# The impact of macro-economic variables on the sovereign CDS spreads of the Eurozone countries

*Examining the determinants of credit default swaps*

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Abstract:

This thesis studies the determinants of sovereign CDS spreads. The paper starts off by providing an analytical framework of sovereign credit risk, in order to identify the macro-economic variables that influence sovereign risk and to discuss the functionality of CDS spreads compared to other credit risk measures. Regression analysis is then used to study the impact of the identified variables on the CDS spreads. The study is aimed at the CDS spreads of sixteen Eurozone countries and uses data from 2007 until 2011 as input. Results indicate that there are indeed various macro-economic variables that have a significant and rational effect on CDS spreads, but the paper also discovers that there are various non-credit risk related factors that have a big impact on the size of CDS spreads.

Key words: sovereign credit default swap, CDS, default, credit rating, regression analysis, event study, Eurozone

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# Contents

# 1 Introduction

Sovereign credit ratings have long served as the most used proxy to measure the amount of credit risk linked to an economy. However, more and more criticism is being directed towards the rating agencies that determine the credit ratings. The common view is that the credit ratings do not accurately reflect the amount of credit risk attached to an entity (Mora 2006)[1]. This view is based on the current sovereign debt crisis but also on the subprime banking crisis of a few years ago. Credit rating agencies were unable to foresee this crisis. The most prominent example of this was the bankruptcy of the American investment bank Lehman Brothers. This bank still had a very high credit rating right before it defaulted, even though there were indicators at that time that the credit risk attached to the bank had increased (Flannery et al. 2010)[2]. The critiques directed toward the use of credit ratings have raised the demand for a different and more accurate proxy of sovereign credit risk. Investors are more and more acknowledging the need for a credit risk measure that correctly conveys the current market situation and can adapt quickly to changing conditions, which is especially important in light of the current sovereign debt crisis.

The Credit Default Swap (CDS) spread can be a potential substitute to the use of credit ratings as the leading indicator for sovereign risk. The premium that has to be paid in a sovereign CDS conveys the amount of credit risk associated with the entity underlying the contract. A CDS contract can insure an investor against the credit risk that he or she faces. Because CDS spreads are market-assessed indicators, unlike credit ratings, they should adjust more accurate and also quicker to changing market conditions (Flannery et al. 2010)[3]. The CDS has become a very popular instrument. It is the most actively traded credit derivative and the market for these swaps has grown to well over 62 trillion dollar (Greatrex 2009)[4]. However despite the size of the market, the subject of sovereign CDS spreads has remained relatively untouched in academic literature up to this point. This paper hopes to fill in this existing gap to some extent, by studying whether sovereign CDS spreads can potentially be used as a solid and accurate proxy for sovereign risk.

The reason why it is so important that more is known about the accuracy of sovereign CDS spreads is that sovereign defaults can severely damage the global financial stability. The sovereign credit risk that is attached to a nation has a bigger impact on the financial system than macro-economic risks, market liquidity risks, and emerging market risks (IMF 2011)[5]. The main

[1] Mora, N. (2006). *Journal of Banking & Finance*, 30, p2042
[2] Flannery, M., Houston, J. and Partnoy, F. (2010). *University of Pennsylvania Law Review*, 158, p2100
[3] Flannery, M., Houston, J. and Partnoy, F. (2010). *University of Pennsylvania Law Review*, 158, p2088-2089
[4] Greatrex, C. (2008). Fordham University: Department of Economics Working Paper 05, p19
[5] International Monetary Fund. (2011). *Global financial stability report October 2011,* p2

reason why sovereign defaults can be so devastating to the financial sector is because of the attached spillover effects. If a country is facing liquidity problems, this almost always affects nearby countries and both foreign and domestic banks. The problems of one country can thus quickly stress an entire region. There are various types of sovereign spillover effects (IMF 2010)[6]. For one, high sovereign risks increase the correlation of risk premia. A rising risk premium of a country in turmoil impacts the risk premium of nearby economies as well, even though these economies might not even face liquidity problems. Another effect is that financial distress causes investors to behave more herd-like, which can rapidly put troubled economies into even bigger problems. The final and most dangerous spillover effect is disrupted bank funding sources. This often leads to defaults or debt restructuring if there is no supranational intervention. The European Central Bank (ECB) and local central banks tend to intervene when a European economy has reached this stadium. This year and the year before, a lot of European nations needed the help of the ECB or the International Monetary Fund. The sovereign debt levels of those nations had risen to such high levels that they would not be able to service their debts independently in the near future.

Because of the impact that sovereign credit risk can have on financial systems, it is very important that the amount of credit risk that is attached to a nation is correctly measured and conveyed to investors and policy makers. In order to be able to define the accuracy of a credit risk measure it is crucial that the determinants that underlie the credit risk indicator are identified and acknowledged. These determinants have already been identified for the other sovereign credit risk measures, like credit ratings, default probabilities, and bond yield spreads, but not for credit default swaps. This is mostly because the CDS is still a relatively young instrument, while another reason is the fact that it is quite hard to actively monitor the CDS market. It is difficult to monitor the CDS spreads because transactions take place over the counter, instead of on an exchange (Wallison 2009)[7].

The research objective of this thesis is to find the factors that determine the sovereign CDS spreads. This is done by studying the impact of the variables that are known to explain other credit risk measures on the sovereign CDS spreads. The research objective is formalized in the following research question:

*Which macro-economic variables cause the size and variability of sovereign CDS spreads, and does the impact of those variables differ among the respective countries?*

[6] International Monetary Fund. (2010). *Global financial stability report October 2010,* p7
[7] Wallison, P. (2009), *The Journal of Structured Finance*, 15 (2), p22

The study that is conducted to answer the research question is focused on the CDS spreads of the Eurozone countries. A dataset comprising statistics from 2007 until 2011 is used. The set includes the CDS spreads of sixteen Eurozone sovereign entities, along with the necessary statistics of the potential determinants of the spreads. These statistics are mostly macro-economic. Examples of variables that are included in the study are a sovereign' inflation numbers, debt statistics and GDP data.

The impact of the selected variables is tested using a multivariate regression analysis (Brooks 2008)[8]. The effects of the variables are tested on a pooled sample containing the spreads of all of the sovereign entities and also on the spreads of the sixteen countries individually. This way, results can be compared to see if the variables impact the respective CDS spreads of the nations differently. An additional check is then done to see whether CDS spreads do indeed adjust immediately and significantly to new macro-economic data. An event study is conducted that tests the abnormal returns of CDS spreads on days when announcements are made that present new values for some of the explanatory variables that are used in the regression analysis. The impact of these abnormal returns is tested using both the Constant Mean Return Model and the Market Model (MacKinlay 1997)[9].

This thesis contributes to existing literature in a number of ways. To my knowledge, it is the first paper that focuses primarily on the impact of macro-economic variables on sovereign CDS spreads. By selecting variables that are known to determine other credit risk measures, the paper furthermore provides a unique link between the respective measures of sovereign risk. The study and analysis of the announcement effects surrounding the explanatory variables of the CDS spreads is also something that up to this point has not been done before.

The remainder of this thesis is organized as follows. Chapter 2 provides an explanation of the available literature on sovereign credit default swaps and also on sovereign credit risk in general. This chapter serves as the link between past studies and the research that is done for this paper. The chapter concludes with the hypotheses that are drawn up in order to answer the research question. The first part of Chapter 3 provides an overview of the methodology used for both the regression analysis and the event study, while the second part discusses the data that is used as input for the study. Results of the research that is done can be found in Chapter 4, and based on those results it is then decided whether the selected hypotheses should be rejected or not. Chapter 5 contains the concluding remarks of this thesis, including a summary of the findings and also providing directions for further research.

[8] Brooks, C. (2008). *Introductory Econometrics for Finance*, p88
[9] MacKinlay, A. (1997). *Journal of Economic Literature*, 35 (1), p17-18

# 2 Literature review

*This chapter links existing literature about sovereign credit risk to the research objective of this thesis. In the first section, the impact and drivers of sovereign credit risk in general are explained, while the second section discusses the various types of measures of sovereign risk that can be used. The third section examines determinants of credit ratings and default probabilities, to find the explanatory variables that might drive the sovereign CDS spreads. The potential impact of those variables on the CDS spread is then discussed in the fourth section, and based upon those expectations the hypotheses are drawn up in the fifth section.*

## *2.1 Sovereign credit risk*

### 2.1.1 Drivers of sovereign credit risk

According to Reinhart and Rogoff (2008)[10], there are five drivers that can push a country into a sovereign crisis and towards a default. These factors are the following:

1. *The external government debt*
2. *The amount of domestic debt*
3. *Banking crises*
4. *Inflation outbursts*
5. *Currency crashes*

When a nation is facing a debt crisis, it is almost always a combination of these factors that pushes a country into that position. Despite available knowledge about which factors cause a sovereign debt crisis and plenty of experience from the past, nations almost always get caught up in the same pitfalls. The main reason for this is the common belief that "this time is different". This statement couldn't be further from the truth. History showed that every time a nation had to restructure its debt or go into default, it was caused by one or more of the earlier mentioned drivers. Periods of economic growth always pave the way for over-optimism and dissipation, which leads to neglection of the state of the credit risk drivers and ultimately causes a new debt crisis (Reinhart and Rogoff 2008)[11].

The fact that external debt is named as a driver of sovereign default is logical, since the inability of a nation to fulfill its external debt obligations effectively puts a nation into a state of default. It should come as a bigger surprise that domestic debt is an equally important driver of sovereign

[10] Reinhart, C. and Rogoff, K. (2008). *This time is different: Eight Centuries of Financial Folly,* p4-14
[11] Reinhart, C. and Rogoff, K. (2008). *This time is different: Eight Centuries of Financial Folly,* p15-20

risk. The dangers of domestic debt are always overlooked. Somehow, investors believe that domestic debt will be treated as junior to external debt. This is despite the fact that both must be paid from the same revenue stream. Default probabilities depend way more on the total level of debt, than just on the amount of external debt (Reinhart and Rogoff 2008)[12].

The third driver of sovereign credit risk, a banking crisis, is often preceded by periods of huge economic growth. Increased capital mobility has led to large international banking crises in many cases. Huge capital inflows precede external debt crises on both a local and global level (Reinhart and Rogoff 2008)[13]. Countries that are easily affected by economic crises often borrow too much money during prosperous times, which inevitably leads to liquidity problems when economic growth stalls. The current problems of Greece are an example of this. Even though the nation has a history of default, as it has spent over 50% of its years in default, it seems unable to learn from past mistakes. Excessive borrowing and questionable policy making has put this country again into a deep financial crisis.

High inflation numbers also have a big influence on sovereign debt crises. All of the countries that experienced a default or debt restructuring in the past had soaring inflation rates during those periods. A high inflation rate generally reveals bad monetary and exchange rate policies, and also low quality economic management. This can put a nation into even bigger problems (Mellios and Blanc 2009)[14]. High inflation rates are often followed by currency crashes or depreciations. A currency crash is the final driver of sovereign risk. When a country is in a state of default, exchange rates tend to depreciate 15% or more (Reinhart and Rogoff 2008)[15]. These depreciations are a reaction to high inflation rates, since a country has to maintain its competitiveness during times of financial turmoil.

The impact of the drivers of sovereign risk is influenced by a number of other factors. Avery and Fisher (1992)[16] indicate that both the openness of an economy and the economic growth are very important. If a nation has a very open economy, this means that it is vulnerable to market shocks, which can put a country more easily into liquidity problems. The impact of economic growth speaks for itself. If the economy of a nation is growing while the amount of debt outstanding remains constant, the sovereign risk position of a country improves. Haque et al. (1998)[17], Manasse et al. (2003)[18] and Mellios and Blanc (2009)[19] state the importance of a few

[12] Reinhart, C. and Rogoff, K. (2008). *This time is different: Eight Centuries of Financial Folly,* p119
[13] Reinhart, C. and Rogoff, K. (2008). *This time is different: Eight Centuries of Financial Folly*, p171-172
[14] Mellios, C. and Paget-Blanc, E. (2006). *European Journal of Finance*, 12 (4), p363
[15] Reinhart, C. and Rogoff, K. (2008). *This time is different: Eight Centuries of Financial Folly,* p6-7
[16] Avery, R. and Fisher, E. (1992). *Country Risk Analysis: A Handbook,* p116
[17] Haque, N., Mark, N. and Mathieson, D. (1998). IMF Working Paper 46, p6-7
[18] Manasse, P., Roubini, N. and Schimmelpfennig, A. (2003). IMF Working Paper 221, p3-4
[19] Mellios, C. and Paget-Blanc, E. (2006). *European Journal of Finance*, 12 (4), p363

additional factors. These are the competitiveness of an economy, its current account deficit, and the amount of available reserves. If an economy is competitive, this means that is has a good export position and that it can generate more revenues. This is important since a country has to earn enough money to service its debt payments. A current account deficit is not good for the economy. When this deficit is increasing, a nation is becoming more dependent on foreign creditors. This can increase the default probability of that nation, as high foreign dependencies can lead to large external debt obligations. High reserves of course have a positive impact on the credit risks attached to a country, as this provides a nation with more room to fulfill its future debt obligations.

### 2.1.2 The impact of sovereign credit risk

In case an economy has reached the stadium when a default or debt restructuring cannot be avoided, a series of events tends to occur. This sequence is based on the Debt Deflation theory[20], by Fisher (1933)[21]. The sequence starts when the drivers of credit risk have reached such heights that normal recovery cannot be achieved. Each event triggers the next event, and all eight contribute to the final event. The actual chronology might differ sometimes, but generally the chain of consequences following a default is the following:

1. *Debt liquidation and distress selling*
2. *Contraction of deposit currency*
3. *Decreasing price levels*
4. *Decreasing business net worth's and bankruptcies*
5. *Decreasing profits*
6. *Decreasing labor employment, outputs, and trade*
7. *States of pessimism and low consumer confidence*
8. *Hoarding and decreasing money circulation*
9. *Interest rate disturbances; nominal rates decrease while real interest rates go up*

The sequence provides another argument why sovereign credit risk can have such a massive impact on an economy. As the respective events show, nearly everyone and everything in an economy is affected when a debt crisis occurs. It is therefore critical that sovereign credit risks are very actively monitored, to have a better change to prevent a default from occurring.

[20] This theory was initially ignored by academics that favored Keynes' theory, but has recently gained a lot more appreciation. Fishers' theories are taken into account by more and more policymakers, who are now starting to acknowledge the devastating impact that high sovereign debt levels can have on an economy (The Economist 2009).

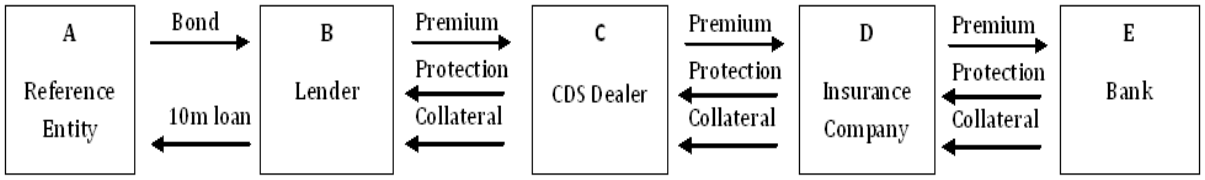
[21] Fisher, I. (1933). *Journal of the Econometric Society, 1 (4),* p342-343

## *2.2 Sovereign credit risk measures*

### 2.2.1 Credit Default Swaps

In order to be able to determine whether CDS spreads can be used as an effective credit risk measure, it is important to know the theory behind the CDS and the way that the market works. The main function of CDS spreads is to transfer the credit risk associated with a potential default from the protection buyer (or lender) to the protection seller (also known as the CDS dealer). The protection buyer is then insured against a credit event of a specific nation or firm, which is called the reference entity. The premium that the protection buyer has to pay is based on the likelihood that the reference entity is unable to fulfill its obligations toward their bondholders (Hull 2008)[22]. This premium is called the CDS spread. The protection seller has to compensate the protection buyer in case of a credit event. Debt restructuring, repudiation and the failure to pay principal or coupon are all seen as credit events. If a credit event occurs under the terms of a CDS, the protection seller has to pay the protection buyer either the face value of the bond or the difference between the post-default value of the bond and the par value (Fontana and Scheicher 2010)[23]. The protection seller thus takes over the counterparty risk on the principal amount that is otherwise faced by the protection buyer. Because this can lead to very high settlement payments, the protection seller generally also hedges the risks it takes on. It can do this by entering a hedge with an insurance company for example, who then again can also hedge the risk that they take on by doing so (Wallison 2009)[24]. This entire process is shown in Figure 2.1.

