Determinants of sovereign yield spreads within the EMU: Country fundamentals and credit rating agencies

Master thesis

MSc. Finance

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ABSTRACT

The start of the worldwide –and euro-crisis has spurred the discussion about the increased problems concerning the public debt of peripheral EMU countries and the role of credit rating agencies. This research uses a panel of ten EMU countries over the period from 2005-2013 to identify the main country fundamentals for explaining sovereign bond yield spreads, including the effect of sovereign ratings from Moody's. I find that country fundamentals are significant in explaining spreads, but do not fully explain all the movements. Furthermore I find that the effects and significance of country fundamentals changed significantly over time and appears to differ between countries. Finally I find that credit ratings from Moody's are significant in explaining spreads and yields approximately the same estimations of spreads as a model based on country fundamentals.

PREFACE

In order to graduate for the Master of Finance at Tilburg University there must be a written thesis. During a somewhat difficult time I had to enter this final stage of the education and focus on obtaining my master's degree, which would not have been possible without the support of some people. Therefore I would like to thank the program coordinator L. van der Tuijn, my supervisor Prof. dr. F.C.J.M. de Jong, my father and my sister with their continuous help and support to pull me through this last and most important part of my life as a student.

Frank Patje
Sittard, November 22, 2014

CONTENT

1. INTRODUCTION

With the beginning of the financial crisis, the fall of the Lehman Brothers, house prices stopped increasing. This started the breakdown of the young subprime mortgage market and stopped the development of complex securitization structures like Mortgage Backed Securities (MBS). The crisis in Europe has different (yet related) causes from the (global) subprime mortgage crisis. The main root of the euro-crisis is an excessive public depth, yet its roots go deeper. At its heart, the euro-crisis was created due to a misallocation of resources within the Euro-zone and the loss of competitiveness of the so-called GIIPS (Greece, Ireland, Italy, Portugal and Spain) countries. This loss of competitiveness is the result of several subsequent events, with at its root the introduction of the euro (Dadush, 2010).

Secondly, fiscal mismanagement was conducted by the GIIPS countries. Due to the lower borrowing costs and increased demand in domestic products, the tax revenues increased significantly. The government of the GIIPS countries chose to spend this increased income, instead of recognizing it as a temporary revenue and keeping it as a reserve for when the market growth stagnated.

But the current euro-crisis can not only be blamed on the GIIPS countries. According to Shambaugh (2012) there are two other causes which, when combined, form the current euro-crisis. The first cause he discusses is the banking crisis in the euro area. The euro-banking crisis has the same origin as the U.S. banking crisis. The banks became illiquid due to the collapse of U.S. house prices. The euro-banks assets that were tied to U.S. mortgages became questionable in value, which made it difficult for the euro-banks to borrow money and increased the spreads. The second cause is the sovereign debt crisis. Investors ask different interest rates on government bonds for two different reasons, devaluation or appreciation of a currency and the chance of default. Within the euro-zone devaluation or appreciation is not applicable, but the chance of default is. If investors expects a government will default, thus not able to repay its debt, investors will require a higher interest rate (sovereign bond yield) to compensate the additional default risk. Within the euro-zone investors look at the spread between a government bonds interest rate and Germany's government bond interest rate, which is expected to be stable and "risk free". An increase in default risk should be reflected in an increase in sovereign spreads.

The first country who encountered the problems of (extreme) high government bond interest rates was Greece. Due to fiscal mismanagement and loss of competitiveness, Greece dove into recession. Because of this recession, investors deemed Greece more risky, thus requiring a

higher interest rate on Greece's government bonds. The high interest rates on Greece's government bonds made it very difficult for Greece to finance itself, therefore becoming insolvent.

The sovereign debt crisis is also tightly connected to the banking crisis because many banks own substantial amounts of government debt. This intertwining resulted in a domino-effect. When investors expect a country to be downgraded they don't only sell their government debt, they sell the bank his shares as well. As a result the cost-off-capital for banks increased, which caused the crash of the interbank lending market and put a halt to economic growth (Gros and Mayer, 2011).

When reading the above it becomes clear a lot of different events helped develop the euro-crisis which resulted in extreme increases in sovereign yields spreads, but are these extreme increases justified by changes in underlying country-specific fundamentals and credit ratings? While there are studies concerning the determinants of sovereign yield spreads, recent research including the effects of the sovereign debt crisis is scarce. This study aims to identify the most important determinants concerning sovereign yield spreads of EMU countries, including the effect of the recent crisis. Furthermore, the relation between sovereign yield spreads and ratings from one of the three biggest CRA companies, Moody's, will be investigated. The empirical analysis used in this thesis will focus on the panel-data methodology to determine the most significant fundamentals of sovereign yield spreads. For the panel regression daily data of the selected countries – Greece, Italy, Portugal, Spain, Ireland, Belgium, Netherlands, France, UK, Austria and Luxembourg - concerning the 10 year government bond yields are obtained from Datastream. The 10 year government bond yield of Germany will be used as benchmark. Data concerning the fundamentals of the selected countries are downloaded from Eurostat. Ratings from Moody's are obtained from the respective website. This research contributes due to the fact that it includes the most recent data, making it possible to identify effects of the recent debt crisis on sovereign yields.

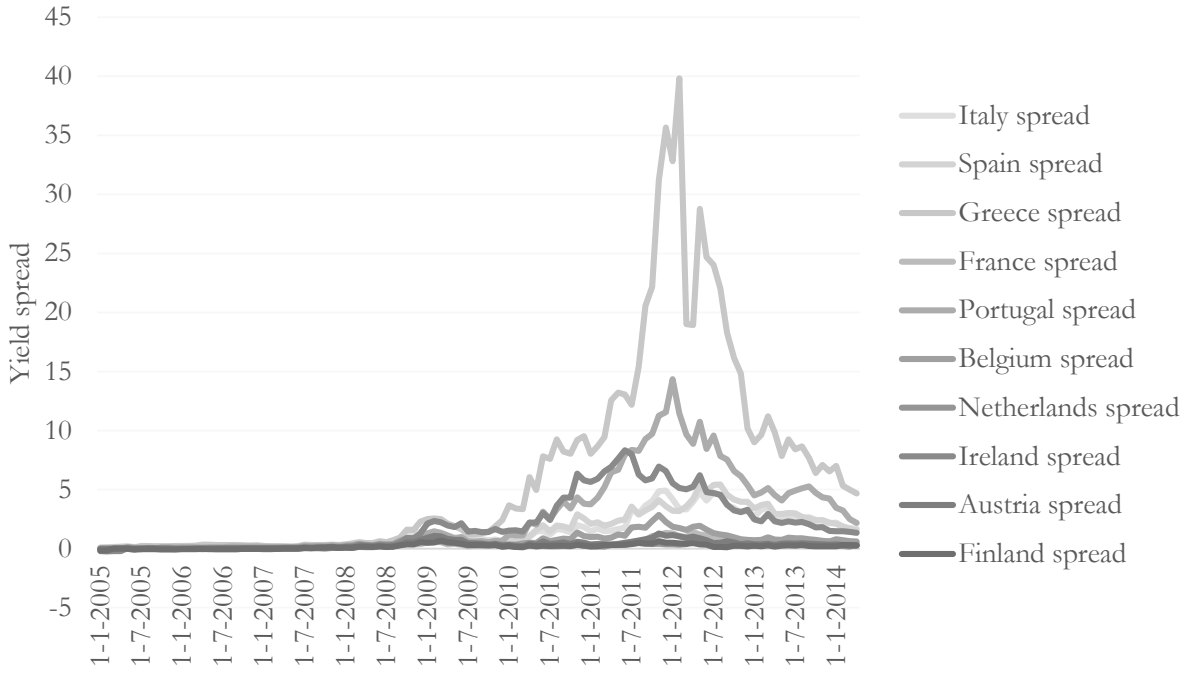
The structure for the rest of the thesis is as follows. Chapter 2 will present a theoretical framework of the most important fundamentals for explaining movements in government bond yield. Chapter 3 discusses the methodology and key variables for rating sovereigns according to Moody's, Fitch and Standard & Poors. In chapter 4 the data and empirical model will be explained, followed by chapter 5 where the results are presented. Finally, chapter 6 concludes.

2. DETERMINANTS OF SOVEREIGN YIELDS

2.1 LITERATURE RESEARCH: SOVEREIGN YIELDS

Figure 1 below shows the historical development of the sovereign yield spreads. You can clearly see how the spreads of peripheral countries skyrocketed since the crash of the Lehman Brothers and the start of the sovereign debt crisis. But what causes these movements in spreads?

Figure 1: Sovereign yield spreads



There has been many research about the determinants of government bond yields, especially since the beginning of the European Monetary Union (EMU). Most of the researchers use models regressing government spreads onto a set of country-specific variables and macro-economic variables. These variables are usually grouped according to the theoretical model. The first group of the theoretical model is the fiscal position of a country which is measured by the fiscal space and the debt-to-GDP ratio. The fiscal space is defined as the debt-to-total tax revenues ratio. Aizenman et al. (2012) and De Grauwe and Ji (2012) advise the use of the fiscal space variable. The second group is a measure of the economic activity of a country. The fundamentals used to measure this are the GDP growth rate and the industrial production index. The third group of fundamentals is the external competitiveness, which is measured by the current-account-balance-to-GDP and the real effective exchange rate. The fourth and final country-specific group of variables is the

liquidity, which is the countries' debt relative to the overall debt of all EMU countries. The theoretical model is a solid foundation because it follows some basic economic rules. If, for example, we look at the seemingly very important fundamental debt-to-GDP ratio we see that an increase in this fundamental results in an extra burden on the debt service which increases the probability of default. Investors would want to have this default risk compensated, thus resulting in an increased spread.

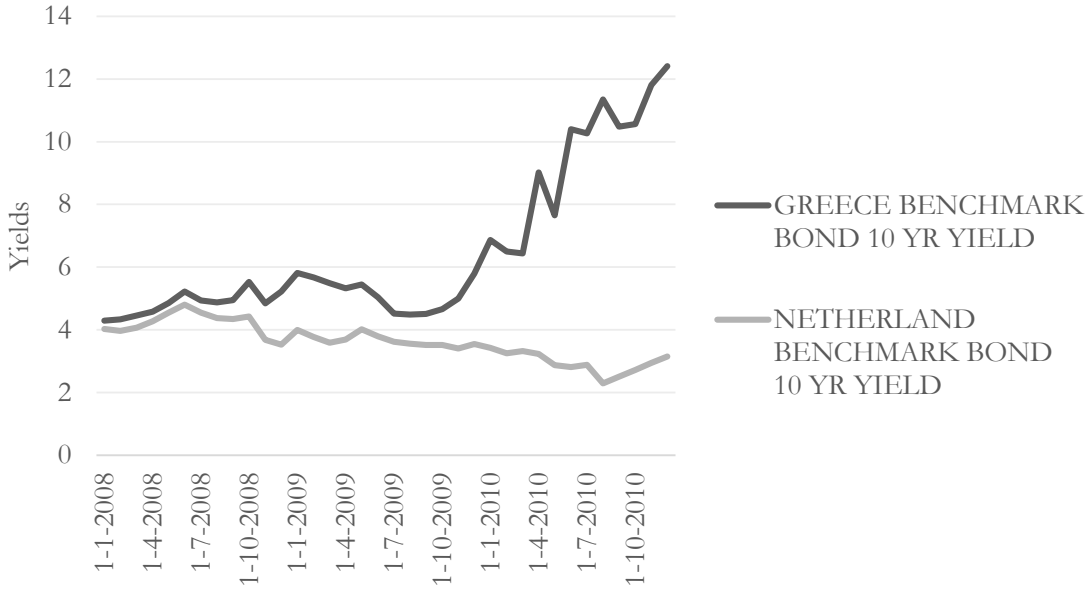
But before the global crisis hit in 2008 the height of the debt-to-GDP ratio does not seem to affect the government bond yield spreads. This changed with the beginning of the global crisis. During the global crisis the regression line does show a positive relation between the debt-to-GDP ratio and the spreads. When De Grauwe and Ji. (2012) compare the regression line (based on the debt-to-GDP ratio) to the sovereign yield spreads, it becomes clear that the theoretical model of the debt-to-GDP ratio does not seem to explain the variation in spreads sufficiently enough, the regression line shows there are a lot of unexplained spread increases. Furthermore, deviations from the regression line seem to be time and country dependent (De Grauwe and Ji, 2012).

