta_0 + \beta X_{it} + \sum_{n=2}^{10} \gamma_n D_n + \varepsilon_{it} \qquad (1)$$

with $i = 1, \dots, 9$ denoting the nine EMU countries and $t = 1, \dots, 48$ the quarterly time dimension.

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[54] To conduct correct inference, we will assume our variables to be stationary. Unit root and other nonstationarities are issues than can be dealed with 'Panel time series' (PTS) or 'non stationarity panel econometrics' (see Eberhardt, 2011). Nevertheless, it is a relatively new field of study with not much accessible literature.

[55] For a full list of advantages and limitations of panel data, see the academic book of Baltagi (2005) Econometric analysis of panel data. It is worth noticing that Baltagi (2005) in fact only rehearse arguments formerly listed by Hsiao (2003).

[56] The reasons behind the choice of an individual fixed effect model (also named covariance model) are detailed in sub-section C of appendix 3: Panel data modeling and estimation process

Here:

i. YD_{it} is the yield differential of country i vis-à-vis Germany at time t.

ii. X_{it} is a (kx1) vector of explanatory variables and comprises four different groups of regressors (as mentioned above): $X_{i,t} = \left[CR_{i,t}, LR_{i,t}, IR_t, MP_t, M_{i,t} \right]$. $CR_{i,t}$ captures country-specific credit risk. It is proxied by the following countries' fiscal fundamentals: the debt-to-GDP ratio and the budget balance-to-GDP ratio. As a matter of robustness, three other macroeconomic variables are included as proxies of credit risk, namely the current account-to-GDP ratio, the private debt-to-GDP ratio and the interest payments/government revenues ratio. $LR_{i,t}$ measures country-specific liquidity risk. It is proxied by the total amount of outstanding debt. IR_t refers to global risk variables, which are common to all countries but vary along time. Here, we use a corporate bond spread as well as the VIX index to gauge investors' risk aversion. Furthermore, MP_t try to assess the effect of monetary policy on government bond yield spreads via the Eonia rate . Finally, we decided to include the GDP growth rate in all our specification as a control variable, which is here denoted with $M_{i,t}$.

iii. As modeled in the baseline specification, the exogenous variables also contain N countries dummy variables D_n. These latest absorb the effects specific to each country by allowing the intercept to vary for each cross-sectional unit. Nevertheless, only N-1 country dummies are introduced in order to avoid perfect multicollinearity (Klepsh, 2011). By including dummy variables, we control for unobserved heterogeneity and are able to estimate the pure effects of the vector of explanatory variables X_{it} .

iv. ε_{it} is idiosyncratic (i.i.d) error term.

Moreover, we address the question of possible parameter instability in the aftermath of the financial crisis. In order to assess whether a shift in the marginal effect of our explanatory variables has occurred, we include a dummy variable (CRISIS) that takes a value of zero in the pre-crisis period (one henceforth) and calculate the coefficients of the interactions between this dummy and the different regressors (Gomez-Puig, 2006 and 2008)[57]. So, this dummy variable technique captures markets' reaction vis-à-vis the determinants of spreads in

[57] We choose as exogenous structural breakpoint the bankruptcy of Lehman Brothers on the 18th of September 2008.

distressed time periods (an upward re-assessment is expected). Mathematically, our second regression model is specified as follow:

$$YD_{it} = \beta_0 + \beta X_{it} + \sum_{n=2}^{10} \gamma_n D_n + \lambda\, CRISIS_{it} + \varepsilon_{it} \qquad (2)$$

Where: $\beta = \beta_1$ if $CRISIS_{it} = 0$

$\beta = \beta_1 + \beta_2$ if $CRISIS_{it} = 1$

In consequence, the marginal effect of any independent variable is $\beta = \beta_1$ in the pre-crisis period whereas it is equal to $\beta = \beta_1 + \beta_2$ in period of financial turbulence[58]. In fact, β_2 is the estimated coefficient of the interaction term $[CRISIS_{it} * X_{it}]$. Finally, λ captures the absolute effect of the crisis, which is not absorbed by the other explanatory variables.

2.3. Estimation method

Given that the disturbance term of our panel data structure is characterized by heteroskedasticity, serial correlation and contemporaneous correlation, Ordinary Least Square (OLS) is no longer the best linear unbiased estimator for our model. Following Gomez-Puig (2006 and 2008), we run our panel estimation using Feasible Generalized Least Square (FGLS) estimator[59]. This method, also named the Parks-Kmenta (1986) approach, is an application of GLS that is robust to the existence of non-spherical errors.

More specifically, two features makes from our panel-data a favorable case for FGLS estimation: First, our data displays quite pronounced cross-sectional correlation (0.42). Second, it is hardly temporal dominant (T=48, N=9). According to Beck and Katz (1995), these two facts render our estimation method more efficient than his alternative counterpart, namely the OLS estimator with panel corrected standard errors (PCSE's)[60].

To the best of our knowledge, no empirical analysis has attempted to fully cover the Eurozone sovereign debt crisis (up to the 4th quarter of 2013) with an FGLS estimation method allowing for such a flexible error term structure.

