Master Thesis Finance

The impact of credit ratings on sovereign bond yields

A case study for countries in the eurozone

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Acknowledgments

Five years ago I unpacked my bags when I started studying at Tilburg University. Now, writing these acknowledgements, it feels like I have to pack my bags again and take the next step in my journey through life. But as always when you pack your bags, one inevitable thing happens, you forget to pack something important. For the bags I have to pack now, years of memories, experiences, education, and friends must fit in a limited space, and I am sure I will forget to mention and thank someone important.

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I will end packing, look at my checklist one more time, and I am sure I forget someone. All people who do not appear in this word of gratitude were very important to me as well since they contributed to shaping me in the person I am now.

A.M.T. Sturmans
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Abstract

This study uses daily sovereign bond yield (Credit Default Swap (CDS) spread) data of eurozone countries to conduct an event study on the reaction of these yields and spreads before, during, and after credit rating events provided by the big three Credit Rating Agencies (Standard & Poor's, Moody's, and Fitch). In addition, a regression is run to determine whether a spillover effect exists and an additional event study is carried out to measure the impact of credit rating events on exchange rates. Significant responses are found of sovereign bond yield, CDS spreads, and exchange rates being influenced by credit rating events, particularly in the case of negative rating events (both announcements and rating changes). Announcements are anticipated over a 1-2 month horizon but do not show persistence of an equally long period following the rating event. Finally, this study shows the existence of spillover effects in which the yield of non-event countries is influenced by the negative ratings in event countries.

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1. Introduction

Since the subprime crisis in the late 2000s the scientific and political interest in credit rating agencies[A*] (CRAs) rose tremendously. Several studies blamed the CRAs being the cause of the crisis due to flaws in their rating methodology. For example, White (2009) showed that the subprime crisis was fueled by CRAs, Eijffinger (2012) found evidence that the three big CRAs (Moody's[1], Standard and Poor's[2] (S&P), and Fitch Ratings[3]) had too much power and provided flawed assessments, and Mora (2006) implied that CRAs do not give an accurate reflection of the risk attached to the rated entity. But also before the subprime crisis the effects of the ratings by the three big CRAs have been discussed. Hite and Warga (1997), Steiner and Heinke (2001), and Hull, Predescu and White (2004), amongst many others, found evidence that credit ratings had an impact on economies. Although the credit rating agencies have been discussed widely and scientific evidence was found that there were flaws in their assessments, investors and governments still attach value to the ratings. Both private and institutional investors are more interested in rated securities than in unrated securities (Larrain et al., 1997) and sovereigns still request credit ratings because they want to access capital markets at an international level (Cantor & Packer, 1996).

In addition, research showed that investors lean towards less risky and more liquid portfolios in times of economic distress, the flight-to-safety (Beber et al, 2006). Since government bonds[B] are considered a relatively safe investment, the findings of Beber, et al. (2006) indicate that sovereign bonds are higher in demand during the subprime crisis and the European sovereign debt crisis. During and following the subprime crisis and European sovereign debt crisis, the sovereign bond yields[C] increased substantially in a few Euro area countries (also reported by news agencies[4]), even more than one would expect based on several macroeconomic indicators such as Gross Domestic Product (GDP) growth, fiscal developments, and inflation (Afonso et al., 2012). According to Afonso et al. (2012), the capital market had increased awareness to the macroeconomic indicators and the following sovereign downgrades by the CRAs were not surprising.

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* Words indicated with a superscript letter (For example: [A]) are explained in Appendix I, the terminology list.

[1] Moody's provides credit ratings through a segment of Moody's Corporation, Moody's Investor Service. Moody's Corp. Annual Report (Form 10-k), filed 26-2-2013.

[2]Standard & Poor's provides its ratings through a segment of The McGraw-Hill Companies Inc., S&P Ratings. The McGraw-Hill Companies Inc. Annual Report (Form 10-k), filed 28-2-2013.

[3]Fitch Ratings, a subsidiary of Fitch Group, provides credit rating services. Fitch Inc., Annual Certification 2012.

[4]Meakin & Charlton (June 14, 2012), Spanish, Italian Bond Yields Rise. Bloomberg

Previous studies investigated the relation between ratings, sovereign bond yields, and Credit Default Swap (CDS)[D] spreads in emerging and / or developing countries (Reinhart, 2010), as government debt crises do not often occur in developed countries. Only little work exists covering the relation between ratings, sovereign bond yields, and CDS spreads for a set of developed countries, sharing the same currency.

This study will test the possible effect of credit ratings on CDS spreads in addition to the possible effect on sovereign bond yields alone for a set of developed countries that all share the same currency. Flannery et al. (2010) suggest that CDSs should be used to assess the risk attached to an entity instead of a credit rating because CDSs are more accurate and react quicker to changing market conditions. A study of Larrain et al. (1997) revealed that investors rely heavily on credit ratings and a negative correlation between credit ratings and CDS spreads exists, indicating that a lower credit rating should go together with a higher CDS spread and vice versa (Hull et al., 2004). Previous research studied effects of credit ratings on sovereign bond yields (CDS spreads) for a set of developing countries (Reisen & von Maltzan, 1999) or a set of developed countries which use different currencies (Afonso et al., 2012). This research will study the anticipating, direct, persistency, and spillover effect of credit ratings on sovereign bond yields (CDS spreads) for a set of developed countries which all share the same currency. In addition, I will study these effects for two subgroups of the sample which act in a different economic environment. Finally, I will test the effect of credit ratings on the exchange rate of the Euro against several major investment currencies.

I will use an event study methodology to examine the effects of sovereign credit rating events on sovereign bond yields and CDS spreads for countries in the eurozone (with the exception of Luxembourg) that adopted the Euro as a physical currency in 2002. The sample period covers the period January 2002 until December 2012 and daily data covering the same period, if available in datastream, to conduct the empirical tests for the research. First, I conduct an event study analysis to measure the bond yield (CDS spread) reaction over a window of one day before the rating event until the day after the event, where the rating announcement is provided by S&P, Moody's, or Fitch. Secondly, I will check whether sovereign bond yield (CDS spread) developments anticipate rating events. Thirdly, I will check whether the possible rating effect is persistent or that the sovereign bond yield (CDS spread) moves back to the situation before the rating. Fourthly, I will check whether a spillover effect exists to check whether a rating event in one country affects the sovereign bond yield (CDS spread) in another country, where no rating event takes place. Finally, I will check whether rating events influence the value of the euro by measuring the impact of credit rating events on several exchange rates.

According to my analysis the main findings are:

i) Sovereign bond yields (CDS spreads) significantly react to credit rating events with a stronger effect in case of negative credit rating events.
ii) Sovereign bond yields (CDS spreads) react to both credit rating changes and credit rating announcements.
iii) Rating events are anticipated in both the thirty and sixty days preceding the rating event.
iv) Ratings are non-persistent, strong moves in sovereign bond yield (CDS spread) take place in the thirty and sixty days following the rating event.
v) Significant contagion effects are found for sovereign bond yields. The results for CDS spreads are ambiguous, either positive or negative, and the significance is varying.
vi) Credit rating events trigger, most of the time, a depreciation of the Euro In this, the ratings provided by Standard & Poor's provide significant and positive impact for all exchange rates, whereas the impact for Moody's and Fitch is bi-directional and varies in significance.

The remainder of this paper is organized as follows. At the bottom of this page, three important points* are provided which apply for the whole research. Section two briefly describes the events (over the past fifteen years) which lead to the financial situation in which the eurozone is now. This part is particularly important to gain insight in the events which lead to the increase in credit ratings for countries in the eurozone. Section three reviews related literature. Section four describes the data and provides some stylized facts. Section five describes the empirical analysis and provides the results. Section six concludes, discusses the limitations of this study, and provides recommendations for future research.

***Important:** In this paper I assume a credit rating is attributed to a sovereign entity rather than a specific bond since a CRA often refers to the entity as a whole instead of the issued bond.

***Important:** The impact of credit ratings will be investigated over the period 2002-2012 whereas the focus of this research is the second half of this interval, 2007-2012.

***Important:** Some references to the bibliography can be found in the footnotes.

2. Background information

I. The Euro

History

Ten years after the introduction in 2002 the Euro is shared by 17 European Union (EU) member states, which combined are referred to as the eurozone. Although the birth of the Euro took place in 1992 when the Treaty on European Union was signed in Maastricht (the Maastricht Treaty), the official launch was in 1999 as an accounting currency and finally in 2002 when the Euro was introduced as a physical currency. In order to be eligible for the Euro a country had to comply with the Euro convergence criteria. The most important criteria are (Stability and Growth Pact and the Treaty on European Union):

- Maximum allowed inflation: average three lowest inflation member states EU + 1,5%
- Ratio government deficit to gross domestic product (GDP) needs to be equal to or smaller than 3%
- Ratio government debt to GDP < 60%, or at least approaching this value at pace
- No devaluation of applicants currency during the two years in the exchange-rate mechanism under the European Monetary System
- Long term interest rate must not exceed inflation three lowest inflation member states +2%

Advantages and disadvantages

The need to introduce a common currency was fed by the advantages which would come along on all scales. Consumers, companies, governments, and economies would benefit from the Euro. These promised advantages, amongst others, are:

- Economic stability
- Economic growth
- Integrated financial markets
- Stronger presence of EU economy on a global scale
- Inflation reduction

Other important factors to consider before implementation of the single currency were the consequences of the elimination of exchange rate risk, the costs of implementation, and the previous lack of transparency in cross-border transactions. The most important, believed to be, benefit of the Euro was the creation of a stable economic entity which could put its mark on the global economy. In the latter, putting a mark on the global economy, the Euro succeeded. Within ten years the Euro and the eurozone have

become important players in the global marketplace where only the U.S. are bigger. In 2006 already the Euro took second place as issue currency of sovereign and corporate debt worldwide. It is the second most traded currency in foreign exchange markets and several countries use the Euro as reference for their own currency[5]. The Euro also became an attractive reserve currency for prudent economic management and the Euro was more capable to absorb external shocks because of its size and strength.

Thus, the Euro had to be able to withstand negative macroeconomic and financial shocks[E], but the introduction of the Euro meant the elimination of one of the main instruments to absorb these negative shocks by individual countries: a national entity could no longer devaluate its currency (Copeland, 2008). In addition, Buiter et al. (1993) and Beetsma and Uhlig (1999) exposed one major drawback of the Euro even before it was introduced as a physical currency: the ability to borrow in a shared currency provides free-rider problems if strong incentives exist to bail out a country in trouble (although the Maastricht Treaty tries to capture this problem by the stability and growth pact).

Although the Euro has become one of the leading currencies in the world, this relatively new currency also faced a major burden to overcome when the European Sovereign Debt crisis started in 2009 (which will be discussed in part II, section B). Governments within the eurozone had violated and violate the most important criteria of the Treaty on the European Union and the Stability and Growth Pact and the consequences had to be faced (Eurostat and Stability and Growth Pact). Political reforms and economic actions took place to smooth the impact as much as possible. The European Central Bank (ECB) lowered interest rates, provided cheap loans, bought bonds, and governments had to implement severe austerity measures. Now, more than three years later, it is still not sure whether or not this was sufficient to save the Euro in its original shape since the crisis is still going on.

II. The recessions

The second part of the period 2002-2012 is characterized by times of economic distress, crises, and recessions. Europe was struck by the subprime crisis in 2008 and not even a year later another crisis hit Europe, the European Sovereign Debt Crisis. This part will distinguish and clarify the crisis which led to the worst financial meltdown of the world in eighty years, the subprime crisis, and the following European sovereign debt crisis. This part of the research is particularly important to gain insight in the events that caused the crises.

[5]The Euro is also used and issued by neighboring countries such as Vatican City, Monaco and San Marino, meanwhile other countries, without issuing right, widely use the Euro.

***** Information provided by the website of the European Commission and European Central Bank is used to describe the history, development and advantages of the Euro in part I: http://ec.europa.eu/economy_finance/euro/index_nl and www.ecb.int/euro.

A. Subprime crisis

Causes

The subprime crisis started in the third quarter of 2007 when the United States were struck by dropping residential real estate prices and rising default rates, whereas the base of the crisis lies further back in the past. The repealing of the Glass-Steagall act by the Gramm-Leach-Billey act in 1999 meant that the separation of commercial and investment banking was revoked, which made it possible for financial institutions to grow further and further (Crawford, 2011 and Janger & Schwartz, 2002). Plus, this repealing was also the base of bank-, securitization- and insurance-deregulation (Markham, 2009). In addition, the Government Sponsored Entities[F] (GSE), Fannie Mae and Freddie Mac, were requested by both the Clinton and the Bush administration to devote their residential mortgage portfolio partly to Americans with lower credit ratings (subprime mortgages). The U.S. government would guarantee these mortgages and it was widely assumed that the government would also bail out investors who invested in these subprime mortgages.

Although the subprime residential mortgages market is only a small part of the financial system it grew rapidly over the period 2003-2007 to a value of $1.3 trillion. Investment banks had found a profitable opportunity to make use of the subprime mortgages. Since the Federal Reserve lowered interest rates to one percent after the dot-com bubble it was cheap to lever up (Ackermann, 2008). This money was used to buy enormous amounts of mortgage portfolios which were packaged into securities: securitization. The GSEs used pass-through securitization since the 1970s when they pooled assets and issued it as a security (Troia, 2009). By using pass-through securitization every investor has a proportional claim on the underlying set of assets. The other main securitization option was to use tranched securitization. Just like the pass-through possibility the assets are pooled, but in this case the issuer creates several securities with different levels of risk (the tranches or slices) and prioritized claims on collateral. To keep things simple we assume the creation of only three different levels of risk, low, mediocre, and high respectively. The low and mediocre risk slices were insured by a CDS. By using CDSs to insure the so-called Collateralized Debt Obligations[G] (CDO) these tranches got good credit ratings, AAA or BBB. The investment banks sold the safe slice to pension funds or other risk-averse investors. The slice of mediocre risk was sold to other banks and the subprime slice was sold to hedge funds. After they sold all slices the investment banks could pay of their low interest debt and make enormous amounts of money. By now, it is clear that the rating models were incompetent in estimating and accounting for the correlation degree of residential real estate prices on a national scale of the securities which were tranched (Benmelech & Dlugosz, 2009).

Consequences

Since the residential real estate prices had been rising year after year, no one cared whether or not some people defaulted on their subprime mortgages since the house, with increasing value, acted as collateral. The problem started when a lot of peopled defaulted their mortgage and the house prices were under pressure. The sudden point of avalanche-like depreciation of residential real estate prices were likely caused by the gradual increased interest rates by the Federal Reserve, starting in 2004 (Ackermann, 2008). From 2006 and onwards the house prices declined fast and the investment banks were stuck with large portfolios of worthless real estate. The rise in residential real estate prices and the following decline is reflected well by the S&P/Case-Shiller U.S. National Home price index (Case-Shiller index), a composite of single family real estate prices.

Over the period January 2000 – June 2006, the Case-shiller index rose with approximately 90%, supporting the previously made claim that banks did not care whether someone defaulted on their mortgage since the collateral increased in value. From June/July 2006 and onwards a sharp decline in real estate prices took place. Over the period July 2006 – May 2009 the Case-Shiller index dropped more than 30% (S&P / Case-Shiller U.S. National Home Price Index). Nobody wanted to buy the CDOs anymore and insurance companies which had to cover their CDS-exposure were unable to do so. For example, ACA Financial Guaranty, a small and relatively unknown company was exposed to a coverage of $60 billion, but was only able to pay a fraction of this amount. Citigroup, Merrill Lynch, and other financial institutions had to write down billions when ACA Financial collapsed. The excessive risk taking in the financial sector made it possible a chain reaction occurred in which the collapse of a small firm covering OTC[H] derivatives (CDSs) of large institutions lead to a economic meltdown (Troia, 2009).

This all went together with a bank run on the shadow banking system[I] (Gorton & Metrick, 2009 and Pozsar et al., (2010)). In case of a classic bank run the bank is not able to convert its long term assets into cash. The explanation of the ‘shadow bank run’ is more complex. Financial institutions use long term mortgage-backed securities as collateral for short-term liabilities (short-term borrowing). An important factor in this borrowing is the so-called ‘haircut’, which means that borrowers have to post more collateral than the value of the loan. When the mortgage-backed securities dropped in value, the ‘haircut’ rose, so the same amount of collateral backed fewer liabilities. Banks and other financial institutions had to sell their assets to support their loans. This caused a vicious circle of “fire sale” (Shleifer & Vishny, 2011). The lower asset value caused a decline in collateral value which raised uncertainty. Because of the higher uncertainty the requested ‘haircuts’ were also higher which caused financial institutions to deleverage more by selling their assets, and so on.

The panic escalated when the GSEs, the banks where many (if not all) investment banks had huge exposures to, were nationalized. Within days of each other Lehman Brothers entered bankruptcy, AIG collapsed and the passing of the Troubled Asset Relief Program (TARP) started. This act allowed the U.S. Treasury to purchase subprime mortgage assets from institutions which were troubled, up to a total value of $700 billion (Mishkin, 2011). By this time the crisis also caused damage in the European financial sector, the eurozone was officially in a recession in the third quarter of 2008. More than $1 trillion in bail-out packages were necessary across the eurozone to keep banks capitalized.

Looking back

Following the events in 2007, the Congressional Budget Office[J] (CBO) predicted a mild recession in 2008 with a small decline in GDP growth (Congress of the United States, CBO). A year later the seemingly innocent event of falling prices of residential real estate had caused a global financial crisis. The events of September 2008 showed that excessive risk taking was an integral part of the financial system and was bigger than anticipated and imagined (Mishkin, 2011). The extensive growth of CDS[6] and OTC derivatives over the period 2004-2007 show this as well. The notional value of OTC derivatives and CDS combined was a staggering $585 trillion in 2008 and exceeded the value of the New York Stock Exchange ($30 trillion) tremendously (Troia, 2009). Financial institutions worldwide were too big and complicated to fail and had leverage ratios which were too high and had too much exposure. A relative innocent event of falling residential real estate prices triggered the worst global financial meltdown since the Great Depression in the 1930s.

