IDENTIFYING THE DETERMINANTS OF EMU LONG-TERM BOND YIELD SPREAD

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PROJECT: IDENTIFYING THE DETERMINANTS OF EMU LONG-TERM BOND YIELD SPREAD

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ABSTRACT

My current research studies the fiscal and market determinants responsible for the escalated bond yield spread, that arose as a result of the European Debt Crisis. Spread is defined as the difference between 10-year bonds yields issued by European Monetary Union members and the corresponding German 10-year yields. Specifically, the study will focus on the time period that encompasses the Great Recession as well as the European Debt Crisis, from the first quarter of 2003 to the second quarter of 2015.

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Chapter 1

Introduction

1.1 Bailouts and Debt

With the advancements of computer technology the world has become increasingly interconnected and subject to the forces of globalization. This is especially the case with financial markets, economies, and the movement of capital. Although globalization has had an enduring effect on the spread of knowledge and affluence across the world, its ability to reverberate financial unrest across markets has contributed to the Euro Zone Debt Crisis of the last decade.

One of the primary downfalls of the European Monetary Union is that it provided for a monetary coalition but failed to establish a fiscal union (Wall Street Journal, 2012). As a result, there was a lack of oversight, and fiscal control was taken on faith. Even with the onset of the EMU, fiscal mismanagement was common. Up until 2006 Germany maintained a budget deficit that surpassed 3% of GDP, and they were not the exception. It was assumed that with the onset of the EMU the less stable and fiscally unsound periphery European nations, which included Spain, Greece, Ireland, and Portu-

gal, backed by German hard money would experience enhanced stability and increased growth. Consequently, capital flowed into the less established bond markets and banks of periphery nations in the hopes of capitalizing on the eventual fall in yields and increases in the price of bonds resulting from convergence (Eichengreen, 2015). In addition, fiscal mismanagement was exasperated by the fact that the incoming capital wasn't used to pay down government deficits, rather it was used to finance private investments (Eichengreen, 2015).

By the onset of the financial crisis in 2007, European banks were heavily leveraged to a greater extent than American banks. By the end of 2007, Duetsche Bank's leverage ratio was at 68% compared to JP Morgan which was at 15% (Aaron Kirchfeld and Comfort, 2012). As the contagion and credit crunch of the American financial crisis spread, over-leveraged European banks found themselves in trouble. Banks across Europe were so inundated with debt and on the brink of failure that bailouts were unavoidable. The widespread bailouts contributed to the European sovereign debt crisis as sovereign liquidity dried and credit risk increased. The problem was exasperated by risk aversion. In response to the additional debt responsibility, investor sought guaranteed cash flow and demanded greater returns to compensate for the increased sovereign risk. Credit risk, Liquidity risk, and risk aversions have contributed to the amplified divergence of EMU 10-year bond yields during the European Debt Crisis. The purpose of this study is to identify the determinants that are responsible for the escalated basis point spread that arose as a result of the European Debt Crisis, between 10-year bonds yields issued by European Monetary Union countries and corresponding German 10-year yields.

With the signing of the Maastricht Treaty in 1993, the European Union came into existence and fiscal regulations and procedures were put in place for all EMU members. These provisions known as convergence criteria asserted that members maintain a high

degree of price stability, government budget deficits could not surpass 3% of GDP, debt as a percentage of GDP could not surpass 60%, and that the average long term interest rates could not exceed 2% points higher than the three nations with the lowest long term yields (European Central Bank, 2016). During the European debt crisis, several of the preceding requirements were not met or maintained by many EMU members including Germany.

Figure 1.1 displays the spread between ten EMU sovereign bond yields and German yields. Notice in Figure 1.1, long-term EMU government bonds have gone through two distinct phases. The first phase is convergence which was from the first quarter of 2003 until the first quarter of 2008 and then divergence started around the second quarter of 2008 until its peak in the first quarter of 2013. During convergence, the spread between long-term EMU yields and German yields was practically non existent. Notice that up to about 2008 all spreads were consistently near zero. However, as the contagion of the U.S. Financial Crisis proliferated and initial bailout offers emerged, bond yield spreads began to diverge and led to the appearance of the second distinct phase in Figure 1.1 which is the focus of this study.

1.2 Credit Risk, Liquidity Risk, and Risk Aversion

The divergence in EMU long-term bonds resulted partly as a consequence of the transfer of credit risk from financial institutions to their corresponding governments via bailouts (Afonso, Arghyrou and Kontonikas, 2015). Spain injected over 60 billion euros into its failing financial sector, Ireland pumped 64 billion euros into their banks, and the Netherlands infused more than 40 billion euros into their failing financial sector (The Economic Times, 2015). Bailouts were not the only source of debt, EMU countries had