Afonso, Arghyrou and Kontonikas (2012) find similar results. They used a panel of 10 EMU countries to investigate the determinants of government bond yield spreads. For their analysis they used an extensive set of variables, such as fiscal fundamentals, international risk, liquidity conditions, sovereign credit ratings and the risk of crisis transmission between EU members. Their model also allows for differences in spreads determinants between three distinct time periods: First, the period preceding the global credit crunch (from January 1999 to July 2007), second the period when the preceding global crisis had not yet been mutated into the sovereign debt crisis (August 2007 to February 2009) and thirdly the period of the sovereign debt crisis (March 2009 to December 2010). Their research shows that the determinants of sovereign spread change significantly over time. In the period preceding the global crisis, fiscal –and macro fundamentals where not significant in explaining government bond spreads. This changed when the global crisis hit in the summer of 2007. During this period fiscal –and macroeconomic fundamentals do explain movements in spreads in a way which is consistent with theoretical expectations. As of 2009 (the start of the sovereign debt crisis) the amount of sovereign spread determinants increased, which indicates that markets are now pricing risk which they did not consider before (contagion, size, liquidity and maturity of debt issuance). This is in line with studies conducted by other researchers, such as Schuknecht, von Hagen and Wolswijk (2010) who find that spreads can still largely be explained by the economic principles during the crisis, but also that fiscal imbalances are more penalized after September 2008.

As stated in the beginning of this chapter, country specific variables are not the only factor in determining the spreads. Macro-economic variables, such as time-varying international risk factors, also play an important role in explaining spreads. Time-varying international risk factors explain spreads because they affect the risk appetite of investors. According to existing literature, the risk appetite (or Global Risk Aversion) can be captured by the spread between the yield on AAA and BBB US corporate bonds (Giordano, Linciano and Soccorso, 2012) and/or the VIX variable (Aizenman, Jinjarak, Lee and Park, 2012). This is especially the case in the period after 2008 when the global crisis began. Since the start of the global crisis the regression slope (with the debt-to-GDP ratio as independent variable) is positive and significant, suggesting investors seem to see the deterioration of country fundamentals as increased default risks. But certain peripheral countries seem to be the victim of higher risk aversion among investors. If you compare the estimated spread with the actual spread, it becomes clear that an increase in sovereign spread is not linearly connected with changes in underlying country fundamentals. When the debt-to-GDP ratio of these countries increases, the increase in sovereign spreads is significantly higher than justified by the fundamentals model (De Grauwe and Ji, 2012).

Poghosya (2012) and Giordano, Linciano and Soccorso (2012) finds similar results. Since the beginning of the global crisis, spreads for peripheral countries are higher than they should be according to the fundamentals model. This is an indication for market overreaction and shows that investors are prone to "herding behavior" during periods of recession. But the opposite seems true for some core countries within the EMU. Core countries such as The Netherlands and Germany seem to benefit from the global crisis, the so-called "safe-haven" or "flight-to-quality" effect. This could be the result of an increased investors' preference in high rated government bonds.

Figure 2: Flight-to-Quality effect



When we summarize the findings above it becomes clear that we can identify three main findings. First, it seems that sovereign yields are not constant over time. At the beginning of the EMU spreads where unreasonable low. This changed with the beginning of the sovereign debt crisis, when the yields started to increase significantly. Secondly the yields movements seem to differ between countries. The yields of core countries, compared to peripheral countries, seem to be less affected by the crisis (figure 1 illustrates this as well). Finally there seems to be a global decrease in the risk appetite of investors, especially during the latter phase of the crisis. Spreads of peripheral EMU counties seem to be higher than can be explained with the country fundamentals model (Haan, Hessel and End, 2013).

2.2 KEY FUNDAMENTALS FOR EXPLAINING SOVEREIGN YIELD SPREADS

So, what are the most important country fundamentals for explaining yields? Rowland and Torres (2004) follow the method of Sala-i-Martin (1997) who starts with a small set of variables which are found (by previous literature) to be significant in explaining spreads. Rowland and Torres started with a liquidity and solvency variable, an indicator of vulnerability to external shocks and a default dummy. They continue with adding various variables and test whether or not they are significant. Insignificant variables are than replaced by other variables from the same group. This procedure was continued till they found a robust set of variables. Using this method they found six significant fundamentals, real GDP-growth, debt-to-GDP, reserves-to-GDP, Debt-to-export, export-to-GDP and debt service-to-GDP.

Haan, Hessel and End (2013) also look at previous used models to identify the most used macroeconomic fundamentals that explain sovereign yields. Their variables are limited to four fundamentals, real GDP-growth, (government) debt-to-GDP ratio, inflation and the current account-to-GDP ratio. D'Agostino and Ehrmann (2013) use roughly the same fundamentals to estimate the sovereign yields, with the difference that they use the expected values of their fundamentals. The fundamentals used in their analysis are real GDP-growth, debt-to-GDP, current account-to-GDP, unemployment and inflation. If you look at the variables identified by Rowland and Torres (2004), Haan, Hessel and End (2013) and D'agostine and Ehrman (2013) you notice they are show great similarities with the variables grouped according to the theoretical model as discussed in paragraph 2.1. Table 1 will present a list of the most important fundamentals identified.

Table 1: Most significant country fundamentals in determining sovereign yields

	Macroeconomic fundamentals
Variable:	Real GDP-growth
	Debt-to-GDP ratio
	Reserves-to-GDP ratio
	Debt-to-export ratio
	Export-to-GDP ratio
	Government deficit-to-GDP ratio
	Consumer price inflation
	Current account balance-to-GDP
	Unemployment rate

1. Real GDP growth rate: Economic growth generates a stronger fiscal position, which suggests that that the country's debt burden will be easier to service over time.
2. Debt-to-GDP ratio: When the debt burden of a country increases it will be more difficult for that country to service its debt over time. An increase in debt burden will therefore result in an increase of default risk, which will increase the sovereign yields demanded by investors.
3. Reserves-to-GDP ratio: Because debt has to be serviced out of the reserves, low levels of reserves increase the risk of default.
4. Debt-to-export ratio: Export is a major source of foreign exchange, so countries with large current account receipts will be less vulnerable to external shock, thus decrease the default risk for servicing their debt.
5. Export-to-GDP ratio: Same as above, large export implies a lower default risk.
6. Government deficit-to-GDP ratio: The general government deficit is defined by the Maastricht Treaty as the difference between the revenue and the expenditure of the government. If a country has a high deficit it could face problems in paying off its obligations and even become insolvent, thus higher default risk which results in a higher yield. Because a government deficit is indicated by a negative number, the relation with spread is also negative (a lower negative should yield a higher spread).
7. Inflation: Governments can use inflation instead of taxation as a mean of financing its expenditures and bringing down their deficit. A high inflation could indicate structural problems in government finances and is measure of government discipline.
8. Current account-to-GDP ratio: The current account is defined as the sum of the balance of trade (exports minus imports), net income from other sovereigns and the net current transfers. A positive current account means that the sovereign is a net

lender to other sovereigns, a negative current account means the opposite (net borrower from the rest of the world). A large deficit in the current account indicates that a country is very dependent from funds abroad. Long-term current account deficit results in a growth in foreign debt, which may become unsustainable over time.

9. Unemployment rate: The unemployment rate should capture the growth potential of a country. An increase in the unemployment rate should represent a deterioration of the growth potential of a country.

Table 2: Effects of fundamentals on yields according to the theoretical framework

		Effect on sovereign yield
↑	Real GDP-growth	↓
↑	Debt-to-GDP ratio	↑
↑	Reserves-to-GDP ratio	↓
↑	Debt-to-export ratio	↑
↑	Export-to-GDP ratio	↓
↑	Government deficit-to-GDP ratio	↓
↑	Consumer price inflation	↑
↑	Current account balance-to-GDP	↓
↑	Unemployment rate	↑

The table above (table 2) shows the most important country fundamentals and their expected (theoretical) relation on sovereign yields. If you want to make an estimation of the sovereign yield spreads using the fundamental model, the combination of these variables are most likely to give you the best result. But using only country fundamentals has its shortcomings, other factors such as political risks also affects sovereign yields. The problem with these kind of factors is that they are usually qualitative of nature and are hard to quantify, thus difficult to incorporate in economic models (Haan, Hessel & End, 2013).

Fortunately there are organizations (credit rating agencies) who are specialized in assessing the creditworthiness of countries (and companies). In order to make their assessment as accurate as possible they do have to take into account certain qualitative factors, making (in theory) ratings of rating agencies contain more information than the fundamental model. So, does a model with these ratings alone provide us with a (more) accurate estimation of sovereign yield spreads? To answer that question we first need to do research concerning the credit rating agencies.

3. CREDIT RATING AGENCIES

Credit rating agencies (CRA) are institutions who provide investors with information concerning the creditworthiness of issuers of debt and fixed income securities. This information is aimed to assist (potential) investors in determining the risk whether or not the issuer is able to meet their obligation concerning the issued security. CRAs provide this information based on an objective analysis and independent assessment of companies and countries who issue those securities.

The need for credit rating agencies emerged since the 19th century when the US market started to grow exponentially due to large investments in a continental infrastructure such as railroads. When the economy was relatively small and foremost local, capital providers knew their clients personally. But as the scale and geographical scope of transactions expanded, it was no longer possible for capital providers to know all of their clients personally. At first recommendations from respective people sufficed, but as the market grew larger, more complicated and less transparent this no longer was the case. The rapidly expanding US market gave rise to new institutions which specialized in the reporting and rating of creditworthiness of customers. In 1973 the role of rating agencies became a lot bigger when the SEC appointed some rating agencies as Nationally Recognizes Statistical Rating Organizations (NRSRO).

This decision lead to a shift in the income-model of the rating agencies. Due to the fact that the SEC appointed some rating agencies as NRSRO, these rating agencies did not only sell a service (rating your business), but also status. So rating agencies started to charge issuers for ratings. Some people believe that this resulted in abuse and conflicts of interest between the NRSROs and issuers.

The credit rating agencies discussed in the literature research are Fitch, Moody's and Standard and Poors, which together form the "big three". These big three where the only NRSROs in the US, and are by far the most dominant in the rating business (the three together control an estimated 90% of the business). It is because of their dominance and their alleged role in the crisis that this paper will focus only on those three rating agencies. Although the big three are all NRSROs, their credit rating scales are not standardized and do differ somewhat from each other. The highest rating given is AAA (for Standard & Poor's and Fitch) and Aaa (for Moody's). The lowest ratings are D (for Standard & Poor's and Fitch) and C (for Moody's). Table 3 shows the full range of ratings from the three leading rating agencies.

