Master Thesis Dissertation

ERASMUS UNIVERSITEIT ROTTERDAM

EMU-Sovereign Bonds: Yield Spread Determinants. Great Recession vs Sovereign Debt Crisis

MSc Economics & Business

Financial Economics

Author:

Ioannis Antoniou

474600

Supervisor:

Dr. Jan J.G. Lemmen

Second reader:

Prof. Mary A. Pieterse-Bloem

Publication date:

28/05/2020

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Acknowledgements

I would like to express my gratitude to my supervisor dr. Jan Lemmen, for his patience and his insightful remarks. In addition, I would like to grant my special thanks to Prof. Mary Pieterse-Bloem, who gave me the excellent opportunity to work with a unique dataset for my dissertation.

Secondly, I would also like to thank my wife and my parents for their considerable support in finalizing this research. Without them, this incredible odyssey would be an arduous obligation.

Abstract

After the outburst of the Great Recession in May 2008, the euro area sovereign yield spreads started to diverge, raising several questions about their potential drivers. A consensus was drawn towards the existence of a common factor that represents international risk aversion. The present thesis explores this conclusion, by incorporating a global financial stress index (in short GFSI), launched by Bank of America Merrill Lynch (BAML) in 2010. To shed light on the dynamics of the market-specific determinants, I initially conduct a series of OLS regressions in two subperiods: the Great Recession (2008-2010) and the Sovereign Debt Crisis (2010-2013). Besides, I expand my analysis by employing a dynamic OLS (DOLS) model to treat my results from a common characteristic of yield spreads; autocorrelation. I deploy this cointegrating model in the whole timespan of my dataset on both a country level and on an aggregate level. To achieve the latter, I construct market capitalization-weighted yield indices for the EMU core and peripheral countries. My results support that GFSI has a robust relationship with the majority of the EMU-yield spread differentials under both crises. Moreover, I conclude that, for countries with weak fiscal fundamentals, yield spreads are primarily explained by the country's credit/liquidity profile and are prone to contagion risk. In contrast, for countries with robust macro-fundamentals yield spread differentials are mainly determined by global risk aversion and flight-to-liquidity, while contagion risk has a diminished effect.

Keywords: Global financial crisis, Sovereign Debt Crisis, yield-spread determinants, sovereign bonds, financial distress, cointegrated model, panel data.

JEL Classification: C3, F30, G01, and G12.

1. Introduction

Regardless of a country's financial status, government securities play a prominent role in the general economy. Central banks have traditionally regarded sovereign debt instruments for estimating inflation and gauging an outlook important for fiscal policies. Meanwhile, monetary policies consult the whole term structure they comprise as it is a highly-informative source. Moreover, from a corporate and private perspective, government securities are not only treated as a benchmark to price fixed-income securities but also, in the context of hedging, are treated as risk-free investment or used as collateral to compensate interest rate risks. Overall, government securities are the essential bedrock to develop internal financial markets. The prominent role of such securities is attributed to various characteristics such as high market liquidity, minimal credit risk, and a broad range of maturities under a well-developed market infrastructure.

Particular attention was raised into understanding the determinants of yield spreads, as in terms of policy-making, it is a matter of great importance. From a macroeconomic perspective, relative indebtedness may stimulate a rise in the borrowing costs between nations. Market-induced discipline would be a substantially effective technique, especially in a unified monetary regime such as the European Monetary Union (EMU), where its members are unable to inflate away their debt. Stability and Growth Pact and other binding fiscal rules would turn futile, while policies prompted to reduce the levels of indebtedness would be self-motivated. On the other hand, if the majority of the spread differential can be attributed to market characteristics, such as liquidity, then reforms on microstructure and appropriate issuing techniques should be considered.

The widening of the spread differentials in periods of financial turmoil has been investigated widely. Nevertheless, the research question remains ambiguous. According to a

Bloomberg article (2019), debt ratios of euro-area governments may have decreased in 2018, compared to the prior year, yet they are still significantly higher than before the 2008 financial crisis. In particular, eleven euro-zone countries had debt ratios higher than 60 percent of Gross Domestic Product (GDP), with the highest registered in Greece, Italy, and Portugal. With that being said, the European Central Bank (ECB) interventions are expected, and yields rise are possible in the future.

The present thesis concludes that international risk aversion is the primary driver of the EMU yield spread divergences under two periods of crisis: Global Financial Crisis of 2008 and the Sovereign Debt Crisis of 2010. To that extent, it introduces an index of financial stress (GFSI), and it investigates its performance against the popular in the literature variables: Volatility Index (VIX) and the spread between US Corporate bonds (of BBB rating) and US Treasury bills. Both an OLS specification and a cointegrating method (dynamic OLS) confirm its explanatory power as a measure of global risk aversion. The results are consistent across both maturities (5-year and 10-yeat) and in both subperiods. Besides, I conclude that, for countries with weak fiscal fundamentals, yield spreads are primarily explained by the country's credit premium (CDS spreads, credit ratings, and Debt-to-GDP) and are more prone to contagion risk. In contrast, yield spreads for countries with rigor fiscal fundamentals are better explained by investor's risk aversion and flight-to-liquidity effects.

The thesis is organized as follows: The second chapter consists of the literature review on sovereign bond yield spread determinants and the scope of the thesis. In the third chapter, the institutional setting is explained. Moving forward, chapter four elaborates on the data and methods used for the variable construction. Chapter five describes the empirical models that are employed. The sixth chapter analyses the results concerning previous academic findings. Finally, chapter seven draws the main conclusions and suggests references for future research.

2. Literature review

The following chapter summarizes the main findings from the existing literature on the yield spread differentials. On account of the financial events, the chapter is divided into three sub-sections, covering three different periods. Each one dedicates a few critical facts about the economic climate and empirical evidence drawn by the academic community, respectively. The final section presents the main hypotheses upon which the thesis is revolved.

2.1. EMU Introduction

The institutional reforms which applied in Europe over the previous decade inherited crucial changes in the financial markets. The most prominent one was engendered by the introduction of the single monetary policy in 1999. This regime established uniform conditions across the euro area, eliminating the exchange rate risk component of the government yield spreads. As a result, international investors were enabled to diversify their bond-portfolios, focusing solely on credit and liquidity risk. To that end, governments adopted supply-side innovations to render their issues more attractive[1]. Overall, these developments drew the attention of the academic community to investigate the EU-sovereign yield spread differentials and their determinants.

Among the first studies on EU-yield spread determinants, Codogno et al. (2003) concentrate on their relationship with macroeconomic variables. Moreover, they investigate an exogenous risk premium measure, proxied by the spread between US corporate and government bonds. They obtain their results by regressing spreads (relative to the German Bund) against countries' deviation of Debt-to-GDP ratios and their international risk premium proxy. The international risk aversion proved to be significant, particularly for countries with high levels of public debt. Geyer et al. (2004), in an attempt to measure systematic risk within

[1] Governments, with the notable example of Ireland in May 1999, restructured their debt into a few liquid benchmarks. Also, they undertook buy-back programs that targeted illiquid and/or short-dated instruments (e.g., Spain and the Netherlands).

EMU, reach a similar conclusion, using a pricing model for EMU government bonds. The authors derive spread factors from being related to EU corporate bonds. Also, they conclude credit risk as a significant driving force, but a limited liquidity effect, which is aligned with Bernoth et al. (2004), Jankowitsch et al. (2006), Lemmen and Goodhart (1999).

Finally, later studies, using a higher frequency of data, focus on the existence of an exogenous factor that can play a role, both explicitly and interactively, to the determinants of yield differentials. Favero et al. (2010) propose a theoretical model where liquidation ("demand for liquidity") is determined endogenously. The authors suggest that a function of aggregate risk interacts with market liquidity. In their example, the probability of liquidation is reduced in the absence of attractive aggregate investment opportunities. Their analysis results in a positive and significant coefficient on the aggregate risk factor, for all eight countries, as well as on the liquidity variable, only when the interaction term is included. Beber et al. (2009) examine the "flight-to-quality" effect and deduce that, in time of market distress, investors seek liquidity and not credit quality. Their findings display liquidity as, almost, an exclusive driver for the arrival of large inflows to the EU bond market.

Collectively, the academic consensus on government bond yields conditions the latter on three variables: Market liquidity, reflecting the hazard of capital losses in the case of early liquidation or substantial price movements from a small number of transactions; International risk factors, representing either the risk of the banking and the corporate sector, or the uncertainty and its unit price; and credit risk, capturing the probability of sovereign default. Despite the controversy regarding the contribution of liquidity and its relationship with credit, the literature is unanimous about the presence of common international factors.

2.2. Global Financial Crisis 2007-09

The financial crisis brought many implications for the banking system and the real economy. Since its beginning and its intensification with the collapse of Lehmann Brothers in the summer of 2008, spreads have rebounded to levels higher than the observed ones in the early period of EMU. Chart 1 illustrates the evolution of the ten-year, on-the-run, government bond yields during the crisis. Besides, EU-governments resource commitments to the impaired financial institutions raised increasing concerns about their abilities to fulfill their future debt obligations. International investors turned less willing to trade their debt issues and sought higher compensation for risk. Hence, succeeding an era where the differentials across the euro area were virtually absent, literature that poses the question:

Can this substantial widening be explained by general market factors, or by countries' macroeconomic/fiscal imbalances, which are affected by bailout costs?

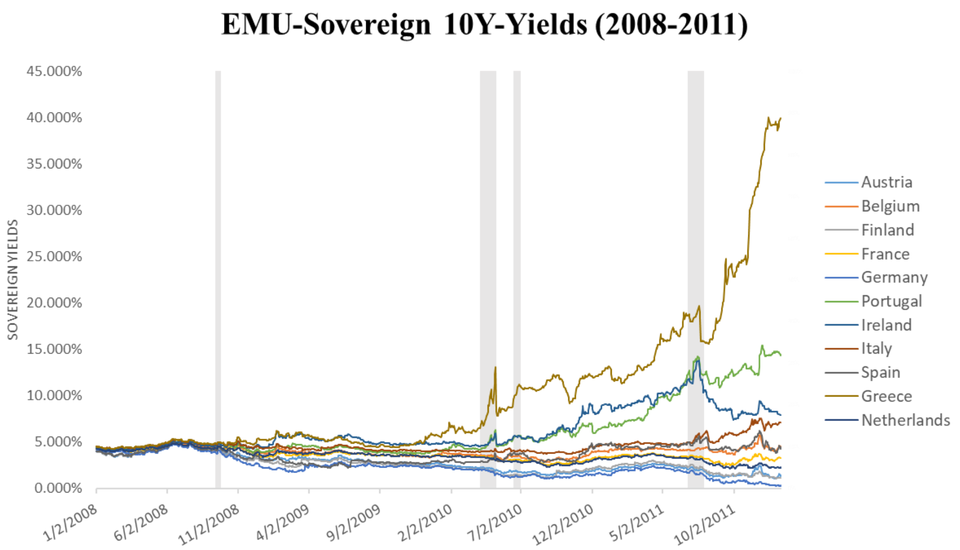

Figure 1. The evolution of yield to maturity (YTM) for 10-year EMU sovereign bonds. The highlighted bars indicate events of financial severity. In ascending order: The fall of the Lehman brothers (2008), IMF bailouts, and a sub-investment downgrade for Greece (2010), Greek and Irish bailouts failure, and premature government resignation for Portugal.

Source: Bloomberg

Among the earliest, ECB and IMF published a series of event studies to answer this contemporary puzzle. Attinasi et al. (2009) probe the role of fiscal fundamentals to yield spreads and their link with sovereign creditworthiness. Their paper offers particular attention to government announcements, bank rescue packages, and their possible impact. In line with prior empirical studies, spread differentials encapsulate liquidity, credit, and global risk variables. Bank rescue packages led to the re-assessment of sovereign credit risk from an investor's perspective, through a transfer of risk from the bank sector[2]. Nevertheless, the size of the packages proved to be statistically insignificant. Authors referred to this result as "credible commitment", where investors' beliefs expected governments to sufficiently support banks regardless of the announced amounts.

Furthermore, certain papers were dedicated to differentiating the global risk aversion component and identifying the contribution of macroeconomic fundamentals. Sgherri and Zoli (2009) follow a method to review the economic forces of international risk aversion. In particular, they employ a theoretical model to dissect the common risk factor and examine its time-varying dynamics. With that approach, they outline that country-specific developments, such as rising debt levels and solvency concerns, are becoming more evident during the financial crisis. Caceres, Guzzo, and Segoviano (2010) developed a swap spread model based on measures of global risk aversion (Index of Global Risk Aversion), country-specific fiscal fundaments, and contagion (Spillover Coefficient). Including countries beyond EMU during four different phases, they indicate that U.S. sovereign bonds, described as “safe haven” assets, capture the general risk aversion adequately. Also, their results suggest that during the systemic outbreak (Oct 2008-Mar 2009), the role of global risk aversion was overshadowed by crisis-

[2] A later publication by Alter and Schüler (2012) examines this risk channel and concurs that after bailouts, shocks in the financial sector affect sovereign Credit default swap (CDS) premia primarily in the short run.

related interventions, fiscal packages, and their diluting effects on sovereign credit risk.

Finally, the authors drew attention to risk contagion from the financial sector, conditioning on momentous events. Mody (2009) pinpoints the bailout of Bear Stearns in March 2008 as a watershed with the spreads widening when the expectation of a domestic financial sector aggravated. Schuknecht et al. (2011) compare the magnitude of fiscal deficits and debt during the crisis to tranquil times and the contribution of the general risk aversion. The authors include spreads denominated in the US dollar relative to the US benchmark. They find that, after the Lehman Brothers' default event, markets penalize fiscal imbalances more strongly. Overall, the academic community drew a concord about the risk transmission from the financial industry and the rising importance of country-specific fundamentals, which were reflected in the credit risk component.

2.3. EMU-Sovereign Debt Crisis and beyond

The beginning of our decade witnessed the transformation of the global financial crisis into a Sovereign Debt Crisis in the EMU. Initially emerging from Greece in the autumn of 2009, the crisis prompted European policymakers to create financial rescue schemes in order to restrict the effect on the infected countries and prevent further contagion. These include the large bailout package to Greece, 110-billion-euro, agreed-upon March 2010, and the foundation of the 440-billion-euro European Financial Stability Facility (EFSF). Nonetheless, these attempts proved to be futile, as both Ireland in 2010 and Portugal in April of 2011 applied for emergency assistance.

Furthermore, in the third quarter of 2011, the Italian and Spanish government bonds came under significant market pressure. As a response to the political and economic turmoil, the economics literature shifted their focus to the impact of the contagion effects caused by the peripheral countries such as Portugal, Italy, Ireland, Greece, and Spain, also known as PIIGS.

Arghyrou and Kontonikas (2012), covering an extensive period, January 1999-August 2011 with monthly frequency data, confirm the transition from 'convergence-trade' prior to August of 2007 to a market-driven by macro-fundamentals and global risk aversion. Their research divided the debt crisis into an early risk transmission from the global financial crisis and a later phase characterized by the Greek debt crisis outburst. They contend that sovereign bond spreads' sensitivity shifts to fundamentals during the early phase, while contagion effects primarily drive the latter phase. De Santis (2012) examines the critical influence of regional and international risk factors, as well as spillover effects. Among the variables, his analysis uses a measure of aggregate market liquidity[3]. After controlling for a set of fundamentals and regional factors, the author suggests that the spillover effect from Greece and sovereign solvency risk should be a priority for policymakers to secure the stability of the EU-financial system.

Beirne and Fratzscher (2013) concentrate on the pricing of sovereign risk and contagion during the European Sovereign Debt Crisis. The paper generalizes the research above on a global level, considering in total thirty-one advanced and emerging economies. Fundamental deterioration and fundamental contagion can mainly explain the rise in the sovereign yield spread and the Credit default swap (CDS) spread. By contrast, regional spill-overs and contagion have a minor role, even in the euro area countries. Costantini et al. (2014) take a novel approach taking the viewpoint of optimal currency areas (OCA). They perform a co-integration test which results indicate an increase in the risk awareness of investors and point at fiscal imbalances as the main drivers. In their empirical specification they introduce cumulated inflation differentials (CID) of euro area countries with respect to Germany as a measure of competitiveness. Through their findings they argue that international investors

[3] Introduced by Longstaff et al. (2005) for US Treasury securities, estimating their differential over RefCorp (Resolution Funding Corporation).

heavily penalize the deterioration of expected debt positions, a condition which holds for PIIGS, prompting EU-countries for fiscal consolidations in order to return their sovereign spreads to acceptable levels.

Conclusively, the consensus emerging from the literature, during the European debt crisis, is summed up in two main findings. First, during economic downslide, both the amount and the price of the perceived international risk connected with investments in sovereign securities, relative to the safe havens of the US and Germany, have grown. This evidence describes the across the board increase in EMU spreads. Second, intra-EMU differences in spreads' increases are explained mainly by the worsening of country-specific fundamentals and their macroeconomic transference. Onwards, empirical studies were dedicated to distinguishing the underlying drivers and their interrelations to the crisis. In that respect, this topic is the focal point of the present dissertation.

For the sake of clarity, Table 1 in the following pages offers an overview, in chronological order, of the main features of the studies, as mentioned above.

Publication	Explanatory Variables	Findings
I. Introduction of EMU		
Codogno et al. (2003)	$R_t^{C,US} - R_t^{US}, \frac{Debt_t}{GDP_t}, BidAsk_t, Turnover_t, Volume_t$	International risk factor has the highest explanatory power. 'Structural' liquidity could explain it
Bernoth et al. (2004)	$\frac{Debt_t}{GDP_t}, Deficit_t - GDP_t, DebtService_t, R_t^{C,US} - R_t^{US}, LIQ_t, Bus.Cycle_t$	Default risk premia is significant and it reflects to fundamentals. Liquidity risk premia is decreased with the EMU introduction.
Jankowitsch et al. (2006)	$BidAsk_t, \overline{Spread}, \log(IssueSize_t), Contributors_t$	Liquidity has negligible impact on the prices. In contrast, issue size and number of contributors have greater impact.
Beber et al. (2008)	$CDS_t, BidAsk_t^{Eff}, Vol_t^{quote}, Ord.Depth_t, FundFlows_t^{Net}$	Credit quality has a major role, while liquidity is significant under market uncertainty. Large flows are determined by liquidity measures.
Favero et al. (2010)	$BidAsk_t, Vol_t^{trade}, Max.(AvailableQty_t), R_t^{C,US} - R_t^{US}$	Yield differentials' co-movement is associated with the international risk factor. Liquidity has heterogeneous effect across countries.
II. Global Financial Crisis		
Attinasi et al. (2009)	$Debt_t, E[Budget]_t, E[\frac{Debt_t}{GDP_t}], BankRescue_t, R_t^{C,US} - R_t^{US}$	Positive relationship between budget deficits and/or debt with yield spreads. Size of rescue packages is not statistically significant.
Sgherri and Zoli (2009)	$E[Budget]_t, E[\frac{Debt_t}{GDP_t}], Vol_t^{trade}, EDF_t, VIX_t$	Expected Default Frequency (EDF) in financial sector is associated positively with yield differentials. Credit spreads raise importance on fiscal balances.
Mody (2009)	$BankCDS_t^{U.S}, Debt_t, \frac{Debt_t}{GDP_t}, \frac{Eq.Index^{Fin}}{Eq.Index}_t$	Global financial instability lead to rise in the CDS. U.S bank CDS are associated with yield rise. Policy making is reflected to default premia.
Schuknecht et al. (2011)	$\frac{Debt_t}{GDP_t}, \frac{Budget\ Surplus_t}{GDP_t}, R_t^{C,US} - R_t^{US}, i_t^{Short-term}$	Yield spreads can largely be explained by economic principles during crisis. Global risk aversion penalizes fiscal imbalances in turmoil periods.
Caceres et al. (2010)	$IGRA_t, PoD_t, SC_t, Debt_t, Budget_t$	Global risk aversion is a positive factor for EMU government bonds against the swaps, while contagion and fundamentals are negative.

(break)

(continue)

III. EMU-Sovereign Debt crisis		
Arghyrou and Kontonikas (2012)	CDS_t , Gr_t^{Ind}, $\frac{Debt_t}{GDP_t}$,$E[Fiscal.Pos\ ]_t$, VIX_t , $BidAsk_t$, Vol_t^{trade}	EMU yield spreads are linked to both international risk aversion and fiscal fundamentals. Markets believed to convergence to German fundamentals.
De Santis (2012)	CDS_t, $CR_t^{i=3}$, $\frac{Budget_t}{GDP_t}$,$Growth_t^{GDP}$, KfW_t,Vol_t^{trade} ,$BidAsk_t$	Core countries depend on the high demand of German bonds during crisis. Credit ratings are significant and associated with peripheral yield spreads.
Beirne and Fratzscher (2013)	CDS_t, $S\&P_t$, VIX_t, $\frac{Debt_t}{GDP_t}$, $\frac{Budget_t}{GDP_t}$, $Growth_t^{GDP}$	Markets' sensitivity to macro-fundamentals suggests contagion risk as a driver of euro area yield differentials. Herding contagion is insignificant.
Costantini et al. (2014)	$R_t^{C,US} - R_t^{US}$, CID_t, $BidAsk_t$, $\frac{Debt_t}{GDP_t}$, $\frac{Balance_t}{GDP_t}$	Debt and fiscal balances are the most important determinants, while liquidity comes second. Cumulated inflation differentials are positively related with yield spreads.

Table 1. Overview of academic findings on sovereign yield spread differentials across the EMU countries. Three periods of high economic interest were set as breakpoints; each one offers a distinctive angle to euro-area yield spread evolution. EMU- introduction papers study the influence of a unified monetary regime on the yield spreads among the Eurozone countries; Global financial crisis papers research the international risk aversion and market sentiment as drivers of EMU-yield divergence; and EMU- sovereign debt literature argues on the contribution of contagion risk, which is reflected through fundamentals, shifting investors preferences to secure alternatives. All the variables are estimated as differentials against the German equivalent variables.

Thesis Scope

The present thesis shifts toward a twofold aim: First, it investigates the explanatory power of global financial distress, international risk aversion, and issuer-specific factors, over the EMU yield spread differentials on a country level. I append the existing literature on international risk factors by inspecting a financial distress index. In particular, I incorporate the Global Financial Stress Indicator (GFSI) launched by BofA Merrill Lynch in 2010. Additionally, based on prior literature, I introduce a contagion index. The second part focuses on answering how spread determinants between core and peripheral European countries differ. Due to the large macro-fundamental differences between Eurozone countries, it is interesting to investigate these effects on a higher level. Thus, I divide the sample into EMU-peripheral, and EMU-core countries[4], and I construct nationwide yields indices. Subsequently, I assess a comprehensive model that regards three dimensions: financial distress, risk aversion, and contagion. Finally, the study regards two maturity points, 5-year, and 10-year, of on-the-run EU-sovereign bonds actively traded in the MTS interdealer platform. By that means, I consider only the most liquid securities. The dataset spans 2008-2013, covering all the significant financial events.

In general, the scope of the thesis can be formulated in the following three hypotheses:

Hypothesis 1

Global international risk-aversion, alongside the flight-to-liquidity effect, constitutes the main key driver of yield differentials,

Sovereign securities should retain the title of the safe-haven under periods of financial turmoil. Nonetheless, differences concerning fiscal fundamentals rise in importance as investors seek

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[4] Core countries: Austria, Belgium, Germany, Finland, France, the Netherlands.
Peripheral countries: Ireland, Italy, Greece, Portugal, and Spain.

thoroughly for financial stability in creditworthy counterparties. Consequently, international-risk aversion reflects these asymmetrical preferences and holds a predominant role in yield divergence in the Euro area countries, where their payback ability (proxied with Debt-to-GDP ratio) differ widely. On that respect, a measure that captures flight-to-quality should also constitute a strong indicator. To suit this purpose, in accordance with Schwarz (2018), I consider the KfW-Bund spread.

Hypothesis 2

Global financial stress index (GFSI) captures international risk aversion more consistently than the common in the literature measurements.

Several studies investigated the financial distress that rippled over the economic system after the collapse of the Lehman brothers. However, the considered proxies held a positive relationship yet, due to their one-dimensional nature, provided ambiguous results. GFSI combines angles from multiple market elements that might encapsulate greater these effects. Therefore, it should qualify as a more consistent measure of global risk aversion and should maintain a significant relationship with the EMU yield spread differentials under both crises.

Hypothesis 3

Yield spread developments in core countries are primarily driven by exogenous variables, whereas in peripheral countries are led by country-specific variables.

Core countries with strong macro-fundamentals exhibited higher resistance to credit deterioration during both periods of crises, followed by a faster recovery. To that extent, exogenous factors such as financial distress, risk-aversion, and spill-over effects should account the most to their yield spread developments. In contrast, peripheral countries were wounded directly in their government budget balances. This had a detrimental effect on their credit-premium and is reflected explicitly to country-specific factors such as CDS spreads, credit ratings, and debt-to-GDP ratio.

3. EU-Bond market setting

As mentioned in the previous chapter, market liquidity is one of the two explanatory - for the yield spreads - factors that after the introduction of the EMU was not eliminated. Both primary and secondary sectors influence the price dynamics via supply and demand, where the first one acts as the conclusive provider of liquidity. Hence, before proceeding to the data and methods, it is useful to describe the market setting. In general, the primary sector resolves the financial policy upon the funding requirement of each government. Specified treasury agents are operating for the execution of these strategies; The secondary sector determines the trading facilities between brokers and market makers, such as the structure of payments and settlements. A particular magnitude will be granted to the latter and, precisely, the *Mercato dei Titoli de Stato* (MTS) whose data are utilized in the research.

3.1. Primary Market

AFME (2017) starts by emphasizing that government bonds, inherently, are less liquid than equities since a big part of the investors apply a "buy and hold" strategy. Therefore, individual participants are necessitated to address this liquidity concern. For that purpose, primary dealers are assigned to serve the role of the liquidity supplier. Primary dealers are financial institutions that are agreed by sovereign issuers to purchase, promote, and distribute government bonds. From the issuance date, issuers are relying on their Primary dealers for market-making and liquidity support. This setting motivates the market makers to be more aggressive in their pricing for clients because they know that they can unwind positions taken from clients in this market. The quoting in the interdealer market can also be expressed as quoting obligation. Under contractual agreements, banks are required to quote two-way prices to each other within a fixed spread and for a limited time window within a day. This market-making model is facilitated on recognized electronic trading platforms, providing liquidity and transparency.

3.2. Secondary Market

The secondary market is an over the counter (OTC) market, where trades are facilitated electronically, via platforms, or in the floor, via voice broking. Over the last two decades, electronic trading has marked a substantial increase in popularity with the loss of floor trading. Primarily trades take place in inter-dealer platforms rather than dealer-to-customer platforms. The first historically electronic inter-dealer platform, launched in 1988, is the MTS system. Nowadays, it is managed by a set of shareholders. In its thirty years of operation, MTS experienced many reforms, maintaining the "Europe's premier" title among electronic fixed income markets. One of the reasons behind this dominance is its dealership model, which acts as a coordination platform for the primary dealers' activity for European sovereign securities. This novelty, introduced by the Italian Treasury, was replicated domestically and spread across Europe, resulting in the formation of EuroMTS, a pan-European platform for sovereign bonds, quasi-government bonds, and repurchase agreements.

Furthermore, across the literature, the MTS-order book has its timeless excellence. In fact, in a 2000's issue of the Italian treasury and securities markets, it is postulated that the MTS platform facilitates the 65 percent of all secondary market activities. Also, Italian treasury reports that approximately an average of 6.4 billion euro of Italian government bonds[5] was traded during 2002 by the MTS trading platform. From the academic community, Persaud (2006) reckons that nearly 72 percent of the European government bond volume is executed in electronic trading systems. Finally, a Celent report accounts for an approximate 65 percent share of the average number of trades executed daily by inter-dealer platforms.