**Figure 2.1: How the CDS market works**

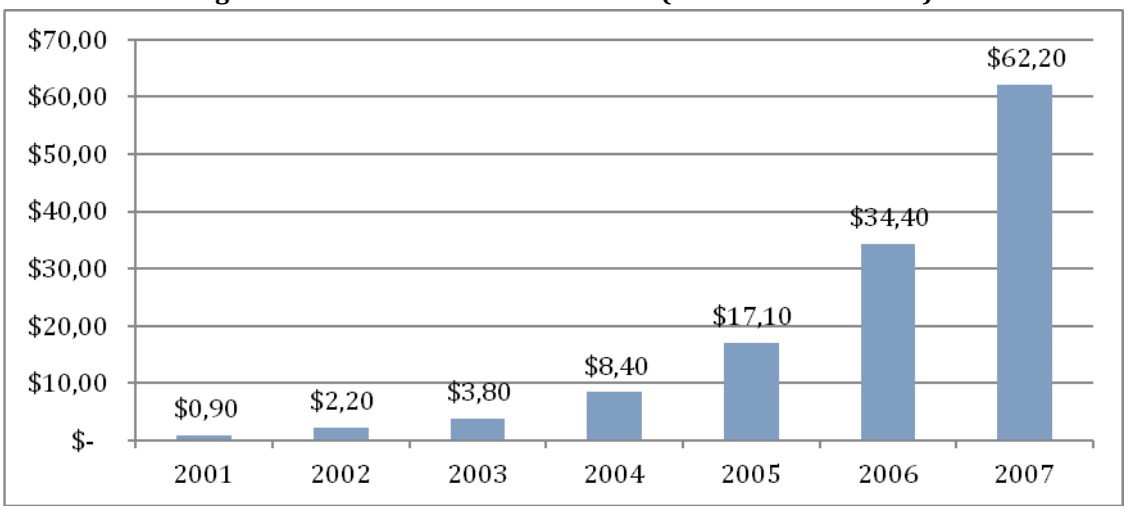



CDS spreads are used for more purposes than to serve solely as an insurance premium. Sovereign CDS contracts are bought for a number of other reasons. Credit default swaps also function as a trading instrument. Arbitrage trading, relative-value trading, and macro-risk hedging are all widely accepted reasons to buy a CDS. Spreads are also paid just because investors want to take a position in the market, based on what they expect is going to happen in the near future to the price of the CDS (Fontana and Scheicher 2010)[25].

[22] Hull, J. (2008). *Options, Futures, and other Derivatives,* p526-527
[23] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p9
[24] Wallison, P. (2009), *The Journal of Structured Finance*, 15 (2), p22
[25] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p9

The CDS market has grown extensively the last decade. Currently, credit default swaps are the most actively traded credit derivative (Hull 2008)[26]. The size of the swap market had grown to over $62 trillion dollar in 2007, and at this point the market should be even bigger. Credit default swaps are even more actively traded than the bonds of the companies and nations against which they provide default protection. Figure 2.2 shows the development of the CDS market between 2000 and 2007, according to a study by Greatrex (2009)[27].

**Figure 2.2: The size of the CDS market (in trillions of dollars)**




CDS spreads are now collected at a daily frequency, while many corporate bonds are only observed at a monthly frequency (Ericsson et al. 2009)[28]. The fact that spreads are collected so regularly is the biggest advantage that CDS spreads have over other credit risk measures. Since spreads are updated daily and because they are based on the supply and demand for the respective CDS contract, new information can be incorporated quickly into the CDS prices. If all investors thought rational, spreads would always have the correct price based upon the probability of a default occurring at the reference entity (Hull 2008)[29]. This concretely means that CDS spreads could potentially function as an accurate measure of sovereign risk.

The Lehman Brothers case confirmed the potential that CDS spreads have as credit risk indicators. Flannery et al. (2010)[30] studied the accuracy of corporate CDS spreads compared to corporate credit ratings for the past subprime crisis. They proved that the CDS spreads of Lehman Brothers increased a lot in the period leading up to the bankruptcy of the firm. Table 2.1 shows this development. The table shows that on 15-9-2008, the day that Lehman Brothers filed for bankruptcy, the CDS spreads of that bank were the highest among all investment banks.

[26] Hull, J. (2008). *Options, Futures, and other Derivatives,* p526
[27] Greatrex, C. (2008). Fordham University: Department of Economics Working Paper 05, p19
[28] Ericsson, J., Jacobs, K. and Oviedo, R. (2009). *Journal of Financial and Quantitative Analysis*, 44 (1), p111
[29] Hull, J. (2008). *Options, Futures, and other Derivatives,* p528-530
[30] Flannery, M., Houston, J. and Partnoy, F. (2010). *University of Pennsylvania Law Review*, 158, p2099-2102

Table 2.1 furthermore conveys that the credit ratings of Morgan Stanley and Merrill Lynch decreased in 2008, while the rating of Lehman Brothers remained constant. This means that there were indicators that the credit situation for Morgan Stanley and Merrill Lynch had worsened, but that the credit position of Lehman Brothers was supposedly unchanged. The at that point pending bankruptcy of Lehman Brothers proved that this assessment was completely off. This example therefore provides some proof that based on their ability to assess and predict credit risk; more weight should be given to (corporate) CDS spreads than to credit ratings.

**Table 2.1: CDS spreads and credit ratings prior to the Lehman Brothers bankruptcy**

| | **Goldman Sachs** | | **Morgan Stanley** | | **Merrill Lynch** | | **Lehman Brothers** | |
|---|---|---|---|---|---|---|---|---|
| **Date** | Spread | Rating | Spread | Rating | Spread | Rating | Spread | Rating |
| **2-1-06** | 21 | A | 22 | A | 21 | A | 25 | A |
| **1-1-07** | 21 | AA | 22 | AA | 16 | AA | 21 | A |
| **2-4-07** | 32 | AA | 33 | AA | 35 | AA | 38 | A |
| **10-7-07** | 41 | AA | 41 | AA | 42 | AA | 45 | A |
| **17-8-07** | 81 | AA | 83 | AA | 83 | AA | 150 | A |
| **1-1-08** | 67 | AA | 99 | AA | 126 | A | 120 | A |
| **14-3-08** | 240 | AA | 311 | AA | 339 | A | 448 | A |
| **12-9-08** | 198 | AA | 265 | A | 454 | A | 702 | A |
| **15-9-08** | 324 | AA | 458 | A | 343 | A | 703 | A |
| **16-9-08** | 420 | AA | 681 | A | 421 | A | | |
| **17-9-08** | 596 | AA | 909 | A | 530 | A | | |
| **18-9-08** | 491 | AA | 875 | A | 397 | A | | |
| **22-9-08** | 282 | AA | 422 | A | 271 | A | | |

This type of comparison isn't done between sovereign CDS spreads and credit ratings yet. If it is proven that sovereign CDS spreads can function as a credible and accurate measure of credit risk, CDS data can help alert regulators to problems at investments banks, insurance companies and sovereign entities. The regulators can then use this information to try to fix the credit problems that the respective countries face (Wallison 2009)[31]. Since credit default swaps can ultimately influence policy making as well, it is important that the spreads credibly convey all of the information available and that they are not over- or underpriced. Based on the previous arguments, it could be concluded that sovereign CDS spreads are a credible measure of sovereign risk, but the extensive use of credit default swaps has led to a lot of criticism as well. This is because there are quite a few disadvantages attached to CDS spreads. The critiques aren't

[31] Wallison, P. (2009), *The Journal of Structured Finance*, 15 (2), p23-24

particularly aimed at the way that the CDS as an instrument is constructed, but are directed more toward the use of CDS spreads by firms and investors. The concrete disadvantages of CDS spreads that currently make it a sub-optimal credit risk measure are the following:

1. *CDS spread increases lead to spill-over effects in nearby countries.*

When the CDS spread of a nation increases, this generally affects spreads of nearby nations as well. This means that even though the credit situation in a nation does not change, the CDS spread of that country can still go up because of what happens in other nations. This effect is disadvantageous for the use of CDS spreads as a credible measure of credit risk (Arezki and Candelon 2010)[32].

2. *The pro-cyclical impact of CDS spreads in times of crisis*

CDS spreads can put nations facing liquidity problems into a situation of even more financial distress. This is because higher CDS spreads increase the return investors want because of the increase in credit risk that rising CDS spreads convey. Increasing CDS spreads can therefore make it harder for countries in distress to obtain loans at favorable terms, which can put countries in even bigger financial problems. The ongoing European debt crisis has provided proof for this statement, as this is exactly what happened with Greece and other Mediterranean countries this year.

3. *Uncertainty about the effect that the CDS market has on the world economy.*

This uncertainty is generated mostly by the way that credit default swaps are traded. Since the CDS market is an over-the-counter market, trading is unregulated. This makes it hard to know how big the market actually is (Wallison 2009)[33]. The exact exposure that some protection sellers have is often unknown. It is important however that this information is available. This is because CDS dealers might sell so much CDS contracts that they are unable to fulfill their obligations to the protection buyers if the reference entity were to go bankrupt. This could then lead to a snowball effect in the financial world, impacting global stability to a large extent. The reason why the American insurance firm AIG had to be bailed out in 2008 was because of this potential causality (Sjostrom 2009)[34].

4. *The impact of other, non-credit risk related factors on the size of the CDS spread.*

This means that the amount of credit risk attached to a nation does not fully determine the size of the CDS spread of that country. Other variables also influence the CDS spread. One variable that plays a big role in determining the spread size is the liquidity of the CDS market. A market is supposed to be liquid if a CDS can be bought or sold quickly without affecting the spread.

[32] Arezki, R., Candelon, B. and Sy, A. (2010). *Finance & Development,* p36-37
[33] Wallison, P. (2009), *The Journal of Structured Finance*, 15 (2), p21
[34] Sjostrom, W. (2009). *Washington and Lee Law Review,* 66, p977-983

According to Tang and Yan (2007)[35], the CDS market is a relatively illiquid market, as the bid-ask spread is large and the market is not continuous. CDS spreads contain an illiquidity premium, and liquidity risk is incorporated in CDS spreads beyond the liquidity level (Tang and Yan 2007)[36]. The amount of liquidity in general and the liquidity risk can account for 20% of CDS spread variation. Since the liquidity factor is in no way related to the credit risk associated with the reference entity, this variable affects the credibility of CDS spreads as a measure of sovereign credit risk. In order for CDS spreads to be a better proxy of sovereign risk, the CDS pricing model must be adjusted to take the liquidity effects into account (Tang and Yan 2007)[37].

Because of the disadvantages attached to the CDS spreads there are various proposals for improvements and reforms of the CDS market. Plans already exist for a clearinghouse or exchange for credit default swaps, while other forms of regulation are suggested as well (Wallison 2009)[38]. These ideas could solve some of the negative aspects of credit default swaps, which can ultimately make it a very solid measure of sovereign risk.

### 2.2.2 Sovereign Credit Ratings

Most of the existing research regarding sovereign credit measures studies the impact of credit ratings. A credit rating describes the creditworthiness of a corporate or sovereign bond. The credit ratings are relative as the countries are compared with each other (Mellios and Blanc 2006)[39]. As mentioned in Chapter 1, credit ratings are far from optimal when it comes to accurately reflecting the credit situation of a nation. Corporate credit ratings already caught a lot of flack during the subprime-crisis because of their inability to foresee the upcoming crisis, and recently a lot of criticism again faced the credit rating agencies because of the way that they assess sovereign credit ratings.

Sovereign credit ratings can have a big influence on the terms for which a country can borrow on the international capital market (Mellios and Blanc 2006)[40]. A lowered credit rating of a sovereign increases the interest rate that the sovereign has to pay when it wants to obtain a new loan (Reisen and Von Maltzan 2006)[41]. High credit ratings can thus be very beneficiary for a country. This can have the effect that the rating agencies purposely keep ratings higher than they should be, because they have to take the political and economic impact of a downgrade into account as well in their decisions. Rating agencies take a lot of aspects into account for their

[35] Tang, D. and Yan, H. (2007). University of South Carolina Working Paper, p7
[36] Tang, D. and Yan, H. (2007). University of South Carolina Working Paper, p29
[37] Tang, D. and Yan, H. (2007). University of South Carolina Working Paper, p29
[38] Wallison, P. (2009), *The Journal of Structured Finance*, 15 (2), p29
[39] Mellios, C. and Paget-Blanc, E. (2006). *European Journal of Finance*, 12 (4), p365
[40] Mellios, C. and Paget-Blanc, E. (2006). *European Journal of Finance*, 12 (4), p361
[41] Reisen, H. and Von Maltzan, J. (1998). *Intereconomics*, 33 (2), p7

credit risk assessments. The solvency situation, political system, social cohesion, and interdependence of a country with international financial systems are all seen as important in the derivation of the credit rating of a sovereign entity (Afonso 2003)[42]. Because investors depend on credit ratings for their own evaluations of sovereign credit risk, it is the job of the rating agencies to make sure that the respective ratings of the countries are accurate. This responsibility to the public can lead to conflicts of interests with the sovereign entities because a rating that is higher than justified is very advantageous for a country in obtaining loans (IMF 2010)[43].

The accuracy of sovereign credit ratings has been the subject of a lot of papers. The reigning opinion in academic research is that credit ratings are not as accurate as the agencies convey. One of the reasons for this is that rating agencies use smoothing practices in their assessments. The agencies don't want their ratings to fluctuate a lot. This is because quick rating reversals negatively affect the reputation of a rating agency. Agencies thus try to avoid being too quick in their rating up- or downgrades, leading to less accurate credit ratings (Altman and Rijken 2006)[44]. The credit rating agencies' achieve stable ratings by using the "Through-The-Cycle" perspective (TTC), instead of the "Point-In-Time" view (PIT). Measuring TTC implies that the agencies focus more on the long term, while the PIT approach also takes the short term credit risk fluctuations into account (IMF 2010)[45]. Since investors look at their investments using the PIT-perspective, there are discrepancies in the way that credit ratings are perceived. Altman and Rijken (2006)[46] prove that the TTC-method not only delays rating migrations for both upgrades and downgrades, it also affects the accuracy of the predictions. If credit rating agencies' would determine their ratings using the PIT-view, more weight can be given to what the credit ratings imply for the short term.

Sovereign credit ratings can also influence financial stability, just like sovereign CDS spreads. Mora (2006)[47] mentions that credit ratings can work pro-cyclical in times of crisis. Rating agencies were not able to anticipate past crisis situations and afterwards downgraded the ratings more than was necessary. This intensified the liquidity problems of sovereign entities that faced a financial crisis. Sovereign downgrades also do not only negatively impact the nations in turmoil; they affect the financial situation of nearby countries as well (IMF 2010)[48].

[42] Afonso, A. (2003). *Journal of Economics and Finance*, 27 (1), p60
[43] International Monetary Fund. (2010). *Global financial stability report October 2010,* p94
[44] Altman, E. and Rijken, H. (2006). *Financial Analysts Journal*, 62 (1), p54
[45] International Monetary Fund. (2010). *Global financial stability report October 2010,* p90
[46] Altman, E. and Rijken, H. (2006). *Financial Analysts Journal*, 62 (1), p67-68
[47] Mora, N. (2006). *Journal of Banking & Finance*, 30, p2042
[48] International Monetary Fund. (2010). *Global financial stability report October 2010,* p88

### 2.2.3 Bond yield spreads and Default probabilities

Another variable that can be used as an indicator of sovereign credit risk is the bond yield spread of a country. Sovereign bond yield spreads represent the risk premium that a nation has to pay to obtain loans (Baek et al. 2005)[49]. For sovereigns, high risk premiums indicate an increasing probability that the nation might not be able to repay its future obligations. The size of the yield spread can thus serve as a proxy of sovereign credit risk. Just like CDS spreads, bond yields spreads are a market-assessed indicator. They can adjust relatively quickly to new information. According to Baek et al. (2005)[50], they function better than credit ratings because of this. Bond yield spreads do adjust slower than CDS spreads to changing market conditions. This is because as stated in Section 2.2.1, CDS spreads are adjusted on a daily basis while bond yields are changed at a monthly frequency. This gives CDS spreads an edge because they can adapt more frequently than bond yield spreads to credit risk changes. The study by Zhu (2004)[51] confirms that CDS spreads work better than bond yields in assessing credit risk. He concludes that corporate CDS spreads and bond yield spreads move together in the long run, but that on the short term CDS spreads move ahead of the bond yields in terms of adjusting to changing credit conditions. This difference isn't proven for sovereign CDS spreads and bond yields, but because the corporate and sovereign CDS market work the same way it is reasonable to assume that this conclusion will hold for the sovereign market as well.