Table 3: Long-term rating scales of Standard & Poor's, Fitch and Moody's

Rating	Score	S&P	Fitch	Moody's
Highest investment grade	0	AAA	AAA	Aaa
	1	AA+	AA+	Aa1
	2	AA	AA	Aa2
	3	AA-	AA-	Aa3
	4	A+	A+	A1
	5	A	A	A2
	6	A-	A-	A3
	7	BBB+	BBB+	Baa1
	8	BBB	BBB	Baa2
Lowest investment grade	9	BBB-	BBB-	Baa3
Highest speculative/junk grade	10	BB+	BB+	Ba1
	11	BB	BB	Ba2
	12	BB-	BB-	Ba3
	13	B+	B+	B1
	14	B	B	B2
	15	B-	B-	B3
	16	CCC+	CCC+	Caa1
	17	CCC+	CCC	Caa2
	18	CCC-	CCC-	Caa3
	19	CC	CC	Ca
Lowest speculative/junk grade	20	C	C	C
In default	21	D	D	-

(Source 1: Bank for International Settlements)

(Source 2: Standard & Poor's)

(Source 3: Moody's)

Table 3 shows the ratings and scales used by S&P, Fitch and Moody's, as well as scores assigned to each rating. These scores aren't official scores assigned by the credit rating agencies, but are roughly copied from the paper of Ghosh (2013). Although the ratings and scales of Standard & Poor's and Fitch are the same, Moody's seems go another direction and uses another scale and other ratings. But the rating scale and rating names aren't the only differences, also the way they measure is different. Standard & Poor's ratings are relative opinions of the creditworthiness of an issuer, where the likelihood of default is the single most important factor in their assessment of creditworthiness. Fitch uses a similar measurement, their ratings provide an opinion on the relative ability of an entity to meet their financial commitments. Moody's ratings are somewhat different, they look at the expected loss which is measured by the probability of default as well as expected financial loss in case of default (Loss Given Default). Despite the (small) differences between the measurement and rating scale, most investors, regulators and analysts treat

the ratings of the big three as the same. Table 1 also shows that there are different grades of issuer ratings: Investment grade, speculative or junk grade and default grade (for S&P and Fitch). The differentiation between investment grade and speculative grade is very important. Many investors are restricted by federal regulations, contract or investment guidelines to only invest in investment grade financial instruments due to risk aversion. These restrictions obviously affect speculative grade and issuers who are downgraded to speculative grade issuers, as it will become more difficult and expensive to finance their operations (cost of capital increases). Therefore ratings from credit rating agencies do affect issuers, especially if issuers are downgraded to speculative grade. But how do the credit rating agencies determine/measure the rating of issuers? Because this paper focusses on EU countries and the sovereign debt crisis, the next paragraph will focus on explaining the sovereign rating methodology as conducted by Standard & Poor's, Fitch and Moody's.

The sovereign rating methodology reflects the CRAs opinion on the country's financial ability and willingness to service its commercial debt obligations on time and in full. Within this definition are two important criteria. The first is that rating scores exclusively focus on the creditworthiness of governments, which provides an assessment of sovereign risk. The second is that the rating focusses exclusively on the creditworthiness of sovereign debt to private creditors (bank loans, treasury bills and bonds) and provide no assessment of the credit risk on sovereign debt to official creditors such as other governments and supranationals (Bhatia, 2002).

To estimate the creditworthiness of governments, credit rating agencies use an extensive set of variables containing both quantitative and qualitative variables. Table 4 summarizes the most important variables used by S&P, Fitch and Moody's to estimate the creditworthiness.

Table 4: Sovereign rating factors of Standard & Poor's, Fitch and Moody's

Standard & Poor's	Fitch	Moody's
Economic score:	**Macroeconomic performance, policies and prospects:**	**Economic strenght:**
Economic structure		Growth dynamics
Economic growth prospects	Growth prospects	Scale of the economy
Political score:	Economic stability	National income
Institutional and governance effectiveness	Coherence and credibility of policy	Adjustment factor
	Risk posed by the financial sector	**Institutional strenght:**
Security risks	**Structural features of the economy that render it more or less vulnerable to shocks:**	Institutional framework and effectiveness
External score:		Policy credibility and effectiviness
External liquidity	Political risk	Adjustment factor
International investment position	Governance factors	**Fiscal strenght:**
Fiscal score:	**Public finances:**	Debt burden
Fiscal performance	Budget balances	Debt affordability
Fiscal flexibility	Structure of public debt	Adjustment factor
Fiscal debt burden	Sustainability of public debt	**Suspectibility to event risk:**
Monetary score:	**External finances:**	Political risk
Monetary flexibility	Fiscal financing	Government liquidity risk
	Sustainability of current account balances	Banking sector risk
	Sustainability of capital flows	External vulnerability risk
	Level of external debt	
	Structure of external debt	

(Source 1:Fitch)

(Source 2: Standard & Poor's)

(Source 3: Moody's)

By looking at table 4 it becomes clear that the methodology for rating sovereign credit issuers among the three biggest rating agencies bear some similarities. Each credit rating agency pools certain variables together into categories, such as economic performance/strength and fiscal performance/strength etc. These categories will then be given a score based on the weights given to the underlying variables. They then combine the score of each category to determine the sovereign credit rating.

Standard & Poor's starts its rating process by giving the 5 categories, economic, political, external, fiscal and monetary a score ranging from 1 to 6 (where 1 is the strongest, and 6 is the weakest). Each of the scores is based on quantitative factors and qualitative considerations. They then combine the economic and political score to form a sovereign's economic and political profile, and the external, fiscal and monetary score to form a flexibility and performance profile. These two profiles combined are used to measure the foreign-currency sovereign rating. For the countries used in this paper, the foreign-currency sovereign rating is the same as the local-currency sovereign rating due to the fact that these countries are part of a monetary union, thus giving up monetary – and exchange-rate policies to the common central bank (ECB) (Standard & Poor's, 2011).

Fitch's rating process uses an Ordinary Least Squares (OLS) regression as their Sovereign Rating Model (SRM), which estimates a score calibrated to the Long-Term Foreign-Currency IDR (Issuer Default Rate) scale. The SRM is a multiple regression model that uses 19 different economic and financial variables, which are structured by the 4 categories seen in table 2. These 4 categories then get weights corresponding to the amount of variation they explain in the predicted ratings. These weights are fully determined by the coefficients of OLS regression model, so no subjective judgement is involved. The most recent weights (August 2014) are:

1. Macroeconomic performance, policies and prospects: 10.3%
2. Structural features: 47.4%
3. Public finances: 25.4%
4. External finances: 16.9%

Although their SRM is an important analytical tool, Fitch does acknowledge the fact that no model can fully capture all relevant factors on sovereign creditworthiness. Therefore the actual rating as determined by the rating committee can and does differ from the rating as implied by the SRM (Fitch, 2014).

Moody's rating process of sovereign credit is based on the interplay of the 4 key categories, which are composed out of multiple sub-factors. These sub-factors consists of multiple indicators and are estimated/calculated with the help of data from a number of international sources (IMF, ECB, BIS). After the indicators are estimated, the outcomes are mapped to one of the 15 ranking categories ranging from Very High Plus (VH+) to Very Low Minus (VL-). These rankings are then used to determine the score of the relevant sub-factors using the same scale as the indicators, and in turn the score for the 4 broad rating factors. After the individual key factors are rated, Moody's combines the factors economic strength and institutional strength (with equal weight) into a new construct they call economic resiliency. The next step in the rating process of Moody's is using an aggregation function which combines the economic resiliency with fiscal strength (following a non-linear pattern). As a final step the preliminary rating is lowered (if necessary) with a country's susceptibility to event risk (Moody's, 2013). Table 5 shows the key variables used by Standard & Poor's, Fitch and Moody's for their credit assessment of sovereigns.

Table 5: Glossery of key indicators for sovereign rating from Standard & Poor's, Fitch and Moody's

Standard & Poor's	Fitch	Moody's
Economic and monetary score:	**Structural variables:**	**Economic strenght:**
GDP per capita	Composite governance indicator	Average real GDP growth
Real GDP per capita (% change)	GDP per Capita	Volatility in real GDP growth
Consumer price index (% change)	Share in world GDP	WEF global competitiveness index
Domestic claims (% change)	Years since default	Nominal GDP
Monetary base	Money supply	GDP per capita
External score:	**Public finances, general government:**	Diversification
Current Account Receipts (CAR)	Gross debt forreserve currency sovereign	Credit Boom
Gross External Financing needs (% of CAR+usuable reserves)	Gross debt for non-reserve currency sovereign	**Institutional Strenght:**
Narrow net external debt (CAR (%):	Budget balance	World bank government effectiveness index
Reserves	Public foreign-currency debt	World bank rule of law index
Foreign exchange usuable reserves	Interest payments	World bank control of corruption index
Current account balance/CAR (%)	**External finances:**	Inflation level
Net foreign direct investment/GDP (%)	Reserve currency flexibility	Inflation volatility
Terms of trade	Commodity dependence	Track record of default
Fiscal score:	Official internation reserves for non-reserve currency-sovereigns	**Fiscal strenght:**
General government	Sovereign net foreign assets	General government debt/GDP (%)
Change in general government debt as percentage of GDP	Current account balance plus net foreign direct investment	General government debt/revenues (%)
Net general government debt/GDP (%)	External interest service	General government interest payments/revenue (%)
General government financial assets	**Macroeconomic performance:**	General government interest payments/GDP (%)
Gross general government debt/GDP (%)	Real GDP growth volatility	Debt trend
General government interest/general government revenues (%)	Consumer price inflation	General government foreign curency debt/general government debt (%)
Central government debt service/central government revenues (%)	Real GDP growth	Other public sector debt/GDP (%)
		Public sector financial assets or sovereign wealth funds/GDP (%)
		Suspectibility to event risk:
		Domestic political risk
		Geopolitical risk
		Fundamental metrics
		Market funding stress
		Strenght of banking system
		Size of banking system
		Funding vulnerabilities
		(Current account balance+FDI)/GDP (%)
		External vulnerability indicator (EVI)
		Net international investment position/GDP (%)

(Source 1:Fitch)

(Source 2: Standard & Poor's)

(Source 3: Moody's)

The table above shows us that Moody's uses more variables in their analysis. This is most likely the result of their different approach concerning the rating of sovereigns: where the other two CRAs measure the probability of default, Moody's measures the expected loss which is measured by the probability of default as well as expected financial loss in case of default.

4. EMPIRICAL RESEARCH

4.1 DATA DESCRIPTION

The empirical analysis covers 10 euro zone countries: Greece, Ireland, Italy, Portugal, Spain, Netherlands, Finland, Austria, Belgium and France. Germany will be used as the benchmark country to calculate de sovereign yield spreads for the other countries. The dataset covers the period from January 2005 until December 2013. This time-span has been chosen because it encompasses the pre-crisis period, the subprime-mortgage crisis as well as the recent sovereign debt crisis. The data used in the research consists of daily data of sovereign bond yields and quarterly data of the country fundamentals. Quarterly data is used due to the lack of monthly data. The sovereign bond yields are extracted from the Reuters database, whereas country fundamentals are obtained from Eurostat. Unfortunately data concerning the reserves of countries was not complete, therefore I have chosen to exclude this fundamental from my analysis. The dataset comprises of 36 observations for each country and has a total of 360 observations for the entire dataset. Due to the lack of data availability of ratings from Standard & Poor's and Fitch, only sovereign ratings from Moody's are included in the empirical research. This data is extracted from the website of Moody's.

4.2 THE MODEL

As mentioned in the introduction, this research will focus on the determinants of sovereign yield spreads. In this section of the thesis we continue with the empirical analysis to estimate them. To assess the potential determinants identified I will use a panel regression model according to the fixed effects principal. The fixed effects model is used because it (partly) removes the omitted variable bias that occurs with regressions relying on intercountry (across) variations. In its most simple form this model can be written as:

$$y_{it} = \alpha_i + x_{it}'\beta + \varepsilon_{it} \quad for\ i = 1 \ldots\ldots N, t = 1 \ldots\ldots T \tag{1}$$

where y_{it} is the dependent variable and refers to the spread of country i at time t, x_{it} is a vector of the explanatory variables, α_i are fixed country-specific effects and ε_{it} are idiosyncratic errors. So, equation (1) models the 10-year government bond yield spread versus Germany, on fundamentals incorporating country specific fixed effects.