The MTS system is a quote-driven order book market for dealers in government bonds. Cheung et al. (2005), Caporale and Girardi (2013), and Darbha and Dufour (2013), among

[5] Known as Buono del Tesoro Poliennali (BTP)

many, describe the microstructure of the European government MTS market. All government securities issued by European countries are listed on their respective domestic MTS platform. MTS system effectively operates as a centralized limit order book for each local platform. The quoted proposals are firm, instantly executable, and recorded in a limit order book. For instance, to execute a trade, an end-client expresses his interest on a dealer-to-customer platform. Quotes on dealer-to-customer platforms are indicative of the dealer. Therefore, if the end-client's preference agrees upon the indicated price, the dealer will accordingly turn to the inter-dealer platform to obtain or place the bonds at firm quotes. This feature, in alignment with Dunne et al. (2008), sets the MTS inter-dealer platform an ultimate source of liquidity.

4. Data and Methods

The dataset is initially built around the EuroMTS order book. An immediate arising issue is determining a set of securities that is similar in terms of their features to minimize potential price influence. Treasury securities outstanding at any point differ in multiple dimensions, including issuer type, callable features, coupon type, liquidity, etc. To that end, I apply the following set of filters to my dataset:

i. First, since I concentrate solely on sovereign securities, I exclude from the sample non-Euro denominated bonds, sub-sovereign, supranational, and agency bonds.

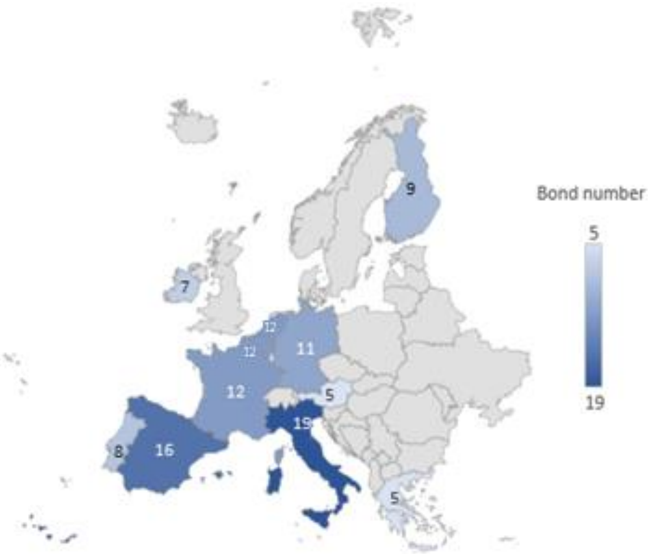
ii. In alignment with relevant literature, I include only fixed-coupon securities in my sample. Hence, I omit inflation-linked bonds, bonds with callable features, zero-coupon bonds, and floaters.

iii. I exclude bonds with less than three months to maturity since their yields tend to behave unusually due to segmented demand for short-term securities and, consequently, liquidity constraints.

iv. Finally, I partition the securities in two different maturity points; five and ten years.

With the remaining securities, I construct a time series comprised of only on-the-run securities, listed in the MTS interdealer platform. More precisely, at time *t* when a newly issued security is traded in the MTS, I discontinue on my running time series on *t+22* and append the series with the data of the new bond. The one trading month lag is considered to circumvent abnormal trading activity that was observed in our sample. The final dataset consists of 116 sovereign bonds, from eleven different European countries. Nevertheless, the coverage is not the same for every country. Figure 2 provides an overview of the number of bonds and their time coverage on a country level:

MTS Dataset Overview



Country	Start Date	End date
*I. **5-year***		
Austria	6/10/2009	31/12/2013
France	1/18/2008	31/12/2013
Greece	1/2/2008	7/1/2011
Rest	1/2/2008	31/12/2013
*II. **10-year***		
Greece	1/2/2008	12/22/2011
Rest	1/2/2008	31/12/2013

Figure 2. MTS dataset overview. The map chart on the left side depicts the number of bonds per country used in the sample. Italy, Spain, and France have the most issues in the MTS platform for that given period. The right side table contains the timespan of the time series. Greece is the only country that its series is terminated prior to 2013. This is the product of its default announcement in 2010 and the EMU rescue program, which involved the withdrawal of Greek bonds from the markets.

Source: MTS-Order book

Finally, besides MTS, I collect a list of candidate explanatory factors from multiple data sources. Table 2 offers an overview of them, along with some additional information:

Variable	Datasource	Frequency	Expected sign
I. Regional Variables			
Bid Ask spread (L_t^{BA})	MTS Order book	Transformed to daily	-
Order book slope (L_t^{LOS})	MTS Order book	Transformed to daily	-
Quoted volume (L_t^{VOL})	MTS Order book	Transformed to daily	-
CDS premia ($CDS_{i,t}$)	Datastream	Daily	+
Credit rating ($S\&P_t$)	Datastream	Daily	+
II. International Variables			
Financial Distress Index ($GFSI_t$)	Bloomberg	Daily	+
Volatility Index (VIX_t)	CBOE	Daily	+
US Corporate spreads ($US_{i,t}^{Spr}$)	FRED	Daily	+
KfW-Bund spreads (KfW_t^{i})	Bloomberg	Daily	+/-
III. Control Variables			
Debt-to-GDP ($Debt_{i,t}/ GDP_{i,t}$)	Eurostat	Quarterly	+
GDP-growth rate ($GDP_{i,t}^{gr}$)	Eurostat	Quarterly	-
Inflation index ($HICP_t$)	Eurostat	Monthly	+

Table 2. Overview of variables. The variables are divided into three panels based on their nature and use: (I) Regional, (II) International, and (III) Control variables. The liquidity variables are intraday measurements that are aggregate on a daily frequency using a time-weighted method. Macro-fundamentals are discrete control variables that change at the end of each quarter, as reported by Eurostat. The expected sign is based on the findings from the academic community on the subject.

4.1. Benchmark selection

The calculation of the yield spread entails the selection of a benchmark for the sake of comparison. The majority of the academic community take the German government bond's (Bund) yield vis-a-vis the rest of the European sovereign securities for the estimation of the spread. The reasoning behind this selection is its comparatively low yield for any given maturity, as well as its consideration as a safe haven among investors globally. Nevertheless, Dunne, Moore, and Portes (2002) argue that within MTS, data vary by maturity, and this criterion might not be accurate. With that respect, they document that German bonds cannot be taken categorically as a benchmark mainly for the 5-years maturity case, where French OATs stand more suitable.

Furthermore, certain papers assert that government bonds are less than an ideal proxy, because of differences in taxation treatments (Hull, Predescu, and White, 2004; Blanco, Brennan, and Marsh, 2005) and choose the Euro-swap curve as a benchmark. As the first segment of the analysis concentrates on the explanatory power of international risk-aversion, I estimate the spreads over the German bonds (y_t^{GER}) since they are qualified as "*safe havens*" from the investment community. Thus, for each country i, the yield spreads are calculated as:

$$S_{i,t} = y_{i,t} - y_t^{GER} \tag{1}$$

4.2. Sovereign yield determinants

Despite the lack of agreement on the yield spread determinants, literature concurred in a set of candidate factors. Their main distinction-line can be drawn with respect to the origin of the effect. Endogenous, are issue-specific factors that are either attributed by the issuer or induced by the market, such as credit and liquidity risk, respectively. These factors, by nature, are closely connected with macroeconomic fundamentals. Exogenous variables are market-wide factors that are associated with investors' sentiment and reflect risk aversion. To be more precise, they capture the preferences of market participants under financial distress. These factors are easier to estimate and are commonly associated with the '*flight-to-quality*' phenomenon. Figure 3 illustrates an overview of the considered variables, and their differences as described above. The following subsection delves deeper into the theoretical background of the variables as well as their methods of estimation.

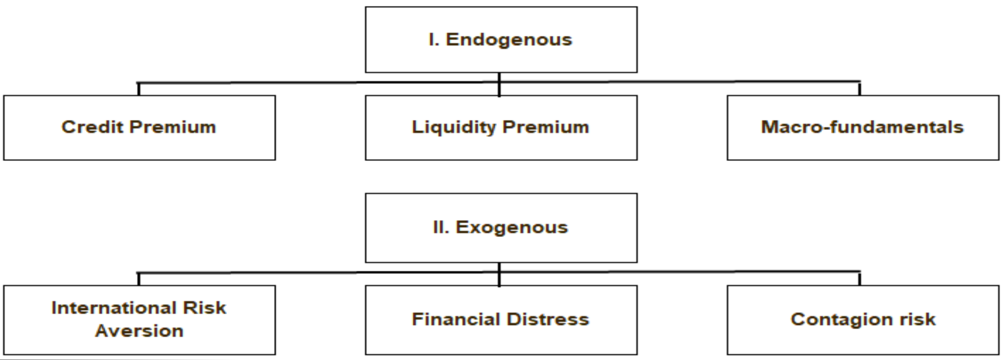


Figure 3. Yield spread determinants. They can be distinguished in (I) Endogenous variables that are related to market and country-specific variables. Those variables have a direct relationship with the development of yield spreads; (II) Exogenous variables that encompass risk aversion and systemic risk. Those variables have an indirect relationship with the yield spreads as they reflect market sentiment.

4.2.1. Liquidity measures

In general terms, a financial security is considered as liquid when it can be traded without impacting its price. Nevertheless, it is a quite elusive concept to measure, primarily because of its multidimensional nature. In that respect, there are a plethora of available measures in the literature. One can separate them into two main groups: Trade book and Order book measures. Trade measures, as the name suggests, are based on the actual financial transactions which take place in the market. In contrast, order book, incorporate the order book's characteristics, or else the proposals of transactions which are quoted in the market. As described in Chapter 2, MTS markets are an example of a quote-driven electronic order book, so the quality of the order book is particularly relevant. Therefore, I follow Coluzzi et al. (2008), Ejsing and Sihvonen (2009), and Wuyts (2008) for the selection of the three liquidity measures used in the analysis.

Price (e.g., bid-ask spreads) and volume (e.g., quoted volume) are one-dimensional measures. While both are popular in the academic community, they might stand problematic in the limit case of a very tight spread yet virtually no tradeable volume. Conversely, the posted volume could be abundant at an unreasonably large spread. In either limit case, such liquidity measures would contradict. For this reason, Buis et al.'s (2017) methodology is carried out. In the empirical model, bid-ask spread and order book slope are used as independent variables, whereas the latter one, given that is a flow measure, is incorporated as a control variable that addresses for the flight-to-quality phenomenon.

To sum up, I address for three dimensions of liquidity: tightness measured by the bid-ask spread, market depth measured by the quoted volume, and total resiliency measured by a slope (LOS), which combines all the elements of the order book. For the sake of interpretation, a visual representation of these dimensions is illustrated in Figure 4 on the next page.

Order Book Structure

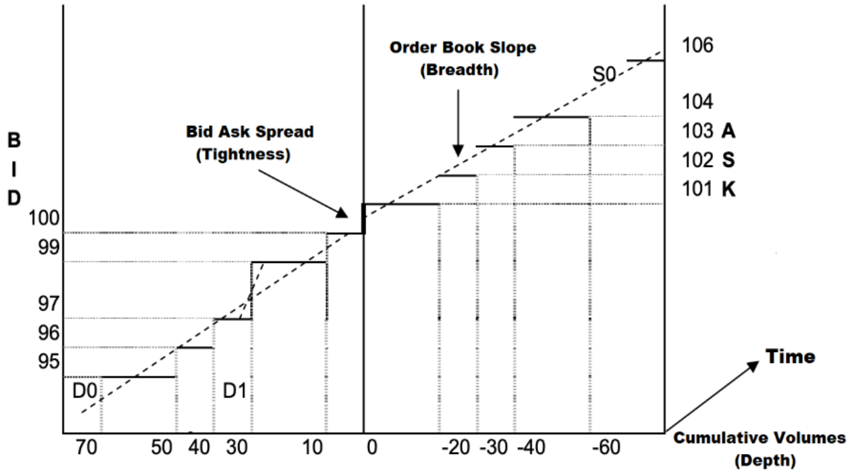


Figure 4. Order book structure. Bid-ask represents the tightness denoting the difference of the highest asking-price for an asset and the lowest offering-price at which a seller is willing to sell it. Cumulative volume defines the depth as it expresses the quantity to be traded against a unit price. The order book slope describes the breadth of the market, representing the rate of change of price increases from the midpoint over their respective quoted volume.

Source: AFME (2018)

The EuroMTS order book quotes the best three proposals (bid and ask prices) with their corresponding volumes. In each timestamp τ we can represent the bid and ask prices as $p_{i,\tau,b}$ and $p_{i,\tau,a}$ respectively, and their matching volumes as $V_{i,\tau,b}$ and $V_{i,\tau,b}$. Subsequently, we can define the midpoint as $P_{t,\tau,mid} = \frac{1}{2}\left(p_{1,\tau,b} + p_{1,\tau,a}\right)$, and the cumulative volumes as $V_{t,\tau,b} = \sum_{i=1}^{3} v_{t,\tau,b}$ and $V_{t,\tau,a} = \sum_{i=1}^{3} v_{t,\tau,a}$. Now we can formulate the three liquidity measures as:

- **Bid-ask spread**: $l_{t,\tau,BA} = P_{1,\tau,b} - P_{1,\tau,a}$ (2)
- **Quoted Volume**: $l_{t,\tau,V} = V_{t,\tau,b} + V_{t,\tau,a}$ (3)
- **Order Book Slope**: $l_{t,\tau,LOS} = \frac{1}{3}\sum_{i=1}^{3}\frac{\left(p_{i,\tau,a} - P_{t,\tau,mid}\right)}{V_{t,\tau,a}} + \frac{1}{3}\sum_{i=1}^{3}\frac{\left(P_{t,\tau,mid} - p_{i,\tau,b}\right)}{V_{t,\tau,b}}$ (4)

The order book slope essentially is the average slope of the price increments from the midpoint over the cumulative limit order book volume posted. According to Buis et al. (2017): *"the main feature of this measure is that it can be interpreted as the elasticity of supply and demand"*.

Currently, each measurement represents a snapshot in time. The next step is to aggregate the liquidity measures on a daily frequency. A time-weighted methodology is applied to correct for irregular time-spacing. The formula below describes the weighting scheme:

$$l_{j,t} = \frac{\sum_{\tau=1}^{S_\tau} w_{\tau,t}\, l_{j,\tau,t}}{\sum_{\tau=1}^{S_\tau} w_{\tau,t}} \quad \text{where } j \in \{LOS, BA, V\} \tag{5}$$

Particularly, the assigned weights ($w_{\tau,t}$) are the time-difference, in seconds, between two unique records (e.g., 09:02:45 AM and 09:03:15 AM) on a given day *t* in the order book. Subsequently, the denominator is the total number of unique snapshots S_τ. Under this method, the most time prominent entries receive higher weights than the least ones. Thereupon, to normalize the variables and mitigate the extreme points, a natural logarithmic transformation is applied to the bid-ask and the slope measure:

$$L_{LOS,t} = \ln\left(l_{los,t}\right) \tag{6}$$

$$L_{BA,t} = \ln\left(l_{BA,t}\right) \tag{7}$$

In addition, for ease of interpretation in the regressions, I convert the total quoted volumes from hundreds of millions to units. Under these transformations, the liquidity measures gain the following properties; high values of *BA* and *LO*S indicate liquid assets, whereas low values indicate illiquid assets. In contrast, the opposite stands for *V*. Figure A1 portrays the development of the final measures' time series. Finally, similarly to the estimation of the yield spreads, German liquidity measures are deducted per country:

$$\mathcal{L}_{i,j,t} = L_{i,j,t} - L_{j,t}^{GER} \tag{8}$$

where *i* represents the number of countries (10), *j* indicates the three liquidity measures (LOS, BA, and Vol), and $L_{j,t}^{GER}$ denotes the German equivalent liquidity measures.

4.2.2. Credit measures

Credit risk is the probability of a loss followed by a borrower's inability to repay a loan or meet contractual obligations. Traditionally, it refers to the risk that a borrower or issuer may not return the principal and interest, which results in an interruption of the coupon payments and possibly default. On a country level, creditworthiness can be assessed by either macroeconomic/fiscal variables such as the primary deficit, or by market originated variables such as credit ratings and credit default swap spreads. The following section focus on the latter variables as the study's approach requires so.

Default Swap spreads.

Credit default swaps are insurance-like instruments against credit default or specified in the contract events. The buyer agrees to pays a premium, usually, every quarter, called the CDS spread to the protection seller throughout the contract's life. In this case, EMU member states have the role of the protection seller. The premium is quoted on basis points (bps), or one-hundredth of a percentage point, that is applied on a notional amount. Consequently, the CDS price represents the cost of hedging and answers to the question, *"how much is the insurance premium against issuer X for n-amount of years?"* reflecting the market expectation on the issuer's default.

Figure 5 depicts the average CDS-spread of the Euro area countries for the two subperiods of the sample: Left diagram, the global recession; right diagram the Sovereign Debt Crisis. The steepness of the indicator line in the right figure highlights the sharp increase of the CDS premia. As it can be derived, core countries with solid fundamentals exhibit the lowest change between these two periods, such as Germany (5.51bps) and Finland (9.58bps). In contrast, peripheral countries that received a direct impact experience the highest, such as

Greece (3500bps) and Portugal (488bps).

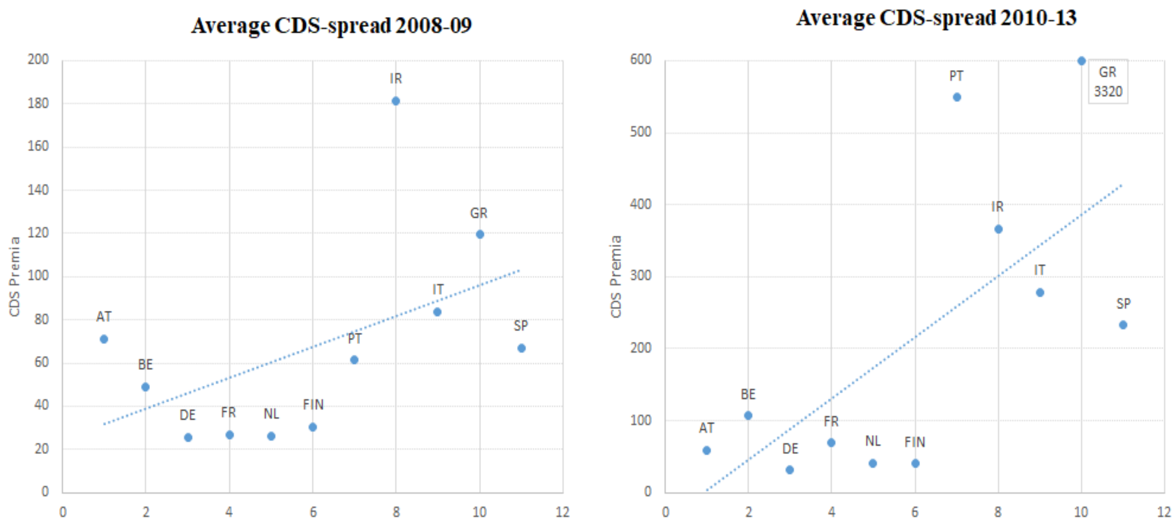


Figure 5. Scatterplot of the average 5-year CDS. The horizontal axis designates the number of countries, and the vertical axis the CDS-premia measured in bps. As the steepness of the curve indicates, besides Austria, a substantial increase in the CDS premia is observed under the EMU Sovereign Debt Crisis.

Source: Thomson Reuters Eikon

Credit Ratings

Credit ratings are categorical measurements that capture the likelihood of default of an obligor. The three leading rating agencies, Standard and Poor's (S&P), Moody's, and Fitch, use similar rating scales with the most creditworthy issuer receiving a triple-A notation. For a sovereign issuer, a large set of indicators is examined: public finance situation (past dynamics through debt levels, current dynamics through budget deficit, and future dynamics through pension liabilities streams), growth opportunities, levels of interest rate, and the government's capacity to meet its obligations. Consequently, ratings can assist as a comprehensive measure for the local macroeconomic fundamentals. In the analysis, I solely use the S&P long-term ratings as is the most consulted one by practitioners.

As often implemented in the literature (see Gande and Parsley, 2005; and Afonso et al., 2012), I discretize sovereign credit rating information using a linear scale, as depicted in Table A1 in the Appendix. NAertheless, a demerit of sovereign credit ratings is the low frequency of their revision. To account for a higher time variation, I encompass the changes in the Credit Outlook and Credit Watch. According to Standard & Poor's factsheet, "*a Credit Watch is turned on if there is at least a one-in-two likelihood of a rating change within 90 days*". Moreover, potential events or issues that present such substantial uncertainty to the creditworthiness of an issue or issuer can trigger Credit Watch without the need to assess this threshold of possible change. That being said, negative news, related to Credit Watch, receives a +0.5 magnitude, while positive news receives -0.5.

Contrary to Credit Watch, Outlooks are assigned as an ongoing component of long-term ratings, where appropriate, to both corporate and government entities. Outlooks, in principle, have a longer looking horizon than Credit Watch listings and incorporate trends or risks that have implications for credit quality. Hence, outlook related negative news receives relatively lower weights (+0.33 for negative and -0.33 for positive related news) as they foreshadow to a longer horizon. To be noted that these changes do not necessarily indicate a precursor of a rating change; however, while the rating is on Credit Watch, along with the credit rating revision, outlook falls under investigation.

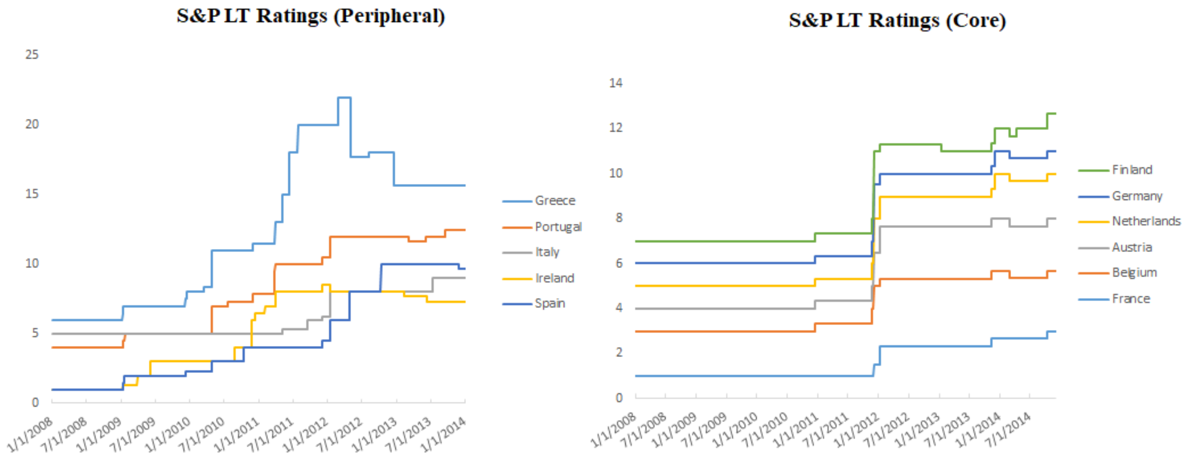


Figure 6. S&P Long-term ratings for peripheral and core countries. The horizontal axis represents the discretized values of the ratings. From the peripheral countries, Greece (12), Portugal (7), and Spain (7) received the most revisions, for the period 2008-2013. From the core countries, France and Belgium counted 3 and 2 revisions respectively, while they maintained the longest duration with a negative economic outlook.

Source: Thomson Reuters Eikon

As depicted in Figure 6, the credit rating evolution for Greece and Portugal worsened dramatically over the estimation period (2008-2013). For the rest of the peripheral countries while Italy and Belgium received only one negative credit outlook over the sample period.

4.2.3. Control Variables

A series of macroeconomic variables were collected for robustness purposes. Laubach (2009) shows that bond yields could be determined by real GDP. The dependence of the yield spread, and GDP growth can be derived by their connection with monetary policy. GDP is a measure that captures economic activity. A rise in economic growth suggests a positive economic outlook that is reflected to lower borrowing costs and lower sovereign yields. Besides, the impact of fiscal balances to the long-term interest rates has been researched widely in the literature. Poghosyan (2014) found that government bond yields increase by about two (2) basis points in response to a one percentage point (1%) increase in government debt-to-GDP ratio and by about 45 basis points in response to a one percentage point increase in the potential growth rate. Therefore, I incorporate quarterly developments of real GDP growth and debt-to-GDP-ratio in my specification, as announced by Eurostat.

Furthermore, sovereign yields could also be increased due to expectations for higher inflation rates. Such expectations may produce macroeconomic uncertainty leading to higher country-specific credit-risk premia and aggravating fiscal solvency concerns (Baldacci, Gupta, and Mati, 2011). The HICP is a composite measure of inflation within the Eurozone. The estimation method considers pricing patterns for both urban and rural goods. Eurostat announces the price levels per EMU country monthly; hence, I estimate the quarter developments.

Nevertheless, this measure is backward-looking and might encapsulate the effects of business cycles. To control for such a case, I employ the one-year-ahead consensus forecast of inflation as it is published by the European Commission quarterly. All the aforementioned figures are discrete control variables that are updated at the end of each quarter to the introduction of the non-country-specific factors. Table 3 summarizes the statistics of the variables mentioned in the previous sections. Gradient coloring takes place to highlight the countries with the weakest/robust means per variable. Technically, variables with means that indicate high liquidity and credit risk premia are displayed in red, while the opposite holds for those that are displayed in green. Consequently, as expected, peripheral countries fall under the red-orange side of the spectrum and core countries under the green-yellow one.