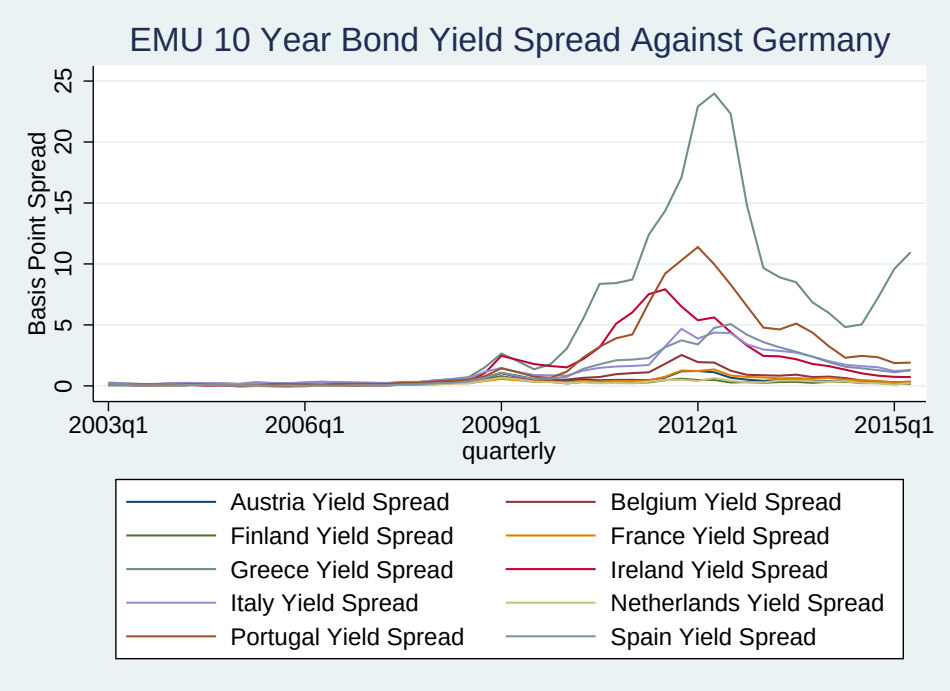

Figure 1.1: Sovereign 10 year yield spreads when compared to corresponding German values from the first quarter of 2003 to the second quarter of 2015 (quarterly).

budgetary mismanagement issues far before the Great Recession. One particular article of the Maastricht Treaty required members to maintain debt as a percentage of GDP below 60% (The World Bank, 2016). However, Austria, Italy, and Belgium all had debt above 60% prior to the Great Recession. In addition, Italy had debt as a percentage of GDP that consistently topped 100%. In response to the growing debt, as a consequence of the bailouts, long-term bond yields began to spread. The spread in bond yields between country i and Germany represents the risk associated with country i's debt position and its potential for default. This relationship is clearly represented in Figure 1.1, where the burgeoning yield spreads are clearly visible after the region of cointegration. German bonds are accepted as benchmarks due to their consistently low yields and relative stability and that is why most of the variables that are in the estimation are differenced against

corresponding German values (Codogno, Favero and Missale, 2003).

The spread in 10-year EMU government bonds over German rates can partly be explained by a lack of liquidity (Klepsch and Wollmershäuser, 2011). According to Attinasi, Checherita-Westphal and Nickel (2009), the state of liquidity of a country is influenced in several ways, trading volume, bonds outstanding, and trading activity. Liquidity risk effects the spread of long-term bonds by requiring greater returns to compensate for the increased risk of default, particularly when conditions are analogous to the recent financial crisis. Liquidity risk will sometimes arise when there is a large spread between ask and bid prices due to decreasing trading activity and volume. When the bid-ask spread increases, bondholders trying to sell are unable to exit their position and must except a lower price since investors require greater returns as compensation for the risk. The expansion of bonds outstanding also increases risk due to a lack of liquidity. In order for sovereigns to finance their spending, such as the bank bailouts, they issue bonds leading to the accrual of substantial debt and decreased liquidity. Due to this relationship, outstanding debt as a percent of total EMU debt is used as a proxy for liquidity risk.

Risk aversion has a similar effect on EMU yield spread. With the onset of the financial crisis investors reassessed their risk positions and preferred to be risk averse. Consequently, investors found refuge in less risky assets such as government bonds, which typically have low return paired with low risk of default. However, while the European debt crisis persisted and many sovereign bonds had credit and liquidity issues, investors moved their money to the less risky and liquid German bonds (Barrios et al., 2009). This is why we compare many of our variables to corresponding German values due to Germany's monetary and financial reputation. Risk aversion similarly bore influence on the spread and yields as a result. EMU members now had to increase their rates to make their riskier bonds attractive.

Chapter 2

Literature Review

Codogno, Favero and Missale (2003) produced an original model for yield spread prior to the Great Recession and are prominently referenced for their findings. The researchers identified the role of credit risk and liquidity risk on yield movement and their findings have been widely cited in literature from Klepsch and Wollmershäuser (2011), Afonso, Arghyrou and Kontonikas (2015), and Santis (2012). Codogno, Favero and Missale (2003) focus on spread in sovereign bond yields preceding convergence. Codogno, Favero and Missale (2003) established that the determinants of spread varied prior to and after yield convergence. Prior to the EMU, spreads were subject to the influence of expected exchange rate, tax treatment, liquidity, and credit risk (Codogno, Favero and Missale, 2003). After EMU convergence, expected exchange rates no longer had an effect on yields as EMU members shared a common currency. Similarly, tax treatment lost any influence as it was standardized with the emergence of the EMU (Codogno, Favero and Missale, 2003). However, their analysis determined that credit risk and liquidity risk are significant.

