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CDS-Bond Basis: An Empirical Study of European Sovereign Credit Spreads

Master Thesis

by
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MSc in Finance

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ABSTRACT

We study the eurozone sovereign CDS-bond basis and evaluate the link between the sovereign CDS premiums and the corresponding bond yield spreads. We find statistically significant differences in determinants of sovereign credit risk in periods of market distress and in normal times between 2010 and mid-2021. We also confirm substantial heterogeneity among countries in the euro area and that creditworthy countries react differently in times of market distress compared to riskier nations. There is a sustained positive CDS-bond basis in countries like Germany and UK and a recurring negative basis for countries like Italy and Portugal. These results imply that limits-to-arbitrage partly can be explained by liquidity constraints, flight-to-liquidity, currency risk, and counterparty risk in the cash and derivative market.

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1 Introduction

The law of one price states that in an efficient market, two assets with identical cash flow should have the same price. If the law is violated, an arbitrage opportunity will arise, and the arbitrageur can earn a ”risk-free” return; hence, prices should rapidly converge (Ross, 1976). On the other hand, empirical evidence shows that markets are not fully efficient, and this theory of one price does not hold. In this thesis, we study the eurozone sovereign credit markets, more specifically, we study the link between a country’s Credit Default Swap (CDS) and its corresponding government bond. A CDS contract is a popular derivative product that allows the investor to swap a company or a country’s default risk in exchange for a periodic payment. The characteristics of a CDS are similar to an insurance contract. The investor pays a periodic premium to the seller until maturity or until the underlying entity default (Hull, 2003). In order to obtain a similar exposure to a credit default risk, an investor can also short the bond for the same underlying security and go long a risk-free bond; this yield is called the bond spread. In an efficient market, the CDS premium and bond yield spread with the same maturity should provide the investor with the same exposure, thus, they should offer the same yield. Our motivation for this study is to define risk drivers in the sovereign credit risk market and we believe that a better understanding of the risks can assist policymakers, regulators, and investors make more informed decisions.

The traditional arbitrage theory in the CDS-bond basis states that the basis (the difference between the CDS premium and the corresponding bond yield spread) should be close to zero (Duffie, 1999). Over the last decade, the European financial markets have experienced several market disruptions and high market volatility periods that have challenged the no-arbitrage theory.

We examine the limits-to-arbitrage theories that define the credit spread proxies in the period after the great global financial crisis in 2010 until June 2021. Fontana & Scheicher (2016) documents that the basis has deviated from zero, and explains how funding cost affects "convergence trading," which keeps the basis negative. The authors identify and examine the "flight-to-quality/liquidity" phenomenon, suggesting that more creditworthy countries like Germany have larger bases due to low government bond yields. In comparison, lower creditworthy countries such as Italy have a persistent lower CDS-Bond basis.

Furthermore, there exists extensive research into the explanations for why this deviation persists through time. Bai & Collin-Dufresne (2011) find that counterparty risk, funding risk, and collateral quality affect the relationship. These findings motivate us to investigate and isolate the differences in the dynamics during high-uncertainty periods based on specific threshold criteria. We specify the research question as:

"How do periods of high market uncertainty affect sovereign credit spreads in the Eurozone, and are risky sovereigns more sensitive to macro risks than comparably more robust economies?"

To answer the research question, we follow some of the methodologies and data collecting procedures deployed in the working paper Fontana & Scheicher (2010). The methodology allows us to compare time series and cross-sectional dynamics in the spreads and the bases over multiple periods. We aim to control if the same traditional factors are still relevant with newer data and in line with the literature. In contrast to Fontana & Scheicher (2010), we apply a new approach to collectively isolate the periods of market distress vs. normal times. We justify our threshold using the VIX 75th percentile to filter for periods of market distress, and normal times otherwise.

Moreover, we conduct panel data regressions to control for country-fixed effects, and we collect credit risk proxies, global risk factors, and regulatory proxies to identify the determinants of the dynamics. Following Fontana & Scheicher (2010), we separate the sample into two subgroups to isolate the differences between higher and lower creditworthy countries. The core subsample consists of Austria, Belgium, Finland, France, Germany, the Netherlands, and the United Kingdom. The peripheral subsample consists of Italy, Portugal, and Spain. Primarily, the methodological strategy consists of three elements. First, we run separate panel regressions on CDS premiums and the bond yield spreads during market distress vs. normal times with variables inspired by traditional structural credit risk models of Merton (1974). Secondly, we apply a broader set of explanatory variables and conduct an extended panel regression for the spreads and basis. Lastly, we conduct a Principal Component Analysis on the spreads and the residuals from the panel regressions.

Our main contribution to the existing literature on sovereign credit spreads consists of two components. First, we separate and collectively isolate periods of market distress in the eurozone area. This isolation allows us to study how European sovereigns behave during high uncertainty periods. Where previous studies focus on single crises and credit events, e.g. Fontana & Scheicher (2016), we show how traditional credit risk models' determinants affect credit spreads differently through multiple periods. Secondly, with both sovereign CDS and bond data from Jan 2010 until June 2021, we can study the CDS-bond basis after the standardization of CDS contracts which increased the liquidity of the CDS market (Wang et al., 2021).

The main finding of this paper is that the CDS premium and bond yield spread reacts differently in periods of market distress vs. normal times. For both periods, we find that the traditional proxies for liquidity, volatility, and leverage are more significant in normal times compared to times of market distress and that there are differences across time. We also uncover that peripheral countries are more sensitive to global risk factors and liquidity proxies in periods of market distress compared to core countries.

From the panel regression where the variables are based on traditional credit risk proxies, we find that interest rate risk has strong positive effects on core countries for both CDS premiums and bond spreads in normal times and little to no effect on peripheral countries. Leverage primarily affects market distress for bonds, but there is some indication that a country's leverage ratio correlates negatively with CDS premiums for weaker sovereigns. Liquidity is affecting core countries in both periods. An increase in the bid-ask spread on corporate CDS has downward pressure on CDS premiums in volatile times. Increased volatility in the traditional structured model in Merton (1974) predicts an upward pressure on credit spreads. Our empirical analysis indicates that increased uncertainty increases bond spreads for risky sovereigns in distressing times, but volatility in normal times seems to do the opposite for core countries. We confirm from earlier studies that the CDS corporate bond market has a high correlation with credit spreads in the cash and derivative markets, where we find significant upward pressure on both spreads in normal and distressing times.

We find evidence that an increasing term structure of interest rate and an increasing foreign exchange rate between the euro and the USD has downward pressure on the spreads. On currency risk, we find that EUR/USD volatility has a much stronger relationship in market distress on the spreads compared to normal times. These currency risk results indicate that the market deems sovereign credit risk riskier when volatility passes a certain threshold and does not react notably when the volatility is relatively low. Another important finding is the effect of the Asset Purchasing Program from the ECB. The program's objective is to increase liquidity in the peripheral bond markets in the euro zone area (Andrade et al., 2016). We find strong, statistically significant relationships between the program and the spreads.

Interestingly, we find that idiosyncratic risks are not essential drivers for sovereign credit risk, indicating that macro risks play a crucial role in predicting default risk from countries in the euro zone. Lastly, we find that peripheral countries react with lower credit spreads to increased market volatility in the euro area in times of market distress, whereas increasing volatility in core countries has increasing spreads in normal times. The result of market volatility reflects the ambiguity between the cash and derivative market in sovereigns in the euro area, where the core and peripheral countries react opposite to market movements and in different market environments.

In the principal component, we discover a single common factor that drives the CDS premiums and bond yield spreads. Applying a similar method as Collin-Dufresne et al. (2001), we do a PCA on the CDS premium, bond spreads, and CDS-Bond basis and compare them to the PCA on the residuals of the benchmark regression. The CDS-bond basis is more diverse in its factors, where the first five PCs explain 75% of the spread's variance.

2 Theory

2.1 Credit Default Swap

A Credit Default Swap is the most popular credit risk derivative whose purpose is to transfer default risk from the protection seller to the protection buyer, where the underlying security, in this case, the country, is called the reference entity (Hull, 2003). The protection buyer pays periodic installments until the maturity of the CDS contract or until the reference entity default, which triggers a credit event. The sovereign CDS contracts usually have a maturity of between 1-10 years, and the settlement for a credit event can be both physical delivery and cash settlement. If the reference entity has several underlying bonds specified in the contract, the buyer has a "cheapest to deliver option" in the case of physical settlement, but in recent times cash settlement has been widely used through an auction scheme[1]. With cash settlements, the number of outstanding CDS contracts can be larger than the number of underlying entity bonds.

The pricing of CDS contracts is derived similarly to a vanilla interest rate swap, where the value is zero at initiation for both parties. Since 2009, there has been a standardization in CDS contracts, where the CDS premium is preset to 100 bps or 500 bps, where additional upfront payments set the value equal to zero at the initiation[2].

[1] See Ammer & Cai (2011) how the "cheapest to delivery option" affects sovereign CDS prices.

[2] For more detail on standardization of CDS contracts in 2010, see Markit (2009).

$$EPV\,(Total\ CF\ buyer) = \sum_{i=1}^{T} z(0,i) \cdot q(i) \cdot \frac{x}{4} + \sum_{i=1}^{T} z(0,i) \cdot [q(i-1)] \cdot \frac{X}{4} \cdot \frac{1}{2} \quad (1)$$

$$EPV\,(CF\ seller) = \sum_{i=1}^{T} z(0,i) \cdot [q(i-1) - q(i)] \cdot (1-R) \quad (2)$$

$$x = \frac{\sum_{i=1}^{T} z(0,i) \cdot [q(i-1) - q(i)] \cdot (1-R)}{\sum_{i=1}^{T} z(0,i) \cdot q(i) \cdot \frac{1}{4} + \sum_{i=1}^{T} z(0,i) \cdot [q(i-1) - q(i)] \cdot \frac{1}{8}} \quad (3)$$

We set the Expected Present Value (EPV) from the protection buyer equal to the expected value of the protection seller and solve for the spread x to find the periodic payment until the maturity or until a credit event. $z(0,i)$ is the discount factor, $q(i)$ is the default probability, and R is the recovery rate. Investors buy and sell sovereign CDS for several reasons: (i) Speculation, where they take positions based on a short-term expectation of the direction of one or several securities. (ii) Risk management, where they hedge macro risks for specific countries. (iii) Arbitrage trading bets against convergence or divergence of economic relationships such as the CDS premium vs. bond spreads.

2.2 Credit Spreads

The credit spread is the difference between the yields of two bonds with different characteristics with the same maturity. The credit spread for sovereign debt is the government bond's yield over a risk-free rate. There are several proxies to use for the risk-free rate in the Eurozone. Haugh et al. (2009) uses the German bund as the risk-free rate, deemed the most stable and liquid government debt in the Eurozone. The downside of using the German bund as the risk-free rate is that we must exclude Germany from our regressions on CDS premium and bond spreads. Another popular method is to use the swap rate based on overnight lending between banks, used in the papers of Bai & Collin-Dufresne (2019) and Klingler & Lando (2018). The swap rate is the fixed portion of a fixed-for-float swap contract. We use the 5-year EONIA for all the nine countries in the Eurozone area and SONIA for the United Kingdom.

