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The effect of credit and rating events on credit default swap and equity markets

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List of Abbreviations

ACAR average cumulative abnormal average return

BMP Boehmer, Musumeci, Poulsen (1991)

bps basis points

CAR cumulative abnormal return

CASC cumulative adjusted spread changes

CDS credit default swap

CE credit event

CZ Corrado and Zivney (1992)

Fitch Fitch Ratings

MCASC mean cumulative abnormal CDS spread change

Moody's Moody's Investors Service

NBER National Bureau of Economic Research

NRSRO nationally recognized statistical rating organization

OLS ordinary least squares

OTC over-the-counter

UIH Uncertain Information Hypothesis

S&P Standard & Poor's

SEC Securities and Exchange Commission

Chapter 1

Introduction

1.1 Motivation

How the creditworthiness of a borrower is determined remains a question of much scholarly debate. Asymmetric information between borrowers and lenders is one of the main issues. The borrower has better information about his finances than the lender. The lender, on the other hand, has to approximate the likelihood that the borrower will default. The information asymmetry results in imperfect financial markets where investors need to trust the borrower's commitment to repay the debt. Therefore, investors need to assess the creditworthiness of the borrower, and credit ratings are potentially able to support investors in their evaluation of a borrower's probability of default. Credit rating agencies provide their opinion of the creditworthiness of debt issues in an easy to understand letter rating, indicating the issuer's probability of default. The higher the credit rating, the lower the probability of the borrower defaulting. Credit ratings are not a new instrument in financial markets, but are still the most important supporting tool in the evaluation of credit risk. In several markets, such as the U.S., credit ratings are even mandatory when firms issue new debt. Research shows that credit ratings play a prominent role in determining firm's capital structure (e.g. Kisgen, 2006, 2009; Tang, 2009) and their cost of capital (e.g. Kisgen and Strahan, 2010). Therefore, rating agencies serve as gatekeepers to capital markets (Xia, 2014). It is nevertheless questionable to what extent credit rating announcements provide new information to financial market participants, in particular debt market participants.

Ratings should provide timely and unbiased information about a firm's default probability assigned by credit specialists. Moreover, credit rating agencies should make their evaluation to the best interest of investors. However, as the rated firm pays the credit rating, it is critical to ensure that rating fees are not linked to the rating level and that the rating process is designed to be free of bias by incorporating multiple perspectives and views (Bolton et al., 2012; Mathis et al., 2009). In addition, it is maybe possible that firms choose the best rating offer, a practice referred to as "rating shopping". In this situation, issuers solicit ratings from multiple agencies and then choose the most favorable one (Griffin et al., 2013). A potential consequence of the rating shopping process would be a rating inflation and a biased rating. Moreover, the credit rating market is very concentrated. The three largest credit rating agencies have a market share of approximately 90-95%. Their dominance of the rating market may have detrimental effects on the proper functioning of competitive forces in the rating industry. This raises the question whether credit rating agencies are driven by other incentives than the best interest of investors. Another set of concerns has emerged concerning the adaption to credit events. Credit rating agencies focus on a rating stability and may therefore react slower to new information (Altman and Rijken, 2004).

Rating changes only occur when the rating agency has evidence that the change in the financial position is permanent (Altman and Rijken, 2004; Cheng and Neamtiu, 2009; Löffler, 2005). This slow adjustment of ratings is most prominent in cases of sudden bankruptcies (e.g. the cases of Enron, Worldcom and Lehman Brothers).

1.1.1 The impact of credit rating changes on financial markets

The first part of this dissertation focuses on the impact of credit rating changes on financial markets. In particular, the equity and debt market reactions are analyzed. Prior research shows that credit ratings have an impact on a firm's stock price and its bond spreads (e.g. Bannier and Hirsch, 2010; Goh and Ederington, 1993, 1999; Gropp and Richards, 2001; Hand et al., 1992). However, the impact of rating announcements can vary during different market periods (Duff and Einig, 2009; Ferri et al., 1999; Michayluk and Neuhauser, 2006; Pianeselli and Zaghini, 2014). In times of crisis, credit ratings play a minor role for financial markets. Ferri et al. (1999) show that the East Asian crisis made it impossible for rating agencies to forecast the effects of the crisis. Credit rating agencies have an incentive to become more conservative to avoid reputation damage caused by a worse assessment of the current firm's position (Ferri et al., 1999). During crisis periods, firms face new challenges and the probability of default increases to a certain point, which seems not surprising to investors.