In 2007 and 2008 over sixty percent of the rating downgrades were attributed to residential real estate loans and mortgages. These were also the securities suffering from the most severe downgrades (eight notches or more) and caused securities to shift from investment grade to speculative grade (Benmelech & Dlugosz, 2009). White (2010) puts the blame of the subprime crisis directly at the credit rating agencies by stating that without the high ratings it had been doubtful that the mortgages were issued and tranched in such large volumes (a reason for the boom in subprime lending was the increased demand for high-rated bonds). A combination of the complexity of securities, a lack of sufficient data, carelessness, and market pressure in combination with lacking financial regulation protecting the three agencies against

[6]Between 2002 and 2007 the outstanding amount of CDSs increased from USD 2 trillion to USD 60 trillion (Source: Deutsche Bank Research, 2009)

*Additional information regarding the subprime crisis is derived from Mishkin (2011), Troia (2009), Greenlaw et al. (2008), Greenspan et al. (2010), and Gerardi et al. (2008).

competition proved to be the ideal mixture for a global crisis since investors blindly believed anything the ratings agencies stated. The complexity of the products and the carelessness of rating agencies is well reflected by two intercepted messages of S&P employees. 'It could be structured by cows and we would rate it' and 'Let's hope we are all wealthy and retired by the time this house of card falters', both referring to the CDO market, prior to the crisis[7].

B. European sovereign debt crisis (eurozone crisis)

After being hit by the subprime crisis in 2008 Europe was starting to recover by the end of 2009, when the next crisis struck. The Greek government announced they had difficulties repaying their debt and needed help. Following Greece, also Ireland, Portugal, Spain, Cyprus, and Italy were in trouble. The breakup of the eurozone seemed to be a considerable option within ten years of its introduction. Intrade, a popular online betting agency, awarded a 65% chance in the end of 2011 that a member would leave the eurozone before the end of 2013.

The crises which took place in Europe can be seen as threefold (Shambaugh et al., 2012):

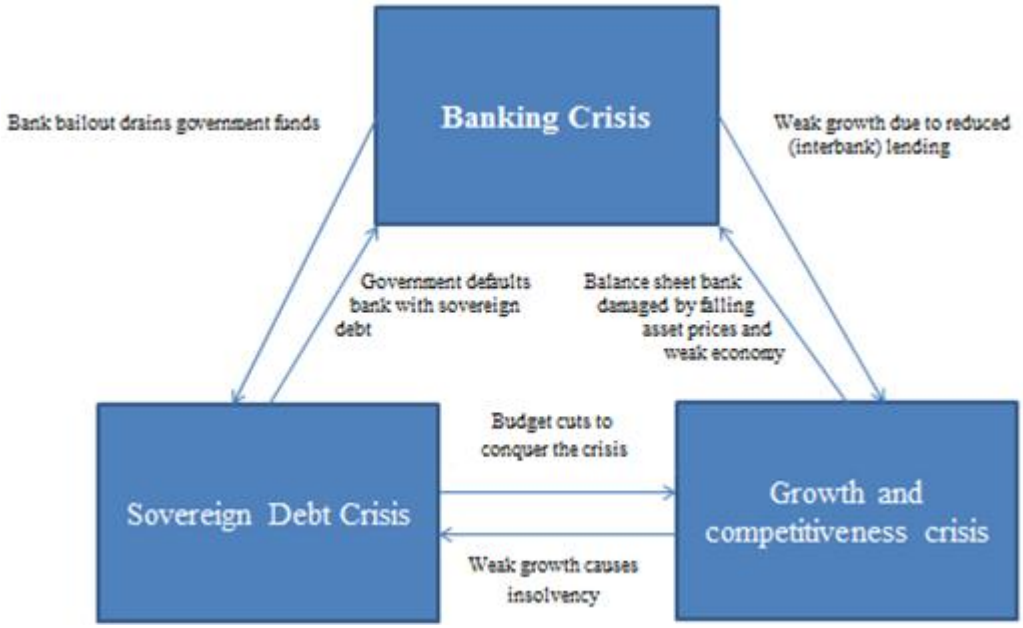
- Banking crisis: liquidity constrained and undercapitalized banks
- Sovereign debt crisis: rising sovereign bond yields and funding problems
- Growth crisis: slow and unequally distributed economic growth in the Euro area

Figure I provides a simple overview of the three crises which are going on in the eurozone and the way they are intertwined. Especially the link of the banking crisis with the sovereign debt crisis is important and will be discussed later on in this part.

The aftermath of the subprime crisis was partly the base of the Greek Fiscal Crisis, which evolved in the eurozone crisis. The situation of Greece was so bad that the Economic and Monetary Union (EMU) had to make a choice, either let Greece default, safe Greece, or coerce Greece to leave the EMU. The default or coerced exclusion of Greece would put even more pressure on the Euro and all organizations and institutions that hold Greek bonds. Since other countries (Ireland, Italy, Spain, and Portugal) in the EMU already faced budgetary problems, the default of Greece could lead to the default of more countries.

[7]Appelbaum, B., (April 22, 2010), E-mails offer look at rating firms during crisis. Dealbook NY Times.

Figure I. The three crises in the eurozone (Based on Shambaugh et al., 2012)



If Greece would leave the EMU they had to quit the Euro and get their own national currency. This would bring certain costs to the EMU, but especially to Greece. Greece should devaluate their own currency, would be unable to borrow on international capital markets for a few years (Eichengreen, 2007), and they had to reach equilibrium in their budget since they cannot borrow on the international capital markets. The EMU chose to save Greece by means of an extensive bail-out package. Looking back it seems like the Greek Fiscal Crisis was at the base of the European sovereign debt crisis and therefore I will discuss the causes of this crisis.

Internal causes of the Greek fiscal crisis

When the Greek government announced they were not able to repay their debts it became clear they had violated several criteria of the Maastricht Treaty. Deteriorating macroeconomic fundamentals, as provided in table 1, were consistently too high due to a unsustainable path of fiscal finances (Arghyrou & Tsoukalas, 2011).

Table 1. Greek deficit and sovereign debt as percentage of GDP

	2007	2008	2009	2010	2011	2012[1]
Deficit as Percentage of GDP	-6.5%	-9.8%	-15.6%	-10.7%	-9.4%	-6.8%
Sovereign Debt as Percentage of GDP	107.4%	112.9%	129.7%	148.3%	170.6%	176.7%

Table 1 provides an overview of the annual changes of the Greek deficit and sovereign debt as percentage of GDP. This table provides clear evidence that regulations of the Maastricht Treaty were consequently violated by the Greek government. Source: Eurostat and [1]Forecast by European commission 2011

No doubt exists that the increasing deficit and sovereign debt was an integral part of the deteriorating economy of Greece. In the years of economic expansion, preceding the financial crises, no fiscal consolidation was done which ultimately backfired. False reporting weakened and undermined the credibility of the Greek government. At the same time the Greek government had to deal with a persistent deficit due to a decline in competitiveness since the entry of Greece in EMU (Malliaropoulos, 2010). This weakened competitiveness was caused by high wage and price inflation and the inability of the government to devaluate its currency because of the shared currency.

External causes of the Greek fiscal crisis

As the crisis is caused partly by Greece, external events contributed to the crisis and made it more severe (Kouretas & Vlamis, 2010).

(i) No clear signal from the EU
(ii) Inexistence of supranational economic policy
(iii) Weakened position trading partners

(i) No clear signal from the EU

While the crisis was escalating in Greece the eurozone failed to provide a clear signal of their support for Greece. It was a topic of discussion whether or not it was illegal to support Greece in this time of distress. During this period of ambiguity institutions holding Greek bonds faced problems (Kouretas & Vlamis, 2010). It became extremely expensive for the Greek government to issue debt since the 10 year bond yield of Greece reached an all-time high of 48.6% in March 2012 (source: DataStream, as described in chapter 4) and 'insuring' your exposure towards Greece via a CDS for a period of 5 year was priced at $5.75 million upfront and an annual fee of $100.000 per $10 million Greek debt (Watts, 2011).

(ii) Inexistence of supranational economic policy

Since the economic policy is still in the hands of the member states, it was not possible to use an overall adjustment policy to deal with the crisis (Kouretas & Vlamis, 2010). Finally, the EU members agreed upon a support package of €110 billion, partly paid by the EMU (€80 billion), partly by the IMF (€30 billion). In addition the EU founded a permanent institution to deal with the crisis, the European Stability Mechanism (ESM).

(iii) Weakened position trading partners

The main trading partners of Greece in the Balkan were also hit by the subprime crisis, but lagged (Vlamis & Karousos, 2010). This shows that the blame for the causes of the Greek crisis, which developed to the eurozone crisis, is shared by Greece, the eurozone, and the subprime crisis.

How widespread is the European Sovereign Debt Crisis?

Figure II provides an overview of all countries that were violating the criteria of the Maastricht Treaty. All countries left of the vertical red line and/or above the horizontal red line were structurally violating the agreements from the Treaty on the European Union. The countries which were, and/or are, in the most severe financial turmoil in the eurozone will be described in the upcoming part. When these countries are compared to the place they take in Figure II, these are in general the countries which violate the Maastricht Treaty criteria severely.

Figure II. Average Debt / GDP ratio and Surplus (Deficit) / GDP ratio

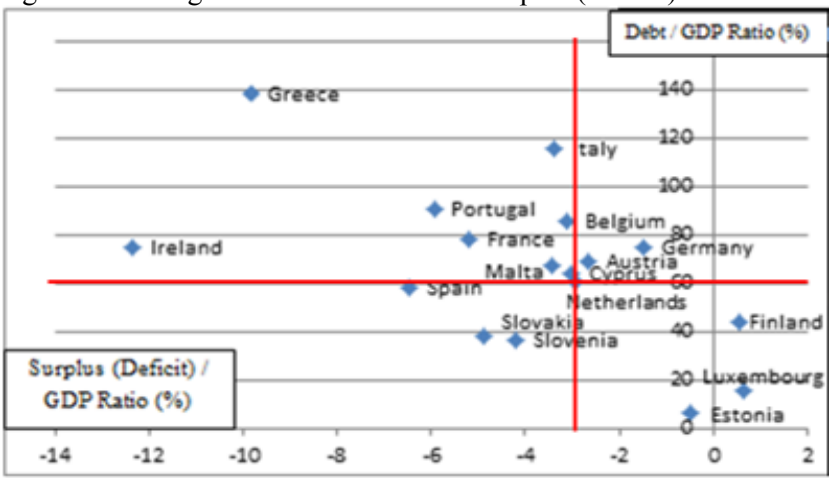


Figure II provides an overview of the Average Debt / GDP ratio and Surplus (Deficit) / GDP ratio of countries which are currently in the eurozone. Average ratio is taken over the period 2007 – 2012. Source data: Eurostat.

As mentioned before, governments in Europe had to provide financial institutions with bail-out packages worth over $1 trillion. To put this amount in perspective, $1 trillion is about 10% of the Gross Domestic Product of the eurozone in 2009 (Source: Eurostat). Although these bail-out packages were perceived as necessary to stabilize financial institutions, some countries suffered from the consequences only a year later. The crisis in Ireland was not the cause of governmental mismanagement and overspending, as was the case in Greece, but was a direct consequence of the subprime crisis. The Irish government had guaranteed to rescue banks which were hit by the property bubble and needed help. This weakened the position of the Irish financial position and by 2010 a bail-out package of €67.5 billion was necessary to save Ireland.

After the subprime crisis and the consequent eurozone crisis hit Europe, the bond rating of Portugal was downgraded by the Credit Rating Agencies and the bond yield of Portugal started to rise. The pressure on the bond yield, combined with a sovereign debt / GDP ratio of about 120%, was too much and Portugal had to request help from the EMU and the IMF in the form of a €78 billion bail-out package.

Just like the Irish government the Spanish government also had to save banks they had guaranteed. A bail-out package up to a value of €100 billion was promised by the EU and the IMF. In addition Spain had to cope with unemployment rates up to almost 30%.

After Spain it seemed like Italy was the next stone to fall in the domino game of countries requesting an EU bail-out. Although Italy is struggling with higher and higher bond yields and a shrinking economy, the Italian government did not request any financial help from the EMU of IMF and is also not planning to do so[8]. The uncertainty about Italy by the capital market is fed by political instability and the inability to form a functioning government.

The Cypriot financial crisis was mainly caused by the Greek financial crisis[9]. As a part of the bail-out program of Greece, Greek bond holders had to write off 53.5% of the face value of the bonds they held. As many Cypriot institutions held Greek bonds, more than 50% of the value of the Cypriot GDP had to be written-off.

Consequences of the crisis

In reaction to the Greek fiscal crisis which developed in to the European Sovereign Debt Crisis, the Euro area member states founded the European Financial Stability Facility (EFSF). The purpose of the EFSF is to "safeguard financial stability in Europe by providing financial assistance to the Euro area Member States within the framework of a macro-economic adjustment programme" (EFSF 2013). The EFSF was founded as a temporary mechanism in 2010, but by 2012 the EMU decided there was need for a permanent rescue mechanism, the European Stability Mechanism (ESM). By providing loans, issuing debt, finance recapitalizations, and provide financial assistance the ESM can "provide financial assistance to Euro area Member States experiencing of threatened by financing difficulties" (ESM, 2013). All members requesting help from the EFSF/ESM should also make a similar request to the IMF, if possible. All countries that requested help from the EFSF/ESM had to implement severe austerity measures in exchange for the financial help they got.

An important action which should prevent crises, such as the subprime crisis, to occur in the future is the Third Basel Accord (Basel III). This accord, whose introduction started in 2013, was developed because of the revelation of flaws in banking and financial regulation during the crisis in the late 2000s. The purpose of Basel III is to enhance bank leverage and liquidity and to make the capital requirements of bank stronger.

[8]Spiegel online, Euro Crisis Deepens: Italy Struggles to Break Out of Downward Spiral, June 13, 2012
[9]The New York Times, Greek Crisis Leaves Cyprus Mired in Debt, April 11, 2012

The main points of Basel III are:

- Over-the-counter contracts should be central cleared[K] and more standardized
- Supervision and registration of credit rating agencies
- Increased required capital banks: reserve risk-weighted assets from 2% to minimal 7%
- Equilibrium granting loans and collecting deposits for sufficient liquidity in case of 30 days of stressed conditions (measured by standardized stress tests)

Finally, to conclude this part discussing the eurozone crisis I will provide two views regarding the crisis. Although the cause of the eurozone crisis seems to be the result of fiscal imbalances, mismanagement of budget deficits, and the aftermath of the subprime crisis, Afonso et al. (2012) provide an interesting view by not blaming the fiscal imbalances causing the crisis, but by blaming the increased awareness of these imbalances by the capital markets. The second view deals with the question whether or not the eurozone crisis can be stamped to be a currency crisis. Reinhart (2002) states that systematic downgrades precede currency crises[L] in developing countries (for example Mexico and Thailand) meanwhile currency crises in developed countries (exchange rate mechanism crisis in France and the U.K. in 1992-1993) will not lead to downgrades. In case of the eurozone crisis many of the characteristics of a currency crisis are met: the Euro is under pressure, the mismanagement of government budget causes chronic deficits on the current account, and expected inability of governments to meet their debt obligations exists. Combined with the fact the many (severe) downgrades occurred over the period 2008-2012 and considering that these countries belong the thirty-five most advanced economies in the world (source: IMF), it might be the case that the statement of Reinhart (2002) does not longer hold.

*Additional information regarding the eurozone crisis is based on Lane (2012), Eurostat, the European Central Bank website (www.ecb.europe.eu), and the Dutch government website (www.rijksoverheid.nl)

3. Literature Review

I. Credit rating agencies and the determinants of credit ratings

Credit rating agencies

A Credit Rating Agency (CRA) is an independent, commercial institution providing risk assessments for debt instruments as well as risk assessments of the debt issuer. These assessments are mostly requested by the issuer and made available to the public for free (Cantor & Packer, 1995). A credit rating refers to the forward-looking risk assessment of a debt obligation (in this research the sovereign bond) and the ability of the issuer to meet the debt obligations(Cantor & Packer, 1995). In this the credit rating provides an easy and accessible representation of the default likelihood. Over time credit ratings have become widely accepted in the market due to desirable attributes such as, easy to understand information, independence, market coverage, and stability. Thus, a credit rating agency is not an absolute predictor that a certain debtor will default on its obligations, but is an institution providing a subjective view regarding the creditworthiness of an issuer or an obligation. The view of creditworthiness is typically represented by a letter-grade scale which reflects the opinion of the CRA, as provided in table 2.

The big three CRAs*, Standard & Poor's, Moody's, and Fitch, which account for approximately 95% of the market share, divide their ratings in numerous categories which indicate the level of risk attached to a debt instrument. The most important distinction to be made in the rating category is whether or not a debt instrument is at investment grade (IG) or at speculative grade. An IG instrument indicates a low likelihood of default and a large likelihood that the issuer can meet the according obligations, a junk grade instrument on the other hand indicates the opposite (Cantor & Packer, 1994). An Investment Grade security has a rating of BBB-, Baa3, BBB- or higher for respectively Standard & Poor's, Moody's, and Fitch, whereas anything lower is considered to be of speculative grade. In addition to rating changes, the CRAs also provide outlook revisions and future rating reviews. A positive or negative outlook notification indicates a potential rating change within two years, a watch notification insinuates the same but only within a shorter period of 90 days.

* Additional information describing credit ratings determinants is obtained from Standard & Poor's and Moody's (ICRA Rating).