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[58] Following Gomez-Puig *et al.*(2014), we believe a formal test taking the form of $H_0: \beta_1 = \beta_1 + \beta_2$ is not necessary as long as the interaction term β_2 is statistically significant.

[59] Non spherical standard errors and the estimation issue are discussed in sub-sections D and E of appendix 3: Panel data modeling and estimation process

[60] ibid

Part 3. ESTIMATION RESULTS

3.1. All-sample analysis

We start the empirical investigation with our baseline specification assuming stability of all parameters over time. Gathered via FGLS estimators correcting for heteroskedasticity and correlation, the estimation results of our basic model are reported in *Table C* (see appendix 4)[61].

Table C contains columns of figures for three different groups: All sample EMU countries, EMU central countries and EMU peripheral countries[62]. The objective of this distinction is control for the substantial heterogeneity between different countries. Clustering was performed on the basis of a market-related terminology rather than any quantitative macroeconomic threshold. Indeed, membership to the 'PIIGS' club was used as decision-making factor for this distinction[63].

At first glance, *Table C* suggests that a common determinant significantly enters in our baseline specification, may it concern central or peripheral countries. This global factor represents the willingness of investors to bear risk, proxied here by the US corporate bond spread. Hence, its coefficient captures movements in yield differentials that can be allotted to a shift in market risk aversion. A justification for spreads' sensitivity to corporate bond risk premia is that corporate credit shocks may depress underlying bond prices and leave exposed investors with sudden paper losses. As a result, investors become more risk averse, which discourages risk taking and pushes them to flow into 'safe-haven' assets like German bonds. With regard to the figures in *Table C*, the extend of this phenomenon varies within our

[61] In our case, the estimation technique allows for the most flexible error structure, i.e. serial and contemporaneous correlation.

[62] As mentioned in section 2.1, central countries comprise Belgium, Finland, France and the Netherlands whereas peripheral countries encompass Greece, Ireland, Italy, Portugal and Spain.

[63] The acronym PIIGS refers to five EMU countries (Portugal, Ireland, Italy, Greece and Spain), which were considered vulnerable in the aftermath of the financial crisis (The Economist).

clustering: central and peripheral countries' differentials will respectively rise by 17.7 and 43.9 basis points (bp) following a 1-percentage point increase in the corporate spread. Overall, this first finding supports some precedent empirical evidence, which had found US corporate bond spreads to positively impact sovereign bond spreads (see e.g. Kamin *et al*., 1999, Eichengreen *et al.*, 2000).

Nonetheless, *Table C* also depicts striking differences between central and peripheral countries. Indeed, developments in PIIGS' sovereign bond spreads are affected by a broad spectrum of risk factors, a feature not shared by EMU central countries. In particular, two traditional determinants of sovereign bond spreads, namely fiscal fundamentals and liquidity, seem to play a non-negligible role in PIIGS spread fluctuations.

In effect, our results provide evidence that liquidity is a significant driver for this subset of countries. Assuming all other variables constant, a 10-percentage point increase in our liquidity proxy (cf. ratio of overall amount of outstanding debt in country i to overall amount in Germany) will decrease peripheral countries' yield spreads by 25 bp[64]. This attention devoted by investors to market depth does not apply to EMU central countries. Indeed, the coefficient associated to relative market size does not only exert a slight influence for these countries but it also fails to be relevant for any confidence level.

Moreover, variables that monitor fiscal positions also offer stark contrasts when comparing peripheral and central EMU countries: From *Table C*, we can conclude that a 10-percentage point increase in the debt-to-GDP ratio provokes an average 39 bp rise in PIIGS' bond yield spreads. On the contrary, this coefficient is ten times smaller and statistically not significant when concerning central EMU countries. With reference to the budget balance-to-GDP ratio, the variation between central and peripheral is also worth noticing. For a 1-percentage point increase in the stated variable, yield spreads of peripheral countries should narrow by an

[64] In our results, the marginal effect of our liquidity variable (= -2.548) corresponds to 100-percentage point increase in the value of the regressor X_{it}. Thus, a little mathematical calculation will be required every time we deal with liquidity figures.

average of 9 bp while for central countries the same coefficient estimate is neither robust nor bearing the expected sign.

The aforementioned results state that sustainability of public finances matters for PIIGS countries. As the perceived creditworthiness of most of these countries has deteriorated during the sample period under analysis (see *Graph 3,* appendix 1), market participants assign a higher credit risk premium to this subset of countries. On the contrary, the same variables seems to be irrelevant in the case of central countries, meaning markets do not take into account fiscal fundamentals in the pricing of these sovereigns. Therefore, these facts partly supports the market disciplining hypothesis, which state that markets do exert their disciplinary function vis-à-vis the countries pursuing unsound fiscal policies (see e.g. Bernoth *et al.*, 2004 and 2012, Manganeli and Wolswijk, 2009, Schuknecht *et al*., 2009).