The interest rate differs widely between countries in the Euro area, and an essential determinant for the variability is the risk premium the investor requires to hold the security[3]. We can divide risk premium into two categories: credit risk, compensating the investor for the expected loss from the debtor in case of a default, and liquidity risk, which is the premium of not being able to sell the security close to its real market value. The credit spread should, in theory, isolate the credit risk from other risks embedded in the interest rate, but the evidence is that both CDS premium and bond spreads contain elements of uncertainty outside credit risk. Ammer & Cai (2011) find that the relationship between the CDS premium and bond spreads with the same underlying entity is not the same and that the cheapest-to-delivery option and liquidity constraints drive some of the difference.

2.3 CDS-Bond Basis

Duffie (1999) showed that an exact relationship exists between a risky floating rate bond, a risk-free floating rate bond, and a CDS contract, all trading at par, with the same maturity, and where the risky bond and the CDS contract have the same underlying. In the case of a credit event, the CDS protection seller would compensate the buyer with the difference between the face value

[3] See Haugh et al. (2009) for more detail on the embedded risk premium in sovereign debt.

and the market value of the underlying bond. Thus, as mentioned, a long position in a CDS contract is similar to a short position in the same reference entity bond, and long a risk-free rate bond should be the same:

$$CDS\ premium = Bond\ Yield - risk\ free\ rate \tag{4}$$

Hence, the two strategies should have the same risk and return relationship. The CDS-bond basis equation is then:

$$CDS\ bond\ basis = CDS\ premium - bond\ yield\ spread \tag{5}$$

If this relationship does not hold and the market is efficient, there is an arbitrage opportunity. If the CDS premium is higher than the bond yield spread, implying a positive basis, an investor can short the bond, short the CDS, and lock in a risk-free profit. If the CDS-bond basis is negative, the bond yield is higher than the CDS premium. Hence the bond is cheaper than the CDS, and the investor should buy the bond and buy the CDS financed by borrowing at the risk-free rate. However, there is well-documented research into the limitation-of-arbitrage which we cover in the literature review (Section 3.2).

3 Literature review

We discuss the relevant theory for our study below. We first cover the important early work on credit risk on both corporate and sovereign debt, and then we give an overview of studies regarding CDS premiums. Lastly, we cover essential papers regarding the CDS-Bond Basis and findings on the determinants for the deviation from the law of one price.

3.1 Credit Spreads

The literature on credit risk is extensive, and one of the early seminal studies on credit risk is Merton (1974), which is still relevant for both students and researchers. By using contingency claim analysis inspired by Black & Scholes (1973), he developed a structural model to explain the price of risky debt with observable variables similar to the option pricing theory. With the four variables: Time, value of the underlying, a constant risk-free rate, and volatility, the model can price any risky debt contracts. Since the first three variables are directly observable and volatility can easily be estimated through time-series data on the underlying security, the variables can directly be tested empirically and applied to other credit risk puzzles. Later, Gapen et al. (2005) extended the Merton (1974) model to analyze and measure sovereign debt. This study is essential to our research, where we base our benchmark panel regression on proxy variables developed in this study. However, practitioners no longer use structural models to price default risk instruments. Instead, they use reduced-form models[4]. A reduced-form model uses statistical processes such as stochastic interest rates to calculate the probability of default. The main difference between the models is that a reduced form model makes use of fewer assumptions to find the probability of default. However, structural models are still widely used to analyse credit

[4]See for example Jarrow & Turnbull (1995) for a reduced form model on credit risk.

risks, where the models' inputs are based on economic theory and utilize information on the entity's capital structure.

Important discoveries on corporate bond spreads were made by Collin-Dufresne et al. (2001), where they find a single common factor captures 48.4% of the unexplained variation and that firms-specific and macroeconomic variables are poor indicators of yield spreads. The regression model used in the study is popularly called a CDGM model, which later studies into yield spreads have used as a benchmark for further investigation. We employ a similar methodology to our study, where we conduct a panel regression model on explanatory variables onto credit spreads before conducting a principal component analysis of the residuals of the CDS premiums, bond yield spreads, and the CDS-bond basis regressions. We also perform a PCA analysis directly on the spreads and CDS-bond basis data.

The large single common factor for yield spreads has been (and still is) a puzzle to solve. A recent study by Friewald & Nagler (2019) finds that systematic over-the-counter market friction explains 23.4% of the variation in the first common factor. They run a CDGM model, add systematic OTC market components to the model, and compare the principal components on the residuals of the two models.

In our extended model, we utilize some of the same variables used by the papers above to explain changes in sovereign spreads and bases. There is evidence that sovereign and corporate credit spreads are correlated. Bedendo & Colla (2015) finds that an increase in sovereign risk increases the corporate credit spread for non-financial firms. Hence, the expectation is that some of the same factors determine changes in both sovereign and corporate credit spreads.

Evidence shows that liquidity is integral to sovereign CDS premiums and bond spreads. According to Beber et al. (2009), credit quality and liquidity are non-trivial in explaining sovereign bond yields. Especially in times of market distress, investors focus on liquidity rather than credit quality. In our study, we will use proxies for liquidity risk that we connect to the phenomena of flight-to-liquidity in distressed times.

Before the global financial crisis in 2007-2008, default risk among advanced economies was not considered a significant risk. The study of Dieckmann & Plank (2012) provides evidence of private-to-public risk transfer in strong economies and finds co-movements in CDS premiums and the country's financial sector. The close relationship between a country and its financial institution can reduce the insurance provided by CDS contracts, and counterparty risk will possibly matter more for sovereign CDS than for corporate CDS (Fontana & Scheicher, 2016). Its widely documented that corporate bond defaults have a strong negative correlation with the business cycle, where we see clustered defaults at distressed times. Jarrow & Turnbull (1995) show that these correlated defaults are not only due to common risk factors but to firm-specific risks called counterparty risk. Our study uses an indirect proxy for counterparty risk to study the differences between periods of market distress and normal times.

3.2 CDS-Bond Basis

In March 2009, there was a so-called big bang in the CDS market, where CDS products started to be sold through standardized contracts with predetermined periodical payments and upfront premiums (see Section 2 above). This new standard led to a more liquid derivative market of CDS contracts which increased the data availability for empirical studies into credit. Wang et al. (2021) displays how the bid-ask spread on CDS contracts dropped significantly after March 2009 and thereby confirmed the theory by Brunnermeier & Pedersen (2009) that funding cost is negatively related to market liquidity. Funding cost and liquidity constraints play important roles in the sovereign CDS market. There are costs connected to short-selling and collateralization of securities (Bai & Collin-Dufresne, 2019);(Lleshaj & Kocian, 2021). Short selling requires an initial margin on the amount shorted, and collateralization of securities only funds a portion of its market value. These frictions create potential limits to arbitrage between the CDS premium and bond spread, where deviation from the no-arbitrage relationship can proceed for extended periods. We will use proxies for liquidity costs in our model based on the fundamental findings from Brunnermeier & Pedersen (2009), which state that market liquidity comoves with funding costs (margins and haircuts[5]) where there is an element of "flight-to-liquidity" in market distress and that asset volatility negatively affects liquidity.

Fontana & Scheicher (2016) find evidence that sovereign credit markets are affected by liquidity components mentioned in Brunnermeier & Pedersen (2009). Their study compares market prices of sovereign credit default swaps and bond spreads with the same underlying country in the euro area. They find that the CDS-Bond Basis significantly deviates from zero over time, where a positive basis can be explained by short-selling frictions and "flight-to-liquidity" effects, and that funding frictions partly determine the negative basis. They also find that countries with a strong economy and liquid markets have a sustained positive basis and that comparatively weaker countries have an ongoing negative basis. Inspired by this paper, we use a similar methodology through a sample of weekly data in our empirical study.

[5] A haircut is the difference between the amount funded by the collateral and its market value (Metrick & Gorton, 2010).

When we investigate the CDS-bond basis in market distress and normal times, we use the VIX index as a broad market volatility index to categorize the two periods of high and low volatility.

Previous studies of the CDS-bond basis in the global financial crisis in 2007-2008 by Bai & Collin-Dufresne (2011) finds evidence of a consistent negative basis that is partly explained by liquidations of bonds by large financial institutions to free up balance sheet space which creates downward pressure on bond prices. However, since the basis was consistent, there must be some limits to arbitrage (Shleifer & Vishny, 1997). Other determinants found in the study are funding cost risk and counterparty risk. In our panel regression, the proxy for counterparty risk partly explains the decrease in CDS premiums in times of market distress, which leads to a lower CDS-bond basis.

Noteworthy findings on the sovereign CDS-bond basis are found by Klingler & Lando (2018), who found a disconnect between CDS premiums and bond spreads for safe sovereigns. These findings are consistent with our study into sovereign credit spreads, where we also find that safe and risky countries do not correlate noteworthy in times of market distress and normal times. Other studies, such as Longstaff et al. (2011), find that sovereign credit spreads are more related to the US stock market than local economic measures. Our panel regression includes proxies for the US market and idiosyncratic variables for each country to see if the findings still hold across high and low volatile times.

4 Hypothesis Development

This section briefly introduces how we evaluate and design our approach to the research question. In general, we develop three hypotheses that form the groundwork of this study. After Gapen et al. (2005) expansion of the Merton (1974) credit risk model, the related literature has extensively focused on the credit spreads during single financial crises and pre/post single credit events. The literature settles on several factors that determine the dynamics but struggles to identify the single common factor as Collin-Dufresne et al. (2001) do for the unexplained variation in corporate bond spreads. Thus, we investigate whether the difference in the determinates of the CDS premiums, bond yield spreads, and the bases is consistent through time and across eurozone countries. Eventually, we derive the following three hypotheses:

Hypothesis 1: *The traditional credit risk factors affect the credit spreads differently during market distress vs. normal times.*

The CDS premium and the bond yield spread should offer the same risk-return characteristics (Ross, 1976), but we expect the changes in liquidity risk, counterparty risk, and currency risk to influence the spreads differently over the two subperiods.

Hypothesis 2: *Peripheral sovereigns depend more on global market risk proxies than core sovereigns in market distress periods.*

According to the previous studies, credit risk proxies, followed by liquidity and currency proxies, affect the peripheral and core sovereigns differently over extended periods. We expect to see collective differences between the two groupings during periods of market distress.