If we apply this most simple form of the model (1) and rewrite it to fit the variables identified in chapter 2 we get:

$$Spread_{it} = \alpha + \beta_1 Growth_{it} + \beta_2 Debt_{it} + \beta_3 Debt/export_{it} + \beta_4 Export_{it} + \beta_5 Deficit_{it} + \beta_6 Inflation_{it} + \beta_7 CA_{it} + \beta_8 Unempl_{it} + \mu_{it} \quad for\ i = 1 \ldots\ldots N, t = 1 \ldots\ldots T \tag{2}$$

In (2) $Growth$ stands for the real GDP growth, $Debt$ for the Debt-to-GDP ratio, $Debt/export$ for the Debt-to-Export ratio, $Export$ for the Export-to-GDP ratio, $Deficit$ for the Deficit-to-GDP ratio, CA for Current account balance-to-GDP ratio, $Inflation$ and $Unempl$ speak for themselves.

The second question I wanted to answer is whether or not a model with credit ratings alone as explanatory variable would make a good estimation of sovereign yields. If we apply this to model (1) we get:

$$Spread_{it} = \alpha + \beta_1 CRA_{it} + \mu_{it} \quad for\ i = 1 \ldots\ldots N, t = 1 \ldots\ldots T \tag{3}$$

where CRA_{it} stands for the sovereign ratings of Moody's, for of country i at time t.

Finally I will combine model (2) and (3) into one model, which will look like:

$$Spread_{it} = \alpha + \beta_1 Growth_{it} + \beta_2 Debt_{it} + \beta_3 Debt/export_{it} + \beta_4 Export_{it} + \beta_5 Deficit_{it} + \beta_6 Inflation_{it} + \beta_7 CA_{it} + \beta_8 Unempl_{it} + \beta_9 CRA_{it} + \mu_{it} \quad for\ i = 1 \ldots\ldots N, t = 1 \ldots\ldots T \tag{4}$$

According to previous research the determinants of sovereign yield spreads are not stable across time. To account for these differences I created 4 dummy variables:

1. Pre-crisis: This variable has a value of 1 when an observation falls between 01-01-2005 till 30-06-2008
2. Subprime-crisis: This variable has a value of 1 when an observation falls between 01-07-2008 till 30-09-2009
3. Euro-crisis: This variable as a value of 1 when an observation fall between 01-10-2009 till 31-12-2013
4. Crisis: This variable has a value of 1 when an observation falls between 01-07-2008 till 31-12-2013

To see if there are differences in determinants across the time-line, three different kind of regressions will be performed. The first regression will encompass all the data, from the first quarter of 2005 till the last quarter of 2013. The second regression will only include data from the pre-crisis period. The third regression includes data of the entire crisis period. For this third regression, the subprime –and euro crisis are joined together due to the low amount of observation for the subprime-crisis. These first three regressions will not include data concerning sovereign ratings because this has an impact on the coefficients of country fundamentals, thus could affect the result whether or not the significance of fundamentals changed over time.

Finally I have to take into consideration a well-known problem in time series analysis: interdependence between consecutive observations. Looking at figure 1 it seems that government bond yield spreads shows features of this problem, which is also known as non-stationary or unit-root. This is in line with earlier research conducted by Giordano, Linciano & Soccorso (2012) and Rowland & Torres (2004) who tested for autocorrelation. Both found that government bond yield spreads has a unit root, thus is non-stationary and autocorrelated. To correct for the effects of autocorrelation (overestimation of t-values) I will use the Newey-West estimator.

5. EMPIRICAL RESULTS: DETERMINANTS OF SOVEREIGN YIELD SPREADS

5.1 DESCRIPTIVE STATISTICS

The empirical analysis starts with looking at descriptive statistics. As mentioned in the theoretical framework, yields seem to be time –and country dependent, so I created two different tables containing descriptive statistics. The first table (table 6) shows the mean, standard deviation, minimum –and maximum spread per country over the entire period. In the second table (table 7) the descriptive statistics are split into three periods (pre-crisis, subprime crisis and euro-crisis).

Table 6: Descriptive statistics of spreads

Country:	Mean	Std. deviation	Min	Max
Greece	6.3369	8.2791	0.1014	35.645
Portugal	2.8772	3.3533	-0.0193	11.565
Ireland	2.1156	2.3428	-0.2075	8.323
Italy	1.4683	1.3511	0.1344	4.908
Spain	1.4475	1.5271	-0.0137	4.871
Belgium	0.6324	0.5606	0.0067	2.271
France	0.3779	0.3392	-0.0082	1.338
Austria	0.3613	0.3141	-0.0633	1.106
Netherlands	0.2226	0.1769	-0.0625	0.5969
Finland	0.2047	0.1889	-0.0669	0.6844

If you look at table 6 you clearly see the difference in spreads between the GIIPS –and core countries. All GIIPS countries have a mean yield spread higher than 1, with the yield spread of Greece even topping at 35 points. The same applies to the standard deviation of spreads, all GIIPS countries have a standard deviation above 1, whereas the core countries are a lot less volatile. Even the worst performing core country (Belgium) has a mean and standard deviation which is approximately two times less risky than the best performing GIIPS country (Spain), although Spain (as well as Ireland and Portugal) at one time was perceived as less risky than Germany. Because table 6 shows the descriptive statistics per country over the entire time-span, it could be that the mean and standard deviation give a wrong image of a country due to the extreme market movements since the start of the subprime crisis. That is why in table 7 the descriptive statistics are split into three periods.

Table 7: Descriptive statistics of spreads, per period

Country:	Period	Mean	Std. deviation	Min	Max
Greece	Pre-crisis	0.2841	0.1482	0.1014	0.6342
	Subprime-crisis	1.7283	0.6551	0.9355	2.4926
	Euro-crisis	12.3247	8.4055	2.4109	35.645
Portugal	Pre-crisis	0.1554	0.12894	-0.0193	0.4062
	Subprime-crisis	0.9299	0.2796	0.6239	1.3153
	Euro-crisis	5.5350	2.9907	0.6733	11.565
Ireland	Pre-crisis	0.0293	0.1454	-0.2075	0.3436
	Subprime-crisis	1.5126	0.7009	0.5227	2.2342
	Euro-crisis	3.9057	2.0992	1.4165	8.323
Italy	Pre-crisis	0.2637	0.1048	0.1344	0.5227
	Subprime-crisis	1.0818	0.3051	0.7866	1.4229
	Euro-crisis	2.5126	1.2006	0.6072	4.908
Spain	Pre-crisis	0.0684	0.0909	-0.0137	0.3066
	Subprime-crisis	0.6919	0.1488	0.5252	0.8711
	Euro-crisis	2.7300	1.2046	0.5435	4.871
Belgium	Pre-crisis	0.1022	0.1235	0.0067	0.3965
	Subprime-crisis	0.6778	0.2027	0.4416	0.9433
	Euro-crisis	1.0322	0.4928	0.3233	2.271
France	Pre-crisis	0.0512	0.0567	-0.0082	0.1822
	Subprime-crisis	0.3857	0.1035	0.2961	0.5605
	Euro-crisis	0.6299	0.2891	0.2009	1.338
Austria	Pre-crisis	0.0522	0.0779	-0.0633	0.2162
	Subprime-crisis	0.6482	0.2816	0.3153	1.0277
	Euro-crisis	0.5221	0.2355	0.1912	1.106
Netherlands	Pre-crisis	0.0434	0.0757	-0.0625	0.217
	Subprime-crisis	0.4426	0.1439	0.2872	0.5969
	Euro-crisis	0.3009	0.0995	0.1624	0.513
Finland	Pre-crisis	0.0173	0.0856	-0.0669	0.2087
	Subprime-crisis	0.4489	0.1668	0.2809	0.6844
	Euro-crisis	0.2826	0.1027	0.1219	0.498

Table 7 shows a couple of things. First, for the GIIPS countries the mean and standard deviation increased significantly during the euro-crisis period. The mean yield spread of Greece during the euro-crisis increased with 613% relative to the subprime-crisis period. Second, if you look at the yield spreads and standard deviation of Austria, Netherlands and Finland you can see these countries seem to benefit from the euro-crisis. This is in line with the theory "flight-to-quality" as discussed in chapter two. Thirdly, it seems that the market considers Germany as the

"safe-haven" (or benchmark country) since no country has had a negative spread after the beginning of the subprime-crisis. Finally, as stated in the beginning of this paragraph, the mean (and standard deviation) seem to differ over time which is an indicator that the government bond yield spreads are non-stationary, thus has a unit root.

5.2 PANEL REGRESSION: COUNTRY FUNDAMENTALS

As mentioned before I would like to identify the determinants of sovereign yield spreads and compare a model based on country fundamentals with a model based on the sovereign ratings of Moody's alone. To accomplish this, (panel) regressions will be made using the model as specified in chapter 4.2.

The first part of this analysis will focus on the complete sample of data including all the explanatory variables over the entire period (pre-crisis, subprime-crisis and euro-crisis). Table 8 shows the final result of eight separate Newey-West regressions per fundamental with country fixed effects, over the entire sample containing the 10 selected countries.

Table 8: Newey-West regression per fundamental on sovereign yield spreads

Variable:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Debt-to-GDP ratio	0.0974***							
Export-to-GDP ratio		0.1696***						
Current account-to-GDP ratio			0.2683***					
Deficit-to-GDP				-0.0675**				
Real gdp growth					-0.0370			
Debt-to-Export ratio						2.5737***		
Inflation							-0.3932*	
Unemployment								0.5263***
Observations	360	360	360	360	360	360	360	360
R^2 within	0.3466	0.0943	0.1175	0.0161	0.0044	0.1626	0.0082	0.4076
Country fixed effects	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled

Dependent variable: sovereign yield spreads

Note: The asterisks ***, **, * indicate significance at the 1, 5 and 10 percent level respectively

Table 8 shows the relation between the sovereign yield spread and the individual key country fundamentals. If you compare these results with the theoretical predictions as shown in table 2, you see that there are three discrepancies. First, the export-to-GDP ratio should have a negative relation with sovereign yield spreads, yet the results in table 8 shows a positive coefficient. Second, the current account has a positive relation with sovereign yield spreads, which also should be negatively related. Finally, the inflation has a coefficient of -0.3932 which means that an increase of 1 point inflation results in a decrease in sovereign yield spreads of 0.3932 points. This is strange, because an increase in inflation could indicate structural problems in government finances, thus

increase default risk. If we further analyze the results in table 8 we see that all fundamentals (even though some fundamentals have a very low coefficient) are economical significant and almost every fundamental is statistical significant at the 1 percent level with the exception of the deficit-to-GDP ratio (which is a close call with a p-value of 0.012), inflation (only significant at a 10 percent level) and the real GDP growth (not statistical significant at all). Also, the models based on these three fundamentals seem to yield the lowest R^2, meaning they explain the least of the variation in sovereign yield spreads.

Now that the individual relations between the selected fundamentals and the sovereign yield spreads are known, it is time to combine all the key fundamentals into one model, over the entire time-span including all the selected countries. Table 9 below presents the results of such a model.