Simply because EMU central countries' yield spreads are not sensitive to these credit and liquidity variables, it does not follow that their respective bonds can be seen as perfect 'substitutes' of German Bunds. Indeed, central countries carry risk premia, which is responsible for the fluctuations of theirs spreads towards the 'risk-free' benchmark. According to our parameters estimation, risk premia can almost entirely be attributed to investors' risk aversion.[65] As mentioned above, an increase in global market uncertainty may trigger a 'flight-to-quality' phenomenon in capital flows, benefiting the safest government bonds (here Germany) and thus pressure central countries' spreads upward[66].

Finally, variables gauging countries' future ability to meet debt payments obligation, like the current account balance-to-GDP or the current GDP growth, were not found to be statistically significant, whether countries are threated in clusters or not[67].

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[65] In the third paragraph of subsection 3.1, we have suggested that for every one-percentage point increase in markets' level of uncertainty, a 17.7 bp increase in yield differentials is observed.

[66] For example, as leading indicator of economic conditions, the corporate bond spread might capture unobserved variations in fiscal stance, like higher or lower expected budget balances (Codogno *et al*., 2003)

[67] It should be noted that the analysis of monetary policy has been voluntary omitted in this first specification. We will tackle this topic in the next section.

3.2. Pre-crisis and crisis period analysis

As mentioned in section 2.2, one of the objectives of this thesis is to unveil whether investors' perception vis-à-vis the riskiness of EMU government bonds has changed with the start of the financial crisis. By means of a dummy variable technique, we will thus check for this possible time-varying pricing of risks by market participants.

By looking at our first column in *Table D* (see appendix 4), which takes into account all sample countries, we can conclude that a change in the market assessment of credit risk partly explains the rise in yield differentials with the financial crisis. Debt-to-GDP and budget balance-to-GDP ratios, besides being statistically significant for both periods, have seen the magnitude of their marginal effects increased during the euro area debt crisis. Indeed, the figures provided in the first column of *Table D* show that the impact of a 1-percentage point rise in these two fiscal fundamentals doubles in the crisis period[68].

Not only do country-specific fiscal fundamentals exert a greater influence on sovereign yield spreads but also our proxy of perceived global risk, whose associated coefficient has been attributed a higher value during the economic downturn.[69]. This environment of heightened uncertainty has pushed investors to adjust their portfolio towards 'safe-haven' assets like German bonds, which explains the across-the-board rise in other EMU bond yield differentials.

More surprisingly, the dramatic move in EMU government bond spreads occurred in an environment of highly accommodative monetary conditions (see *Graph 7*). This finding

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[68] For the period up to 3rd quarter of 2008, a 10-percentage point increase in debt or budget balance to-GDP accounts respectively for a 20 bp widening or 66 bp squeezing in yield spreads. Afterwards, a nearly identical deviation should be added to the above-mentioned basis points, which consequently gives us a marginal impact of respectively 42bp and 116bp for the two variables.

[69] In addition of having switched from a non-relevant status to a statistically significant one, our corporate spread variable has in effect also witnessed an increase in its coefficient magnitude (see column 1 of Table 2). So, our results corroborate literature's finding about the increased sensitivity of government yield spreads vis-à-vis the global market sentiment in times of economic trouble (see e.g. Afonso et al, 2015, Arghyrou et al, 2012, Gomez-Puig, 2014)

undermines the expected positive relationship between policy rates and sovereign bond spreads proposed in our data description. While this positive impact seems to prevail in normal economic times, *Table D* suggest that monetary easing has not dampen the post-crisis increase in EMU government borrowing costs, may they be central or peripheral (Manganelli and Wolswijk, 2009)[70].

"Financial fragmentation" suffered by the Eurosystem during the sovereign debt crisis might be responsible for this puzzling finding (Coeuré, 2013)[71]. According to the author, the soaring economic and financial discrepancies between member states have impaired the pass-through of ECB's policy rate: Despite cuts in ECB reference rate, funding costs (notably of banks) and availability of credit have remained intertwined with risks coupled to sovereign debts. Thus, the Eurozone members seem to have suffered from dispersion in their financial conditions, which could not be bridged by monetary policy. Actually, the loosening of monetary conditions has 'benefited' the safest long-term assets (here the 10-year German Bond), as is demonstrated by the historically low interest rates paid by such issuers (Coeuré, 2013)[72]. Two coexisting reasons may be invoked: The effectiveness of the transmission mechanism of the EBC reference rate to the nominal yield on long-term 'risk-free' bonds and, as mentioned above, the increasing demand for safe assets accompanying the flight-to-safety phenomenon, which reduces its term premium.

Once again, we consider relevant to unravel some of the precedent effects. Therefore, we will now look at the second at third column of *Table D*, which extend the analysis of the dynamic properties of spread drivers for both central and peripheral countries. A first quick review of the two columns seems to indicate that, during the financial crisis period, the increase in the marginal effect of our explanatory variables is more pronounced in peripheral countries than in central countries

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[70] Indeed, the EONIA rate is found to be statistically significant and has a negative sign for both central and peripheral countries, i.e. lower policy rates are associated with increasing sovereign spreads (see *Table D*)

[71] Following the ECB, this type of disturbance is characterized by capital repatriation and big jumps in the home bias in all markets (Coeuré, 2013).