In addition, prior studies primary focus on the U.S. market and neglect external conditions, such as the market environment or the respective financial systems. It is reasonable to assume that the bank market structure has an impact on how credit ratings are perceived by the financial market. In contrast to the U.S., German firms supposedly have a strong bank relationship and therefore banks play a more prominent role in the German market. Boot et al. (2006) show in their theoretical model that credit rating agencies act as monitoring providers for investors. The monitoring role may be particularly evident when the credit quality of a firm is deteriorating, resulting in an attempt of the firm to shore up its risk position to avoid a rating downgrade. Bannier and Hirsch (2010) support this assumption to a certain extent, as they document that disciplinary effects are more prevalent for firms rated in lower rating classes than for firms in higher rating classes. In bank-based systems, on the other hand, the monitoring role is facilitated by banks. Therefore, the prior findings, whether credit ratings provide new information to financial markets or not, are incomplete. The first part of the dissertation extents the prior findings of the impact of credit rating changes on financial markets. It includes the respective national financial system and adds a time component when analyzing the impact of credit ratings on financial markets. These research objectives can be summarized in the first two research questions of this dissertation:

Research question 1. *Do periods of crisis change the impact of credit ratings on financial markets?*

Research question 2. *Does the financial system change the impact of credit ratings on financial markets?*

1.1.2 Credit default swap market efficiency

Besides credit ratings, the credit default swap (CDS) spread of a firm may be viewed as an indicator of a firm's creditworthiness. CDS are a relative new instrument to hedge against a default of an entity. CDS contracts are generally quoted daily and the aggregated CDS spread is a good indicator for the default probability of an issuer. The higher the CDS spread, the higher the probability of default. The CDS spread has several advantages in comparison to credit ratings. First, CDS spreads can be observed on a daily basis, so the CDS spread is sensitive in small changes in firm characteristics. The rating scale of rating agencies is discrete, whereas CDS spreads can take continuous values. Second, the CDS spread is a market-based measure. It aggregates the assessment of many investors as well as insurance providers in contrast to the opinion of few credit rating analysts. If the assessment of the CDS market participants is misguided, they lose money. Due to the fact that credit rating agencies only communicate their opinion, incorrect valuations result in reputation damage only. However, the reputation damage would be less due the oligopoly market structure. Therefore, the CDS market could complement equity and debt markets as an additional market-based measure of the creditworthiness of a firm. The CDS market, however, is a relatively new market and studies on CDS do not have a long history. There is an extensive and still growing literature on the efficiency of stock markets, yet few studies address the efficiency of CDS markets as a whole.

The second part of this dissertation analyzes the CDS market efficiency. In contrast to stock and bond markets, the CDS market is still a comparatively unregulated over-the-counter (OTC) market, dominated by large institutional investors, such as banks, insurance firms, and hedge funds. It is therefore possible that these investors possess informational advantages that stem from trading in an opaque market with relatively few market participants. This leads to the third research question:

Research question 3. *How efficient is the CDS market?*

In addition, since the financial crisis with its peak in 2008 and the European debt crisis beginning in 2009, CDS have had a bad reputation. Authorities blamed the OTC traded instrument for causing systemic risk and being one trigger of the crisis (Barnier, 2010; Das, 2010). Therefore, regulators had the idea to prevent speculative traders from betting on a default without actually being a creditor. The CDS market efficiency depends on the market stability and speculative traders which are actually not a creditor of the reference entity. This results in the final research question:

Research question 4. *Does new regulation improve the CDS market efficiency?*

The following subsection provides a brief summary on credit rating agencies and their impact on financial markets. The basic structure of a CDS contracts is then provided in order to understand the underlying idea of CDS contracts.

1.2 Credit rating agencies and financial markets

Credit rating agencies have a long history. In 1909, John Moody published the first publicly available bond rating, mostly concerning railroad bonds. Moody's firm was followed by Poor's Publishing Company in 1916, the Standard Statistics Company in 1922, and the Fitch Publishing Company in 1924. Poor's Publishing Company and the Standard Statistics Company merged later into what is now known as Standard & Poor's (S&P). Since the first rating agency was formed at the beginning of the 20th century, the role of rating agencies has become central to financial markets due to the rising complexity of financial products in conjunction with the reliance of institutional investors on credit ratings for their investment decisions and the expansion in the use of ratings by financial regulators.