Panel I. Maturity 5-year

		Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
$Y_{i,t}$	Mean	0.20%	1.08%	0.34%	0.01%	5.35%	2.96%	2.08%	2.07%	4.67%	2.07%
	St. Devation	0.03	0.01	0.00	0.00	0.06	0.03	0.02	0.02	0.05	0.02
	Skewness	-0.12	0.97	0.05	0.68	1.32	1.66	0.80	0.39	1.08	0.39
L_t^{BA}	Mean	-1.50	-1.06	-0.89	-0.42	-2.08	-2.31	-0.74	-0.23	-2.70	-1.39
	St. Devation	1.25	0.72	0.56	0.68	1.31	1.46	0.63	0.64	1.56	0.80
	Skewness	0.24	0.74	1.46	1.53	-0.08	0.62	1.51	1.04	0.18	0.51
L_t^{LOS}	Mean	-0.90	0.16	0.02	0.46	-2.94	-2.49	0.30	-0.32	-2.21	-0.50
	St. Devation	2.27	1.69	1.62	1.58	3.13	2.23	1.59	2.11	2.42	1.71
	Skewness	0.43	0.73	0.36	0.20	0.21	0.74	0.60	0.20	0.69	0.89
L_t^{VOL}	Mean	0.11	0.53	0.39	0.41	-0.58	-0.38	0.43	0.27	-0.04	0.04
	St. Devation	0.53	0.45	0.63	0.43	0.38	0.21	0.49	0.39	0.31	0.32
	Skewness	0.25	-0.05	1.00	-0.03	0.23	-0.19	0.57	0.16	1.25	0.15
CDS_t	Mean	28.35	58.75	6.91	26.14	387.79	255.30	184.48	7.01	358.14	148.32
	St. Devation	224.85	52.79	10.63	25.12	416.92	226.03	134.10	11.51	350.97	100.88
	Skewness	0.85	1.28	1.08	0.80	1.28	0.94	0.79	1.13	1.01	0.60
$S\&P_t$	Mean	0.61	1.40	0.05	0.44	7.44	4.04	5.13	0.12	7.17	3.61
	St. Devation	3.30	0.45	0.12	0.64	2.63	2.86	1.51	0.18	3.25	3.27
	Skewness	0.16	0.47	1.80	0.75	1.01	-0.22	0.78	1.76	0.01	0.65
No of observations		1088	1540	1540	1528	892	1540	1540	1540	1540	1540

Panel II. Maturity 10-year

		Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
$Y_{i,t}$	Mean	0.48%	0.96%	0.24%	0.55%	3.78%	3.19%	2.10%	0.38%	4.45%	2.16%
	St. Devation	0.02	0.01	0.00	0.00	0.03	0.02	0.01	0.00	0.04	0.01
	Skewness	0.82	1.30	0.13	1.33	0.83	0.78	0.74	0.88	0.84	0.47
L_t^{BA}	Mean	-1.65	-1.08	-1.04	-0.81	-1.77	-2.72	-0.70	-0.57	-2.77	-1.48
	St. Devation	1.11	0.64	0.57	0.46	1.21	1.05	0.48	0.51	1.45	0.71
	Skewness	0.35	0.24	-0.22	1.21	-0.70	0.16	0.95	-0.17	0.20	0.57

(break)

(continue)

L_t^{LOS}	Mean	-1.20	-0.12	-0.27	-0.13	-2.48	-2.93	-0.09	-0.74	-2.46	-0.91
	St. Devation	2.19	1.60	1.60	1.39	3.24	2.19	1.68	1.97	2.44	1.76
	Skewness	0.95	0.75	0.35	0.70	0.20	0.92	1.07	0.36	0.60	1.03
L_t^{VOL}	Mean	0.04	0.48	0.39	0.35	-0.37	-0.35	0.26	0.26	-0.04	0.05
	St. Devation	0.46	0.33	0.52	0.37	0.52	0.22	0.42	0.26	0.39	0.30
	Skewness	2.23	0.74	0.83	1.02	0.93	0.47	0.87	-0.21	1.18	0.96
CDS_t	Mean	30.27	57.48	0.55	30.90	297.94	223.49	142.70	12.39	305.90	142.24
	St. Devation	170.43	46.33	13.59	24.05	284.87	174.58	95.86	13.08	268.72	89.65
	Skewness	0.80	1.34	0.76	0.72	0.83	0.79	0.72	1.25	0.76	0.43
$S\&P_t$	Mean	0.43	1.40	0.05	0.44	7.11	4.04	5.13	0.11	7.17	3.61
	St. Devation	3.24	0.45	0.12	0.64	2.21	2.86	1.51	0.18	3.25	3.27
	Skewness	0.74	0.47	1.80	0.76	0.69	-0.22	0.78	1.70	0.01	0.65
No of observations		1540	1540	1540	1540	849	1540	1540	1538	1540	1540

Table 3. Summary statistics of country-specific variables. Panels are divided per maturity; 5-year and 10-year, respectively. Three statistics are calculated per variable: (i) the statistical mean (ii) standard deviation and (iii) skewness. The estimation period covers the whole dataset's timespan, January 2008 – December 2013. The highlighting of the records segregates countries with high liquidity/credit premiums from those with low ones. The gradient coloring is set between the min and max values of the cross-sectional means.

4.2.4. Contagion risk

Contagion is the economic phenomenon where instability of a specific market is transmitted to one or more other interconnected markets. Kalbaska, and Gatkowski (2012), following a correlation analysis, found shreds of evidence of a contagion channel from PIIGS to core countries via the CDS market. In-depth, they highlight that cross-country interdependencies increased after the events of August 2007.

However, credit rating agencies had a significant role in the magnification of the contagion. Under the downgrade escalation of Greece, developments in spreads of countries with weaker fiscal fundamentals were chained: Ireland, Portugal, Italy, Spain, Belgium, and France. For instance, a primary argument of S&P's four-notch (from Baa1 to Ba2) downgrade of Portugal's long-term government on 5 July 2011 was a debate about the voluntary debt rollover for Greece. More precisely, they argued that private sector participation could become a precondition for additional rounds of official lending to Portugal as well. Consequently, the news caused a major re-assessment of the Portuguese outlook and triggered an increase in its yield spreads.

Thus, to capture both developments under one contagion measure, I estimate a spread between EMU Core and an EMU Peripheral CDS index. For the indices' weighting scheme setups, major index providers, such as IHS Markit and iTraxx, use an equal weighting setup; however, this setting accentuates the enormous spreads of Greece and Portugal (see Graph 2 on the previous section) and distorts the overall picture. Besides, European governments aimed to stabilize the financial system by introducing stimulus packages. Through the stimulus packages, a part of the credit risk from the financial sector transferred to the public one as issuers undertook substantial financial costs and credit risks that are reflected in the evolution of the CDS premium.

Thereupon, to control over credit-premia, credit ratings ($S\&P_{i,t}$) are incorporated in the estimations of the weighting schemes regarding the CDS indices. First, similar to the method in the prior section, 3.2.2, long term-ratings are classified into 22 segments yet in reverse order, from 1 (triple-A) to 22 (default) for the core countries and in the opposite order for the peripheral ones. Under this process, I mitigate the considerable heterogeneity between core and peripheral spreads. Subsequently, at the end of each month, I calculate a cross-sectional sum of the discretized ratings ($\sum_i^n S\&P_{i,t}$) and use it as the denominator of the weight:

$$w_t^{CDS} = \frac{S\&P_{i,t}}{\sum_i^n S\&P_{i,t}} \text{ where } n = \text{number of countries} \quad (9)$$

Since CDS spreads are not available for all countries across the dataset's timespan, countries with spreads less than 18-trading days available are not considered in the cross-section for the weighting estimations. Finally, I take the spread of those indices to refine their co-movements and focus solely on the divergence of the PIIGS area, which concentrates the contagion risk. The differences for both maturity points j are formulated as:

$$CON_{j,t} = CDS_{j,t}^{Core} - CDS_{j,t}^{Per} \quad \text{where } j = 5,10 \tag{10}$$

where $CDS_{i,t}^{Core}$ is the CDS index for the core countries (Austria, Belgium, Finland, France, and the Netherlands) and $CDS_{j,t}^{Per}$ is the CDS index for the peripheral countries (Greece, Ireland, Italy, Portugal, and Spain).

4.2.5. Global risk factors

As it has been discussed, empirical analyses conducted before the burst of the financial crises of 2010 and 2011, qualified an international risk factor as a primary driver of the euro ear sovereign spreads. With that respect, researchers have appraised a broad set of global risk aversion variables. Nevertheless, the primary weakness of these measurements is their one-dimensional nature. Either spread on corporate securities or implied volatility, the focus is one-sidedly centered on market viewpoint, disregarding other significant indicators with potential explanatory power. Hence, I incorporate the Global Financial Stress Index (GFSI). Consequently, I collect the literature's most common factors to assess for its performance against them. The following chapter highlights the academic findings on their respect and their relationship across my dataset's timespan.

Among the most popular candidates, the US high yield corporate bonds over treasuries spread is defined as a measure of sentiment toward risk and global risk appetite. (see Bernoth and Erdogan (2012)). In the same year, Maltritz (2012) employs this measure as an indicator of market sentiment and finds a probability of about 99% for this factor in determining the sovereign risk. Thus, I use the spread between the US triple-B corporate bonds ($Y_{j,t}^{BBB}$) provided by Merill Lynch and US Treasury bills ($Y_{j,t}^{T-bill}$), for both 5 and 10-year maturity, j, as:

$$US_{j,t}^{spr} = Y_{j,t}^{BBB} - Y_{j,t}^{T-bill}, \qquad where\, j = 5,10 \tag{11}$$

Furthermore, the Volatility Index (VIX) is commonly used as a measure of risk aversion and overall financial market risk. VIX is referred to as the "*fear index*" and is a proxy of the implied volatility of the S&P 500 index (see Gueye and Sy, 2013). Technically, it formulates a theoretical expectation of the stock market's volatility. Therefore, I assess a log of VIX index provided by the Chicago Board Options Exchange (CBOE) to mitigate the spikes that characterize the turmoil period of my dataset. I hypothesize that all the above measures have a positive correlation with the sovereign bond spreads (see D'Agostino and Ehrmann, 2014).

GFSI incorporates twenty-three (23) key measures of financial risk, hedging demand, and investor risk-appetite across global credit, equity, rates, FX, and commodity markets. All these events rarely occur when there is substantial fundamental turmoil in the global economic and financial landscape. Additionally, in their whitepaper, released in 2011, they argue that the *GFSI* has higher predictive power for equity declines than the VIX, primarily because a strong rise in the *GFSI* is likely a product of numerous risk factors across markets pointing at the same direction. Figure A2, in the appendix, provides a granular overview of the index's components. VIX is very volatile and can surge in occasions where other areas of the market are relatively unperturbed; therefore, their signal is unlikely to be predictive across asset classes.

Last but not least, I consider a common euro area risk factor. As observed by the literature, the sovereign spreads of countries with robust fiscal fundamentals move in harmony with the spread between the German sovereign bond and the German state-owned bank bond, KfW ('*Kreditanstalt fur Wiederafubau'*). Both instruments are guaranteed by the German government. Hence they share the common default risk. With that in mind, the credit risk component between them is negated and, therefore, any differences between the agency and the government bond yields should be evidence of both flight-to-liquidity (investors' aversion to liquidity risk premium) and flight-to-quality (investors' preference for solid German assets) in alignment with Longstaff (2005). For the sake of simplicity, similarly to Schwarz (2018), I refer to this variable as K-spread.

As portrayed in Figure 7, there is a strong co-movement between the four factors, especially in the outburst of the Great Recession of 2008. All three risk indices rise substantially, with the latter one exhibiting the sharpest increase. However, in the transition phase to the EMU-Sovereign Debt Crisis, we can see a relatively more responsive reaction from GFSI. Besides, the distress index seems to capture[6] turmoil events in the Eurozone, such as the difficult period for Greece (second bailout; Papandreou's resignation) and Ireland (Moody's downgrade of banks' debt to 'junk') in the first two quarters of 2011.

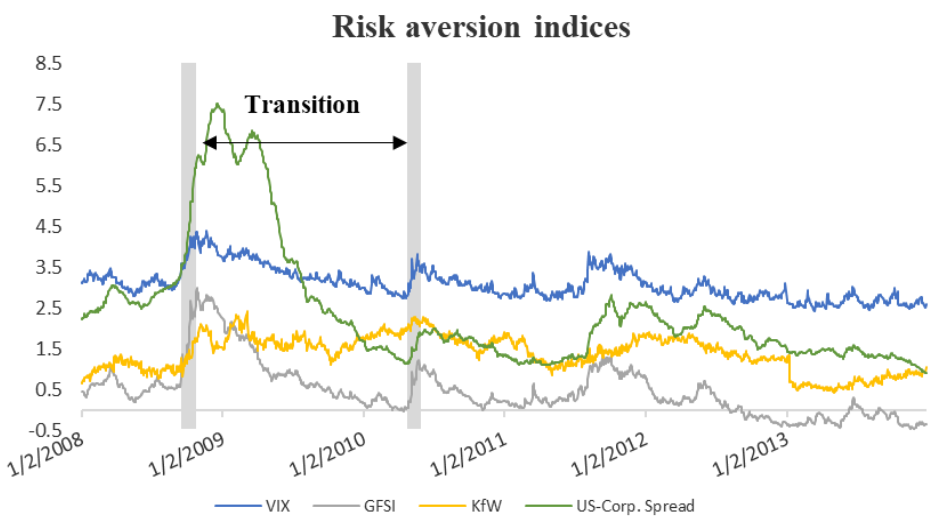


Figure 7. Risk aversion factors time-series. *VIX*, *GFSI* and *US-Corporate spread* to capture the global risk aversion, whereas *K-spread* the euro-area factor of 'flight-to-liquidity'. The grey columns indicate the intensification of the global financial crisis in September of 2008, with the collapse of the Lehman brothers, and Greece's first call for assistance from the Eurozone. From the development of the indices, we can define a transition period from the Great Recession of 2008 to the EMU-Sovereign Debt Crisis of 2011 using these critical events as starting/ending points.

[6] Effectively, the components of the index (described in Figure A.3) change in real-time. At the end of the business day, the appropriate weighting takes place, and the levels of GFSI reflect the market's reaction to the events.

The correlation matrix in Table 4 confirms the positive linear relationship of the four indices across the whole timespan of my dataset. These preliminary results prove GFSI's parsimonious ability to capture incidents related to the yield spreads determinants in a more consistent way. Thereupon, in my baseline specification, I run regressions using both measures to cross-validate this claim and assess my second hypothesis.

	VIX_t	$GFSI_t$	KfW_t^{5Y}	KfW_t^{10Y}	$US^{spr}{}_{5,t}$	$US^{spr}{}_{10,t}$
VIX_t	1.00					
$GFSI_t$	0.94*	1.00				
KfW_t^{5Y}	0.51*	0.49*	1.00			
KfW_t^{10Y}	0.52*	0.52*	0.84*	1.00		
$US^{spr}{}_{5,t}$	0.79*	0.84*	0.35*	0.38*	1.00	
$US^{spr}{}_{10,t}$	0.8*	0.85*	0.39*	0.44*	0.99*	1.00

Table 4. Correlation matrix of risk factors. The estimated correlation measure is Pearson's correlation coefficient per pair of variables. The asterisk indicates a statistical significance on the 1% level (*p-value* <=0.01). A correlation factor between ± 0.25 - 0.5 indicates moderately, positively/negatively, correlated variables, and above ± 0.5 strong, positively/negatively, correlated variables

4.2.6. Index construction

In the second part of the analysis, yield dynamics are examined on an aggregate level. For this purpose, I distinguish my dataset from the core and peripheral countries, and, after establishing certain criteria, I construct yield indices. A benchmark's construction prerequisites several aspects. An essential one is the instrument selection criteria to control for liquidity constraints. Market indices providers consider on-the-run securities with market size bandwidths of 40 and 20 billion euros and a minimum issue size of 2.5 billion[7]. Data from Bloomberg are collected to inspect if my selected universe of securities complies with them. Subsequently, the weighting setting and rebalancing frequency must be defined. The widely used scheme considers market capitalization daily. As a result, I collect the end of day market cap of my MTS long term bond universe, I segregate the countries into "*Core*" and "*Peripheral*", and

[7] Those thresholds are determined by FTSE and Citi in their officially published factsheets. The primary goal of these conditions is to filter out illiquid securities that might distort the index's estimations.

after summing up the total market cap per category, I define the weights as:

$$w_t^j = {MC_{i,t}^j}\Big/{\sum_i^n MC_{i,t}^j}\ , \quad j = \begin{cases} Core \\ Peripheral \end{cases} \tag{12}$$

where $MC_{i,t}^j$ denotes the market capitalization of country *i* per category *j* at day *t* and *n* is the number of countries per category, which equals to five each.

5. Empirical specification

As it is mentioned, the first hypothesis inquiries into the long-term determinants of sovereign bond yield differentials on a country level. Thus, the dataset composites an unbalanced panel structure of *NxT* dimensions (where *N*=10 and T=1524 days). First, I consider an OLS estimation with Newey-West (1986) standard errors to control for possible correlation and heteroskedasticity in the residuals. Nonetheless, one drawback of this methodology is the risk of estimating spurious regressions. Therefore, following De Santis (2012), I extend my analysis by considering cointegration methodologies, in particular Dynamic Ordinary Least Squares (DOLS). The present chapter formulates in-depth the specification of the empirical models, the considered statistical tests, and the robustness measures that are taken.

5.1. Baseline model

As a beginning, I estimate a multiple linear regression in two subperiods, using the 10th of May, 2010, as a breakpoint. This selection was made due to the ECB Governing Council announcement that took place during the weekend of the Security Market Programme (SMP). Their thoughts on purchasing euro area government bonds with an eye to enhance market depth and ameliorate liquidity in dysfunctional markets to recover a proper monetary transmission mechanism. In its simplest form, the model is defined as:

$$Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}\left(\mathcal{L}_{,i,t}{}^{BA}\right) + \beta_{3,i}CDS_t + \beta_{4,i}GFSI_t + KfW_t + CON_{i,t} \tag{13}$$

where the regression terms are: the bid-ask spread, ${\mathcal{L}_{i,t}}^{BA}$, the CDS spread differentials between country i and the German Bund, CDS_t, the financial distress index $GFSI_t$, the KfW_t spread, and the Contagion index, $CON_{i,t}$. In order to challenge the explanatory power of GFSI, I re-evaluate the model with VIX on its place, shedding light to the first hypothesis. Additionally, in order to assess my second hypothesis, I use MTS quoted volume to control for trading activities that might indicate a 'flight-to-quality' effect.

Finally, I append the equation (13) with the set of control variables $C_{i,t}$ for robustness purposes:

$$Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}\left({\mathcal{L}_{,i,t}}^{BA}\right) + \beta_{3,i}\left(CDS_{i,t}\right) + \beta_{4,i}GFSI_t + KfW_t + CON_{i,t} + C_{i,t}$$

$$where\ C_{i,t} = \begin{cases} HICP_t \\ {GDP^{gr}}_{i,t} \\ Debt_{i,t}/GDP_{i,t} \\ L_{i,t}^{VOL} \end{cases} \qquad (14)$$

The control variables (as discussed in Section 4.2.3) are the inflation index $HICP_t$, the GDP growth, ${GDP^{gr}}_{i,t}$, the country's repayment ability, $Debt_{i,t}/GDP_{i,t}$, and the total quoted volume, $L_{i,t}^{VOL}$. In total, I estimate three regressions per maturity and per subperiod, for each country of my sample, using two different specifications, with and without the control variables. Hence, in total, I run one hundred and twenty regressions. The results of the baseline model are reported in the subsequent chapter, while the complementary ones in the appendix tables. All model specifications are extended with a Newey-West variance estimator, setting the length of the lag terms to three.

Nevertheless, a well-known feature of Euro area yield spreads is their interdependence between consecutive days. Among numerous researches, Giordano et al. (2012) and Sibbertsen and Wegener (2014) perform a series of tests, examining their persistence under crises. Both analyses accept the null hypothesis that a unit root is present; thus, sovereign yield spreads are non-stationary and autocorrelated. For the sake of this issue, I perform a battery of time series tests. The next section elaborates on the statistical methods that were employed to investigate these effects.

5.2. Unit root tests

Unit root tests formulate a null hypothesis under which a time series variable possesses a unit-root and then is generated by a stationary process. As a starting point, I follow the Dickey-Fuller specifications, and I run a series of OLS regressions of each variable against a constant term, a_i ,a trend term, $t_{i,t}$, and their own lagged value, $y_{i,t-1}$, as:

$$y_{i,t} = a_i + \rho_i y_{i,t-1} + t_{i,t}\beta_i + u_t \tag{15}$$

A major drawback of this approach is the disregard of potential serial correlation in my time-series. To account for this, I consider the Phillips-Perron (1988) test. Philips and Perron's test enhances the estimation process by incorporating heteroskedasticity – and autocorrelation – consistent covariance matrix estimator. For the lag length selection, I consult the AIC criterion as it was suggested in Ng and Perron (2001), and I set it to six (6).

Besides, I complement my results by further employing the Dickey-Fuller t-test (academically known as DF-GLS test) proposed by Elliott, Rothenberg, and Stock (1992). Essentially, it is performed by initially transforming the time series, via a generalized least squares (GLS), regression before performing the test. Multiple studies have shown that this test has significantly greater power than the previous versions of the augmented Dickey-Fuller test (ADF). The statistical tests are applied over the whole span of the series, which stands with the January 2008 – December 2013 period. The null hypothesis supports the absence of a unit root.

Table 5 reports the values for the intercept, the trend coefficient, the slope coefficients, the Phillips-Perron test statistic, *Z(t)*, and the Dickey-Fuller GLS statistic, DF^{GLS}. The standard unit root tests applied to each variable somewhat mixed results.

For the 5-year maturity bonds –Panel I– yield spreads across all EMU countries proved to follow a unit-root process. However, the CDS spreads results for certain core countries to generate mixed impressions. More precisely, the Dutch CDS spreads accept the null hypothesis of stationarity. Also, for the 10-year maturity –Panel II– the Dutch and Finnish yield spreads reject the null hypothesis (in both statistical tests). In contrast, their CDS spreads reject the null hypothesis entirely and at a 5% level, respectively. Consequently, I exclude Finland and the Netherlands from my cointegration analysis.

Concerning the Austrian and French yield and CDS spreads, 10-year maturity, the variables reject the null hypothesis at only a 1% level. For these cases, I consult the *p*-value (see Table A3). According to MacKinnon (1996), a value higher than 5% validates the existence of a unit root for these variables. Therefore, both variables for Austria and France pass the test significance test and are considered as non-stationary in my analysis. Last, yet importantly, all the global risk factors –Panel III– but one, VIX, reject the null hypothesis. That is a favorable advantage for the *GFSI*, which seems that satisfies the non-stationarities properties of the yield differentials. These results herald the employment of cointegration tests, which are introduced in the next section.

Panel 1: 5 - Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Yield Spread										
ρ_t	0.99	1.00	0.99	0.99	1.00	1.00	1.00	0.99	1.00	0.99
α_t	5.E-05	5.E-05	3.E-05	2.E-05	-2.E-04	1.E-04	7.E-05	5.E-05	1.E-04	5.E-05
$t_{i,t}$	-9.E-08	-3.E-08	-4.E-09	-3.E-08	1.E-06	-8.E-08	2.E-08	9.E-08	-1.E-07	9.E-08
Z(t)	-2.13	-1.49	-2.70	-2.15	0.28	-1.82	-1.33	-1.79	-0.98	-1.79
DF^{GLS}	-1.95***	-1.54***	-2***	-1.81***	-0.14***	-1.61***	-1.68***	-1.79***	-1.37***	-2.45***
II. CDS-Spread										
ρ_t	0.98	1.00	0.98	0.99	1.01	1.00	1.00	0.90	1.00	0.99
α_t	8.E-05	3.E-05	-3.E-06	9.E-06	-9.E-05	1.E-04	6.E-05	-3.E-05	1.E-04	5.E-05
$t_{i,t}$	-5.E-08	-1.E-08	2.E-08	3.E-08	3.E-07	-9.E-08	5.E-08	1.E-07	4.E-09	6.E-08
Z(t)	-2.50	-1.70	-3.07	-2.31	0.84	-1.23	-1.67	-7.21	-1.32	-1.91
DF^{GLS}	-2.76**	-1.9***	-3.22*	-2.79**	0.2***	-1.19***	-2.07***	-5.66	-1.6***	-2.35***

(break 1)

(continue 1)

III. Bid Ask										
ρ_t	0.77	0.72	0.58	0.71	0.58	0.84	0.62	0.61	0.81	0.72
α_t	-4.E-04	-2.E-04	-4.E-04	-2.E-04	-3.E-04	-1.E-04	-2.E-04	3.E-05	-1.E-04	-2.E-04
$t_{i,t}$	2.E-07	-1.E-07	5.E-08	1.E-07	-1.E-06	-3.E-07	-1.E-07	-2.E-07	-5.E-07	-3.E-07
$Z(t)$	-11.33	-16.16	-22.29	-16.62	-16.23	-10.46	-20.43	-21.06	-11.55	-16.43
DF^{GLS}	-5.57	-8.55	-9.49	-9.41	-9.89	-6.64	-10.87	-12.38	-7.54	-8.82
IV. Volume										
ρ_t	0.89	0.84	0.89	0.89	0.78	0.79	0.89	0.85	0.80	0.80
α_t	-1.E-05	1.E-05	-5.E-05	1.E-03	-2.E-05	-1.E-04	1.E-05	-3.E-05	5.E-05	5.E-05
$t_{i,t}$	5.E-08	9.E-08	1.E-07	3.E-07	-2.E-07	2.E-08	4.E-08	1.E-07	-8.E-08	-8.E-08
$Z(t)$	-6.40	-10.48	-7.82	-8.63	-9.79	-13.01	-8.07	-10.20	-12.59	-9.35
DF^{GLS}	-4.61	-4.01	-3.98	-6.69	-4.70	-8.69	-3.44	-5.35	-7.07	-3.52

Panel 2: 10 - Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Yield Spread										
ρ_t	0.98	0.99	0.95	0.98	0.99	1.00	1.00	0.92	1.00	0.99
α_t	6.7E-05	5.4E-05	2.2E-04	6.9E-05	-1.6E-04	1.1E-04	5.9E-05	3.0E-04	1.1E-04	5.1E-05
$t_{i,t}$	2.E-08	2.E-08	-1.E-07	6.E-08	1.E-06	-1.E-07	6.E-08	5.E-09	-4.E-08	1.E-07
$Z(t)$	-2.80	-2.03	-4.58	-2.76	-1.64	-0.89	-1.63	-6.44	-1.00	1.73
DF^{GLS}	-3.03*	-2.37***	-4.46	-3.22*	-1.6***	-0.92***	-2.08***	-6.04	-1.29***	-2.36***
II. CDS-Spread										
ρ_t	0.98	0.99	0.98	0.98	0.99	1.00	0.99	0.87	1.00	0.99
α_t	8.0E-05	3.7E-05	1.0E-05	1.3E-05	-1.8E-04	1.1E-04	4.8E-05	1.2E-04	6.5E-05	5.6E-05
$t_{i,t}$	-3.E-08	2.E-10	-1.E-08	6.E-08	1.E-06	-4.E-08	1.E-07	5.E-08	1.E-07	1.E-07
$Z(t)$	-3.21	-2.04	-3.15	-2.96	-1.81	-1.75	-2.53	-8.61	-1.83	-2.49
DF^{GLS}	-2.91*	-2.25***	-3.42*	-2.44***	-1.58***	-1.72***	-2.4***	-5.91	-2.14***	-2.18***
III. Bid Ask										
ρ_t	0.73	0.77	0.71	0.55	0.68	0.86	0.62	0.53	0.87	0.76
α_t	-4.6E-04	-2.1E-04	-3.6E-04	-2.9E-04	-6.7E-05	-2.4E-04	-1.8E-04	-2.2E-04	-1.2E-04	-1.9E-04
$t_{i,t}$	1.E-08	-5.E-08	8.E-08	-1.E-07	-1.E-06	-2.E-07	-1.E-07	-6.E-08	-3.E-07	-2.E-07
$Z(t)$	-15.96	-13.86	-16.76	-22.97	-12.80	-9.40	-20.59	-23.60	-8.91	-14.58
DF^{GLS}	-7.03	-8.55	-7.74	-10.25	-8.92	-5.51	-10.51	-14.44	-6.40	-8.00
IV. Volume										
ρ_t	0.90	0.84	0.91	0.88	0.84	0.81	0.84	0.83	0.88	0.88
α_t	7.3E-08	5.8E-05	-1.4E-05	2.0E-05	5.8E-05	-3.7E-05	4.0E-05	7.3E-05	1.8E-05	1.8E-05
$t_{i,t}$	4.E-09	2.E-08	6.E-08	3.E-08	-3.E-07	-4.E-08	-2.E-10	-1.E-07	-2.E-08	-2.E-08
$Z(t)$	-8.06	-10.70	-6.91	-8.63	-7.76	-11.89	-7.60	-10.20	-11.25	-8.62
DF^{GLS}	-2.18***	-3.64	-3.29	-3.50	-4.14	-4.80	-3.17	-5.04	-3.76	-3.62

Panel 3: Common factors

Credit Rating ($S\&P_t$)										
ρ_t	1.00	0.99	0.99	1.00	0.99	1.00	1.00	1.00	0.99	1.00
α_t	-2.1E-03	3.8E-03	5.6E-05	-2.7E-03	3.0E-02	7.1E-03	1.1E-02	-1.3E-03	1.4E-02	-5.7E-03
$t_{i,t}$	7.E-06	5.E-06	3.E-07	8.E-06	1.E-04	3.E-07	2.E-05	3.E-06	4.E-05	4.E-05
$Z(t)$	-2.04	-2.14	-1.92	-1.94	-1.95	-0.48	-1.88	-0.82	-2.23	-2.12
DF^{GLS}	-1.73***	-1.49***	-1.94***	-1.41***	0.13***	-0.81***	-1.17***	-1.03***	-1.65***	-1.35***
$Debt_{i,t}$ / $GDP_{i,t}$										
ρ_t	0.99	0.99	0.99	1.00	0.97	0.99	0.99	0.99	0.99	1.00
α_t	1.6E-03	2.6E-03	-1.1E-03	8.9E-04	2.0E-02	3.1E-04	3.2E-04	2.1E-03	2.1E-03	-4.5E-04
$t_{i,t}$	-7.E-08	-1.E-07	7.E-07	2.E-07	2.E-05	3.E-06	2.E-07	4.E-06	4.E-06	1.E-06
$Z(t)$	-2.27	-2.20	-2.76	-1.89	-3.58	-1.72	-1.65	-2.12	-2.78	-1.71
DF^{GLS}	-1.91***	-2.07***	-2.46***	-1.52***	-2.55***	-1.73***	-1.61***	-1.74***	-1.96***	-1.3***

(break 2)

(continue 2)

Risk Factors	$GFSI_t$	VIX_t	$US_{5,t}^{spr}$	$US_{10,t}^{spr}$	KfW_t^{5Y}	KfW_t^{10Y}	CON_t^{5Y}	CON_t^{10Y}
ρ_t	0.99	0.97	1.00	1.00	1.00	0.98	1.00	0.99
α_t	7.2E-05	1.1E-03	1.1E-04	6.9E-05	7.0E-05	3.5E-04	3.5E-04	8.4E-05
$t_{i,t}$	-7.E-08	-2.E-07	-8.E-08	-6.E-08	-5.E-08	-1.E-07	-3.E-08	5.E-08
Z(t)	-2.47	-4.05	-1.80	-1.56	-1.84	-3.20	-1.27	-1.63
DF^{GLS}	-1.87^{***}	-3.510	-0.682	-0.758	-0.59^{***}	-1.69^{***}	-1.36^{***}	-1.7^{***}

Table 5. Unit root test results. The first four lines report the regression coefficient, the intercept, the trend term, and the *Z(t)* statistic from the $y_{i,t} = a_i + \rho_i y_{i,t-1} + t_{i,t}\beta_i + u_t$ specification corrected for autocorrelation with the Newey-West estimator; lag length is set to seven. The frequency zero spectrum default method is kernel (Bartlett) sum-of-covariances for the Phillips-Perron test and autoregressive spectral regression (GLS-detrended) for the Dickey-Fuller test. The critical values for the Phillips-Perron statistic are reported by Hamilton (1994, Table B.6, 763): -2.57^{*} (10%), -2.86^{**} (5.0%), --3.43^{***} (1.0%). The critical values for the DF^{GLS} statistic are computed from the response surface analysis of Cheung and Lai (1995): -3.48^{*}(10%), -2.85^{**} (5.0%), -2.56^{***} (1.0%). The grey highlighted values indicate the rejection of the null hypothesis.