[72] In the worst cases, nominal rates, once corrected for inflation previsions (anchored at 2%), transform into slightly negative expected real rates. Paradoxically, safety becomes expensive since holding safe assets is punitive.

What concerns the EMU periphery, the last column of *Table D* suggests that markets have completely re-priced and enriched the menu of risks once the financial bubble burst. Indeed, our estimations for peripheral countries display huge figures concerning the sensitivity of yield spreads to fiscal fundamentals (debt and budget balance-to-GDP ratios) as well as to variables measuring future ability to meet debt obligations (GDP growth rate and current account-to-GDP)[73].

This evidence of markets' disciplining mechanism towards peripheral countries is in total contrast with developments occurred in the pre-crisis period. In effect, the four above-mentioned regressors, in addition of exerting only a slight influence on yield spreads, failed to be statistically significant during that period. Only our liquidity proxy, i.e. countries' relative market size, seems to have a relevant and substantial marginal impact on PIIGS' sovereign yield spreads up to the 3rd quarter of 2008 (see *Table D*). All in all, this reversal makes now clear that peripheral countries have witnessed a mispricing of their underlying risks till the financial crisis. Put differently, PIIGS countries have been able to pursue unsound fiscal policies in this climate of stability without being punished in marketplace[74]. But, as risk perceptions increased with the outburst of the crisis, investors have turned around and started to discriminate on the basis of countries' fiscal position.

On the other side, (co-) movements in central countries' yield spreads are mostly explained by changes in investors risk appetite along out dataset [75]. However, our results suggest a time varying pricing of markets risk aversion, as the associated coefficient of the corporate bond spread is 22 bp higher in the crisis period compared to the pre-crisis period. This finding supports our above-mentioned results, which point out the increased importance of global

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[73] During the crisis period, the last column of *Table D* points that every 1-percentage point increase in debt-to-GDP leads to a 6 bp average increase on yield spreads. On the contrary, the same rise in budget-balance-to-GDP, current account-to-GDP and GDP growth rate leads respectively to a 19,4 and 18 bp narrowing in yield differentials.

[74] Markets' inertia in the face of these deteriorating fiscal balances may be explained by both the lack of credibility of the SGP no-bailout clause and the abnormal low level of risk aversion within the EMU during this period.

[75] Concerning central EMU countries, the second statistically significant variable is our proxy of monetary policy. Since we have dealt with this topic above, we will not come back on this variable here.

market sentiment in times of deteriorated economic conditions and the subsequent flight-to-quality.

This increased sensitivity of sovereign bond yield spreads to international risk factors has taken a worrying turn in the case of PIIGS countries. By looking at *Table D*, we can conclude that the marginal impact of our regressor, keeping other factors fixed, amounts to an average of 186 bp. Indeed, given the new consideration assigned to low creditworthiness, these countries are not considered anymore as safe assets. Therefore, they suffer even more from capital moves into 'safe-haven' assets during periods of heightened uncertainty (or risk aversion), pushing bond spreads upward. In the words of Dufour *et al* (2014), PIIGS' government bonds have display a more equity-like behavior during the financial crisis, as illustrated by the positive correlation between their respective bond price and stock markets.

Part 4. ROBUSTNESS CHECK

In this section, we will test if our results are robust to the introduction of an alternative variable gauging markets risk aversion, namely the VIX index.

As the VIX index displays important correlation with our former international risk factor (see correlation matrix in *Table A* (see appendix 4), we cannot merely add the VIX in our model as a control variable. Therefore, we will directly check for its significance by swapping the two variables. Our alternative estimation results are reported in *Table E* and *Table F* (see appendix 4).

By looking at *Table E*, we can notice that our new proxy enters significantly in the regressions, except for the subsample of EMU peripheral countries. This reports that investors' expectations about US stocks volatility may play a role in EMU bond yield fluctuations. Furthermore, the coefficients reported are almost identical to those in our former baseline specification (see *Table C*), should it concern statistical significance or marginal impact. So, the results confirm the market discipline imposed on the EMU periphery along our dataset whereas EMU central government bond yield seem to be driven by international risk factors.

However, results in *Table F* are not particularly encouraging from a robustness perspective. The VIX index looses in significance in the crisis period for the two subsamples of countries (and even in marginal impact in the case of EMU periphery). This finding clearly contradicts the results found in *Table D*[76]. Concerning the other regressors, fiscal positions seem to have an even more prominent role in the widening of EMU peripheral bonds. For EMU central government, no clear consensus emerges from the parameter estimations.

[76] We should recognize this is a real puzzling finding if we consider our variable time-series along our dataset. Indeed, VIX developments seem to fully coincide with the difficulties faced by EMU government bonds.

Furthermore, the swap in favor of the VIX index decreases our chi-square statistics, which test for the null hypothesis that all of the coefficients in the model (except constant) are zero[77].

Hence, these findings likely favor the US corporate bond spread as measurement instrument in our study.