Hypothesis 3: *Flight-to-liquidity and currency risk are essential drivers for a positive CDS-bond basis for creditworthy countries in times of market distress.*

We expect that investors' preferences for safe assets during turbulent times and an implicit currency hedge in the CDS contracts denominated in dollars contribute to a sustained positive basis in safe countries.

5 Methodology

The two main methods we use in our empirical analysis are panel regressions and Principal Component Analysis. Below we give a brief explanation of why we decided to use these methods and how they work:

5.1 Panel Regression

The goal is to capture relationships and explanatory variables in credit spreads that might differ through time, such as differences in market distress and normal times. Panel data regressions allow us to control for cross-sectionality in the data to focus on significant changes across the sample across all spreads. We use the approach called a fixed-effect model, where in this case, we control for cross-sectional differences between the countries. We conduct the time series analysis of the spreads as follows:

$$Y_{it} = \alpha + \beta' X_{it} + \mu_i + v_{it} \tag{6}$$

Where Y_{it} is a vector of dependent variables for country i in time t, β' is the regression coefficient vector, X_{it} is the covariate of independent variables, μ_i is the fixed effect vector which encapsulates all the cross-sectional effects on Y_{it} and, v_{it} is an error term. This technique allows us to investigate the time dependency that is not affected cross-sectionally. In our case, Y_{it} is the CDS Spreads, bond-spreads, or CDS-bond Basis for each country i in period t and X_{it} is the variables we expect to correlate with the spreads.

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We test the credit spreads using the equation (7) below. The first panel regression builds on the theoretical framework of Merton (1974), and its adjusted to incorporate sovereign credit risk according to Gapen et al. (2005). The main reason for this regression is to figure out how traditional variables in structural models explain sovereign credit risk in liquid markets. The second extended panel regression adds variables we hypothesize to be significant to the spreads that align with the literature. We divide the sample into periods of market distress and normal times according to a threshold filtered with the VIX Index 75th percentile[6].

$$\begin{aligned} \Delta Y_{i,t} =& \beta^{Factor1} Factor1_{i,t} + \beta^{Factor2} Factor2_{i,t} + ... \\ &+ \varphi^{Factor1} Factor1_{i,t} \times 1_{\{peri\}} + ... + \mu_i + \epsilon_{i,t} \end{aligned} \tag{7}$$

Where the ΔY_{it}represent the weekly changes in the CDS premiums and bond yield spreads in two separate regressions for for country i at time t. On the right-hand side, we have the changes in the explanatory variables and their corresponding beta coefficients. $Factor1_{i,t} \times 1_{\{peri\}}$ represent the control variables for comparatively weaker countries equal to one for the peripheral sovereigns Italy, Portugal, and Spain, and zero otherwise. μ_i is the fixed effect vector that encapsulates all the cross-sectional effects on ΔY_{it} and $\epsilon_{i,t}$ is an error term.

[6]See section 6.3 for threshold justification

Before every panel regression, we run tests for stationarity and heteroskedasticity. For stationarity, we apply the test developed for panel data by Levin et al. (2002) for all the panel data in levels. We do not reject H0 (unit root case) for any panel regression in levels. Hence, we apply the first differences for all the variables. We apply the Breusch-Pagan test (Breusch & Pagan, 1979) for benchmark regression and the extended regression to test for heteroskedasticity, and we find evidence at 5% significant that there is heteroskedasticity in the panel data. To control for heteroskedasticity, we calculate the t-statistics with robust standard errors[7]. All panel regressions in this study are conducted using RStudio.

5.2 Principal Component Analysis

We conduct an explanatory factor analysis to understand the underlying spread and basis variation. This analysis shows the amount of variance explained by the main underlying factors through a principal component analysis Wold et al. (1987). The different variables in the panel regressions do not explain a significant portion of the changes in the spreads and basis. Hence, factor analysis on the residuals can show co-movements and directions of common factors not explained by the regression. Principle Component Analysis is essentially a dimensionality reduction technique where we can take a correlation matrix Π of the explanatory variables in the regression and decompose it into eigenvalues and eigenvectors:

$$\Pi = C^{-1} \times \lambda \times C \tag{8}$$

Where λ is the diagonal matrix with the eigenvalues and C is the non-zero eigenvector matrix, all $n \times n$ dimensions. The idea is to transform the ex-

[7]The results are reported in the regression tables, but detailed results are omitted due to space.

planatory variables into uncorrelated principal components and then report how much each principal component captures the unexplained proportion of variance in the response variable. In our case, the spreads and basis are the response variables, and the explanatory variables are the macro and market risk proxies. We use RStudio to conduct the principal component analysis. More specifically, we use the r-package “plm“ and a built-in function constructed for assessing principal components in panel data.

6 Data

In this section, we provide the information on the data used in the analysis of the credit spreads and what expectations we have for the different proxy variables. The first part summarizes the countries we use in the regressions and their descriptive statistics. Further, we introduce the variables employed as proxies for the different risks. Due to the extensive data set, we have spent a lot of time organizing, computing, and filtering the data. For the most part, we collected the data we needed for the study, but there are some minor limitations of data availability in the sources from the BI library. When we did not access the desired data, we used the closest related data or omitted the variable.

6.1 CDS Premium and Bond Yield Spreads

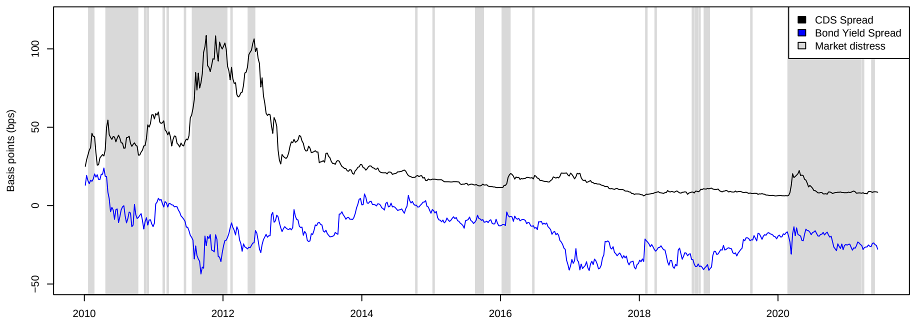
The analysis focuses on the credit spreads at a weekly frequency for the following 10 European countries: Austria (AT), Belgium (BE), Finland (FE), France (FR), Germany (DE), Italy (IT), Netherlands (NL), Portugal (PT), Spain (SP), and the United Kingdom (UK). The sample covers the period from January 1, 2010, until June 9, 2021. The CDS spreads are obtained with a 5-year maturity using US dollars and are sampled on a mid-week frequency (Wednesdays)[8] from the Bloomberg terminal.

We collect each country's corresponding 5-year government bond yields from Bloomberg with a mid-weekly frequency. The Bloomberg terminal uses the latest 5-year government bond prices to calculate the yields. We follow Klingler & Lando (2018) and obtain the country-specific risk-free proxies as the overnight lending rates with the same 5-year maturity from Bloomberg.

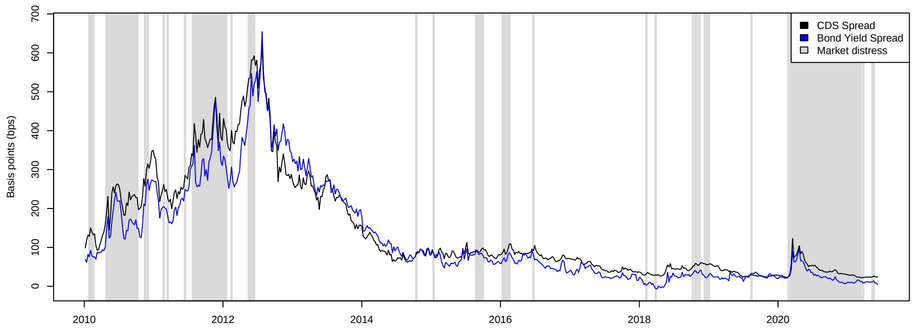
[8]Mid-week frequency allows us to control for autocorrelation that occur with weekly average.

We use the EONIA swap rates for the countries that use euro, and for the United Kingdom, we use the SONIA swap rates. The rates represent the 5-year overnight interest rate spreads (OIS) for unsecured interbank borrowing in the European countries. Finally, we calculate the bond yield spreads by subtracting the risk-free proxy from the government bond yield.

Figure 1 displays the credit spreads for (a) Germany and (b) Spain in periods of market distress vs. normal times. We see a significant difference in the time series dynamics between the two sovereigns. Germany generally holds a lower CDS premium than Spain, and we also see a more substantial disconnect with their corresponding bond yield spread. In times of market distress, both sovereigns typically experience an increase in the CDS premium. On the other hand, the main difference between the two is the bond yield spread: Spain's yield spread encounters a stronger co-movement with the CDS premia, in contrast to Germany, that experience an instant divergence in the event of market distress. During normal times, we observe an essential element: Where Spain sees a decreasing trend in both credit spreads, Germany first sees a mean reversion between 2012 and 2015, but later, between 2016 and 2018, the relationship diverges.



(a) Germany



(b) Spain

Figure 1: Credit Spreads - Two sovereigns

Figure (a) and (b) show the time series of the CDS premium and the corresponding government bond yield spread for Germany and Spain, respectively. The CDS premium and the bond yield spread have a 5-year maturity and are sampled every Wednesday at a weekly frequency. The bond yield spread is computed by subtracting the risk-free proxy (EONIA) from the national benchmark bond of the respective sovereign. The grey areas display the periods of market distress with the threshold of the 75th percentile of the VIX index. All observations are in basis points (bps).

Table 1 contains summary statistics for all sovereigns' CDS premium and bond yield spreads. We divide the statistics into market distress vs. normal times filtered with the VIX 75th percentile threshold. On average, the core sovereigns have lower spreads over both subperiods than the peripheral countries. Furthermore, we see significantly higher spreads during market distress vs. normal times over the whole sample. Finland, Germany, and the Netherland have the lowest credit spreads over both periods.

Table 1: Descriptive Statistics Credit Spreads

The table reports the descriptive statistics of all countries' CDS premiums and corresponding government bond yield spreads during periods of market distress vs normal times from January 6, 2010, to June 9, 2021. The bond yield spread is calculated by extracting the risk-free proxy from the government bond yield. For the countries that use Euros, we apply the EONIA swap rate as risk-free, and for the UK, we apply the SONIA swap rate. All securities have a 5-year maturity and are at a weekly frequency (Wednesdays). All observations are in basis points (bps).