5.3. Cointegration tests

Before I proceed with the implementation of the cointegrated model, I study the cointegrating relationship of the non-stationary variables. Therefore, I follow-up by testing the CDS spread, the S&P credit ratings, the KfW-Bund spread, the GFSI index (international risk factor), the Contagion index (spill-over effect), the Debt ratio (payback ability). Two cointegration tests are considered for the panel data structure; Kao (1999) and Westerlund (2005). Both tests are based on the following panel-data model:

$$y_{i,t} = \beta_i x'_{i,t} + z'_{i,t}\gamma_i + e_{i,t} \tag{16}$$

The vectors $x'_{i,t}$ and $z'_{i,t}$ denote the vector of the non-stationary variables and the deterministic terms that control for panel-specific effects respectively. Vector β_i is the cointegrating vector that may vary across panel, and γ_i is a vector of coefficient on $z'_{i,t}$. Finally, $e_{i,t}$ is the error term of the regression. Although they both share a common null hypothesis, the tests implement different set of tests to examine non-stationarity in the error term. For instance, Kao tests report the four modifications of the Dickey-Fuller t-statistic (*DF- t*): standard, modified, unadjusted, and unadjusted modified. All these variants are generated by fitting the model (15) in

OLS, extracting the residuals ($\hat{e}_{i,t}$), and subsequently fitting them in an autoregressive model:

$$\hat{e}_{i,t} = \rho\hat{e}_{i,t-1} + u_{i,t} \tag{17}$$

where ρ represents the autoregressive parameter and $u_{i,t}$ the stationary error term. The difference between the standard *DF- t* and the unadjusted modified *DF- t* is that, under the null hypothesis, the first one tests whether $\rho = 1$ whereas the latter $\rho - 1 = 0$. Also, the ADF test incorporates extra lags of the residuals to control for serial correlation:

$$\hat{e}_{i,t} = \rho\hat{e}_{i,t-1} + \sum_{j=1}^{\rho}\rho_{ij}\Delta\hat{e}_{i,t-1} + u^{*}{}_{i,t} \tag{18}$$

where $\Delta\hat{e}_{i,t-1}$ is the *j*th lag of the first difference of the lagged error term and *p* is the number of the lag differences.

Similarly, Westerlund presumes panel specific cointegrating vectors as in equation (16), where each panel has its slope coefficient. The variance ratio test statistic (VR) is used to assess the null hypothesis of no cointegration against the alternative hypothesis that some panels are cointegrated. Henceforth, the variance ratio is constructed by obtaining the predicted residuals as gauged by the equation (18). In particular, it is mathematically determined as:

$$VR = \sum_{i=1}^{N}\sum_{t=1}^{T}\hat{E}_{i,t}{}^{2}\widehat{R_{i,t}}^{-1} \tag{19}$$

where $\hat{E}_{i,t}{}^{2} = \sum_{j=1}^{t}\hat{e}_{i,j}$, $\hat{R}_{i,t} = \sum_{t=1}^{T}\hat{e}_{i,t}{}^{2}$, and $\hat{e}_{i,t}$ are the residuals. The overall results are reported in the Table 5.

According to Table 6, for both maturities, all the Kao statistics are in favor of the alternative hypothesis, supporting the existence of a cointegrating relationship between the yield spread differentials and the six non-stationary variables (*p-value* <= 0.01 per statistic). Likewise, Westerlund's volatility ratio designates the rejection of the null hypothesis across each panel. Similar results are yielded using the alternative global risk aversion factors: Volatility index, VIX_t, and the US Corporate spreads, $US_{j,t}^{spr}$ (see Table A2). These outcomes raise a flag for the baseline OLS specification as the independent variables are correlated positively with the error term, causing endogeneity bias and distorting the estimation of the coefficients. As a result, to correct my initial model, I supplement my analysis with the inclusion of a cointegrated model.

Panel 1: 5 - Year maturity		
I. Kao cointegration tests	**Statistic**	**P-Value**
Modified DF_t	-21.25	0.00%
DF_t	-8.76	0.00%
Augmented DF_t	-7.83	0.00%
Unadjusted modified DF_t	-25.12	0.00%
Unadjusted DF_t	-9.06	0.00%
II. Westerlund variance ratio		
VR_t	-2.64	0.42%
Panel 2: 10 - Year maturity		
I. Kao cointegration tests	**Statistic**	**P-Value**
Modified DF_t	-65.33	0.00%
DF_t	-17.22	0.00%
Augmented DF_t	-14.84	0.00%
Unadjusted modified DF_t	-70.82	0.00%
Unadjusted DF_t	-17.28	0.00%
II. Westerlund variance ratio		
VR_t	-2.68	0.37%

Table 6. Panel cointegration test results. The two panels are distinguished per maturity. Section (I) contains the set of t-statistics reported by Kao (1993), whereas Section (II) holds the Variance ratio as introduced by Westerlund (2005). Both statistical tests are based on firstly running the panel-regression model of the form $y_{i,t} = \beta_i x'_{i,t} + z'_{i,t}\gamma_i + e_{i,t}$ and collecting the estimated residuals $\hat{e}_{i,t}$. Thereafter, the Dickey-Fuller statistics are gauged by running an autoregressive model on those residuals. Following Bartlett kernel with Newey and West (1994) automatic selection algorithm, the lag length is set to 7. The variance ratio is directly computed using the regression's error terms. All the statistics converge to an asymptotic distribution *N*(0,1).

5.4. Dynamic OLS

Stock and Watson (1993) propose a specification that adds non-trending variables to the cointegrated regression. This technique performs better than an OLS, by coping with a dynamic source of bias in a single equation approach. More specifically, the DOLS method augments the regression with lags and leads of the differences of the cointegrated variables, including the independent variable, $\Delta X'_{i,t}$. Applying this to my initial specification in the equation (13) the model is transformed into:

$$Y_{i,t} - Y_{GER,t} = \beta_{i,0} + \beta_i X'_{i.t} + \delta_{i,j} \sum_{j=-q}^{r} \Delta X'_{i.t+j} + \gamma_{4,i} D'_t + S\&P_t + \frac{Debt_{i,t}}{GDP_{i,t}} + u_{i,t} \quad (20)$$

where the sovereign yield spread of country i vis-à-vis the German Bund lays in the right part of the equation, while on the left there is $X'_{i.t}$ the vector of regressors ($Y_{i,t} - Y_{GER,t}$, CDS_t, $GFSI_t$, KfW_t, CON_t); D'_t the breakpoint dummy variable which takes the value of 1 post 10th May, 2010, $S\&P_t$ the quantified long term credit rating, and $\frac{Debt_{i,t}}{GDP_{i,t}}$ the debt-to-GDP ratio. Finally, $u_{i,t}$ are the uncorrelated with the $X'_{i.t}$ innovations. In accordance with the Akaike information criterion (AIC), I set the length of the lags q and leads *r* equal to six (6) to gain results that are entirely comparable across countries. Herewith, I control for potential correlation between the non-spread variables and the estimated residuals from the integrating relationship. The remaining serial correlation and heteroskedasticity in the error terms of equation (20) are treated by incorporating the Newey-West error variance estimator.

This final specification is run for both maturities for all the countries, with the only exemptions being Finland (10-year maturity) and the Netherlands (both maturities), due to the negative unit-root results in the previous section. Finally, I run the specification using only the risk factors for the core and peripheral yield indices. With this technique, I circumvent the country-specific fundamental differences among them by segregating and aggregating those that share similar yield spread movements throughout the crises. The following chapter elaborates in depth the results of my analysis.

6. Results

The results are organised into three (3) main sections, with a specific focus on deriving distinct empirical answers to my three formulated hypotheses. The first section is dedicated to examining my first hypothesis. In particular, it describes the outcomes of the OLS regression analysis and how the global financial risk aversion, along with the '*flight-to-liquidity*' factor, predominantly determine the sovereign EMU yield spread widening across countries and maturities (5-year and 10-year). The second section focuses on my second hypothesis, reporting the results with the inclusion of the control variables. On that respect, it ascertains the explanatory power of GFSI, as it preserves its significant relationship with yield differentials in both subperiods. Finally, the third section outlines the results of the cointegrated model (DOLS), which is employed in the full time span of my dataset: Firstly, on an aggregate level to reaffirm the findings of my two previous hypotheses; Secondly, on a country level to examine my third hypothesis, which supports that for peripheral countries yield spreads can be primarily explained by country-specific variables that are associated with solvency risk, whereas for core countries yield spreads are mainly influenced by exogenous factor variables.

6.1. OLS Regression results

The OLS results are consistent with the initial hypothesis, which postulates that during periods of a financial crisis, the global risk aversion factors have a considerable effect on the sovereign bond yield spread. Specifically, for the 5-year sovereign bond (Table 7), the results indicate that during the financial crisis period (1^{st} January 2008-10^{th} May 2010), except for Finland, Greece and, Portugal, the global financial stress index ($GFSI_t$) has a significant positive relationship with the sovereign yield spreads. On the other hand, for the same maturity, the OLS results show that during the Sovereign Debt Crisis period (11^{th} May 2010-31^{st} December 2013), with the exception of France, Ireland and Spain, the $GFSI_t$ had a significant positive effect on variations in the EMU sovereign yield spread.

With respect to the 10-year maturity bonds, the results are similar. Specifically, with the exception of Greece and Portugal, the global financial risk aversion, proxied by GFSI, has a significant effect on yield differentials during the global financial crisis period. In the subsequent subperiod – Panel II – except for only Ireland, the GFSI also marked similar results. Similarly, the US Corporate spread variable ($US_{i,t}^{spr}$) and the Volatility index (VIX_t) display a significant effect in the cross-section of the EMU yield spreads (see Table A5 and Table A6, respectively). Therefore, a rise in terms of explanatory power can be observed for the international risk aversion factors in the EMU Sovereign Debt Crisis.

Furthermore, the K-spread factor ($\text{KfW}_{i,t}$), in the Great Recession subperiod, enters with a significant positive sign for the 5-year maturity bonds. In contrast, for the 10-year maturity sovereign bonds, its resulted sign is negative, and, with the exemption of Austria and Belgium, the coefficients of $\text{KfW}_{i,t}$ are statistically insignificant. Alongside the bid-ask spread factor ($L_{i,t}^{BA}$) has a comparatively stronger relationship with 5-year maturity bonds' the yield spreads. These pieces of evidences suggest that liquidity premium has higher importance in the medium term for the investors. Nevertheless, in the Sovereign Debt Crisis subperiod, there is a rise in the significance of the for K-Spread the 10-year bonds, in particular for the core countries. Additionally, for the same maturity, $\text{KfW}_{i,t}$ significance accompanies that of $GFSI_t$ variable, especially for the core countries.

These outcomes are consistent with the initial hypothetical formulation on the impact of the global risk aversion. The implication is that during the period of tight global financial conditions, risk-averse investors and corporate entities prefer to hold a higher proportion of their investment portfolio in the form of safer haven government bonds. Consequently, these risk mitigating actions are translated into the 'flight-to-liquidity' effect (see e.g., Haugh et al., 2009).

5 - Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Period: 2008-2010										
L_t^{BA}	0.32**	-0.58*	-0.21	0.28	0.97**	-0.15	0.29	-0.18	-0.95***	-0.15
	(0.14)	(0.34)	(0.18)	(0.21)	(0.46)	(0.59)	(0.19)	(0.22)	(0.36)	(0.28)
$CDS_{i,t}$	0.24***	1.15***	1.18***	0.33	1.33***	0.57***	0.21	0.43	0.93***	-0.15
	(0.05)	(0.26)	(0.22)	(0.53)	(0.14)	(0.17)	(0.15)	(0.41)	(0.2)	(0.39)
$GFSI_t$	0.14**	0.2***	0.01	0.29***	0.03	-0.37***	0.29***	0.08**	-0.11	0.1***
	(0.05)	(0.04)	(0.02)	(0.05)	(0.07)	(0.1)	(0.05)	(0.04)	(0.06)	(0.04)
KfW_t^{5Y}	-0.01	0.35***	0.53***	0.21**	0.63***	0.93***	0.42***	-0.02	0.2	-0.03
	(0.13)	(0.1)	(0.06)	(0.1)	(0.21)	(0.33)	(0.07)	(0.09)	(0.22)	(0.11)
CON_t^{5Y}	0.07***	0.08	-0.12***	-0.27***	0.05	0.02	0.09	0.77***	0.01	0.83***
	(0.02)	(0.09)	(0.04)	(0.1)	(0.54)	(0.22)	(0.1)	(0.06)	(0.32)	(0.25)
R^2 - adjusted	0.57	0.75	0.75	0.70	0.96	0.77	0.85	0.67	0.72	0.66
Observations	151	603	603	591	603	603	603	603	603	603
II. Period: 2010-2013										
L_t^{BA}	-0.5***	-0.9***	1.2***	-1.91***	-1.98**	1.18	-2.85***	-9.07***	-1.76***	-2.44***
	(0.17)	(0.32)	(0.26)	(0.24)	(0.85)	(0.98)	(0.65)	(0.96)	(0.67)	(0.58)
$CDS_{i,t}$	0.13	0.85***	-0.19	0.73***	1.34***	1.83***	0.98***	1.89***	1.09***	1.17***
	(0.08)	(0.12)	(0.12)	(0.12)	(0.15)	(0.13)	(0.03)	(0.47)	(0.06)	(0.06)
$GFSI_t$	0.11**	0.17***	0.15***	0.07	-2.15***	-0.17	-0.41***	-0.31*	-0.58**	-0.18
	(0.05)	(0.06)	(0.05)	(0.05)	(0.68)	(0.42)	(0.1)	(0.16)	(0.26)	(0.13)
KfW_t^{5Y}	0.67***	0.02	0.31***	-0.03	-2.03*	-1.44***	0.21**	0.04	0.08	-0.03
	(0.05)	(0.09)	(0.05)	(0.06)	(1.18)	(0.44)	(0.1)	(0.17)	(0.27)	(0.12)
CON_t^{5Y}	0.03***	0.15***	0.1***	0.06***	0.33	-0.37***	0.11***	0.22***	0.61***	0.04
	(0.01)	(0.02)	(0.01)	(0.01)	(0.59)	(0.08)	(0.03)	(0.04)	(0.1)	(0.02)
R^2 - adjusted	0.90	0.95	0.72	0.82	0.96	0.88	0.95	0.60	0.97	0.89
Observations	937	937	937	937	289	937	937	937	937	937

10 - Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Period: 2008-2010										
L_t^{BA}	-0.48	-0.27	-0.4	0.25	-1.51***	-0.46	-0.16	-0.61*	-1.08**	-0.29
	(0.31)	(0.25)	(0.27)	(0.25)	(0.52)	(0.36)	(0.24)	(0.34)	(0.52)	(0.31)
$CDS_{i,t}$	0.42***	1.22***	-0.38	-0.2	0.46***	0.9***	0.24*	0.65***	0.06	-0.25
	(0.09)	(0.16)	(0.28)	(0.15)	(0.11)	(0.06)	(0.13)	(0.14)	(0.19)	(0.2)
$GFSI_t$	0.3***	0.13***	0.18***	0.09***	0.06	-0.18***	0.14***	0.07***	0.07	0.08**
	(0.03)	(0.02)	(0.03)	(0.01)	(0.06)	(0.05)	(0.04)	(0.02)	(0.04)	(0.03)
KfW_t^{10Y}	-0.23***	-0.15***	-0.03	-0.01	0.11	0.18*	0.09*	-0.08	0.02	0.1*
	(0.06)	(0.05)	(0.05)	(0.05)	(0.13)	(0.1)	(0.05)	(0.05)	(0.09)	(0.06)
CON_t^{10Y}	-0.02	0.02	-0.01	0.12***	1.57***	0.08	0.18**	0.08**	0.74***	0.55***
	(0.04)	(0.04)	(0.05)	(0.04)	(0.31)	(0.15)	(0.08)	(0.04)	(0.19)	(0.13)
R^2 - adjusted	0.67	0.63	0.55	0.27	0.94	0.88	0.69	0.46	0.72	0.64
Observations	603	603	603	603	603	603	603	603	603	603

(break)

(continue)

II. Period: 2010-2013										
L_t^{BA}	-0.83**	0.45	0.1	-1***	0.71	-3.5***	-1.74***	-0.4***	-2.85***	-2.44***
	(0.39)	(0.34)	(0.22)	(0.35)	(0.64)	(0.59)	(0.53)	(0.11)	(0.81)	(0.57)
$CDS_{i,t}$	0.64***	0.67***	0.15	1.17***	1.04***	1.2***	1.13***	0.27***	1.18***	1.46***
	(0.12)	(0.14)	(0.1)	(0.12)	(0.12)	(0.06)	(0.03)	(0.07)	(0.06)	(0.04)
$GFSI_t$	0.02***	0.07**	0.33***	0.21***	-1.37***	-0.02	-0.38***	0.06**	-0.87***	-0.31***
	(0.05)	(0.07)	(0.04)	(0.04)	(0.31)	(0.15)	(0.08)	(0.02)	(0.26)	(0.11)
KfW_t^{10Y}	-0.35***	-0.22***	-0.24***	-0.11**	-0.97***	-0.05	0.11	-0.05**	0.74***	-0.19*
	(0.07)	(0.05)	(0.03)	(0.04)	(0.37)	(0.12)	(0.07)	(0.02)	(0.19)	(0.1)
CON_t^{10Y}	0.19***	0.19***	-0.01	0.07***	-0.74***	-0.18***	0.16***	0.03***	0.43***	-0.03
	(0.02)	(0.03)	(0.01)	(0.01)	(0.26)	(0.05)	(0.02)	(0.01)	(0.11)	(0.03)
R^2 - adjusted	0.74	0.86	0.36	0.72	0.87	0.93	0.93	0.32	0.95	0.87
Observations	937	937	937	937	246	937	937	935	937	937

Table 7. Baseline specification with financial stress index. Each panel reports the estimated coefficient of multiple linear regressions per country, for 5 and 10 year maturity government bonds. The model is formulated as: $Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}(\mathcal{L}_{,i,t}{}^{BA}) + \beta_{3,i}CDS_{i,t} + \beta_{4,i}GFSI_t + KfW_t{}^i + CON_{i,t}$ Where $\mathcal{L}_{,i,t}{}^{BA}$ is the bid-ask spread; $CDS_{i,t}$ the country's i CDS-spread; $GFSI_t$ *BofA's* financial distress index; $KfW_t{}^i$ the KfW spread against the German Bund, and $CON_{i,t}$ the contagion index. Each panel's results are distinguished in two subperiods: (I) *1 Jan 2008 – 10 May 2010* and (II) *11 May 2010 – 31 Dec 2013*. The breakpoint is when the ECB Governing Council announcement on large scale purchases of sovereign bonds took place. The standard errors, which are presented within the parenthesis below their respective coefficients, are corrected for autocorrelation by incorporating the Newey-West (1985) error variance estimator. The lag selection, according to the majority of the AIC criterion per country, was set to seven. The asterisks indicate the statistical level of significance of the regression as: *** *p-value <=1.0%*, ** *p-value <=5.0%*, * *p-value <=10.0%*.

Lastly, yet importantly, there are several key findings to be noted. Firstly, the risk aversion factors exhibit a negative relationship with the yield spreads during the EMU Sovereign Debt Crisis. This effect is more prominent in the peripheral countries. This result indicates that for PIIGS, the yields maintain an upward trend regardless of the improvement of the global financial outlook. This finding is in alignment with Barrios et al. (2009) where he concludes the same for countries with high levels of public debt. Secondly, the bid-ask spread ($\mathcal{L}_{,i,t}{}^{BA}$) is preferred over the order book slope ($\mathcal{L}_{,i,t}{}^{LOS}$) as a liquidity premium variable, due to its considerably higher statistical significance (see Table 7 against Table A4). This suggests that transaction costs can explain more accurately the variation in the yield spreads (see Langedijk et al., 2018). Therefore, for the rest of my analysis, the bid-ask spread is considered as the sole independent variable for liquidity premium.

6.2. Control Variables

This subsection evaluates how the control variables (debt-to-GDP ratio, GDP growth rate, inflation index, and the MTS cumulative quoted volume) influence the results of the baseline specification. Moreover, it inquiries into GFSI's explanatory power against that of the VIX and the US Corporate bond spread.

Starting with the first set of panels in Table 8, we focus on the financial crisis subperiod. As it can be derived, the fiscal variables (mainly $\frac{Debt_{i,t}}{GDP_{i,t}}$ and $GDP_{i,t}^{gr}$,) have a prominent role in the yield spreads, especially for the peripheral countries. The impact on Ireland, Italy, Portugal, and Spain is estimated to be statistically significant (with *p-values* at least less than five percent). As for the core countries, the risk aversion and the 'flight-to-liquidity' factors seem to capture the higher variation based on their coefficients and their respective *p-values*. Moreover, it is interesting to notice how the incorporation of the macro-fundamentals negate the significance of the contagion index (compared to the values of Table 6), specifically for the 5-year maturity bonds. Finally, the cumulative quoted volume seems to augment negatively the liquidity premia and the $KfW_{i,t}$ factor as it was expected. In absolute terms, the significance of the liquidity premia seems marginal.

Moving on to the second set of panels, and the Sovereign Debt Crisis subperiod, the overall picture changes slightly. In particular, with the exemption of Finland and the Netherlands, GFSI preserves its positively statistical significance for the 5-year bonds. Besides, it outcomes similar results for the 10-year issues, with Austria being the only exemption.

Nevertheless, the $KfW_{i,t}$ factor has a strong positive relationship with the core countries' yield spreads. This evidence implies that in the period of fiscal instability, investors tilted their preference towards countries with more robust economies (see Codogno, 2003). On the other hand, the yields for the peripheral countries portray a strong relationship with credit and liquidity premium. CDS spreads result high explanatory power (*p-value <=1%)* across both maturities. Similarly, bid-ask spreads enter with the right sign (negative) and with large significant coefficients. More specifically, they score *p-values* of less than one percent (1%) for Italy, Portugal, and Spain for both maturities, and Ireland for the ten year maturity. In the case of Greece, the weight falls logically on the credit premium factors, captured by $CDS_{i,t}$ and $\frac{Debt_{i,t}}{GDP_{i,t}}$.