[77] Except for EMU central countries in our first model specification

CONCLUDING REMARKS

Overall, our findings suggest the global financial crisis has impinged on EMU sovereign bonds in a heterogeneous fashion. Indeed, yield spread fluctuations subsequent to the 2008 systemic shock are not founded solely on the deterioration of determinants' fundamental values but also on an alteration of market pricing vis-à-vis these different risks. Our estimation results thus corroborate the dynamic properties of factors driving government bond yield spreads, especially for EMU peripheral countries. Using Arghyrou *et al*. (2012) terms, we could characterize markets' attitude along our dataset as a turnaround from "*a 'convergence-trade' model in the pre-crisis period to one driven by macro-fundamentals and international risk thereafter"*[78].

Concerning the EMU periphery, the increased sensitivity of yield differentials to countries' creditworthiness could be the reason behind their upward trend in the aftermath of the crisis. Evidence of this increased market discipline on fiscal positions re-enforces the importance of the Stability and Growth Pact enforcing rules and the need for PIIGS' countries to implement structural and competitiveness reforms. However, we can also conclude that investors have become schizophrenic about both fiscal consolidation and growth perspective (Blanchard, 2011). This observation stresses the importance to implement adjustment mechanisms that include growth stimulus packages in addition to austerity measures. Since the joint effects of fiscal consolidation and slow growth have proven to leave governments worse-off, partial policy measures can thus have an even more dramatic effect on already vulnerable countries[79].

Besides idiosyncratic fundamentals, global risk aversion also records an increase in its marginal impact on sovereign bond spreads following the bursting of the financial bubble.

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[78] Arghyrou, M. G., & Kontonikas, A. (2011). The EMU sovereign-debt crisis: Fundamentals, expectations and contagion. *European Commission, Directorate-General Economic and Financial Affairs, Economic Papers, 436.*

[79] See the example of Greece: Despite the consolidation of its budget balance, the country is trapped in a downward spiral of continuous contraction of GDP. Consequently, it becomes impossible to contain the explosive dynamic of its debt-to-GDP ratio.

Applicable to both EMU central and peripheral countries, our result confirms part of the literature highlighting the importance of global market sentiment during economic downturns. Our parameter estimate indicates that, in an environment of heightened uncertainty, EMU government bond spreads are pressured upward due to the adjustment of portfolios in favor of 'safe haven' assets, status enjoyed by German bonds. Interestingly, we note that this resulting risk premium has taken dramatic proportion for PIIGS' countries, which even display an equity-like behavior during the crisis period.

Moreover, we observe that monetary policy measures have been ineffective in their purpose of invigorating the European economy following the financial turmoil. While loose monetary policy should normally tally with a narrowing in government yield spreads, an inverse relation has emerged during that period. This counter-intuitive finding brings up the question of ECB's operational capacity, more precisely the scope of his mandate. In our opinion, the ECB is stuck with its price stability objective and suffers from a timing issue vis-à-vis the investors[80].

Thus, the forward-looking nature of EMU government bond markets will greatly depends of the above-mentioned issues. However, welfare of EMU countries will also inevitably pass through the strengthening of the governance body at EMU level. With the aim to enhance economic policy coordination, this latest will permit to member states to cope more easily with economic shocks.

We are fully aware this master thesis represents a modest attempt to disentangle the different risk factors underlying EMU government bond yield spreads. A limitation of our research might be the use of a dummy variable technique to account for the time-varying sensitivity of spreads to our explanatory variables. In this respect, an alternative specification is to interact our exogenous regressors with the proxy of market risk aversion (see e.g. Codogno *et al*,

[80] Although ECB unconventional measures (for example: the Outright Monetary Transactions, enlargement of the set of eligible collateral, etc.) helped to restore the efficiency of financial markets, many investors already had left troubled sovereign markets and their negative perceptions were not likely to change as rapidly to bring them back soon in these markets. In this perspective, a pro-active policy body is of prime importance for financial markets.

2003). Differently, Bernoth and Erdogan (2012) use a semiparametric time-varying coefficient model, which remains out of our reach given our current econometric knowledge.

Finally, we end this paper with a note on the benchmark role of German bonds in standard asset pricing models. The recent volatility in the German government bond market (April-May 2015) has putted credit investors in trouble, as they had to act big losses on supposedly safe government papers. According to Jan Straatman[81], these developments suggest bond markets enter an area of "return-free" risk, where safe sovereign debt instruments combine the characteristic of being both expensive and volatile. This new market environment calls into question the traditional association of German bond yield with the concept of 'risk-free' return. So, we invite other academic scholars to further investigate this topic and look at the alternative instruments competing for this benchmark status.

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REFERENCES

Abreu, F. T. S. F. (2014). Government bond yield spreads in EMU countries: The story of an ephemeral convergence.

Acharya, V.V., Drechsler, I., & Schnabl,P. (2011). A Pyrrhic Victory ? : Bank Bailouts and Sovereign Credit Risk. *National Bureau of Economic Research Working Paper*, *1736*.