The credit rating market is highly concentrated due to economies of scale, as the costs of gathering and analyzing data are a potential barrier to market competition. The market share of the big three credit rating agencies, S&P, Moody's Investors Service (Moody's), and Fitch

Ratings (Fitch), is approximately 96.5% of all credit ratings in the U.S. (U.S. Securities and Exchange Commission, 2014), while it is 90% of all credit ratings in Europe (European Securities and Markets Authority, 2013). Moody's and S&P have a market share of approximately 35% each, followed by Fitch with a market share of 18% (European Securities and Markets Authority, 2013). These three agencies operate in all economic sectors, whereas smaller rating agencies mostly focus on one particular sector. The leading position of the three agencies is also developed by U.S. regulation (U.S. Securities and Exchange Commission, 2014). In the U.S., credit rating agencies need to be recognized as a nationally recognized statistical rating organization (NRSRO) by the Securities and Exchange Commission (SEC). Credit ratings define a globally uniform benchmark for firm's credit risk and this is an attractive reference for international standards, such as Basel II.

The main function of rating agencies is to reduce information asymmetry between investors and the issuers of securities. They assign a credit rating to express their evaluation of the issuer's creditworthiness. S&P defines a credit rating as a "forward-looking opinion about the creditworthiness of an obligor with respect to a specific financial obligation" (Standard & Poor's, 2016). Altough credit rating agencies adopted different rating scales, there is equivalence across the scales which facilitates comparison (see Table 1.1 for a detailed description of rating classes). The Baa1 assigned by Moody's is equivalent to a BBB+ rating from S&P or Fitch. The rating letters can be split into investment grade and non-investment grade. A firm or bond is considered as investment grade if its rating is BBB- or higher rated by S&P or Fitch or at least Baa3 rated by Moody's. Firms rated as investment grade are likely enough to meet payment obligations that banks are allowed to invest in them. The threshold between investment and non-investment grade therefore has important implications for issuer's borrowing costs (Hite and Warga, 1997).

Table 1.1: Definition of rating classes

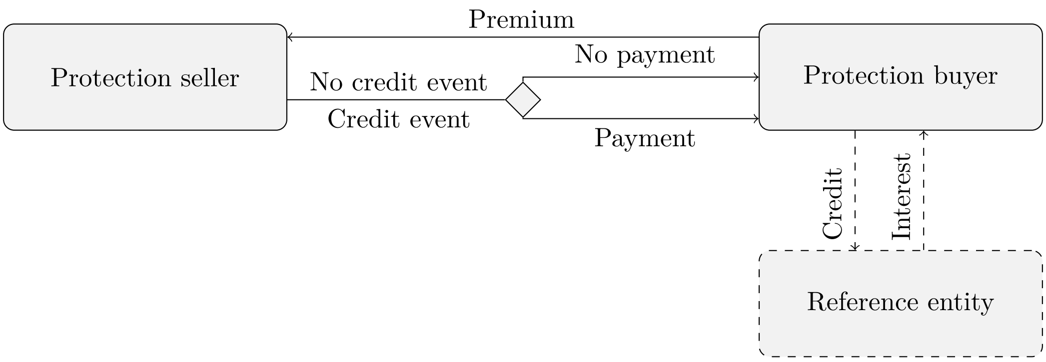
Moody's	S&P	Fitch	Rating category definition	Investment status
Aaa	AAA	AAA	Prime	
Aa1	AA+	AA+		
Aa2	AA	AA	High	
Aa3	AA−	AA−		
A1	A+	A+		Investment grade
A2	A	A	Upper medium	
A3	A−	A−		
Baa1	BBB+	BBB+		
Baa2	BBB	BBB	Lower medium	
Baa3	BBB−	BBB−		
Ba1	BB+	BB+		
Ba2	BB	BB	Speculative	
Ba3	BB−	BB−		
B1	B+	B+		
B2	B	B	Highly speculative	
B3	B−	B−		
Caa1	CCC+		Substantial risks	Non-Investment grade
Caa2	CCC		Extremely speculative	
Caa3	CCC−	CCC	Default imminent	
Ca	CC		with little prospect	
	C		for recovery	
C	D	DDD	In default	
/		DD		
		D		

Prior to the financial crisis beginning in 2007, market participants and regulators relied heavily on the ratings that credit rating agencies assigned to determine the creditworthiness of companies and financial products. Credit rating agencies were generally recognized as one of the primary information providers for debt (e.g. Finnerty et al., 2013; Hull et al., 2004; Norden and Weber, 2004) and equity investors (e.g. Bannier and Hirsch, 2010; Goh and Ederington, 1993, 1999; Gropp and Richards, 2001; Hand et al., 1992). As firms began to default and many highly rated securities, indicated as investment grade, lost value, the poor quality of these ratings became apparent and brought increased attention to credit rating agencies and their credit rating process (Bolton et al., 2012). In many cases, credit rating agencies have failed to properly assess the creditworthiness of a firm and their ratings were not a reliable medium-term prognosis for the borrower's credit risk. Events at the firm level (e.g. the cases of Enron from 2001, Worldcom from 2002, and the case of Lehman Brothers from 2007), and at the sovereign level (e.g. the case of Greece in the EU in 2010) indicate that rating agencies had a too optimistic assessment. Against this background, CDS are increasingly viewed as an alternative to credit ratings.