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Period: 2008-2010										
L_t^{BA}	0.29^{**}	-0.14	0.1	-0.06	0.4	-1.12^{**}	0.2	0.46^{**}	-0.63^{**}	0.14
	(0.12)	(0.28)	(0.1)	(0.16)	(0.37)	(0.52)	(0.13)	(0.19)	(0.31)	(0.16)
$CDS_{i,t}$	0.16^{***}	0.8^{***}	0.83^{***}	-0.14	1.45^{***}	0.25^{**}	0.07	-0.25	1.03^{***}	-0.21
	(0.06)	(0.26)	(0.21)	(0.35)	(0.14)	(0.12)	(0.12)	(0.44)	(0.22)	(0.18)
$GFSI_t$	0.14^{**}	0.14^{***}	0.05^{*}	0.06	-0.46^{***}	-0.76^{***}	0.19^{***}	0.23^{***}	-0.06	0.19^{***}
	(0.06)	(0.04)	(0.02)	(0.04)	(0.12)	(0.08)	(0.05)	(0.05)	(0.07)	(0.03)
KfW_t^{5Y}	0.02	0.53^{***}	0.43^{***}	0.53^{***}	1.31^{***}	1.89^{***}	0.63^{***}	0.23^{*}	0.18	0.12^{**}
	(0.12)	(0.15)	(0.06)	(0.07)	(0.27)	(0.25)	(0.06)	(0.12)	(0.19)	(0.06)
CON_t^{5Y}	0.08^{***}	0.13^{*}	-0.06	-0.02	0.04	0.57^{***}	0.27^{***}	0.57^{***}	-0.38	0.56^{***}
	(0.02)	(0.07)	(0.05)	(0.07)	(0.5)	(0.17)	(0.08)	(0.05)	(0.32)	(0.11)
$Debt_{i,t}/ GDP_{i,t}$	-0.1^{**}	-0.02	-0.01	-0.06^{*}	0.06^{***}	0.05^{***}	0.05^{***}	-0.02	0.04^{**}	0.02^{**}
	(0.04)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
$GDP_{i,t}^{gr}$	-0.14^{***}	-0.04^{***}	-0.08^{***}	-0.05^{***}	-0.03	-0.02	-0.04^{***}	-0.37^{***}	-0.04^{**}	-0.27^{***}
	(0.04)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0)	(0.05)	(0.04)	(0.02)
$HICP_t$	-0.06^{***}	0.03	-0.06^{***}	-0.1^{***}	0.03	-0.08^{**}	-0.05^{***}	-0.09^{***}	-0.19^{***}	-0.01
	(0.02)	(0.03)	(0.02)	(0.03)	(0.06)	(0.03)	(0.01)	(0.02)	(0.06)	(0.02)
L_t^{VOL}	-0.28	-2.12^{***}	-0.98^{***}	-0.02	-0.98	-3.64^{***}	-0.39	-0.41	0.39	-2.59^{***}
	(0.25)	(0.42)	(0.32)	(0.05)	(1.3)	(1.32)	(0.32)	(0.6)	(0.78)	(0.42)
R^2 - adjusted	0.63	0.79	0.82	0.87	0.97	0.87	0.94	0.81	0.76	0.89
Observations	151	603	603	591	603	603	603	603	603	603
II. Period: 2010-2013										
L_t^{BA}	-0.56^{***}	-0.44	0.71^{**}	-2.01^{***}	-0.41	-0.69	-2.8^{***}	-8.32^{***}	-1.24^{***}	-1.86^{***}
	(0.15)	(0.3)	(0.3)	(0.24)	(0.52)	(0.92)	(0.58)	(1.01)	(0.72)	(0.46)
$CDS_{i,t}$	0.11	0.96^{***}	-0.02	0.73^{***}	1.11^{***}	1.83^{***}	1.02^{***}	2.32^{***}	1.08^{***}	1.09^{***}
	(0.15)	(0.13)	(0.11)	(0.13)	(0.1)	(0.13)	(0.03)	(0.49)	(0.07)	(0.06)
$GFSI_t$	0.15^{***}	0.18^{**}	0.05	0.16^{***}	-1.94^{***}	-0.36^{***}	-0.4^{***}	0.2^{***}	-0.62^{**}	-0.29^{**}
	(0.05)	(0.07)	(0.04)	(0.05)	(0.48)	(0.37)	(0.08)	(0.19)	(0.27)	(0.11)
KfW_t^{5Y}	0.61^{***}	0.23^{***}	0.24^{***}	0.07	-0.83	-2.86^{***}	0.27^{*}	0.4^{***}	0.08	0.64^{***}
	(0.06)	(0.08)	(0.08)	(0.07)	(0.96)	(0.48)	(0.14)	(0.27)	(0.44)	(0.22)

(break 1)

(continue 1)

CON_t^{5Y}	0.04***	0.12***	0.08***	0.07***	0.29	-0.1	0.08***	0.13***	0.56***	-0.01
	(0.01)	(0.02)	(0.01)	(0.01)	(0.36)	(0.12)	(0.02)	(0.04)	(0.1)	(0.02)
$Debt_{i,t}/ GDP_{i,t}$	-0.02	-0.01	0.03***	0.02***	0.18***	0.05***	0.01***	-0.01	0.01**	0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.04)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
$GDP_{i,t}^{gr}$	-0.06	-0.04	-0.01	-0.05*	-0.07**	-0.21***	-0.1***	-0.13*	-0.11***	-0.15***
	(0.05)	(0.03)	(0.01)	(0.02)	(0.06)	(0.07)	(0.02)	(0.07)	(0.04)	(0.04)
$HICP_t$	0.08***	-0.01	0.04	0.03	0.61**	0.19***	-0.01	-0.19**	0.29***	-0.02
	(0.02)	(0.01)	(0.03)	(0.02)	(0.26)	(0.06)	(0.01)	(0.08)	(0.1)	(0.03)
L_t^{VOL}	-1.31***	3.25***	0.76*	-0.03	1.42***	2.78***	1.56***	5.82***	1.98	6.2***
	(0.32)	(0.46)	(0.45)	(0.04)	(4.46)	(4.64)	(0.45)	(1.26)	(2.99)	(0.85)
R^2 - adjusted	0.92	0.95	0.75	0.84	0.98	0.91	0.96	0.64	0.97	0.91
Observations	937	937	937	937	289	937	937	937	937	937
10 - Year maturity										
	Austria	**Belgium**	**Finland**	**France**	**Greece**	**Ireland**	**Italy**	**Netherlands**	**Portugal**	**Spain**
I. Period: 2008-2010										
L_t^{BA}	-0.65***	-0.37	-0.5**	-0.19	-1.36***	-0.52	-0.21	-0.31	-1.02***	-0.15
	(0.23)	(0.23)	(0.22)	(0.2)	(0.45)	(0.36)	(0.17)	(0.28)	(0.39)	(0.3)
$CDS_{i,t}$	0.38***	1.09***	-0.27	0.13	0.85***	0.9***	0.29***	0.47***	0.34*	-0.24
	(0.09)	(0.17)	(0.28)	(0.16)	(0.15)	(0.06)	(0.1)	(0.12)	(0.18)	(0.17)
$GFSI_t$	0.26***	0.13***	0.15***	0.13***	0.07	-0.15***	0.2***	0.03	-0.11**	0.04
	(0.03)	(0.02)	(0.03)	(0.02)	(0.07)	(0.05)	(0.03)	(0.02)	(0.05)	(0.03)
KfW_t^{10Y}	-0.13**	-0.28***	0.06	-0.06	0.2*	0.13	-0.13**	0.05	0.28***	0.09
	(0.06)	(0.07)	(0.05)	(0.04)	(0.11)	(0.11)	(0.06)	(0.06)	(0.09)	(0.06)
CON_t^{10Y}	0.08	-0.01	0.02	0.09**	0.55	0.06	0.11*	0.16***	0.78***	0.65***
	(0.05)	(0.04)	(0.07)	(0.04)	(0.53)	(0.22)	(0.06)	(0.03)	(0.24)	(0.09)
$Debt_{i,t}/ GDP_{i,t}$	-0.02	0.04***	0.01	0.01**	0.02**	0.01	0.04***	-0.01	-0.04***	0.01
	(0.01)	(0.01)	(0.01)	(0)	(0.01)	(0)	(0.01)	(0.01)	(0.01)	(0.01)
$GDP_{i,t}^{gr}$	-0.03***	-0.03**	-0.05**	-0.01	0.07***	-0.02	0.02***	0.13***	0.05***	0.06***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)	(0)	(0.02)	(0.01)	(0.01)
$HICP_t$	-0.09**	0.01	0.02	0.02	0.01	-0.07**	-0.02**	0.03**	-0.04	-0.12***
	(0.03)	(0.01)	(0.03)	(0.02)	(0.04)	(0.03)	(0.01)	(0.01)	(0.04)	(0.02)
L_t^{VOL}	1.54***	-0.32	0.55	1.61***	2.29***	-0.05	0.12	1.6***	0.73	0.23
	(0.23)	(0.28)	(0.38)	(0.19)	(0.48)	(1.09)	(0.32)	(0.47)	(0.44)	(0.39)
R^2 - adjusted	0.75	0.66	0.57	0.46	0.95	0.89	0.81	0.60	0.79	0.73
Observations	603	603	603	603	603	603	603	603	603	603
II. Period: 2010-2013										
L_t^{BA}	0.1	0.12	0.39*	-1.11***	0.54	-2.85***	-1.81***	-0.2**	-2.1***	-2.03***
	(0.20)	(0.28)	(0.23)	(0.35)	(0.4)	(0.53)	(0.5)	(0.09)	(0.79)	(0.55)
$CDS_{i,t}$	0.89***	0.76***	0.14	1.02***	0.66***	1.1***	1.19***	0.12*	0.88***	1.45***
	(0.12)	(0.14)	(0.09)	(0.12)	(0.1)	(0.05)	(0.03)	(0.06)	(0.08)	(0.05)
$GFSI_t$	0.04	0.05***	0.4***	0.21***	-0.72**	-0.06	-0.53***	0.07***	-0.38	-0.35***
	(0.05)	(0.07)	(0.04)	(0.04)	(0.28)	(0.16)	(0.07)	(0.02)	(0.27)	(0.12)
KfW_t^{10Y}	-0.36***	-0.25***	-0.2***	0.09**	-0.21	-0.27*	0.01	-0.06**	1.36***	-0.17*
	(0.07)	(0.05)	(0.04)	(0.04)	(0.31)	(0.15)	(0.07)	(0.02)	(0.24)	(0.09)
CON_t^{10Y}	0.16***	0.16***	-0.01	0.09***	0.44*	-0.06	0.12***	0.06***	0.74***	0.02
	(0.02)	(0.03)	(0.01)	(0.01)	(0.23)	(0.07)	(0.03)	(0.01)	(0.1)	(0.03)
$Debt_{i,t}/ GDP_{i,t}$	-0.03**	0.02**	0.01	0.03***	0.16***	-0.01	-0.02	0.02***	0.06***	0.01*
	(0.01)	(0.01)	(0)	(0)	(0.02)	(0.01)	(0.01)	(0)	(0.01)	(0.01)

(break 2)

(continue 2)

$GDP_{i,t}^{gr}$	-0.17***	0.12***	0.05***	0.09***	-0.19***	-0.07**	-0.1***	0.02**	0.06	-0.12***
	(0.04)	(0.02)	(0.01)	(0.02)	(0.03)	(0.03)	(0.02)	(0.01)	(0.04)	(0.04)
$HICP_t$	0.02	-0.04**	0.06**	0.02	0.23*	-0.02	0.01	0.06***	0.17*	0.04
	(0.03)	(0.01)	(0.02)	(0.02)	(0.13)	(0.03)	(0.01)	(0.01)	(0.09)	(0.04)
L_t^{VOL}	0.89	-0.97	0.92***	-2.26***	-1.83	-1.43***	-2.27***	-1.5***	-3.18	-5.09***
	(0.71)	(0.72)	(0.32)	(0.48)	(2.16)	(2.22)	(0.63)	(0.23)	(3.12)	(1.28)
R^2 - adjusted	0.77	0.88	0.46	0.78	0.94	0.94	0.95	0.50	0.96	0.88
Observations	937	937	937	937	246	937	937	935	937	937

Table 8. Baseline specification with control variables ($C_{i,t}$). Each panel reports the results of an OLS multiple linear regressions per country, for 5 and 10 year maturity government bonds. The model is formulated as: $Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}(\mathcal{L}_{,i,t}{}^{BA}) + \beta_{3,i}CDS_{i,t} + \beta_{4,i}GFSI_t + KfW_t{}^{i} + CON_{i,t} + C_{i,t}$. The control variables are: country's payback ability, estimated as the $\frac{Debt_{i,t}}{GDP_{i,t}}$ ratio; GDP growth $GDP_{i,t}^{gr}$; the inflation index $HICP_t$; and the MTS cumulative quoted volume, $L_t{}^{VOL}$. Each panel's results are distinguished in two subperiods: (I) 1 Jan 2008 – 10 May 2010 and (II) 11 May 2010 – 31 Dec 2013. The standard errors, which are presented within the parenthesis below their respective coefficients, are corrected for autocorrelation by incorporating the Newey-West (1985) error variance estimator. The lag selection, according to the majority of the AIC criterion per country, was set to seven. The asterisks indicate the statistical level of significance of the regression as: *** *p-value <=1.0%*, ** *p-value <=5.0%*, * *p-value <=10.0%.*

Furthermore, Table 9 sheds further light on my second hypothesis, offering an overview of GFSI's performance against the common in the literature global risk factors. The table reports the cross-sectional average of the adjusted R-squared ($\bar{R}^2$) per specification (with and without the control variables) for both maturities. Alongside this, the count of statistically significant coefficients (at least on a 5% level) for the global risk aversion variables is reported within parenthesis. The model specifications with $GFSI_t$ yield higher $\bar{R}^2$ compared to the VIX_t specifications for both maturities. In particular, for the 5-year bonds (left side) the GFSI models result statistics of 0.74 and 0.83, for the Great Recession subperiod, and 0.87 and 0.88 for the Sovereign Debt Crisis subperiod; both higher than the 0.72 of the VIX specifications' $\bar{R}^2$ statistics. Similar results are derived for the 10-year maturity bonds (right side). Moreover, GFSI's coefficients are indicated as statistically significant more times than VIX's coefficients for both specifications and subperiods. These empirical results suggest that GFSI can explain the variation of the EMU yield spreads better than the Volatility Index (VIX), supporting my second hypothesis.

	5- year maturity			10- year maturity		
	$GFSI_t$	***$US_{5,t}^{spr}$***	***VIX_t***	***$GFSI_t$***	***$US_{10,t}^{spr}$***	***VIX_t***
I. Period: 2008-2010						
Baseline model	0.74	0.75	0.72	0.66	0.68	0.65
	(7.00)	(6.00)	(5.00)	(8.00)	(9.00)	(6.00)
Control variables incuded	0.83	0.83	0.72	0.72	0.75	0.72
	(7.00)	(9.00)	(6.00)	(7.00)	(6.00)	(6.00)
II. Period: 2010-2013						
Baseline model	0.87	0.87	0.86	0.76	0.73	0.74
	(6.00)	(8.00)	(6.00)	(9.00)	(7.00)	(7.00)
Control variables incuded	0.88	0.88	0.81	0.81	0.78	0.79
	(9.00)	(6.00)	(5.00)	(7.00)	(7.00)	(6.00)

Table 9. Adjusted-R^2 overview per model. Each panel reports the cross-sectional averages of adjusted $\overline{R^2}$ per specification, along with the count of statistically significant coefficients (at least on a 5% level) per global risk aversion variable within parenthesis. The adjusted R-squares evaluate the goodness of fit of the baseline specification with and without the control variables (C'_t) , $Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}(\mathcal{L}_{,i,t}{}^{BA}) + \beta_{3,i}CDS_{i,t} + \beta_{4,i}I'_t + KfW_t{}^i + CON_{i,t} + C'_t$. The vector I'_t contains the international risk aversion variables: the global financial stress index released by BofA, $GFSI_t$, the volatility index released by CBOE, VIX_t , and finally the spread between the US Corporate (BBB credit rating) bonds and the US Treasury bills published by FDER, $US_{i,t}^{spr}$. The vector (C'_t) contains the four control variables: debt-to-GDP ratio, $\frac{Debt_{i,t}}{GDP_{i,t}}$, GDP growth, GDP_t^{gr}, the harmonized inflation index, $HICP_t$, and the cumulative quoted volume, $L_t{}^{VOL}$. The three former variables are released by Eurostat on a quarterly basis, while the latter one is estimated using the order book of the MTS platform.

Nevertheless, when compared to the US Corporate bond spreads, GFSI cannot be clearly defined as a better explanatory variable. For instance, in the Global financial crisis subperiod – Panel I – the specifications with the $US_{i,t}{}^{spr}$ factor score, almost in both specs, higher $\bar{R}^2$ statistics for both maturities. Besides, in the same subperiod, the coefficients of $US_{i,t}{}^{spr}$are indicated as statistically significant for more countries than the coefficients of $GFSI_t$. Given the rippling effect of the Great Recession in the global financial markets, the co-movement of the US spreads is reasonable. However, shifting to EMU Sovereign Debt Crisis – Panel II – this outcome is inverted. In particular, for the 10-year maturity bonds, GFSI contributes to a higher adjusted R-squares for both specifications. Therefore, GFSI's explanatory ability is more consistent across both periods of financial instability compared to that of the spread between US corporate bonds and Treasury bills.

Finally, the results pave the way for my third hypothesis, suggesting that countries with solid fundamentals are less exposed to contagion risk and that exogenous variables (e.g. global risk aversion, flight-to-liquidity) predominantly drive their yield spread divergence. In contrast, variables associated with the credit and liquidity premia (endogenous variables) can explain better the yield spread differentials of peripheral countries. Notwithstanding, the insight based on the cointegration tests (Chapter 5.3) reveals that there is a significant cointegration relationship among the OLS model specification variables. The implication is that the non-stationarity of the variables is likely to influence the validity of the estimated multiple OLS regression results. Therefore, the following section employs the dynamic OLS regression model to ascertain the robustness of those findings in the entire timespan of my sample.

6.3. DOLS results

This section concentrates on the results of the dynamic OLS regression model, which corrects the effect of the cointegration relationship. As it was derived from the previous section, fiscal variables have a distinct role per country, affecting the relationship of the external variables. Thus, in the first subsection, I deploy a comprehensive DOLS model against the yield spread indices (as estimated in Section 4.2.6) to establish my previous findings on the global risk aversion and the influence of the exogenous variables on a higher level. Subsequently, the second subsection focuses on country-level data and examines the third hypothesis of how yield spread determinants for core countries might differ from those of the peripheral countries. In that case, the DOLS specification is applied in the whole time span of my dataset, including the breakpoint on the 10^{th} of March, 2010, like a dummy variable (see equation 20).

6.3.1. Core vs Peripheral indices

According to the results of Table 10, the financial stress index maintains its statistical significance across both indices and bond maturities (5-year and 10-year). In the 5-year and the 10-year maturity DOLS regression model, the coefficient of $GFSI_t$ is consistently significant. In particular, its respective coefficients are significantly higher across the core countries compared to the peripheral countries in both the 5-year and the 10-year bond maturities. This outcome bolsters the previous conclusion about how GFSI strongly drives the yield spread widening in periods of financial turmoil.

	10-May-10	$GFSI_t$	$US_{5\text{-}10,t}^{spr}$	$KfW_t^{5\text{-}10Y}$	$CON_t^{5\text{-}10Y}$
I. 5-Year Maturity					
Core Index	-0.02***	0.55***		0.5***	0.11***
	(0.17)	(10.25)		(17.52)	(3.15)
	-0.03***		0.01	-0.05	0.1***
	(0.2)		(5.16)	(17.9)	(3.36)
Peripheral Index	-0.01	0.23***		0.06**	0.58***
	(0.16)	(7.39)		(12.71)	(4.73)
	-0.01***		-0.06	0.23	0.56***
	(0.16)		(3.51)	(14.2)	(4.97)
II. 10-Year Maturity					
Core Index	-0.02***	0.38***		0.28**	0.05
	(0.16)	(7.49)		(13.94)	(3.16)
	-0.02***		-0.03	-0.07	0.07**
	(0.18)		(3.6)	(13.66)	(3.37)
Peripheral Index	-0.01***	0.33***		1.67***	1.29***
	(0.17)	(7.00)		(11.85)	(5.57)
	-0.01***		0.12***	1.57***	1.3***
	(0.17)		(2.63)	(10.87)	(5.6)

Table 10. Dynamic OLS per aggregate yield index ($Y_t{}^i$). The table reports the estimated cointegrating vector's coefficients along with their respective robust standard errors from a dynamic ordinary least squares regression per yield index i = *Peripheral, Core*. The panels are divided into two based on the indices' maturity. The model specification is defined as: $Y_t{}^i = \beta_{i,0} + \beta_i I'_{i.t} + \delta_{i,j} \sum_{j=-q}^{r} \Delta I'_{i.t+j} + \gamma_{4,i} D'{}_t + u_{i,t}$. Where $I'_{i.t}$ is the vector of index coefficients: $GFSI_t$ *BofA's* financial distress index, capturing financial turmoil ; $KfW_t{}^i$ the KfW agency's spread against the German Bund, and $CON_{i,t}$ the contagion index, $D'{}_t$ is a dummy variable that indicates the breakpoint on the 10th of May, 2010,. $\Delta X'_{i.t+j}$ represents the vector of differentials of those variables. The selection of the q leads and r lags was set to six. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below their coefficient estimates. Sample period: 1 Jan. 2008 – 31 Dec. 2013. The total number of observations equals to 1526.

Furthermore, flight-to-liquidity factor KfW_t played substantial for both indices with a stronger influence on the 10-year spread core index. This outcome supports my first hypothesis, as investor's preference for countries with highly liquid bonds is reflected to the yield spreads differentials (Schwarz, 2018). Finally, the contagion risk coefficient, $CON_{i,t}$, is positive and highly significant for the 5-year securities. This outcome suggests that investors are highly aware of the spill-over risk in the short-term. Hence, they do penalize not only the countries with weaker fiscal fundamentals but also the robust ones who are prone to contagion risk. The opposite holds for the long-term bonds (10-year maturity), where – as concluded in Section 6.2 – countries with rigorous fundamentals are not vulnerable to contagion risk.

6.3.2. Country level

At first sight, Table 11 delivers that the DOLS specification is much more robust compared to the baseline specification. The estimated DOLS regression model results in better goodness of fit due to its higher adjusted R-squared, when assessed against the simple OLS regression model (see Table 7 and Table 8). In particular, for each of the ten countries in both bond maturities (5-year and 10-year bond) as well as the financial crisis period and the EMU sovereign debt period, the adjusted coefficient of determination (R^2) is significantly higher compared to the explanatory ability of the simple OLS regression.

Table 11 designates that the respective European countries' CDS prices, $CDS_{i,t}$, provide a much better estimate of the credit risk premium when assessed against the Standard and Poor's long term credit rating, $S\&P_{i,t}$. The coefficients and their respective *p-values* can derive this conclusion. The stated trend is evident in both the medium-term government bond (5-year bond maturity) and the long-term government bond (10-year maturity). Given the daily frequency of the sample, this finding is logical since credit ratings are not as much as responsive as CDS prices in the developments of the markets (the Greek credit rating exhibited only twelve revisions across the whole dataset's time span).

The overall outcome based on the dynamic OLS regression shows that there is a higher risk aversion in the long-run (10-year maturity) compared to the medium-term (5-year maturity) period. The coefficient of $GFSI_t$ is significantly higher for the 10-year maturity bond compared to the 5-year maturity bond for all sampled countries except for Greece and Ireland. The insinuation based on the DOLS results is that European investors develop a more significant risk aversion in the long-run compared to the medium-term period. Bernoth et al. (2004) contend that due to their higher risk aversion in the long-run, investors must be compensated with a higher risk premium to invest in long-term government bonds. The nature of the yield curve illustrates the investors' risk premium preference in the long-run period, where the interest rate differentials increase as the term maturity of the bond also increases.

The insight based on analysis of the dynamic OLS regression for the 5-year bond indicates that the country-specific variables ($CDS_{i,t}$, $S\&P_{i,t}$, and $\frac{Debt_{i,t}}{GDP_{i,t}}$) have a more imposing effect on the yield spread across the peripheral countries compared to the core countries. For instance, in all the peripheral countries, the coefficient of CDS_t is either equal to or greater than one compared to the corresponding coefficients across the core countries for the 5-year maturity bond. The coefficients of $S\&P_{i,t}$, as well as the debt-to-GDP in the 5-year maturity bonds, are substantially higher across the peripheral countries when assessed against the stated coefficients in the core countries. At last, with Ireland being the only exemption, peripheral countries' debt-to-GDP coefficients are statistically significant for the 5-year maturity. As about the 10-year maturity bonds, only the peripheral countries return significant coefficients for the $\frac{Debt_{i,t}}{GDP_{i,t}}$ variable. These pieces of evidence support my previous findings on the third hypothesis, as the solvency risk is more profound for countries with weak fundamentals; thus, it is reflected in their yield spread wideness.

	Austria	**Belgium**	**France**	**Greece**	**Ireland**	**Italy**	**Portugal**	**Spain**
I. 5 - Year maturity								
10-May-10	-0.01***	0.01***	-0.01***	-0.02***	0.01	0.01**	-0.02***	0.01***
	(0.02)	(0.05)	(0.05)	(0.59)	(0.34)	(0.08)	(0.22)	(0.08)
$CDS_{i,t}$	0.34**	0.76***	0.34**	1.01***	1.67***	1.01***	0.98***	1.25***
	(7.63)	(11.98)	(15.65)	(13.83)	(15.2)	(4.55)	(7.11)	(5.49)
$S\&P_t$	0.01***	0.01***	0.01***	0.01	0.01	0.01***	0.01***	0.01***
	(0.03)	(0.06)	(0.03)	(0.19)	(0.14)	(0.04)	(0.11)	(0.04)
$GFSI_t$	0.23***	0.26***	0.22***	0.61***	-0.24*	0.07	-0.01	0.03
	(4.49)	(3.55)	(3.23)	(20.16)	(14.06)	(4.24)	(7.37)	(3.46)
KfW_t^{5Y}	0.58***	0.35***	0.22***	-1.14***	-0.73**	0.28***	-0.35***	0.12*
	(6.49)	(7.14)	(5.43)	(40.18)	(29.76)	(9.11)	(12.61)	(7.21)
CON_t^{5Y}	0.03***	0.13***	0.06***	1.69***	-0.35***	0.03	0.78***	0.04
	(0.91)	(2.32)	(1.6)	(44.26)	(7.83)	(2.99)	(9.82)	(2.16)
$Debt_{i,t}/GDP_{i,t}$	-0.01	-0.01	-0.04***	-0.04*	-0.02	-0.04***	-0.03**	-0.02*
	(0.41)	(0.58)	(0.4)	(1.77)	(1.23)	(0.84)	(1.31)	(0.72)
R^2 - adjusted (%)	0.93	0.95	0.80	0.99	0.92	0.97	0.99	0.97
Observations	1075	1527	1515	879	1527	1527	1527	1527
II. 10 - Year maturity								
10-May-10	-0.01***	-0.01***	-0.01***	0.01	0.01***	0.01	-0.02***	-0.01
	(0.05)	(0.03)	(0.03)	(0.32)	(0.14)	(0.08)	(0.22)	(0.08)
$CDS_{i,t}$	0.39**	0.8***	0.68*	0.83***	1.12***	1.16***	0.9***	1.26***
	(7.68)	(10.22)	(12.96)	(13.21)	(5.71)	(4.51)	(8.92)	(7.56)
$S\&P_t$	0.01***	0.01***	0.01***	0.01*	0.01***	0.01*	0.01***	0.01***
	(0.03)	(0.04)	(0.03)	(0.13)	(0.06)	(0.03)	(0.1)	(0.04)
$GFSI_t$	0.29***	0.18***	0.09***	-0.3***	-0.16***	0.09**	-0.15**	-0.12***
	(3.05)	(2.24)	(2.09)	(7.49)	(5.24)	(3.95)	(6.09)	(3.68)
KfW_t^{10Y}	-0.2***	-0.14***	-0.08**	-0.58***	0.28***	-0.08	0.05	-0.09
	(5.46)	(4.55)	(3.15)	(18.64)	(10.6)	(5.91)	(12.6)	(6.03)
CON_t^{10Y}	0.18***	0.12***	0.1***	0.23	-0.13***	0.12***	0.72***	0.06*
	(1.24)	(2.46)	(1.24)	(27.81)	(4.49)	(2.99)	(13.47)	(2.86)
$Debt_{i,t}/GDP_{i,t}$	-0.03*	0.01	-0.01	0.03***	0.03***	0.03***	0.05***	0.04***
	(0.54)	(0.56)	(0.32)	(1.12)	(0.42)	(0.76)	(1.3)	(0.81)
R^2 - adjusted	0.83	0.94	0.84	0.99	0.97	0.97	0.98	0.96
Observations	1527	1527	1527	836	1527	1527	1527	1527

Table 11. Dynamic OLS with robust errors. The table reports the estimated cointegrating vector's coefficients along with their respective robust standard errors from a dynamic ordinary least squares regression of country *i* across the whole sample. The model specification is defined as: $Y_{i,t} - Y_{GER,t} = \beta_{i,0} + \beta_i X'_{i.t} + \delta_{i,j} \sum_{j=-q}^{r} \Delta X'_{i.t+j} + \gamma_{4,i} D'_t + S\&P_t + \frac{Debt_{i,t}}{GDP_{i,t}} + u_{i,t}$. Where $S\&P_t$ is the long term credit rating by S&P, $\frac{Debt_{i,t}}{GDP_{i,t}}$ is the Debt-to-GDP ratio, D'_t is a dummy variable that indicates the breakpoint on the 10th of May, 2010, and $X'_{i.t}$ is the vector of coefficients: CDS_t, CDS spread differentials, *BofA's* financial distress index; $KfW_t^{\,i}$ the KfW agency's yield against the German Bund, and $CON_{i,t}$ the contagion index. $\Delta X'_{i.t+j}$ represents the vector of differentials of those variables. The selection of the *q* leads and *r* lags was set to six. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below their coefficient estimates. Sample period: 1 Jan. 2008 – 31 Dec. 2013.

In conclusion, the results are consistent with the postulation of my third hypothesis, which states that the yield spreads in core countries are mainly influenced by exogenous variables such as risk aversion flight-to-liquidity, and contagion risk. In contrast, the yield spreads in peripheral countries are influenced by the county-specific variables such as the credit risk rating and macro-fundamentals. The findings are in accordance with the results of De Santis (2012), who noted that the respective firms' credit rating mainly influences the peripheral yield spread during the financial crisis while the yield spread across the core countries is determined by the demand fluctuation of the German bond during the period of financial turmoil.