	Market Distress				Normal Times			
	CDS Premium	Bond Spread			CDS Premium	Bond Spread		
	Mean	Mean	Corr	N	Mean	Mean	Corr	N
AT	61.22	21.51	0.91	149	36.01	4.03	0.83	447
BE	96.89	59.08	0.97	149	56.52	21.51	0.93	447
FI	30.01	-0.69	0.62	149	22.99	-5.74	0.6	447
FR	67.49	18.11	0.91	149	47.03	11.48	0.86	447
DE	35.65	-18.04	-0.08	149	23.34	-16.15	0.26	447
IT	200.03	175.25	0.96	149	155.89	140.94	0.94	447
NL	38.79	-3.44	0.77	149	30.06	-5.25	0.72	447
PT	361.37	367.77	0.99	149	269.96	276.1	0.99	447
SP	169.81	134.58	0.99	149	132.37	121.13	0.97	447
UK	46.17	6.06	0.78	149	32.55	4.32	0.24	447
Core	53.75	11.8	0.70		35.5	2.03	0.63	
Peripheral	243.74	225.87	0.98		186.07	179.39	0.97	

As we can see from the table, the peripheral sovereigns have a higher correlation[9] in periods of market distress than the core sovereigns. Where Italy, Portugal, and Spain report a 0.96, 0.99, and 0.99 correlation, respectively, Finland and Germany report a 0.62 and -0.08 correlation. This observation is displayed in Figure 1 above, where we see a substantial disconnect in the spreads between Germany and Spain during the shadowed areas. On the other hand, we see a slightly lower average correlation amongst the core sovereigns during normal times. Notably, we see that Germany holds a positive 0.26 correlation in this period and that the UK reports an even lower correlation of 0.24.

6.2 Computing the Basis

The process for computing the CDS-Bond Basis is simply extracting the bond yield spread from the CDS premium for each sovereign (see Section 2.3). Ta-

[9] Pearson Correlation Coefficient.

ble 2 reports the summary statistics for all CDS-bond basis during periods of market distress vs. normal times filtered with the VIX 75th percentile threshold. In periods of market distress, the core sovereigns report a higher basis with an average of 41.95 bps vs. the peripheral sovereigns holding an average of 17.87 bps. Notably, we see that Portugal is the only country with a negative average during normal times. From the table, we have three main takeaways to explain the dynamics. First, peripheral countries are more volatile than core countries in both market distress and normal times, with a standard deviation of 49.19 and 44.19 bps, respectively. Second, core sovereigns have a higher max basis during market distress than normal times. Lastly, we see that the peripheral sovereigns have, on average, a basis of 6.69 bps in normal times. These time series are also visualized in Appendix A.1 and A.2 for core and peripheral sovereigns, respectively. Notably, we see recurring yet, very volatile, negative bases for the peripheral countries and a sustained positive basis for the core sovereigns, especially from 2014 until June 2021.

Table 2: Descriptive Statistics CDS-Bond Basis

The table reports the descriptive statistics of all sovereigns' CDS-Bond Basis during market distress and non-distress periods between January 6, 2010, to June 9, 2021. The CDS-Bond Basis is computed by the CDS premium minus the bond yield spread. All observations are at a mid-weekly frequency and in basis points (bps).

	Market Distress					Normal Times				
	Mean	St.dev	Max	Min	N	Mean	St.dev	Max	Min	N
AT	146.87	32.20	146.87	-12.21	149	31.98	20.11	138.16	-2.78	447
BE	161.52	31.57	161.52	-12.85	149	35.01	24.06	125.61	-30.78	447
FI	80.68	19.32	80.68	-11.24	149	28.73	13.69	74.49	-19.23	447
FR	148.33	41.73	148.33	7.01	149	35.55	24.52	141.91	2.11	447
DE	137.68	36.19	137.68	18.04	149	39.49	19.82	118.32	6.10	447
IT	141.14	40.96	141.14	-132.17	149	14.96	33.57	110.68	-83.72	447
NL	122.78	26.39	122.78	7.67	149	35.31	16.96	104.86	-1.57	447
PT	115.86	77.94	115.86	-382.16	149	-6.13	66.79	150.40	-352.82	447
SP	118.37	28.68	118.37	-36.17	149	11.24	32.22	136.37	-93.17	447
UK	88.26	21.60	88.26	5.41	149	28.24	18.32	85.38	-6.11	447
Core	41.95	29.86	126.59	0.26		33.47	19.64	112.68	-7.47	
Peripheral	17.87	49.19	125.12	-183.50		6.69	44.19	132.48	-176.57	

6.3 Threshold Justification

The model focuses on cross-sectional differences between sovereigns during market distress and normal times. Longstaff et al. (2011) find that most sovereign credit risks can be related to global risk factors and that the US stock market returns are significant for 17 sovereigns. Therefore, we outline the model using a global risk proxy defining periods of financial uncertainty. In general, we aim to isolate the data into periods where we see high uncertainty in the US stock market and investigate how this affects the European sovereign credit spreads. Hence, we justify our threshold using the VIX Index with its 75th percentile threshold (Figure 2).

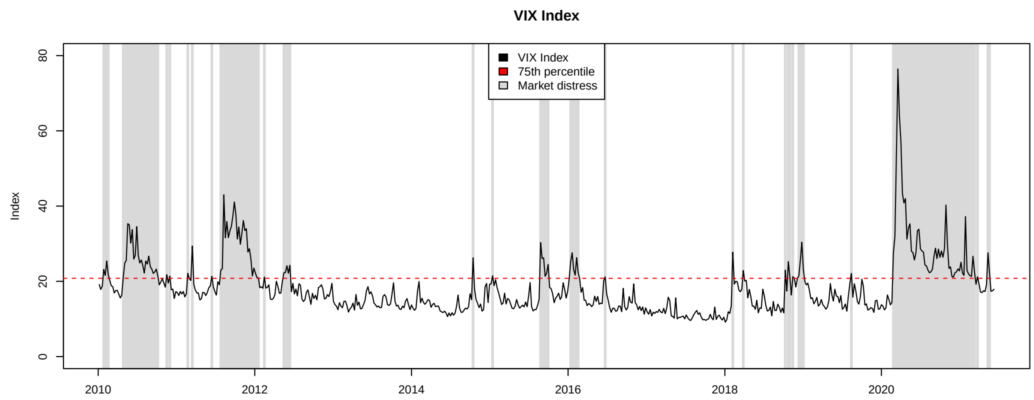


Figure 2: VIX Index

This figure shows the time series dynamics of the CBOE VIX Index from January 6, 2010, to June 9, 2021. The index is sampled every Wednesday and is expressed in index points. The grey areas display the periods of market distress with the threshold of the 75th percentile of the VIX index.

6.4 Set of Variables

This subsection presents the set of variables used in our empirical models. Table 3 below summarizes the variables' definition and their notations. Accordingly, we also report our expectations for the covariate coefficient for the credit spreads with their respective data source.

Table 3: Set of Variables with Expected Sign

This table shows an overview of the set of variables and includes our notation, variable definition, covariate expectations, and the source. The table includes proxies for credit risks, global and idiosyncratic risks, and currency and liquidity risks that we apply in the benchmark and extended panel regressions.

Notation	Variable Definition	Exp. Sign (+/-)	Source
Rf	3-month Euribor	(-)	Bloomberg
SLOPE	10-year Euribor minus 3-month Euribor	(-)	Bloomberg
RA	S&P 500 VIX Index	(+)	Bloomberg
iTraxx	European Corporate CDS Index 10Y	(+)	Bloomberg
BidAsk	iTraxx Bid-Ask 10Y	(-)	Bloomberg
R	National Indices Returns	(-)	Bloomberg
VOL	Realized Volatiltiy of R	(+)	Bloomberg
Leverage	Oustanding gov. Debt over GDP	(+)	ECB/BoE/BoP
FX	EUR/USD Exchange rate	(+)	Bloomberg
EVZ	EUR/USD Exchange rate Uncertainty	(+)	Bloomberg
APP	Asset Purchase Program	(-)	ECB
VSTOXX	EURO STOXX 50 volatility	(+)	Bloomberg

We follow Fontana & Scheicher (2016) and apply the three-month Euribor rate as a broad European risk-free proxy in the panel regression. There are several theories on how the risk-free rate affects credit spreads. According to Merton (1974), an increase in the risk-free rate will increase the call option price in the model, which again decreases the value of debt and leads to lower credit spreads. However, Morris et al. (1998) found the opposite: the credit spread widens with an increasing risk-free rate. Empirical evidence from Fontana & Scheicher (2010) reports a negative relationship between the spreads and the risk-free rate.

Like Merton (1974), Longstaff & Schwartz (1995) find that an increasing risk-free rate reduces the credit spread. They create a model with stochastic interest rates where the short rate converges to the long rates. According to the model, an increasing short rate should lead to lower credit risk. We regress a proxy for the slope of the term structure of interest rate by taking the 10-year swap rate minus the three-month Euribor onto the spreads. We hypothesize that an increasing slope would lead to tightening sovereign credit spreads, where we interpret a steepening yield curve as an indication of stronger economic activity[10].

We include a proxy for overall market risk appetite in the benchmark panel regression. We use the VIX index, the weighted average of implied volatility for options on selected stocks in the S&P 500 index (Figure 2). When the VIX increases, we generally expect to see an increase in credit spreads. Previous studies on sovereign CDS premiums Pan & Singleton (2008) and Fontana & Scheicher (2010) find the VIX to be an insignificant factor in explaining the sovereign CDS premiums, but we suspect that the risk aversion proxy might reveal information on the flight-to-liquidity factor in sovereigns. We expect a decrease in the risk appetite proxy to increase the demand for sovereign credit products and thus decrease the credit spread. This relationship should reflect investors' risk aversion by pivoting towards safer securities such as sovereign credit products.

We collect the iTraxx European CDS Index on a mid-weekly frequency from the Bloomberg system(Appendix Figure A.3). The iTraxx index represents an aggregate premium on corporate CDS, and we expect an increase in the CDS index would correlate positively with sovereign CDS premiums. The equally weighted index consists of 125 CDS on investment grade European corporate entities with a 10-year maturity[11]. The index captures the systematic risks in the European sovereign CDS market. The index represents European corporate credit risk, and we hypothesize that peripheral countries are more sensitive to changes in the index.

[10]See Haubrich & Dombrosky (1996)for an overview of studies regarding interpretations of the yield curve.

[11]The iTraxx Europe CDS 5-year Index is not available for us over the whole sample period, hence we collect the 10-year maturity index as the relevant proxy.

Additionally, we collect national equity indices for each of the ten countries on a weekly frequency from the Bloomberg terminal. The indices represent each country's leading stock exchange and, according to Collin-Dufresne et al. (2001), illustrate a good proxy for the overall financial health of the country. According to the structural credit risk model of Gapen et al. (2005)), sovereign assets are essential in determining default risk for sovereign nations. We compute the realized volatility[12] for each sovereign's stock returns to find the idiosyncratic volatility. When the idiosyncratic volatility increases, we expect to see an increase in all credit spreads, and for idiosyncratic returns, we expect an increase in return to be negatively correlated with credit spreads. In our extended model, we model the returns for each country directly onto the spreads and CDS-Bond basis. We also collect the VSTOXX volatility index for the biggest European companies, which is calculated similarly to the VIX index. The index is sampled on a mid-weekly frequency and downloaded from the Bloomberg system. Applying this to the extended models, we aim to describe how the credit spreads react to European market volatility.