1.3 Basic structure of credit default swaps

The main purpose of this dissertation is to investigate the impact of credit events, such as rating changes, on financial markets and the efficiency of the CDS market. Therefore, it is important to understand how CDS contracts are structured. Figure 1.1 illustrates the basic structure of a CDS contract. Typically, the buyer of a CDS has bought a corporate bond issued by a reference entity. Therefore, he receives periodic coupons from the reference entity until the maturity of the bond. The basic idea of a CDS contract is to protect the buyer against a possible default of the reference entity, which may result in inability of the reference entity to pay the coupons and/ or the principal of the bond. In order to eliminate this default risk, the buyer enters into a CDS contract with the protection seller. The buyer pays a premium to the protection seller and in return the seller protects the buyer in case of a default of the reference entity. It is common in the CDS market to state the premium payments as a percentage of the value of the reference asset. This percentage is called credit spread and is expressed in basis points (bps). In case of a default before the maturity of the swap, the protection seller has to pay a specific amount (called default premium) to the protection buyer. If the reference entity does not default on its debt payments, the protection seller has no obligation to the protection buyer.

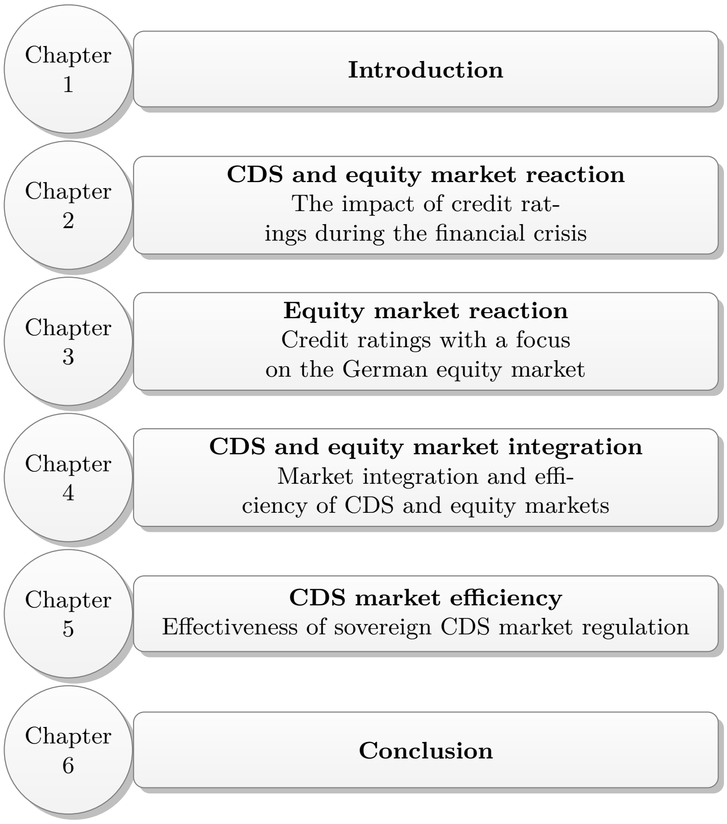
Figure 1.1: Basic structure of a credit default swap contract.



1.4 Thesis structure

This cumulative dissertation comprises four stand-alone papers. Each of the papers includes an introduction, a data and methodology part, a section on the empirical results and concluding remarks. All papers have been published or accepted for publication and are available on the respective journal website. The first paper (Chapter 2) examines the impact of credit rating announcements during the period of the financial crisis. The second paper (Chapter 3) analyzes the role of rating agencies in Germany, one of the premier bank-based systems. The third paper (Chapter 4) tests the market integration and efficiency of CDS and equity markets. The fourth paper (Chapter 5) examines the European sovereign CDS market and analyzes the worldwide first uncovered CDS regulation. Figure 1.2 illustrates the main focus of the four papers. The final Chapter 6 summarizes the main findings of the dissertation and concludes with suggestions for future research. The following part of the introduction summarizes each paper and briefly outlines the respective key findings.