Table 9: Newey-West regression fundamentals on sovereign yield spreads

Variable:	**Coefficient**	**Newey-west std. err.**	**T-value**
Intercept	-6.4739***	2.4134	-2.68
Debt-to-GDP ratio	0.0623**	0.02903	2.14
Export-to-GDP ratio	-0.0663	0.04128	-1.61
Current account-to-GDP ratio	-0.0551	0.0650	-0.85
Deficit-to-GDP	0.0792	0.04923	1.61
Real gdp growth	-0.0142	0.0174	-0.81
Debt-to-Export ratio	-0.2161	0.5420	-0.40
Inflation	0.2196*	0.1166	1.88
Unemployment	0.4269**	0.1713	2.49
Observations		360	
R^2 within		0.4557	
Country fixed effects		Controlled	

Dependent variable: sovereign yield spreads

Note: The asterisks ***, **, * indicate significance at the 1, 5 and 10 percent level respectively

Table 9 shows that, according to this model, the debt-to-GDP ratio and unemployment are statistical significant at a 5 percent level (t-value > 1.96) and inflation is significant at the 10 percent level. The rest of the fundamentals do not seem to be statistical significant, not even at the 10 percent level, although the export-to-GDP and deficit-to-GDP are very close with a p-value of 0.108. The coefficients show that all the fundamentals are economically significant. Comparing theoretical expectations with the results presented in table 9 we see that the coefficients of export-to-GDP, current account-to-GDP and real GDP growth are negative which is in line with

theoretical expectations. But not all fundamentals have a coefficient that coincides with theory. The debt-to-export ratio should have a positive relation with sovereign yield spreads, yet it seems to be negative. The coefficient of the deficit-to-GDP ratio also does not line up with theory, it should have a negative relation with sovereign yield spreads. The problem we saw in table 8, where inflation had a negative relation with spreads, is now corrected. The rest of the variables (debt-to-GDP and unemployment) have positive coefficients conforming expectations. Table 9 shows furthermore that a model based on only country-specific fundamentals (after correcting for fixed effects) explains 45.57% of the variation in sovereign yield spreads.

The next step is to see whether or not this model is good for estimating sovereign yield spreads. The easiest way to accomplish this is to make a visual representation of the real observed spreads versus the fitted values according to the model used in table 9. Figure 3 till figure 12 are line-charts that plots the real spread of a country versus the estimated spread according to the fundamentals model.

Figure 3: Real vs estimated spread, Greece

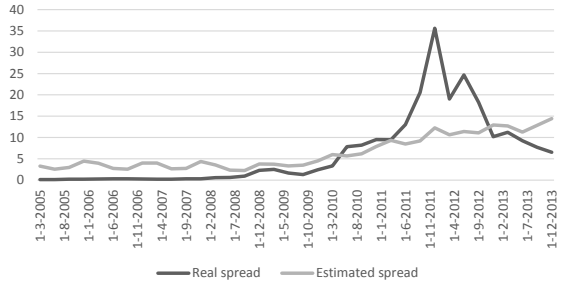


Figure 4: Real vs estimated spread, Italy

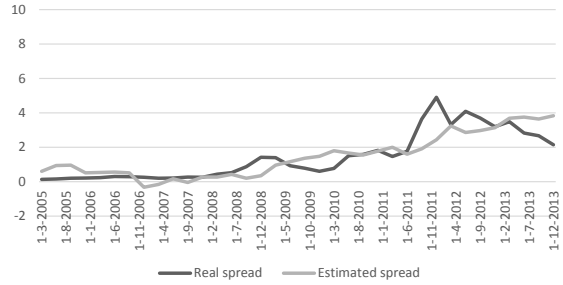


Figure 5: Real vs estimated spread, Ireland

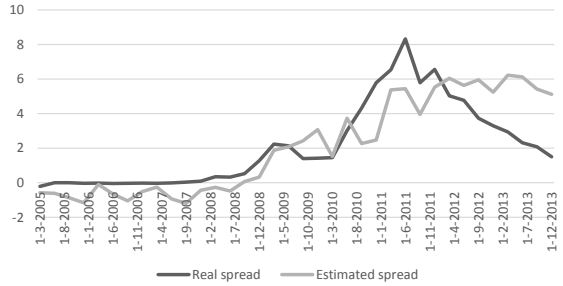


Figure 6: Real vs estimated spread, Portugal

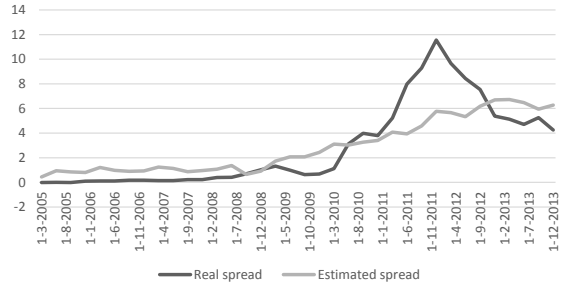


Figure 7: Real vs estimated spread, Spain

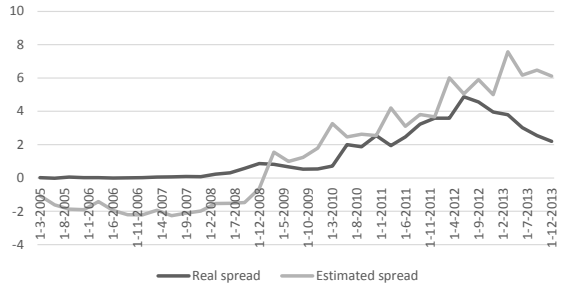


Figure 8: Real vs estimated spread, France

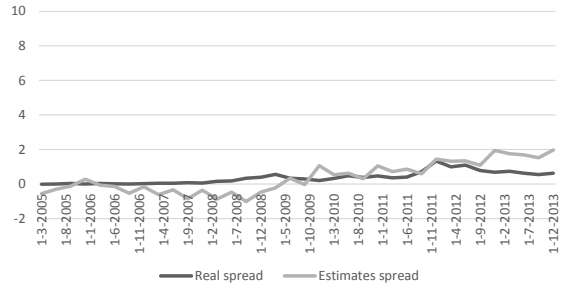


Figure 9: Real vs estimated spread, Belgium

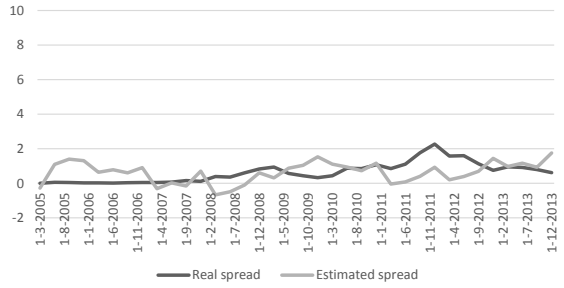


Figure 10: Real vs estimated spread, Netherlands

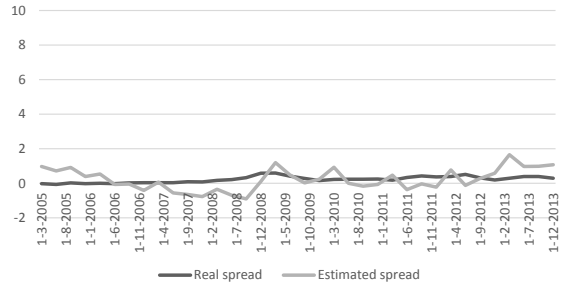


Figure 11: Real vs estimated spread, Austria

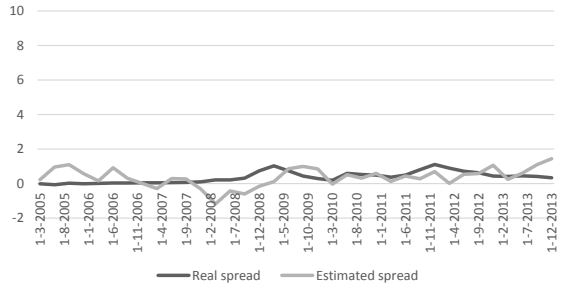
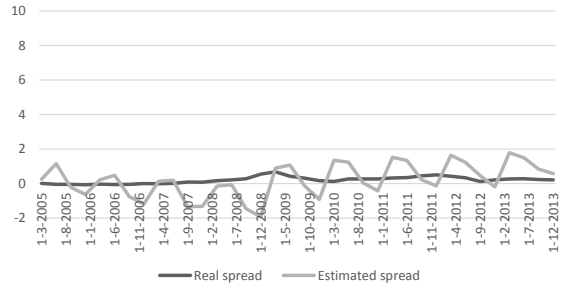


Figure 12: Real vs estimated spread, Finland



A first glimpse at the figures shows that the model does seem to (roughly) follow the actual spreads, meaning that the spreads can be (partly) explained with the fundamentals used. When analyzed deeper we see that the actual spread of Greece, Italy and Portugal during the period before the crisis is lower than can be explained with the fundamentals model, meaning the sovereign risk of these countries was underpriced in the period preceding the crisis. This is in line with previous research, who found that the peripheral countries seemed to benefit from the introduction of the European Monetary Union (EMU) due to the mispricing of their economic and fiscal fragility. Since the beginning of the crisis however, the real spread of these three countries and Ireland increases in a way that cannot be justified with the underlying fundamentals. So, the figures indicate that investors demanded a premium, relative to the country fundamentals, that was too low pre-crisis and too high during the crisis. These excessive increases in demanded yields could indicate that the global risk aversion (GRA) increased since the start of the crisis. This is in line with the findings of Giordano, Linciano and Soccorso (2012). Schuknecht, von Hagen and Wolswijk (2010) also found similar results and came to the conclusion that fiscal imbalances of peripheral countries where more penalized after 2008.

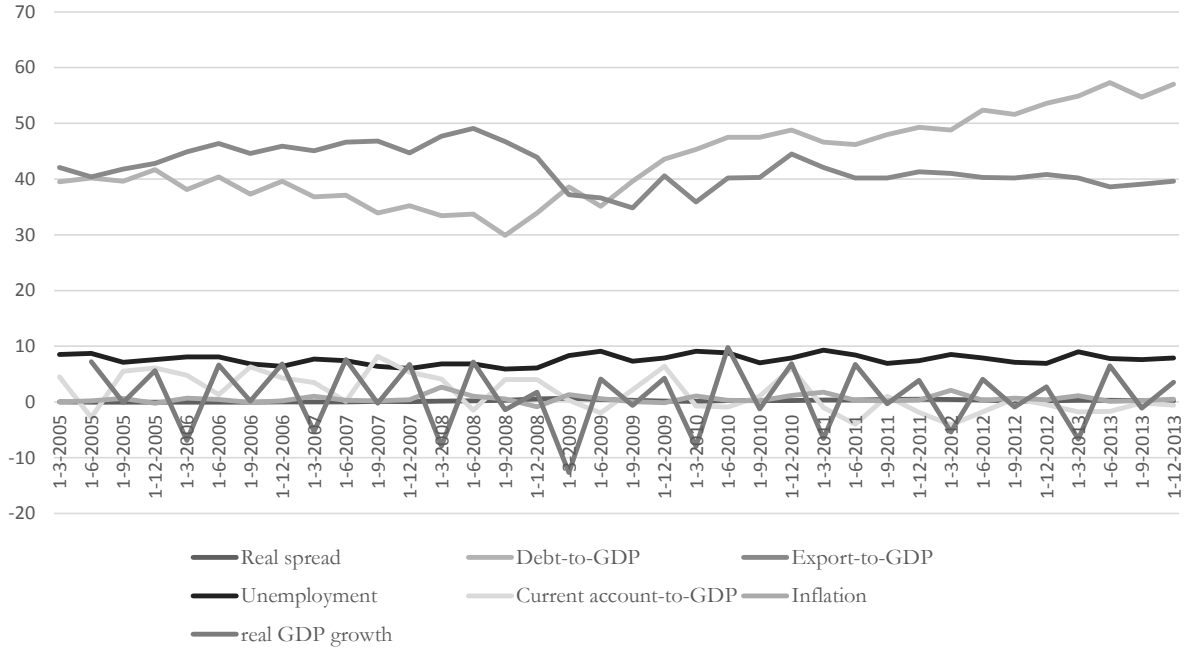
As for the remaining GIIPS country, Spain, the result is a little bit off from the expectation. Giordano, Linciano and Soccorso (2012) and Poghosyan (2012) find that in the period preceding the crisis the actual spread is lower than what is estimated with their model and that the opposite is true since the start of the crisis. Looking at figure 7 we see that up to 2009 the actual spread is higher than the predicted spread and in the period after 2009 the predicted spread is consistently higher than the actual spread. These differences are most likely the result of the models used, both

papers use country fundamentals complemented with variables such as short-term interest and a measure of risk aversion whereas my research only includes country fundamentals. Another difference that could had led to other results is the time-span used in the analysis. Poghosyan (2012) used data over a period from 1985-2010, Giordano and Linciano and Soccorso (2012) from January 2002 till May 2012 and this research from January 2005 till December 2013.