Acharya, V. V., & Pedersen, L. H. (2005). Asset pricing with liquidity risk. *Journal of Financial Economics*, *77*(2), pp. 375-410.

Adjaouté, K. and J.-P Danthine (2003), European Financial Integration and Equity Returns: A Theory-Based Assessment, in Gaspar, V. et al. "The transformation of the European financial system", ECB, Frankfurt.

Afonso, A., Arghyrou, M.G., Bagdatoglou, G., & Kontonikas, A. (2015). On the time-varying relationship between EMU sovereign spreads and their determinants. *Economic Modelling, 44,* pp 363-371.

Afonso, A., Arghyrou, M.G., & Kontonikas, A. (2015). The determinants of sovereign bond yield spreadqs in the EMU. *ECB Working Paper Series, 1781.*

Alesina, A., De Broeck, M., Prati, A., & Tabellini, G. (1992). Default risk on government debt in OECD countries. *Economic policy*, *15*, pp 427-463.

Arce, O., Mayordomo, S., & Peña, J. I. (2011). Do sovereign CDS and bond markets share the same information to price credit risk? An empirical application to the European monetary union case. *XIX Foro de Finanzas*.

Arce, O., Mayordomo, S., & Peña, J. I. (2012). Credit-risk valuation in the sovereign CDS and bonds markets: Evidence from the euro area crisis. *Universidad de Navarre, Working Paper, 22.*

Arghyrou, M. G., & Kontonikas, A. (2011). The EMU sovereign-debt crisis: Fundamentals, expectations and contagion. *European Commission, Directorate-General Economic and Financial Affairs, Economic Papers, 436.*

Attinasi, M-G., Checherita, C., & Nickel, C. (2009). What explains the surge in euro area sovereign spreads during the financial crisis of 2007-09 ? *ECB Working Paper Series, 1131.*

Baele, L., Ferrando, A., Hördahl, P., Krylova, E., & Monnet, C. (2004). Measuring financial integration in the euro area. *ECB Occasional Paper Series, 14.*

Barbosa, L., & Costa, S. (2010). Determinants of sovereign bond yield spreads in the euro area in the context of the economic and financial crisis. *Banco de Portugal Estudos e Documentos de Trabalho, Working Papers, Vol.22.*

Barrios, S., Iversen, P., Lewandowska, M., & Setzer, R. (2009). Determinants of intra-euro area government bond spreads during the financial crisis. *European Commission, Directorate General for Economic and Financial Affairs, Economic Papers, 388.*

Bayoumi, T., Goldstein, M., & Woglom, G. (1995). Do Credit Markets Discipline Sovereign Borrowers ? Evidence from U.S. States. *Journal of Money, Credit and Banking, vol.27 (4), part 1,* pp1046-1059.

Beber, A., Brandt, M.W., & Kavajecz, K.A. (2009). Flight-to-Quality or Flight-to-Liquidity? Evidence from the Euro-Area Bond Market. *The Review of Financial Studies*, *Vol.22 (3)*, pp 925-957.

Bernoth, K., & Erdogan, B. (2012). Sovereign bond yield spreads: A time-varying coefficient approach. *Journal of International Money and Finance*, *31*, pp 639-656.

Bernoth, K., Von Hagen, J., & Schuknecht, L. (2004). Sovereign risk premia in the European government bond market. *ECB Working Paper Series, 369.*

Bernoth, K., Von Hagen, J., & Schuknecht, L. (2012). Sovereign risk premiums in the European government bond market. *Journal of International Money and Finance, 31,* pp 975-995.

Bishop, G., Damrau, D. &, Miller, M. (1989). Market Discipline Can Work in the E.E.C. Monetary Union, *London, Salomon Bros.*.

Blanchard, O. (2011). 2011 in review : Four hard truths. *IMFdirect blog*. *http://blog-imfdirect.imf.org/2011/12/21/2011-in-review-four-hard-truths/* (consulté le 15/12/15)

Bodie, Z., Kane, A., & Marcus, A. (2013). *Essentials of Investments, 9th edition.*, NewYork (US) : McGraw-Hill/Irwin.

Buti, M., Franco, D., & Ongena, H. (1998). Fiscal discipline and flexibility in EMU: The implementation of the Stability and Growth Pact. *The Oxford Review of Economic Policy Limited*, *Vol.14* (3), pp 81-97.

Caceres, C., Guzzo, V., & Segoviano, M. (2010). Sovereign Spreads: Global Risk Aversion, Contagion or Fundamentals?. *IMF Working Paper*, *10/120,* pp 1-29.

Cafruny, A. W., & Schwartz, H. M. (Eds.). (2013). Exploring the global financial crisis. *Lynne Rienner Publishers*, pp 13-33.

Codogno, L., Favero, C., & Missale, A. (2003). Yield spreads on EMU government bonds. *Economic Policy*, *18(37),* pp 503-532.