Figure 1.2: Overview of the key elements of the thesis.



Chapter 2 provides an analysis of the effects of rating announcement on financial markets during the global financial crisis (2008-mid 2009) and the subsequent period (mid 2009-2013), with a focus on non-financial firms.[1] It seems plausible that downgrades during periods of crisis are not surprising to investors. Investors do not require downgrade announcements during crisis periods, as they lead rating agencies because the agencies only react to the deteriorating market environment. However, rating upgrade releases during a crisis can potentially be a positive signal. Rating upgrades during crises rarely happen and indicate that companies have a solid capital structure or a good operating performance even during an economic downturn. The global financial crisis offers a unique setting to examine the effects of rating changes during a crisis and to test how investors react during a crisis.

Chapter 3 analyzes the role of credit rating agencies as financial intermediaries in bank-based systems.[2] For many years now, rating agencies play an instrumental role in investors' decision

[1] This article is published in The Journal of Fixed Income, Vol. 25 No. 4, Kiesel, F., Do investors still rely on credit rating agencies? Evidence from the financial crisis, pp. 20-31, Copyright Institutional Investor Journals Group (2016), doi: 10.3905/jfi.2016.25.4.020

[2] This article is published in The Journal of Fixed Income, Vol. 25 No. 4, Kiesel, F. & Schiereck, D., The Effect

making, but research has rarely considered how the importance of rating agencies may differ across different financial systems. It is reasonable to assume that banks are much better informed than rating agencies when evaluating the creditworthiness of their debtors. How financial intermediation differs in the financial systems of Germany and the U.S. has important implications for the role and focus of credit rating agencies. This study focuses on the value of rating agency announcements to equity investors in a leading bank-based system, namely Germany. In bank-based systems, such as Germany, banks are the most important intermediaries that evaluate the creditworthiness of a given company. Therefore, different market reactions in this system are expected.

The market integration and efficiency of CDS and equity markets is analyzed in Chapter 4.[3] The empirical evidence on parallel information processing in equity and credit markets is still incomplete and offers a conflicting picture. While there are stable results that stock markets are processing information faster than CDS markets (e.g. Forte and Peña, 2009; Norden and Weber, 2009; Trutwein and Schiereck, 2011; Wang and Bhar, 2014), the announcement effects of credit rating changes show that there are also significant information spillovers from credit to equity markets, particularly for negative rating events (e.g. Imbierowicz and Wahrenburg, 2013; Norden and Weber, 2004). As a consequence of these findings, the question arises whether stock markets have the ability to process information more quickly than debt and credit markets. However, the stock market efficiency still remains incomplete, as large debt valuation adjustments, credit rating news, and credit risk changes exert a significant influence on stock prices.

Chapter 5 examines one of the first worldwide uncovered CDS regulations.[4] The EU enacted Regulation (EU) No. 236/2012 for banning short sells and uncovered sovereign CDS in 2012. Since the recent financial crisis with its peak in 2008 and the European debt crisis beginning in 2009, CDS have had a bad reputation. Especially, the EU identified speculations on uncovered CDS as an important factor for apparent market failures during the sovereign debt crisis. The EU does not totally prohibit CDS, but they should not be used as a speculative instrument (e.g. for short selling). The idea is to prevent speculative traders from betting on a default without actually being a creditor. The results of this analysis indicate widening CDS spreads prior to the regulation and stable CDS spreads following the introduction of the regulation. Especially sovereign CDS of European crisis-hit entities are stable since the regulation was introduced.

The final Chapter 6 summarizes the results of the four articles. The main conclusions of the papers are discussed and the implications for financial markets, in particular for the credit market, are described.

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of Rating Announcements on Firms in Bank-Based Systems, pp. 84-95, Copyright Institutional Investor Journals Group (2015), doi: 10.3905/jfi.2015.24.4.084

[3] This article will be published in The Quarterly Review of Economics and Finance, Kiesel, F., Kolaric, S. & Schiereck, D., Market integration and efficiency of CDS and equity markets, Copyright Elsevier (2016), doi: 10.1016/j.qref.2016.02.010

[4] This article is published in The Journal of Risk Finance, Vol. 16 No. 4, Kiesel, F., Lücke, F. & Schiereck, D., Regulation of uncovered sovereign credit default swaps – Evidence from the European Union, pp. 425-443, Copyright Emerald Group Publishing Limited (2015), doi: 10.1108/JRF-02-2015-0025

Chapter 2

Do investors still rely on credit rating agencies? Evidence from the financial crisis*

Abstract

The global financial crisis brought increased attention to the importance of rating agencies. There is a broad consensus that they were unable to detect any deterioration of the issuer's credit quality in a timely manner. This study analyzes the credit default swap (CDS) and stock market response to rating changes during the financial crisis and the subsequent years. The sample includes 542 companies from the U.S. and 15 European countries and examines 915 corporate issuer ratings.