Afonso, Arghyrou and Kontonikas (2015) studied the determinants of bond spread before and after the beginning of the financial crisis. Their estimation technique was similar to Codogno, Favero and Missale (2003); however, instead of simply studying the bearing of liquidity and credit risk on yield spreads, they studied the effects of a slowdown in growth, real exchange rate apprecation, and credit rating announcments. Real exchange rate was included due to its ability to represent credit risk resulting from macroeconomic shocks. In addition, the influence of a slowdown in growth makes sovereign debt more risky (Afonso, Arghyrou and Kontonikas, 2015). Finally, credit rating announcements were included to determine the efficiency of markets. According to Afonso, Arghyrou and Kontonikas (2015), in a strong market this information would already be priced in. If markets are semi-strong, then any change in ratings would be treated as news and would effect yields. The researchers broke up their data into three distinct periods representing the pre-crisis (Jan, 1999 to August, 2007), financial crisis (August, 2007 to March, 2009), and the Euro debt crisis (March, 2009 to Dec, 2010). To represent these periods, they used two dummy variables. The first dummy captured the effect of the financial crisis and the second captured the effect of the Euro debt crisis.

A similar dummy estimation method was used by Klepsch and Wollmershäuser (2011). Their research focused on discovering the determinants of EMU bond divergence prior to and after the financial crisis. Particularly, they focused on the effect of credit risk, liquidity risk, and risk aversion. The reason for using risk aversion is to capture the effect of investors' attitudes and uncertainty after the financial crisis (Klepsch and Wollmershäuser, 2011). In order to identify the determinants of long-term bond yield spread, they focus their analysis on 11 of the original 12 EMU members which include Austria, Belgium, Finland, France, Greece, Germany, Ireland, Italy, Portugal, and Spain. To address credit and liquidity risk, they use projections of debt as a percentage of GDP and total debt is-

sued by a member as a percentage of total EMU debt, respectively. Lastly, risk aversion is represented by the VIX [1], a measure representing stock market volatility. In addition to the variables mentioned, their empirical approach included several dummies. The first dummy is a country dummy that attempts to capture any country specific effects and they also included a crisis dummy which accounts for the influence of the financial crisis (Klepsch and Wollmershäuser, 2011).

Acharya, Drechsler and Schnabl (2014) and Gerlach, Schulz and Wolff (2010) both describe the divergence of EMU bond yields as a result of the link between the financial sectors and sovereign credit risk. Acharya, Drechsler and Schnabl (2014) study the role of the financial sector bailout in initiating sovereign credit risk. They claim risk is transferred to sovereigns due to the manner in which they financed the bailout. Mainly, increasing taxation of the non-financial sector in order to pay for the bailout diminishes incentive to invest, and therefore it affects growth (Acharya, Drechsler and Schnabl, 2014). Finally, the authors provide empirical evidence of a credit risk feedback mechanism between governments and the financial sector. Acharya, Drechsler and Schnabl (2014) claim that the feedback exists due to implicit and explicit guarantees of the financial sector and their holdings of sovereign bonds. Gerlach, Schulz and Wolff (2010) similarly argue for the interconnectedness of sovereign credit risk and the financial sector. Their claim includes credit risk as the main driver of EMU yield spread and that changes in risk are dependent on the interaction between international risk and the size of the national financial sector. The greater the size of the banking sector and the lower the equity ratio of a country, the greater the spread in long-term yields (Gerlach, Schulz and Wolff, 2010).

[1] VIX is Calculated by the Chigago Board Options Exchange and conveys market expectations of short-term volatility in the S&P 500 (Chicago Board Options Exchange, 2016).

Chapter 3

Methodology

The following methodology is conducted using a similar method to Klepsch and Wollmershäuser (2011) and Afonso, Arghyrou and Kontonikas (2015). The estimation technique that is applied is feasible generalized least squares in order to capture heteroskedasticity across panels. Historical quarterly data on EMU bond yields, expected debt as a percentage of GDP, expected budget balance, expected debt ratio, and the volatility index are utilized in the estimation.

Along with the aforementioned variables, the estimation also includes three distinct dummy variables. The first dummy that is included is a country dummy to capture county specific effects on bond spreads that is not captured by the other variables. There are 10 different country dummies one for each EMU member in the study excluding Germany. In addition a bailout dummy is included and is dependent on each countries initial bank bailout offer. A value of 0 is assigned to the period prior to the first bank bailout and a value of 1 is assigned for the period after. The final dummy that is included is a crisis dummy which captures the effect of the European Debt Crisis on yield spreads. The crisis dummy only takes on a value of 0 or 1 and the second quarter of 2009 is used as

a marker for the beginning of the European Debt Crisis since on that particular date the magnitude of yield spreads began to grow (Afonso, Arghyrou and Kontonikas, 2015). Therefore, the period before the second quarter of 2009 is designated with 0 and the period after up to and including the first quarter of 2014 with a 1. Finally, anything after the first quarter of 2014 is be designated with a 0. The reason for including the period up to the first quarter of 2014 is because by 2014 Ireland, Portugal, and Spain exited their bailout programs provided by the cohort that included the ECB, IMF, and European Commission and required no further aid. Obviously this was not the case for Greece but they are an exception.

$$\begin{aligned} S_{i,t} =& \beta_0 + \beta_1 S_{i,t-1} + \beta_2 D_i + \beta_3 G_{i,t} + \beta_4 H_{i,t} + \beta_5 R_t + \beta_6 L_{i,t} + \beta_7 C_t + \beta_8 C_t D_i + \beta_9 C_t G_{i,t} \\ &+ \beta_{10} C_t I_{i,t} + \beta_{11} C_t R_t + \beta_{12} C_t L_{i,t} + \varepsilon_t \end{aligned} \tag{3.1}$$