Table 2. Overview Long-Term and Short-Term Credit Ratings

Standard & Poor's		Moody's		Fitch		Quality	
LT	**ST**	**LT**	**ST**	**LT**	**ST**		
AAA	A1+	Aaa	P1	AAA	F1+	Highest Credit Quality	Investment Grade (IG)
AA+ AA AA-		Aa1 Aa2 Aa3		AA+ AA AA-		Very High Credit Quality	
A+ A	A1	A1 A2		A+ A	F1	High Credit Quality	
A-	A2	A3	P2	A-	F2		
BBB+ BBB BBB-	A3	Baa1 Baa2 Baa3	P3	BBB+ BBB BBB-	F3	Good Credit Quality	
BB+ BB BB-	B	Ba1 Ba2 Ba3	Not prime	BB+ BB BB-	B	Speculative	Speculative / Junk Grade
B+ B B-		B1 B2 B3		B+ B B-		Highly Speculative	
CCC+	C	Caa1		CCC+	C	Substantial Credit Risk	
CCC		Caa2		CCC		Very High Credit Risk	
CCC- CC C		Caa3 Ca		CCC- CC C		Exceptionally High Credit Risk	
D	SD	C		D		In Default	

Table 2 provides a summarized overview of rating categories of the three big credit rating agencies. Both Long Term (LT) and Short Term (ST) credit ratings are included. Short Term rating events assess the risk of sovereign bond with a maturity of 1 year or less, Long Term rating events assess the risk of sovereign bonds with a maturity of 10 years or more. The Quality column shows the quality of the debt instrument behind the rating were the creditworthiness and likelihood of fulfilling the debt obligations decreases the lower the rating. Sources: data obtained from Standard & Poor's, Moody's and Fitch.

Determinants

In order to establish a rating for a certain debt instrument the three major CRAs use quantitative analysis and qualitative analysis to determine the default probability and the loss in case of default. The rating process exists out of a complex combination of a weighted political and economic score combined with a weighted external, fiscal, and monetary score (to provide a profile of flexibility and performance) (Frost, 2007). The political, economic, and flexibility / performance indicators provide an indication of the rating level, which can be adjusted for external factors and the currency of the debt instrument in order to complete the assessment.

The exact variables on the other hand are kept secret and became a widely discussed topic in literature over the past 20 years. Several empirical studies, for example Cantor & Packer (1995, 1996), Haque et al. (1996), Larrain et al. (1997), Afonso (2003), Reisen & von Maltzan (1999), Juttner & McCarthy (2000), and Bhatia (2002), show that only a parsimonious set of variables is required to measure the impact of factors on sovereign credit ratings. Ninety percent of the variation in ratings can be explained by as little as six variables. The most important indicators and their theoretical effect on default of ratings are provided in table 3.

Table 3. Credit rating indicators

Indicator	Change	Effect
Per capita income	Increase	Negative
GDP growth	Increase	Negative
Inflation rate	Increase	Positive
Current account (Surplus or Deficit)	Increase[1]	Negative
Ratio non-gold foreign exchange reserve to imports	Increase	Positive
Economic development and default history	Increase	Positive

Table 3 provides an overview of the parsimonious set of indicators, as determined by Elkhoury (2008) that impact sovereign credit ratings. The effect of an increase in the indicator on the theoretical likelihood of default is provided in column 3.

[1]The meaning of increase in this context is either a decrease of deficit or an increase in surplus.

Other literature also makes use of these indicators, amongst others, in their research to determine the core variables of credit ratings (Afonso et al., (2011), Cantor & Packer, (1996), Depken et al., (2007) and, Afonso, (2003)). Depken et al. (2007) for example included a fiscal policy indicator and social indexes meanwhile Bissoondoyal-Bheenick (2005) included macroeconomic indicators such as unemployment rate and investment/GDP ratio. Manso (2011) suggests an interesting additional factor to incorporate in credit ratings: the CRAs should focus on the effect of their rating on the probability of survival next to the accuracy of the rating, which is now point of focus.

In leading literature on this topic, two empirical approaches are used in the determination of credit rating criteria. One strand of literature, Afonso (2003) and Cantor and Packer (1996) amongst others, use linear regression methods by converting ratings in a numerical representation whereas the other strand, for example Bissoondoyal-Bheenick (2005) and Depken et al. (2007), use ordered response models to overcome the drawbacks of linear regressions. In the conversion of the rating classes into numbers an implicit assumption is made that the difference between any two rating notches is the same causing samples to be biased because of top and bottom ratings with high and low numerical representation. Although the ordered response model strand determines the size of the notches itself, this method also has drawbacks due to a lack of observations for a cross-section of countries (Afonso et al., 2011).

Functions of credit ratings

The function of credit ratings is threefold (Ryan, 2012):

(i) Information and Assessments
(ii) Capital market accessibility
(iii) Helping hand in regulation

(i) Information and Assessments

The CRAs provide ratings which contain information that is perceived as an invaluable source for investors. The CRAs play a key role in providing creditworthiness views of securities which otherwise needed to be made by the investors themselves (Ryan, 2012). As determined in the previous section, the credit quality is determined by the default probability and the expected loss in case of default, based on a, as far as previous research determined, parsimonious set of variables.

(ii) Capital market accessibility

In the earlier times of the CRAs the agencies got paid by the investors to provide a rating, nowadays it is more common that the issuer requests a rating to get an evaluation of their creditworthiness. Sovereigns request credit ratings because it eases the access of the government, and other issuers domiciled (the highest possible rating for a domiciled entity is often capped by the sovereign rating), to international capital market thanks to the increased transparency of the entity (Cantor & Packer, 1996). Since ratings provide an indication of the future strength of the issuer, the rating lasts for multiple years and while the issuer is monitored by the rating agency it possible for the issuer to access the capital markets at a lower cost of borrowing (Reinhart, 2002). Theoretically the CRAs claim their ratings to be constant and only to be subject of small changes. These 'time-invariant' ratings are established by incorporating cyclical economic conditions and vulnerabilities of the issuer, where the rating only will be changed in case of strong changes in the financial situation of the rated entity at hand. The recent subprime crisis and eurozone crisis proved this claim to be false.

(iii) Helping hand in regulation

Sovereigns and regulating institutions increased their use of rating agencies over time and the CRAs have become an important instrument from a regulatory perspective. The CRAs provide risk assessments of regulated entities. (U.S. Securities and Exchange Commission, 2003)

Flaws in the credit rating industry

After the subprime crisis the CRAs were acquiesced of having flawed assessments and having too much market power (Eijffinger, 2012). Several flaws of the credit rating industry can be pinpointed:

(i) Lack of Competition

The three largest CRAs (Standard and Poor's, Moody's, and Fitch) dominate the whole industry worldwide and are accountable for approximately 95% of the ratings. This oligopoly provides the agencies the opportunity not to compete and to charge high fees since a rated security normally needs two ratings of different agencies. This lack of competition might have caused the laziness the agencies are acquiesced of. In the rating of corporate bonds standard correlation rates were taken irrespective of the state of the economy meanwhile correlations are substantially higher in downturns (Pagano & Volpin, 2009).

(ii) Conflict of interest

Although CRAs consider their independence one of the key aspects of their role, they do not meet the criterion of independence because of a conflict of interest. The CRAs are paid for ratings by issuers and the agencies are allowed to sell advice how to construct an instrument to get a certain rating. This might cause deficient and smudged assessments in order to please the paying client as a pleased client is more likely to return in the future (and is willing to pay for more ratings). In line with this point is a form of competitive 'laxity', rating agencies provided favorable ratings to the issuers in order to get the job. In addition, the rating is more likely to diverge from the true situation since the rating requestor is likely to provide favorable information regarding the entity or security over unfavorable information. (Pagano & Volpin, 2009)

(iii) Lack of accountability

It is hard to prosecute CRAs for malfeasance since the ratings are seen as journalism and therefore they are protected by constitutional law, they have the freedom of speech. A rating assignment, according to the rating agencies, is based on information which is non-verifiable and non-auditable, so legal actions are not possible (Rousseau, 2006).

(iv) Rating triggers

The rating agencies have too much power in the form of 'rating triggers'. A CRA can, whenever they want, downgrade or upgrade a rating. This might cause a shift in the financial cost of the involved entity, immediate liquidity problems, and a change in investor confidence. As stated by Thomas Friedman, a journalist, columnist, and author, (February 13, 1996 interview with Jim Lehrer) "There are two

superpowers in the world today in my opinion. There's the United States and there's Moody's Bond Rating Service. The United States can destroy you by dropping bombs, and Moody's can destroy you by downgrading your bonds. And believe me, it's not clear sometimes who's more powerful".

(v) Lack of time-invariance

Although CRAs claim to be time-invariant in their ratings, during the East Asia Crisis in 1997 it became apparent that the ratings were not. The CRAs only followed the market and did not provide pro-cyclical behavior. Agencies reacted too late and too quickly/severely (multiple notches per day). During the European Sovereign Debt crisis this was also the case (Ryan, 2012). Data of this research supports this claim made by Ryan (2012).

(vi) Inexperience

Financial institutions keep inventing new instruments which they want to be rated. The reputation of a CRA towards the rating of this novel instrument does not exist yet and hence the rating agency will not fear depleting its reputational capital by an inadequate, favorable rating of this instrument (Hunt, 2008).

In addition to these flaws it also became apparent that CRAs had underestimated the risk attached to the now-notorious CDOs and mortgage backed securities in the years preceding the subprime crisis. Because of tranched securitization the rating agencies awarded an AAA rating to the 'safe CDO slice'. In the years of the crisis the value of these triple-A rated securities dropped causing a stream of downgrades. Although part of the blame for the crisis can be attributed to the flawed assessments, most of the blame is awarded to the naïve investors who blindly followed the inflated credit ratings and caused a "cliff" effect. The overreliance of ratings caused exacerbated instability in the financial sector as the world has seen during the subprime crisis and eurozone crisis when a rating inflation took place (Ma, 2009). Finally, a research of Cantor and Packer (1996) showed that divergence between sovereign ratings is quite common. This is another indication of flawed assessments since the agencies cannot agree on the creditworthiness of a debt instrument. Interesting for this research is that divergent ratings occur even more often for sovereign ratings than for corporate ones. The same study of Cantor and Packer relates this divergence to the difficulty related to measurement of political and economic conditions in a country which affect the creditworthiness and inexperience[10]. Supporting the claim that investors can be blamed is the fact that they seized the opportunity to go rating shopping[M], which might have indulged inadequate ratings of CRAs in order to please the investor (Bolton et al., 2012).

[10] widely covered sovereign credit rated debt instrument market only developed from 1975

Overcoming the flaws

As a result of the flaws, the CRAs have (unwillingly) become subject of a legislative process. The European Commission (EC) adopted a new regulation in December 2010 which requires CRAs to provide high quality and more transparent ratings, more transparency[11] in the process, and to mitigate and prevent conflicts of interest. In addition, another set of new regulation was approved by the European Parliament in January 2013. This paragraph addresses the problem drivers, the operational objectives to solve the problems, and the solutions according to the European Union.

The following points provide a summarized description of the operational objectives and accordingly their solutions of the new regulations set by the EC (Plenary session European Parliament, economic and monetary affairs January 16, 2013, proposal for and amending regulation (EC) No 1060/2009):

- Registration: a CRA must meet the requirements set by the EU to be eligible for registration.
- Conflict of interest: in order to avoid conflicts of interest the CRAs have a conduct of business which encompasses a transparent and systematic policy which is supervised.
- Fixed dates for sovereign ratings: floors and caps on the number (minimal 2, maximum 3) of unsolicited sovereign ratings on pre published dates (not during market opening).
- Liability: if a CRA breaks the rules of the EU legislation, intentionally or by negligence, the agency can be held responsible for losses made by investors relying on the ratings.
- Over-reliance: diminishing over-reliance by urging institutions to create own rating mechanisms and capability for assessments.
- Capping shareholding: no longer allowed to provide ratings in case an entity is owned (measure: voting rights) by at least 10% by a shareholder or holding of the agency.

A problem which is not solved by these new regulations is when the situation occurs that a novel rating instruments needs to be rated. As described previously, a CRA cannot have a reputation regarding this new instrument and will not fear depleting its reputational capital by rating the product with high quality and will not be constrained to do so (Hunt, 2008). As a result it is plausible to assume that policy makers, governments, and regulation will always be one step behind as long as financial innovation exists. A solution, although it is rather radical, to this problem is that the profits made by novel-product ratings need to be disgorged in case the new product proves to be of substantial lower quality than the rating initially indicated. This solution provides an incentive to provide qualitative ratings and to establish a reputation regarding the ratings of the novel-product. Although this might be effective, Greenspan et al. (2010) also offer a drawback of this solution: no financial institution will default in case their capital is sufficient and the institutions are able to stymie serial contagion. The protection of tax-payers should be

[11] Transparency: ability to read a the rating construction by outsiders and measure how well the rating approaches the real default probability.

the focus of future reforms by determining a proper level of risk-adjusted capital. Greenspan (2010) goes even further by insinuating the next crisis will be caused by a plethora of innovative new securities which go together with unintended toxic characteristics that only will be recognized when it is too late. A solution is offered, in the same research of Greenspan, which entails reforms and an adequate level of risk-adjusted capital and collateral. In case the levels of capital and collateral are sufficient, the losses will be suffered by the investors, who expose themselves to abnormal high levels of losses in their search for the high returns, instead of the tax-payers.

II. Bond yields, Credit Default Swaps, and how they are affected by credit ratings

A. Sovereign bonds

A sovereign bond is a debt security issued by a national government, promising to repay the principal at a pre-agreed date as well as periodic interest payments. In order to obtain the fund the sovereign has to pay interest over the borrowed amount, the sovereign bond yield (U.K. Debt Management Office). Characteristics of sovereign bonds are low coupons, step-up[12], and long maturities which can cause the bond to be traded at a wide variety of prices (Lim et al., 2005). Sovereign (or municipal) bonds are considered to be one of the safest investment positions since the repayments are guaranteed by a country. On itself this seems logically, but a closer look reveals that there are strings attached to this seemingly safe investment. In case of corporate default the assets will be liquidated in order to meet the debt obligations (if possible), meanwhile in case of sovereign default only a restructuring of debt will take place and bondholders are left with nothing. As history shows, dozens of countries defaulted (for example: Russia, 1998 and Argentina, 2002).

Building blocks of the "Sovereign Debt Puzzle"

The existence of sovereign bonds is a puzzle and appears to be a paradox since no mechanism is available for private creditors to coerce governments into repaying loans or withhold a sovereign debtor from repudiating debts unless the government of the country where the investor is domiciled is willing to do so (Eaton & Gersovitz, 1981). Because of this, countries might behave opportunistic since they can balance the benefits of repudiating against the costs of default (Bulow & Rogoff, 1989, Cohen & Sachs, 1986, and Eaton, Gersovitz & Stiglitz, 1986). This causes a problem to arise which might affect the possibilities of sovereigns to borrow and the possibility of a creditor to lend money. If creditors do not have the guaranty a sovereign will not repudiate it is unlikely the investors will lend money in the future. This part discusses the pieces of the puzzle.

[12]Step-up: a bond pays a certain coupon for the first period and a higher coupon rate for following periods.

(i) No connection ability to pay and willingness to pay

A discrepancy might exist between the ability to pay and the willingness to pay. Although a country might have the funds to meet its debt obligations it might take the political decision not to do so and repudiate (Drazen, 2000).

(ii) Little to no collateral

Any collateral in case of sovereign default can be considered to be irrelevant. The fraction of collateral which can be seized in case of default pales in to significance when compared to the value of the outstanding debt. The assets of a country are only partially kept abroad and it is not possible to seize domestic assets (Bulow & Rogoff, 1989).

(iii) Limited instruments to coerce

An important principle to consider, which became more restrictive after the Second World War, is sovereign immunity. Under international law, as derived from equality of sovereigns, it is not possible, to sue a sovereign entity in a foreign court without the consent of this sovereign entity: "legal persons of equal standing cannot have their disputes settled in the courts of one of them as long as the immunity is not waived via a contract in which the sovereign entity voluntarily submits to the authority of a foreign court in the event of a dispute" (Brownlie, 2003). Following the Second World War and as a consequence of the Cold War, the United States (and followed by many other jurisdictions) adopted laws under which immunity was denied to foreign sovereigns for commercial activities in, or directly effecting, the United States (or the jurisdiction at hand) (Brownlie, 2003). Next to the sovereign immunity principle one also has to keep the act of state doctrine and the international comity principle in mind when suing a sovereign. The international comity principle is defined as "the recognition which one nation allows within its territory to the legislative, executive or judicial acts of another nation" (Guyot, v. H., United States Reports, Vol. 154, p. 159: source: Panizza et al., (2009)) which can according to Brownlie (2003) be interpreted as a rule of practice convenience and expediency instead of as a rule of law. The act of state doctrine is: "a judicially created rule of abstention concerning the justiciability of the acts of foreign government" (Power 1996, p. 2732).

Solving the puzzle

The research of Eaton and Gersovitz (1981) also provide retaliatory actions against repudiation, of which permanent exclusion from capital markets is leading, although this solution can be unsatisfactory in certain situations. If a sovereign entity plans to borrow for only one uninterrupted period with no intent to borrow again in the future, although this is unlikely, denying access to capital markets is pointless since the government has no need of accessing capital markets in the future. If this situation occurs, a sovereign

can repudiate on its debts as soon as cash flows become negative. Even now, thirty years after the groundbreaking findings of Eaton and Gersovitz (1981) no satisfactory explanation is available to clarify the existence of this debt instrument. In case the debt need of a government is reciprocal, repudiation will not occur. This country has the incentive to meet these obligations since the need for new debt might exist in the future and a rational lender will not provide a loan to a country that repudiates. History on the other hand shows that investors are not rational at all. Retaliatory actions of permanent exclusion from capital markets do not hold. Over the past few decades dozens of countries defaulted on their debt obligation, but the exclusion from capital markets and the mark-up on their yields proved to be temporary.

Construction of bond yields and the mark-up

The paid interest over a bond, the bond yield, by the issuer is a compensation for the credit risk of the bond holder. The bond yield therefore reflects the price of credit risk attached to the bond. The credit risk (a rating provides an indication of this risk) consists out of default probability, expected loss in case of default, and the correlation between the previous two. Since investors want to be compensated for the risk they take by means of a risk premium this research only touches the most important risk factors as discussed by Blundell-Wignall & Slovik (2010).

Liquidity risk: investors want to be compensated for illiquidity

Contagion risk: contaminating domino-effect can occur in case of cross-relationship bonds

Time varying risk premium: it is not plausible to assume risk premiums are time invariant since the premium is affected by market perceptions of country risk, macroeconomic news, and policies, for example devaluate currency to make debt less valuable (as discussed, not possible for Euro bonds).