The results show that there is no CDS market response to rating announcements during the crisis, but that the stock market anticipates downgrade announcements.

2.1 Introduction

For several decades now, credit rating agencies were considered important actors in financial markets. Investors rely on the agencies' announcements and evaluation procedures for investment decisions (Bannier and Hirsch, 2010; Boot et al., 2006; Finnerty et al., 2013). Prior research shows that downgrades increase credit default swap (CDS) spreads and have a negative effect on stock prices, whereas rating upgrades only have a weak positive effect on stock returns and a weak negative or non-significant effect on CDS spreads (Hull et al., 2004; Imbierowicz and Wahrenburg, 2013; Norden and Weber, 2004).

During 2008 through mid-2009, financial markets were heavily influenced by negative news. The global financial crisis brought increased attention to the importance of rating agencies and their valuation process. There is a broad consensus that credit rating agencies bear at least some responsibility for the crisis. Their ratings were too lax, and they were unable to detect any deterioration of the issuer's credit quality in a timely manner. The recent financial crisis has also shown that rating releases of credit rating agencies have potentially systematic consequences. Recent regulatory changes in the U.S. and the European Union have sought to reduce the power of rating agencies and their announcements.

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This article examines the influence of rating announcement for investors during the global financial crisis (2008 through mid-2009) and the subsequent period (mid-2009 through 2013), with a focus on non-financial firms. The financial market is differentiated into the equity and debt market. The stock market indicates the equity investor reaction, whereas the CDS market can be viewed as an indicator of the market reaction of bond holders. The corporate CDS market is used instead of the bond market because CDS spreads provide a better measure for credit quality (Hull et al., 2004).

It seems plausible that downgrades in years of uncertainty are not surprising to investors. Investors do not require downgrade announcements during crisis periods, as they lead the rating agencies, because the agencies react to the negative market environment only. Rating upgrade releases during a crisis, however, can potentially provide positive information. Rating upgrades during crises rarely happen and indicate that companies have a solid capital structure or a good operating performance even during an economic downturn. The global financial crisis offers a unique data set to examine effects of rating changes during a crisis and to test how investors react during a crisis. Since the global financial crisis, research primarily has focused on sovereign ratings. Corporate ratings are rarely investigated.

2.2 Rating announcements before the financial crisis

Credit rating changes have a long research history. The literature can be divided in two fields of research: *(i)* the impact of rating actions on stock returns, and *(ii)* the relationship between CDS spreads and credit ratings.

Negative market reactions on stock and bond markets after rating downgrades are well documented (Bannier and Hirsch, 2010; Goh and Ederington, 1993, 1999; Gropp and Richards, 2001; Hand et al., 1992). In contrast to downgrades, findings on rating upgrades are inconclusive. Holthausen and Leftwich (1986), Goh and Ederington (1993, 1999), Bannier and Hirsch (2010) and Kiesel and Schiereck (2015) find an insignificant market reaction to rating upgrades, Jorion and Zhang (2007b), Dichev and Piotroski (2001) are able to empirically verify a weak reaction on stock and bond markets. Significant positive market reactions following rating upgrades are found by Jorion et al. (2005) after SEC Regulation Fair Disclosure became effective in October 2000. More recently, several studies investigate the reactions of sovereign rating changes since the global financial crisis (Borensztein et al., 2013; Kiesel et al., 2015; Klein and Stellner, 2014; Williams et al., 2013).

Academic research on CDS is still gaining since 2000. CDS were conceived in the early 1990s, but the CDS market did not start to became relevant before 2000. The CDS market is an OTC market and the availability of CDS spreads increased after 2000. The relationship between equity and bond markets is one area of research related to CDS (Blanco et al., 2005; Hull et al., 2004; Longstaff et al., 2005; Norden and Weber, 2004; Trutwein and Schiereck, 2011). Hull et al. (2004) examine the relationship between CDS spreads and bond yields. Using CDS data by GFI and ratings by Moody's they find evidence in the USA that CDS spreads predict negative rating events. This finding is supported by Acharya and Johnson (2007) who document the presence of information flow from the CDS market to the equity market. The methodology of Hull et al. (2004) is also applied by Norden and Weber (2004) who investigate a large European bank sample for the period between July 1998 and December 2002. They find a significant negative effect for downgrades on the CDS and stock market for rating announcements by S&P, Moody's and Fitch. They also find an anticipation effect for the CDS and stock market. An analysis of 1,951 S&P rating actions, 1,323 downgrades and 628 upgrades from January 2001 to May 2009 is conducted by