Following the structural model of sovereign credit risk in Gapen et al. (2005), we use Debt-to-GDP as a proxy for a sovereign's leveraged debt to assets ratio. We do not have access to weekly Debt/GDP data, but we collect the ratio quarterly for the countries that use the euro from the European Central Bank. For the United Kingdom and Portugal, we download the ratio from the Bank of England, and Banco de Portugal, respectively. We interpolate the ratio into a weekly frequency to fit the panel regression. Because this variable is heavily interpolated, we need to be careful with interpreting the coefficients. However, we do not expect high volatility between the quarterly data points; hence we expect the interpolation to be relatively accurate. We

[12]See Garman & Klass (1980) for detailed computation of the realized volatility

expect a positive relationship between Debt-to-GDP-ratio and the spreads, reflecting that increased leverage raises the riskiness of the country (Gapen et al., 2005). However, we expect bond liquidity to increase with more outstanding debt, and safer countries have more liquid bonds than the peripheral countries, hence lower transaction costs, putting downward pressure on the spreads. The expectation is that the riskiness factor dominates the liquidity factor. Notably, we see from Appendix Table B.1 that the peripheral sovereigns have a higher average leverage ratio than the core sovereigns. We also note that the peripheral sovereigns hold a remarkably higher standard deviation implying a greater leverage uncertainty than the core.

We use the bid-ask spread in the iTraxx European CDS index as a proxy for liquidity in the European CDS market. The Index spread highlights the common liquidity variability in the corporate CDS market, extracted from the Bloomberg system at a weekly frequency (Appendix Figure A.3). In addition, we obtain factors that reflect the level of European quantitative easing from monetary policies. The Asset Purchase Program (APP) was initiated at the end of 2014 and publicly announced on January 22, 2015, with its primary role of facilitating low inflation periods, providing market liquidity by purchasing sovereign bonds[13]. We include the Pandemic Emergency Purchase Programme (PEPP) as this provides us a better understanding of the total quantitative ease. The total APP cumulative purchase is downloaded from the European Central Bank at an end-of-week frequency (Appendix Figure A.4). To correctly use the proxy, we lag the APP for one week and use the previous observation.

[13] See Andrade et al. (2016) for the effects of the European Central Bank's expansion of the Asset Purchase Program.

For the liquidity proxy, we use the bid-ask spreads for corporate CDS premiums in the euro area. A decrease in the corporate CDS liquidity can have at least two effects on sovereign spreads. First, lower liquidity in the corporate CDS market could reflect a sell-off with an offsetting increase in sovereign debt purchases. Secondly, it could reflect a general downturn in the market where credit spreads will widen. We expect to see the flight-to-liquidity effect dominate for core countries where the increased bid-ask spread on the European corporate CDS Index leads to reduced sovereign spreads.

The sovereign CDS contracts we study are denominated in USD, which practically works as a hedge against depreciation in EURO. In order to evaluate the currency risk exposure, we collect both the mid-week EUR/USD exchange rate and EVZ Volatility Index. The difference between them is that the EVZ Index is constructed by the same method as the CBOE VIX index and evaluates the markets' expectations of the past 30 days' volatility in the EUR/USD options from the Currency Shares Euro Trust. We hypothesize that EUR/USD should affect CDS premiums negatively, as the price of the CDS contract should incorporate the implicit currency hedge and counterparty risk. Sovereign bonds in the euro area are denominated in Euros. Hence we expect bond spreads to be less correlated to the currency relationship.

7 Results and analysis

In this section, we provide the results from our investigation and discuss the various implications of the models. First, we discuss how the variables in the traditional structural model of Gapen et al. (2005) perform in the benchmark panel regression regarding the spreads. Next, we review the results on the extended model of the spreads and the CDS-bond basis. Lastly, we review the PCA analysis and explain our findings in the sub-samples of market distress and non-distressed times. The results of the panel regressions are reported in table 4-6 with t-statistic adjusted for a heteroscedastic-consistent estimate of the covariances with adjusted R^2. The general expectations are that flight-to-quality, liquidity risk, and currency risk affect spreads in times of market distress, and we expect them to affect core and peripheral countries differently.

7.1 Benchmark Panel Regression

The benchmark panel regression in Table 4 reveals information on three aspects of the credit spreads; How the variables affect the CDS premiums and bond spreads, the differences in the variables during market distress and non-distressed times, and how the variables differ between safe countries versus risky countries (core and peripheral). The goodness of fit for the different panel regressions reported in table 4 varies significantly, depending on whether the dependent variable is CDS premium and bond spread or whether it is times of market distress or non-distressed times. For CDS premiums, the adjusted R^2 is 0.26 in normal times and 0.21 in times of market distress. For the bond spreads, the adjusted R^2 is only 0.04 in times of market distress, which means the benchmark regression with variables from the traditional structured model does not explain the bond spread variations well in bad times. The adjusted R^2 is 0.16 in non-distressed times. The R^2 appears small, but the regressions are conducted in changes, not levels that inflate the goodness of fit coefficient.

Table 4: Empirical Results - Benchmark Panel Regression

The table shows the results of a panel regression for the CDS premium and the bond yield spread in the periods of market distress vs. normal times. The regression is on the following form:

$$\begin{aligned}\Delta Y_{i,t} =& \alpha + \beta^{rf}\Delta rf_t + \beta^{RA}\Delta RA_t + \beta^{iTraxx}\Delta iTraxx_t + \beta^{Debt}\Delta Leverage_{i,t} + \beta^{VOL}\Delta VOL_{i,t} \\ &+ \beta^{BidAsk}\Delta BidAsk_t + \varphi^{rf}\Delta rf_t \times 1_{\{peri\}} + \varphi^{RA}\Delta RA_t \times 1_{\{peri\}} \\ &+ \varphi^{iTraxx}\Delta iTraxx_t \times 1_{\{peri\}} + \varphi^{Debt}\Delta Leverage_{i,t} \times 1_{\{peri\}} + \varphi^{VOL}\Delta VOL_{i,t} \times 1_{\{peri\}} \\ &+ \varphi^{BidAsk}\Delta BidAsk_t \times 1_{\{peri\}} + \mu_i + \epsilon_{i,t}\end{aligned}$$

Where the dependent variable $Y_{i,t}$ is the 5-year CDS premiums and the 5-year bond yield spreads. rf_t denotes the risk-free proxy measured by the 3-month Euribor, RA_t is the Risk Appetite measured by the VIX index. The $iTraxx_t$ represent the 10-year European Corporate CDS Index, $Leverage_{i,t}$ is the debt/GDP ratio. $VOL_{i,t}$ is the realized volatility of leading stock exchange in each sovereign i, and $BidAsk_t$ is the bid-ask spread of the 10-year European Corporate CDS Index. The $X_{i,t} \times 1_{\{peri\}}$ is an indicator equal to one for the peripheral sovereigns Italy, Portugal, and Spain, and zero otherwise. μ_i is the fixed effect vector which encapsulates all the cross-sectional effects on $\Delta Y_{i,t}$ and, $\epsilon_{i,t}$ is an error term. The coefficients betas are reported below with their heteroskedasticity robust t-statistics in parenthesis. The sample period is January 2010 to June 2021, sampled every Wednesday and all variables are denominated in first difference. Market distress is defined by the periods of high market uncertainty filtered with the VIX 75th percentile and normal times otherwise. The Levin-Lin-Chu Unit-Root test gives a p-value $<$ 2.2e-16, hence we reject the H_0 stating the time series contains a unit root. We also did a Breush-Pagan tests for heteroskedasticity where we rejected H_0, which states that there is heteroskedasticity in the residuals of the panel data with a p-value $<$ 2.2e-16. Significance levels at 0.01%, 1% and 5% are denoted by ***, ** and *, respectively.

	$\Delta CDS\ Premium$		$\Delta Bond\ Yield\ Spread$	
	Market Distress	Normal Times	Market Distress	Normal Times
Δrf_t	-13.27*	24.51***	1.79	41.51***
	(-2.18)	(5.48)	(0.16)	(3.87)
ΔRA_t	-0.16**	-0.17***	-0.03	-0.01
	(-2.66)	(-3.71)	(-0.89)	(-0.18)
$\Delta iTraxx_t$	0.54***	0.35***	0.28**	0.13
	(5.32)	(5.02)	(2.92)	(1.87)
$\Delta Leverage_{i,t}$	0.55	0.18	1.50**	0.36
	(1.64)	(0.35)	(2.69)	(0.73)
$\Delta VOL_{i,t}$	0.01	-0.01**	-0.02	0.01
	(2.31)	(-2.87)	(-1.24)	(1.04)
$\Delta BidAsk_t$	-0.37**	0.07**	-0.05	0.09
	(-3.26)	(2.91)	(-0.63)	(1.82)
$\Delta rf_t \times 1_{\{peri\}}$	-36.10	11.21	136.17	49.04
	(-1.26)	(0.18)	(1.37)	(0.46)
$\Delta RA_t \times 1_{\{peri\}}$	-0.58	-0.60***	-1.32	-0.62***
	(-1.70)	(-3.77)	(-1.85)	(-9.92)
$\Delta iTraxx_t \times 1_{\{peri\}}$	1.41***	2.04***	1.12***	2.08***
	(6.76)	(9.89)	(9.21)	(10.07)
$\Delta Leverage_{i,t} \times 1_{\{peri\}}$	4.31	-2.46**	9.06	3.98
	(1.34)	(-2.94)	(1.31)	(1.04)
$\Delta VOL_{i,t} \times 1_{\{peri\}}$	0.01	0.01	0.03	0.03
	(0.65)	(0.18)	(1.61)	(4.22)
$\Delta BidAsk_t \times 1_{\{peri\}}$	0.14	0.31*	-0.19	0.85*
	(0.29)	(2.52)	(-0.43)	(1.96)
No Obs.	1490	4470	1490	4470
$Adj.R^2$	0.21	0.26	0.05	0.16

7.1.1 Interest Rate Risk and Term Structure Risk

The CDS premium and the bond spread react differently in terms of changes in interest rates in both market distress and normal times, which aligns with previous studies like Fontana & Scheicher (2010) that find the relationship between the cash and derivative market to be complex. The β^{rf} (3-month Euribor) is statistically significant at 0.01% in both spreads during normal times with positive coefficients of 23.91 and 40.99, but in times of market distress, the coefficient turns negative and statistically significant only for the CDS premium at 5%. For peripheral countries, the risk-free rate is only statistically significant for CDS premium in times of market distress with a negative coefficient. The result indicates that a rising risk-free rate in non-distressed times increases the spreads, whereas a rising risk-free rate decreases the CDS premium for risky countries. This result is in line with the negative CDS-bond basis observed for risky countries, where the risk-free rate has downward pressure on the CDS premium in times of market distress.