Thus, a sovereign bond where the credit rating changes from IG to speculative grade, or vice versa, might cause drastic changes in bond yields and the whole economy of the country at hand (a rating often caps the ratings of the domiciled entities). Additionally, the magnified cliff effects and recoveries in the markets as suggested by Ferri et al. (1999) might be caused by the pro-cyclical behavior of CRAs. If ratings and their announcements are not pro-cyclical, they still might trigger market jitters because certain investors are only allowed to hold investment grade securities (Kaminsky & Schmukler, 2002).

B. Credit Default Swaps

A credit default swap (CDS) is an agreement between two parties where the buyer transfers the risk of a certain credit event to the seller in exchange for periodic payments until maturity or at the credit event, whatever occurs first (Hull et al., 2004). The CDS spread is the cost, per annum, of the protection offered

by the CDS (Fontana & Scheicher, 2010). The costs ("insurance fee") for a CDS[13] are relatively low since only the credit risk is transferred and not the market and operational risk (Pausch & Welzel, 2012). The price of a CDS should therefore reflect the market opinion of the probability the credit event will occur, the loss due to the credit event, and the value of the security after the credit event. The latter, the value of the security after the credit event, means that in case of default (the credit event), the seller compensates the difference between the market value and the par value of the bond to the buyer and the CDS seller will possess the defaulted loan. Although CDSs are in simple explanations often referred to as a guarantee or insurance one important distinction needs to be made. Whereas a guarantee compensates a buyer for the losses following a credit event, a CDS compensates the buyer irrespective if losses were experienced. In addition a clear distinction between the bond yield and the CDS[14] spread needs to be made. Whereas the yield of a bond can be seen as a risk spread which is the product of the risk of default and the loss rate, the partial recovery of the face value of the bond is reflected by the CDS spread (Andritzky & Singh 2006).

Controversy in Europe

It is also possible to buy a CDS without holding a loan, a situation in which the investor bets the debt can be bought cheaper at a later point in time when the default occurs, a so-called naked CDS (Stulz, 2010). This controversial debt instrument was banned on the 15th of November 2011 after a vote by the European Parliament. This financial instrument, which was used by the market to speculate on a government's default probability, puts pressure on certain countries. In the words of Markus Ferber (member of the European Parliament) the use of a naked CDS is "pure speculation that can have incalculable effects, as in the case of Greece, and ought therefore, be contained."

CDS spread calculation

A topic of discussion is whether or not the coexistence of default swap and bond markets causes the price of default swaps to be just a mirror image of bond prices (the results of this research show otherwise). In case credit risk, the probability of default and the subsequent loss, are the only factors affecting CDS spreads it would indeed be a mirror image, but several market friction cause the two to diverge. The difference, the default swap basis, is positive (negative) when the CDS trades at premium (discount) relative to the bond spread (Chan-Lau, 2003). The same research provides factors which cause the CDS spread and bond yields to diverge, the default swap basis, by widening the CDS spread or tightening the bond spread. A brief overview of these points is provided in table 4. An approximation, under assumptions, of the relation between the CDS spread and the bond yield is explained clearly by Hull et al. (2004).

[13]For example: 10 year CDS covering a 10-year sovereign bond, principal $10 million and CDS spread of 250 basis points. The buyer pays $250.000 per year, acquiring the right to sell the bond ($10 million) to the CDS seller in case the credit event occurs.
[14] A CDS is a par value instrument.

$s = y - r$ Where: s = n – year CDS spread
y = yield on n-year par yield riskless bond issued by a reference entity
r = yield on n-year par yield riskless bond

This relation should hold because otherwise arbitrageurs will take advantage of the disequilibrium. In case s is larger than y-r it is profitable to buy a riskless bond, short a corporate bond and sell the CDS. Vice versa, if s is smaller than y-r it is possible to buy a corporate bond, buy a CDS and short the riskless bond in order to make a profit. The CDS premium is thus roughly equal to the spread of the reference entity over the risk-free rate of an equal-maturity obligation. Therefore, the CDS premium should hold a more the less cross-sectional relationship with the credit risk of the underlying as measured by credit ratings (Packer & Suthiphongchai, 2003). A credit rating provides an indication of the risk attached to a security and its default probability, whereas a CDS provides 'insurance' against default. Thus, the relation between CDSs and ratings is indirect, if the default probability rises (descends), the rating will be lower (higher) and the CDS spread will be higher (lower).

Table 4. Factors affecting the default swap basis

Widening CDS Spread	**Tightening Bond Spread**
Cheapest-to-deliver option: higher premium requested by CDS seller to account for less valuable asset settlement possibility	**Counterparty risk**: larger for CDS buyer than the seller. Buyer protected by paying less than bond spread
New bonds issuance: increased hedging pushes up price and increases number of cheapest-to-deliver assets	**Funding risk**: removed for CDS seller → selling = funding at Libor → less risk thus less compensation
Ability to short CDSs rather than bonds: inflation of bond issuer's credit quality increases protection market buy- in	**Increase supply of structured products**: protection supply of market increases by more CDS-backed CDOs
Bond prices under par: CDS seller guarantees recovery par price, not current bond price.	
Factors that can either cause the CDS spread to widen or the Bond spread to tighten	
Mainly high cost or low cost investors[1]	
Relative liquidity[2]	

Table 4 summarizes the factors affecting the default swap basis provided by Chan-Lau (2003).

[1]Explained with an example: Investors with a long position holds credit risk by selling CDSs or buying risky bond. CDS best alternative if premium lower than difference bond yield and funding cost.

As Funding costs ↑ → Premium will ↓ → Tighter basis
Thus: An overbalance of low cost investors and low funding costs lead to a wider default swap basis

[2]In illiquid markets compensation is necessary in the form of wider spreads → a more liquid CDS market than the bond market underlying causes a narrow basis and vice versa.

C. The effect of credit ratings

A wide range of scientists conducted research to the effect of credit ratings on markets and (sovereign) bond yields (CDS spreads) in both emerging and developed countries. For example, Larraín et al. (1997) and Reisen and von Maltzan (1998) find evidence that in emerging countries a highly significant announcement effect exists when sovereign bonds have a negative rating outlook or a negative rating meanwhile a positive rating seems to have no effect at all. Kaminsky and Schmukler (2002) come to the same result but in addition they find evidence of a spillover effect which are stronger during crises than during market rallies and they prove that the market is also affected by the ratings. On the contrary, Ismailescu and Kazemi (2010) get results which state that positive events have a more consistent impact on CDS spreads in emerging markets. The heterogeneity of the finding regarding the impact of credit ratings on bond yields, financial markets and or CDS spreads, although they are closely related, is not surprising given the variety in sample period and countries included in the different studies.

Afonso et al. (2012) prove that the effects of credit ratings also hold for developed countries in Europe by finding significant results following negative ratings for EU members. In addition to this they find a spill-over effect for EMU countries, for lower and for higher rated countries, although persistence of rating effects apply only for recently downgraded countries. Hull et al. (2004) find significant effects for CDS changes following negative credit ratings or outlooks whereas the positive ratings had less significant effects. Portugal, Spain, Ireland, and Greece were driven into trouble by the CRAs due to their high debt ratio to some extent according to Gärtner et al. (2011). Canton and Packer (1996) provide significant evidence of bond yields moving in the expected direction after credit rating announcements with changed sovereign risk opinions and Pukthuanthong-Le et al. (2007) also find significant results, over a sample of both developing and developed countries, of bond yields moving in the expected direction after a credit rating and a positive or negative outlook has a stronger effect than a rating. An interesting detail is that they find stronger effects for speculative grade bonds than for investment grade bonds, which also popped up in a research regarding emerging markets by Andritzky et al. (2005).

The importance of this research lies in the fact that previous studies covering this topic did not include the effect of credit ratings on sovereign bond yields or CDSs during times of economic distress in developed countries with a shared currency. As discussed before, a flight-to-safety takes places in times of financial turmoil but the problem during the past few years was that the considered to be safe investments, the sovereign bonds, were no longer ‘guaranteed‘ safe investments. By controlling for a potential spillover effect and the effect of credit ratings on exchange rates I want to test whether a credit rating in a certain countries causes an effect in another country or maybe even the whole eurozone.

4. Data

I. Data description

The sample of credit rating assessments consists of ratings, rating announcements, and views from the three main credit rating agencies, Standard & Poor's, Moody's, and Fitch, over the period January 1, 2002 until December 31, 2012. I will transform the credit rating categories into discrete variables as provided in table 5 by using linear scale[15] transformation. In the dataset of Afonso et al. (2012), the number of ratings of category B- / B3 or lower is scarce, so a study of the effects of these ratings would be inflated, deflated, or non-existing and not reliable. The dataset of this research entails a larger quantity of the junk grade ratings, and therefore, these will be included in the research.

Dummy variables will be generated to include the linear transformed credit rating values on a certain date, where S&P, M and F refer to respectively Standard & Poor's, Moody's and Fitch.

$$(1.1) \quad \text{upS\&P}_{it} = \begin{cases} 1, if\ an\ upgrade\ occurs \\ 0, otherwhise \end{cases} \qquad \text{downS\&P}_{it} = \begin{cases} 1, if\ a\ downgrade\ occurs \\ 0, otherwise \end{cases}$$

In addition to the credit rating announcements, I also incorporate rating outlooks and views on a certain date, using analogous discrete dummy variables.

$$(1.2) \quad \text{posS\&P}_{it} = \begin{cases} 1, if\ positive\ outlook\ occurs \\ 0, otherwhise \end{cases} \quad \text{negS\&P}_{it} = \begin{cases} 1, if\ negative\ outlook\ occurs \\ 0, otherwise \end{cases}$$

The incorporation of credit outlooks and views is important since they anticipate / seem to be predictive in nature for future credit rating events. The information contained in a view or outlook might therefore be predictive for bond yield and CDS spread fluctuation. To maximize the power of the tests some restrictions are set:

- The ratings are obtained via direct information of the CRAs
- Sovereign bond yield and CDS spread data is available in DataStream
- Data is available for the period [-180;180] around the rating event, measured in days
- No confounding events took place over a period of 21 days surrounding a credit rating event

[15]Linear transformation is used as methodology since Afonso et al. (2011) confirmed that logistic transformation, as applied by Reisen and Maltzan (1999) and exponential transformation, as applied by Afonso (2003) provide little improvement over linear transformation.

Other research (for example Pukthuanthong-Le, 2007) used data restriction to eliminate confounding events from the research for a period of 21 days before and after the event. I will use the same elimination period of 21 days before and after the credit rating event. Although a confounding event might trigger the credit rating event the data will be eliminated if this confounding event takes place in the event window as it is one of the restrictions of event study methodology (McWilliams & Siegel, 1997).

Table 5. Linear Transformation rating systems

Rating Agency			Linear Transformation
S&P	Moody's	Fitch	Expanded Version
AAA	Aaa	AAA	22
AA+	Aa1	AA+	21
AA	Aa2	AA	20
AA-	Aa3	AA-	19
A+	A1	A+	18
A	A2	A	17
A-	A3	A-	16
BBB+	Baa1	BBB+	15
BBB	Baa2	BBB	14
BBB-	Baa3	BBB-	13
BB+	Ba1	BB+	12
BB	Ba2	BB	11
BB-	Ba3	BB-	10
B+	B1	B+	9
B	B2	B	8
B-	B3	B-	7
CCC+	Caa1	CCC+	6
CCC	Caa2	CCC	5
CCC-	Caa3	CCC-	4
CC	Ca	CC	3
C		C	2
D	C	D	1

Table 5 provides an overview of the linear transformation of the credit rating categories into numerical variables. Whereas Moody's Ca rating covers two rating categories of the other CRAs, the value for this variable is set at 2,5. (Standard & Poor's is denoted as S&P).

This research encompasses eleven countries which introduced the Euro as a physical currency at January 1, 2002: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain. Luxembourg is omitted from the initial sample because of lack of data. The dataset, on a daily basis, starts at January 1, 2002 and ends at December 31, 2012. The sovereign credit ratings, outlooks, and views are directly obtained from Standard & Poor's, Moody's, and Fitch. The sovereign bond yield data on a daily basis, for the 10-year government bond and daily CDS spread data for five-year senior sovereign debt is obtained via Datastream (Appendix II provides the codes of the obtained data).

A. Credit Ratings

The complete sample of credit ratings covers all sovereign credit ratings over the period 2002-2012 by Standard & Poor's, Moody's, and Fitch. As provided in table 6, Standard & Poor's was the most 'active' rating agency (114 ratings and views combined) over the sample period, followed by Fitch (85) and Moody's (54). A schematic overview of the ratings of countries over time can be found as appendix III.

Table 6. Credit Rating events Long Term (LT) and Short Term (ST) eurozone over the period 2007-2012

	Standard & Poor's	**Moody's**	**Fitch**	**Total**
Downgrade LT	35	27	27	89
Upgrade LT	4	2	6	12
Downgrade ST	16	10	14	40
Upgrade ST	2	0	1	3
Positive view	1	0	2	3
Negative view	56	15	35	106
Total	114	54	85	253

Table 6 provides an overview of all credit rating events in the eurozone over the period January 1, 2002 – December 31, 2012. Short Term rating events assess the risk of sovereign bond with a maturity of 1 year or less, Long Term rating events assess the risk of sovereign bonds with a maturity of 10 years or more. Source: Standard & Poor's, Moody's, Fitch. As this research investigates the impact on 10-year sovereign bonds and 5-year CDS spreads, only LT events are used.

When comparing the frequency of sovereign credit ratings over time it becomes apparent that during the subprime crisis almost no sovereign credit rating changes took place (Table 7), indicating that the ability of governments to meet their debt obligations was not much affected by this crisis. During the eurozone crisis the number of credit rating changes increased rapidly from 15 in 2009 to more than 40 in 2011 and 2012. Table 6 and 7 combined support the claim of severe credit rating inflation over a part of the sample period, 2009-2012. About 90% of the rating changes over the sample period (2002-2012) took place between the beginning 2009 and the end of 2012. Of these 90% of the ratings, approximately 90% were negative rating events. A summary of credit rating events can be found as Appendix IV.

Table 7. Number of credit rating changes per year in the eurozone

	2002-2008	2009	2010	2011	2012	Total
Standard & Poor's	6	8	9	14	20	57
Moody's	2	2	9	16	10	39
Fitch	7	5	9	14	13	48

Table 7 provides an overview of the number of credit rating changes per year in the eurozone excluding announcements and/or views over the period January 1, 2002 - December 31, 2012. The table shows an increase of credit rating changes over time. Rating changes for both long and short term creditworthiness are included. Credit rating changes for domestic and foreign currencies are counted as once since they are publicized on the same date with similar rating changes. Source: Standard & Poor's, Moody's, Fitch.

B. Sovereign bond yields, Credit Default Swaps, and exchange rates

Sovereign bond data is obtained via Datastream as the 10-year sovereign benchmark bond yield. The benchmark bonds are the most representative on-the-run bonds[N], given the maturity at each point in time and giving consideration to coupon, issue size, and liquidity. Thomson Reuters Datastream compiles the benchmark bond data from the central bank of each country following the statistical reporting standards of the IMF. The main advantage of using this data, the benchmark ten-year bonds, is that the high trading volume in the secondary markets eliminates any liquidity constraints and prevents the results of being blurred (Georgoutsos & Migiakis, 2009). This characteristic, the high trading volume in the secondary markets, is one of the determinants of a bond to have a benchmark status.

Appendix V provides an graphical overview of all 10-year benchmark sovereign bond yields and 5-year CDS spreads included in this research. The bond yield is on average downward sloping over the sample period for countries which are awarded an AA-rating or higher (Austria, Belgium, Finland, France, Germany, and the Netherlands). Finland, Germany, and the Netherlands all three have an AAA-rating for the complete sample period, but their bond yield is approximately 5% in 2002, by 2012 this yield is decreased to less than 2% (Appendix V). This downward sloping yield can possibly be explained by the flight-to-safety by investors in times of economic uncertainty (Beber et al., 2006). De Broeck and Guscina (2011) provide evidence sovereigns increased debt issuance in both frequency and average size of the debt issuance, but it seems like the demand of safe investments increased so much it offset the increase in issued sovereign debt, causing the bond yield to decrease. Although the creditworthiness of Austria, Belgium, and France had decreased, based on credit ratings, over the period 2002-2012, the bond yields of these sovereign entities also decreased on average. This supports the finding of Beber et al. (2006) that a flight-to-safety took place, even though the creditworthiness decreased.

The Credit Default Swap dataset consists out of CDS spread quotes provided by Datastream and covers eleven sovereign entities[16]. To cover an as large as possible period I will use two different datasets, the first one covers the period 2004-2010 (CMA Data), the second one covers the period 2008-2012 (Thomson Reuters Data)[17]. To get a reliable dataset I matched the series from both sources using the file provided by Datastream Extranet. The dataset contains CDS data at the 5-year maturity mark, mid-rate[O], Dollar-denominated spreads. The 5-year CDS spread is chosen since it is the most liquid one (Pan & Singleton, 2008).

[16] Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain.

[17] CMA data is only available until 2010 when the agreement between CMA and Datastream was terminated.

The exchange rate dataset consists out of the daily data of the following exchange rates: Norwegian Krone / Swiss Franc (which acts as reference), Euro / US Dollar, Euro / GB Pound, and Euro / Japanese Yen. Appendix VI provides an overview of exchange rate fluctuations over the period January 1, 2002 – December 31, 2012. Appendix VI shows that even the most stable exchange rate still has a 60% fluctuation over this interval. This shows that exchange rates (can) have substantial impact on the purchasing power and competitiveness of a country and its inhabitants. Concluding, the exchange rate can affect the bond price substantially.

5. Methodology and Results

I. Data preparation, methodology outset, and methodology

Data preparation and outset of the methodology

The focus of this research is to test if a relation between sovereign credit ratings, bond yields, and CDS spreads exists. The methodology used in this research is closely related to and partly resembles the research of Afonso et al. (2012). This study will:

- Analyze and measure the impact of credit rating events on sovereign bond yields, CDS spreads, and exchange rates.
- Test if a credit rating event is anticipated and / or persistent.
- Gauge whether a spill-over effect exists.