Finnerty et al. (2013). They add the impact of placements on watchlist and on the outlook for rating actions and confirm the results of prior studies that the CDS market anticipate rating changes. In addition, Finnerty et al. (2013) find a significant impact of rating upgrades on CDS spreads since 2003. Overall, Finnerty et al. (2013) confirm the results that downgrades have a much greater impact on CDS than upgrades. Imbierowicz and Wahrenburg (2013) analyze the wealth transfer between stockholders and bondholders after Moody's rating downgrades and reviews. Their data covers the time period from January 2001 to December 2007 and includes a sample of 472 firms. Imbierowicz and Wahrenburg (2013) find a negative effect on CDS and stocks and conclude that there exists a wealth transfer from equity- to bondholders. Galil and Soffer (2011) are researching a more detailed aspect of the influence of rating announcements. They show that bad news and negative rating announcements tend to cluster, whereas positive rating announcements are less frequent. They confirm the previous findings that the CDS market has a stronger response to bad news than to good news.

The role of rating agencies during crises is examined in several studies. During the 1997 Asian financial crisis, Michayluk and Neuhauser (2006) find strong evidence of stock market overreaction. They also report an increase in uncertainty during the crisis period. Ferri et al. (1999) analyze the responsibility of rating agencies during the East Asian crisis. They find that rating agencies underestimate the economic fundamentals in their downgrades formulations. Duff and Einig (2009) analyze the function of credit rating agencies during the subprime crisis and the global credit downturn in 2008 and conclude that rating agencies should make more of an effort in defining their credit criteria to avoid future rating mistakes. Pianeselli and Zaghini (2014) examine determinants of the risk premium paid by non-financial corporations on long-term bonds between 2005 and 2012. They show that Italian, Spanish, and Portuguese firms paid on average between 70 and 120 bps of additional premium due to the negative spillovers, while German firms received a discount of 40 bps.

The present study examines the rating announcement effect on the CDS and stock market since the global financial crisis started in 2008. The financial crisis is an interesting time to analyze rating changes on both markets as there is a broad consensus that credit rating agencies bear at least some responsibility for the global financial crisis. If credit rating agencies were too lax and they were unable to detect any deterioration of the issuer's credit quality in a timely manner, stock and CDS market reaction should be different during this time. In addition, the paper examines whether the CDS and stock market reaction is different in the subsequent years of the financial crisis.

2.3 Data and Methodology

2.3.1 Data sample and selection

The analysis is based on an international sample of listed firms with available CDS and long-term issuer ratings by S&P and/or Moody's. Banks, financial services and insurance companies (SIC 6000-6999) are excluded for this investigation, because they have a unique capital structure and are heavily regulated especially during the global financial crisis, which affects their performance differently. The data covers the time period from January 2008 to December 2013. The CDS data is based on the Thomson Reuters Composite CDS data. Thomson Reuters uses CDS quotes from over 30 worldwide contributors and applies a screening procedure to eliminate outliers and doubtful data. The CDS data is available since December 2007. I focus on five-year quotes because this is the benchmark maturity in the CDS market and therefore these CDS are the most liquid ones. After excluding sovereigns and financial-related companies, I matched CDS data to their respective company. In total, 593 complete data sets were found. In a next step, I examine for these companies whether S&P or Moody's rates them. In 542 of the 593 companies, I found ratings by S&P and/ or Moody's. The rating changes of the sampled firms are from Thomson Reuters and additionally the press announcement via large newspapers and the websites of the rating agencies were collected. Using the data of two rating agencies the minimum distance of a rating changes is 20 days to avoid confounding events. In total, I collect 915 rating changes of the two major rating agencies. As shown in Figure 2.1 and Table 2.1, I find 429 downgrade and 386 upgrades between the years 2008 and 2013. The National Bureau of Economic Research (NBER) concluded that the crisis ended in June 2009. Figure 2.1 shows that most of the rating changes in the sample are between 2008 and mid-2009 and therefore confirm the conclusion of the NBER.

Figure 2.1: Graphical distribution of rating events between 2008 and 2013.