Even though the comparison done by Zhu already proves that bond yield spreads are not optimal when it comes to their use as credit risk indicators, some additional negative aspects attached to bond yield spreads are also worth mentioning. These disadvantages are the following:

1. *Bond yield spreads are highly contagious.*

Increasing bond yield spreads of one country often lead to higher bond yield spreads of neighboring countries, even though economic fundamentals mostly don't justify these increases (Baek et al. 2005)[52].

2. *Risk attitudes play a big part in determining the size of the yields.*

The impact of risk attitudes has a negative effect on the accuracy of bond yields spreads as a sovereign credit risk indicator (Baek et al. 2005)[53]. This is because this variable is not related to sovereign risk, which makes the impact of this variable more or less the same as the impact of the liquidity of the CDS market on the accuracy of CDS spreads.

[49] Baek, I., Bandopadhyaya, A. and Du, Chan. (2005). *Journal of International Money & Finance*, 24, p534
[50] Baek, I., Bandopadhyaya, A. and Du, Chan. (2005). *Journal of International Money & Finance*, 24, p535
[51] Zhu, H. (2006). *Journal of Financial Services Research, 29*, p11-14
[52] Baek, I., Bandopadhyaya, A. and Du, Chan. (2005). *Journal of International Money & Finance*, 24, p536-553
[53] Baek, I., Bandopadhyaya, A. and Du, Chan. (2005). *Journal of International Money & Finance*, 24, p545

When comparing the respective characteristics of the credit risk measures that are discussed above it is clear that there is no right answer regarding to which measure should be used as a leading proxy for sovereign credit risk. All of the mentioned credit risk measures have their pros and cons and because a dysfunctional system shouldn't be replaced with another broken one, sovereign credit ratings have remained the most used credit risk indicator up to this point (Flannery 2010)[54]. The common belief is that credit default swaps can in the future potentially be the most optimal credit risk measure, although improvements are necessary. It is critical that the spillover effects of CDS spread increases are minimized, and that a solution is found to take the impact of the CDS market liquidity on the spreads better into account. Furthermore it is necessary that the CDS market becomes regulated, as this way the CDS market can be monitored better (Wallison 2009)[55].

## *2.3 Determinants of sovereign CDS spreads*

### 2.3.1 The selection of the potential CDS spread determinants

This section looks into the variables that determine the size and variability of the measures of sovereign risk. Only a few studies try to find the determinants of sovereign CDS spreads, while numerous studies are done to derive the factors that impact credit ratings and default probabilities. All of the respective factors that are studied in each article are noted to see which ones are supposed to be important in determining the size of a credit risk measure. These factors can be seen in Table 2.2. The table shows that many factors are studied in multiple articles as potential explanatory variables of sovereign risk. The impact of the Inflation variable for example is tested in four different studies. Other factors that are studied a lot are the Real Exchange rate and the Debt/GDP ratio. Eleven of the variables named in Table 2.2 are selected to function as independent variables for this thesis. These variables are listed in Table 2.3. The only factor that is studied in this thesis and not mentioned in previous literature regarding sovereign credit risk measures is the Household Debt/GDP ratio. This ratio is included because Reinhart and Rogoff (2008)[56] mentioned that the amount of domestic debt in a nation is one of five drivers of a credit crisis. Since household debt is a part of domestic debt, along with business debt, it is interesting to study the impact of the Household Debt/GDP ratio on the respective sovereign CDS spreads of the Eurozone entities. The amount of business debt of a nation is not studied because the necessary statistics for this variable could not be obtained.

Nearly every selected variable represents some sort of driver or factor that is known to influence sovereign risk and mentioned in Section 2.1. The impact of every key fundamental that

[54] Flannery, M., Houston, J. and Partnoy, F. (2010). *University of Pennsylvania Law Review*, 158, p2087
[55] Wallison, P. (2009), *The Journal of Structured Finance*, 15 (2), p29
[56] Reinhart, C. and Rogoff, K. (2008). *This time is different: Eight Centuries of Financial Folly,* p119

can convey the strength of an economy is studied for this thesis. The effect of factors showing the competitiveness, growth, and openness of an economy is measured, along with the impact of variables that convey the chance that an economy will face liquidity issues or the dependence of a nation on foreign savings. The only studied factor that isn't macro-economic by nature is the Risk Appetite. The reason why the effect of this variable on sovereign spreads is still tested is because this factor can be very important in determining the accuracy of a CDS spread as a credit risk indicator. Fontana and Scheicher (2010)[57] already indicated that the Risk Appetite of investors can explain some of the CDS variation. The Risk Appetite variable can have a huge negative influence on the credibility of CDS spreads as a sovereign credit risk indicator, because the variable is not related to the credit risk of the entity underlying the CDS contract. This means that the impact of this variable on the CDS spread accuracy is potentially the same as the impact of the market liquidity. As discussed in Section 2.2.1, the liquidity factor can determine up to 20% of CDS spreads, even though this variable doesn't influence the credit condition of a sovereign entity. The impact of the liquidity variable is not studied again in this paper. This is because multiple authors (Tang and Yan 2007[58] and Ashcraft and Santos 2007[59]) already proved the significant impact of this variable on CDS spreads.

It is reasonable to assume that a lot of the selected explanatory variables will significantly affect the size of the CDS spreads. The reason for this is that the respective credit risk measures are positively correlated with each other. The credit ratings of Greece for example can explain a large part of the CDS spread variation for that nation (IMF 2010)[60]. This connection is also proven between default probabilities and credit ratings (Georgievska et al. 2008)[61]. The explanatory variables that have a significant impact on credit ratings and default probabilities are thus expected to influence the sovereign CDS spreads as well.

[57] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p18
[58] Tang, D. and Yan, H. (2007). University of South Carolina Working Paper, p52
[59] Ashcraft, A. and Santos, J. (2009). *Journal of Monetary Economics, 56*, p19-21
[60] International Monetary Fund. (2010). *Global financial stability report October 2010,* p106-107
[61] Georgievska, A.; Georgievska, L.; Stojanovic, A. and Todorovic, N. (2008). *Journal of Applied Statistics, 35*, p1031

**Table 2.2: Determinants of sovereign credit risk measures (sorted based on year published)**

| Author | Year | Dependent Variable | Explanatory variables | |
|---|---|---|---|---|
| **Avery and Fisher** | 1992 | Default probability | Economic growth | Imports/GDP |
| | | | Debt/export | |
| **Haque et al.** | 1998 | Credit rating | Risk-free rate | GDP Growth |
| | | | Export growth | Inflation |
| | | | Current Account/GDP | Real Exchange rate |
| | | | Reserves/Imports | Debt/GDP |
| **Catao and Sutton** | 2002 | Default probability | Policy volatility | GDP Growth |
| | | | Real Exchange rate | Debt/Export |
| | | | Interest rate | Reserves/Debt |
| **Afonso** | 2003 | Credit Rating | GDP per capita | Default history |
| | | | Debt/Export | GDP Growth rate |
| | | | Inflation | |
| **Baek et al.** | 2005 | Bond yield spread | Risk appetite | Inflation |
| | | | Economic growth | Real Exchange rate |
| | | | Current account/GDP | Reserves/Imports |
| | | | Debt/GDP | |
| **Mellios and Blanc** | 2006 | Credit Rating | Reserves/Imports | Inflation |
| | | | Real Exchange rate | External debt |
| | | | Government Revenue | Default History |
| **Georgievska et al.** | 2008 | Default probability | Debt/GDP | Imports/GDP |
| | | | Exports/GDP | GDP growth |
| | | | Current Account/GDP | Reserves/GDP |
| **Fontana and Scheicher** | 2010 | Sov. CDS spread | Risk-free rate | External debt |
| | | | Risk appetite | Equity volatility |
| | | | Corporate CDS spread | Bid-ask spread |

**Table 2.3: Identified potential determinants of CDS spreads**

| Potential explanatory variables of Credit Default Swaps | | | |
|---|---|---|---|
| Economic Growth | Debt/GDP | Debt/Export | Reserves/Debt |
| Current Account/GDP | Reserves/Import | Imports/GDP | Inflation |
| Risk-free rate | Risk Appetite | Real Exchange rate | Household debt |

### 2.3.2 The expected impact of the selected CDS spread determinants

The selected explanatory variables all influence the amount of credit risk that is attached to a country in a different way. The impact that these variables should have on sovereign credit risk in general and on CDS spreads is discussed next for each variable individually:

1. *Current Account/GDP:* Large current account deficits can put nations into problems when they have to service their debt. An increase in this ratio decreases the countries dependence on foreign savings, which reduces their foreign debt and this in turn should decrease default probabilities and CDS spreads (Georgievska et al. 2008)[62].
2. *Debt/Export:* A higher Debt/Export ratio means that the country can cover less debt with their exports. This means that a nation has less room to service their debts, which should increase a country's credit risk and CDS spread (Catao and Sutton 2002)[63].
3. *Debt/GDP:* If debts go up it comprises a larger part of the GDP of a nation. The higher this ratio is, the higher the probability of an upcoming liquidity crisis. This ratio is thus positively related to the CDS spread (Mellios and Blanc 2006)[64].
4. *Economic growth:* When the GDP of a country goes up this indicates that there is economic growth. This means that a nation is doing relatively well, which should decrease the credit risk associated to that country and thus its CDS spread as well (Baek et al. 2005)[65].
5. *Household Debt/GDP:* High household debt levels can put more pressure on the external debt obligations of a nation. Because both domestic and external debt has to be paid from the same revenue pool, increasing household debts can put a nation into bigger liquidity problems (Reinhart and Rogoff 2008)[66]. This means that an increase in the Household Debt/GDP ratio of an economy increases the credit risk attached to that nation, which should lead to higher CDS spreads.
6. *Inflation:* This factor has a positive impact on the CDS spread. High inflation numbers convey instability while a low inflation rate tends to be founded by solid monetary policies. Because of this reasoning, a high inflation rate should increase the credit risk attached to a nation (Mellios and Blanc 2006)[67].
7. *Import/GDP:* This ratio relates to the openness of an economy. A high Imports/GDP ratio means that a country is very open, which concretely means that it is relatively more vulnerable to foreign shocks. This leads to higher probabilities of default, and because of that an increase of this ratio should lead to higher CDS spreads (Georgievska et al. 2008)[68].
8. *Real exchange rate:* This factor conveys how competitive a country is in terms of trade. A devaluation of a currency signals uncertainty about an economy, which can generate further depreciations. As a result, investments in that particular country become more risky. This

[62] Georgievska, A.; Georgievska, L.; Stojanovic, A. and Todorovic, N. (2008). *Journal of Applied Statistics, 35*, p1037
[63] Catão, L. and Sutton, B. (2002). International Monetary Fund Working Paper 149, p16-18
[64] Mellios, C. and Paget-Blanc, E. (2006). *European Journal of Finance*, 12 (4), p363
[65] Baek, I., Bandopadhyaya, A. and Du, Chan. (2005). *Journal of International Money & Finance*, 24, p544
[66] Reinhart, C. and Rogoff, K. (2008). *This time is different: Eight Centuries of Financial Folly,* p119
[67] Mellios, C. and Paget-Blanc, E. (2006). *European Journal of Finance*, 12 (4), p363
[68] Georgievska, A.; Georgievska, L.; Stojanovic, A. and Todorovic, N. (2008). *Journal of Applied Statistics, 35*, p1036

causes higher risk premiums. A devaluation of the exchange rate of a country should therefore increase the price of the CDS spreads as it conveys a doubtful credit position (Baek et al. 2005)[69].

9. *Reserves/Debt:* If this ratio increases this means that a country is better able to service its debt using their official reserves. This lowers a countries credit risk and thus this variable should have a negative relationship with the sovereign CDS spread (Catao and Sutton 2002)[70].
10. *Reserves/Import:* This ratio works the same way as the Reserves/Debt ratio. If this ratio is high, it means that there are more reserves available to service foreign obligations, leading to a better credit position and lower CDS spreads (Mellios and Blanc 2006)[71].
11. *Risk Appetite:* an increasing Risk Appetite means that investors are becoming more willing to bear credit risks themselves. This should lower the demand of CDS spreads and thus its price. Because of this causality, the Risk Appetite variable has to be negatively related to the sovereign CDS spread (Fontana and Scheicher 2010)[72].
12. *Risk-free rate:* As an increasing Risk-free rate leads to higher growth rates and lower option prices, this factor has a negative impact on the amount of credit risk associated with the sovereign entity. The Risk-free rate should therefore be negatively related to CDS spreads (Fontana and Scheicher 2010)[73].

## *2.4 Hypotheses*

Based on the research question and the selected explanatory variables, three distinct hypotheses are derived. The first two hypotheses focus on the specific impact that the explanatory variables can have on the CDS spreads, while the third hypothesis is aimed at the abnormal returns surrounding the CDS spreads. Hypothesis 1 focuses on the pooled sample containing the CDS spreads of the selected Eurozone countries, while Hypothesis 2 is directed at the countries individually. By doing so, results can be compared to see if the impact of the variables on the spreads for a specific country somehow differs from the general impact that those same variables have on the pooled sample. Hypothesis 3 then provides an extra check to see whether the CDS spreads do indeed adjust immediately to changes in the values of the explanatory variables. If it is proven that the selected factors have a significant impact on the CDS spreads, it is very well possible that there are significant CDS abnormal returns surrounding the

[69] Baek, I., Bandopadhyaya, A. and Du, Chan. (2005). *Journal of International Money & Finance*, 24, p544
[70] Catão, L. and Sutton, B. (2002). International Monetary Fund Working Paper 149. p16-18
[71] Mellios, C. and Paget-Blanc, E. (2006). *European Journal of Finance*, 12 (4), p363
[72] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p16
[73] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p16

announcement of new values for the explanatory variables. Formally, the three hypotheses are as follows:

Hypothesis 1:

$H_0$: The explanatory variables used in the regressions do not have a significant impact on the CDS variability for the pooled sample of Eurozone sovereign entities

Hypothesis 2:

$H_0$: The explanatory variables used in the regressions do not have a significant impact on the CDS variability for all of the individual Eurozone sovereign entities

Hypothesis 3:

$H_0$: There is no abnormal return on the CDS spreads surrounding the announcement of new values for the explanatory variables for each Eurozone sovereign entity.

# 3 Methodology & Data description

*This chapter describes the techniques used to test the three hypotheses. The first two hypotheses are tested using regression analysis, while the third one is tested by conducting an event study. All of the methods used are discussed in detail below, providing an argumentation why the selected methods are appropriate. The second part of the chapter discusses the data that is used as input in the study. Data sources are named, along with the characteristics of the dataset and the criteria that it has to meet. Descriptive statistics are then presented for all of the variables included in the study and finally a correlation analysis is done to find relationships among the CDS spreads of the respective sovereign entities.*

## *3.1 Methodology*

### 3.1.1 The use of regression analysis

Since various variables have to be tested against the CDS spread for the first two hypotheses, a model is needed that can test the impact of multiple variables. Regression analysis is done in order to test Hypothesis 1 and 2. Regression analysis works by testing how the value of the underlying dependent variable, in this case the CDS spread, varies if any of the underlying independent variables change (Brooks 2008)[74]. A multivariate regression is employed for this thesis, because the equations contain more than one independent variable. The basic form of the regression equation is as follows:

$$y = \alpha + \beta_1 x_1 + .. + \beta_p x_p + \mu_t \quad (3.1)$$

In this function y is the dependent variable, $\alpha$ is the constant, $\beta_p$ represent the coefficients of the independent variables and $\mu_t$ is the standard error. The coefficients convey the impact that a certain variable has on the CDS spread, while the standard error is added as a random disturbance term (Brooks 2008)[75]. This term is added because otherwise the model would fit the data perfectly and that isn't realistic[76].

Different regression methods are chosen in order to accurately model the impact that the various variables have. This is because the data that is used as input for the variables differs for

[74] Brooks, C. (2008). *Introductory Econometrics for Finance*, p28-30
[75] Brooks, C. (2008). *Introductory Econometrics for Finance*, p30
[76] A model that fits the data perfectly is unrealistic for a number of reasons. For one, some determinants of the dependent variable might be omitted from the sample. Secondly, there can be errors in the way that the dependent variable itself is modeled. Thirdly, there might be random outside influences like a terrorist attack of which the impact that cannot be modeled (Brooks 2008, p30).

the selected hypotheses. The respective methods are chosen based upon the properties of the data. The main reason why different methods have to be used for Hypothesis 1 and 2 is that the inputs used to test Hypothesis 1 are based on a pooled sample, while the second hypothesis is tested using the data for all of the sixteen sovereign entities individually. For both hypotheses, multiple different regressions are done. This is because the data for some variables are updated on a daily basis, while for other variables the data are adjusted only on a monthly basis. The impact of the monthly updated variables is tested in different regressions. In these regressions, weighted averages of the CDS spreads for each month are used to serve as dependent variables. The reason for this is that CDS spreads are a daily updated factor, which means that they have to be adjusted to be able to accurately model the impact of the monthly updated variables on the spreads. All of the specific regressions are discussed in more detail in the next section for the respective hypotheses.