Where i represents each individual sovereign and can take on a value of 1 through 10, and t equals the current period. S_i,t denotes the spread of a particular country's long-term yield differential against Germany. Similarly, $S_{i,t-1}$ is the lag of a countries yield spread against Germany, and it is included because of the dependence of bond yields on past values. Country dummies, D_i, are included to capture country specific effects that might be missed by the other variables. $G_{i,t}$ represents each countries expected budget balance differenced against German values. $H_{i,t}$ corresponds to the expected debt as a percentage of GDP, also differenced against German values. R_t is the risk aversion variable and is proxied by the VIX. $L_{t,i}$ is the liquidity variable and it is also expressed as the difference to matching German values. Finally, C_t represents the crisis dummy and has two separate applications, first as an intercept dummy and then as a slope dummy.

Expected debt as a percentage of GDP and expected budget balance are anticipated

to have a positive influence on yield spreads as they increase. In addition, a decrease in liquidity should increase yield spreads. Finally, any increase in the VIX should coincide with a proliferation of yield spreads. When controlling for the crisis period these effects should intensify.

Chapter 4

Data

The proposed analysis is focused on 11 of the original 12 European Union members which include Austria, Belgium, Finland, France, Ireland, Italy, Germany, Greece, Netherlands, Portugal, and Spain. Particularly, the analysis is focuses on the time period from the first quarter of 2003 until the fourth quarter of 2015. While long-term sovereign yields began to converge by the second quarter of 2012, as can be seen in Figure 1.1, yield spreads still remain high even today. For example, in the second quarter of 2015, Greece's spread against Germany was 10,000 basis point, Italy was 133 basis points above, and Portugal's spread was over 200 basis points. As a result, the interest rate spread is still persistent even though it has partially subsided in recent years.

To address the influence of credit risk on sovereign yield divergence, expected budget balance and expected debt as a percentage of GDP are used. The reason for using expected fiscal measures rather than historical data is due to the assumption that we can expect investors to be well informed and to have access to forecasts and economic outlooks. The data for expected debt to GDP and expected budget balance was acquired from the European Commission's Index of of Economic Forecast, which is published

bi-annually. Afonso, Arghyrou and Kontonikas (2015) and Klepsch and Wollmershäuser (2011) used expected, rather than historical data, for credit risk in their research. The expectation is, if debt as a percentage of GDP increases, the magnitude of the spread should likewise increase. Also, if the budget experiences a surplus it will decrease spread, and if there is a deficit, spreads should increase.

The graphs in Figure 4.1 display the expected debt as a percentage of GDP for each EMU county excluding Germany, prior to calculating differentials. The values for the graphs in Figure 4.1 are estimated by taking two year averages of the bi-annual forecasts provided by the European Commission. The features worth noticing, across all graphs, are the apparent negatively slopped dip that occurs prior to 2009 and the immediate jump proceeding it. The positively slopped sections after 2009 most probably coincides with the bailouts of financial institution and the increased debt position that accompanied them. Similarly, the default risk that stems from rising debt positions warranted a rise in bond yields. Some of the most outstanding increases in the forecasted debt ratios were from Greece and Portugal. From 2009 until 2012 Greece's forecasted debt ratio increased from 35% to 120%. In the same time period Portugal's debt ratio increased by approximately 55%.

Figure 4.2 illustrates the expected budget position of EMU members, excluding Germany. The data was acquired by calculating the two year average of European Commission forecasts. All ten graphs have a similar defining feature, which is illustrated by the dip that reflects the period of the European Debt Crisis. In 2010, each country's budget balance decreases substantially likely due to the increased spending driven by bank bailouts.