We observe a statistically significant idiosyncratic volatility β^{VOL} in the regression for core countries during market distress and normal times for CDS premium. In market distress, volatility behaves as we expected with a positive coefficient, but in normal times the coefficient turns negative and significant. Bond spreads are not affected by idiosyncratic volatility in any state.

7.1.2 Global Risks and Idiosyncratic Risk

The result from the Risk appetite β^{RA} variable is statistically significant in both market distress and normal times for the CDS premiums with a negative coefficient of (-0.16) and (-0.17). This is in line with our expectation, where increased global market volatility(reduced risk appetite) leads to decreasing credit spreads. Generally, when global market volatility increases, sovereign credit spread in the eurozone decreases, which we assign to flight-to-liquidity effects.

β^{iTraxx}, the proxy for changes in corporate CDS premiums, is significant for both spreads and periods. For peripheral countries, the sensitivity (1.41 and 2.04) is significantly higher in both market distress and normal times compared to core countries (0.54 and 0.35). For bond spreads, it is less significant, which is expected since the index is based on CDS contracts. However, the index shows a strong positive correlation between corporate credit market and peripheral credit spreads.

7.1.3 Liquidity Risk and Currency Risk

From the β^{BidAsk}, we see a significant coefficient for CDS premiums for core countries. In market distress, the coefficient has a negative sign which could indicate a pivot to safer assets in sovereigns when the corporate CDS market dries up. In non-distressed times, core countries correlate positively with the liquidity measure. However, the coefficient is relatively small (0.07)

$\beta^{Leverage}$ affects peripheral and core countries differently. The high sensitivity of peripheral countries to the debt over GDP reflects their relatively weaker fundamentals. However, we see a significant negative relationship in normal times, indicating that the liquidity factor dominates the increase in risk from fundamentals, where increased outstanding bonds increase the market's liquidity.

7.2 Extended Panel Regression

In this panel regression we add variables we think can influence the spreads. The adjusted R^2 for all the panel regressions follows the same pattern as in the benchmark regressions with the difference that the model can explain more of the variation in the spreads in normal times compared to times of market distress for the bond spreads. Table 5 highlights the results and interestingly the model can explain more in times of market distress for CDS premiums compared to normal times (0.22 against 0.18).

As expected, the β^{SLOPE} factor is significant at 0.01% for the CDS premium regression in both good and bad times, with negative coefficients of -10.98 and -6.41. It also plays a role in the bond spreads in times of market distress, with a positive significant coefficient for core countries and a negative sign for peripheral countries. This result could indicate that investors interpret the steepening of the yield curve as a positive sign for the economy and shift funds back to more risky assets.

For currency risk, we find strong evidence that the proxies (β^{EVZ} and β^{FX}) affect the CDS premiums more strongly than bond spreads. This result is expected, as the embedded currency hedge should be incorporated in the CDS premium. The β^{FX} is positive in both market distress and normal times at 0.01%, with coefficients of -139.46 and -58.26. As we hypothesized, the solid negative coefficient in the β^{FX} is also evidence of increased counterparty risk in times of market distress. β^{FX} is only significant in distressed times for bond spreads with a coefficient of -113.64. A higher coefficient during market distress could also indicate a higher value of hedging in volatile times versus normal times. The negative coefficient for the bond spread in distressed times could reflect that an appreciating Euro currency relative to the USD signals

Table 5: Empirical Results - Extended Panel Regression

The table shows the results of an extended panel regression for the CDS premiums and the bond yield spread in the periods of market distress vs. normal times. The regression is on the following form:

$$\begin{aligned}\Delta Y_{i,t} =& \alpha + \beta^{R}\Delta R_{i,t} + \beta^{FX}\Delta FX_t + \beta^{SLOPE}\Delta SLOPE_t + \beta^{EVZ}\Delta EVZ_t + \beta^{APP}\Delta APP_t \\ &+ \beta^{VSTOXX}\Delta VSTOXX_t + \varphi^{R}\Delta R_{i,t} \times 1_{\{peri\}} + \varphi^{FX}\Delta FX_t \times 1_{\{peri\}} \\ &+ \varphi^{SLOPE}\Delta SLOPE_t \times 1_{\{peri\}} + \varphi^{EVZ}\Delta EVZ_t \times 1_{\{peri\}} + \varphi^{APP}\Delta APP_t \times 1_{\{peri\}} \\ &+ \varphi^{VSTOXX}\Delta VSTOXX_t \times 1_{\{peri\}} + \mu_i + \epsilon_{i,t}\end{aligned}$$

Where the dependent variable $\Delta Y_{i,t}$ is the 5-year CDS premiums and the 5-year bond yield spreads. $R_{i,t}$ is the returns of the leading stock exchange in each sovereign i, FX_t is the EUR/USD exchange rate. The $SLOPE_t$ is measured by the 10-year euribor minus the 3-month euribor, EVZ_t is the eurocurrency volatility index, APP_t is the weekly purchase in the Asset Purchase Program initiated by the European Central Bank and $VSTOXX_t$ is the volatility based on EURO STOXX 50 realtime options prices. The variable $\Delta Xi,t \times 1_{\{peri\}}$ is an indicator equal to one for the peripheral sovereigns Italy, Portugal, and Spain, and zero otherwise. μ_i is the fixed effect vector which encapsulates all the cross-sectional effects on $\Delta Y_{i,t}$ and, $\epsilon_{i,t}$ is an error term. The coefficients betas are reported below with their heteroskedasticity robust t-statistics in parenthesis. The sample period is January 2010 to June 2021, sampled every Wednesday and all variables are denominated in first difference. Market distress is defined by the periods of high market uncertainty filtered with the VIX 75th percentile and normal times otherwise. The Levin-Lin-Chu Unit-Root test gives a p-value < 2.2e-16, hence we reject the H_0 stating the time series contains a unit root. We also did a Breush-Pagan tests for heteroskedasticity where we rejected H_0, which states that there is heteroskedasticity in the residuals of the panel data with a p-value < 2.2e-16. Significance levels at 0.01%, 1% and 5% are denoted by ***, ** and *, respectively.

	$\Delta CDS\ Premium$		$\Delta Bond\ Yield\ Spread$	
	Market Distress	Normal Times	Market Distress	Normal Times
$\Delta R_{i,t}$	-0.02	-0.01*	-0.01	0.00
	(-1.34)	(-2.01)	(-0.72)	(1.10)
ΔFX_t	-139.46***	-58.26***	-113.64	-72.04*
	(-6.22)	(-4.32)	(-3.19)	(-0.89)
$\Delta SLOPE_t$	-10.98***	-6.41***	18.98***	0.52
	(-4.62)	(-6.24)	(7.13)	(0.30)
ΔEVZ_t	1.07***	0.01	0.38	-0.01
	(5.27)	(0.15)	(2.20)	(-0.74)
ΔAPP_t	-0.03**	0.04***	-0.01	-0.01**
	(-2.47)	(5.28)	(-0.49)	(-2.60)
$\Delta VSTOXX_t$	-0.01	0.62***	0.06	0.38
	(-0.01)	(6.13)	(0.87)	(3.93)
$\Delta R_{i,t} \times 1_{\{peri\}}$	-0.01**	-0.01**	-0.01**	-0.02***
	(-2.87)	(-3.33)	(-2.78)	(-4.16)
$\Delta FX_t \times 1_{\{peri\}}$	-84.41	-190.52***	6.38	-211.32***
	(-1.26)	(-7.68)	(0.03)	(-9.95)
$\Delta SLOPE_t \times 1_{\{peri\}}$	-38.24**	-34.67***	-2.56	-41.29
	(-2.79)	(-6.24)	(-0.51)	(-1.94)
$\Delta EVZ_t \times 1_{\{peri\}}$	10.03***	0.72	12.00***	2.37*
	(4.01)	(1.76)	(3.72)	(2.36)
$\Delta APP_t \times 1_{\{peri\}}$	-0.01*	0.01	-0.31***	0.04*
	(-2.19)	(1.69)	(-3.87)	(1.99)
$\Delta VSTOXX_t \times 1_{\{peri\}}$	-1.73***	0.22	-2.78***	-0.28*
	(-5.68)	(1.35)	(-4.04)	(-2.09)
No Obs.	1490	4470	1490	4470
$Adj.R^2$	0.22	0.18	0.08	0.15

a stronger European market. For weak countries, we find statistical significance only in normal times. The β^{EVZ}, which is the proxy for EUR/USD volatility, the peripheral countries responded strongly with a coefficient of 10.04 and 11.78 in times of distressed and non-distress times, respectively. Again, peripheral countries respond more vital to an increase in volatility compared to core countries.

The asset purchase program from ECB, which is used as a means to reduce credit risks among peripheral countries seems to be working as intended. The β^{APP} has a negative statistical correlation for bond spreads in market distressed times for peripheral countries with a coefficient of -0.31. It also affects the CDS spreads for core and peripheral countries with negative coefficients except for normal times in core countries.

7.3 Analysis of the Basis

In the panel regression of the CDS-bond basis, shown in Table 6, we find evidence that variables of interest rate risk, idiosyncratic risk, currency risk, and counterparty risk affect the basis in market distress and normal times differently. However, the adjusted R^2 is low, with 0.02 in normal times and 0.07 in market distress. Note that this regression is also in changes.

We find a negative relationship between the basis and the risk-free rate in times of distress, and the term structure variable slope is significant in both periods with a strong negative coefficient. For peripheral countries, the effect is the same with an even more negative coefficient, but only significant at 5%.