Cœuré, B. (2013). The economic consequences of low interest rates. *Public lecture at ICMB. https://www.ecb.europa.eu/press/key/date/2013/html/sp131009.en.html*. (consulté le 17/12/15)

European Commission - Directorate General for Economic and Financial Affairs. (1990). One market, one money : An evaluation of the potential benefits and costs of forming an economic and monetary union. *European Economy*, *44*.

Cordemans, N., & de Sola Perea, M. (2011). Central bank rates, market rates and retail bank rates in the euro area in the context of the recent crisis. *National Bank of Belgium Economic Review*, *1*, pp 27-52.

De Grauwe, P., & Ji, Y. (2012). Mispricing of Sovereign Risk and Multiple Equilibria in the Eurozone. *Centre for European Policy Studies. Working Document, 361*.

Delatte, A. L., Gex, M., & López-Villavicencio, A. (2012). Has the CDS market influenced the borrowing cost of European countries during the sovereign crisis?. *Journal of International Money and Finance*, *31*(3), pp 481-497.

De Santis, R.A. (2012). The Euro area sovereign debt crisis: Safe haven, credit rating agencies and the spread of the fever from Greece, Ireland and Portugal. *ECB Working Paper Series, 1419.*

Dornbusch, R., Park, Y. C., & Claessens, S. (2000). Contagion: How it spreads and how it can be stopped ?. *World Bank Research Observer*, *15*(2), pp 177-197.

Dufour, A., Stancu, A. T., & Varotto, S. (2014). The Equity-like Behaviour of Sovereign Bonds. *International Capital Market Association, Discussion Paper, 16.*

Eichengreen, B., & Mody, A. (2000). What Explains Changing Spreads on Emerging debt.: Capital flows and the emerging economies: theory, evidence and controversies. *National Bureau of Economic Research, vol.0-226-18470-6,* pp 107-134.

Eichengreen, B., & Wyplosz, C. (1998). The Stability Pact : more than a minor nuisance ?. *Economic Policy*, *26*, pp 67-113.

European Central Bank (2014). The determinants of Euro area sovereign bond yield spreads during the crisis. *Monthly Economic Bulletin,* Frankfurt-am-Main

Fabozzi, F. J. (2007). *Fixed income analysis* , *2nd edition*. New Jersey (US) : John Wiley & Sons, Inc.

Favero, C. A., Giavazzi, F., & Spaventa, L. (1997). High Yields : The spread on German interest rates. *The Economic Journal*, *Vol.107, 443*, pp 956-985.

Favero, C. A., Pagano, M., & von Thadden, E.L. (2005). Valutation, Liquidity and Risk in Government Bond Markets. *CEPR, NBER and Università Bocconi, Working Paper, 281.*

Favero, C., Pagano, M., & von Thadden, E. L. (2007). How Does Liquidity Affect Government Bond Yields?. *Centre for Studies in Economics and Finance, Working Paper, 181.*

Fitoussi, J. P. (2005). Fiscal Indiscipline: Why no reaction yet by the markets? *European Parliament -Committee For economic and Monetary Affairs Briefing Paper, 2*.

Fontana, A., & Scheicher, M. (2010). An analysis of euro area sovereign CDS and their relation with government bonds. *National Centre of Competence in Research Financial Valuation and Risk Management, Working Paper, 695.*

Fontana, A., & Scheicher, M. (2015). An analysis of euro area sovereign CDS and their relation with government bonds. *Journal of Banking & Finance*.

Friedman, M.(1997). The Euro: Monetary Unity To Political Disunity?. *Project Syndicate*, *29*.

Gerlach, S., Schulz, A., & Wolff, G. B. (2010). Banking and Sovereign Risk in the Euro Area. *Deutsche Bundesbank Research Centre Discussion Paper Series 1: Economic Studies*.

Geyer, A., Kossmeier, S., & Pichler, S. (2004). Measuring systematic risk in EMU government yield spreads. *The Review of Finance*, *8*(2), pp 171-197.

Giordano, L., Linciano, N., & Soccorso, P. (2012). The determinants of government yield spreads in the euro area. *Commissione Nationale per le Società e la Borsa Research Division, Working Papers, 71.*

Gonzalez-Hermosillo, B. (2013). A new look at the role of sovereign credit default swaps. *IMF Global Financial Stability Report, april, chapter 2,* pp57-92.

Gómez-Puig, M. (2006). Size matters for liquidity: Evidence from EMU sovereign yield spreads. *Economics Letters*, *90*(2), pp 156-162.

Gómez-Puig, M. (2008). Monetary integration and the cost of borrowing. *Journal of International Money and Finance*, *27*(3), pp 455-479.

Gómez-Puig, M., Sosvilla-Rivero, S., & del Carmen Ramos-Herrera, M. (2014). An update on EMU sovereign yield spread drivers in times of crisis: A panel data analysis. *Research Institute of Applied Economics Working Paper, 07.*

Hallerberg, M., & Wolff, G. B. (2008). Fiscal institutions, fiscal policy and sovereign risk premia in EMU. *Public Choice*, *136*(3-4), pp 379-396.