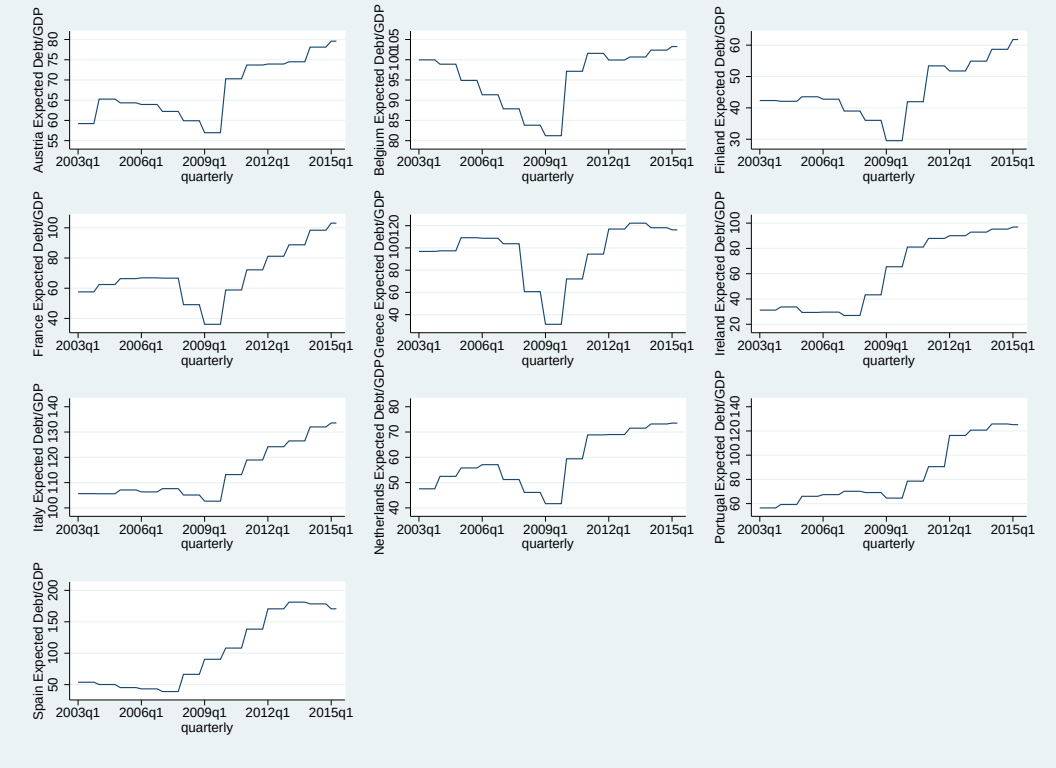

Figure 4.1: European Commission's expected debt as a percentage of GDP for the EMU.

Representing the influence of liquidity on yield spreads is the total government debt issued, for each country, as a percentage of aggregate EMU debt. Using national debt as a percentage of total EMU debt is a proxy commonly used to represent liquidity. This proxy has been used by Klepsch and Wollmershäuser (2011) and Attinasi, Checherita-Westphal and Nickel (2009). The data was gathered on a quarterly basis from European Commission's Eurostat database. Once the debt ratio for each country is calculated, it is then be differenced against the corresponding German ratio. As a result, the expectation is that the proxy will be negative since increased liquidity is associated with lower bond yields as illustrated in Figure 4.3. Since the emergence of the EU Germany has consistently held the largest percentage of total EMU debt, the only exception is Italy, that is why when viewing Figure 4.3 most graphs are negative. Prior to the Great Recession

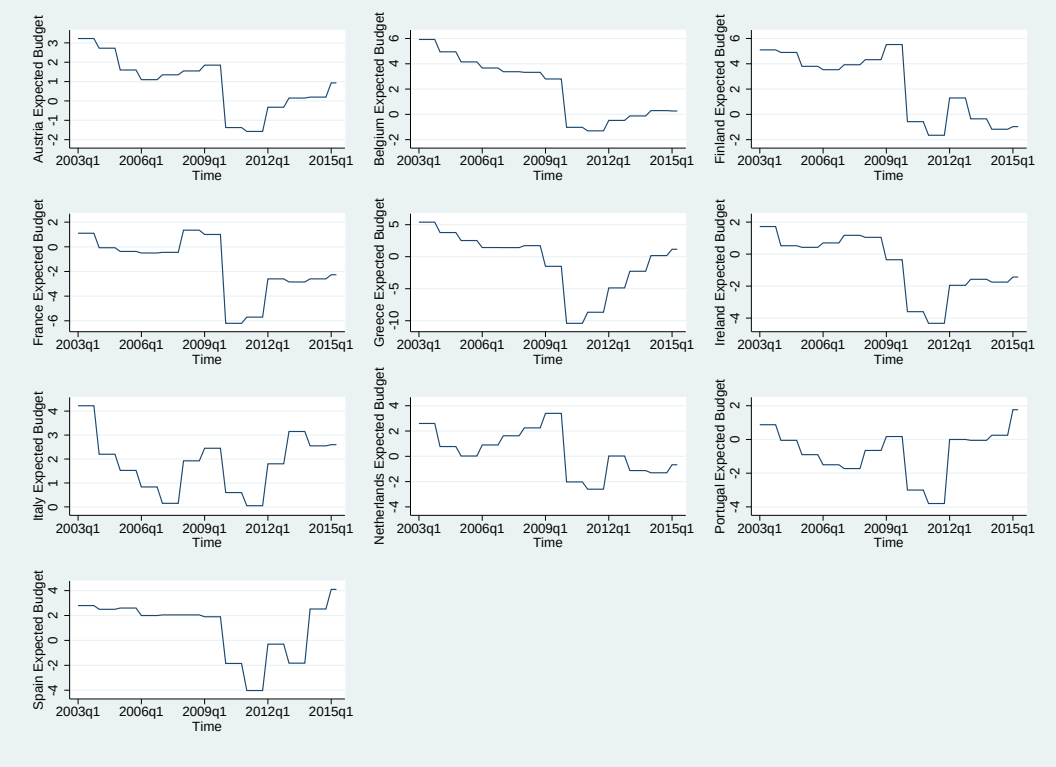

Figure 4.2: European Commission's expected budget balance for the EMU.

the debt ratios spread against Germany were typically low. For example, examining the graph of Greece, Ireland, Portugal, and Netherlands illustrates this relationship. In 2000 Greece, Ireland, Portugal and Netherlands had roughly 8% less of the total share of EMU debt when compared to Germany, meaning, those countries were far more liquid. This relationship coincides with the tight band in Figure 1.1 when all EMU bond yields were tightly cointegrated. Another clear trend is the jump that occurs in each graph, except for Italy, during the financial crisis. The jump in the share of debt from 2008 until 2010 is a result of the Euro Debt Crisis. As the credit crunch persisted and banks were facing bankruptcy, that jump signifies the point where banks were bailed out by their national governments. The bailout resulted in almost every country taking on a bigger share of total EMU debt. As a result, as time went each sovereigns debt position began approaching

converging upon the German debt position.