Table 6: Analysis of the Basis

The table shows the results of a panel regression for the CDS-Bond Basis in the periods of market distress vs. normal times. The regression is on the following form:

$$\begin{aligned}\Delta Y_{i,t} =& \alpha + \beta^{R}\Delta R_{i,t} + \beta^{FX}\Delta FX_t + \beta^{rf}\Delta rf_t + \beta^{SLOPE}\Delta SLOPE_t + \beta^{EVZ}\Delta EVZ_t \\ &+ \beta^{APP}\Delta APP_t + \beta^{VSTOXX}\Delta VSTOXX_t + \varphi^{R}\Delta R_{i,t} \times 1_{\{peri\}} + \varphi^{FX}\Delta FX_t \times 1_{\{peri\}} \\ &+ \varphi^{rf}\Delta rf_t \times 1_{\{peri\}} + \varphi^{SLOPE}\Delta SLOPE_t \times 1_{\{peri\}} + \varphi^{EVZ}\Delta EVZ_t \times 1_{\{peri\}} \\ &+ \varphi^{APP}\Delta APP_t \times 1_{\{peri\}} + \varphi^{VSTOXX}\Delta VSTOXX_t \times 1_{\{peri\}} + \mu_i + \epsilon_{i,t}\end{aligned}$$

Where the dependent variable $\Delta Y_{i,t}$ is the 5-year CDS premium and the 5-year bond yield spread. $R_{i,t}$ is the returns of the leading stock exchange in each sovereign i, FX_t is the EUR/USD exchange rate, rf_t denotes the risk-free proxy measured by the 3-month Euribor, the $SLOPE_t$ is measured by the 10-year euribor minus the 3-month euribor, EVZ_t is the eurocurrency volatility index, APP_t is the weekly purchase in the Asset Purchase Program initiated by the European Central Bank and $VSTOXX_t$ is the volatility based on EURO STOXX 50 realtime options prices. The variable $\Delta Xi,t \times 1_{\{perp\}}$ is an indicator equal to one for the peripheral sovereigns Italy, Portugal, and Spain, and zero otherwise. μ_i is the fixed effect vector which encapsulates all the cross-sectional effects on $\Delta Y_{i,t}$ and, $\epsilon_{i,t}$ is an error term. The coefficients betas are reported below with their heteroskedasticity robust t-statistics in parenthesis. The sample period is January 2010 to June 2021, sampled every Wednesday and all variables are denominated in first difference. Market distress is defined by the periods of high market uncertainty filtered with the VIX 75th percentile and normal times otherwise. The Levin-Lin-Chu Unit-Root test gives a p-value $<$ 2.2e-16, hence we reject the H_0 stating the time series contains a unit root. We also did a Breush-Pagan tests for heteroskedasticity where we rejected H_0, which states that there is heteroskedasticity in the residuals of the panel data with a p-value $<$ 2.2e-16. Significance levels at 0.01%, 1% and 5% are denoted by ***, ** and *, respectively.

	$\Delta Basis$	
	Market Distress	Normal Times
$\Delta R_{i,t}$	-0.01	-0.01*
	(-0.48)	(-4.71)
ΔFX_t	-27.39	-51.30***
	(-1.80)	(-6.68)
Δrf_t	-23.52**	-6.8
	(-2.97)	(-0.80)
$\Delta SLOPE_t$	-29.70***	-6.78***
	(-10.04)	(-4.71)
ΔEVZ_t	0.69***	-0.05
	(3.66)	(-0.71)
ΔAPP_t	-0.00	0.00***
	(-0.89)	(15.32)
$\Delta VSTOXX_t$	-0.05	-0.07
	(-0.97)	(-1.75)
$\Delta R_{i,t} \times 1_{\{peri\}}$	0.01	0.01***
	(1.44)	(5.13)
$\Delta FX_t \times 1_{\{peri\}}$	-84.31	20.63
	(-0.57)	(0.51)
$\Delta rf_t \times 1_{\{peri\}}$	-163.63*	-37.02
	(-2.09)	(-0.51)
$\Delta SLOPE_t \times 1_{\{peri\}}$	-38.04*	6.97
	(-1.96)	(0.61)
$\Delta EVZ_t \times 1_{\{peri\}}$	-1.83*	-1.64*
	(-2.21)	(-2.12)
$\Delta APP_t \times 1_{\{peri\}}$	0.01***	-0.01***
	(3.53)	(-2.41)
$\Delta VSTOXX_t \times 1_{\{peri\}}$	1.11**	0.50
	(2.63)	(1.83)
No Obs.	1490	4470
$Adj.R^2$	0.07	0.02

There are some effects on currency risk and counterparty risk, where the EUR/USD relationship is negative in normal times and the euro volatility proxy EVZ is positive in market distress. We find a distinction between peripheral countries and core countries in the EVZ variable, where in market distress, euro volatility presses up the basis, whereas, for peripheral countries, it pressures the basis down. This is according to our expectations where flight-to-liquidity gives downward pressures to bond spreads, making the basis positive for core countries.

We find evidence that idiosyncratic risk is significant, however, with a low coefficient. The idiosyncratic variability in returns for each country's major stock index affects the basis on a small scale. For core countries, the returns affect the basis positively, whereas for peripheral countries, it negatively affects the relationship. The asset purchase program of the ECB is significant in both periods for peripheral countries.

Overall, we find evidence that idiosyncratic, currency, and counterparty risk affect the CDS-bond basis. We assign most weights to flight-to-liquidity for the positive bond basis in strong countries over the sample.

7.4 Principal Component Analysis

Table 7 present the results of our Principal Component Analysis on the CDS Spread, Bond Yield Spread and the Basis, respectively. From the analysis, we can see that the CDS-premium's first principal component explains 68.69% of the variation in market distress and close to the same in normal times. This result is similar to the 64% found in Fontana & Scheicher (2016), where they describe the first principal component as the "level factor". We observe all the ten countries to have a similar negative relationship of close to -0.33 on average for core countries and -0.27 for peripheral countries (Appendix Table B.2). For the second component, we find differences in core and peripheral countries, where core countries inhibit positive coefficients, whereas peripheral countries have a negative coefficient. A significant finding is that the traditional credit risk variables from Merton (1974) explain a large portion of the first principal component in the CDS premiums. The first PC of the residuals in the benchmark regression explains 39.15% of the variance. This could indicate that traditional credit risk variables can partly explain some of the unexplained variations in the first PC.

Table 7: PCA Analysis

The table reports the results from the principal component analysis of the changes in the CDS premium, bond spread, and the residuals of the benchmark regressions. The table also report the results of the CDS-bond basis regression and its residuals. The numbers reported are the percentage proportion of variance explained by the first principal component. Market distress is defined by the periods of high market uncertainty filtered with the VIX 75th percentile threshold and normal times otherwise.

	Market Distress	Normal Times
CDS Premium	68.69%	67.12%
Bond Spread	44.50%	32.66%
CDS-Bond Basis	40.97%	35.20%
Residuals CDS Premium	45.58%	54.52%
Residuals Bond Spread	41.11%	39.33%
Residuals CDS-Bond Basis	34.37%	34.14%

From the PCA on the bond spreads, our findings differ from earlier studies. The first principal component in our study in times of market distress and normal times reveals 44.50% and 32.66% of the first PC, whereas Fontana & Scheicher (2016) arrive at 50%. There are many commonalities between the countries, as we find for CDS premiums. In the principal component analysis of the CDS-bond basis and the benchmark regression residuals, we find lower first PCs of 40.97% and 35.20%, respectively. However, there was not much covariation between the countries, with an average coefficient of -0.25

7.5 Robustness

To test the robustness of our analysis, we ran the panel regressions with a different market distress threshold of 90 percentile on the VIX to see if the results differ from the 75 percentile we ran in the first regressions. When reducing the sub-sample to contain very volatile times, we eliminate some of the short periods of market distress that can create noise in the data. For the CDS premium regression, we found the debt-to-GDP variable to be more significant for both core and peripheral countries in market distress. For the benchmark bond spreads in market distress, we found that peripheral countries reacted strongly to changes in the liquidity and volatility variable, contrary to what the regression displayed with the 75th percentile. For the basis regression, we found peripheral countries to be slightly more significant in times of crisis than in the first regression. Overall, peripheral countries are more responsive to the 90th percentile cutoff than the 75th percentile, which could indicate that the lower threshold contains noise that does not play a role in distressed times. However, we see that the spreads react strongly already at 75th percentile of the VIX, which indicates that we see movements in the spreads before the market reaches exceptionally volatile times.

8 Conclusion

We find that the market for sovereign credit spreads in the euro area is complicated, where spreads differ between countries and across time. We also find a major difference in the determinants between the cash and derivative market. Important reasons for the non-negative basis are liquidity risk, currency risk, and counterparty risk. We find that macro factors affect each country's credit spread more strongly than idiosyncratic risks, similar to the findings of Collin-Dufresne et al. (2001). We also discover that the Asset purchasing program European central bank is a significant driver of credit spreads. Further studies into factors affecting credit risk in the euro area could assist policymakers in making accurate programs to assist the sovereign credit market in Europe.

Our main findings are that liquidity, currency, and counterparty risk affect credit spreads widely in times of market distress and normal times. We observe flight-to-liquidity effects in creditworthy countries such as Germany in times of market distress, and also that there is a significant hedging premium in CDS contracts denominated in dollars contra euros. Also, we noted that weaker economic countries are more strongly affected by global macro volatility than the more stable countries in the euro area.

Like previous studies, we find a single common factor in the credit risk market that captures the majority of the variance, 68% in the CDS contracts and 44.5% in the bond market. In our sample between 2010 and mid-2021, we find that the traditional risk factors from Merton (1974) possibly could explain large parts of the first principal component for CDS-premiums in the euro area. Further investigation into the component of credit spreads could help uncover what drives credit risk in sovereigns in the eurozone area.

APPENDIX

A Additional Figures

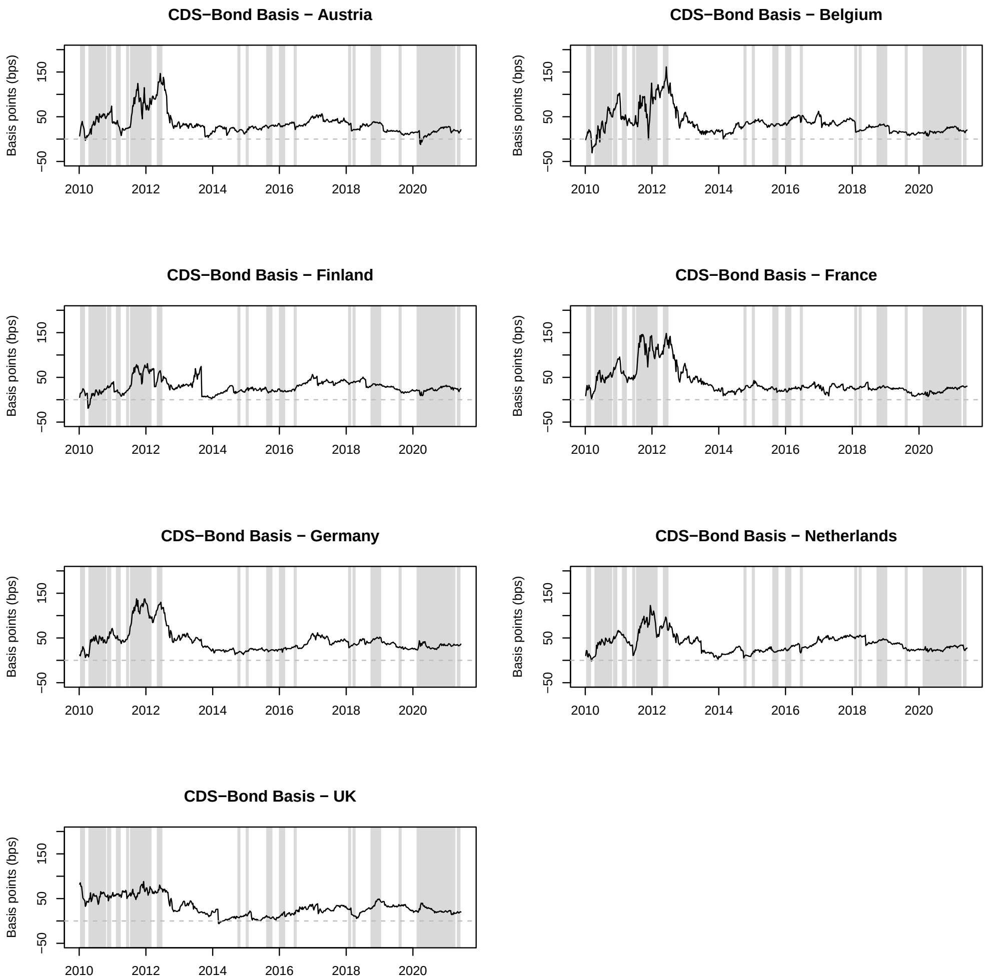


Figure A.1: CDS-Bond Basis - Core Sovereigns

Time series of the CDS-Bond Basis for the seven core European sovereigns; Austria, Belgium, Finland, France, Germany, the Netherlands, and the United Kingdom. The CDS-bond basis is the difference between a country's CDS premium and its corresponding bond yield spread. The grey areas shadow the periods of market distress with the 75th percentile VIX threshold Figure 2. All observations are at a weekly frequency, sampled every Wednesday and in basis points (bps).