The response of sovereign bond yields and CDS spreads to credit rating announcements will be analyzed using a standard event study methodology[18]. In the first test I measure the response of the yield and CDS spread over a short window of three days [-1;1], where the event takes place at time zero. This small window is chosen to decrease the degree of contamination which might bias the results. A standard event study normally links actual values to model generated values, but in the case of this dataset this is not possible since credit rating events are too close to each other. Too little data of "no-rating periods" is available in the given sample to construct representative model generated values. Instead of the model generated dataset I will use a reference bond yield as reference in this event study: the German 10-year bond yield (See Campbell et al. (1997) for a discussion).

Another problem that arises is the high correlation between sovereign bond yields as shown by Longstaff et al. (2011), but also supported by the data from this research (appendix VII). An interesting result is that the countries that were in severe financial turmoil are highly correlated with each other but have lower correlation with the rest of the countries and vice versa, the PIGS versus the Non-PIGS[19]. The PIGS are the countries which received financial support from the EMU and IMF whereas the Non-PIGS did not. Although the countries which received financial support, Greece, Ireland, Portugal, and Spain, are commonly referred to as PIGS, I will refer to these countries as GIPS (because of the negative load attached to PIGS). The countries which did not receive financial aid from the EMU and IMF will from now on be referred to as Non-GIPS. The countries without financial turmoil are highly correlated with each other and have lower correlation with the GIPS. The only country standing out from the rest is Italy, floating somewhere in between financial stability and severe turmoil, as reflected in the correlation ratios.

[18]MacKinlay (1997), Campbell et al. (1997), and Nieuwenhuis (2009) are used to describe the event study methodology.

[19]GIPS (Portugal, Ireland, Greece, and Spain) vs. Non-GIPS (Austria, Belgium, France, Finland, Germany, Italy, the Netherlands)

To deal with the problem of high correlation, I will follow Afonso et al. (2012) by constructing an adjusted measure of sovereign bond yields (CDS spreads) which will reduce the common signal in all bond yields (CDS spreads) to zero. This newly constructed measure is calculated as the sovereign yield (and CDS spread) minus the average spreads of the countries, which is a portfolio of all sample countries in an equally weighted portfolio (demeaned measure of sovereign bond yield (CDS spread)). Studies of Hill et al. (2010) and Cantor and Packer (1996) provide evidence that CRAs often disagree about the credit quality of an entity. By conducting event studies for each individual CRA, I want to control for differences between the effects of their credit ratings.

In addition, when controlling for correlation between the bond yield and CDS spread of a certain country, interesting results come forward (appendix VIII). The high rated countries (Austria, Belgium, France, Finland, Germany, and the Netherlands) all have negative correlations while the GIPS and Italy all have high positive correlations. The negative correlation for the high rated countries might be explained by the fact that the bond yields decreased substantially over the period 2002-2012 (from 5%-7% down to 2%) due to the increased uncertainty in the financial markets, while the CDS spreads increased due to the decreased confidence in sovereign creditworthiness. As mentioned before, the CDS data consists of two datasets and is matched using the file provided by Datastream Extranet. The first set covers the period 2004 – 2010 (CMA Data) and the second set covers the period 2008 – 2012 (Thomson Reuters Data).

Before I conduct the study to measure the existence and possible impact of credit ratings on sovereign bond yields, I provide a clear overview per rating category and per agency of the average sovereign bond yield over the German yield. Table 8 shows that clear differences in bond yields exist depending on the rating category and/or per CRA. The results of this research vary heavily due to the European Sovereign Debt crisis where both the confidence in the financial world decreased (leading to an increasing demand of sovereign debt and thus decreasing bond yields) and a decrease in creditworthiness of countries took place (resulting in increasing bond rates because of an increased default likelihood).

Methodology: Event Study

In order to measure the possible impact of rating events on sovereign bond yields (and CDS spreads) I will use event study methodology[*]. In this study an event is defined as a credit rating change or a credit rating outlook/view, provided by either Standard & Poor's, Moody's, or Fitch. The first step is to pinpoint the event(s) of interest and the sample period over which the securities will be analyzed, [-1,1], [-30,-1], [-60,-1], [1,30], and [1,60] (in days) where the event occurs at t = 0. After the event and the period of interest are determined, the selection criteria are established (see data description).

[*]MacKinlay (1997), Campbell et al. (1997), and Nieuwenhuis (2009) are used to describe event study methodology

By subtracting the normal return over the event window from the actual ex post return of the security, the abnormal return (AR) is calculated which appraises the impact of the event. The normal return is the expected return of the security in case no event had occurred.

Abnormal Return equation: $AR_{i\tau} = R_{i\tau} - E(R_{i\tau}|X_\tau)$ (2)

Where $AR_{i\tau}$, $R_{i\tau}$, and $E(R_{i\tau}|X_\tau)$ represent the abnormal, actual, and normal return for the period τ respectively. X_τ represents the conditioning information for the normal return (the reference bond). In this research the normal return will be the return of a reference entity since the credit events have a too high frequency and are clustered, which make it impossible to establish a representative model return. MacKinlay (1997) stated that to prevent the event from influencing normal return estimates, the event period is not included in the estimation period, which otherwise would have been the case.

Table 8. Sovereign yields over Germany (%)

Rating	Average bond yield over German bond spread (%)		
	S&P	Moody's	Fitch
AAA	0.31	0.28	0.25
AA+	0.42	0.68	0.83
AA	0.81	0.84	0.56
AA-	0.83	0.13	1.25
A+	0.85	1.06	1.79
A	1.08	2.20	1.01
A-	2.38	2.67	1.85
BBB+	3.23	5.81	4.07
BBB	4.42	1.68	2.61
BBB-	6.42	3.96	7.00
< BB+	13.84	10.89	21.45

Table 8 provides an overview of the percentage of interest above the German bond spread given a certain rating. As expected the amount of interest increases as the creditworthiness decreases. Since every instrument with a rating of BB+ or lower is considered to be of junk status, all separate categories are included as one. Important note: due to a lack of data in certain rating categories no average yield could be calculated or the average yield shows irregularities towards the risk-return tradeoff (Appendix IX provides a complete overview of all separate categories). Another cause of the irregularity might be the on average downward sloping yield curve over the period combined with the appearance of certain categories towards the end of the sample period.

*Now the AR calculation method has been established, the AR needs to be analyzed and measured. By introducing notations I will facilitate the analysis of the ARs. τ is used to index returns in event time. τ = 0 will denote the event date, $\tau = T_1 + 1$ to $\tau = T_2$ the event window, and the estimation window is defined as $\tau = T_0 + 1$ to $\tau = T_1$. The length of the estimation window and event window will be $L_1 = T_1 - T_0$ and $L_2 = T_2 - T_1$ respectively. Similarly, it is also possible to form a post-event window by using different time frames (Figure III).

Figure III. Time line for an event study

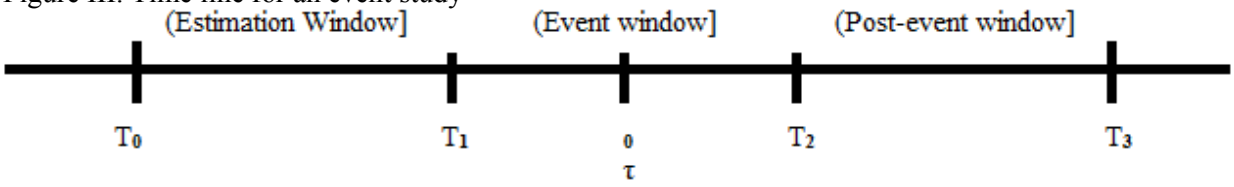


Figure III shows a time line for an event study, separating the estimation, event and post-event window.

The aggregated ARs, Cumulative Abnormal Returns (CAR) and its variance, will be defined from τ_1 to τ_2, where $T_1 < \tau_1 \leq \tau_2 \leq T_2$ (Mackinlay, 1997 and Luoma & Pynnönen, 2010)

Cumulative Abnormal Return (CAR)equation: $$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau 1}^{\tau_2} ARi\tau \quad (3)$$

Variance Cumulative Abnormal Return equation: $$\sigma_i^2(\tau_1, \tau_2) = (\tau_2 - \tau_1 + 1)\sigma_{\varepsilon_i}^2 \quad (4)$$

where,$\sigma_{\varepsilon_i}^2$ is the variance of the disturbance term[20].

Since events with only one observation are generally considered to be less useful, aggregation is necessary. To aggregate the individual securities through time and security by security, I form the Cumulative Average Abnormal Return (CAAR) in order to progress to the final formulae (7)*, used to test the null hypothesis which states that abnormal returns are equal to zero. By dividing one by the numbers of events (N), and consequently aggregating the CARs through time, the CAAR is calculated.

Cumulative Average Abnormal Return (CAAR) equation: $$\overline{CAR}(\tau_1, \tau_2) = \frac{1}{N}\sum_{i=1}^{N} CAR_i(\tau_1, \tau_2) \quad (5)$$

As the final step before I can test the null hypothesis I need to calculate the variance of the CAAR, where σ_i^2 represents the variance of each individual CAR, as calculated in formulae (4) and N represents the number of events. The assumption is made that events are independent and that the N number of event windows for the variance estimators do not overlap, setting the covariance terms to zero.

[20] $\sigma_{\varepsilon_i}^2$ is the variance of the disturbance term. The disturbance term is a part of the equation to calculate the normal performance

* MacKinlay (1997), Campbell et al. (1997), and Nieuwenhuis (2009) are used to describe event study methodology, including formulas.

Variance CAAR equation: $$var(\overline{CAR}(\tau_1,\tau_2)) = \frac{1}{N^2}\sum_{i=1}^{N}\sigma_i^2(\tau_1,\tau_2) \qquad (6)$$

*Finally to test the null hypothesis, that states that abnormal returns are zero, equation 7 is used[21].

Test: $$\hat{\theta}1 = \frac{\overline{CAR}(\tau_1,\tau_2)-0}{var(\overline{CAR}(\tau_1,\tau_2))^{1/2}} \sim N(0,1) \qquad (7)$$

An example of a hypothesis being tested using equation (7) is:

H_0: Credit rating events do not impact sovereign bond yields (CDS spreads)

H_1: Credit rating events do impact sovereign bond yields (CDS spreads)

Based on the test statistic resulting from formulae (7) I either reject or accept the null hypothesis. Figure IV provides a graphical representation of the hypotheses testing. Three normal distributions are shown were the middle represents the null hypothesis with a zero mean. The left and right distributions represent the alternative hypotheses. Figure IV shows that the mean of H_1 is clearly shifted to the left or the right in case the null hypothesis is rejected (significantly).

Figure IV. Hypothesis testing

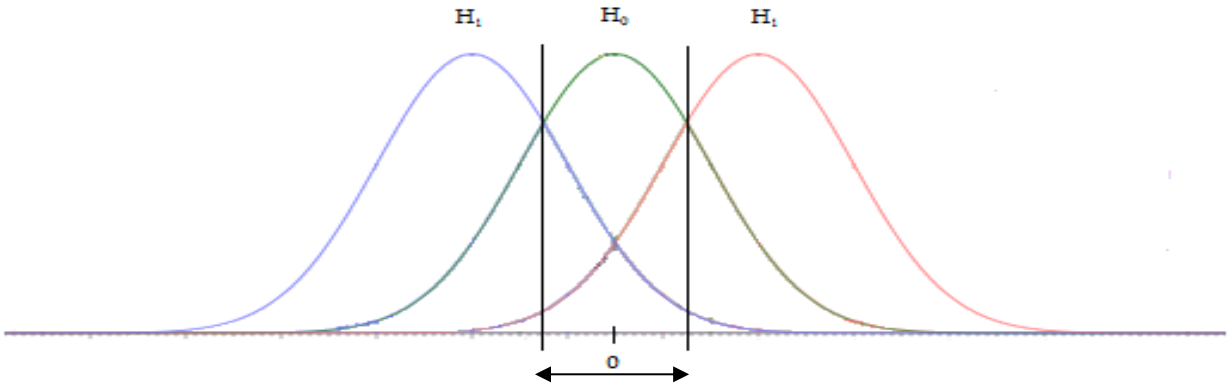


Figure IV provides a graphical presentation of hypothesis testing where the middle distribution represents H_0 and the outside curves represent H_1.

While conducting the event study I take into account some restrictions set by this methodology (McWilliams & Siegel, 1997):

- Markets are efficient
- The event (the credit rating change) was unanticipated
- No confounding event in the event window

[21] All hypotheses will be mentioned at the respective part dedicated to the hypothesis being tested.

* MacKinlay (1997), Campbell et al. (1997), and Nieuwenhuis (2009) are used to describe event study methodology

Since the CRAs provide a view or outlook, indicating a possible credit rating change in the near future, one could expect an event to arise. Plus, recent regulation obliges the CRAs to provide their announcements (regarding sovereigns) at fixed dates, which also gives an indication when an event is likely to occur. Although these drawbacks exist, it still seems plausible to conduct a robust event study because the view/outlook provided by a CRA is not a guarantee of a rating change, thus the event is still unanticipated to some extent. In addition, it is not known whether a rating event will take place at the preset date and to what extent (the number of notches).

II. Results

A. Direct effects

Table 9 provides an overview of the average change of sovereign yields and CDS spreads over the period [-1,1], measured in days and using the adjusted measure of sovereign yields as described before. The hypothesis being tested is:

H_0: Credit rating events do not impact sovereign bond yields (CDS spreads)

H_1: Credit rating events do impact sovereign bond yields (CDS spreads)

Table 9. Yield (spread) changes of event countries during rating events

	Rating Agency	Negative Events		Positive Events	
		[-1,1]		[-1,1]	
Sovereign yield	S&P	0.322**	(2.48)	-0.005	(-0.46)
	Moody's	0.414	(1.64)	----------	----------
	Fitch	0.131**	(2.26)	-0.189**	(-2.43)
CDS	S&P	0.111***	(3.20)	-0.068**	(-2.22)
	Moody's	0.119***	(3.19)	----------	----------
	Fitch	0.103***	(2.67)	-0.023	(-0.83)

Table 9 provides an overview of sovereign yield (CDS spread) changes, in decimal points, over the sample period and sample countries. Negative (Positive) events indicate either a downward (upward) credit rating revision or a negative (positive) sovereign credit outlook / view. T-statistics (calculated following equation (7)) of the mean are reported in brackets. ***, **, * indicate significance at 1%, 5%, 10% respectively. [-1,1] means the yield (spread) change between t – 1 and t + 1. --------- denotes no results because no event study was conducted (less than five events during the sample period).

The results presented in table 9 are comparable to the results of previous studies in the literature which generally conclude that positive events remain largely insignificant whereas negative events usually have a significant positive effect on sovereign bond yields (Reisen & von Maltzan, 1999 and Hull et al., 2004). This study shows stronger effects for both sovereign bond yields and CDS spreads than previous research which is most likely be caused by the different sample period. The last two years of the sample period used in this research, the years 2011 and 2012, are not included in previous research (for example, Afonso et al., (2012)). As can been seen in Appendix V, these two years are characterized by large fluctuations in bond yields (CDS spreads). Although the results of this research show that both bond yields and CDS

spreads move in the expected downward (upward) direction following positive (negative) credit rating events (similar to Cantor & Packer, 1996), one should be careful with the interpretation of the results for positive events. The results for positive credit rating events are based on a limited amount of events (S&P: 5 and Fitch: 8) and might therefore be biased. The results in table 9 also show a difference in magnitude of reaction towards negative and positive credit rating events. Previous research suggest that negative news impacts peoples' attitude more than positive news. In other words, people care more about possible losses than about potential gains of equal magnitude (Bowman et al., 1999 and Soroka, 2006). This might explain the larger economic reaction of sovereign bond yields (CDS spreads) towards negative events.

Whereas previous research investigating the impact of credit rating events in developed countries only distinguished EMU countries from non-EMU countries (Afonso et al., 2012), no distinction has been made for a set of developed countries that share the same currency, but act in a different economic environment. Therefore, I created two sub-categories within the sample, GIPS and Non-GIPS. These countries all adopted the Euro in 2002, but the difference lies in the fact that GIPS-countries made use of bail-out packages of the EMU and IMF whereas Non-GIPS countries did not. To this purpose I recalculated the adjusted measure of sovereign yield (CDS spread), using an adjusted version of the equally weighted portfolio for each sample.

The hypotheses being tested are:

H_0: Credit rating events do not impact sovereign bond yields (CDS spreads) in GIPS
H_1: Credit rating events do impact sovereign bond yields (CDS spreads) in GIPS

H_0: Credit rating events do not impact sovereign bond yields (CDS spreads) in Non-GIPS
H_1: Credit rating events do impact sovereign bond yields (CDS spreads) in Non-GIPS

Table 10 shows the results of the event study for the two sub-categories, GIPS and Non-GIPS. A priori one would expect that the impact of credit ratings for GIPS, given the severe financial turmoil in these countries, would be larger than for Non-GIPS. The results confirm this expectation by showing a decline in sovereign yields for negative events in case of Non-GIPS whereas in case of GIPS the yield increases. The negative reaction in sovereign bond yields to negative credit rating events in Non-GIPS is in line with the (on average) downward sloping bond yield in these countries, but is contradicting Cantor and Packer (1996). This decline following negative credit rating events can be explained by the before mentioned flight-to-safety.

Compared to the reaction of sovereign bond yields (CDS spreads) for the whole sample the reactions for the sub-categories seems to be little. This difference is caused by the difference in the recalculated measure of sovereign yields (CDS spreads). CDS spreads react as expected. This can possibly be, just like the findings of table 9, explained by the risk aversion of people.

The varying results for GIPS are most likely caused by the huge up and downward variation of sovereign yields (CDS spreads) and the clustering of credit ratings. A small timing difference in credit rating event can cause substantial differences. The reaction towards positive events only shows an almost negligible effect for CDS spreads in the expected direction. Bond yields show a stronger reaction towards positive events for rating of Fitch while the reaction caused by ratings of S&P are also almost negligible.