Figure 4.3: The differential between sovereign debt as a percentage of total EMU debt and the corresponding German values.

The role of risk aversion in bond spread is a common theme that arises in empirical literature and the most suitable proxy has continually been the VIX or volatility index. The VIX measures expected volatility in the equity market. To appreciate the role of the VIX in yield spreads notice the spike in Figure 4.4 around 2009 that spike corresponds to the emergence of the financial crisis and when investors appropriation of risk shifted significantly. Therefore, the expectation is that when controlling for the crisis period the VIX should be significant and cause yields spread to increase. The riskier the asset the greater the expected return. Therefore, countries that were most inundated with debt and at greater risk of default had to reassess their coupon rates. Acharya, Drechsler and Schnabl (2014), Klepsch and Wollmershäuser (2011), and Afonso, Arghyrou and Kontonikas (2015) all use the VIX to represent risk aversion. The VIX data was acquired via Google finance.

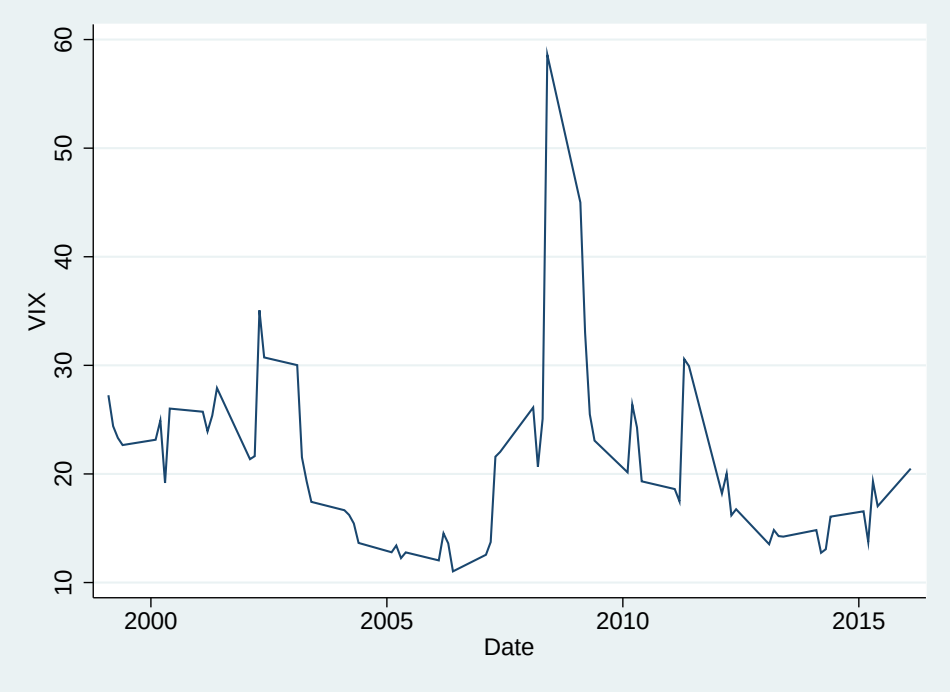

Figure 4.4: Quarterly VIX Data

Chapter 5

Results

Table 5.1 shows the generalized least squares regression results when correcting for heteroscedasticity. The table includes two regressions with different specification. Regression (1) is the primary benchmark estimation without taking into account for dummies. Regression (2) expands upon Regression (1) by including European Debt Crisis, initial bailout, and country specific dummies.

The results from the benchmark regression in column (1) demonstrates that without accounting for the influence of the European debt crisis and country specific effects the benchmark variables representing credit risk and liquidity have no significance on their own. The only variables that had any influence on the spread of EMU bond yields are the lagged yield spread and the VIX, which were both significant at 0.1%. While the VIX is significant its influence is minimal. For every 1% increase in the VIX, yield spreads increase by 0.8 basis points. The expected budget balance and expected debt to GDP ratio are both found to be insignificant; and surprisingly, the expected budget balance coefficient is negative. Furthermore, the expectation is that the liquidity variable should also be insignificant and negative which it is. Overall, the effect that the determinants

	(1)	(2)
	Yield Spread	Yield Spread
Lagged Yield Spread	0.948***	0.85737***
Expected Budget Balance	-0.00374	-0.0066
Expected Debt to GDP	0.000879	.00008
VIX	0.00803***	0.00738***
Liquidity	-0.395	3.8575
CrisisBelgium		-2.1756***
CrisisFinland		-2.2382***
CrisisFrance		-0.7736***
CrisisGreece		.5678*
CrisisIreland		-2.1246***
CrisisItaly		0.41693***
CrisisNetherlands		-1.7597 ***
CrisisPortugal		-2.5186***
CrisisSpain		-1.4967***
Euro Crisis Dummy		-2.2341***
Bailout Dummy		-0.03194
CrisisLiquidity		-38.1288***
CrisisExp Budget Balance		-0.0454***
CrisisExpected Debt GDP		0.0063***
CrisisVix		0.0176***
Cons	-0.143***	.13055*
N	500	500

t statistics in parentheses

Estimated with FGLS and corrected for heteroskedasticity across panel variables. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Sovereign country dummies were included in both regression. However, none were significant so they were excluded from the above table.