Haugh, D., Ollivaud, P., & Turner, D. (2009). What Drives Sovereign Risk Premiums? : An Analysis of Recent Evidence from the Eura Area. *Organisation for Economic Co-operation and Development , Economics Department Working Papers ,718.*

Heppke-Falk, K., & Hüfner, F. P. (2004). Expected budget deficits and interest rate swap spreads-Evidence for France, Germany and Italy. *Deutsche Bundesbank Research Centre, Discussion Paper Series 1, n°40.*

Kamin, S. B., & von Kleist, K. (1999). The evolution and determinants of emerging markets credit spreads in the 1990s. *Board of Governors of the federal Reserve System*. *International Finance Discussion Papers, 653.*

Klepsch, C. (2011). Yield Spreads on EMU Government Bonds-During the Financial and the Euro Crisis. *Available at SSRN 1810704*.

Lemmen, J.J., & Goodhart, C.A. (1999). Credit risks and european government bond markets: A panel data econometric analysis. *Eastern Economic Journal*, *Vol.25* (1), pp 77-107.

Maastricht Treaty. (1992). Treaty on economic union. *Office for Official Publications of the European Communities, Luxembourg*.

Manganelli, S., & Wolswijk, G. (2007). Market discipline, financial integration and fiscal rules: What drives spreads in the euro area government bond market?. *ECB Working Paper Series, 745.*

Manganelli, S., & Wolswijk, G. (2009). What drives spreads in the euro area government bond market?. *Economic Policy*, *24*(58), pp 191-240.

Matei, I., & Cheptea, A. (2013). Sovereign bond spread drivers in the EU market in the aftermath of the global financial crisis, *hal-00845660*.

Mosley, L. (2003). Global capital and national governments. *Cambridge University Press*.

Pepino, S. (2013). Sovereign risk and financial crisis: the international political economy of the Euro area sovereign debt crisis. *Doctoral dissertation, The London School of Economics and Political Science.*

Rajan, R. G. (2005). Has financial development made the world riskier?. *National Bureau of Economic Research*, *Working Paper 11728,* pp 313-369.

Rankin, E., & Idil, M. S. (2014). A Century of Stock-Bond Correlations. *Reserve Bank of Australia, September Bulletin,* pp 67-74.

Reinhart, C. M. (2010). This time is different chartbook: country histories on debt, default, and financial crises. *National Bureau of Economic Research*, *Working Paper Series, 15815.*

Schuknecht, L., von Hagen, J., & Wolswijk, G. (2010). Government bond risk premiums in the EU revisited: The Impact of the financial crisis. *ECB Working Paper Series, 1152.*

Sgherri, S., & Zoli, E. (2009). Euro area sovereign risk during the crisis. *IMF Working Paper, 09/222.*

Van Landschoot, A. (2004). The determinants of credit spreads, *Financial Stability Review 2004, National Bank of Belgium.*

Whaley, R. E. (2008). Understanding vix. *Available at SSRN 1296743*.

Wooldridge, P.D. (2001). The emergence of new benchmark yield curves. *BIS Quarterly Review*, pp 48-57.

Econometric references

Baltagi, B. (2005). *Econometric analysis of panel data*. West-Sussex (GB) : John Wiley & Sons, Ltd.

Baum, C. F. (2001). Residual diagnostics for cross-section time series regression models. *The Stata Journal*, *1*(1), pp 101-104.

Baum, C. F. (2013). Financial Econometrics EC327. *Boston College.*

Beck, N., & Katz, J. N. (1995). What to do (and not to do) with time-series cross-section data. *American Political Science Review*, *Vol.89,* (03), pp 634-647.

Blackwell III, J. L. (2005). Estimation and testing of fixed-effect panel-data systems. *Stata Journal*, *5*(2), pp 202-207.

Cameron, C., & Trivedi, P. K. (2008). Panel data methods for microeconometrics using Stata. *Microeconometrics Using Stata.* Texas (US) : Stata Press.

Eberhardt, M. (2011). Panel time-series modeling: New tools for analyzing xt data. *UK Stata Users Group meeting Cass Business School , London.*

Greene, W. H. (2008). *Econometric analysis*, 6th edition, Upper Saddle River, N.J. (US) : Prentice Hall.

Hoechle, D. (2007). Robust standard errors for panel regressions with cross-sectional dependence. *The Stata Journal*, *7*(3), pp 281-312.

Park, H. M. (2011). Practical Guides To Panel Data Modeling: A Step-by-step Analysis *Using* Stata. *Graduate School of International Relations, International University of Japan,. Tutorial Working Paper.*

Podestà, F. (2002). Recent developments in quantitative comparative methodology: The case of pooled time series cross-section analysis. *DSS Papers Soc*, *3*(2), pp 5-44.

Stata Corp . (2014). *Stata longitudinal-data/panel-data reference manual: release 14*. Texas (US) : Stata Corp LP.

Torres-Reyna, O. (2007). Panel data analysis fixed and random effects using Stata (v. 4.2). *Data & Statistical Services, Princeton University*.

Wooldridge, J. (2012). *Introductory Econometric : A modern approach*, *5th edition*. Ohio (US) : South-Western Cengage Learning.