### 3.1.2 Hypothesis 1: Pooled sample regression analysis

The regression method that has to be selected to test Hypothesis 1 has to be able to accurately predict the impact of the explanatory variables based on a pooled dataset. The respective data statistics for the twelve variables are pooled because the data has both cross-sectional and time-series elements, as the input for the variables is based on data of 16 different sovereign entities and is measured through multiple points in time. This means that the input is panel data (Brooks 2008)[77]. Based on this panel data, four different regressions are done. The first regression tests the impact of the daily adjusted variables, which are the Real Exchange rate, Risk free rate and Risk Appetite. The second regression studies the impact of the monthly adjusted ratios that are based on sovereign external debt. These are the Debt/GDP ratio, Debt/Export ratio and Reserves/Debt ratio. The third regression tests the effect of the Household Debt/GDP ratio. The fourth and final regression focuses on the impact of the remaining monthly adjusted variables, like the Economic Growth and the Inflation. The reason why the influences of the ratios that are based on external debt and household debt aren't tested along with the other monthly adjusted variables is because the amount of cross-sections has to be the same for all of the explanatory variables (Brooks 2008)[78]. Since the debt statistics could not be obtained for all of the countries, the amount of cross sections available for each variable differs and therefore the impact of the monthly updated variables cannot be tested collectively.

To test the impact of panel data using a regression analysis, both the fixed effects model and the random effects model can be used. The random effects model is appropriate when the entities in the sample can be thought of as having been randomly selected from the population,

[77] Brooks, C. (2008). *Introductory Econometrics for Finance*, p487
[78] Brooks, C. (2008). *Introductory Econometrics for Finance*, p490

while the fixed effects model normally can be used if the entities in the sample effectively constitute the population. The properties of the data determine which model is the best selection to test the hypothesis. The random effects model can be employed if the error term of the model is uncorrelated with all of the explanatory variables; otherwise the fixed effects model should be used (Brooks 2008)[79]. The Hausman test[80] is performed to see whether the error terms are correlated or not. The results of this test can be seen in Table 2.1. The error terms of the variables are considered to be correlated if the P-value of the test is below 0,05.

**Table 2.1: Hausman test results for Hypothesis 1**

| Independent variables used | Hausman test P-value |
|---|---|
| **Daily adjusted variables** | 0,6571 |
| **Monthly adjusted external debt ratios** | 0,0000 |
| **Household debt/GDP ratio** | 0,0122 |
| **Remaining monthly adjusted variables** | 0,7608 |

The table shows that the P-value is below 0,05 for the regression testing the impact of the three external debt ratios and for the regression that tests the Household Debt/GDP ratio. As these P-values indicate correlated error terms this makes it not correct to run these regressions using the random effects model. These regressions are therefore done using the fixed effects model. The P-values from the Hausman test are above 0,05 for the regression based on the daily adjusted variables and for the regression based upon the remaining monthly adjusted variables. This means that the error terms for these regressions are uncorrelated which makes the random effects model the right model to use for these regressions.

The difference between the random effects and fixed effects model lies in the disturbance term of the models. The fixed effects disturbance term consists of an individual specific effect, $\mu_i$, and a remaining disturbance factor, $v_{it}$ (Brooks 2008)[81]. The random effects disturbance term is measured by $\omega_{it}$. This term is based on a random variable $\in_i$, which measures the deviation of each variable's intercept term from the common intercept $\alpha$, and the individual error term $\vartheta_{it}$ (Brooks 2008)[82]. How these specific models look for the regressions done in this thesis can be seen in the following functions:

Fixed Effects equation

$$CDS_i = \alpha + \beta_1 Debt/Exp_{it} + \beta_2 Res/Debt_{it} + \beta_3 Debt/GDP_{it} + \mu_i + v_{it} \quad (3.2)$$

[79] Brooks, C. (2008). *Introductory Econometrics for Finance*, p500
[80] Results from the Hausman test indicate whether variables are endogenous or exogenous. If they are exogenous, this means that the error terms of the variables are uncorrelated (Brooks 2008, p273-274).
[81] Brooks, C. (2008). *Introductory Econometrics for Finance*, p490-491
[82] Brooks, C. (2008). *Introductory Econometrics for Finance*, p498

$$CDS_i = \alpha + \beta_1 Household\ Debt/GDP_{it} + \mu_i + v_{it} \quad (3.3)$$

Random Effects equations

$$CDS_i = \alpha + \beta_1 Riskfree_{it} + \beta_2 RealExch_{it} + \beta_3 RiskAppetite_{it} + \omega_{it} \quad (3.4)$$

$$CDS_i = \alpha + \beta_1 CPI_{it} + \beta_2 CurrAcc/GDP_{it} + \beta_4 GDP_{it} + \beta_5 Imp/GDP_{it} + \beta_6 Res/Imp_{it} + \omega_{it} \quad (3.5)$$

where $\omega_{it} = \epsilon_i + \vartheta_{it}$

The explanatory variables used in all three equations are comprised with data from all of the countries. These nations are represented by $i$ in the equation, while $t$ stands for the specific dates attached to the respective values of the variables. $\beta_i$ measures coefficients attached to the different explanatory variables in each equation.

### 3.1.3 Hypothesis 2: Country-specific regression analysis

The regression analysis used to study the CDS spreads of the individual countries differs from the method used to test the first hypothesis. This is because the regressions are now done for each country individually, instead of using a pooled sample to test the total impact for all of the countries. A total of 31 regressions are performed to test Hypothesis 2, with a maximum of four regressions for each sovereign entity. For some countries a few possible regressions could not be done because either the necessary data was missing or there weren't enough observations available. This is explained more in Section 3.2, in which the properties of the data are discussed.

The regressions each use exactly the same underlying variables as the regressions done to test the impact for the pooled sample. For each country, the first regression thus tests the daily adjusted factors like the Risk-free rate as explanatory variables, while the second regression studies the impact of the external debt ratios of the sovereign countries. The third regression tests how the Household Debt/GDP factor influences the CDS spreads and the fourth and final regression studies the impact of the remaining monthly adjusted explanatory variables. By using this methodology, the results of the pooled sample regression for an explanatory variable can easily be compared with the results for that same explanatory variable from the regressions done for each country individually.

The following four regressions are done for each sovereign entity:

$$CDS_t = \alpha + \beta_1 Riskfree_t + \beta_2 RealExch_t + \beta_3 RiskAppetite_t + \mu_t \quad (3.6)$$

$$CDS_t = \alpha + \beta_1 Debt/GDP_t + \beta_2 Debt/Exp_t + \beta_3 Res/Debt_t + \mu_t \quad (3.7)$$

$$CDS_t = \alpha + \beta_1 Household\ Debt/GDP_t + \mu_t \quad (3.8)$$

$$CDS_t = \alpha + \beta_1 CPI_t + \beta_2 CurrAcc/GDP_t + \beta_3 GDP_t + \beta_4 Imp/GDP_t + \beta_5 Res/Imp_t + \mu_t \quad (3.9)$$

As with the functions used to test the first hypotheses, $t$ stands for the respective dates matching the values of the variables, while $\alpha$ conveys the constant and $\beta_i$ represents the coefficients of the variables.

The models that are used to estimate the regressions are selected based upon various statistical tests run in EVIEWS. All of the regressions are first done using the commonly used OLS-model[83]. The Ramsey RESET test[84] is then used to see whether OLS is indeed the correct form for the respective regressions. The results of the RESET test for each regression can be seen in Tables 2-5 in the Appendix. The RESET test confirms that OLS is the right functional form for nearly half of the regressions, which indicates that another model is required for the other regressions. For these regressions, either the non-linear ARCH or GARCH[85] method is used. Theoretically, the ARCH model can be used if the conditional variance term depends only on previous values of the squared error, while the GARCH model has to be used if the variance term depends on own lags as well (Brooks 2008)[86]. EVIEWS tests proved that for each regression that couldn't be done using OLS, one of these models could be employed. The amount of lags that is used for each model is also based on EVIEWS tests. For most of these regressions the used method is ARCH(1) or GARCH(1,1), but for some regressions ARCH(2) or GARCH(2,2) is selected. This concretely means that the GARCH(1,1) model for example is employed for the countries where the variance term depends on one of its own lags and the previous value of the squared error, whereas the GARCH(2,2) model is used for the countries where the variance term depends on two lags and two previous values of the squared error. The respective model that is used for each regression can be seen in Appendix tables 2-5.

[83] OLS is the most used method by academics to determine the coefficients for the explanatory variables and to fit a line to the data. The standard form of the OLS-model is as shown in equation 3.1. The model has a linear nature. It works by taking each distance from a data point to the line, squaring it, and then minimizing the total sum of the areas of squares (Brooks 2008, p31).

[84] This test models whether the used regression method is the right functional form. A model has the correct functional form is the P-value of the RESET test is above 0,05. If this is not the case, another type of model should be selected (Brooks 2008, p174-178)

[85] Both of these methods are also commonly used in finance. The reason for this is that it can model for some factors that the linear model cannot deal with. The ARCH and GARCH methods can take both autocorrelation in volatilities and heteroskedastic error terms into account (Brooks 2008, p386-p394).

[86] Brooks, C. (2008). *Introductory Econometrics for Finance*, p386-392

The difference between OLS, ARCH(1) and GARCH(1,1) lies in the error term, $\mu_t$. For OLS, this is just a random disturbance term, but for ARCH(1) and GARCH(1,1) this term depends on some more factors. The error term for these models is also based upon the conditional variance, $\sigma_t^2$. The next equations show how the conditional variances are calculated respectively:

$$ARCH(1)\ \sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 \tag{3.10}$$

$$GARCH(1,1)\ \sigma_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \beta \sigma_{t-1}^2 \tag{3.11}$$

The equations show that both variance terms are based on its own squared error term, $\mu_{t-1}^2$, but that the GARCH(1,1) conditional variance also depends on its own squared lag, $\sigma_{t-1}^2$.

### 3.1.4 Hypotheses 3: Abnormal return event study

The third and final hypothesis is tested by using the event study methodology. According to DataStream, new data for the macro-economic variables is announced for some of the variables at the middle of the month and for some at the end of the month. Based on this information, CDS spreads are studied for both dates to see whether the information that is conveyed in these announcements is immediately incorporated in the prices. This is done by testing the abnormal returns of the spreads. An event window of 3 days is selected to test the announcement effect, as CDS spreads might not adjust immediately to the new information.

The Constant Mean Return Model and the Market Model are used to calculate the abnormal returns surrounding the announcements. These models are based on relatively old fundamentals, but are nevertheless still used often in financial studies (MacKinlay 1997)[87]. The Constant Mean Return model uses Mean Adjusted abnormal returns, which can be calculated by taking the difference between the CDS return on the announcement date and the average return over the entire period. The Market Model uses Market Adjusted abnormal returns. This return is the difference between the return on the announcement date and the return on a market index on the same date (Brown and Warner 1985)[88]. The Mean Adjusted average abnormal returns are compared with the average return of the CDS spread in the entire sample period, while the Market Adjusted average abnormal returns are compared with the average return of the market index during that same sample period. Even though the calculations underlying the models are relatively simple, they achieve the same results as newer, more sophisticated methods

[87] MacKinlay, A. (1997). *Journal of Economic Literature*, 35 (1), p17-18
[88] Brown, S. and Warner, J. (1985). *Journal of Financial Economics*, 14 (1), p7

(MacKinlay 1997)[89]. The exact functions used to derive the abnormal returns for the respective models are the following:

$$Mean\ Adjusted\ AR_{i\tau} = R_{i,t} - K_i \tag{3.12}$$

$$Market\ Adjusted\ AR_{i\tau} = R_{i,t} - R_{m,t} \tag{3.13}$$

In these equations $AR_{i\tau}$ represents the abnormal return, $R_{i,t}$ is the return on day t for country $i$ and $K_i$ is the average return in the whole sample period. $R_{m,t}$ is the return on the market index $m$ on day $t$. The index that is used in this study to calculate the Market adjusted abnormal return is the DataStream Sovereign CDS Index.

The Student's T-test[90] is used to test whether the average abnormal returns on the announcement dates are significantly higher or lower than the average returns over the whole sample period (Newbold et al. 2006)[91]. T-values are calculated for day 0-1, and day 1-3 of the event window. This is done to see whether CDS spreads adjust immediately to the announcements or if this adjustment is delayed by a few days. The T-tests are done for all of the Eurozone countries. The T-test results show for which countries there are significant abnormal returns surrounding macro-economic data announcements and for which countries these effects are not present. If the models are correct, the Constant Mean Returns Model and Market Model should yield the same T-test results for the respective event windows.

## *3.2 Data description*

### 3.2.1 Collection of the data and respective sources

Data for 16 Eurozone countries are collected to be able to test the hypotheses and derive robust results. The main source that is used to collect the data is Thomson DataStream. CDS spreads based on a contract maturity of 5 years are selected to serve as dependent variables for this thesis. Spreads with this maturity are chosen since 5-year spreads are used the most for credit default swaps, and also because the common contractual maturity of CDS spreads lies between 1 and 10 years (Fontana and Scheicher 2010)[92]. CDS spreads are available for most countries since December 2007 in DataStream. This date is therefore used as the starting point for this research.

[89] MacKinlay, A. (1997). *Journal of Economic Literature*, 35 (1), p17
[90] The Student's T-test compares the value of the test statistic, which in this case is based upon the abnormal return and the standard deviation, with a critical value that is based upon some sort of significance level. If the T-value lies above this critical value, the null hypothesis can be rejected (Newbold et al. 2006, p290).
[91] Newbold, P., Carlson, W. and Thorne, B. (2006). *Statistics for Business and Economics,* p328
[92] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p8

For some of the Eurozone countries, CDS monitoring started later. The date when CDS monitoring actually started served as the starting point for these sovereign entities. The respective timeframes for which data is collected for each country can be seen in Table 3.1. The smallest timeframe used in the study is for the United Kingdom, as for that country the CDS spreads are only available since 6-11-2008.

**Table 3.1: Timeframes European countries and explanatory variables tested**

| | Timeframe sample | Expl. Variables |
|---|---|---|
| **Austria** | Juli 2008 - Mar. 2011 | 3 |
| **Belgium** | Dec. 2007 - Mar. 2011 | 8 |
| **Cyprus** | Dec. 2007 - Mar. 2011 | 9 |
| **Estonia** | Apr. 2008 - Mar 2011 | 3 |
| **Finland** | Mar. 2008 - Mar. 2011 | 3 |
| **France** | Dec. 2007 - Mar. 2011 | 8 |
| **Germany** | Dec. 2007 - Mar. 2011 | 11 |
| **Greece** | Dec. 2007 - Mar. 2011 | 12 |
| **Ireland** | Mar. 2008 - Mar. 2011 | 3 |
| **Italy** | Dec. 2007 - Mar. 2011 | 12 |
| **Netherlands** | Apr. 2008 - Mar 2011 | 3 |
| **Portugal** | Dec. 2007 - Mar. 2011 | 12 |
| **Slovakia** | Dec. 2007 - Mar. 2011 | 12 |
| **Slovenia** | Dec. 2007 - Mar. 2011 | 12 |
| **Spain** | Mar. 2008 - Mar. 2011 | 3 |
| **United Kingdom** | Nov. 2008 - Mar. 2011 | 3 |

The table also identifies for how many of the twelve variables there is enough data available to test the significance of the respective variables. The impact of the monthly adjusted variables is not tested for the sovereign entities for which CDS monitoring started later than December 2007. For the December 2007 – March 2011 timeframe there are only 40 unique observations that can be collected for each monthly adjusted variable. For the nations having starting points later than December 2007, the amount of observations is even smaller and in my opinion too small to be able to give enough weight to the results if the impact of the monthly adjusted variables is to be tested for those nations. For these nations only the impact of the daily adjusted explanatory variables is tested. This is done for seven of the sixteen sovereign entities. Another reason why the amount of studied explanatory variables differs among the nations is because the external debt and household debt statistics are unavailable for some countries. This is the case for Belgium, Cyprus, France and Germany. Table 3.1 shows for how many variables the impact is studied for these countries. The table furthermore shows that the impact of all twelve explanatory variables is tested for only five of the sixteen countries.