7. Conclusion

The impact of the Great recession of 2008 rippled in the euro area economies, and its effect brought under debate the significance of safe assets and liquidity in the sovereign spreads. Subsequently, the EMU Sovereign Debt Crisis raised the attention to sovereign solvency risk in countries with weak fiscal fundamentals and the risk of contagion among euro area countries' sovereign spreads. The motivation of the research is informed by the need for an empirical answer to the question: "*What are the underlying drivers of the euro area yield spread differentials in periods of financial turmoil?*" In my research to answer this question, I shed light on the hypothesis, as reformulated below.

Hypothesis 1

Global international risk-aversion, alongside the flight-to-liquidity effect, constitute the main key drivers of yield differentials, especially during the EMU Sovereign Debt Crisis.

For the investigation of this statement, I first employ a baseline specification (OLS), also including fiscal fundamental figures as control variables. Complementary, I run a cointegrating model (DOLS) to control for the autocorrelation of the non-stationary variables. For this particular case, two yield spread indices are used, namely Core Index and Peripheral Index. The rationale behind this step is the mitigation of the country-specific characteristics. Throughout my analysis, I derive the following two key findings:

- The results of the OLS specification indicate that during the Great Recession subperiod, international risk aversion measures show a significant relationship with the majority of the yield spreads of both maturities. For the exemptions of Greece, Portugal, and France, liquidity premia and contagion risk have a more prominent effect in the variations of their yield spreads. Additionally, the inclusion of the macro-fundamental variables augments the explanatory power of global risk factors. Lastly, the results of the cointegrated model (DOLS), applied in the whole timespan of the dataset, bolsters the previous findings on the statistical significance of the international risk aversion measures.
- The spread between the KfW agency and the German Bund (K-spread) enters with a negative sign for the core countries' yield spreads, while the opposite stands for the peripheral ones. This outcome implies that when the K-spread widens, investors seek lower liquidity premia to countries with solid fundamentals (flight-to-liquidity). On that respect, the spread between core countries and Germany converges, while the opposite happens for the peripheral countries' spreads. Moreover, the K-spread factor accompanies the significance the international risk aversion factors, particularly for the yield spreads of the core countries in both turmoil subperiods.

Conclusively, under periods of financial instability, investors penalize countries' weak macro-fundamentals and prioritize the low liquidity premium, or else the better "quality". Thereupon, this action is translated into global risk aversion, which is adequately reflected in the cross-section of the EMU yield spreads. With that being said, these two key findings lead to the acceptance of my first hypothesis.

Hypothesis 2

Global financial stress index (GFSI) captures international risk aversion more consistently than the common in the literature measurements.

To evaluate the validity of this hypothesis, I initially collect the adjusted R-squared from the OLS specifications, with and without the control variables, with the three global risk factors. Subsequently, I calculate the cross-sectional average of the adjusted R-squared and count the statistically significant coefficients (at least on a 5% level) per global risk aversion variable. Thereupon, the following empirical findings suggest that:

- GFSI has greater explanatory power than the Volatility Index (VIX) concerning the euro area yield differentials. In particular, the specifications with GFSI return higher adjusted R-squares across both maturities and subperiods. Besides, GFSI's coefficients are indicated as statistically significant thirty times (30) for the OLS specification, including the control variables, while VIX's coefficients are indicated only twenty-three (23) times. Finally, regardless of their high positive correlation, VIX fails to satisfy the non-stationarity attribute, which characterizes yield spreads during periods of financial turmoil.
- Although the US Corporate bonds factor yields better estimates during the Great Recession subperiod, the GFSI specification yields higher adjusted R-squares for the Sovereign Debt Crisis. Besides, when assessed on an aggregate level, with the DOLS specification, GFSI outperforms the US Corporate bond factor, as the latter fails to explain the variations of the Core yield spread index.

Consequently, GFSI's composition seems to adequately capture market indicators of financial distress that are associated with the euro area yield spread widening. These shreds of evidence corroborate the second hypothesis, as GFSI not only qualifies as a sufficient measure of global risk aversion but also performs in tune with the yield spread differentials under both turbulent periods.

Hypothesis 3

Yield spread developments in core countries are primarily driven by exogenous variables, whereas in peripheral countries are led by country-specific variables.

In the first leg of my analysis, the inclusion of the control variables reveals a significant role of the fiscal fundamentals in the yield spreads of the peripheral countries. Nonetheless, the cointegrated tests unraveled a cointegrating relationship among the OLS specification variables. Hence, I appraise those outcomes by further employing a DOLS specification on a country level, excluding Finland and the Netherlands, for the whole timespan of my dataset. The quantitative results reveal that:

- The debt-to-GDP ratio and the GDP growth have a significant positive and negative relationship, respectively, to the peripheral countries. Specifically, debt-to-GDP coefficients are estimated as statistically significant for Greece, Ireland, Portugal, and Spain (with *p-values* at least less than five percent) for both maturities and subperiods. In particular, during the Sovereign Debt Crisis, the explanatory power of these variables rises along with the CDS premia. Regarding core countries, GFSI is highlighted as statistically significant during the Great Recession, with France as the only exemption for the 5-year maturity bonds and the Netherlands for the 10-year maturity bonds. At last, although the K-spread and the Contagion index do not stand out as highly explanatory variables for the core countries, their significance rises substantially during the EMU Sovereign Debt Crisis subperiod. Particularly, for both maturities, the coefficients of GFSI, K-spread, and contagion index have *p-values* of less than five percent.
- Regarding the dynamic OLS regression, the results point in the same direction. For both maturities, CDS spreads remain positively significant for all eight of the countries, yet with substantially higher coefficients for PIIGS. The debt-to-GDP ratio is indicated as significant for Greece, Italy, and Portugal for the 5-year maturity bonds, while its

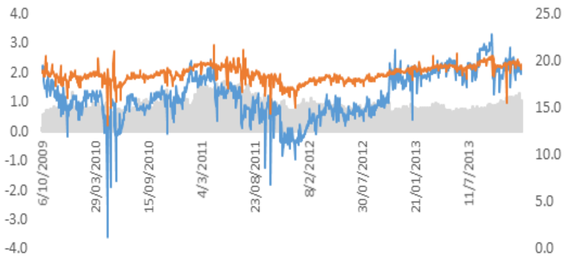
significance raises substantially for the 10-year maturity issues. To be more precise, the debt-to-GDP's coefficients reveal a positive relationship with a *p-value* of less than one percent. Besides, although the S&P credit rating maintains is high explanatory power for Italy, Portugal, and Spain, CDS spreads capture the variations of the yield spreads more efficiently. In contrast, for the core countries, the debt-to-GDP ratio returns insignificant results, while the CDS spreads, except for Belgium, yield less significant coefficients compared to the exogenous variables.

These findings suggest that countries with strong fundamentals display tolerance to credit risk (lower CDS coefficients and insignificant S&P credit rating) during both periods of crises. To that extent, external factors such as investor's risk aversion channeled to the 'flight-to-quality' phenomenon, and spill-over effects primarily accounted for their yield spread developments. In contrast, the impact on the peripheral countries' fiscal fundamentals is profound. This had a detrimental effect on their solvency risk and is reflected in the CDS spreads, credit ratings, and debt-to-GDP ratios. Hence, this outcome is consistent with the postulation of my third hypothesis.

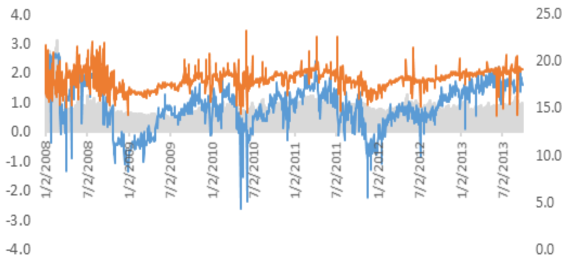
The empirical findings have considerable relevance to financial policymakers' appropriate response to safeguard financial stability in the euro area. Based on my study, priority should be given to solvency and contagion risk to countries with fragile fundamentals, while regulating the investment preference for euro area countries with rigid fundamentals properly. The key limitation of this study is that the euro yield spread differentials were assessed using a restricted set of market indicators. Future studies should ascertain how fluctuations in the stock market; commodity prices might influence the core and peripheral yield spread widening. It would be interesting to also examine the explanatory ability of the Euro-area interbank spreads to the yield spread differentials in periods of high uncertainty.

Appendix

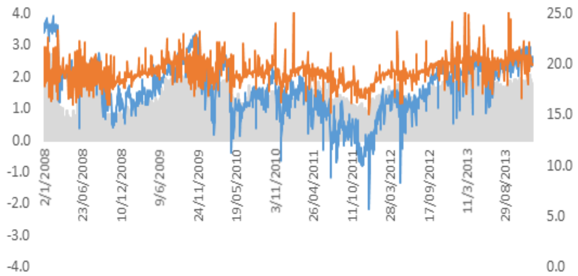
Austria-5y



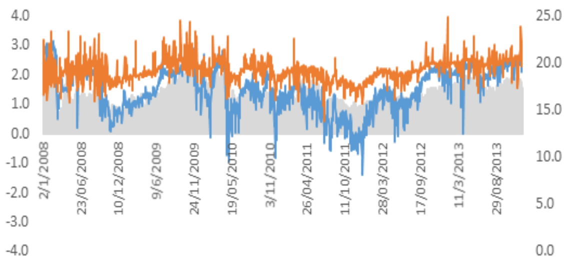
Ausria-10y



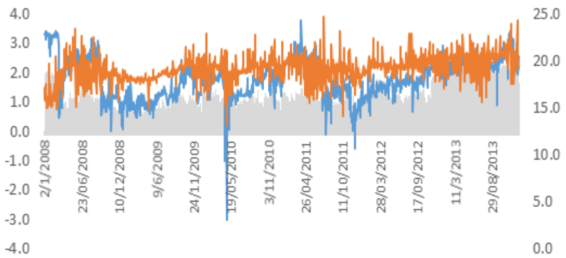
Belgium-5y



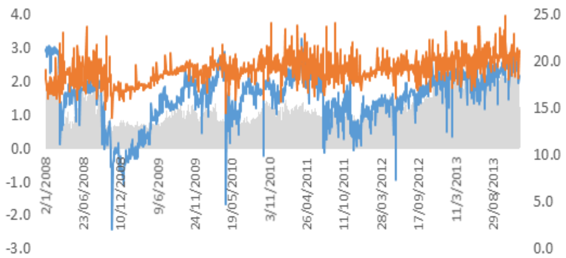
Belgium-10y



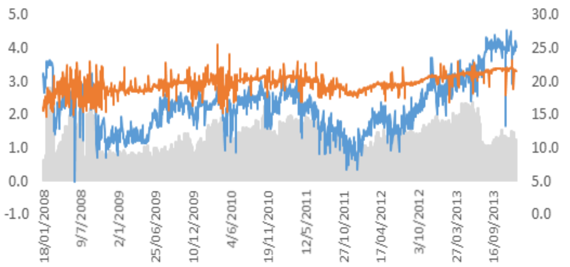
Finland-5y



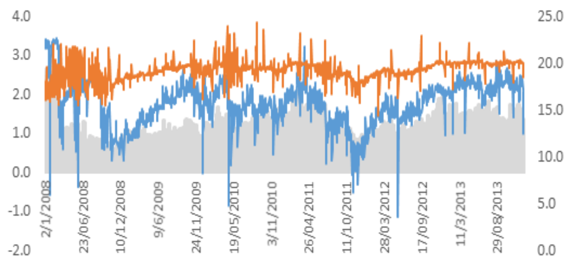
Finland-10y



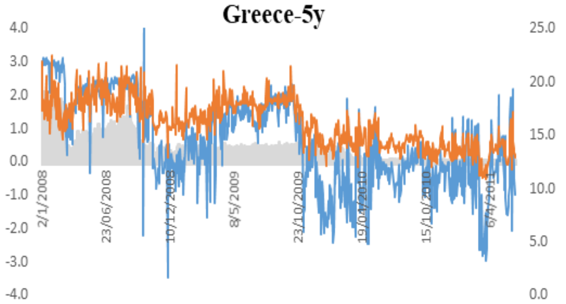
France-5y



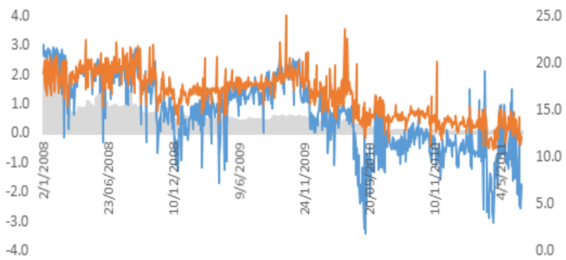
France-10y



Greece-5y



Greece-10y



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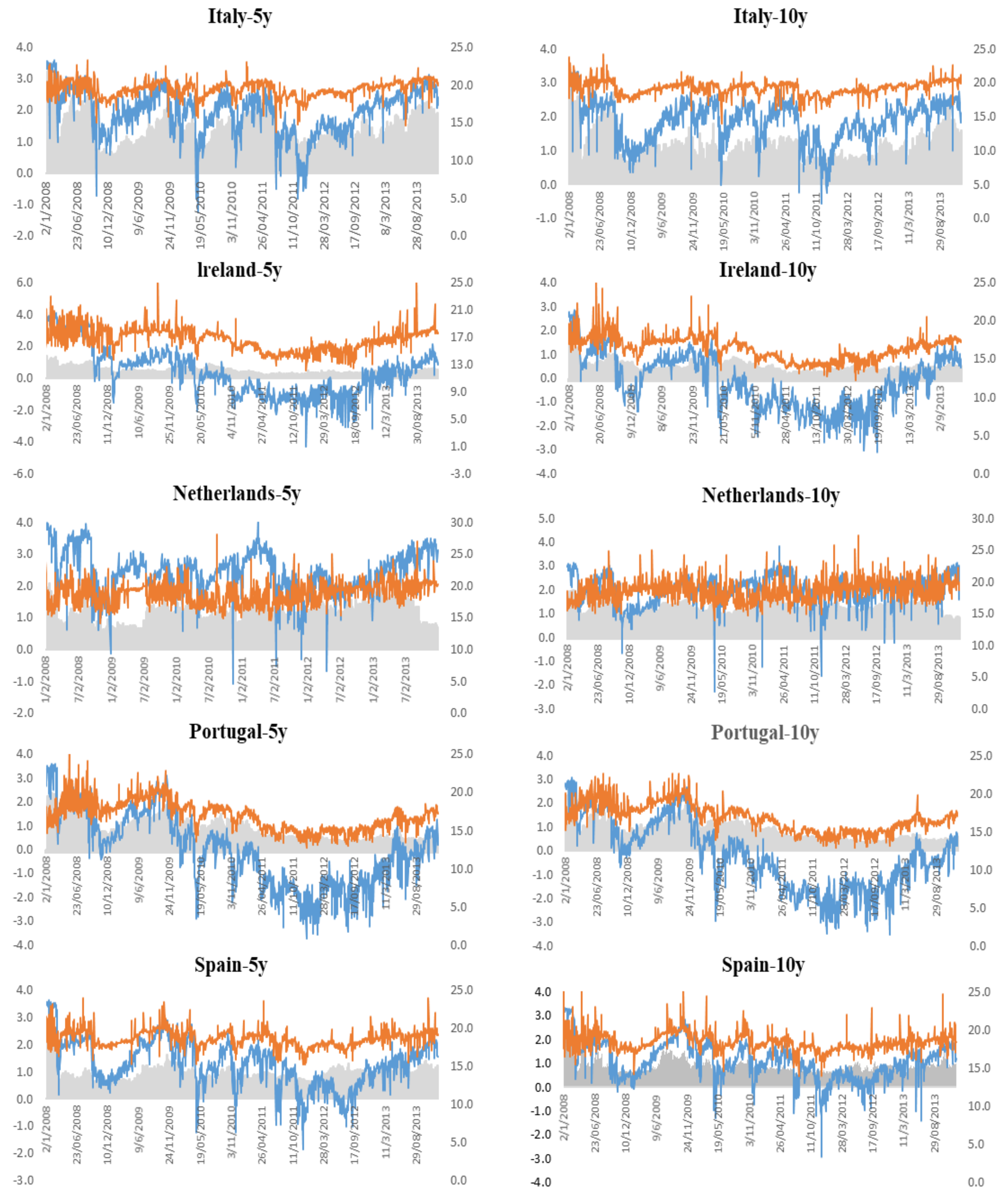

Figure A1. MTS daily liquidity measures. Bid-ask (blue line) represents the tightness denoting the difference of the highest asking-price and the lowest offering-price at which a seller is willing to sell it, $P_{1,\tau,b}$ - $P_{1,\tau,a}$. Order book slope (orange line) describes the breadth of the market, expressing the rate of change of price increases from the midpoint over their respective quoted volume, $\frac{1}{3}\sum_{i=1}^{3}\frac{(p_{i,\tau,a}-P_{t,\tau,mid})}{V_{t,\tau,a}} + \frac{1}{3}\sum_{i=1}^{3}\frac{(P_{t,\tau,mid}-p_{i,\tau,b})}{V_{t,\tau,b}}$. Cumulative volume (grey bars) defines the depth as it expresses the quantity to be traded against a unit price, $V_{t,\tau,b} + V_{t,\tau,a}$.

S&P Rating	Value
AAA	1
AA+	2
AA	3
AA-	4
A+	5
A	6
A-	7
BBB+	8
BBB	9
BBB-	10
BB+	11
BB	12
BB-	13
B+	14
B	15
B-	16
CCC+	17
CCC	18
CCC-	19
CC	20
C	21
SD	22
Credit outlook	
Positive	+0.33 or +0.66
Negative	-0.33 or -0.66
On Watch	
Positive	+0.5
Negative	-0.5

Table A1. S&P credit rating discretization table. Positive/negative credit rating revisions increase/decrease by an increment of one. Credit Watch is an indicator of a possible rating change within 90 days. Credit outlook incorporates trends or risks that have implications for credit quality on a long-term basis. Due to these properties, the size of a Credit Watch change is larger than that of a Credit outlook change, as, given the short period of the sample, I control for short-term impact on the S&P rating.

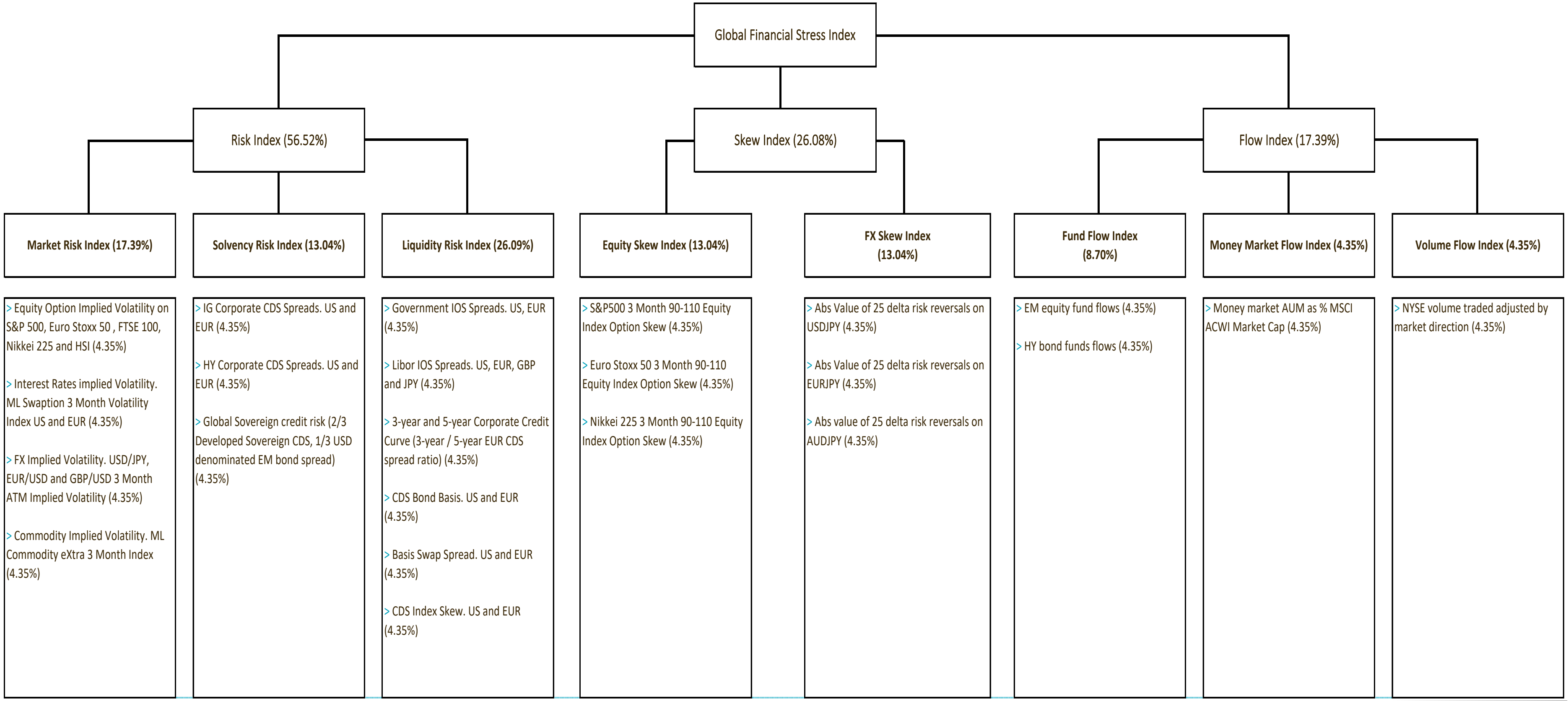

Figure A2. The Global Financial Stress indicator is calculated by the bank of America Merrill Lynch, as a cross-market measure of risk, hedging demand and investor flows in the global financial system. Levels greater or less than 0 indicate more or less financial market stress than normal. Apart from the headline GFSI, there are three sub-indicators, risk (an indicator of solvency and liquidity risk in the financial system), Flow (an indicator of investor sentiment for equities, bonds, and money markets), and Skew (an indicator of relative demand of protection against large market movements).

Source: Bank of America Merrill Lynch, Bloomberg.

US Corporate Spreads		
Panel 1: 5 - Year maturity		
I. Kao tests	**Statistic**	**P-Value**
Modified Dickey-Fuller t	-21.10	0.00%
Dickey-Fuller t	-8.72	0.00%
Augmented Dickey-Fuller t	-7.81	0.00%
Unadjusted modified Dickey-Fuller t	-24.99	0.00%
Unadjusted Dickey-Fuller t	-9.03	0.00%
II. Westerlund tests		
Variance ratio	-2.93	0.17%
Panel 2: 10 - Year maturity		
I. Kao tests	**Statistic**	**P-Value**
Modified Dickey-Fuller t	-66.88	0.00%
Dickey-Fuller t	-17.49	0.00%
Augmented Dickey-Fuller t	-15.11	0.00%
Unadjusted modified Dickey-Fuller t	-72.50	0.00%
Unadjusted Dickey-Fuller t	-17.54	0.00%
II. Westerlund tests		
Variance ratio	-2.64	0.42%

VIX		
Panel 1: 5 - Year maturity		
I. Kao tests	**Statistic**	**P-Value**
Modified Dickey-Fuller t	-21.71	0.00%
Dickey-Fuller t	-8.88	0.00%
Augmented Dickey-Fuller t	-7.90	0.00%
Unadjusted modified Dickey-Fuller t	-25.61	0.00%
Unadjusted Dickey-Fuller t	-9.18	0.00%
II. Westerlund tests		
Variance ratio	2.51	0.60%
Panel 2: 10 - Year maturity		
I. Kao tests	**Statistic**	**P-Value**
Modified Dickey-Fuller t	-67.14	0.00%
Dickey-Fuller t	-17.53	0.00%
Augmented Dickey-Fuller t	-15.07	0.00%
Unadjusted modified Dickey-Fuller t	-72.77	0.00%
Unadjusted Dickey-Fuller t	-17.58	0.00%
II. Westerlund tests		
Variance ratio	-2.31	1.04%

Table A2. Panel cointegration test results with US-corporate spreads (left) and VIX (right). The two panels are distinguished per maturity. Section (I) contains the set of t-statistics reported by Kao (1993), whereas Section (II) holds the Variance ratio as introduced by Westerlund (2005). Both statistical tests are based on firstly running the panel-regression model of the form $y_{i,t} = \beta_i x'_{i,t} + z'_{i,t}\gamma_i + e_{i,t}$ and collecting the estimated residuals $\hat{e}_{i,t}$. Henceforth, the Dickey-Fuller statistics are gauged by running an autoregressive model on those residuals. Henceforth, the Dickey-Fuller statistics are gauged by running an autoregressive model on those residuals. Following the Bartlett kernel with Newey and West (1994) automatic selection algorithm, the lag length is set to 7. The variance ratio is directly computed using the regression error terms. All the statistics converge to an asymptotic distribution *N*(0,1).

Panel 1: 5 - Year maturity

	$Y_{i,t}$	$CDS_{i,t}$	$L_{i,t}^{BA}$	$L_{i,t}^{VOL}$	$S\&P_t$	$Debt_{i,t}/GDP_{i,t}$
Austria	52.9%	32.9%	0.0%	0.0%	58.2%	45.3%
Belgium	83.2%	75.2%	0.0%	0.0%	52.3%	48.8%
Finland	23.8%	11.3%	0.0%	0.0%	64.6%	21.1%
France	51.7%	43.0%	0.0%	0.0%	63.4%	66.0%
Greece	99.6%	100.0%	0.0%	0.0%	63.1%	95.2%
Ireland	69.3%	90.4%	0.0%	0.0%	98.4%	74.1%
Italy	88.1%	76.2%	0.0%	0.0%	66.6%	77.3%
Netherlands	71.0%	0.0%	0.0%	0.0%	96.4%	53.3%
Portugal	94.7%	88.2%	0.0%	0.0%	47.2%	20.4%
Spain	71.0%	65.0%	0.0%	0.0%	53.5%	74.7%

Panel 2: 10-- Year maturity

	$Y_{i,t}$	$CDS_{i,t}$	$L_{i,t}^{BA}$	$L_{i,t}^{VOL}$
Austria	19.88%	8.18%	0.00%	0.00%
Belgium	58.48%	57.74%	0.00%	0.00%
Finland	0.11%	9.41%	0.00%	0.00%
France	15.23%	14.32%	0.00%	0.00%
Greece	77.71%	70.22%	0.00%	0.00%
Ireland	95.77%	72.69%	0.00%	0.00%
Italy	78.10%	31.20%	0.00%	0.00%
Netherlands	0.00%	0.00%	0.00%	0.00%
Portugal	94.39%	68.85%	0.00%	0.00%
Spain	73.93%	33.15%	0.00%	0.00%

Panel 3: Risk factors

	5-Year	10-Year
$GFSI_t$	34.09%	
VIX_t	0.75%	
$US_{j,t}^{spr}$	70.28%	80.75%
KfW_t	68%	8%
$Contagion_t$	90%	78%

Table A3. MacKinnon's approximate *p-value*. The table is divided into three panels; first two per maturity points and the third one for the common risk factors. The tested variables per maturity are: Yield spreads, $Y_{i,t}$, CDS-spreads, $CDS_{i,t}$, bid-ask spread differentials, $L_{i,t}^{BA}$, quoted volume differentials, $L_{i,t}^{VOL}$, S&P credit rating, $S\&P_t$, the debt-to-GDP as $\frac{Debt_{i,t}}{GDP_{i,t}}$. The risk factors are global financial stress index, $GFSI_t$, log of volatility index, VIX_t , the spread between the US corporate bonds and the T-bills, $US_{i,t}^{spr}$, and the spread between KfW and the German Bund, KfW_t. The *p-values* are approximate on the basis of a regression surface. The result is the cumulative probability of the finite sample distribution of the Philips-Perron unit root statistic *Z(t)*. The higher the probability (green) the higher the significance of the test statistic into the rejection of the null hypothesis. The lower limit of significance is equals to *5%*.