Table 10. Yield (spread) changes of event countries during rating events (Non-GIPS and GIPS)

	Rating Agency	Negative Events Non-GIPS		Positive Events Non-GIPS	
		[-1,1]		[-1,1]	
Sovereign yield	S&P	-0.124***	(-4.02)	----------	----------
	Moody's	-0.030*	(-1.77)	----------	----------
	Fitch	-0.036**	(-2.22)	----------	----------
CDS	S&P	0.156**	(2.04)	----------	----------
	Moody's	0.198	(1.66)	----------	----------
	Fitch	0.393*	(1.95)	----------	----------
	Rating Agency	GIPS		GIPS	
		[-1,1]		[-1,1]	
Sovereign yield	S&P	0.217**	(2.25)	0.019*	(1.94)
	Moody's	-0.031*	(-1.75)	----------	----------
	Fitch	0.038*	(1.71)	-0.124**	(-2.20)
CDS	S&P	0.022	(1.47)	-0.041**	(-2.20)
	Moody's	0.089*	(1.71)	----------	----------
	Fitch	0.069**	(2.56)	----------	----------

Table 10 provides an overview of sovereign yield (CDS spread) changes, in decimal points, over the sample period and sample countries by creating two different groups, Non-GIPS and GIPS. Negative (Positive) events indicate either a downward (upward) credit rating revision or a negative (positive) sovereign credit outlook / view. T-statistics (calculated following equation (7)) of the mean are reported in brackets. ***, **, * indicate significance at 1%, 5%, 10% respectively. [-1,1] means the yield (spread) change between t – 1 and t + 1. ---------- denotes no results because no event study was conducted due to a lack of events (less than five events during the sample period).

So far, I generalized the events in either positive (upgrade or positive outlook/announcement) or negative events (downgrade or negative outlook/announcement). The next test will make a distinction between the two, in order to test the difference in impact. Due to a lack of data no event study will be conducted for any of the positive events since the criteria of minimal five events is not met for any of the CRAs.

The hypotheses being tested are:

H_0: Negative credit rating changes do not impact sovereign bond yields (CDS spreads)
H_1: Negative credit rating changes do impact sovereign bond yields (CDS spreads)

H_0: Negative outlook revisions do not impact sovereign bond yields (CDS spreads)
H_1: Negative outlook revisions do impact sovereign bond yields (CDS spreads)

Table 11. Yield (spread) changes of event countries during rating events

	Rating Agency	Downgrade		Negative outlook	
		[-1,1]		[-1,1]	
Sovereign yield	S&P	0.404*	(1.88)	0.252**	(2.28)
	Moody's	0.512	(1.52)	0.231***	(2.16)
	Fitch	0.211*	(1.80)	0.097***	(3.14)
CDS	S&P	0.071*	(1.90)	0.132*	(1.45)
	Moody's	0.015	(0.50)	0.226***	(3.10)
	Fitch	0.067**	(2.23)	0.132**	(2.41)

Table 11 provides an overview of sovereign yield (CDS spread) reactions, in decimal points, over the sample period and sample countries following either a downgrade or a negative outlook (for either the 90 day or 2 year period). T-statistics (calculated following equation (7)) of the mean are reported in brackets. ***, **, * indicate significance at 1%, 5%, 10% respectively. [-1,1] means the yield (spread) change between t – 1 and t + 1.

Table 11 provides an overview of the results of the impact of the downgrades and negative outlooks on the sovereign bond yields (CDS spreads). The results of table 11 show that downgrades lead to larger bond yield changes in magnitude but of lower statistical significance when compared to negative outlook reactions which cause smaller bond yield changes of higher statistical significance. For CDS spreads, downgrades cause small changes in magnitude and of low significance, while negative outlooks cause reactions of larger magnitude and statistical significance.

B. Anticipation

As provided in the previous section, credit ratings affect sovereign bond yields (CDS spreads) significantly. A remaining question is whether all available information regarding these credit rating events is absorbed during this small window, [t -1, t + 1], or whether part of the information is anticipated and absorbed during the period preceding the rating event. In order to test this hypothesis, I conduct an event study over a thirty and a sixty day window preceding the credit event, [-30,-1] and [-60,-1]. As contamination is likely in case of large windows, I will eliminate all rating events that were preceded by other events in the same country in the previous thirty days, for the period [30,-1], or sixty days for the period [-60,-1]. In this caution is requested when interpreting the results as even the best methods for long-horizon abnormal return analysis are treacherous (Lyon et al., 1999)

The hypotheses being tested are:

H_0: Credit rating events are not anticipated by sovereign bond yields (CDS spreads) for the period [-30,-1]
H_1: Credit rating events are anticipated by sovereign bond yields (CDS spreads) for the period [-30,-1]

H_0: Credit rating events are not anticipated by sovereign bond yields (CDS spreads) for the period [-60,-1]
H_1: Credit rating events are anticipated by sovereign bond yields (CDS spreads) for the period [-60,-1]

Table 12. Anticipation sovereign bond yield (CDS Spread) Changes Full Sample

		Negative Events			
	Rating Agency	[-30,-1]		[-60,-1]	
Yield	S&P	1.876***	(5.72)	2.043***	(2.84)
	Moody's	0.446***	(4.78)	0.757***	(6.13)
	Fitch	1.241**	(2.42)	1.043***	(10.87)
CDS	S&P	-0.122	(-1.32)	-0.891*	(-1.91)
	Moody's	-0.267**	(-2.35)	-0.687***	(-4.99)
	Fitch	-0.037	(-0.53)	-0.395***	(-2.86)

Table 12 provides the anticipation effect of sovereign bond yields (CDS spreads) changes, in decimal points, caused by negative credit rating events. Negative (Positive) events indicate either a downward (upward) credit rating revision or a negative (positive) sovereign credit outlook / view. T-statistics (calculated following equation (7)) of the mean are reported in brackets. ***, **, * indicate significance at 1%, 5%, 10% respectively. [-1,1] means the yield (spread) change between t – 1 and t + 1.

These results show that a significant anticipation effect exists for both the thirty and sixty day period preceding the credit rating event. Whereas the yields are rising in the period preceding the event, the CDS spreads decrease. Possible explanations for this reaction are, firstly, rating inflation and financial deterioration of several sovereign entities over the period 2009-2012. Secondly, the decrease in CDS spread might be caused by unawareness of investors who notice the yield increases due to possible increased uncertainty/risk of a sovereign entity, but only react by 'insuring' against this risk as the credit

rating event takes place. Thirdly and finally, the strong decrease in CDS spread might be caused by upgrades in between two negative rating events (outside the thirty and sixty day elimination window). Although the positive rating events are scarce, they have substantial impact on the CDS spread (a rough visual indication, which shows a great fluctuation of CDS spreads, can be found in Appendix V). The results found in this study are similar to the findings of Afonso et al. (2012) but are of larger magnitude. This difference is most likely caused by the different country sample and period.

C. Persistence

The previous results show that credit ratings affect sovereign bond yields (CDS spreads) significantly over a small window of three days and over a longer period preceding the event. The remaining question is whether the effects of anticipation and of the event itself are persistent. In order to test this hypothesis, I conduct an event study over a thirty and sixty day window following the credit event, [1,30] and [1,60]. As was the case for the study to measure the anticipation effect, contamination is also likely for the same length windows following a credit rating event. Therefore, I will eliminate all rating events followed by other events in the same country for a period of thirty days, for the window [1,30], or for a period of sixty days after the event, for the window [1,60]. When determining the anticipation effect, caution was requested when interpreting the results of long horizon abnormal return analysis, this is also the case for the persistency effect.

The hypotheses being tested are:

H_0: Credit rating events do not have persistent effects on sovereign bond yields (CDS spreads) for the period [1,30]
H_1: Credit rating events do have persistent effects on sovereign bond yields (CDS spreads) for the period [1,30]

H_0: Credit rating events do not have persistent effects on sovereign bond yields (CDS spreads) for the period [1,60]
H_1: Credit rating events do have persistent effects on sovereign bond yields (CDS spreads) for the period [1,60]

Table 13 shows strong reactions of both sovereign bond yields and CDS spreads following credit rating events over both the thirty and sixty day window. The results for S&P and Moody's show a decrease in sovereign bond yield following a credit rating, indicating a possible adjustment (an overreaction might have been occurred in the period preceding the rating event and the period of the event itself, which are characterized by increasing bond yields for these two agencies). The reaction of bond yields to credit ratings provided by Fitch is hard to explain. An explanation might be that the market attaches less value to Fitch ratings or that the timing of the rating events deviate from the rating events of the other two

CRAs. Positive events show a small, insignificant, change over the thirty day window. This might indicate the market has already incorporated all available information and can be seen as a form of persistence. Over the longer period following the event, the sixty day window, bond yields show an upward reaction towards positive events. This reaction can indicate the market is not completely confident and fears a decreased creditworthiness.

The reaction for CDS spreads is contradictory. No significant effects are found for S&P ratings while the results of Moody's and Fitch are opposing and significant. The results of Moody's suggest an initial correction is made, due to a too strong reaction, in the thirty days following the credit event. The reaction for the sixty days following the event is positive, although small, indicating the market did not incorporate all information completely. For Fitch the opposite is the case, an initial upward reaction followed by a downward correction.

The results, for both sovereign bond yields (CDS spreads), do not support persistence. The market shows an underreaction or an overreaction following a rating event, indicating that the market does not know what value should be attached to the credit rating event. The results of table 13 combined with the anticipating and direct effect of credit ratings indicate that Fitch credit rating impact on sovereign bond yield (CDS spread) are contradictory to those of S&P and Moody's. It seems like the market already reacted to the rating events of S&P and Moody's when Fitch provides a rating resulting in opposing and smaller effects.

Table 13. Persistence of sovereign bond yield (CDS spread) changes

	Rating	Negative Events				Positive Events			
	Agency	[1,30]		[1,60]		[1,30]		[1,60]	
Yield	S&P	-0.367***	(-2.44)	-0.417***	(-2.79)	-0.072	(-1.30)	0.149***	(7.69)
	Moody's	-0.945*	(-1.88)	-0.270	(-0.90)	----------	----------	----------	----------
	Fitch	0.662***	(12.01)	0.485***	(5.42)	0.013	(0.22)	-0.051	(-0.73)
CDS	S&P	0.227	(0.49)	0.456	(0.72)	----------	---------	----------	----------
	Moody's	-0.327**	(-2.27)	0.152***	(3.56)	----------	---------	----------	----------
	Fitch	0.252***	(2.70)	-0.247**	(-2.25)	----------	---------	----------	----------

Table 13 provides the persistence effect of sovereign bond yields (CDS spreads) changes, in decimal points, caused by credit rating events over a thirty and sixty day window following the event. Negative (Positive) events indicate either a downward (upward) credit rating revision or a negative (positive) sovereign credit outlook / view. T-statistics (calculated following equation (7)) of the mean are reported in brackets. ***, **, * indicate significance at 1%, 5%, 10% respectively. [-1,1] means the yield (spread) change between t – 1 and t + 1. ---------- denotes no results due to a lack of events (less than five events during the sample period).

D. Spillover effect

The previous sections have shown that both a direct and anticipating effect exists of credit rating events on sovereign bond yields (CDS spreads). Another question this research tries to answer is whether sovereign bond yields (CDS spreads) in a certain country react to a rating event in other countries in the eurozone. To test if a spillover effect exists, I will regress the change of sovereign bond yields (CDS spreads) of countries without a change (non-event countries) on the average change of the rating in event countries, following Afonso et al (2012).

$$\Delta S_{it}^{non-event} = \alpha_i + \beta \overline{\Delta R_i^{event}} + \varepsilon_{it} \quad (8)$$

Where, $\Delta S_{it}^{non-event}$ = change sovereign yield (CDS spread) non-event country

R_{it} = average rating across agencies (calculated as equation 9)

$\overline{\Delta R_i^{event}}$ = average change of *R* across event countries

$$R_{it} = (1/3)[(SP_{it} + M_{it} + F_{it}) + 0{,}5(posSP_{it} + posM_{it} + posF_{it}) - 0{,}5(negSP_{it} + negM_{it} + negF_{it})] \quad (9)$$

where, SP, M, and F take the values between 1 and 22 as explained in table 5 for respectively Standard & Poor's, Moody's, and Fitch.

Finally, I will test whether spillover effects differ between GIPS and Non-GIPS countries. In order to conduct these tests I re-estimate equation (8) for GIPS and Non-GIPS separately. The results of these tests are reported in table 14. A factor to remember is that I will not use the adjusted measure as I did before. I will use sovereign yield (CDS spread) change instead, since previous research showed that the use of the adjusted measure will understate possible contagion effects (Jorion & Zhang, 2007 and Ismailescu & Kazemi, 2010).

Table 14. Spillover effect on bond yields (CDS spreads) of non-event countries

Coefficient	Overall		GIPS		Non-GIPS	
	Yields					
(β) Change in rating (event countries)	-0.149***	(-3.04)	-0.134***	(-2.69)	-0.144	(-1.33)
	CDS					
(β) Change in rating (event countries)	-0.045	(-1.48)	-0.210***	(-4.51)	0.030	(0.37)

Table 14 provides an overview of the spillover effect for the overall sample and the subcategories GIPS and Non-GIPS. The overall sample covers all GIPS and Non-GIPS. Yields and spreads are expressed in decimal points; T-statistics are reported in brackets. ***, **, * indicate significance at 1%, 5%, 10% respectively.

The results reported in table 14 provide evidence of a significant spillover effect. An increase in the average rating *R* of one, in country-events, decreases the sovereign yields in non-event countries by approximately 0.15 percent. Important to notice is that if *R* decreases, as is the case when a downgrade occurs, the yield will increase by 0.15 percent. Spillover effects for CDS spreads are only significant for GIPS. The results for the GIPS-countries show significant impact for both sovereign yields and CDS spreads whereas the results for the Non-GIPS countries are more comparable to the results of the overall sample. The difference between GIPS, Non-GIPS, and the overall sample is caused by the different underlying sample. The different statistical significance between sovereign bond yields and CDS spreads might be explained by the fact that local investors have a limited participation in CDS markets while their participation is already longer established in the sovereign bond market (Ismailescu & Kazemi, 2010).

E. Exchange Rates

Next, I investigate the effect of credit ratings on exchange rates. By doing this I intend to measure the impact of the credit ratings on a global scale. The exchange rate shows the value of a currency, denoted in another currency. An increase in the exchange rate indicates a depreciation of the home currency (the Euro in this research) and an appreciation of the foreign currency (the US Dollar, GB Pound, and Japanese Yen in this research), vice versa, a decrease in the exchange rate indicates an appreciation of the home currency and a depreciation of the foreign currency. I used three investment currencies (the before mentioned foreign currencies) to measure the effect, where I used the Norwegian Krone / Swiss Franc exchange rate as reference rate. In the hypothesis being tested, 'the exchange rate' refers to either the Euro / US Dollar, Euro / GB Pound, or Euro / Japanese Yen exchange rate.

The hypothesis being tested is:

H_0: Credit rating events do not have an impact on the exchange rate
H_1: Credit rating events do have an impact on the exchange rate

Table 15. Impact of negative sovereign credit ratings events on exchange rates

Rating	Exchange rates					
Agency	EUR / USD		EUR / GBP		EUR / JPY	
S&P	0.397***	(6.72)	0.138***	(2.22)	0.460***	(4.23)
Moody's	-0.095	(-0.67)	-0.158*	(-1.86)	0.151	(0.89)
Fitch	-0.201**	(-2.24)	-0.019	(-0.22)	(-0.119)	(-0.88)

Table 15 provides an overview of the impact of credit ratings on exchange rates, in decimal points, over a three day window [-1.1], where the event occurs at t = 0. In case a confounding event occurred (for example a war of national disaster) or a credit rating event for a foreign currency entity takes place events are eliminated for a period of twenty-one days following the event. T-statistics (calculated following equation (7)) of the mean are reported in brackets. ***, **, * indicate significance at 1%, 5%, 10% respectively. (EUR = Euro, USD = United States Dollar, GBP = Great Britain Pound, JPY = Japanese Yen).

Table 15 shows positive and significant effects for all exchange rates in case of S&P credit rating events. The Moody's ratings provide significant results for the EUR/GBP which shows a negative reaction. The Fitch ratings provide significant results for the EUR/USD which is negative as well. The results for the EUR / JPY exchange rate might be influenced by the fact that the Japanese has consistently appreciated over the past five years which lead to a change of monetary policy by the Japanese government. The effects of this newly adopted policy are not unnoticed, as in the words of Jens Weidmann, President of the Bundesbank: "Already alarming violations can be observed, for example in Hungary or Japan, where the new government is interfering massively in the business of the central bank with pressure for a more aggressive monetary policy and threatening an end to central bank autonomy" and "a consequence, whether intentional or unintentional, could moreover be an increased politicization of exchange rates".

6. Conclusion and Limitations

I. Conclusion

In this study I have assessed whether credit rating events provided by Standard & Poor's, Moody's, and Fitch impinge on the behavior of sovereign bond yields, CDS spreads, and exchange rates in the eurozone. The so-called sovereign credit rating events are defined as either announcements/outlooks or credit rating changes from the before mentioned CRAs. Event study methodology is used on a selection of EU sovereign bond yields (CDS spreads) and the EUR/USD, EUR/GBP, and EUR/JPY exchange rate over the period January 2002 – December 2012 using daily data.

The main results of this research can be summarized as follows:

i) A significant response of government bond yields (CDS spreads) to credit rating events is found with differences across agencies. The results for negative events are in general larger and of higher significance. The reaction to positive rating events is more mitigated.

ii) The results show significant effects in case of outlook revisions while the effect is larger for rating changes with lower levels of significance (differences across rating agency).

iii) Negative bond yield reactions towards negative rating events are found for Non-GIPS, while CDS spreads show a positive reaction. A positive reaction of bond yields (CDS spreads) towards credit rating events is found for GIPS.

iv) A strong significant anticipation effect is found which is positive for sovereign bond yields and negative for CDS spreads.

v) No evidence of persistency is found. Bi-directional results come forward which might indicate a correction is made following a credit rating event.

vi) Spillover effects are found indicating that a negative credit rating in an event country causes a higher yield (CDS spread) in a non-event country.

vii) The Euro depreciates following credit rating events provided by Standard & Poor's. For credit ratings provided by Moody's and Fitch less significant and bi-directional results are found.