The necessary data for the explanatory variables are collected using DataStream as well. Every statistic is found using this program. The timeframe for which the data are collected is of course the same as for the CDS spreads. The underlying data collected to serve as input for the explanatory variables can be seen in Table 3.2. While the data used as input is self-clarifying for most of the variables, some require an additional explanation. The Euribor 3-month interest rate is chosen as the Risk-free rate because this is a common proxy for it (Fontana and Scheicher 2010)[93]. The VDAX volatility index is selected as a measure for the Risk Appetite. This index measures the implied volatility of the European derivatives market. This statistic is selected because it represents the changes in the risk aversion of investors. If the index goes up, so does the Risk Appetite of investors. The Real Exchange rate is calculated using the following equation:

$$Real\ Exchange\ rate = e \times \frac{P_f}{P_d} \tag{3.14}$$

In this function, $e$ is the nominal exchange rate, $P_f$ is the foreign price level, and $P_d$ is the domestic price level. The nominal exchange rate is measured by the US$/Euro exchange rate, the foreign price level by the CPI of the United States, and the domestic price level by the respective CPI levels of the different Eurozone countries. The CPI levels are also used as input for the respective Inflation levels of the sovereign entities. The Gross Domestic Price (GDP) level is used to measure economic growth because a nations' GDP is known to be a good indicator of domestic economic performance (Haque et al. 1998)[94].

[93] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p16
[94] Haque, N., Mark, N. and Mathieson, D. (1998). IMF Working Paper 46, p6

**Table 3.2: Statistics used as input for each explanatory variables (in alphabetical order)**

| Explanatory variable | Data used as input |
|---|---|
| **Current Account/GDP** | Current Account Balance |
| | Gross Domestic Product |
| **Debt/Export** | Amount of external debt |
| | Foreign export number |
| **Debt/GDP** | Amount of external debt |
| | Gross Domestic Product |
| **Economic growth** | Gross Domestic Product |
| **Household debt/GDP** | Amount of consumer debt |
| | Gross Domestic Product |
| **Import/GDP** | Foreign import number |
| | Gross Domestic Product |
| **Inflation rate** | CPI levels |
| **Real Exchange rate** | US$/Euro Exchange rate |
| | Respective CPI levels |
| **Reserves/Debt** | Official reserves |
| | Amount of external debt |
| **Reserves/Import** | Official reserves |
| | Foreign import number |
| **Risk Appetite** | VDAX volatility index |
| **Risk-free rate** | Euribor 3m interest rate |

### 3.2.2 Descriptive statistics dataset and subsamples

The collected data are analyzed in a number of ways to find relationships among the variables and to understand the data better. Statistical tests are done on the CDS spreads of the respective countries to determine whether the means and variances are significantly different from each other. Mean equality is tested using the ANOVA F-test[95], while variance equality is tested with the Levene test[96]. The test results are shown in Table 3.3. The means and variances of the CDS spreads are assumed to be equal if the P-values of the ANOVA F-test and the Levene test are above 0,05. Table 3.3 shows that the P-value is 0,00 for both tests, which means that the means and variances of CDS spreads of the countries are significantly different.

[95] ANOVA analysis studies the means of independent samples, which for this thesis are the CDS spreads of the sixteen Eurozone countries. The means are compared and tested using an F-test to see whether they differ significantly among the nations. If the F-test results are below some critical value it can be concluded that the means of the samples are not equal, otherwise there is mean equality among the respective CDS spreads (Newbold et al. 2006, p634).

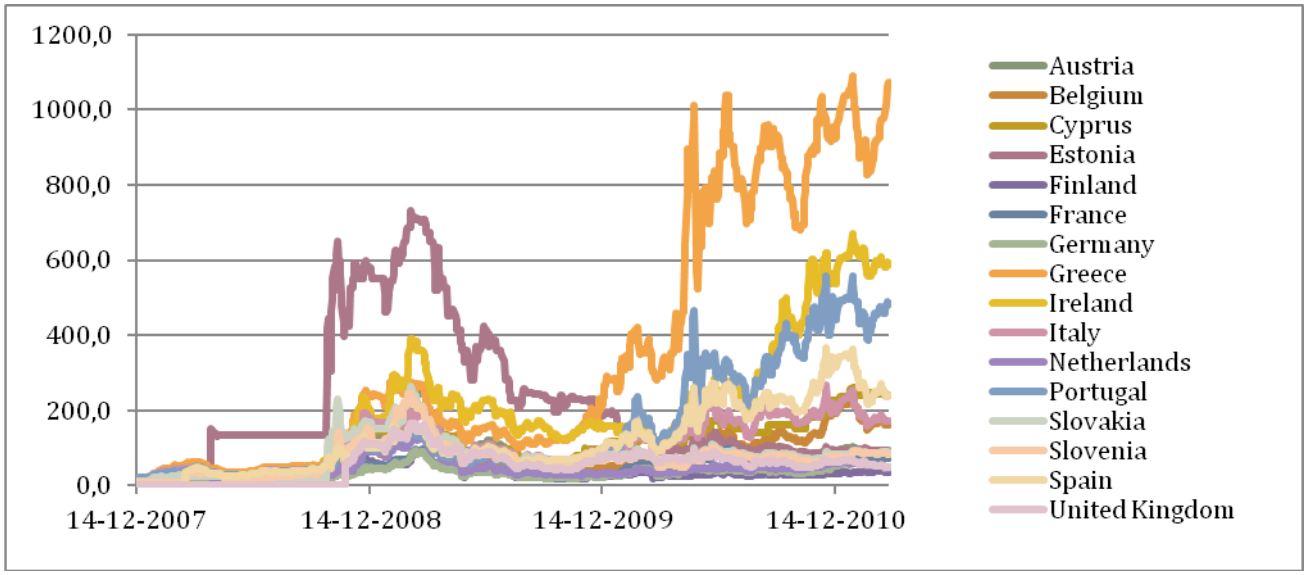
[96] Levene's test works the same as the ANOVA test, the only difference is that variance equality among the individual samples is tested instead of mean equality. Results are interpreted just like the ANOVA test, if the test result is below some critical value, there is variance inequality among the CDS spreads of the countries (Levene 1960, p278).

**Table 3.3: Tests for mean and variance equality individual CDS spreads**

| Mean Equality | Value | P-value |
|---|---|---|
| **ANOVA F-test** | 1210000000,00 | 0,00 |
| **Variance Equality** | **Value** | **P-value** |
| **Levene test** | 1030,39 | 0,00 |

The respective differences in the means and variances can be seen in Figure 3.1 as well. This Figure shows the development of the CDS spreads of the respective countries between 2007 and 2011. As can be seen in the figure, there are huge differences among the spreads of the credit default swaps. Spreads for Greece are around 1000 basis points at the end of 2010, whereas they are almost 0 for countries like Germany and the Netherlands. The figure furthermore shows that the nations that have the highest CDS spreads also have the most volatile ones. Spreads of Greece and Ireland for example change a lot more over time than the spreads of other countries.

**Figure 3.1: Development CDS spreads 2007-2011**




The descriptive statistics for the CDS spreads of the Eurozone countries also convey differences among the sovereign entities. These statistics are shown in Table 3.4. Looking at the respective means presented in this table, it shows that they differ a lot. This could be expected based on the Mean Equality test results and Figure 3.1. The table also shows that the countries facing high CDS means all have high maximums, especially compared to the more stable countries like the Netherlands and Germany. All of the countries have relatively low minimums however, proving that for some entities the CDS spreads have gone up dramatically over the 2007-2011 timeframe. The standard deviations reflect this increase as well. They are the highest for the countries that experienced a huge CDS increase. The standard deviation for Greece for example is almost twenty times as big as the standard deviation of Germany. Table 3.4 furthermore

conveys that the spreads of the nations are not symmetric. The skewness statistic indicates that that the CDS spreads are positively skewed for every sovereign entity. This means that the majority of the observations lie to the left of the mean, and that the distribution is skewed to the right (Newbold et al. 2006)[97]. The kurtosis statistic measures the peaks of the CDS spreads and the weight in the tails of the distribution. For a normal distribution the kurtosis is three, but the kurtosis of the CDS spreads lies above this number for most countries. This means that the variances of the CDS spreads are likely the result of infrequent and extreme deviations (Newbold et al. 2006)[98].

A characteristic of the spreads that isn't conveyed by Table 3.4 is the amount of times that the spread is actually updated. Among the respective countries, there are quite some differences in the amount of days that the spread is actually adjusted. For some nations CDS spreads didn't adjust for months while for others the spreads are more actively monitored. So even though CDS spreads by nature are a daily monitored and adjusted variable, an examination of the data showed that for some nations this monitoring didn't always happen. The fact that the spreads aren't updated equally regularly among the nations isn't a big problem, as there are still plenty of unique CDS observations per nation, but it is important that the knowledge of these differences is taken into account when assessing the results of the regressions for the respective nations.

**Table 3.4: Descriptive statistics CDS spreads individual countries (sorted based on mean)**

| | Mean | Median | Max | Min | Stdev | Skew | Kurt | Obs. |
|---|---|---|---|---|---|---|---|---|
| **Finland** | 30,5 | 29 | 94 | 9,3 | 16,4 | 1,4 | 5,6 | 776 |
| **Germany** | 31,5 | 32,9 | 92,5 | 5,2 | 18,6 | 0,4 | 3,1 | 838 |
| **France** | 43,6 | 41 | 98,6 | 6,5 | 26,1 | 0,1 | 1,7 | 838 |
| **Netherlands** | 44,3 | 42,9 | 130 | 6,3 | 26,3 | 1 | 4,4 | 759 |
| **Slovenia** | 71,4 | 70 | 247,5 | 8 | 42,7 | 1,3 | 6 | 843 |
| **Belgium** | 74,5 | 58 | 253,8 | 11,3 | 52,8 | 0,9 | 3,1 | 843 |
| **United Kingdom** | 75,6 | 69,2 | 165 | 42 | 25,8 | 1,4 | 4,9 | 609 |
| **Slovakia** | 78 | 78 | 265 | 13 | 48,8 | 1 | 4,4 | 843 |
| **Austria** | 87,2 | 82,1 | 265 | 11 | 42,9 | 1,4 | 7,1 | 687 |
| **Cyprus** | 108,9 | 101,8 | 261,5 | 13 | 64 | 0,4 | 2,4 | 843 |
| **Italy** | 113,9 | 107 | 268,3 | 16,5 | 62,2 | 0,2 | 1,8 | 843 |
| **Spain** | 128,6 | 100,6 | 368 | 24 | 84,7 | 0,8 | 2,7 | 788 |
| **Portugal** | 156,1 | 84 | 557,3 | 16,3 | 145,9 | 1,1 | 2,9 | 843 |
| **Ireland** | 218,5 | 172,7 | 668,8 | 18 | 168,4 | 1 | 3,3 | 787 |
| **Estonia** | 237,3 | 134 | 732,5 | 84 | 181 | 1,3 | 3,2 | 760 |
| **Greece** | 346,2 | 187 | 1088,9 | 16,9 | 337 | 0,9 | 2,2 | 843 |

[97] Newbold, P., Carlson, W. and Thorne, B. (2006). *Statistics for Business and Economics,* p49
[98] Newbold, P., Carlson, W. and Thorne, B. (2006). *Statistics for Business and Economics,* p620

The same descriptive analysis is also done for the explanatory variables. Results from this analysis are shown in Table 3.5. The mean of the GDP statistic is in this case the average GDP for all of the sixteen Eurozone countries over the entire sample period. The other statistics have to be interpreted the same way. For example, the maximum Reserves/GDP ratio of 4 is the highest ratio as measured over the entire sample of 16 countries. The amount of cross sections listed in the table is the amount of countries upon which the descriptive statistics of a certain variable are based. The mean CPI or Inflation level thus can be seen as the average CPI level of 9 different Eurozone nations.

Because the variables are based on different inputs it doesn't make much sense to compare most of the descriptive statistics of the respective variables with each other, but it is interesting to look at the skewness and kurtosis statistics. The skewness statistic is positive for each variable, which means that the distribution is skewed to the right for every factor. The kurtosis statistic differs more among the explanatory variables. For some variables these values are higher than three, which indicates extreme deviations. For other variables, like the Debt/GDP ratio, the kurtosis value is a lot lower. For these variables this means that the variance is the result of modest deviations.

**Table 3.5: Descriptive statistics explanatory variables (sorted based on mean)**

| | Mean | Median | Max | Min | Stdev | Skew | Kurt | Obs. | Cross sec. |
|---|---|---|---|---|---|---|---|---|---|
| **Reserves/Debt** | 0,1 | 0,0 | 0,3 | 0,0 | 0,1 | 1,2 | 3,0 | 239 | 6 |
| **Reserves/GDP** | 0,9 | 0,3 | 4,0 | -0,1 | 1,2 | 1,3 | 3,2 | 358 | 9 |
| **Household Debt** | 1,5 | 0,3 | 4,9 | 0,0 | 1,68 | 0,8 | 2,0 | 238 | 6 |
| **Curr.Acc/GDP** | 1,5 | 0,0 | 11,7 | -0,4 | 3,2 | 1,9 | 5,1 | 358 | 9 |
| **Risk-free Rate** | 1,6 | 0,7 | 5,0 | 0,3 | 1,6 | 0,9 | 2,1 | 12743 | 16 |
| **Real Exch. Rate** | 2,7 | 2,7 | 3,3 | 2,1 | 0,2 | 0,1 | 2,6 | 12743 | 16 |
| **Debt/GDP** | 3,6 | 2,8 | 9,5 | 0,2 | 3,1 | 0,5 | 1,8 | 239 | 6 |
| **Risk Appetite** | 28,5 | 25,2 | 83,2 | 15,3 | 11,4 | 1,9 | 6,9 | 12743 | 16 |
| **Imports/GDP** | 47,4 | 0,1 | 568,9 | 0,1 | 123,7 | 2,7 | 8,7 | 358 | 9 |
| **CPI** | 110,1 | 109,5 | 120,4 | 104,9 | 3,0 | 0,9 | 3,8 | 358 | 9 |
| **Debt/Export** | 416,6 | 175,8 | 1737,1 | 0,9 | 512,7 | 1,3 | 3,4 | 239 | 6 |
| **GDP** | 187579 | 58345 | 645400 | 3975 | 224235 | 0,9 | 2,1 | 358 | 9 |

### 3.2.3 Correlation analysis

The respective correlations and covariances of the sovereign entities are analyzed in this section. This analysis is done to see which relationships exist among the CDS spreads of the respective Eurozone countries. The test results provide proof for the existence of spillover effects attached to CDS spreads, because the correlations and covariances are high and positive in most cases. The respective relationships among the CDS spreads can be seen in the Appendix.

Table 5 shows the correlations and Table 6 presents the covariances between the CDS spreads of the respective Eurozone countries.

Table 5 shows that the correlations differ a lot among the countries. For some countries the correlations are very positive, while for others there is a strong negative relationship. For example, the correlation between the spreads of Austria and Finland is 0,95 whereas the Portugal-Estonia relationship is -0,57. Overall though, far more positive than negative correlations can be seen, thus acknowledging that CDS spreads of Eurozone countries tend to move in the same direction. Analyzing the covariances leads to the same conclusions. Table 6 in the Appendix shows that although there are some negative covariances between the countries, most of them are positive. This table also shows that there are large differences in the sizes of the covariances, which can be explained to some extent by the existing variance inequality of the CDS spreads that is proven by the results of the Levene test. The fact that most of the correlations and covariances are positive and also quite high makes sense in light of existing literature. As said before, one of the disadvantages of CDS spreads are the attached spillover effects (Arezki and Candelon 2010)[99]. The correlations prove that the Eurozone CDS spreads influence each other and that they indeed tend to move in the same direction. Because of this, high increases in the spread of Austria for example can explain movement in the CDS spread of Finland.