Order book slope

5 - Year maturity										
	Austria	**Belgium**	**Finland**	**France**	**Greece**	**Ireland**	**Italy**	**Netherlands**	**Portugal**	**Spain**
I. Period: 2008-2010										
L_t^{LOS}	0.03	-0.29***	0.08**	-0.1*	0.39**	-0.19	-0.07	-0.23***	-0.05	-0.3***
	(0.02)	(0.08)	(0.04)	(0.05)	(0.17)	(0.13)	(0.05)	(0.07)	(0.12)	(0.08)
$CDS_{i,t}$	0.24***	1.1***	1.14***	0.27	1.3***	0.57***	0.21	0.35	1.07***	-0.15
	(0.06)	(0.26)	(0.22)	(0.54)	(0.14)	(0.17)	(0.16)	(0.41)	(0.2)	(0.37)
$GFSI_t$	0.15**	0.21***	0.01	0.3***	0.03	-0.36***	0.29***	0.08**	-0.11	0.1***
	(0.06)	(0.03)	(0.02)	(0.05)	(0.08)	(0.1)	(0.05)	(0.04)	(0.06)	(0.03)
KfW_t^{5Y}	-0.13	0.32***	0.55***	0.19*	0.65***	0.89***	0.43***	-0.02	0.21	-0.06
	(0.15)	(0.09)	(0.06)	(0.1)	(0.21)	(0.31)	(0.07)	(0.09)	(0.22)	(0.1)
CON_t^{5Y}	0.07***	0.1	-0.13***	-0.25**	0.11	-0.03	0.06	0.74***	-0.02	0.8***
	(0.02)	(0.09)	(0.04)	(0.1)	(0.57)	(0.21)	(0.11)	(0.06)	(0.33)	(0.23)
R^2 - adjusted	0.52	0.75	0.75	0.70	0.96	0.77	0.85	0.68	0.71	0.68
Observations	151	603	603	591	603	603	603	603	603	603
II. Period: 2010-2013										
L_t^{LOS}	-0.25***	0.06	0.17***	-0.34***	-0.98*	-0.66	-0.13	0.99***	-0.78*	0.05
	(0.06)	(0.09)	(0.05)	(0.06)	(0.54)	(0.66)	(0.17)	(0.23)	(0.43)	(0.16)
$CDS_{i,t}$	0.1	0.88***	-0.39***	0.91***	1.32***	1.8***	1.06***	3.35***	1.12***	1.36***
	(0.08)	(0.13)	(0.1)	(0.12)	(0.15)	(0.13)	(0.03)	(0.66)	(0.06)	(0.04)
$GFSI_t$	0.13**	0.17***	0.17***	0.13**	-2.01***	-0.44	-0.48***	-0.75***	-0.64***	-0.35**
	(0.05)	(0.06)	(0.05)	(0.06)	(0.68)	(0.37)	(0.11)	(0.24)	(0.25)	(0.14)
KfW_t^{5Y}	0.68***	0.06	0.29***	0.09	-2.19*	-1.65***	0.4***	0.7***	0.11	0.1
	(0.05)	(0.09)	(0.05)	(0.07)	(1.14)	(0.41)	(0.11)	(0.25)	(0.26)	(0.13)
CON_t^{5Y}	0.04***	0.16***	0.1***	0.07***	0.4	-0.38***	0.09***	0.17***	0.6***	0.02
	(0.01)	(0.02)	(0.01)	(0.01)	(0.58)	(0.08)	(0.03)	(0.05)	(0.1)	(0.03)
R^2	0.91	0.94	0.70	0.77	0.96	0.88	0.95	0.41	0.97	0.88
Observations	937	937	937	937	289	937	937	937	937	937

10 - Year maturity										
	Austria	**Belgium**	**Finland**	**France**	**Greece**	**Ireland**	**Italy**	**Netherlands**	**Portugal**	**Spain**
I. Period: 2008-2010										
L_t^{LOS}	0.03	0.05	-0.13**	0.02	-0.06	-0.07	-0.04	0.05	-0.07	-0.07
	(0.05)	(0.04)	(0.05)	(0.05)	(0.14)	(0.07)	(0.05)	(0.04)	(0.1)	(0.06)
$CDS_{i,t}$	0.47***	1.24***	-0.53**	-0.19	0.54***	0.88***	0.23*	0.64***	0.23	-0.22
	(0.09)	(0.16)	(0.26)	(0.15)	(0.1)	(0.06)	(0.13)	(0.15)	(0.15)	(0.2)
$GFSI_t$	0.3***	0.13***	0.2***	0.09***	-0.09	-0.17***	0.14***	0.07**	0.07	0.08**
	(0.03)	(0.02)	(0.03)	(0.01)	(0.07)	(0.05)	(0.04)	(0.03)	(0.05)	(0.03)
KfW_t^{10Y}	-0.19***	-0.14***	-0.04	-0.02	0.18	0.2*	0.09*	-0.04	0.09	0.1
	(0.07)	(0.05)	(0.05)	(0.05)	(0.14)	(0.1)	(0.05)	(0.05)	(0.1)	(0.06)
CON_t^{10Y}	-0.03	0.02	-0.04	0.13***	1.47***	0.1	0.18**	0.05	0.65***	0.53***
	(0.05)	(0.04)	(0.05)	(0.04)	(0.36)	(0.15)	(0.08)	(0.03)	(0.19)	(0.13)
R^2 - adjusted	0.66	0.62	0.54	0.26	0.93	0.88	0.69	0.43	0.70	0.64
Observations	603	603	603	603	603	603	603	603	603	603

(break)

(continue)

II. Period: 2010-2013										
L_t^{LOS}	-0.01	-0.01	0.15***	-0.24***	-0.28	-1.57***	-0.58***	0.09***	-1.24***	-0.53***
	(0.08)	(0.08)	(0.04)	(0.07)	(0.33)	(0.26)	(0.11)	(0.02)	(0.38)	(0.12)
$CDS_{i,t}$	0.67***	0.66***	0.14	1.19***	1.04***	1.22***	1.15***	0.29***	1.19***	1.54***
	(0.12)	(0.14)	(0.09)	(0.12)	(0.12)	(0.05)	(0.03)	(0.07)	(0.06)	(0.04)
$GFSI_t$	0.01	0.05	0.33***	0.2***	-1.43***	-0.09	-0.4***	0.08***	-0.93***	-0.38***
	(0.05)	(0.07)	(0.04)	(0.04)	(0.32)	(0.15)	(0.08)	(0.02)	(0.26)	(0.11)
KfW_t^{10Y}	-0.33***	-0.22***	-0.23***	0.09*	-0.81**	0.01	0.08	-0.06**	0.67***	-0.19*
	(0.07)	(0.05)	(0.03)	(0.04)	(0.35)	(0.12)	(0.07)	(0.02)	(0.2)	(0.1)
CON_t^{10Y}	0.19***	0.19***	-0.01	0.08***	-0.74***	-0.15***	0.18***	0.02***	0.49***	-0.01
	(0.02)	(0.03)	(0.01)	(0.01)	(0.27)	(0.05)	(0.02)	(0.01)	(0.11)	(0.03)
R^2 - adjusted	0.73	0.86	0.37	0.72	0.87	0.93	0.93	0.31	0.95	0.87
Observations	937	937	937	937	246	937	937	935	937	937

Table A4. Baseline specification with the order book slope ($\mathcal{L}_{,i,t}{}^{LOS}$). Each panel reports the estimated coefficients of a multiple linear regression per country, for five and ten year maturity sovereign bonds. The model is formulated as: $Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}(\mathcal{L}_{,i,t}{}^{LOS}) + \beta_{3,i}CDS_{i,t} + \beta_{4,i}US_{i,t}{}^{spr} + KfW_t{}^i + CON_{i,t}$ Where $\mathcal{L}_{,i,t}{}^{LOS}$ is the order book slope; $CDS_{i,t}$ the country's i CDS-premia; $US_{i,t}{}^{spr}$ the spread between US Corporate bonds of BBB rating and the US treasury bills; $KfW_t{}^i$ the KfW spread against the German Bund, and $CON_{i,t}$ the contagion index. Each panel's results are distinguished in two subperiods: (I) *1 Jan 2008 – 10 May 2010* and (II) *11 May 2010 – 31 Dec 2013*. The breakpoint is the ECB Governing Council announcement on large scale purchases of sovereign bonds to ameliorate the market depth. The standard errors, which are presented within the parenthesis below their respective coefficients, are corrected for autocorrelation by incorporating the Newey-West (1985) error variance estimator. The lag selection, according to the majority of the AIC criterion per country, was set to seven. The asterisks indicate the statistical level of significance of the regression as: *** *p-value <=1.0%*, ** *p-value <=5.0%*, * *p-value <=10.0%.*

US-Corporate spreads

5 - Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Period: 2008-2010										
L_t^{BA}	0.25	-0.52	-0.28	0.37	0.85*	-0.18	0.19	-0.12	-0.83***	-0.29
	(0.16)	(0.34)	(0.19)	(0.22)	(0.45)	(0.63)	(0.19)	(0.21)	(0.32)	(0.28)
$CDS_{i,t}$	0.21***	0.9***	0.52*	0.68	1.43***	0.67***	0.31	2.12***	0.96***	0.08
	(0.05)	(0.29)	(0.26)	(0.42)	(0.15)	(0.19)	(0.19)	(0.81)	(0.21)	(0.39)
$US_{5,t}^{spr}$	0.1***	0.12***	0.05***	0.15***	0.06	-0.11*	0.14***	-0.04	-0.12***	0.01
	(0.03)	(0.02)	(0.01)	(0.02)	(0.05)	(0.06)	(0.02)	(0.03)	(0.04)	(0.02)
KfW_t^{5Y}	0.07	0.19*	0.39***	0.02	0.51**	0.74*	0.23***	0.16	0.51**	0.08
	(0.11)	(0.11)	(0.07)	(0.11)	(0.25)	(0.38)	(0.08)	(0.11)	(0.24)	(0.11)
CON_t^{5Y}	0.09***	0.21**	-0.1**	-0.18**	-0.21	-0.02	0.13	0.78***	-0.2	0.65***
	(0.02)	(0.08)	(0.04)	(0.09)	(0.61)	(0.24)	(0.12)	(0.07)	(0.35)	(0.24)
R^2 - adjusted	0.60	0.75	0.77	0.75	0.96	0.73	0.85	0.67	0.76	0.65
Observations	151	603	603	591	603	603	603	603	603	603
II. Period: 2010-2013										
L_t^{BA}	-0.27*	-0.94***	0.93***	-1.99***	-0.22	2.18***	-2.77***	-9.52***	-1.88***	-2.66***
	(0.17)	(0.34)	(0.27)	(0.23)	(0.53)	(0.84)	(0.69)	(0.99)	(0.6)	(0.57)
$CDS_{i,t}$	0.05	0.93***	-0.01	0.48***	1.22***	1.65***	1.07***	2.15***	1.12***	1.2***
	(0.09)	(0.12)	(0.12)	(0.14)	(0.06)	(0.12)	(0.04)	(0.54)	(0.06)	(0.06)
$US_{5,t}^{spr}$	0.14***	0.01	0.2***	0.2***	-3.69***	-2.34***	-0.63***	-0.33	-1.44***	-0.26**
	(0.05)	(0.07)	(0.06)	(0.04)	(0.35)	(0.49)	(0.15)	(0.26)	(0.3)	(0.12)
KfW_t^{5Y}	0.74***	0.1	0.29***	-0.11***	-3.85***	-0.28	0.22**	-0.06	0.16	-0.07
	(0.04)	(0.08)	(0.05)	(0.03)	(0.72)	(0.39)	(0.1)	(0.14)	(0.22)	(0.09)
CON_t^{5Y}	0.02**	0.14***	0.1***	0.06***	0.29	-0.04	0.11***	0.23***	0.67***	0.05**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.32)	(0.11)	(0.02)	(0.04)	(0.1)	(0.02)
R^2 - adjusted	0.90	0.94	0.72	0.83	0.98	0.90	0.95	0.60	0.97	0.89
Observations	937	937	937	937	289	937	937	937	937	937

10-Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Period: 2008-2010										
L_t^{BA}	0.02	-0.22	0.12	0.33	-1.64***	-0.46	0.26	-0.48	-0.93**	-0.12
	(0.26)	(0.27)	(0.23)	(0.25)	(0.56)	(0.37)	(0.25)	(0.32)	(0.46)	(0.31)
$CDS_{i,t}$	0.08	1.18***	-0.4**	0.05	0.64***	0.95***	0.08	0.37**	0.28	-0.04
	(0.09)	(0.2)	(0.2)	(0.14)	(0.09)	(0.07)	(0.11)	(0.15)	(0.17)	(0.18)
$US_{10,t}^{spr}$	0.15***	0.05***	0.1***	0.04***	0.04	-0.07**	0.08***	0.05***	0.07***	0.05***
	(0.01)	(0.01)	(0.01)	(0)	(0.03)	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)
KfW_t^{10Y}	-0.19***	-0.15***	-0.07*	-0.01	0.06	0.11	0.04	-0.08	0.01	0.08
	(0.05)	(0.05)	(0.04)	(0.05)	(0.14)	(0.11)	(0.04)	(0.05)	(0.1)	(0.06)
CON_t^{10Y}	0.04	0.05	0.04	0.1***	1.06***	0.06	0.33***	0.11***	0.58***	0.47***
	(0.03)	(0.05)	(0.04)	(0.03)	(0.32)	(0.15)	(0.08)	(0.03)	(0.19)	(0.12)
R^2	0.78	0.60	0.67	0.26	0.94	0.87	0.73	0.49	0.75	0.67
Observations	603	603	603	603	603	603	603	603	603	603

(break)

(continue)

II. Period: 2010-2013										
L_t^{BA}	-0.56	-0.11	-0.27	-0.61*	1.37*	-3.61***	-1.7***	-0.26**	-4.35***	-2.93***
	(0.37)	(0.24)	(0.27)	(0.35)	(0.76)	(0.56)	(0.59)	(0.11)	(0.8)	(0.56)
$CDS_{i,t}$	0.48***	0.61***	0.08	0.58***	0.89***	1.15***	1.12***	0.15*	1.07***	1.36***
	(0.14)	(0.09)	(0.12)	(0.16)	(0.13)	(0.05)	(0.05)	(0.08)	(0.06)	(0.06)
$US_{10,t}^{spr}$	0.16***	0.4***	0.03	0.37***	-0.21	-0.33**	-0.02	0.11***	0.79***	0.35***
	(0.06)	(0.05)	(0.05)	(0.06)	(0.34)	(0.16)	(0.11)	(0.03)	(0.23)	(0.11)
KfW_t^{10Y}	-0.35***	-0.29***	-0.08**	-0.11***	-1.78***	0.07	-0.08	-0.05**	0.05	-0.45***
	(0.06)	(0.04)	(0.03)	(0.03)	(0.46)	(0.1)	(0.08)	(0.02)	(0.19)	(0.09)
CON_t^{10Y}	0.18***	0.14***	0.04***	0.05***	-0.29	-0.09	0.12***	0.02**	0.33***	-0.1***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.3)	(0.06)	(0.03)	(0.01)	(0.1)	(0.03)
R^2	0.74	0.90	0.07	0.77	0.84	0.93	0.92	0.34	0.95	0.87
Observations	937	937	937	937	246	937	937	935	937	937

Table A5. Baseline specification with US corporate bond spread ($US_{i,t}{}^{spr}$). Each panel reports the estimated coefficients of multiple linear regressions per country, for 5 and 10 year maturity government bonds. The model is formulated as: $Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}(\mathcal{L}_{,i,t}{}^{BA}) + \beta_{3,i}CDS_{i,t} + \beta_{4,i}US_{i,t}{}^{spr} + KfW_t{}^{i} + CON_{i,t}$, where $\mathcal{L}_{,i,t}{}^{BA}$ is the bid-ask spread; $CDS_{i,t}$ the country's i CDS-premia; $US_{i,t}{}^{spr}$ the spread between US Corporate bonds of BBB rating and the US treasury bills; $KfW_t{}^{i}$ the KfW spread against the German Bund, and $CON_{i,t}$ the contagion index. Each panel's results are distinguished in two subperiods: (I) *1 Jan 2008 – 10 May 2010* and (II) *11 May 2010 – 31 Dec 2013*. The breakpoint is the ECB Governing Council announcement on large scale purchases of sovereign bonds to ameliorate the market depth. The standard errors, which are presented within the parenthesis below their respective coefficients, are corrected for autocorrelation by incorporating the Newey-West (1985) error variance estimator. The lag selection, according to the majority of the AIC criterion per country, was set to seven. The asterisks indicate the statistical level of significance of the regression as: *** *p-value <=1.0%*, ** *p-value <=5.0%*, * *p-value <=10.0%.*

VIX

5 - Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Period: 2008-2010										
L_t^{BA}	0.35*	-0.67*	-0.21	0.46**	0.95**	-0.23	0.29	-0.22	-0.84**	-0.26
	(0.18)	(0.36)	(0.18)	(0.21)	(0.44)	(0.67)	(0.2)	(0.22)	(0.33)	(0.28)
$CDS_{i,t}$	0.26***	1.55***	1.2***	1.56***	1.35***	0.65***	0.65***	1.52***	1.06***	0.02
	(0.05)	(0.24)	(0.19)	(0.52)	(0.14)	(0.19)	(0.16)	(0.58)	(0.22)	(0.4)
VIX_t	0.08*	0.24***	0.01	0.37***	0.01	-0.59***	0.37***	-0.06	-0.36	0.06***
	(0.04)	(0.09)	(0.04)	(0.09)	(0.15)	(0.19)	(0.08)	(0.09)	(0.12)	(0.08)
KfW_t^{5Y}	0.11	0.36***	0.53***	0.38***	0.62***	0.75**	0.4***	0.07	0.36*	0.06
	(0.12)	(0.1)	(0.06)	(0.1)	(0.21)	(0.34)	(0.08)	(0.09)	(0.21)	(0.11)
CON_t^{5Y}	0.06***	-0.03	-0.13***	-0.46***	-0.01	0.01	-0.17	0.8***	-0.2	0.69***
	(0.02)	(0.1)	(0.05)	(0.1)	(0.54)	(0.24)	(0.12)	(0.07)	(0.34)	(0.25)
R^2 - adjusted	0.51	0.72	0.75	0.64	0.96	0.75	0.82	0.66	0.74	0.65
Observations	151	603	603	591	603	603	603	603	603	603
II. Period: 2010-2013										
L_t^{LOS}	-0.48***	-0.9***	1.2***	-2.02***	-1.79**	1.77*	-3.16***	-9.24***	-2.01***	-2.79***
	(0.16)	(0.32)	(0.27)	(0.24)	(0.73)	(0.98)	(0.67)	(0.95)	(0.61)	(0.59)
$CDS_{i,t}$	0.13	0.85***	-0.16	0.67***	1.29***	1.85***	0.97***	1.85***	1.09***	1.15***
	(0.08)	(0.12)	(0.11)	(0.12)	(0.11)	(0.13)	(0.03)	(0.47)	(0.06)	(0.06)
VIX_t	0.19**	0.26***	0.12*	0.03	-2.98***	-0.35	-0.36***	-0.46**	-0.7**	-0.01
	(0.07)	(0.07)	(0.06)	(0.06)	(0.76)	(0.54)	(0.12)	(0.2)	(0.34)	(0.15)
KfW_t^{5Y}	0.66***	0.02	0.27***	-0.08	-2.92***	-1.17***	0.1	0.05	0.04	-0.15
	(0.05)	(0.09)	(0.06)	(0.05)	(0.92)	(0.42)	(0.09)	(0.16)	(0.26)	(0.11)
CON_t^{5Y}	0.03***	0.16***	0.09***	0.06***	0.34	-0.37***	0.1***	0.21***	0.59***	0.04
	(0.01)	(0.02)	(0.01)	(0.01)	(0.51)	(0.08)	(0.03)	(0.04)	(0.1)	(0.02)
R^2 - adjusted	0.91	0.95	0.71	0.82	0.97	0.88	0.95	0.61	0.97	0.89
Observations	937	937	937	937	289	937	937	937	937	937

10-Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Period: 2008-2010										
L_t^{BA}	-0.58*	-0.41	-0.43*	0.29	-1.83***	0.47	0.02	-0.5	-1.16***	-0.19
	(0.33)	(0.28)	(0.25)	(0.25)	(0.46)	(0.5)	(0.24)	(0.33)	(0.39)	(0.29)
$CDS_{i,t}$	0.24*	0.04	0.25**	0.23***	0.64**	1.44***	0.24**	0.25**	0.6***	0.42***
	(0.13)	(0.11)	(0.1)	(0.08)	(0.29)	(0.3)	(0.1)	(0.1)	(0.18)	(0.1)
VIX_t	0.19***	0.18***	0.06	-0.03	0.43***	-0.71***	0.07	0.02	0.22**	0.13**
	(0.07)	(0.06)	(0.05)	(0.04)	(0.15)	(0.15)	(0.06)	(0.05)	(0.09)	(0.06)
KfW_t^{10Y}	-0.13**	-0.1	-0.03	-0.01	-0.17	1.11***	0.06	0.01	-0.05	0.1*
	(0.05)	(0.07)	(0.04)	(0.05)	(0.16)	(0.12)	(0.05)	(0.05)	(0.09)	(0.05)
CON_t^{10Y}	-0.07	0.25***	0.02	0.1***	2.97***	0.42***	0.33***	0.07	0.82***	0.41***
	(0.04)	(0.05)	(0.05)	(0.03)	(0.28)	(0.12)	(0.06)	(0.04)	(0.12)	(0.05)
R^2 - adjusted	0.63	0.63	0.55	0.30	0.94	0.87	0.71	0.48	0.73	0.66
Observations	603	603	603	603	603	603	603	603	603	603

(break)

(continue)

II. Period: 2010-2013										
L_t^{BA}	-1.29***	-0.33	0.02	-1.26***	1.3	-12.75***	-8.16***	-0.58***	-7.35***	-10.28***
	(0.44)	(0.35)	(0.2)	(0.44)	(1.18)	(1.25)	(1.5)	(0.12)	(1.28)	(1.36)
$CDS_{i,t}$	0.37**	0.61***	-0.23**	0.37**	-1.61*	-0.16	1.47***	0.03	1.48*	1.62***
	(0.15)	(0.18)	(0.1)	(0.16)	(0.83)	(0.84)	(0.55)	(0.06)	(0.88)	(0.47)
VIX_t	0.29***	0.12	0.48***	0.35***	-1.13	-1.36**	-1.38***	0.04	-1.6**	-1.53***
	(0.1)	(0.11)	(0.09)	(0.11)	(0.81)	(0.68)	(0.42)	(0.04)	(0.7)	(0.38)
KfW_t^{10Y}	-0.22***	-0.15***	-0.23***	0.05	-1.95***	-0.28	-0.47***	-0.05*	-0.54*	-0.34**
	(0.06)	(0.05)	(0.03)	(0.05)	(0.57)	(0.31)	(0.16)	(0.02)	(0.29)	(0.14)
CON_t^{10Y}	0.26***	0.34***	-0.01	0.19***	1.29***	0.47***	0.56***	0.04***	2.09***	0.32***
	(0.01)	(0.02)	(0.01)	(0.01)	(0.34)	(0.12)	(0.05)	(0.01)	(0.11)	(0.05)
R^2 - adjusted	0.74	0.87	0.25	0.71	0.86	0.93	0.93	0.32	0.95	0.86
Observations	937	937	937	937	246	937	937	935	937	937

Table A6. Baseline specification with volatility index (VIX). Each panel reports the estimated coefficients of the multiple linear regressions per country, for 5 and 10 year maturity government bonds. The model is formulated as: $Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}(\mathcal{L}_{,i,t}{}^{BA}) + \beta_{3,i}CDS_{i,t} + \beta_{4,i}VIX_t + KfW_t{}^i + CON_{i,t}$ Where $\mathcal{L}_{,i,t}{}^{BA}$ is the bid-ask spread; $CDS_{i,t}$ the country's i CDS-premia; VIX_t the *log* values of the CBOE volatility index VIX; $KfW_t{}^i$ the KfW spread against the German Bund, and $CON_{i,t}$ the contagion index. Each panel's results are distinguished in two subperiods: (I) *1 Jan 2008 – 10 May 2010* and (II) *11 May 2010 – 31 Dec 2013*. The breakpoint is the ECB Governing Council announcement on large scale purchases of sovereign bonds to ameliorate the market depth. The standard errors, which are presented within the parenthesis below their respective coefficients, are corrected for autocorrelation by incorporating the Newey-West (1985) error variance estimator. The lag selection, according to the majority of the AIC criterion per country, was set to seven. The asterisks indicate the statistical level of significance of the regression as: *** *p-value <=1.0%*, ** *p-value <=5.0%*, * *p-value <=10.0%.*

US - Corporate spreads

5 - Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Period: 2008-2010										
L_t^{BA}	0.25*	-0.18	0.04	-0.06	0.41	-0.88	0.15	0.27	-0.8**	0.07
	(0.14)	(0.28)	(0.11)	(0.16)	(0.34)	(0.55)	(0.11)	(0.18)	(0.34)	(0.17)
$CDS_{i,t}$	0.16***	0.38	0.34	-0.04	1.51***	0.55***	0.07	0.66	0.95***	0.17
	(0.05)	(0.27)	(0.26)	(0.33)	(0.16)	(0.16)	(0.1)	(0.69)	(0.23)	(0.16)
$US_{5,t}^{spr}$	0.12**	0.1***	0.06***	0.04**	-0.12	-0.25***	0.12***	0.08**	-0.13**	0.09***
	(0.05)	(0.02)	(0.02)	(0.02)	(0.08)	(0.07)	(0.03)	(0.03)	(0.06)	(0.02)
KfW_t^{5Y}	0.08	0.41***	0.3***	0.47***	1.08***	1.61***	0.38***	0.07	0.62**	0.06
	(0.11)	(0.15)	(0.05)	(0.08)	(0.36)	(0.37)	(0.11)	(0.15)	(0.26)	(0.08)
CON_t^{5Y}	0.1***	0.25***	-0.07	-0.02	-0.23	0.15	0.35***	0.64***	-0.18	0.39***
	(0.02)	(0.06)	(0.05)	(0.07)	(0.59)	(0.23)	(0.08)	(0.06)	(0.35)	(0.11)
$Debt_{i,t} / GDP_{i,t}$	0.06	-0.02	-0.01	-0.06***	0.04**	0.04***	0.04***	-0.01	0.02**	0.02**
	(0.05)	(0.02)	(0.01)	(0)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
$GDP_{i,t}^{gr}$	-0.09	-0.07***	-0.09***	-0.06***	0.06*	-0.07*	-0.05***	-0.36***	-0.03**	-0.31***
	(0.05)	(0.01)	(0.02)	(0.01)	(0.03)	(0.03)	(0.01)	(0.06)	(0.04)	(0.02)
$HICP_t$	-0.06***	0.03	-0.08***	-0.09***	-0.01	-0.09	-0.06***	-0.09***	-0.11**	-0.01
	(0.01)	(0.03)	(0.02)	(0.03)	(0.06)	(0.05)	(0.01)	(0.03)	(0.05)	(0.02)
L_t^{VOL}	-0.28	-1.87***	-0.82**	-0.03	-0.66	-4.53***	-0.55	-0.56	0.08	-2.34***
	(0.24)	(0.44)	(0.34)	(0.05)	(1.47)	(1.61)	(0.34)	(0.67)	(0.77)	(0.42)
R^2 - adjusted	0.64	0.80	0.84	0.87	0.96	0.80	0.94	0.78	0.77	0.88
Observations	937	937	937	937	289	937	937	937	937	937
II. Period: 2010-2013										
L_t^{BA}	-0.35**	-0.46	0.68**	-2.11***	0.25	0.39	-2.76***	-8.52***	-1.09*	-2.19***
	(0.16)	(0.3)	(0.28)	(0.24)	(0.53)	(0.86)	(0.64)	(0.94)	(0.61)	(0.47)
$CDS_{i,t}$	0.09	1.02***	0.03	0.5***	1.13***	1.69***	1.08***	2.32***	1.07***	1.11***
	(0.17)	(0.11)	(0.12)	(0.15)	(0.08)	(0.11)	(0.04)	(0.53)	(0.07)	(0.06)
$US_{5,t}^{spr}$	0.06	0.1	0.02	0.15***	-3.39***	-2.21***	-0.56***	0.02	-1.61***	-0.3**
	(0.05)	(0.08)	(0.05)	(0.04)	(0.58)	(0.42)	(0.16)	(0.3)	(0.38)	(0.14)
KfW_t^{5Y}	0.69***	0.3***	0.2**	-0.09*	-1.78**	-1.5***	0.23*	0.26	0.95**	0.62***
	(0.05)	(0.08)	(0.09)	(0.05)	(0.84)	(0.47)	(0.14)	(0.24)	(0.43)	(0.23)
CON_t^{5Y}	0.04***	0.11***	0.07***	0.06***	0.5*	0.07	0.1***	0.12***	0.69***	0.01
	(0.01)	(0.02)	(0.01)	(0.01)	(0.29)	(0.12)	(0.02)	(0.04)	(0.1)	(0.02)
$Debt_{i,t} / GDP_{i,t}$	-0.01	-0.01	-0.04***	0.01*	0.15***	-0.03*	0.01***	-0.02	0.03***	0.02**
	(0.01)	(0.01)	(0.01)	(0)	(0.03)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
$GDP_{i,t}^{gr}$	-0.07	-0.07*	-0.01	-0.02	-0.17***	-0.26***	-0.09***	0.14**	-0.01	-0.15***
	(0.06)	(0.03)	(0.01)	(0.02)	(0.05)	(0.07)	(0.02)	(0.07)	(0.05)	(0.04)
$HICP_t$	0.08***	-0.01	0.05	-0.01	0.17	0.22***	0.01	-0.19**	0.25***	-0.01
	(0.02)	(0.01)	(0.03)	(0.02)	(0.24)	(0.05)	(0.01)	(0.08)	(0.09)	(0.03)
L_t^{VOL}	-1.02***	3.48***	0.83*	-0.03	-2.08	4.87***	0.81	5.98***	-1.54	5.14***
	(0.36)	(0.5)	(0.47)	(0.04)	(3.97)	(3.63)	(0.56)	(1.33)	(2.77)	(0.98)
R^2 - adjusted	0.91	0.95	0.75	0.83	0.98	0.92	0.96	0.63	0.98	0.91
Observations	937	937	937	937	289	937	937	937	937	937