The next country that draws my attention when looking at the figures is Belgium. In the beginning the estimated spreads does seem to line up quite nicely with the actual spreads, but since the beginning of 2011 the actual spread started to exceed the estimated spread. If you take a closer look at figure 9 you will see that the real spread actually began to increase since the second quarter of 2010 and started to decrease since the beginning of 2012, which matches the period that Belgium was without a government. Because my model does not include political risks, this could explain the discrepancy between the estimated spread and the actual spread.

The final figure that I want to discuss is figure 12, Finland. Figure 12 shows us that spreads estimated with country fundamentals show sign of cyclical fluctuations. This is most likely the result of underlying trends in fundamentals. Giordano and Linciano and Soccorso (2012) acknowledge this problem and smoothed out these trends using moving average (MA) smoothing. Figure 13 below indeed shows signs of trends, especially for the current account-to-GDP and real GDP growth.

Figure 13: Finland fundamental analysis



The previous figures as well as the literature research show us that, since the crisis, investors started pricing risk they did not consider before and that fiscal imbalances are more penalized. In other words, the amount of spread determinants and the importance of some fundamentals

increased over time. In order to test this theory I re-ran the same regression, but split the time-span into two periods. The first period runs from 2005 till the start of the subprime-crisis and the second period runs from the start of the subprime crisis till the end of 2013. Table 10 shows the results of these two regressions.

Table 10: Newey-West regression fundamentals on sovereign yield spreads

Variable:	**Pre-crisis**	**t-value**	**Crisis**	**t-value**
Intercept	-0.2222	-0.46	-3.0756	-0.92
Debt-to-GDP ratio	-0.0016	-0.52	0.0457	1.35
Export-to-GDP ratio	0.2031***	3.93	-0.0291	-0.71
Current account-to-GDP ratio	-0.0137***	-3.41	-0.1806	-1.54
Deficit-to-GDP	-0.0012	-0.43	0.0502	1.17
Real gdp growth	-0.0001	-0.10	0.0182	0.79
Debt-to-Export ratio	-0.0039	-0.10	-1.2137	-1.63
Inflation	0.0379***	3.84	0.3823	1.46
Unemployment	-0.0023	-0.12	0.5986***	2.79
Observations	140		220	
R^2	0.4726		0.3446	
Country fixed effects	Controlled		Controlled	

Dependent variable: sovereign yield spreads

Note: The asterisks ***, **, * indicate significance at the 1, 5 and 10 percent level respectively

If you look at table 10 you see that the t-values, which indicates the statistical significance of the fundamental in question, show different values for the two selected periods. This indicates that, indeed, the importance of (some) fundamentals did change over time. In the period preceding the crisis, export-to-GDP, current account-to-GDP and inflation where significant determinants of sovereign spreads (at a 1 percent level). During the crisis their statistical significance dropped till the point they are not even significant at a 10 percent level, only unemployment seems significant since the start of the crisis. Further analyzing the t-values we see that the statistical significance of debt-to-GDP, deficit-to-GDP, real GDP growth, debt-to-export and unemployment did increase, yet not to a level of statistical significance. Although the statistical significance of (almost) all fundamentals decreased, the economic significance did increase for all fundamentals except the export-to-GDP ratio. All but the coefficient of the export-to-GDP ratio increased, meaning that the spreads reacted more intensely on a change in these fundamentals. This decrease in statistical significance, the increase in economic significance and the decrease in R^2 strengthens the idea that

the market did indeed took into account more variables in assessing sovereign risk and investors did require a higher risk premium for changes in certain fundamentals since the start of the crisis.

5.3 PANEL REGRESSION: RATINGS

As stated in chapter 2, a model based on only the fundamentals of a country has its shortcomings. Qualitative factors such as political risks are not accounted for because they are hard to quantify. Fortunately credit rating agencies, such as Moody's, depend on the quality of their ratings as it is their core business and source of income. In order to make their rating as accurate as possible they do have to incorporate qualitative factors in their estimation of a countries ability and willingness to service its public debt. Comparing table 5 with table 2 we see that ratings from rating agencies consists of much more variables, thus contain more information. Therefore a model based on ratings should result in a more accurate estimation of sovereign yield spreads as compared to the fundamental model. Table 11 presents the result of a regression with the quantified ratings of Moody's as the independent variable.

Table 11: Newey-West regression ratings on sovereign yield spreads

Variable:	Coefficient	Newey-west std. err.	T-value
Intercept	-0.8465	0.5625	-1.50
Quantified rating Moody's	0.7100***	0.1376	5.16
Observations		360	
R^2 within		0.5853	
Country fixed effects		Controlled	

Dependent variable: sovereign yield spreads

Note: The asterisks ***, **, * indicate significance at the 1, 5 and 10 percent level respectively

Using only quantified ratings of Moody's yields a coefficient of 0.7100, meaning that sovereign yield spreads increase with 0.7100 basis points when a country is downgraded one grade. The positive relation between rating downgrades and spreads is in line with theoretical expectation. With a t-value of 5.16 the ratings are statistically significant at a one percent level. Table 11 furthermore shows a R^2 of 0.5853 which is higher than the R^2 of the fundamentals model, meaning that the ratings model explains more of the variation.

To evaluate how good this model fits the actual spreads, I followed the same methodology as before and predicted the spreads based on the results shown in table 11. The predicted spreads

are then transformed into line charts and compared to the actual spread. Figure 13 till figure 22 show the results.

Figure 13: Real vs estimated spread ratings, Greece

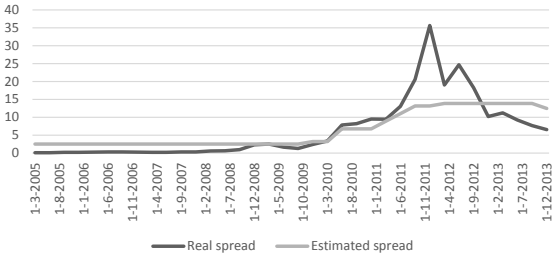


Figure 14: Real vs estimated spread ratings, Italy

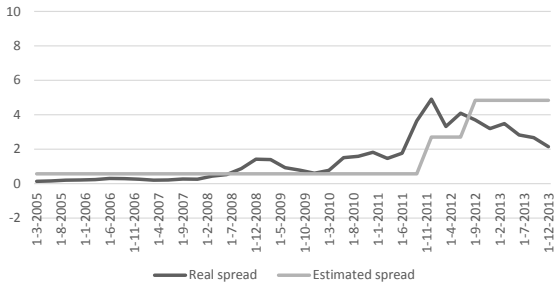


Figure 15: Real vs estimated spread ratings, Ireland

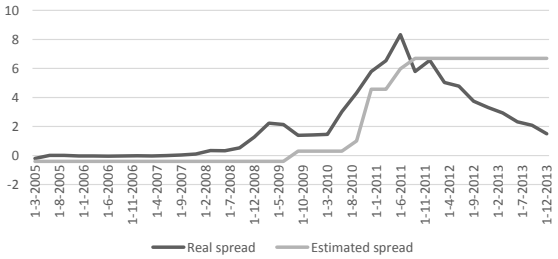


Figure 16: Real vs estimated spread ratings, Portugal

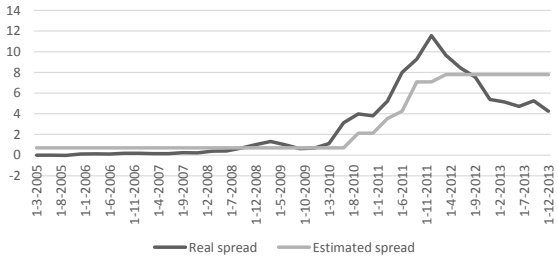


Figure 17: Real vs estimated spread ratings, Spain

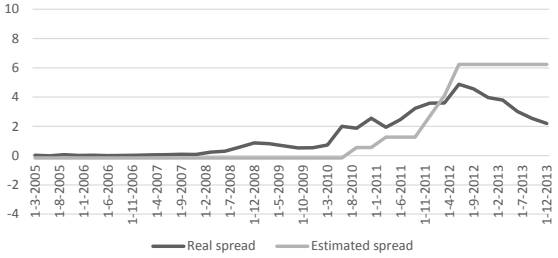


Figure 18: Real vs estimated spread ratings, France

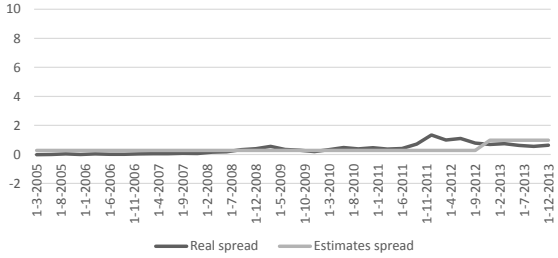


Figure 19: Real vs estimated spread ratings, Belgium

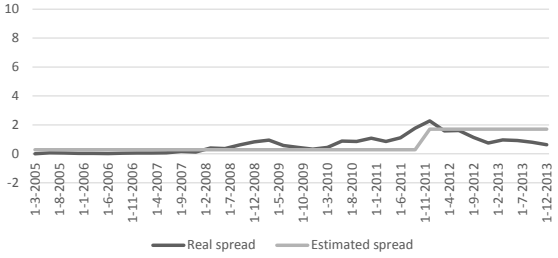


Figure 20: Real vs estimated spread ratings, Netherlands

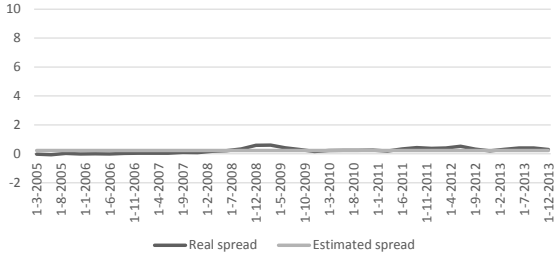


Figure 21: Real vs estimated spread ratings, Austria

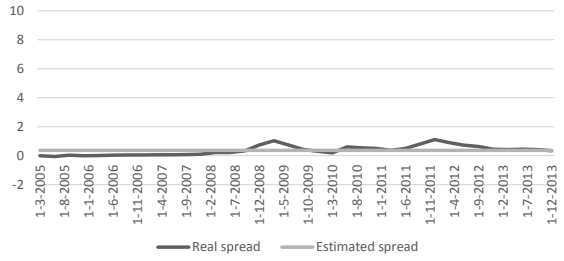
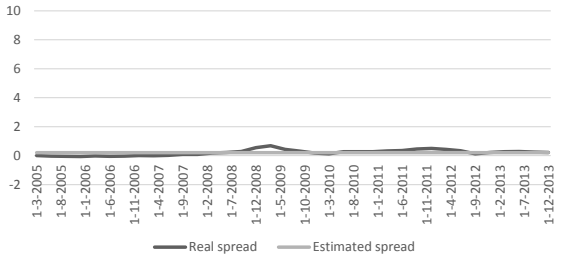