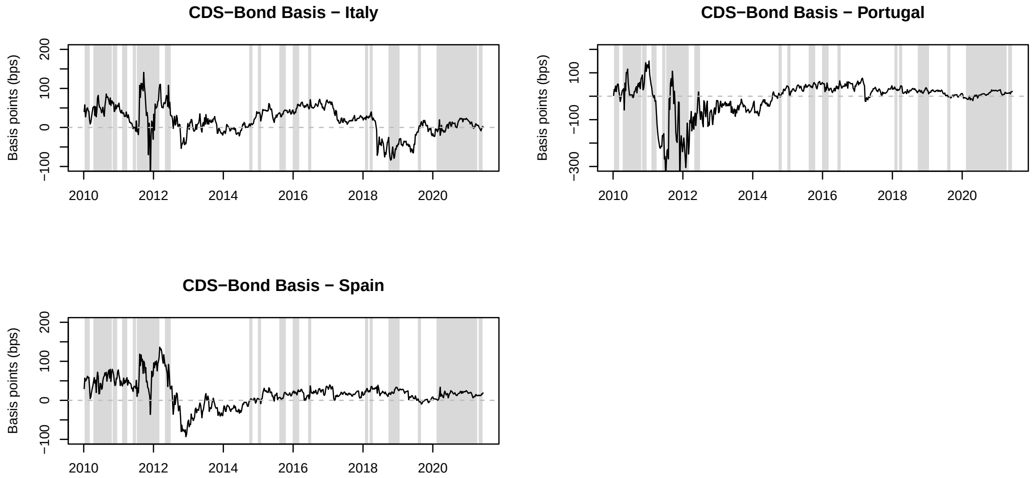


Figure A.2: CDS-Bond Basis - Peripheral Sovereigns

Time series of the CDS-Bond Basis for the three peripheral European sovereigns; Italy, Portugal, and Spain. The CDS-bond basis is the difference between a country's CDS premiums and its corresponding bond yield spread. The grey areas shadow the periods of market distress with the 75th percentile VIX threshold Figure 2. All observations are at a weekly frequency, sampled every Wednesday and in basis points (bps).

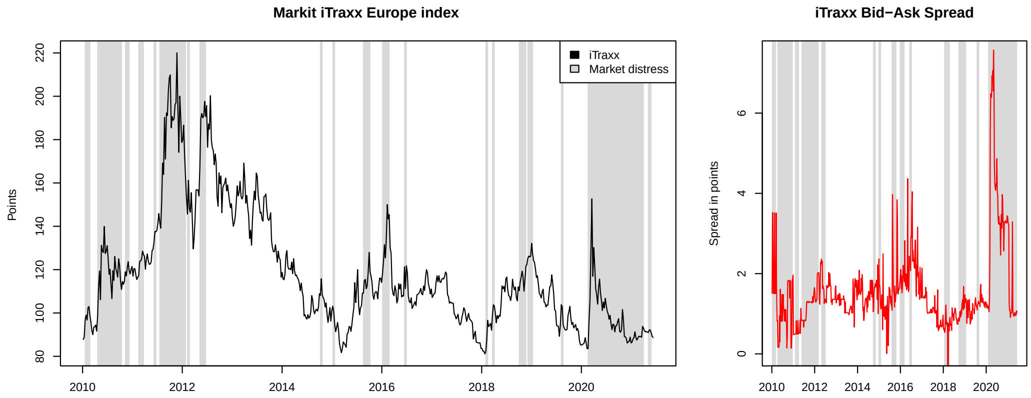


Figure A.3: iTraxx European CDS Index

This figure displays the time series dynamics for the corporate European iTraxx Index from January 6, 2010, to June 9, 2021. The index trades on a 10-year maturity and is extracted from the Bloomberg system on a mid-weekly frequency (Wednesdays). The chart on the right shows the bid-ask spread over the same period. The grey areas shadow the periods of market distress with the 75th percentile VIX threshold. All observations are expressed in index points.

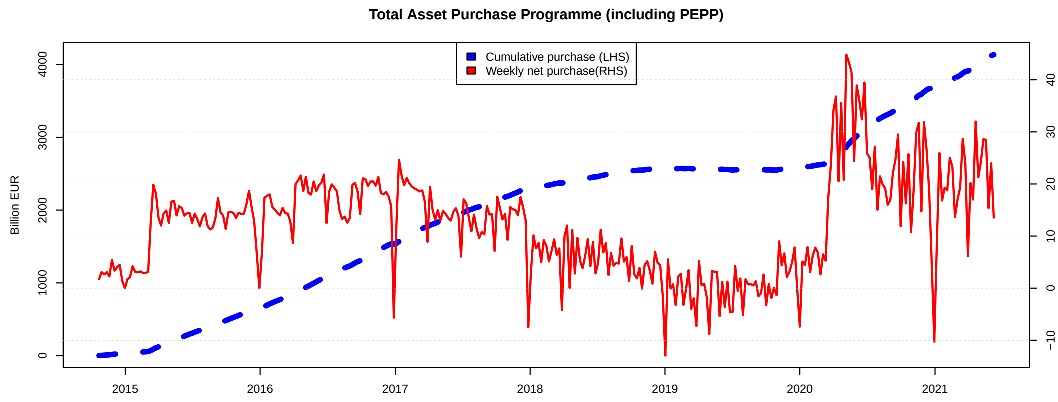


Figure A.4: Total Asset Purchase

This figure shows the total cumulative Asset Purchase Programme (APP) including the Pandemic Emergency Purchase Programme (PEPP). On the right-hand side (RHS), this figure displays the weekly net purchase between October 24, 2014, and June 11, 2021. The observations are sampled from the European Central Bank (ECB) database every Friday and expressed in billion euros.

B Additional Tables

Table B.1: DEBT/GDP-Ratio

This table report the summary statistics of the start-of-year Debt/GDP-ratio for all sovereigns from January 2010 to January 2021.

	AT	BE	FI	FR	DE	IT	NL	PT	SP	UK	Core	Peripheral
2010	80.60	104.10	43.50	85.00	73.30	118.70	57.60	90.40	54.90	62.40	72.36	88.00
2011	82.50	103.80	45.60	86.60	80.80	119.60	59.40	101.50	64.40	68.80	75.36	95.17
2012	82.90	106.80	48.80	90.10	80.00	122.80	62.50	118.50	73.90	72.30	77.63	105.07
2013	82.80	109.60	54.70	92.20	80.30	130.10	66.60	131.50	97.50	75.70	80.27	119.70
2014	81.40	110.10	57.80	95.00	77.00	135.10	67.10	135.20	103.10	77.50	80.84	124.47
2015	84.80	111.00	61.00	96.80	75.00	138.20	68.90	132.90	105.20	79.80	82.47	125.43
2016	85.60	108.40	64.20	98.50	71.60	137.80	64.30	130.80	104.60	79.10	81.67	124.40
2017	81.30	106.20	63.10	100.30	67.40	136.50	59.70	131.50	103.70	81.50	79.93	123.90
2018	77.40	105.00	60.10	98.60	63.50	135.60	55.20	126.50	102.40	80.60	77.20	121.50
2019	72.90	102.80	59.70	98.70	61.00	136.00	50.80	122.70	101.30	78.40	74.90	120.00
2020	73.10	102.80	64.40	100.70	60.10	137.20	49.30	119.10	102.00	82.80	76.17	119.43
2021	87.00	116.90	69.70	117.90	69.90	159.30	54.90	138.90	125.20	93.90	87.17	141.13
Mean	81.03	107.29	57.72	96.70	71.66	133.91	59.69	123.29	94.85	77.73	78.83	117.35
St.dev	4.49	4.16	8.07	8.50	7.42	10.78	6.40	14.39	19.97	7.77	4.03	14.50

Table B.2: PCA - All Sovereigns

The table reports the results from the first three principal components of the changes in the CDS premium, bond spread, and CDS-bond basis for all sovereigns in the sample.

	AT	BE	FI	FR	DE	IT	NL	PT	SP	UK	Core	Peri
CDS Premium												
PC1	-0.33	-0.33	-0.34	-0.36	-0.33	-0.32	-0.33	-0.19	-0.31	-0.29	-0.33	-0.27
PC2	0.17	0.07	0.21	0.08	0.23	-0.31	0.22	-0.75	-0.39	0.09	0.15	-0.48
PC3	0.09	0.21	-0.06	0.13	-0.34	0.30	0.11	-0.42	0.36	-0.64	-0.07	0.08
Bond Spreads												
PC1	0.44	0.43	0.28	0.44	0.12	0.28	0.36	0.02	0.33	0.11	0.31	0.21
PC2	-0.13	0.05	-0.25	-0.07	-0.44	0.47	-0.26	0.45	0.47	-0.11	-0.17	0.46
PC3	0.14	0.23	-0.20	0.20	-0.47	-0.14	-0.01	-0.48	-0.05	-0.61	-0.10	-0.22
CDS-Bond Basis												
PC1	-0.37	-0.35	-0.28	-0.40	-0.35	-0.25	-0.37	-0.19	-0.30	-0.21	-0.33	-0.25
PC2	0.24	0.05	0.28	0.21	0.17	-0.55	0.13	-0.50	-0.46	-0.04	0.15	-0.50
PC3	-0.20	-0.44	0.03	-0.20	0.41	-0.03	0.14	0.13	-0.20	0.69	0.06	-0.03

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