10 - Year maturity

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
I. Period: 2008-2010										
L_t^{BA}	-0.21	-0.31	0.04	-0.09	-1.53***	-0.51	0.17	-0.28	-1.17***	-0.14
	(0.2)	(0.24)	(0.16)	(0.19)	(0.46)	(0.38)	(0.18)	(0.27)	(0.41)	(0.31)
$CDS_{i,t}$	0.21**	0.93***	-0.44**	0.46***	1***	0.9***	0.19**	0.44***	0.53**	-0.12
	(0.09)	(0.2)	(0.19)	(0.16)	(0.15)	(0.06)	(0.09)	(0.14)	(0.2)	(0.16)

(break)

(continue)

$US_{10,t}^{spr}$	0.13***	0.06***	0.1***	0.07***	0.09	-0.03	0.08***	0.02	-0.04	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.06)	(0.03)	(0.01)	(0.01)	(0.03)	(0.01)
KfW_t^{10Y}	-0.12***	-0.25***	-0.01	-0.08	-0.09	0.03	-0.09*	0.05	0.14	0.04
	(0.04)	(0.07)	(0.03)	(0.05)	(0.16)	(0.12)	(0.05)	(0.06)	(0.1)	(0.06)
CON_t^{10Y}	0.08*	0.05	0.01	0.07**	-0.05	-0.03	0.21***	0.16***	0.39	0.59***
	(0.04)	(0.05)	(0.04)	(0.03)	(0.53)	(0.24)	(0.07)	(0.03)	(0.3)	(0.09)
$Debt_{i,t}/GDP_{i,t}$	-0.01	0.03***	0.01	0.02***	0.04***	0.01	0.03***	-0.01	-0.01	0.01
	(0.01)	(0.01)	(0)	(0)	(0.01)	(0)	(0.01)	(0)	(0.02)	(0.01)
$GDP_{i,t}^{gr}$	-0.01	-0.04***	0.06***	-0.03***	0.04	-0.03	0.02***	0.13***	0.04**	0.04***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)	(0)	(0.03)	(0.01)	(0.01)
$HICP_t$	-0.05*	-0.01	0.02	0.05**	0.03	-0.08**	-0.03***	0.03**	-0.07*	-0.11***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)	(0.01)	(0.01)	(0.04)	(0.02)
L_t^{VOL}	1.6***	-0.42	0.5	1.57***	2.96***	-0.54	-0.41	1.56***	1.64***	0.39
	(0.2)	(0.29)	(0.32)	(0.19)	(0.51)	(1.18)	(0.32)	(0.5)	(0.51)	(0.38)
R^2 - adjusted	0.84	0.65	0.74	0.48	0.95	0.88	0.82	0.59	0.78	0.74
Observations	603	603	603	603	603	603	603	603	603	603
II. Period: 2010-2013										
L_t^{BA}	-0.18	-0.24	-0.09	-0.67*	0.97**	-2.93***	-1.61***	-0.16	-2.67***	-2.54***
	(0.21)	(0.24)	(0.27)	(0.36)	(0.46)	(0.52)	(0.59)	(0.1)	(0.82)	(0.56)
$CDS_{i,t}$	0.65***	0.63***	0.13	0.55***	0.57***	1.08***	1.26***	0.08	0.82***	1.36***
	(0.15)	(0.1)	(0.13)	(0.15)	(0.1)	(0.05)	(0.07)	(0.07)	(0.07)	(0.06)
$US_{10,t}^{spr}$	0.18***	0.37***	0.05	0.32***	-0.56**	-0.32*	-0.26**	0.07**	0.34	0.28***
	(0.06)	(0.06)	(0.05)	(0.06)	(0.28)	(0.18)	(0.12)	(0.03)	(0.24)	(0.1)
KfW_t^{10Y}	-0.33***	-0.29***	-0.13***	-0.03	-0.48*	-0.07	-0.06	-0.06**	1.08***	-0.37***
	(0.07)	(0.05)	(0.05)	(0.05)	(0.28)	(0.19)	(0.08)	(0.02)	(0.29)	(0.11)
CON_t^{10Y}	0.14***	0.12***	0.05***	0.06***	0.66***	-0.02	0.1***	0.05***	0.71***	-0.06*
	(0.02)	(0.02)	(0.01)	(0.01)	(0.21)	(0.07)	(0.03)	(0.01)	(0.11)	(0.03)
$Debt_{i,t}/GDP_{i,t}$	-0.03***	-0.01	0.01	0.02**	0.17***	-0.01	-0.01	0.01***	0.06***	0.02**
	(0.01)	(0.01)	(0.01)	(0)	(0.02)	(0.01)	(0.01)	(0)	(0.01)	(0)
$GDP_{i,t}^{gr}$	-0.13***	0.07***	0.05***	0.11***	-0.23***	-0.09**	-0.1***	0.02	0.06	-0.09*
	(0.04)	(0.03)	(0.02)	(0.02)	(0.04)	(0.04)	(0.02)	(0.01)	(0.04)	(0.05)
$HICP_t$	0.04	-0.03**	0.02	-0.03	0.16	-0.01	0.01	0.06***	0.16*	0.04
	(0.03)	(0.01)	(0.03)	(0.02)	(0.12)	(0.02)	(0.01)	(0.01)	(0.09)	(0.03)
L_t^{VOL}	1.82**	-0.33	-0.7*	-0.45	-1.84	-1.31***	-1.62**	-1.6***	-3.76	-4.02***
	(0.76)	(0.55)	(0.4)	(0.48)	(2.21)	(2.11)	(0.73)	(0.26)	(3.17)	(1.31)
R^2 - adjusted	0.78	0.91	0.13	0.80	0.93	0.95	0.93	0.50	0.96	0.88
Observations	937	937	937	937	246	937	937	935	937	937

Table A7. Baseline specification with control variables ($C_{i,t}$). Each panel reports the results of OLS multiple linear regressions per country, for 5 and 10 year maturity sovereign bonds. The model is formulated as: $Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}(\mathcal{L}_{i,t}{}^{BA}) + \beta_{3,i}CDS_{i,t} + \beta_{4,i}US_{i,t}{}^{spr} + KfW_t{}^{i} + CON_{i,t} + C_{i,t}$. The control variables are: debt-to-GDP ratio, $\frac{Debt_{i,t}}{GDP_{i,t}}$; GDP growth $GDP_{i,t}^{gr}$; the inflation index $HICP_t$; and the MTS cumulative quoted volume, $L_t{}^{VOL}$. Each panel's results are distinguished in two subperiods: (I) 1 Jan 2008 – 10 May 2010 and (II) 11 May 2010 – 31 Dec 2013. The standard errors, which are presented within the parenthesis below their respective coefficients, are corrected for autocorrelation by incorporating the Newey-West (1985) error variance estimator. The lag selection, according to the majority of the AIC criterion per country, was set to seven. The asterisks indicate the statistical level of significance of the regression as: *** *p-value <=1.0%*, ** *p-value <=5.0%*, * *p-value <=10.0%.*

VIX

5 - Year maturity	**Austria**	**Belgium**	**Finland**	**France**	**Greece**	**Ireland**	**Italy**	**Netherlands**	**Portugal**	**Spain**
I. Period: 2008-2010										
L_t^{BA}	0.27	-0.16	0.11	-0.05	0.44	-1.34**	0.21*	0.44**	-0.69**	0.13
	(0.17)	(0.29)	(0.11)	(0.16)	(0.4)	(0.63)	(0.12)	(0.19)	(0.32)	(0.17)
$CDS_{i,t}$	0.18***	0.95***	0.94***	0.04	1.45***	0.49***	0.23**	0.94*	1.09***	-0.03
	(0.06)	(0.25)	(0.18)	(0.31)	(0.16)	(0.15)	(0.11)	(0.51)	(0.25)	(0.17)
VIX_t	0.04	0.17**	0.09*	0.06	-0.55***	-1.06***	0.28***	0.28**	-0.17	0.28***
	(0.04)	(0.08)	(0.04)	(0.07)	(0.18)	(0.14)	(0.07)	(0.12)	(0.12)	(0.06)
KfW_t^{5Y}	0.15	0.57***	0.42***	0.57***	1***	1.38***	0.64***	0.21*	0.38*	0.2***
	(0.1)	(0.15)	(0.06)	(0.07)	(0.27)	(0.31)	(0.06)	(0.13)	(0.19)	(0.06)
CON_t^{5Y}	0.07***	0.08	-0.06	-0.04	-0.01	0.31	0.21***	0.61***	-0.4	0.47***
	(0.02)	(0.07)	(0.06)	(0.06)	(0.57)	(0.26)	(0.08)	(0.06)	(0.36)	(0.11)
$Debt_{i,t} / GDP_{i,t}$	-0.12***	-0.03	-0.01	-0.07***	-0.04***	-0.04***	-0.06***	-0.01	0.02***	0.01**
	(0.04)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0)
$GDP_{i,t}^{gr}$	-0.16***	-0.05***	-0.08***	-0.05***	0.05*	-0.05	-0.04***	-0.36***	-0.04**	-0.29***
	(0.04)	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)	(0)	(0.06)	(0.04)	(0.02)
$HICP_t$	-0.04**	0.02	-0.06***	-0.1***	0.04	-0.09**	-0.06***	-0.09***	-0.15***	0.01
	(0.02)	(0.03)	(0.02)	(0.03)	(0.06)	(0.04)	(0.01)	(0.02)	(0.06)	(0.02)
L_t^{VOL}	-0.16	-2.35***	-1.11***	-0.03	-0.1	-4.34***	-0.53	-0.83	0.32	-2.74***
	(0.24)	(0.42)	(0.33)	(0.05)	(1.41)	(1.58)	(0.32)	(0.62)	(0.76)	(0.42)
R^2 - adjusted	0.59	0.78	0.82	0.87	0.96	0.82	0.93	0.78	0.76	0.88
Observations	151	603	603	591	603	603	603	603	603	603
II. Period: 2010-2013										
L_t^{BA}	-0.51***	-0.44	0.66**	-2.17***	-0.43	-0.49	-3.06***	-8.46***	-1.41**	-2.33***
	(0.15)	(0.29)	(0.29)	(0.25)	(0.51)	(0.93)	(0.6)	(0.96)	(0.67)	(0.49)
$CDS_{i,t}$	0.11	0.97***	0.05	0.64***	1.06***	1.83***	1.02***	2.26***	1.08***	1.07***
	(0.15)	(0.11)	(0.11)	(0.13)	(0.09)	(0.13)	(0.03)	(0.48)	(0.07)	(0.06)
VIX_t	0.19***	0.25***	0.04	0.03	-1.91***	-0.66	-0.36***	0.28	-0.78**	-0.1
	(0.06)	(0.08)	(0.05)	(0.06)	(0.63)	(0.44)	(0.1)	(0.21)	(0.33)	(0.14)
KfW_t^{5Y}	0.61***	0.23***	0.19**	-0.04	-1.42	-2.72***	0.13	0.4*	0.08	0.48**
	(0.06)	(0.09)	(0.09)	(0.06)	(0.93)	(0.47)	(0.13)	(0.24)	(0.43)	(0.21)
CON_t^{5Y}	0.05***	0.13***	0.07***	0.06***	0.51	-0.13	0.07***	0.13***	0.54***	-0.01
	(0.01)	(0.02)	(0.01)	(0.01)	(0.36)	(0.12)	(0.02)	(0.04)	(0.1)	(0.02)
$Debt_{i,t} / GDP_{i,t}$	-0.02	-0.01	-0.04***	0.02**	0.18***	-0.05***	0.01***	-0.01	0.01	0.02*
	(0.01)	(0.01)	(0.01)	(0)	(0.04)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
$GDP_{i,t}^{gr}$	-0.07	-0.05*	-0.01	-0.03	-0.07**	-0.2***	-0.1***	0.14**	0.12***	-0.13***
	(0.05)	(0.03)	(0.01)	(0.02)	(0.06)	(0.07)	(0.02)	(0.07)	(0.04)	(0.04)
$HICP_t$	0.08***	-0.01	0.05	0.01	0.67***	0.19***	-0.01	-0.19**	0.29***	-0.01
	(0.02)	(0.01)	(0.03)	(0.02)	(0.25)	(0.06)	(0.01)	(0.08)	(0.1)	(0.03)
L_t^{VOL}	-1.2***	3.24***	0.84*	-0.04	1.71**	2.78***	1.62***	5.59***	1.53	6.03***
	(0.33)	(0.46)	(0.46)	(0.04)	(4.12)	(4.39)	(0.48)	(1.24)	(2.93)	(0.86)
R^2 - adjusted	0.92	0.96	0.75	0.83	0.98	0.91	0.96	0.64	0.97	0.91
Observations	937	937	937	937	289	937	937	937	937	937

10 - Year maturity	**Austria**	**Belgium**	**Finland**	**France**	**Greece**	**Ireland**	**Italy**	**Netherlands**	**Portugal**	**Spain**
I. Period: 2008-2010										
L_t^{BA}	-0.51**	-0.29	-0.52**	-0.09	-1.5***	-0.52	-0.13	-0.29	-1.14***	-0.15
	(0.23)	(0.23)	(0.21)	(0.2)	(0.43)	(0.38)	(0.18)	(0.27)	(0.41)	(0.3)
$CDS_{i,t}$	0.31***	1.12***	-0.06	0.2	0.94***	0.89***	0.47***	0.5***	0.4**	-0.23
	(0.11)	(0.17)	(0.28)	(0.17)	(0.16)	(0.07)	(0.09)	(0.11)	(0.18)	(0.16)

(break)

(continue)

VIX_t	0.47***	0.24***	0.3***	0.22***	0.12	-0.15*	0.29***	0.07	-0.06	0.11**
	(0.07)	(0.04)	(0.06)	(0.03)	(0.13)	(0.08)	(0.05)	(0.05)	(0.09)	(0.05)
KfW_t^{10Y}	-0.07	-0.26***	0.05	-0.03	0.07	0.04	-0.06	0.05	0.22**	0.06
	(0.06)	(0.07)	(0.05)	(0.04)	(0.1)	(0.11)	(0.05)	(0.06)	(0.09)	(0.05)
CON_t^{10Y}	0.11	-0.03	0.02	0.08	0.21	-0.01	-0.01	0.16***	0.63***	0.64***
	(0.08)	(0.04)	(0.06)	(0.05)	(0.55)	(0.25)	(0.06)	(0.04)	(0.24)	(0.09)
$Debt_{i,t}/GDP_{i,t}$	-0.03***	0.04***	-0.01	0.01	0.03***	0.01*	0.03***	-0.01	-0.02**	-0.01
	(0.01)	(0.01)	(0.01)	(0)	(0.01)	(0)	(0.01)	(0.01)	(0.01)	(0.01)
$GDP_{i,t}^{gr}$	0.03*	-0.03***	0.05***	-0.02	0.07***	-0.03	0.02***	0.12***	0.05***	0.05***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)	(0)	(0.03)	(0.02)	(0.01)
$HICP_t$	-0.09**	-0.01	0.01	-0.01	0.01	-0.08**	-0.03**	0.03**	-0.05	-0.11***
	(0.04)	(0.01)	(0.03)	(0.02)	(0.05)	(0.03)	(0.01)	(0.01)	(0.04)	(0.02)
L_t^{VOL}	1.26***	-0.55*	0.45	1.45***	2.48***	-0.17	0.03	1.55***	1.16***	0.18
	(0.26)	(0.28)	(0.38)	(0.2)	(0.56)	(1.15)	(0.31)	(0.48)	(0.43)	(0.37)
R^2 - adjusted	0.72	0.66	0.58	0.46	0.95	0.88	0.80	0.60	0.78	0.74
Observations	603	603	603	603	603	603	603	603	603	603
II. Period: 2010-2013										
L_t^{BA}	0.09	0.14	0.13	-0.99***	0.74*	-2.93***	-1.77***	-0.2**	-2.24***	-2.32***
	(0.19)	(0.27)	(0.25)	(0.36)	(0.41)	(0.54)	(0.54)	(0.1)	(0.81)	(0.58)
$CDS_{i,t}$	0.89***	0.7***	0.17	0.98***	0.59***	1.09***	1.21***	0.13**	0.87***	1.44***
	(0.11)	(0.13)	(0.1)	(0.13)	(0.1)	(0.05)	(0.04)	(0.06)	(0.07)	(0.05)
VIX_t	0.05	0.2**	0.36***	0.16**	-0.7**	-0.03	-0.55***	0.08***	-0.38	-0.07
	(0.06)	(0.09)	(0.05)	(0.07)	(0.3)	(0.2)	(0.1)	(0.03)	(0.36)	(0.14)
KfW_t^{10Y}	-0.38***	-0.27***	-0.2***	0.08	-0.37	-0.29*	-0.04	-0.05**	1.36***	-0.22**
	(0.07)	(0.05)	(0.05)	(0.05)	(0.28)	(0.15)	(0.07)	(0.02)	(0.24)	(0.09)
CON_t^{10Y}	0.15***	0.17***	0.02	0.07***	0.58***	-0.07	0.08**	0.06***	0.72***	-0.02
	(0.02)	(0.03)	(0.01)	(0.02)	(0.21)	(0.06)	(0.03)	(0.01)	(0.1)	(0.03)
$Debt_{i,t}/GDP_{i,t}$	-0.03**	0.02**	0.01	0.03***	0.16***	-0.01	-0.02	0.02***	0.06***	0.02**
	-0.01	(0.01)	(0)	(0)	(0.02)	(0.01)	(0.01)	(0)	(0.01)	(0.01)
$GDP_{i,t}^{gr}$	-0.16***	0.12***	0.05***	0.11***	-0.21***	-0.08**	-0.1***	0.02	0.06	-0.1**
	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.01)	(0.04)	(0.05)
$HICP_t$	0.02	-0.03**	0.04	-0.01	0.25*	-0.02	0.01	0.06***	0.17*	0.04
	(0.03)	(0.01)	(0.03)	(0.03)	(0.12)	(0.02)	(0.01)	(0.01)	(0.09)	(0.04)
L_t^{VOL}	0.94	-0.73	0.27	-1.95***	-1.63	-1.14***	-1.88***	-1.48***	-2.99	-4.3***
	(0.72)	(0.7)	(0.4)	(0.52)	(2.17)	(2.23)	(0.66)	(0.24)	(3.14)	(1.29)
R^2 - adjusted	0.77	0.89	0.30	0.76	0.94	0.94	0.94	0.50	0.96	0.87
Observations	937	937	937	937	246	937	937	935	937	937

Table A8. Baseline specification with control variables ($C_{i,t}$). Each panel reports the results of the OLS multiple linear regressions per country, for 5 and 10 year maturity government bonds. The model is formulated as: $Y_{i,t} - Y_{GER,t} = \beta_{1,i} + \beta_{2,i}(\mathcal{L}_{i,t}{}^{BA}) + \beta_{3,i}CDS_{i,t} + \beta_{4,i}VIX_t + KfW_t{}^i + CON_{i,t} + C_{i,t}$. The control variables are: debt-to-GDP ratio, $\frac{Debt_{i,t}}{GDP_{i,t}}$; GDP growth $GDP_{i,t}^{gr}$; the inflation index $HICP_t$; and the MTS cumulative quoted volume, $L_t{}^{VOL}$. Each panel's results are distinguished in two subperiods: (I) 1 Jan 2008 – 10 May 2010 and (II) 11 May 2010 – 31 Dec 2013. The standard errors, which are presented within the parenthesis below their respective coefficients, are corrected for autocorrelation by incorporating the Newey-West (1985) error variance estimator. The lag selection, according to the majority of the AIC criterion per country, was set to seven. The asterisks indicate the statistical level of significance of the regression as: *** *p-value <=1.0%*, ** *p-value <=5.0%*, * *p-value <=10.0%*.

US-Corporate spreads

	Austria	Belgium	France	Greece	Ireland	Italy	Portugal	Spain
I. 5 - Year maturity								
10-May-10	-0.01***	0.01***	-0.01***	-0.02***	-0.01	0.01***	-0.02***	0.01***
	(0.02)	(0.06)	(0.04)	(0.35)	(0.33)	(0.08)	(0.25)	(0.08)
$CDS_{i,t}$	0.19**	0.82***	0.52**	0.97***	1.66***	1.01***	0.98***	1.22***
	(7.88)	(11.61)	(13.61)	(10.56)	(15.31)	(4.41)	(7.31)	(5.95)
$S\&P_t$	-0.01***	0.01**	0.01***	0.01**	0.01	0.01**	0.01***	0.01***
	(0.02)	(0.07)	(0.04)	(0.14)	(0.14)	(0.05)	(0.12)	(0.04)
$US_{5,t}^{spr}$	0.16***	0.11***	0.12***	0.57***	-0.11**	0.08***	-0.06	0.03
	(3.81)	(1.59)	(1.41)	(6.47)	(5.06)	(1.93)	(4.05)	(2.18)
KfW_t^{5Y}	0.58***	0.27***	0.13**	-2.31***	-0.68**	0.15	-0.24*	0.24***
	(6.19)	(7.87)	(6.17)	(33.64)	(30.11)	(10.38)	(13.38)	(8.07)
CON_t^{5Y}	0.03***	0.15***	0.07***	1.38***	-0.37***	0.05	0.76***	0.04
	(0.83)	(2.49)	(1.44)	(30.91)	(8.05)	(3.14)	(9.68)	(2.21)
$Debt_{i,t}/GDP_{i,t}$	-0.01*	-0.01	-0.03***	-0.08***	-0.02	-0.04***	-0.03**	-0.02**
	(0.36)	(0.6)	(0.45)	(1.61)	(1.22)	(0.86)	(1.35)	(0.77)
R^2 - adjusted	0.94	0.95	0.81	0.99	0.92	0.97	0.99	0.97
Observations	1075	1527	1515	879	1527	1527	1527	1527
II. 10 - Year maturity								
10-May-10	-0.01***	-0.01*	-0.01***	0.01	0.01***	0.01	-0.02***	0.01
	(0.05)	(0.04)	(0.03)	(0.29)	(0.15)	(0.08)	(0.25)	(0.08)
$CDS_{i,t}$	0.33**	0.82***	0.74*	1.01***	1.12***	1.13***	0.92***	1.29***
	(7.49)	(9.66)	(12.71)	(12.32)	(5.8)	(4.55)	(9.13)	(7.6)
$S\&P_t$	0.01***	0.01***	0.01***	0.01***	0.01***	0.01**	0.01***	0.01***
	(0.02)	(0.04)	(0.03)	(0.11)	(0.06)	(0.04)	(0.11)	(0.05)
$US_{10,t}^{spr}$	0.13***	0.07***	0.05***	-0.22***	-0.08***	0.01	-0.13***	-0.07***
	(0.97)	(0.73)	(0.8)	(3.37)	(2.29)	(1.4)	(2.85)	(1.24)
KfW_t^{10Y}	-0.21***	-0.15***	-0.07**	-0.77***	0.26**	-0.12**	0.03	-0.12*
	(5.17)	(4.54)	(3.12)	(17.39)	(10.74)	(5.53)	(11.75)	(6.25)
CON_t^{10Y}	0.2***	0.13***	0.1***	-0.29	-0.14***	0.13***	0.71***	0.05
	(1.34)	(2.52)	(1.22)	(24.59)	(4.38)	(3.05)	(13.33)	(2.84)
$Debt_{i,t}/GDP_{i,t}$	-0.02**	0.01	-0.01	-0.04***	-0.03***	-0.03***	-0.05***	-0.03***
	(0.58)	(0.56)	(0.35)	(0.97)	(0.43)	(0.76)	(1.27)	(0.88)
R^2 - adjusted	0.83	0.94	0.84	0.99	0.97	0.97	0.98	0.96
Observations	1527	1527	1527	836	1527	1527	1527	1527

Table A9. Dynamic OLS with US Corporate spreads. The table reports the estimated cointegrating vector's coefficients along with their respective robust standard errors from a dynamic ordinary least squares regression of country i across the whole sample. The model specification is defined as: $Y_{i,t} - Y_{GER,t} = \beta_{i,0} + \beta_i X'_{i.t} + \delta_{i,j} \sum_{j=-q}^{r} \Delta X'_{i.t+j} + \gamma_{4,i} D'_t + S\&P_t + \frac{Debt_{i,t}}{GDP_{i,t}} + u_{i,t}$. Where $S\&P_t$ is the long-term credit rating by S&P, $\frac{Debt_{i,t}}{GDP_{i,t}}$ is the Debt-to-GDP ratio, D'_t is a dummy variable that indicates the breakpoint on the 10th of May, 2010, and $X'_{i.t}$ is the vector of coefficients: CDS_t, CDS spread differentials, US spreads between corporate bonds (BBB rating) and Treasury bills $US_{i,t}^{spr}$, $KfW_t^{\,i}$ the KfW spread against the German Bund, and $CON_{i,t}$ the contagion index. $\Delta X'_{i.t+j}$ represents the vector of differentials of the variables. The selection of the q leads and r lags was set to six. The estimates are corrected for heteroskedasticity and autocorrelation in the residuals, computed using the Newey-West estimate of the error variance. Robust standard errors are reported within parentheses below their coefficient estimates. Sample period: 1 Jan. 2008 – 31 Dec. 2013.

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