Attention has to be paid to all results since some strange discrepancies and strong fluctuations could be seen in the data. As discussed, the sovereign bond yield of several countries dropped following downgrades which are probably caused by the flight-to-safety. Next to this the results covering positive results are highly depending on just a few events which made it possible that one event can influence the outcome of the whole positive event set substantially. In addition, some extremely sharp bond yield (CDS spread) increases and drops took place, which could have affected the results.

The conclusions of this research shed some additional light on the capital markets of countries in the eurozone in times of crises. Whereas negative rating events so far caught markets by surprise (Afonso et al., 2012) the results of this research show markets anticipate credit rating events. The results show the credit rating events have significant impact on the costs to borrow for a country and the costs to 'insure' for an investor. In addition the whole eurozone is affected by the depreciation of the Euro in case of a credit rating event. All in all, this research provides evidence that CRAs have much power and impact several macroeconomic factors substantially. The results show that sovereign bond yields react (in general) more significant (both economic and statistical) to credit rating changes than CDSs. This difference might be caused by the fact that local investors do not participate as long in the CDS markets as in the sovereign debt market, making them less responsive and informative (Ismailescu & Kazemi, 2010).

II. Limitations and Recommendations

Event study methodology

Some limitations of this study are caused by the used methodology, namely the event study, which provides easy to understand results using a relatively simple research method.

- Firstly, the event study methodology assumes markets are efficient, but this might not be the case in the real world (McWillams & Siegel, 1997). The observed bond yields (CDS spreads) do not necessarily reflect all available information immediately, hence the existence of strong anticipating, direct, and persistency effects.
- Secondly, some events might have been anticipated to some extent which could have affected the anticipating but also the direct effect (the three-day event window).
- Thirdly, the general pattern of sovereign yield (CDS spreads) is not taken into account when using standard event study methodology. This can cause results to be biased due to a specification problem. Using a country fixed panel regression of the yields (spreads) on the dummy, which measures the rating, can correct this bias. Since previous research (Afonso et al., 2012) showed that this adjustment using country fixed effect panel regression only leads to minimal adjustments this study is not conducted.

Credit rating agencies

As can be extracted from the results, large differences exist across agencies and between sovereign bond yields and CDS spreads. A topic for future research would be to determine the drivers behind the differences amongst rating agencies, but also to determine the drivers which cause the reactions to sovereign credit rating by sovereign bond yields (CDS spreads) to diverge.

Data

Another limitation of this research is found in the lack of daily CDS data availability which might have caused results to deviate from the results of a completely covered period. An improvement over this study would be to conduct research over a completely covered sample period in order to incorporate effects of all credit rating events on CDS spreads. In case one acquires CDS data to cover the whole period I recommend to conduct a similar study as soon as conclusive evidence is found that the eurozone crisis is over and research can be conducted over the whole crisis period.

Another data related remark, although not necessarily a limitation, is the chosen reference entity. The reference entity used is of great importance since this entity represents the normal return. Therefore, another reference entity would lead to different results.

Credit rating triggers

I addressed the question on the way credit rating events are received by the financial market by means of an anticipating, direct, persistency, and spillover effect, plus the effect of credit rating events on exchange rates. A question I did not address is which factors triggered the credit rating events over the period 2002-2012. It might be possible that macroeconomic fundamentals triggered credit ratings, but exogenous variables (mistakes by the CRAs) could have triggered the ratings as well. The determination of the factors triggering the credit ratings would be, in my opinion, a valuable contribution for future research. Sovereign bond yields, CDS spreads, and exchange rates might show completely different reactions to rating events triggered by macroeconomic fundamentals or exogenous variables.

Currency crisis

Reinhart (2002) found evidence that currency crises in developed countries do not lead to downgrades. The results of this research on the other hand revealed that many of the criteria indicating a currency crisis were met in the eurozone over the period 2002-2012. In addition, this research presented that a set of developed countries in the eurozone suffered from (severe) downgrades over the same period. A contribution for future research would be to test the results of Reinhart (2002) again to see of the statement made still holds.

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8. Appendix

Appendix I. Terminology list

A. Credit Rating Agency: Institution providing risk assessments of debt instruments and debt issuers.

B. Government / Sovereign Bond: a debt security issued by a national government, promising to repay the principal at a pre-agreed date as well as periodic interest payments.

C. Sovereign Bond Yield: the paid interest over a sovereign bond in order to compensate the bond holder.

D. Credit Default Swap: an agreement between two parties where the buyer, transfers the risk of a certain credit event to the seller in exchange for periodic payments until maturity or at the credit event, whatever occurs first. The spread of the CDS is the premium paid by the buyer to the seller.

E. Macroeconomic and financial shocks: sudden, non-predictable and/or unexpected changes in the macroeconomic environment of a country or multiple countries which cause distortion in trade, government spending, investments, consumption, and/or production.

F. Government Sponsored Entity: a financial corporation created by the U.S. Congress which has the focus to enhance credit flows between targeted economic sectors, make these capital markets sectors more efficient, and to reduce investor-risk.

G. Collateralized Debt Obligation: A type of security in which certainty is assured by means of collateral.

H. Over-the-counter (OTC): Direct transaction between parties with no interference of an exchange.

I. Shadow banking system: Shadow banks conduct the same services as traditional banks but they differ from the traditional banks by their lack of accessibility to public liquidity sources (as offered by the federal reserve).

J. Congressional Budget Office (CBO): federal agency that provides economic data to the congress.

K Central clearing: Individual risk is reduced by clearing financial transactions by a central (single) counterparty. Because of the guarantee of the central clearing counterparty, the impact of one of the parties is reduced. Both parties are required to place liquid collateral as a margin (based on Chatham Financial, The end-user guides to derivatives regulation).

L. Currency crisis: abrupt devaluation of a currency

M. Rating shopping: finding the most favorable rating for a security.

N. On-the-run bonds: the most frequently traded treasury security of its maturity.

O. Mid-rate: the median average of the bid and offer rate.

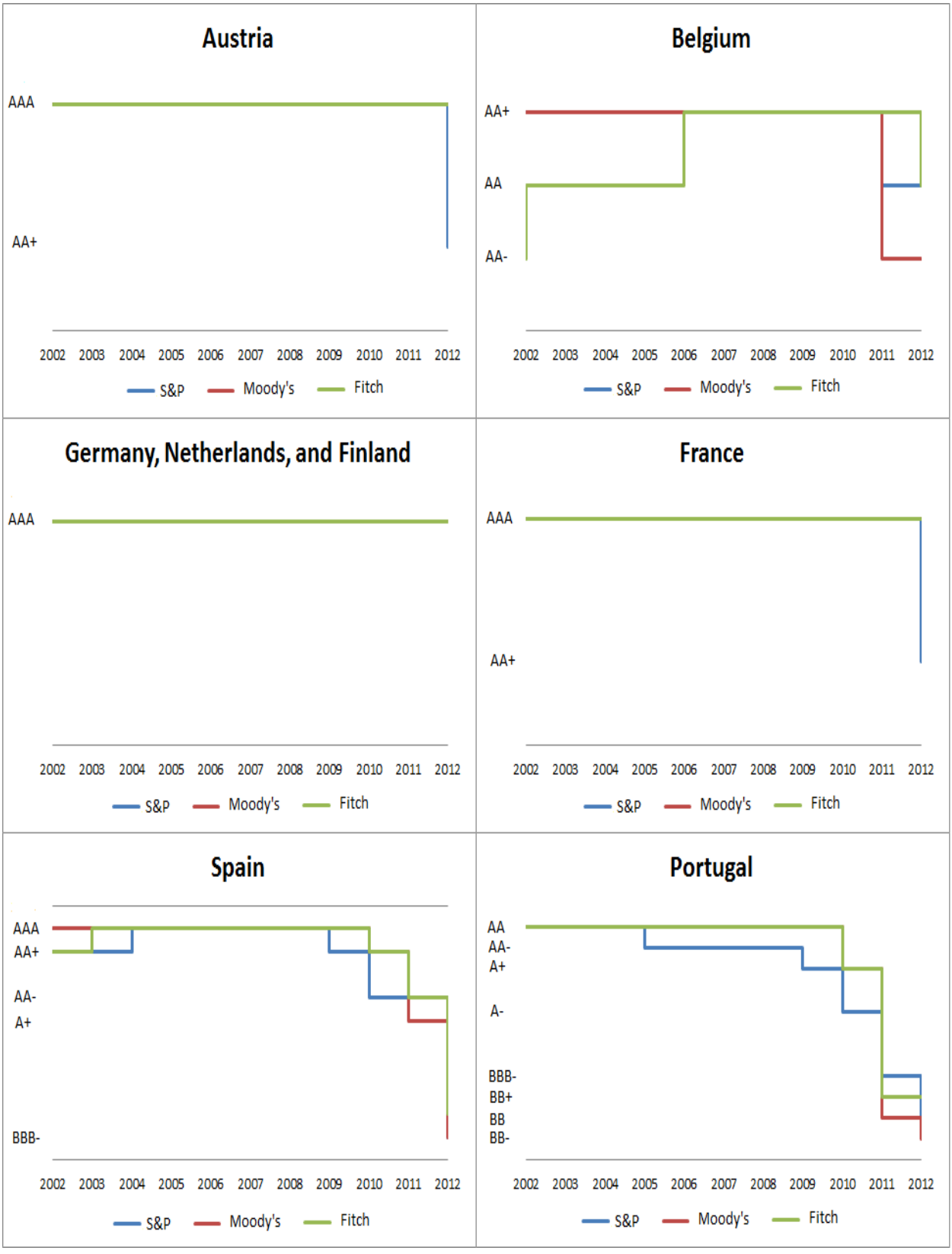
Appendix II. Data Annex

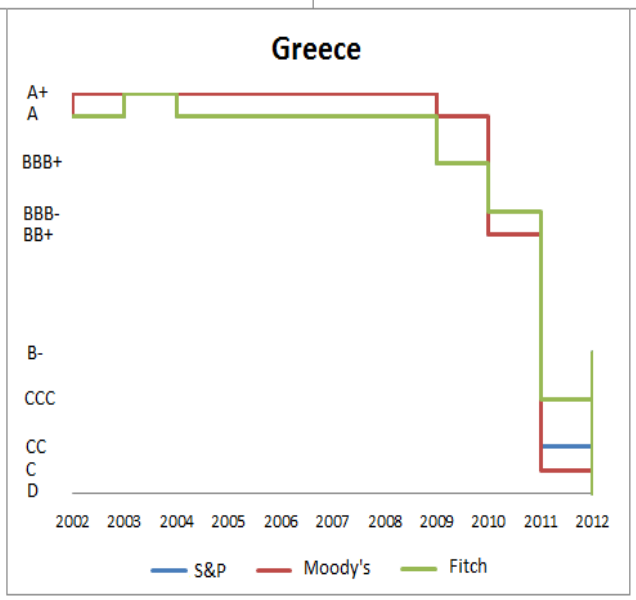
	10 – year Bond Yield		5 – year CDS Spread CMA Data		5 – year CDS Spread Thomson Reuters Data	
	Mnemonic	Code	Mnemonic	Code	Mnemonic	Code
Austria	OEBRYLD	S06676	OEGVTS5	Z07031	ATG5$AC	S183D9
Belgium	BGBRYLD	S06040	BGGVTS5	Z03551	BEG5$AC	S164KT
Finland	FNBRYLD	S06771	FINLDS5	Z16786	FIG5$AC	S183LQ
France	FRBRYLD	S04538	FRGVTS5	Z14751	FRG5$AC	S153V2
Germany	BDBRYLD	S03258	BDGVTS5	Z06871	DEG5$AC	S151RU
Greece	GRBRYLD	S487PL	GRGVTS5	Z01886	GRG5$AC	S157D4
Ireland	IRBRYLD	S06033	ITGVTS5	Z04961	IEG5$AC	S161LU
Italy	ITBRYLD	S05461	IRGVTS5	Z06561	ITG5$AC	S183RQ
The Netherlands	NLBRYLD	S04540	NLGVTS5	Z14927	NLG5$AC	S164RV
Portugal	PTBRYLD	S03692	PTGVTS5	Z04421	PTG5$AC	S1844K
Spain	ESBRYLD	S05462	ESGVTS5	Z05716	ESG5$AC	S164P1

Exchange Rates	**Source**	**Code / URL**
Euro / Dollar	ECB	http://sdw.ecb.europa.eu/browse.do?node=2018794
Euro / GB Pound	ECB	http://sdw.ecb.europa.eu/browse.do?node=2018794
Euro / Japanese Yen	ECB	http://sdw.ecb.europa.eu/browse.do?node=2018794
Norwegian Krone / Swiss Franc	Datastream	NWCHFSP

Appendix II provides an overview of the Datastream Mnemonics and codes of the obtained data. The 5 year CDS dataset consists out of two different sets and are dollar denominated. Dollar denominated CDS spread data is chosen to cover as much of the sample period and sample country set. The URL leads to a selection window to request exchange rates. Daily frequency is selected for the Euro / Dollar, Euro / UK Pound, and Euro / Japanese Yen exchange rate.

Appendix III. Schematic overview credit rating per country (2002-2012)





Based on credit rating events provided by Standard & Poor's, Moody's, and Fitch.

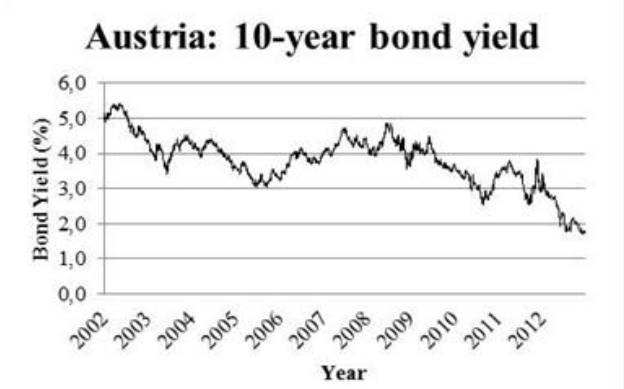
Appendix IV. Summary of credit rating events.

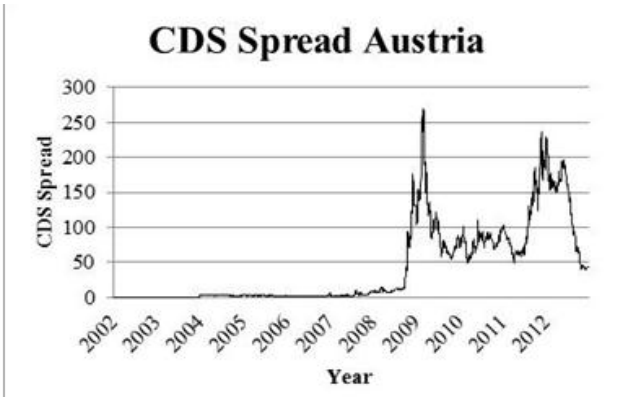
Summary of credit rating events

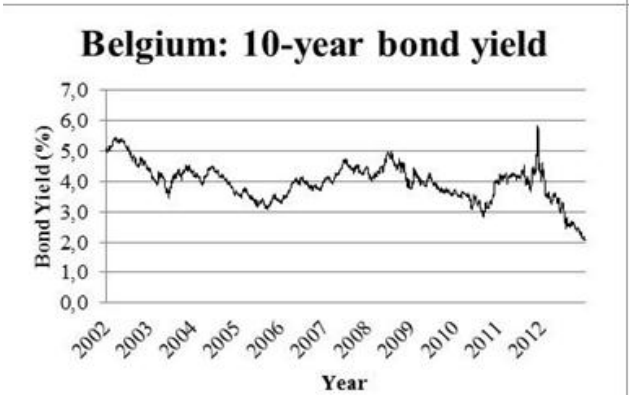
Credit rating events over the period 2002-2012								
Countries	Upgrade		Downgrade		Positive Outlook		Negative Outlook	
Austria	0	(0,0,0)	1	(1,0,0)	0	(0,0,0)	2	(2,0,0)
Belgium	2	(0,0,2)	3	(1,1,1,)	0	(0,0,0)	8	(4,1,3)
Finland	0	(0,0,0)	0	(0,0,0)	0	(0,0,0)	2	(2,0,0)
France	0	(0,0,0)	2	(1,1,0)	0	(0,0,0)	2	(1,0,1)
Germany	0	(0,0,0)	0	(0,0,0)	0	(0,0,0)	1	(1,0,0)
Greece	6	(3,1,2)	27	(10,7,10)	2	(0,0,2)	24	(12,4,8)
Ireland	0	(0,0,0)	15	(6,5,4)	0	(0,0,0)	17	(7,2,8)
Italy	2	(0,1,1)	10	(4,3,3)	0	(0,0,0)	12	(7,1,4)
Netherlands	0	(0,0,0)	0	(0,0,0)	0	(0,0,0)	2	(2,0,0)
Portugal	0	(0,0,0)	16	(6,5,5)	0	(0,0,0)	19	(9,3,7)
Spain	2	(1,0,1)	15	(6,5,4)	1	(1,0,0)	17	(9,4,4)
Total	12	(4,2,6)	89	(35,27,27)	3	(1,0,2)	106	(56,15,35)

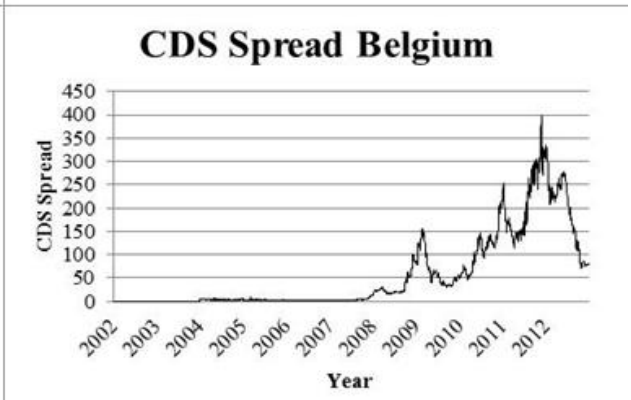
The credit rating events over the period are given as a total per sovereign entity followed by the number of credit rating events awarded by the agencies in brackets (S&P, Moody's, Fitch)