[99] Arezki, R., Candelon, B. and Sy, A. (2010). *Finance & Development,* p36-37

# 4 Empirical results

*The results of the research that is done to test the three hypotheses are published in this chapter. The first section describes in detail the specific results that are found for each hypothesis, while the implications of these results are discussed in the second section. This section provides the explanations why certain results are achieved, and also delivers the argumentation for or against the use of CDS spreads as the leading sovereign credit risk measure.*

## *4.1 Hypothesis analysis*

### 4.1.1 Results regression analysis first hypothesis

Recalling from Section 2.5, the first hypothesis is as follows:

$H_0$*: The different explanatory variables used in the regressions do not have a significant impact on the CDS variability for the pooled sample of Eurozone sovereign entities.*

Table 4.1 shows the results for the four regressions done to test the validity of the null hypothesis. The P-values in this table indicate whether a variable has a significant impact on the CDS spread or not, whereas the respective coefficients show the size of the impact of that certain variable and whether it positively or negatively influences the CDS spreads. The variable is considered to have a significant impact on the CDS spreads if the P-value is lower than 0,05 (Newbold 2006)[100]. The table shows that this is the case for eight of the twelve independent variables. This means that the null hypothesis can be rejected, as some of the studied explanatory variables do have a significant impact on the CDS variability for the pooled sample. The Current Account/GDP ratio, GDP Growth, Debt/Export ratio and Reserves/Debt ratio are the only variables that have P-values that exceed 0,05. The adjusted $R_2$ statistic in Table 4.1 conveys how much of the CDS spread the variables can explain. The Real Exchange rate, Risk Appetite and Risk-free rate variables for example determine the size of the CDS spread for 21,58%. When the adj. $R_2$ of a model is high this means that the variables can explain a lot of CDS variation, while if the adj. $R_2$ is low or negative the explanatory variables have almost no impact on the CDS spreads (Brooks 2008)[101].

Equally important as the fact that the variables do indeed influence the CDS spread is whether or not the coefficients of the variables have the correct sign based on what is expected in theory. In this case, a total of six of the eight significant factors have a rational sign. The Inflation statistic for example has a positive coefficient, meaning that higher inflation leads to

[100] Newbold, P., Carlson, W. and Thorne, B. (2006). *Statistics for Business and Economics,* p490
[101] Brooks, C. (2008). *Introductory Econometrics for Finance*, p110-111

higher CDS spreads, which is logical since increasing inflation numbers have an increasing effect on credit risk (Haque et al. 1998)[102]. The other macro-economic factors with correct signs are the Debt/GDP ratio, the Real Exchange rate, the Risk-free rate and the Household Debt/GDP ratio. The fact that these signs are correct indicates that the CDS spreads adjust correctly to the impact that changes for these variables have on the sovereign credit risk that is attached to a nation. The sign for the Risk Appetite is also correct. Regression results show that an increasing Risk Appetite has a decreasing impact on sovereign CDS spreads, just as Fontana and Scheicher (2010)[103] found. The impact of this variable is not mentioned alongside the effects of the macro-economic factors because the Risk Appetite doesn't affect the credit risk of the underlying sovereign, it influences the demand of CDS spreads. The fact that the Risk Appetite has a significant impact on CDS spreads indicates that credit risk related factors don't fully determine the size of the spread.

**Table 4.1: Regression results pooled dataset (sorted based on p-value)**

| | Sign | Coeff. | P-value | Obs. | Adj. $R_2$ |
|---|---|---|---|---|---|
| **Inflation** | Pos. | 42,4557 | 0,0000 | 351 | |
| **Reserves/Imports** | Pos. | 66,3906 | 0,0001 | 351 | |
| **Imports/GDP** | Neg. | -0,4791 | 0,0042 | 351 | |
| **Current Account/GDP** | Pos. | 16,5584 | 0,0695 | 351 | |
| **GDP Growth** | Neg. | -0,0003 | 0,1632 | 351 | |
| | | | | | **0,4713** |
| **Debt/GDP** | Pos. | 251,9155 | 0,0000 | 234 | |
| **Debt/Export** | Pos. | -0,0518 | 0,1983 | 234 | |
| **Reserves/Debt** | Pos. | 714,7164 | 0,5916 | 234 | |
| | | | | | **0,6371** |
| **Real Exchange Rate** | Neg. | -254,0460 | 0,0000 | 12743 | |
| **Risk-free rate** | Neg. | -6,8870 | 0,0000 | 12743 | |
| **Risk appetite** | Pos. | -1,1062 | 0,0000 | 12743 | |
| | | | | | **0,2158** |
| **Household debt** | Pos. | 165,1843 | 0,0119 | 228 | |
| | | | | | **0,2482** |

### 4.1.2 Results regression analysis second hypothesis

$H_0$*: The explanatory variables used in the regressions do not have a significant impact on the CDS variability for all of the individual Eurozone sovereign entities*

[102] Haque, N., Mark, N. and Mathieson, D. (1998). IMF Working Paper 46, p11
[103] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p16

Results from all four regressions done to test the impact of the variables on the respective CDS spreads of the countries are discussed in this section. The impact of the monthly adjusted explanatory variables is discussed first. The impact of these five variables is studied for the CDS spreads of nine countries. The results can be seen in Table 4.2. Looking at the respective P-values, it shows that results are mixed. The variable that has the biggest impact on CDS spreads is the Inflation. This statistic significantly influences CDS spreads in seven of the nine countries. The Reserves/Imports ratio and Imports/GDP ratio is significant in five nations, while the Current Account/GDP ratio and the GDP growth has a significant impact on CDS spreads in only three countries.

Signs of the coefficients differ among the sovereign entities. The Inflation factor and the Current Account/GDP ratio have the most rational impact on CDS spreads among the nations. The variable Inflation has the correct sign for all nations, while the Current Account/GDP ratio has a correct sign for six of the nine nations. The Inflation sign is positive, just like regressions done for Hypothesis 1 indicate. The Current Account/GDP sign is mostly negative, which is also rational since Mellios and Blanc (2006)[104] prove that an increase in this ratio should decrease the amount of credit risk attached to an economy. Results for the GDP Growth statistic are mixed. The coefficients for this variable not only differ in sign among the countries, they are also very small. This means that the GDP growth itself is not very important for the CDS spread. This is because it isn't about how the GDP itself develops, but more about how it evolves compared to other macro-economic variables. The sign for the Imports/GDP ratio and the Reserves/Imports ratio is wrong for seven of the nine sovereign entities, which means that the impact of these variables on CDS spreads is questionable.

**Table 4.2: Results regression analysis five monthly adjusted macro-economic variables**

| | **Inflation** | | **Curr.Acc/GDP** | | **GDP Growth** | | **Imp/GDP** | | **Res/Imp** | | **Adj. $R_2$** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coeff. | P-val. | Coeff. | P-val. | Coeff. | P-val. | Coeff. | P-val. | Coeff. | P-val. | Total |
| **Belgium** | 14,20 | 0,00 | -105,50 | 0,05 | 0,006 | 0,00 | -244,50 | 0,01 | 32,10 | 0,09 | 0,60 |
| **Cyprus** | 21,03 | 0,00 | -97,19 | 0,30 | -0,060 | 0,16 | -1672,50 | 0,00 | -72,44 | 0,02 | 0,51 |
| **France** | 6,81 | 0,00 | -203,58 | 0,76 | 0,000 | 0,00 | -338,47 | 0,16 | 32,56 | 0,00 | 0,73 |
| **Germany** | 3,25 | 0,41 | -519,03 | 0,09 | 0,00 | 0,09 | -344,98 | 0,47 | 28,33 | 0,01 | 0,49 |
| **Greece** | 57,40 | 0,00 | 2591,40 | 0,00 | -0,06 | 0,00 | -5558,13 | 0,00 | 38,64 | 0,63 | 0,86 |
| **Italy** | 6,95 | 0,32 | -2231,09 | 0,02 | 0,00 | 0,08 | 1618,67 | 0,17 | 72,08 | 0,00 | 0,73 |
| **Portugal** | 80,63 | 0,00 | 1402,00 | 0,38 | 0,06 | 0,05 | -4073,90 | 0,01 | -223,95 | 0,69 | 0,53 |
| **Slovakia** | 18,40 | 0,01 | -279,06 | 0,04 | 0,08 | 0,08 | 0,01 | 0,01 | 0,54 | 0,54 | 0,40 |
| **Slovenia** | 16,63 | 0,00 | 12,21 | 0,86 | -0,03 | 0,09 | -285,85 | 0,27 | 600,91 | 0,01 | 0,09 |

Table 4.3 shows the impact of the variables that are based on external debt. The impact of these variables is studied on the CDS spread of six nations. The Debt/GDP ratio is the most significant

[104] Mellios, C. and Paget-Blanc, E. (2006). *European Journal of Finance*, 12 (4), p363

variable. For five of the six countries the P-value for this variable is below 0,05. The Reserves/Debt variable is significant in four countries, while the Debt/Export factor has a significant impact on the CDS spreads in only three sovereign entities. The respective signs of the coefficients also differ among the nations. For example, the Debt/GDP sign is negative in four out of six cases. This means that an increase in this ratio generally leads to lower CDS spreads. This is not rational, as there is a positive relationship between the Debt/GDP ratio and credit risk (Baek et al. 1998)[105]. The Reserves/Debt ratio should have a negative sign according to Catao and Sutton (2002)[106]. This is the case for only two of the six countries, meaning that for this variable there are also discrepancies in regards to the way that sovereign spreads adjust to the impact that this variable has on credit risk. The sign of the Debt/Export ratio makes more sense in light of existing theories. This ratio has a positive impact on CDS spreads for four of the six sovereigns. A study done by Afonso (2003)[107] proves that this relationship is rational, because an increase in this ratio means that a nation can cover less debt with their exports, which leads to increasing credit risks and thus higher CDS spreads.

Table 4.3 also shows that there is a large variability in the size of the coefficients among the countries. For example, the impact of the Reserves/Debt ratio on the CDS spreads of Portugal is more than 5000 times as large as the impact the same ratio has on the Slovenian spreads. This variation is conveyed by the respective adj. $R_2$ results for each country as well. These statistics are very different among the sovereign entities. One reason for this is that spreads of some countries are updated less actively than others, as mentioned earlier in Section 3.2.2. Because of this, some CDS samples can be studied better than others for the impact of the explanatory variables. Another possible explanation is that different models are used for the respective countries. The way how the used models function can influence the adj. $R_2$, because each model influences the fit between the dependent and independent variables differently (Brooks 2008)[108].

[105] Baek, I., Bandopadhyaya, A. and Du, Chan. (2005). *Journal of International Money & Finance*, 24, p546
[106] Catão, L. and Sutton, B. (2002). International Monetary Fund Working Paper 149. p16-18
[107] Afonso, A. (2003). *Journal of Economics and Finance*, 27 (1), p68
[108] Brooks, C. (2008). *Introductory Econometrics for Finance*, p110

**Table 4.3: Results regression analysis monthly adjusted external debt ratios**

| | Debt/Exp | | Debt/GDP | | Res/Debt | | Adj. $R_2$ |
|---|---|---|---|---|---|---|---|
| | Coeff. | P-value | Coeff. | P-value | Coeff. | P-value | Total |
| **Germany** | 44,86 | 0,00 | -211,51 | 0,00 | 202,89 | 0,01 | 0,59 |
| **Greece** | -0,22 | 0,17 | 250,72 | 0,00 | 110465,00 | 0,00 | 0,76 |
| **Italy** | 2,27 | 0,18 | -73,38 | 0,11 | 3393,18 | 0,00 | 0,82 |
| **Portugal** | -0,04 | 0,87 | 124,08 | 0,00 | 9914,59 | 0,45 | 0,43 |
| **Slovakia** | 5,75 | 0,02 | -118,01 | 0,00 | -238,85 | 0,00 | 0,60 |
| **Slovenia** | 97,24 | 0,03 | -672,94 | 0,00 | 18,32 | 0,93 | 0,17 |

The impact of the Household Debt/GDP ratio on the respective CDS spreads is shown in Table 4.4. This variable has a significant impact on CDS spreads in three of the six countries, while the sign of the coefficient is positive and thus rational in four out of six nations. This sign is correct because an increase in this ratio puts more pressure on the ability of an economy to service debts and it therefore increases the amount of credit risk attached to a sovereign entity. Based on the regressions it is thus safe to say that there is a positive relationship between the Household Debt/GDP ratio and the sovereign CDS spreads.

**Tabel 4.4: Results regression analysis household debt**

| | Household debt | | |
|---|---|---|---|
| | Coeff. | P-value | Adj. $R_2$ |
| **Cyprus** | -59,82 | 0,47 | -0,01 |
| **Greece** | -44910,00 | 0,00 | 0,22 |
| **Italy** | 129,28 | 0,00 | 0,46 |
| **Portugal** | 1042,30 | 0,00 | 0,41 |
| **Slovakia** | 74,28 | 0,11 | -0,01 |
| **Slovenia** | 802,18 | 0,07 | 0,06 |

Table 4.5 presents the results of the regressions based on the daily adjusted explanatory variables. The P-values show that these variables have a very significant impact on the CDS spread of nearly all sovereign entities. The Risk-free rate of Greece is the only variable that doesn't significantly influence its CDS spread. The table provides very strong evidence that both the Real Exchange rate and the Risk-free rate have a negative impact on the CDS spread for most of the countries. These results are the same as the relationships found for the regressions used to test the impact of these variables on the pooled dataset. Signs for the Risk Appetite are more mixed among the countries. The results don't convey a clear positive or negative relationship. The sign is correct for the nations for which the coefficient is negative, as the results from both Hypothesis 1 and the study done by Fontana and Scheicher (2010)[109] indicates a negative connection between the Risk Appetite and the CDS spread. Just like with the results from the

[109] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p18

regressions testing the debt ratios, the adj. $R_2$ results differ a lot among the sovereign entities in Table 4.5. The three explanatory variables can explain only 24% of the CDS variability of the United Kingdom for example, while the same variables determine 77% of the CDS spread of France. The reasons for this variation are probably the same as the ones mentioned to explain the adj. $R_2$ variation of the debt variables.

**Table 4.5: Results regression analysis on the daily adjusted explanatory variables**

| | Exch.Rate | | | Risk-Free Rate | | | Risk appetite | | | Adj. $R_2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sign | Coeff. | P-value | Sign | Coeff. | P-value | Sign | Coeff. | P-value | Total |
| **Austria** | Neg. | -50,95 | 0,00 | Neg. | -13,48 | 0,00 | Pos. | 1,48 | 0,00 | 0,45 |
| **Belgium** | Neg. | -131,24 | 0,00 | Neg. | -2,19 | 0,00 | Neg. | -0,56 | 0,00 | 0,45 |
| **Cyprus** | Neg. | -188,73 | 0,00 | Neg. | -10,73 | 0,00 | Neg. | -1,26 | 0,00 | 0,64 |
| **Estonia** | Pos. | 135,29 | 0,00 | Neg. | -11,10 | 0,00 | Pos. | 11,384 | 0,00 | 0,63 |
| **Finland** | Neg. | -30,88 | 0,00 | Neg. | -2,12 | 0,00 | Pos. | 0,59 | 0,00 | 0,54 |
| **France** | Neg. | -110,62 | 0,00 | Neg. | -1,00 | 0,00 | Neg. | -0,51 | 0,00 | 0,77 |
| **Germany** | Neg. | -26,65 | 0,00 | Neg. | -4,71 | 0,00 | Pos. | 0,29 | 0,00 | 0,62 |
| **Greece** | Neg. | -1025,85 | 0,00 | Pos. | 0,88 | 0,28 | Neg. | -10,70 | 0,00 | 0,70 |
| **Ireland** | Neg. | -348,65 | 0,00 | Neg. | -22,39 | 0,00 | Neg. | -3,43 | 0,00 | 0,28 |
| **Italy** | Neg. | -169,3 | 0,00 | Neg. | -10,48 | 0,00 | Neg. | -0,31 | 0,00 | 0,68 |
| **Netherlands** | Neg. | -59,10 | 0,00 | Neg. | -4,05 | 0,00 | Pos. | 0,74 | 0,00 | 0,56 |
| **Portugal** | Neg. | -108,5 | 0,00 | Neg. | -9,870 | 0,00 | Neg. | -0,154 | 0,00 | -0,02 |
| **Slovakia** | Neg. | -46,10 | 0,00 | Neg. | -12,31 | 0,00 | Pos. | 1,74 | 0,00 | 0,68 |
| **Slovenia** | Neg. | -69,18 | 0,00 | Neg. | -6,41 | 0,00 | Pos. | 1,59 | 0,00 | 0,61 |
| **Spain** | Neg. | -264,38 | 0,00 | Neg. | -7,21 | 0,00 | Neg. | -2,11 | 0,00 | 0,63 |
| **United Kingdom** | Neg. | -62,84 | 0,00 | Pos. | 15,13 | 0,00 | Pos. | 1,04 | 0,00 | 0,24 |

### 4.1.3 Results event study third hypothesis

$H_0$: There is no abnormal return on the CDS spreads surrounding the announcement of new values for the explanatory variables for each Eurozone sovereign entity.