Table 5.1: Regression (1) is a benchmark regression and regression (2) adds fixed effects.

have on yield spread over the span of the first quarter of 2013 until the second quarter of 2015 is minimal.

Regression (2) seeks to expand upon the first regression by controlling for categorical effects. The results for regression (2) are far more significant than the first regression due to the inclusion of the control variables. Similar to regression (1), the only benchmark determinants that are significant is the VIX and lagged spreads. The expected budget, expected debt ratio, and liquidity remained the same in terms of significance, they did however experience a sign change. The country specific fixed effects by themselves have no significance, and as a result they were excluded. However, All sovereign variables are significant when interacting with the crisis dummy. The interaction between the country specific dummies of Greece and Italy with the crisis dummy are both significant and have a positive influence on EMU yield spreads. Furthermore, the product of the crisis dummy with Belgium, Finland, France, Ireland, Netherlands, Spain, and Portugal respectively are also significant; however, they were all negative.

It is surprising to discover that the only positive interactions between the crisis and country dummies are Greece and Italy. This result indicates that there are unique features specific to both Greece and Italy not captured by the benchmark variables. Given that French and Dutch bonds are considered almost as safe and reliable as German bonds and had minimal spread, it makes sense that the interaction between their sovereign dummies and the crisis dummy are negative. However, the fact that the product of sovereign dummies belonging to Belgium, Finland, Ireland, Portugal, and Spain with the crisis dummy are significant and negative likely signifies that there are no country specific effects to capture that would influence the increased spread in yields. On the contrary, what the results indicate is that the country specific effects that are captured are causing spreads to decrease. The negative impact that these interactions have may likely be explained by

the fact that they are compensating for the for the substantial influence of the benchmark variables on spread. Meaning, there were no country specific effects to capture that were not already attained by the benchmark variables and their interaction with the euro crisis dummy.

In essence, the country dummies are included to capture the country specific effects that may not be captured by the benchmark variables or the other fixed effects. As an example, consider Greece, it is likely that due to the corruption, tax evasion, spending habits, and misrepresenting of government financial information Greece's experiences are unique when compared to other EMU nations. Therefore, country dummies are included to capture the distinctive features that may have contributed to the increase in sovereign yield spread. Moreover, notice that the product of the Greek and Crisis dummy resulted in a significant coefficient warranting the use of the variables.

The regression also includes a bailout dummy, and it turns out that the bailout dummy is not significant. To understand why the bailout dummy is insignificant it must be compared to the euro crisis dummy which is multiplied against the sovereign dummy variables. Both need to be evaluated for what categorical effect they are trying to capture. What becomes clear is that the events that each dummy attempts to capture overlap with each other substantially. Furthermore, it is important to note, that a high degree of correlation exists between both variables. They were found to be 75% correlated suggesting the need for one and not the other. On the other hand, the European Crisis Dummy is significant; however, it is negative. The negative sign can be explained by the fact that the negative coefficient for Euro Crisis is simply correcting for the substantial significance of the product of the Euro Crisis dummy and benchmark dummies such as the crisis dummy interaction with liquidity.

The interaction of the benchmark variables and the crisis dummy are all significant

as expected. Comparing these results with the benchmark variable on their own provides significant insight into the responsiveness and discernment of bondholders. Similar in fashion to Codogno, Favero and Missale (2003) findings, the determinants of yield spread vary based on the time period studied. As mentioned previously, the influence that expected fiscal measures and debt issued have on yield spread is not significant in the least. Accordingly, they play no role in determining the movement of yield spreads. However, with the onset of the Great Recession and the European Debt Crisis that relationship changed. The reason for the change in significance is due to the investors taking greater interest in sovereign debt positions, likely in response to the massive bailouts that were distributed.

5.1 Robustness Testing

In order to check for robustness of the model, the sample is condensed from the first quarter of 2003 to the fourth quarter of 2008. In addition, the European Crisis dummy is altered to ensure that the coefficients will vary and that the estimation is robust. Originally, the crisis dummy captured the European Debt Crisis from the second quarter of 2009 until the first quarter of 2014. The crisis dummy is then altered from the first quarter of 2003 until the fourth quarter of 2007 in order to demonstrate that the model is robust. Subsequently, the same regressions as Table 5.1 are conducted in hopes of identifying perceived differences in significance across the regressions in Table 5.1 and Table 5.2. The expectation would be that when excluding the time period that comprised the Great Recession and the European Debt Crisis in addition to altering the crisis dummy, the regressions should have abundantly different results from Table 5.1.