Figure 22: Real vs estimated spread ratings, Finland



The first thing that you notice when looking at the figures above is the stability in the estimated spread, especially when compared to the estimated spreads based on fundamentals. This makes sense because ratings change less often than fundamentals. For the Netherlands, Austria and Finland the ratings never changed, whereas the ratings of Greece changed 8 times (7 downgrades and 1 upgrades). When looking at the countries that did experience a change in rating (figure 13 till 19) you see that the estimated spread using the ratings of Moody's has a delay compared to the actual spread. This delay indicates that rating changes from Moody's lag behind the market, which is in line with findings or Reinhart (2002) and Elkhoury (2009) (Baum, Karpava, Schafer and Stephan, 2013). Finally it is noticeable that Moody's seems to wait with upgrading certain countries. Whereas the actual spreads seem to exhibit a downward trend since the beginning of 2012, the estimated spreads based on the ratings of Moody's seems to stay the same till the end the dataset. The only exception is Greece, which experienced an upgrade on 29-11-2013 resulting in a decrease in estimated spread. This is most likely the result of a limitation in the dataset used. Due to the lack of data availability for the year of 2014 the dataset ends at 31-12-2013, but data concerning ratings of Moody's is available for the year of 2014. Looking at this data we see that Ireland and Portugal were upgraded two times and Spain one time during 2014. This strengthens the belief that rating adjustments from Moody's do experience lag, although the lag concerning upgrades seems to be longer than lag concerning downgrades

5.4 PANEL REGRESSION: FUNDAMENTALS AND RATINGS COMBINED

The next step is to combine the previous two models, creating a model containing both fundamentals and ratings, to estimate sovereign yield spreads. In theory this model should contain the most important quantified determinants and certain non-quantified determinants such as political risks. Therefore this model should, in theory, provide us with a more accurate estimation of sovereign yield spreads. The results of the regression combining both models is found below in table 12.

Table 12: Newey-West regression fundamentals & ratings on yield spreads

Variable:	Coefficient	Newey-west std. err.	T-value
Intercept	0.1337	1.8703	0.07
Debt-to-GDP ratio	-0.0477*	0.0258	-1.85
Export-to-GDP ratio	0.0008	0.0295	0.03
Current account-to-GDP ratio	-0.1118*	0.0588	-1.90
Deficit-to-GDP	-0.0302	0.0205	-1.47
Real gdp growth	0.0073	0.0143	0.51
Debt-to-Export ratio	0.7288*	0.4286	1.70
Inflation	0.0908	0.1068	0.85
Unemployment	0.0592	0.0977	0.61
Quantified rating Moody's	0.9069***	0.2183	4.15
Observations		360	
R^2 within		0.6259	
Country fixed effects		Controlled	

Dependent variable: sovereign yield spreads

Note: The asterisks ***, **, * indicate significance at the 1, 5 and 10 percent level respectively

Table 12 shows how sovereign yield spreads react on changes in the selected country fundamentals and ratings of Moody's. Earlier in the theoretical framework we identified what the effect of fundamentals on spreads would be according to theory. Comparing the coefficients shown in table 12 with the expected theoretical relation we see some discrepancies. First the debt-to-GDP ratio should have a positive relation with sovereign yield spreads (higher debt results in a higher default risk), yet table 12 shows us a negative relation which is economic and statistical significant. Secondly the export-to-GDP ratio has a (very weak) positive relation with spreads, although it should be positive according to theories. Finally the real GDP growth has a positive relation with sovereign yield spreads, which according to theory should be a negative. The variables that do seem to be statistical significant are the debt-to-GDP ratio, current account-to-GDP ratio, debt-to-export ratio and the quantified ratings of Moody's, where the first three are significant at a 10 percent level and the ratings at a 1 percent level. Furthermore, this model explains 62.59 percent of the variations in spread, which is higher than previous models. Again graphical representations of the estimated sovereign yield spreads compared to the actual spreads are created, figure 23 till 32 show the results.

Figure 23: Real vs estimated spread full model, Greece

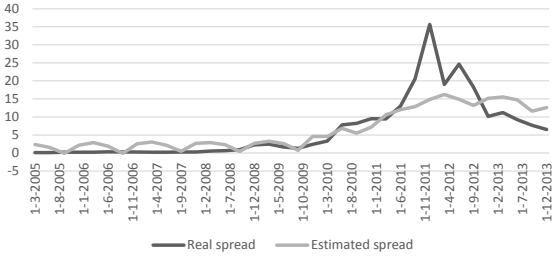


Figure 24: Real vs estimated spread full model, Italy

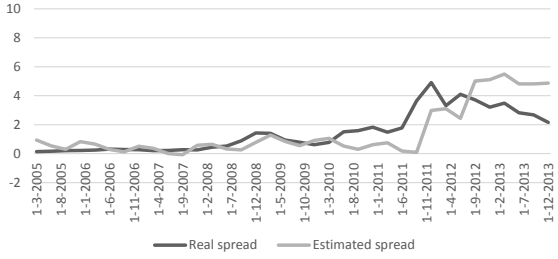


Figure 25: Real vs estimated spread full model, Ireland

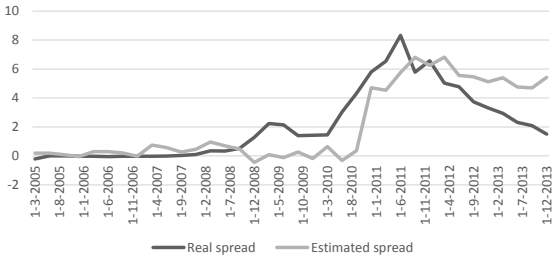


Figure 26: Real vs estimated spread full model, Portugal

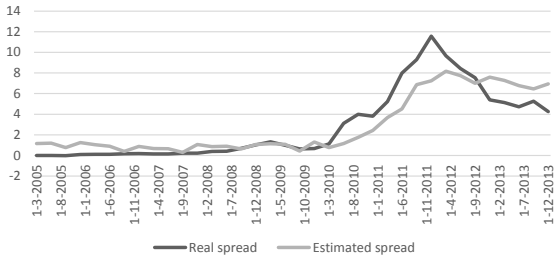


Figure 27: Real vs estimated spread full model, Spain

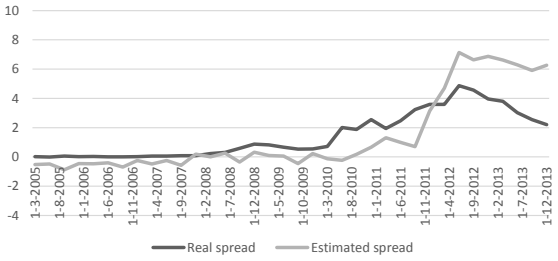


Figure 28: Real vs estimated spread full model, France

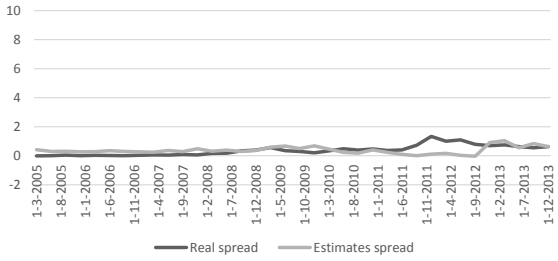


Figure 29: Real vs estimated spread full model, Belgium

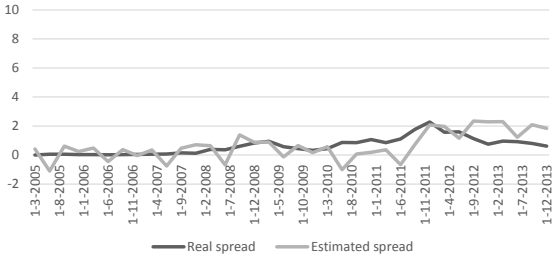


Figure 30: Real vs estimated spread full model, Netherlands

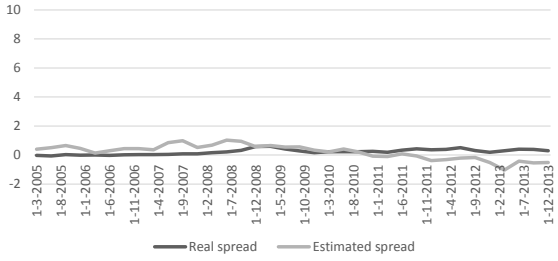


Figure 31: Real vs estimated spread full model, Austria

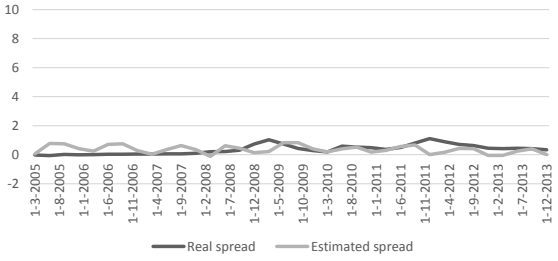
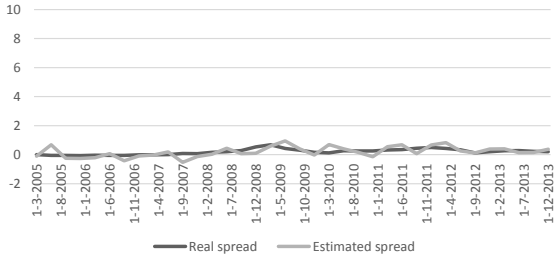


Figure 32: Real vs estimated spread full model, Finland



Combining fundamentals and ratings into one model gives us a good estimate of sovereign yield spreads, although it does not seem to eliminate the lag problem seen in the ratings model. A problem we saw with the fundamental model, the cyclical fluctuations in the estimated spread of Finland, seems to be mitigated to some level. The other problem we saw in the ratings model was the "flat line" at the end of the estimation period, which was due to the lack of downgrades during that period. Combining country fundamentals with ratings seems to give a more accurate estimation during the last part of the period, although the estimated spreads for Italy and Spain are still relatively high compared to the real spread.

5.5: WHAT MODEL YIELDS THE MOST ACCURATE SPREADS?

In the previous paragraphs we separately discussed the results of the three models, but how do they compare to each other? To give an answer to that question, this paragraph will consist of one table containing the results of the three regression and two line-charts that will provide us with a graphical representation of the estimation results. First a comparison of the statistics, table 13 below shows the (simplified) results of the regressions.

Table 13: Model comparison: Fundamentals vs ratings vs combined

Variable:	**(1)**	**(2)**	**(3)**
Debt-to-GDP ratio	0.0623**		-0.0477*
Export-to-GDP ratio	-0.0663		0.0008
Current account-to-GDP ratio	-0.0551		-0.1118*
Deficit-to-GDP	0.0792		-0.0302
Real gdp growth	-0.0142		0.0073
Debt-to-Export ratio	-0.2161		0.7288*
Inflation	0.2196*		0.0908
Unemployment	0.4269**		0.0592
Quantified rating Moody's		0.7100***	0.9069***
Observations	360	360	360
R^2 within	0.4557	0.5853	0.6259
Country fixed effects	Controlled	Controlled	Controlled

Dependent variable: sovereign yield spreads

Note: The asterisks ***, **, * indicate significance at the 1, 5 and 10 percent level respectively

Looking at table 13 we see that the debt-to-GDP ratio is significant in both model (1) and model (3). This is in line with previous research conducted by Rowland and Torres (2004) and Haan, Hessel and End (2013), who find that increase in yield spreads can be explained by the

deterioration of certain fundamentals such as debt. Unfortunately adding ratings had the effect that the debt-to-GDP ratio got the wrong (negative) sign, which is not in line with theoretical expectations but does coincides with results of Afonso, Arghyrou and Kontonikas (2012) who also found that adding ratings resulted in a negative sign for the debt-to-GDP ratio. The same problem occurred with the export-to-GDP ratio, real GDP growth and debt-to-export ratio, model (1) yielded the correct signs whereas model (3) resulted in coefficients that contradicts theoretical intuition as well as results of Haan, Hessel and End (2013). Furthermore, when ratings are added the statistical significance of the debt-to-GDP ratio decreased from a 5 percent level to a 10 percent level whereas the inflation and unemployment became insignificant even at the 10 percent level.