The results of the event study that examines the impact of the macro-economic announcements on the CDS return lead to a very clear conclusion. The results indicate that the announcement of new macro-economic data does not significantly influence the abnormal returns of the CDS spread. This is the case for the announcements done both at the middle of the month and at the end. Test results are insignificant for every sovereign entity. Tables 8 and 9 in the Appendix provide the statistical proof for this conclusion. The T-test results given in these tables are based on the abnormal returns of a day 0-1 event window and also a day 1-3 event window. The used critical T-value in the event study was 1,96. This number is based on a 5% significance level and on 39 degrees of freedom (40 announcement dates minus 1). The values given in the Appendix indicate that the critical T-value is never exceeded. This means that the null

hypothesis does not have to be rejected, as there are no significant abnormal CDS returns surrounding new macro-economic announcements. There are various arguments available why this conclusion shouldn't come as a total surprise. These arguments are the following:

1. *The significant impact of daily adjusted variables on sovereign CDS spreads.*

The Risk-free rate, Risk Appetite and Real Exchange rate all have a big impact on sovereign spreads, as Table 4.5 proved. This decreases the magnitude of the effect that the monthly adjusted macro-economic announcements can have on CDS spreads. The event study results do prove that some abnormal returns are present, but they aren't big enough.

2. *The impact of the CDS market liquidity.*

Tang and Yan (2003)[110] prove that the impact of this variable on the size of the CDS spread cannot be overlooked. Because CDS liquidity can determine up to 20% of size of the spreads, the impact of this factor can also smooth the effect that macro-economic announcements have on CDS spreads.

3. *Bad CDS spread monitoring over the 2007-2011 timeframe.*

For some countries the spreads in the sample aren't updated for months, during which it is therefore impossible to test the impact of the announcements. This can also hurt the significance of the abnormal returns.

## *4.2 Discussion of the results*

The respective results for the regressions performed for this thesis have some interesting implications for the functionality of CDS spreads as a credible credit risk measure. For more than half of the explanatory variables a distinct and rational relationship is found with the CDS spreads. Combining the results of the regressions done on both the pooled dataset and the individual countries, it can be concluded that there are six macro-economic variables for which its impact on credit risk is significantly and rationally reflected by sovereign CDS spreads in general. These variables are the Inflation rate, the Debt/GDP ratio, the Current Account/GDP ratio, the Household Debt/GDP ratio, the Risk-free rate, and the Real Exchange rate. For these variables the CDS spreads adjust quickly and properly to the changes in sovereign credit risk that these variables cause. Higher inflation rates, an increasing Debt/GDP ratio and a higher Household Debt/GDP ratio leads to higher CDS spreads. This is very rational because increasing inflation rates and soaring external and domestic debt levels are indicators for a worsened credit position of an economy. Increases in the Current Account/GDP ratio, the Risk-free rate and the Real Exchange Rate lead to lower CDS spreads, which also makes sense. A higher Current Account/GDP ratio decreases a countries dependence on foreign savings. This decreases the

[110] Tang, D. and Yan, H. (2007). University of South Carolina Working Paper, p29

exposure of a nation which is good news for the credit position of a nation. The Risk-free rate relationship is rational because an increasing risk-free rate leads to higher growth rates, which in turn decreases the credit risk attached to a nation. The Real Exchange rate conveys the competitiveness of an economy. Since exchange rate devaluations signal economic uncertainty, it makes sense that this factor is negatively related to the CDS spread as well. The Risk Appetite also has a significant and negative impact on CDS spreads, but as mentioned in Section 4.1.1 this variable doesn't influence sovereign credit risk. The Risk Appetite impacts the size of the CDS spread because it affects the demand of the credit default swaps. An increasing Risk Appetite means that investors become more willing to bear their exposure to credit risk themselves. This means that they are less interested in insuring their risks and this decreases the demand of CDS spreads, which in turn of course decreases the size of the CDS spreads (Fontana and Scheicher 2010)[111]. The Risk Appetite of investors tends to be very low during sovereign debt crises. In a volatile market with a lot of nations facing financial turmoil this generally leads to increasing CDS demands and thus higher CDS spreads. The expected impact of the Debt/Export ratio, Reserves/Imports ratio, Imports/GDP ratio, GDP Growth and Reserves/Debt ratio on the CDS spread is not proven by this paper. Results show that the impact of these variables is either insignificant or not rational.

Even though a significant and rational relationship has been found between many of the explanatory variables and the CDS spread, the research done for this paper has also proven that there are also some negative aspects attached to sovereign CDS spreads of which the impact should not be overlooked. Some of these disadvantages have been mentioned before, as they may have also caused the lack of CDS abnormal returns surrounding new macro-economic announcements to some extent. The respective arguments hurt the credibility of CDS spreads as accurate sovereign risk indicators. These arguments are the following:

1. *CDS variation are to some extent be explained by non-credit risk related determinants.*

Two of these variables are the before-mentioned Risk Appetite and the CDS market liquidity. Because these variables are unrelated to the credit risk of the underlying sovereign entity, value changes for these variables can cause the CDS spreads to appear to adjust wrong to changes in credit risk conditions. The impact that a rising Reserves/Debt ratio for example should have on the CDS spread can therefore be offset by a decrease in market liquidity or a lowered risk appetite. This can make it look like the Reserves/Debt ratio has a wrong impact on CDS spreads, even though this is not the case. This effect can of course also be caused by additional, unidentified variables that also influence sovereign CDS spreads.

[111] Fontana, A. and Scheicher, M. (2010). European Central Bank Working Paper Series 1271, p16

2. *The positive correlations and covariances among the respective sovereign CDS spreads.*

The correlations study in Section 3.2.3 proves that the respective CDS spreads tend to move in the same direction. This means that sovereign spreads influence each other. In some situations the CDS spread of a nation might therefore increase dramatically, even though the credit position of the underlying entity remains relatively the same. This can affect the impact that some macro-economic variables have on the CDS spread of a sovereign.

3. *The CDS market cannot be monitored good enough.*

For nearly every sovereign entity, there are some months in the 2007-2011 timeframe during which the size of the CDS spread is not updated. This happened mostly during 2007 and 2008. As discussed in the Data description section, the main reasons for this are the relatively young age of the CDS market and the fact that it is an over-the-counter market. Because of this, it remains difficult monitor the CDS spread on a daily basis.

Looking at the total impact of the studied explanatory variables it is clear that macro-economic variables do indeed influence sovereign CDS spreads, which is positive for the use of CDS spreads as an indicator of sovereign credit risk. The problem at this point though is that there are too many other factors that also influence the size of the spread. The adj. $R_2$ results for each regression provide additional proof for this statement. The amount of CDS variability that the explanatory variables can explain differs a lot for each sovereign entity. This means that for each entity the impact of the variables is different, and that there are other effects present that impact the spread of the countries individually. Until more of these factors are identified, it is difficult to construct a general model that is capable of predicting CDS spreads in the future. It can therefore be concluded that CDS spreads are not accurate enough in conveying sovereign credit risk at this point.

There are some indications based on the regression results however that this might be different in the future. Since there are quite a few macro-economic variables that already influence the CDS spread rationally, it is very well possible that the spreads also adjust better to changes for the other tested explanatory variables as soon as the regulation and monitoring of the CDS market improves. This can also lead to more uniform changes for the variables among the sovereign entities, which is a good thing as the impact of a certain variable should be the same for each sovereign. If investors want to be able to use CDS spreads as a credible proxy of sovereign credit risk, the effect of the Debt/GDP ratio on the CDS spread for example can't be positive for one economy and negative for another.

The main implication that must be drawn from this thesis is that at this point it is too early to use CDS spreads as the main proxy of sovereign credit risk. It isn't a particularly bad move

however if an investor decides to use CDS spreads as his or her proxy for sovereign credit risk. This is because the CDS spread does adjust correctly to changes in quite a few variables that are related to sovereign risk, like to the Inflation and the Real Exchange Rate of a nation. Furthermore, the other sovereign credit risk measures also all have their negative aspects, as discussed in Section 2.2. It is advisable however that an investor takes the impact of all of the other aspects that negatively influence the accuracy of a CDS spread as a credit risk indicator into account. The conclusion that has to be made based on the study performed in this paper regarding the potential use of CDS spreads is therefore pretty much the same as the Literature Review conveyed. CDS spreads can potentially serve as the most reliable and accurate sovereign credit risk measure, but in that case some of the disadvantages attached to the use of CDS spreads have to be solved.

# 5 Conclusions

*This chapter provides the concluding remarks of this thesis. In the first part the research method is explained, along with the key findings of the study and the implications that these findings have. The second part of the chapter discusses the limitations of the study, and presents some directions for future research.*

## *5.1 Summary of the research method and key findings*

This thesis studies the sovereign CDS spreads of the Eurozone countries. The main goal of the study is to find the determinants of sovereign CDS spreads, and by doing so providing arguments for or against the use of CDS spreads as a credible indicator of sovereign credit risk. In order to do this, the impact of various explanatory variables on the CDS spreads is tested. The research is aimed at the CDS spreads of sixteen Eurozone sovereign entities between 2007 and 2011. The selected explanatory variables are mostly macro-economic by nature, with the only exception being the Risk Appetite variable. Since there are no other existing studies that also focus primarily on the macro-economic determinants of sovereign CDS spreads, explanatory variables that are known to explain credit ratings and default probabilities are selected to serve as potential determinants for this study. These variables are selected because of the impact that they have on sovereign credit risk. This expected impact is based on existing literature, by studying articles that are aimed at the drivers of sovereign risk and also at the impact that sovereign defaults can have on global stability. Because this thesis discusses the potential use of CDS spreads as credit risk indicators, the pros and cons of other credit risk measures are also explained.

Based on the available literature and the selected explanatory variables, three hypotheses are drawn up. The first hypothesis focuses on the impact that the variables have on a pooled dataset containing the spreads of all sovereign entities, while the second hypothesis is aimed at the impact that the same variables have on the spreads of the countries individually. The third hypothesis is related to the way that CDS spreads adjust to changing macro-economic variables. This hypothesis focuses on the abnormal returns of CDS spreads surrounding macro-economic announcements. By testing this hypothesis it can be concluded whether or not CDS spreads immediately incorporate the information conveyed by these announcements in their prices. The first two hypothesis are tested using regression analysis, while the significance of the third hypothesis is studied using an event study methodology.

Results from the regression analysis show that there are seven explanatory variables that have a significant and rational impact on the size of the CDS spread. These variables are the Inflation

rate, the Debt/GDP ratio, the Current Account/GDP ratio, the Household Debt/GDP ratio, the Risk-free rate, the Risk Appetite, and the Real Exchange rate. The Inflation rate, the Debt/GDP ratio and the Household Debt/GDP ratio are positively related to CDS spreads, while the four other variables are negatively related to sovereign spreads.

The impact that the Debt/Export ratio, the Reserves/Debt ratio, the Import/GDP ratio, the Reserves/Import ratio, and the GDP growth should have on CDS spreads is not proven. Regression results show that these variables have either an insignificant or an irrational impact on sovereign CDS spreads. It is furthermore not proven that there are significant CDS abnormal returns existent surrounding macro-economic announcements. CDS spreads do adjust after new monthly macro-economic values are presented, but this adjustment is not very big.

The paper acknowledges a few reasons for the insignificant impact of these factors. One of the reasons is that there are other determinants present that are not related to sovereign risk but which still influence the CDS spread. The CDS market liquidity is an example of such a variable. The impact of these variables has a negative impact on the accuracy of sovereign CDS spreads as a credit risk measure. The influence of these variables can offset the effect that variables like the Debt/Export ratio should have on the CDS spread. Another feature of sovereign CDS spreads that negatively affects their accuracy as a credit risk indicator is the correlation of the spreads. This thesis provides proof that the CDS spreads of the Eurozone countries influence each other, which can cause the spreads to move irrationally in some situations.

## *5.2 Limitations of the study and directions for future research*

There is one major limitation attached to the research that is performed for this thesis. This limitation is based on the fact that the CDS market is still a relatively young market, as sovereign CDS monitoring didn't start until December 2007. The samples that are used as input for the monthly-available explanatory variables are rather small because of this. For eight of the twelve explanatory variables there are no more than 40 unique observations for each country. This decreases the weight that can be given to the test results that are based on these data and it might have led to skewed results for some variables. An additional limitation that is related to the age of the CDS market is that CDS monitoring isn't very constant. For almost every sovereign entity, there are some periods in the 2007-2011 timeframe during which the CDS spreads are not updated. This has made it even harder to derive solid conclusions for the relationship between the explanatory variables and the sovereign spreads.

This thesis can provide an interesting starting point for future research on sovereign CDS spreads. There are various other aspects of CDS spreads that can be studied in the near future.

For one, it might be valuable to see what the impact of the respective variables tested for this thesis is in a few years from now, when some of the limitations attached to this study might be gone. It is very well possible that the selected explanatory variables are able to explain the CDS spread better at that point. A second direction for future research is a more extensive study of local differences in spreads. While this thesis is focused on the spreads of the respective Eurozone countries, it will also be interesting to study the impact of the selected variables on the spreads of other major economies like the United States or China. The third direction for future research is aimed at the impact of various political and monetary announcements. It might be interesting to study the impact of announcements done by central banks or supranational institutions like the European Union on the sovereign CDS spreads. Potential announcements that can have a significant impact can be an announcement that a nation will receive support from the IMF Emergency Fund, the news that the European Central Bank has bought outstanding debt of a country in distress, or the announcement that a sovereign entity is decreasing its expenditures in order to still be able to service its debts. A fourth and final possible direction for additional research is a study that looks into the effect that the media can have on CDS spreads. The media have the ability to influence the way an investor looks at a certain situation, because of how they convey new information. This can cause investors to overreact to the situation in an economy, which might influence the size of CDS spreads more than the situation actually warrants. As this causality is not proven yet it can turn out to be valuable to study the specific impact of the media on CDS spreads.

# References

Afonso, A. (2003). Understanding the determinants of sovereign debt ratings: Evidence for the two leading agencies. *Journal of Economics and Finance*, 27 (1), 56–74.

Altman, E. and Rijken, H. (2006) A point-in-time perspective on through-the-cycle ratings. *Financial Analysts Journal*, 62 (1), 54–70.

Avery, R. and Fisher, E. (1992). Empirical Models of Debt Rescheduling with Sovereign Immunity. In: Solberg, R., *Country Risk Analysis: A Handbook* (pp 100-117). New York: Routledge.

Arezki, R., Candelon, B. and Sy, A. (2010). Bad news spreads. *Finance & Development*, 36-37.

Ashcraft, A. and Santos, J. (2009). Has the CDS market lowered the cost of corporate debt? *Journal of Monetary Economics, 56*, 514-52.

Baek, I., Bandopadhyaya, A. and Du, Chan. (2005). Determinants of market-assessed sovereign risk: Economic fundamentals or market risk. *Journal of International Money & Finance*, 24, 533–548.

Brooks, C. (2008). *Introductory Econometrics for Finance*. New York: Cambridge University Press

Brown, S. and Warner, J. (1985). Using daily stock returns. *Journal of Financial Economics*, 14 (1), 3–31.

Catão, L. and Sutton, B. (2002). Sovereign defaults: the role of volatility. International Monetary Fund Working Paper 149.

Ericsson, J., Jacobs, K. and Oviedo, R. (2009). The determinants of credit default swap premia. *Journal of Financial and Quantitative Analysis*, 44 (1), 109–132.

Fisher, I. (1933). The debt-deflation theory of great depressions. *Journal of the Econometric Society, 1 (4),* 337-357.

Fontana, A. and Scheicher, M. (2010). An analysis of euro area sovereign CDS. European Central Bank Working Paper Series 1271.

Flannery, M., Houston, J. and Partnoy, F. (2010). Credit default swap spreads as viable substitutes for credit ratings. *University of Pennsylvania Law Review*, 158, 2085–2123.

Georgievska, A.; Georgievska, L.; Stojanovic, A. and Todorovic, N. (2008). Sovereign rescheduling probabilities in emerging markets: a comparison with credit rating agencies' ratings. *Journal of Applied Statistics, 35*, 1031-1051.

Greatrex, C. (2008). The credit default swap market's determinants. Fordham University Department of Economics Working Paper 05.

Haque, N., Mark, N. and Mathieson, D. (1998). The relative importance of political and economic variables in creditworthiness ratings. International Monetary Fund Working Paper 46.

Hull, J. (2008). *Options, Futures, and other Derivatives*. New Jersey: Pearson Education.

International Monetary Fund. (2010). *Global financial stability report October 2010*. IMF Publication Service: Washington.

International Monetary Fund (2010). *Global financial stability report April 2011*, IMF Publication Service: Washington.

Levene, P (1960). Robust checks for equality of variances. *Contributions to probability and statistics,* 1, 278-292.