The results of regression (1) in Table 5.2 are as expected in that they vary from the re-

	(1)	(2)
	Yield Spread	Yield Spread
Lagged Yield Spread	0.866***	0.642***
Expected Budget Balance	-0.0201**	-0.793
Expected Debt GDP	0.000000195	-0.0391
VIX	0.00544***	0.00987***
Liquidity	4.988***	-20.75*
Belgium Dummy	0.0273	2.456
Finland Dummy	0.0647**	1.131
France Dummy	-0.251***	0.163
italy Dummy	-0.247**	3.303
ireland Dummy	0.0228	-1.023
Greeece Dummy	0.0672*	0.484**
Portugal Dummy	-0.0189	-1.372
Spain Dummy	-0.0350*	0.808
Netherlands Dummy	-0.0377**	0.229
CrisisBelgium		-0.725
CrisisFinland		-0.611
CrisisFrance		1.399
CrisisGreece		1.305*
CrisisIreland		2.739
CrisisItaly		-1.718
CrisisNetherlands		1.693*
CrisisPortugal		3.108
CrisiSspain		.8785***
Bailout Dummy		0.0460
Crisis Euro		1.718*
CrisisLiquidity		24.11**
CrisisExp Budget Balance		0.785
Crisis Expected Debt GDP		0.0391
Crisis Vix		-0.00811***
Cons	0.240**	-1.517*
N	241	241

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimated with FGLS and corrected for heteroskedasticity across panel variables

Table 5.2: Regression for the time period from first quarter of 2003 to the fourth quarter of 2007.

gression (1) results in Table 5.1. Comparing the outcomes, there are obvious differences in significance. For instance, regression (1) in Table 5.1 both lagged yield spreads and the VIX are significant; however, when reducing the time period such as in Table 5.2, not only are the VIX and the lagged yield spread significant but so are expected budget balance and liquidity.

Unlike the results in regression (1) in Table 5.1, the country dummies in regression (1) in Table 5.2 are all significant except for Ireland, Portugal, and Belgium. The country dummies on their own have no significance in Table 5.1, suggesting that there are no sovereign effects worth capturing that are unique to that particular nation. However, that is not the case in the above table. With the reduced time period and the altered crisis dummy, most sovereign dummies are significant.

Moving on to the results in the second regression, the significant benchmark variables in Regression (2) vary considerably from Table 5.1. For instance, in Table 5.2, lagged yield spreads, expected debt as a percentage of GDP, VIX, and Liquidity are all significant. On the other hand, in Table 5.1, merely the lagged yield spreads and the VIX are significant. In addition, Regression (2) has almost no significant country dummies. The only country dummy that has any influence on yield spreads is Greece.

In regression (2) the only significant interactions between the country and crisis dummies are Greece, Netherlands, and Spain. This result varies significantly from Table 5.2 in which every individual crisis interaction has an influence on yield spreads whether it be positive or negative. In regards to the crisis dummy interaction with benchmark variables, the significant interactions are with the VIX and liquidity.

The fact that there are significant country dummy interactions with the crisis dummy implies that the model is semi-robust. For the model to be robust the product of the crisis dummy with any country dummy variable should be insignificant. This result indicates

that there are excluded variables that should capture country specific effects which, in turn, should produce insignificant interactions between the two dummies.

Chapter 6

Conclusion

In this paper the determinants of 10-year bond yield spreads of European Monetary Union members are identified and many are found to be significant when controlling for the effects of the European Debt Crisis. Quarterly data is employed for the time period spanning from the first quarter of 2003 until the second quarter of 2015 which spanned three distinct time periods: yield convergence, the crisis period corresponding to yield divergence, and a tapering of spreads. The focus of the analysis is on a panel of 11 of the 12 original EMU members which includes Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal, and Spain. Since Germany is typically considered the safest and most reliable bond in terms of volatility, the differential between sovereign values and German values are calculated in order to capture the dispersion. The determinants are focused on fiscal management and market dynamics. Finally, the estimation also controls for the fixed effects of the debt crisis, issuance of bailouts, and any country specific effects not captured by the other determinants.

When omitting or including fixed effects the estimation results are revealing in terms of the varying roles determinants have on yield spreads. When fixed effects are excluded,

the benchmark determinants, which included credit risk, liquidity risk, and risk aversion, have very little significance. Risk aversion is significant, but its influence on spreads is less than one basis point increase. However, when correcting for the effects of the debt crisis the perception of risk exerts greater influence on yield spreads; and this is especially the case when sovereign fiscal mismanagement is rampant. Similar results are realized with liquidity risk. On its own, liquidity risk is insignificant. Nevertheless, once liquidity interacts with the debt crisis dummy it is not only significant, but it has the greatest effect on yield spreads. For every one percent liquidity decreased yield spreads increased by 3812 basis points. Lastly, the interaction between the Euro debt crisis dummy and the sovereign dummies are all significant though all but Greece and Italy are negative. This result suggest that only Greece and Italy have country specific effects that are not captured by the benchmark variables.

An approach for expanding upon the current research is to include additional variables to further capture any effects that may have been missed by the specified benchmark variables representing credit risk, risk aversion, and liquidity risk. An additional variable that could be included in order to capture any missed influence of credit risk is the real effective exchange rate. The real effective exchange rate measures a currency against a weighted average basket of other currencies. The reason for including the variable is to capture credit risk originating from international competitiveness (Afonso, Arghyrou and Kontonikas, 2015). In order to capture any further effects missed by the liquidity variable it is worthwhile to include bond bid ask spread in order to capture market liquidity. Finally, an additional variable worth including is industrial growth rate as a proxy for economic growth. The idea is that credit risk is augmented when there's a slowdown in industrial growth (Afonso, Arghyrou and Kontonikas, 2015).

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