Adding ratings to the fundamental model also has its advantages, the current account-to-GDP ratio and the debt-to-export ratio became statistical significant at a 10 percent level. Looking at the coefficients we see an increase in economic significance of the current account-to-GDP ratio and the debt-to-export ratio. Including ratings also has a positive effect on the sign of the deficit-to-GDP ratio (became negative) and debt-to-export ratio (became positive) as well as the height of the R^2 which increased from 45.57% to 62.59%. If we compare model (2) with model (3) we see that the economic significance of the ratings increased when combining the ratings with fundamentals and the R^2 also increased compared to the ratings model (2).

Reading the above we can conclude that adding ratings into the fundamentals model has both statistical advantages and disadvantages, but how do the estimated spreads compare to each other? The next pages will focus on the analysis of the estimated spreads according to the three models. This analysis will consist of a comparison between the goodness-of-fit for GIIPS vs. core countries, therefore I created one line-chart of the average GIIPS spreads (figure 33) and one line-chart of the average core country spreads (figure 34).

Figuer 33: Model comparisson for GIIPS countries

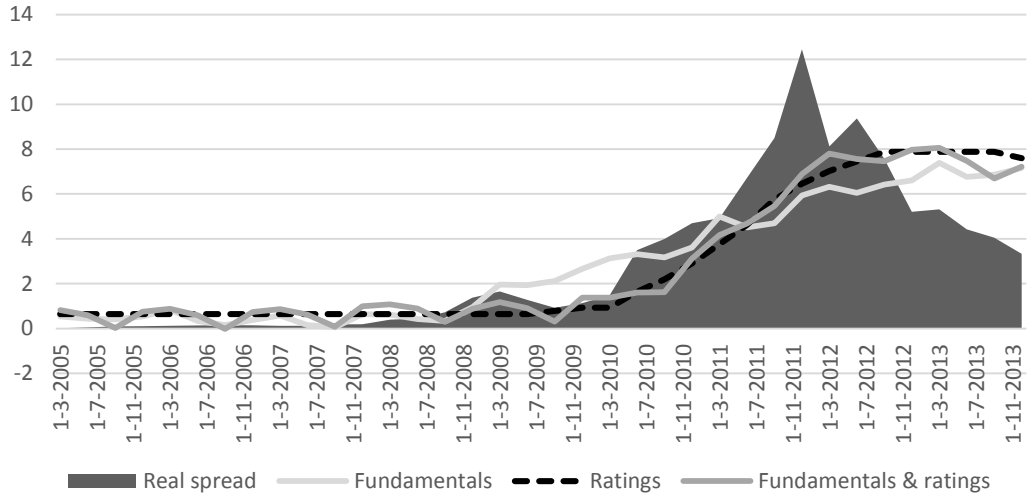


Figure 33 shows the average estimated spreads of the GIIPS countries according to the three models compared to the average actual spread. It seems that the model with fundamentals and ratings combined gives the most accurate estimates of sovereign yield spreads, although the estimates of the three models are very close to each other. Taking a closer look at figure 33 you notice a sharp increase in the actual spread at the beginning of the second quarter of 2010. This increase seems to be the result of the deterioration of country fundamentals which started in 2008, but was not penalized by the market till the second quarter of 2010 (probably when Greece sought financial aid). Since the second half of 2010 till the end 2012 the actual spread is higher than can be justified with fundamentals and ratings. This could be the result of the market overreacting and demanding higher risk premiums for the deterioration of country fundamentals. Another explanation for this discrepancy could be that all three models miss some important variables needed to explain sovereign spreads.

The opposite seems true for the period after 2012, where the estimated spreads are higher than the actual spreads. Figure 33 shows an obvious downward trend in actual spreads since the second half of 2012, but the estimated spread based on fundamentals and the combined model do not seem to go down till the second quarter of 2013. The model based on ratings alone also seems to capture this trend but to a lesser degree than the other two models and with more delay. This is (most likely) a result of Moody's reservedness towards country upgrades. The discrepancy after 2012 can be explained with the market overreacting the other way around, yet this seems highly unlikely. A much more likely explanation would be an incomplete model, some (important) variables needed for explaining spreads could be missing in all three models.

Figure 34: Model comparisson for core countries

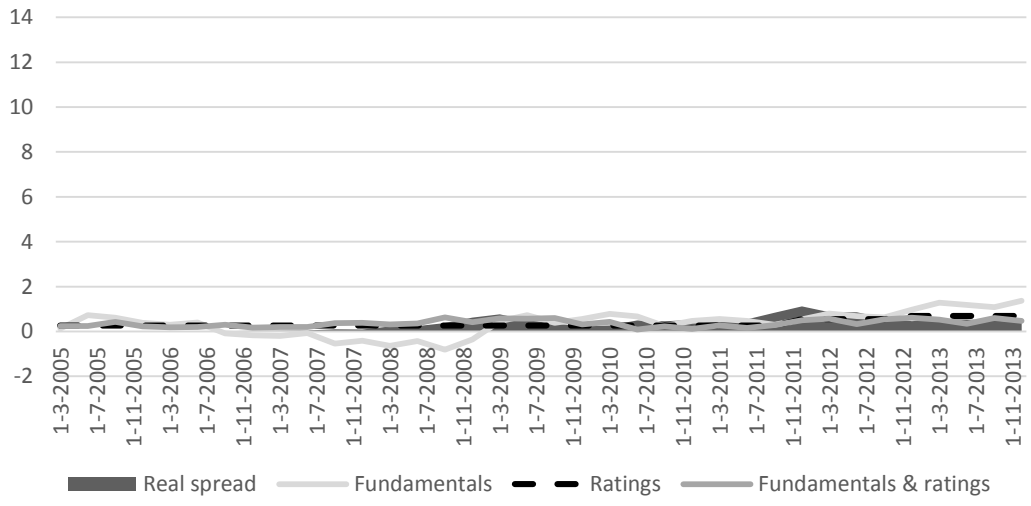


Figure 34 plots the average actual and estimated spreads of Austria, Finland, France, the Netherlands and Belgium. The first thing you notice when looking at the figure is the stability of the spreads compared to the spreads of the GIIPS countries. It seems that all three models are pretty accurate in explaining sovereign spreads for the core countries. Even though all three models come very close to the actual spread, you see that the model based on fundamentals alone sometimes deviates more from the actual spread. During the second half of 2007 till the end of 2008 we see that the actual spread is higher than can be justified with fundamentals alone. Since the second half of 2006 the fundamentals based spread seems to decrease, meaning that the underlying country fundamentals increased in quality. The actual spread however did not decrease, suggesting that investors take into account more factors than fundamentals alone. The opposite seems true for the period after 2012 where the spread based on fundamentals is higher than the actual spread. This could be the result of the earlier discussed safe-haven effects for the core countries and/or an incomplete model. If we look at the estimated spreads using the ratings and combined model we see that both discrepancies that occurred with the fundamentals only model are solved, this again could indicate that using only the core country fundamentals is insufficient for explaining spreads.

When we summarize the above it becomes clear that the estimates of the three models are very close to each other and seem to do a good job in explaining sovereign spreads. The fact that the results of the fundamental model and the ratings model are roughly the same suggests that the variables used by Moody's to estimate their rating has similarities to the variables used in the fundamental model or that these variables have (much) more weight compared to other (qualitative) factors such as domestic –and international political risk.

Although the models do seem to do a good job at explaining the sovereign spreads, there are some discrepancies which could indicate that the models lack some variables needed to capture all movements in sovereign spreads. As discussed earlier, the fundamental model does not take into account some qualitative factors, but the model based on ratings (and the combined model) should correct for that shortcoming. Therefore it seems there are more factors/variables that impacts sovereign yield spreads. Some factors that are not included in my models, but could possibly affect spreads are the (real) exchange rate, short-term interest rate spread, a proxy for the global financial market such as the Eurostoxx 50 and the VIXX (Alexopoulou, Bunda and Ferrando, 2009) and the risk of transmission effects between countries (Afonso, Arghyrou and Kontonikas, 2012). Figure 33 and 34 showed us furthermore that the determinants of sovereign yield spreads seem to be country –and time dependent.

6. CONCLUSION

The aim of this thesis is to identify the main determinants of sovereign yield spreads for EMU countries and to see whether or not ratings contribute in estimating these spreads. I employed a panel of ten euro area countries (Greece, Italy, Ireland, Portugal, Spain, France, Belgium, Netherlands, Austria and Finland) using quarterly data over the period 2005-2013. I investigated the role of a set of potential spread determinants identified by previous research, limited to country fundamentals and sovereign ratings from Moody's. To calculate spreads I have chosen to use the yield of German sovereign bonds as a benchmark. In order to identify whether or not the chosen country fundamentals and ratings are significant determinants of sovereign spread I employed several different panel data regressions. The Newey-West estimator is used to correct for serial correlation in sovereign spreads.

The empirical research indicates that the determinants of sovereign bond yield spreads vary over time and country and cannot be explained by country fundamentals alone. Before the escalation of the crisis fundamentals do seem to explain sovereign spreads, although there are some minor discrepancies. Since the second quarter of 2010 the actual spread of GIIPS countries increased rapidly, which the fundamentals model seems to anticipate. This could indicate that this steep increase in actual spread is a late reaction of the market on the deterioration of (certain) country fundamentals. During the period of 2011 and 2012 I find that the actual spread of the GIIPS countries was higher than can be justified with fundamentals, whereas in the period after 2012 the opposite is true. This suggests that investors started to look at risks they did not consider before (change in determinants) and/or started to react differently to risks (change in the coefficients). When the dataset is split into two periods (pre –and during/post crisis) we see that most of the fundamentals that were significant pre-crisis became insignificant since the start of the crisis indicating that, indeed, the determinants of spreads changed over time. Furthermore, I find that the coefficients of most of the fundamentals increased since the start of the crisis, suggesting that investors react more intensely to changes in country fundamentals since the crisis. Analyzing the estimated spreads on country level I find that the selected country fundamentals seem to be do a better job at explaining spreads for core countries than it does for the GIIPS countries, therefore investors seem to price different factors depending on the country.

Finally, I find that sovereign credit ratings of Moody's are statistically significant in explaining spreads, yet an obvious lag is noticeable indicating that ratings of Moody's do not lead, but lag behind the market. Despite the observed lag, a model based on ratings alone seems to be a good way in estimating spreads especially when the simplicity of the model is taken into account.

Combining both models, therefore implementing ratings into the fundamental model, increases the statistical and economic significance of ratings but has a mixed effect on the country fundamentals. Looking at the estimated spreads of the combined model we notice it flattens the volatility of the fundamentals model and does a better job at explaining spreads for the core countries as well as a couple of peripheral countries. Although adding ratings to the model has its advantages, it does not have a very large impact on the estimated spreads. When comparing the estimated spreads of the three models, we see that they yield roughly the same results. This suggests that the variables used by Moody's for assessing the creditworthiness of countries has similarities to the variables used in the fundamental model or that these variables have (much) more weight compared to the other variables used in Moody's assessment.

While I present empirical evidence that fundamentals as well as ratings are significant in explaining spreads, I do want to emphasize that certain announcement during and concerning the recent crisis seem to affect spreads significantly. Therefore a possible extension to this thesis could be to include data of events and announcements concerning the recent crisis.

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