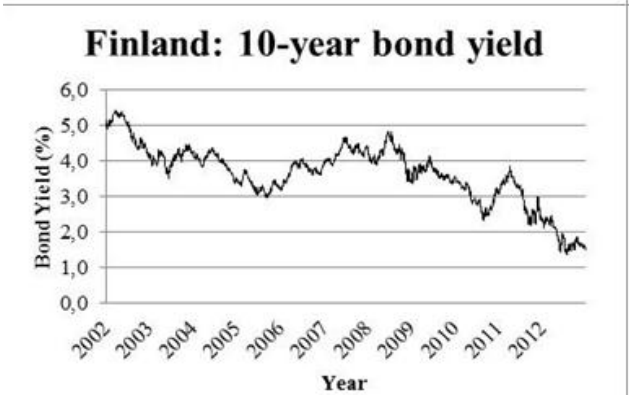
Appendix V. Overview Bond Yields and CDS Spreads

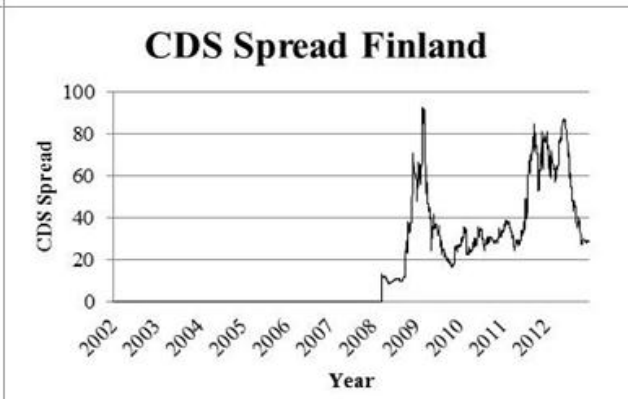


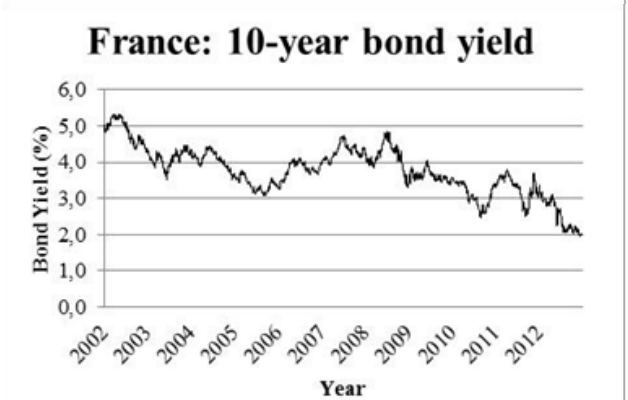


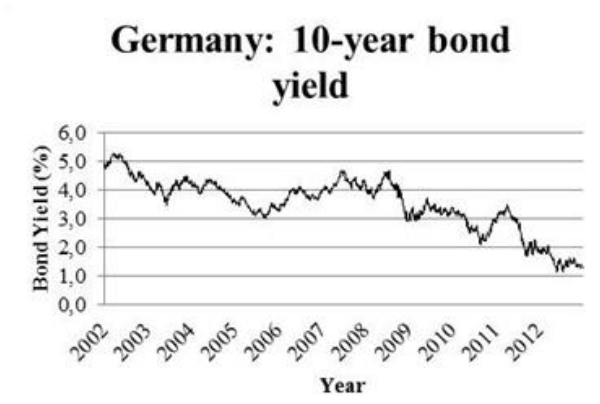


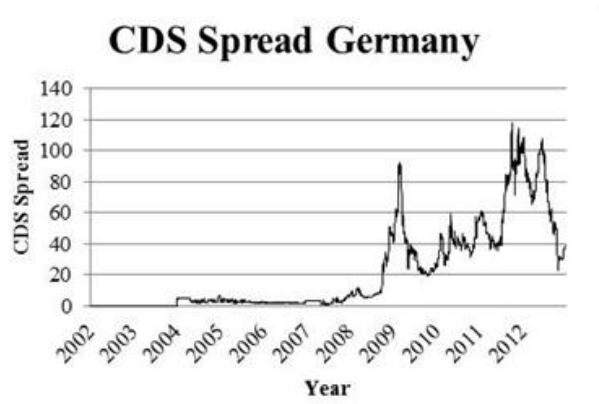


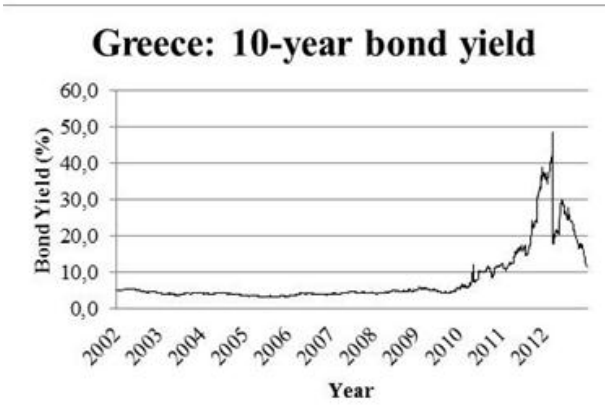


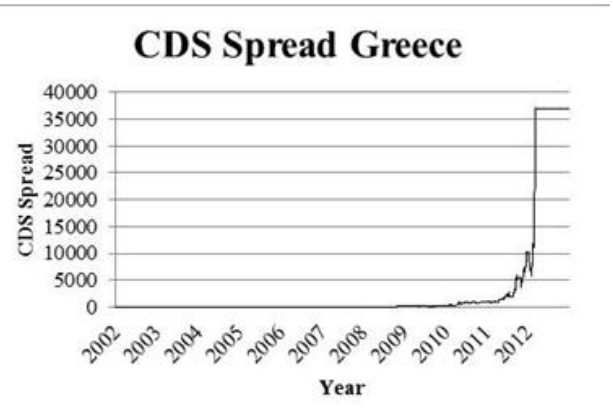


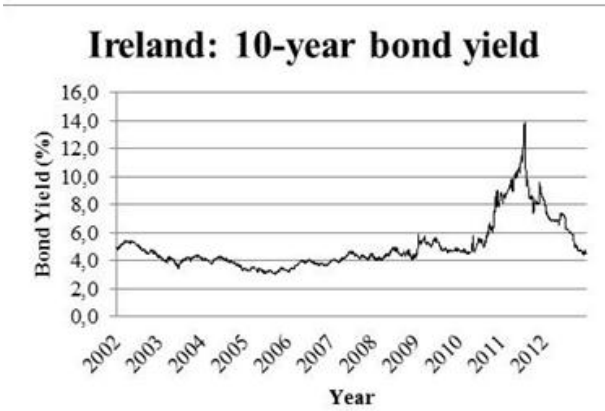


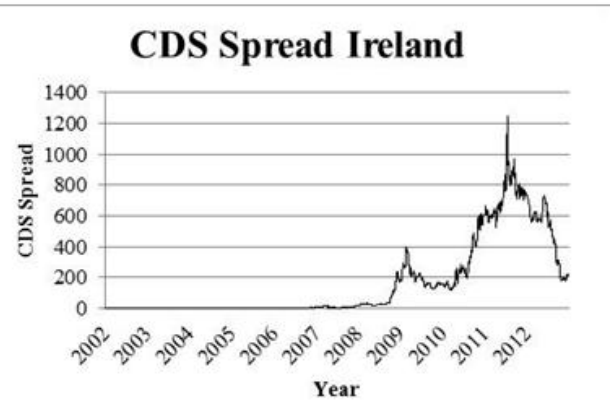

Germany: 10-year bond yield
Bond Yield (%)
6,0
5,0
4,0
3,0
2,0
1,0
0,0
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Year

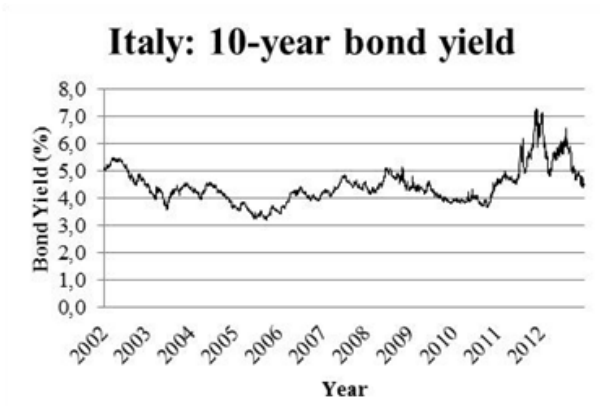

CDS Spread Germany
CDS Spread
140
120
100
80
60
40
20
0
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Year

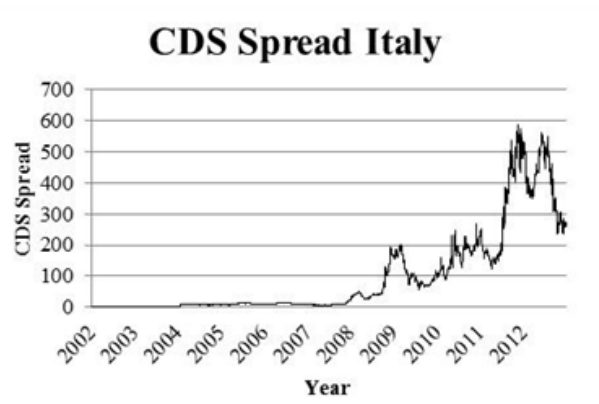

Greece: 10-year bond yield
Bond Yield (%)
60,0
50,0
40,0
30,0
20,0
10,0
0,0
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Year

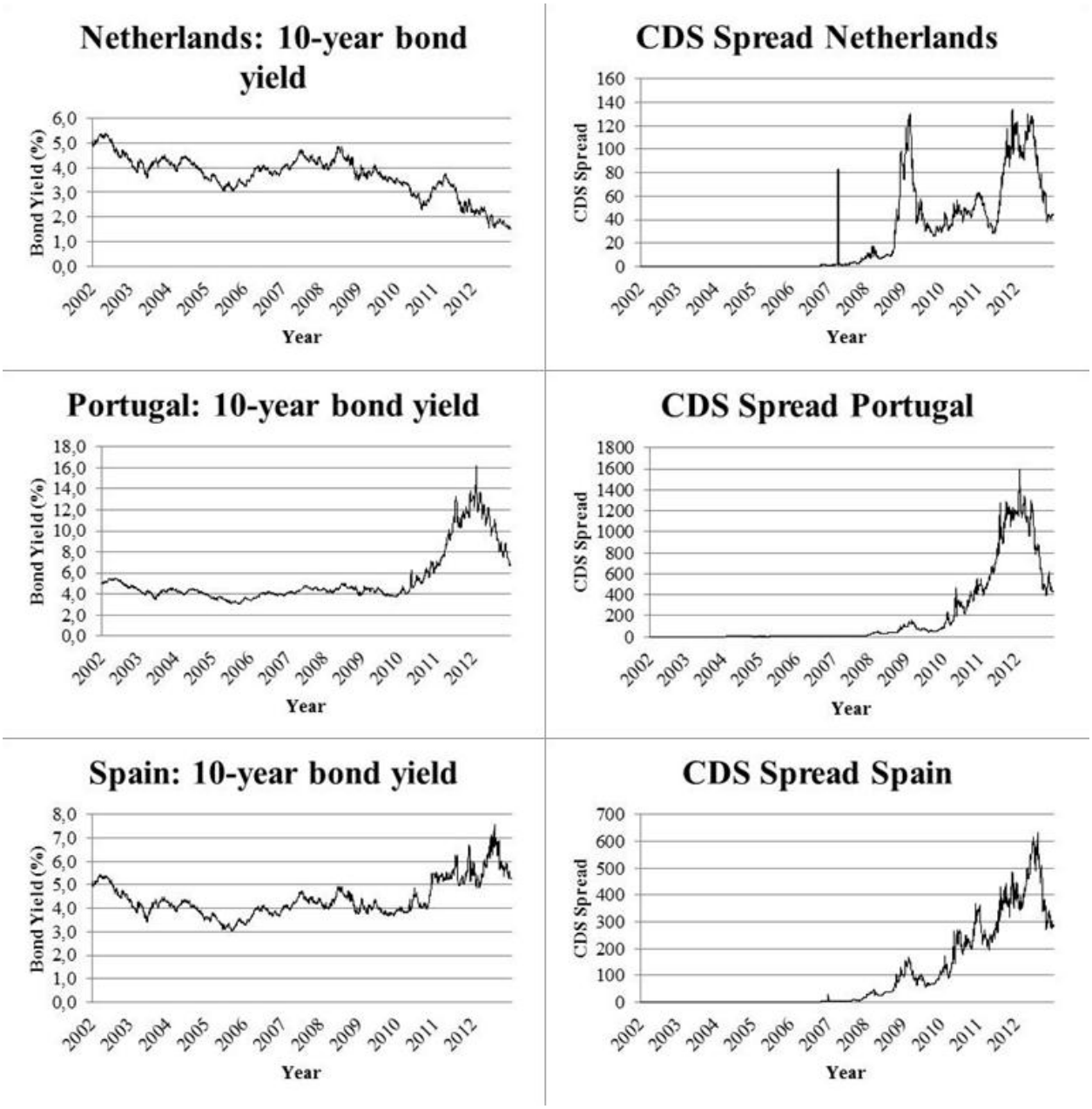

CDS Spread Greece
CDS Spread
40000
35000
30000
25000
20000
15000
10000
5000
0
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Year


Ireland: 10-year bond yield
Bond Yield (%)
16,0
14,0
12,0
10,0
8,0
6,0
4,0
2,0
0,0
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Year


CDS Spread Ireland
CDS Spread
1400
1200
1000
800
600
400
200
0
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Year


Italy: 10-year bond yield
Bond Yield (%)
8,0
7,0
6,0
5,0
4,0
3,0
2,0
1,0
0,0
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Year


CDS Spread Italy
CDS Spread
700
600
500
400
300
200
100
0
2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Year



Appendix V provides an overview of the 10-year bond yield and 5-year CDS spread of the countries in the sample. Since no CDS data was available for the complete period, I combined two different sets to cover a large as possible period following the instructions provided by Thomson Extranet.

Appendix VI. Descriptive Statistics Exchange Rates

	N	Minimum	Maximum	Mean	Standard Deviation	Variance
EUR / USD	2870	0,8609	1,5979	1,2784	0,1495	0,0220
EUR / GBP	2870	0,6091	0,9803	0,7523	0,0917	0,0080
EUR / JPY	2870	1,0318	1,6786	1,4738	0,1400	0,0200

Appendix VI shows the results of the Descriptive Statistics of the exchange rate of the Euro against the US Dollar, GB Pound, and Japanese Yen. Data collected includes daily exchange rates between the before mentioned currencies over the period January 1, 2002 - December 31, 2012 obtained via DataStream and the ECB.

Appendix VII. Correlation Matrix Bond Yields

	Austria	Belgium	Germany	Netherlands	France	Finland	Italy	Portugal	Ireland	Greece	Spain
Austria	1	0.983*	0.946*	0.980*	0.984*	0.984*	-0.320	-0.510*	-0.298*	-0.606*	-0.251*
Belgium		1	0.762*	0.824*	0.896*	0.839*	0.337	-0.121*	0.075*	-0.255*	0.092*
Germany			1	0.985*	0.957*	0.981*	-0.243*	-0.667*	-0.467*	-0.751*	-0.397*
Netherlands				1	0.976*	0.996*	-0.160*	-0.617*	-0.394*	-0.715*	-0.333*
France					1	0.977*	0.012	-0.476*	-0.310*	-0.573*	-0.194*
Finland						1	-0.146*	-0.597*	-0.364*	0.696*	-0.326*
Italy							1	0.779*	0.613*	0.723*	0.891*
Portugal								1	0.815*	0.941*	0.811*
Ireland									1	0.684*	0.712*
Greece										1	0.738*
Spain											1

Appendix VII provides an overview of sovereign bond yield correlation in the eurozone. * denotes significance at the 1-percent level.

Appendix VIII. Correlation matrix CDS – Bond Yields

CDS / Yield	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Austria	-0.452*										
Belgium		-0.123*									
Finland			-0.546*								
France				-0.670*							
Germany					-0.812*						
Greece						0.647*					
Ireland							0.927*				
Italy								0.784*			
Netherlands									-0.701*		
Portugal										0.980*	
Spain											0.843*

Appendix VIII provides an overview of correlation between CDS spreads and bond yields of countries in the sample over the available sample period (differences per country). *indicates significance at the 1-percent level.

Appendix IX. Percentage of interest over the German sovereign bond yield (%)

Rating	Average bond yield over German bond spread (%)		
	S&P	Moody's	Fitch
AAA	0,31	0,28	0,25
AA+	0,42	0,68	0,83
AA	0,81	0,84	0,56
AA-	0,83	0,13	1,25
A+	0,85	1,06	1,79
A	1,08	2,20	1,01
A-	2,38	2,67	1,85
BBB+	3,23	5,81	4,07
BBB	4,42	1,68	2,61
BBB-	6,42	3,96	7,00
BB+	7,20	4,88	9,37
BB	6,87	8,68	-
BB-	10,58	6,53	-
B+	-	10,70	13,06
B	12,55	-	-
B-	8,51	-	17,75
CCC+	-	13,12	-
CCC	18,23	-	21,06
CCC-	-	-	-
CC	25,09	-	-
C	-	21,41	38,59
D	21,71	-	28,84

Appendix IX provides an overview of the percentage of interest above the German bond spread given a certain rating. As expected the amount of interest increases as the creditworthiness decreases. Important note: due to a lack of data in certain rating categories no average yield could be calculated or the average yield shows irregularities towards the risk-return tradeoff.