MacKinlay, A. (1997). Event studies in economics and finance. *Journal of Economic Literature*, 35 (1), 13–39.

Manasse, P., Roubini, N. and Schimmelpfennig, A. (2003). Predicting Sovereign Debt Crises. International Monetary Fund Working Paper 221.

Mellios, C. and Paget-Blanc, E. (2006). Which factors determine sovereign credit ratings? *European Journal of Finance*, 12 (4), 361-377.

Mora, N. (2006). Sovereign credit ratings: Guilty beyond reasonable doubt? *Journal of Banking & Finance*, 30, 2041–2062.

Newbold, P., Carlson, W. and Thorne, B. (2006). *Statistics for Business and Economics*. New Jersey: Pearson Practice Hall.

Out of Keynes' Shadow. (2009, February 14). *The Economist,* 390, 78-79. http://www.economist.com/node/13104022

Reinhart, C. and Rogoff, K. (2008). This time *is different: Eight Centuries of Financial Folly*. New Jersey: Princeton University Press.

Reisen, H. and Von Maltzan, J. (1998). Sovereign credit ratings, emerging market risk and financial market volatility. *Intereconomics*, 33 (2), 73–82.

Sjostrom, W. (2009). The AIG bailout. *Washington and Lee Law Review,* 66, 943-991.

Tang, D. and Yan, H. (2007). Liquidity and credit default swap spreads. University of South Carolina Working Paper

Wallison, P. (2009). Everything you wanted to know about credit default swaps: but were never told. *The Journal of Structured Finance*, 15 (2), 20–30.

Zhu, H. (2006). An empirical comparison of credit spreads between the bond market and the credit default swap market. *Journal of Financial Services Research, 29*, 211-235.

# Appendix

This Appendix contains the following tables:

**Table 1: Results RESET test and the used models to test daily adjusted variables**

| | Ramsey RESET | Method | | Ramsey RESET | Method |
|---|---|---|---|---|---|
| **Austria** | 0,0021 | ARCH(1) | **Ireland** | 0,0195 | GARCH(1,1) |
| **Belgium** | 0,0025 | ARCH(1) | **Italy** | 0,0000 | ARCH(1) |
| **Cyprus** | 0,8275 | OLS | **Netherlands** | 0,3777 | OLS |
| **Estonia** | 0,0000 | GARCH(2,2) | **Portugal** | 0,0000 | GARCH(2,2) |
| **Finland** | 0,5372 | OLS | **Slovakia** | 0,0000 | GARCH(1,1) |
| **France** | 0,0000 | ARCH(1) | **Slovenia** | 0,0000 | ARCH(1) |
| **Germany** | 0,0016 | GARCH(1,1) | **Spain** | 0,0000 | GARCH(1,1) |
| **Greece** | 0,0000 | ARCH(1) | **United Kingdom** | 0,0000 | ARCH(1) |

**Table 2: Results RESET test and the used models to test monthly adjusted variables**

| | Ramsey RESET | Method | | Ramsey RESET | Method |
|---|---|---|---|---|---|
| **Belgium** | 0,0263 | GARCH(1,1) | **Italy** | 0,5393 | OLS |
| **Cyprus** | 0,5539 | OLS | **Portugal** | 0,1202 | OLS |
| **France** | 0,2942 | OLS | **Slovakia** | 0,2482 | OLS |
| **Germany** | 0,6775 | OLS | **Slovenia** | 0,1469 | OLS |
| **Greece** | 0,0000 | ARCH(1) | | | |

**Table 3: Results RESET test and the used models to test external debt ratios**

| | Ramsey RESET | Method | | Ramsey RESET | Method |
|---|---|---|---|---|---|
| **Germany** | 0,6921 | OLS | **Portugal** | 0,0047 | GARCH(1,1) |
| **Greece** | 0,0000 | ARCH(2) | **Slovakia** | 0,5371 | OLS |
| **Italy** | 0,6557 | OLS | **Slovenia** | 0,1454 | OLS |

**Tabel 4: Results RESET test and the used models to test impact household debt**

| | Ramsey RESET | Method | | Ramsey RESET | Method |
|---|---|---|---|---|---|
| **Cyprus** | 0,1234 | OLS | Portugal | 0,0001 | GARCH(2,2) |
| **Greece** | 0,0265 | GARCH(1,1) | Slovakia | 0,0385 | ARCH(1) |
| **Italy** | 0,9751 | OLS | Slovenia | 0,457 | OLS |

**Table 5: Correlation CDS spreads Eurozone countries**

| | Austr. | Belg. | Cyp. | Est. | Finl. | Fra. | Germ. | Spa. | UK | Slove. | Slova. | Port. | Neth. | Irel. | Ita. | Gre. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Austria** | 1 | 0,29 | 0,29 | 0,81 | 0,95 | 0,39 | 0,78 | -0,03 | 0,89 | 0,89 | 0,89 | -0,14 | 0,92 | 0,34 | 0,14 | -0,19 |
| **Belgium** | 0,29 | 1 | 0,95 | -0,16 | 0,33 | 0,83 | 0,73 | 0,91 | 0,13 | 0,28 | 0,25 | 0,87 | 0,46 | 0,90 | 0,91 | 0,81 |
| **Cyprus** | 0,29 | 0,95 | 1 | -0,15 | 0,36 | 0,80 | 0,74 | 0,84 | 0,16 | 0,31 | 0,26 | 0,82 | 0,48 | 0,83 | 0,88 | 0,76 |
| **Estonia** | 0,81 | -0,16 | -0,15 | 1 | 0,80 | -0,08 | 0,38 | -0,49 | 0,80 | 0,80 | 0,84 | -0,57 | 0,74 | -0,10 | -0,26 | -0,62 |
| **Finland** | 0,95 | 0,33 | 0,36 | 0,80 | 1 | 0,45 | 0,80 | 0,01 | 0,90 | 0,91 | 0,92 | -0,08 | 0,95 | 0,40 | 0,16 | -0,14 |
| **France** | 0,39 | 0,83 | 0,80 | -0,08 | 0,45 | 1 | 0,78 | 0,80 | 0,32 | 0,40 | 0,37 | 0,75 | 0,54 | 0,91 | 0,65 | 0,76 |
| **Germany** | 0,78 | 0,73 | 0,74 | 0,38 | 0,80 | 0,78 | 1 | 0,50 | 0,69 | 0,74 | 0,70 | 0,42 | 0,85 | 0,72 | 0,55 | 0,36 |
| **Spain** | -0,03 | 0,91 | 0,84 | -0,49 | 0,01 | 0,80 | 0,50 | 1 | -0,14 | -0,03 | -0,06 | 0,96 | 0,15 | 0,87 | 0,84 | 0,96 |
| **UK** | 0,89 | 0,13 | 0,16 | 0,80 | 0,90 | 0,32 | 0,69 | -0,14 | 1 | 0,88 | 0,89 | -0,26 | 0,87 | 0,27 | -0,09 | -0,29 |
| **Slovenia** | 0,89 | 0,28 | 0,31 | 0,80 | 0,91 | 0,40 | 0,74 | -0,03 | 0,88 | 1 | 0,96 | -0,13 | 0,91 | 0,34 | 0,10 | -0,18 |
| **Slovakia** | 0,89 | 0,25 | 0,26 | 0,84 | 0,92 | 0,37 | 0,70 | -0,06 | 0,89 | 0,96 | 1 | -0,16 | 0,92 | 0,34 | 0,06 | -0,20 |
| **Portugal** | -0,14 | 0,87 | 0,82 | -0,57 | -0,08 | 0,75 | 0,42 | 0,96 | -0,26 | -0,13 | -0,16 | 1 | 0,01 | 0,81 | 0,87 | 0,96 |
| **Netherlands** | 0,92 | 0,46 | 0,48 | 0,74 | 0,95 | 0,54 | 0,85 | 0,15 | 0,87 | 0,91 | 0,92 | 0,05 | 1 | 0,52 | 0,29 | -0,01 |
| **Ireland** | 0,34 | 0,90 | 0,83 | -0,10 | 0,40 | 0,91 | 0,72 | 0,87 | 0,27 | 0,34 | 0,34 | 0,81 | 0,52 | 1 | 0,74 | 0,80 |
| **Italy** | 0,14 | 0,91 | 0,88 | -0,26 | 0,16 | 0,65 | 0,55 | 0,84 | -0,09 | 0,10 | 0,06 | 0,87 | 0,29 | 0,74 | 1 | 0,76 |
| **Greece** | -0,19 | 0,81 | 0,76 | -0,62 | -0,14 | 0,76 | 0,36 | 0,96 | -0,29 | -0,18 | -0,20 | 0,96 | -0,01 | 0,80 | 0,76 | 1 |

**Table 6: Covariances CDS spreads Eurozone countries**

| | Austr. | Belg. | Cyp. | Est. | Finl. | Fra. | Germ. | Spa. | UK | Slove. | Slova. | Port. | Neth. | Irel. | Ita. | Gre. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Austria** | 1468,9 | | | | | | | | | | | | | | | |
| **Belgium** | 554,7 | 2426,7 | | | | | | | | | | | | | | |
| **Cyprus** | 552,5 | 2362,5 | 2550,4 | | | | | | | | | | | | | |
| **Estonia** | 5866,3 | -1526,2 | -1431,0 | 35864,4 | | | | | | | | | | | | |
| **Finland** | 547,8 | 246,1 | 274,4 | 2266,5 | 226,1 | | | | | | | | | | | |
| **France** | 312,4 | 852,2 | 837,5 | -323,8 | 141,4 | 431,8 | | | | | | | | | | |
| **Germany** | 424,2 | 513,0 | 534,9 | 1022,7 | 171,9 | 230,7 | 204,0 | | | | | | | | | |
| **Spain** | -78,3 | 3557,0 | 3362,4 | -7305,6 | 7,7 | 1314,0 | 562,3 | 6252,6 | | | | | | | | |
| **UK** | 877,7 | 163,7 | 210,5 | 3911,2 | 349,8 | 171,8 | 253,5 | -276,7 | 663,7 | | | | | | | |
| **Slovenia** | 1262,8 | 508,1 | 581,1 | 5614,5 | 504,5 | 308,4 | 391,6 | -98,2 | 834,4 | 1361,3 | | | | | | |
| **Slovakia** | 1347,3 | 481,9 | 526,9 | 6300,2 | 550,2 | 307,7 | 398,3 | -196,1 | 909,3 | 1407,1 | 1565,4 | | | | | |
| **Portugal** | -784,9 | 6331,4 | 6166,1 | -15938,4 | -186,8 | 2302,4 | 882,0 | 11328,0 | -991,7 | -739,0 | -955,8 | 22038,9 | | | | |
| **Netherlands** | 814,2 | 529,2 | 555,5 | 3227,3 | 331,4 | 257,2 | 282,1 | 273,7 | 518,4 | 776,8 | 836,6 | 170,5 | 533,8 | | | |
| **Ireland** | 642,0 | 2187,3 | 2076,3 | -901,2 | 298,4 | 933,3 | 505,5 | 3398,8 | 336,7 | 612,8 | 666,6 | 5906,1 | 596,0 | 2431,8 | | |
| **Italy** | 830,3 | 6900,6 | 6871,4 | -7607,6 | 375,5 | 2068,9 | 1201,8 | 10251,6 | -358,2 | 579,8 | 373,1 | 19890,4 | 1021,7 | 5647,4 | 23762,5 | |
| **Greece** | -2358,4 | 13328,9 | 12765,3 | -39005,3 | -692,6 | 5280,3 | 1690,6 | 25119,8 | -2461,8 | -2173,7 | -2680,6 | 47449,1 | -57,0 | 13070,3 | 39100,8 | 110490,4 |

**Table 7: Event study results announcements end of the month**

| Month-end announcements | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Constant Mean Returns Model | | | | Market Model | | | |
| *Country* | *AR 0-1* | *T-test* | *AR 1-3* | *T-test* | *AR 0-1* | *T-test* | *AR 1-3* | *T-test* |
| **Austria** | -0,29% | -0,35 | 0,04% | 0,05 | -0,49% | -0,46 | -0,06% | 0,05 |
| **Belgium** | -0,50% | -0,63 | -0,08% | -0,10 | -0,52% | -0,57 | -0,14% | -0,10 |
| **Cyprus** | -0,09% | -0,13 | -0,50% | -0,76 | -0,15% | -0,13 | -0,56% | -0,76 |
| **Estonia** | -0,33% | -0,33 | -0,61% | -0,61 | -0,74% | -0,33 | -1,02% | -0,61 |
| **Finland** | -0,40% | -0,53 | 0,35% | 0,47 | -0,65% | -0,53 | 0,09% | 0,47 |
| **France** | -0,49% | -0,56 | 0,13% | 0,14 | -0,58% | -0,56 | 0,03% | 0,14 |
| **Germany** | -0,71% | -0,88 | -0,44% | -0,54 | -0,84% | -0,88 | -0,56% | -0,54 |
| **Greece** | -0,89% | -1,24 | -1,00% | -1,40 | -0,78% | -1,24 | -0,90% | -1,40 |
| **Ireland** | -0,35% | -0,44 | -0,32% | -0,41 | -0,32% | -0,44 | -0,30% | -0,41 |
| **Italy** | -0,86% | -1,03 | -0,48% | -0,58 | -0,93% | -1,03 | -0,56% | -0,58 |
| **Netherlands** | -0,86% | -0,96 | 0,62% | 0,69 | -1,01% | -0,96 | 0,47% | 0,69 |
| **Portugal** | -1,07% | -1,31 | -0,70% | -0,85 | -1,03% | -1,31 | -0,65% | -0,85 |
| **Slovakia** | -0,69% | -0,40 | -1,00% | -0,57 | -0,64% | -0,40 | -0,95% | -0,57 |
| **Slovenia** | 2,74% | 1,45 | -0,93% | -0,49 | 2,89% | 1,45 | -0,78% | -0,49 |
| **Spain** | -0,89% | -1,08 | -0,54% | -0,66 | -1,01% | -1,08 | -0,66% | -0,66 |
| **United Kingdom** | -1,26% | -1,94 | -0,47% | -0,73 | -1,70% | -1,94 | -0,91% | -0,73 |

**Table 8: Event study results announcements middle of the month**

| Month-middle announcements | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Constant Mean Returns Model | | | | Market Model | | | |
| *Country* | *AR 0-1* | *T-test* | *AR 1-3* | *T-test* | *AR 0-1* | *T-test* | *AR 1-3* | *T-test* |
| **Austria** | 0,39% | 0,46 | 0,39% | 0,46 | 0,30% | 0,46 | 0,30% | 0,46 |
| **Belgium** | 0,89% | 1,12 | 0,33% | 0,41 | 0,83% | 1,12 | 0,27% | 0,41 |
| **Cyprus** | 0,28% | 0,43 | 0,03% | 0,04 | 0,22% | 0,43 | -0,03% | 0,05 |
| **Estonia** | 0,40% | 0,39 | 0,05% | 0,05 | -0,01% | 0,39 | -0,35% | 0,05 |
| **Finland** | -0,52% | -0,70 | 0,50% | 0,66 | -0,78% | -0,70 | 0,24% | 0,66 |
| **France** | 0,66% | 0,76 | -0,17% | -0,19 | 0,57% | 0,76 | -0,26% | -0,19 |
| **Germany** | 0,16% | 0,20 | -0,23% | -0,28 | 0,03% | 0,20 | -0,35% | -0,28 |
| **Greece** | 0,93% | 1,30 | 0,30% | 0,41 | 1,04% | 1,30 | 0,40% | 0,41 |
| **Ireland** | 0,21% | 0,26 | 0,07% | 0,09 | 0,23% | 0,26 | 0,10% | 0,09 |
| **Italy** | 0,14% | 0,16 | -0,36% | -0,43 | 0,06% | 0,16 | -0,44% | -0,43 |
| **Netherlands** | 0,78% | 0,87 | 0,39% | 0,43 | 0,63% | 0,87 | 0,24% | 0,43 |
| **Portugal** | 0,38% | 0,47 | 0,27% | 0,33 | 0,42% | 0,47 | 0,31% | 0,33 |
| **Slovakia** | -0,78% | -0,44 | -0,37% | -0,21 | -0,72% | -0,44 | -0,32% | -0,21 |
| **Slovenia** | 0,47% | 0,25 | -1,07% | -0,56 | 0,62% | 0,25 | -0,92% | -0,56 |
| **Spain** | 0,50% | 0,61 | -0,22% | -0,27 | 0,38% | 0,61 | -0,34% | -0,27 |
| **United Kingdom** | 0,00% | -0,01 | 0,62% | 0,96 | -0,44% | -0,01 | 0,19% | 0,96 |