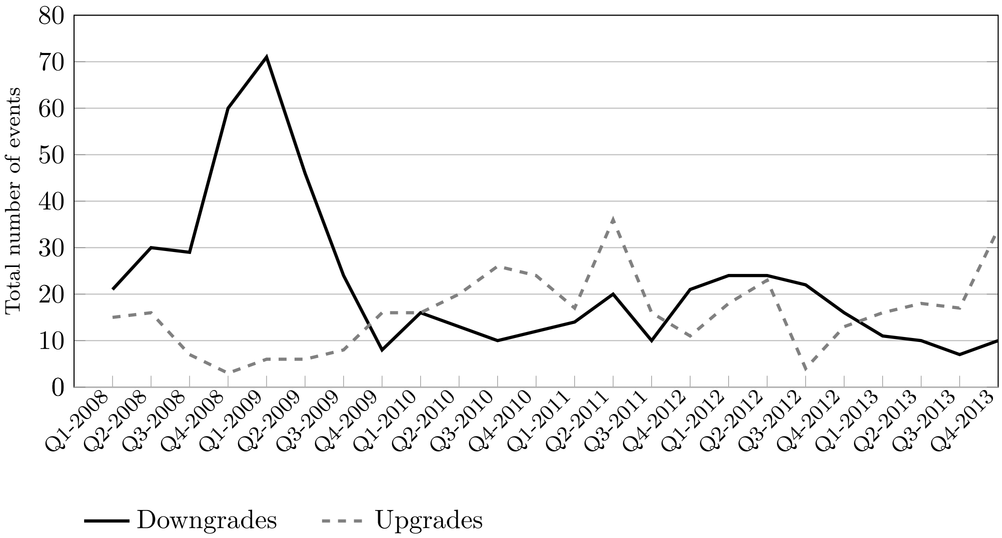

Table 2.2 shows the firm distribution across their geographical regions. The data set is based on companies of 16 different countries. 395 firms are from the United States, whereas 147 firms are from European countries. 65.31% of the European sample is from UK, France and Germany. The first column shows the total number of firms rated by S&P or Moody's whereas the second column displays the number of firms that are affected by rating changes. In total, 70.48% of all examined companies had a rating change between the years 2008 and 2013. Companies without a rating changes are still used for the CDS benchmark model. S&P and Moody's use different rating scales. So, I construct an aggregated rating system. The modified rating scale is according to Norden and Weber (2004) on a numerical 17 grade scale (AAA/Aaa = 1, AA+ / Aa1 = 2,..., CCC/Caa1 and below = 17). The mean rating before downgrades is 9.40 the mean rating before an upgrade is 10.92. 10 is the lowest investment grade status (S&P = BBB-, Moody's = Baa3) whereas 11 is the highest non-investment or speculative grade (S&P = BB+, Moody's = Ba1), respectively.

Table 2.1: Number of ratings events by year

	2008	2009	2010	2011	2012	2013	Total
Downgrades	140	149	51	65	86	38	529
Upgrades	41	36	86	80	58	85	386
Total	181	185	137	145	144	123	915

Table 2.2: Sample sort by Country and Number of Events.

	$Firms_{total}$	$Firms_{changes}$	Events	Down	Up	Mean
Austria	1	1	3	3	0	08.00
Belgium	2	2	4	3	1	06.00
Denmark	1	1	2	0	2	12.50
Finland	7	5	20	16	4	10.25
France	32	26	60	40	20	08.82
Germany	24	22	66	33	33	09.55
Greece	1	1	11	8	3	12.00
Ireland	1	1	3	1	2	12.67
Italy	8	8	34	30	4	08.79
Luxembourg	2	1	3	3	0	09.00
Netherlands	11	5	14	11	3	09.00
Portugal	1	1	4	4	0	07.50
Spain	6	6	19	17	2	08.05
Sweden	9	4	9	6	3	08.00
United Kingdom	40	22	50	31	19	08.58
Europe Total	147	106	302	206	96	09.08
United States	395	274	613	323	290	10.49
Total	542	382	915	529	386	10.02

2.3.2 Methodology

The present study uses two different approaches of event studies. The approach of Hull et al. (2004) and Norden and Weber (2004) is applied to measure the abnormal CDS spread changes after rating changes. The event study on stocks uses a four factor model by Fama and French (1993, 1996) and Carhart (1997).

Event study on CDS

I analyze abnormal CDS spread changes of non-financial firms to measure the CDS market reaction. CDS spread changes before day zero are adjusted by changes of a CDS spread index of the same rating class and the same geographical region as the company's old rating. From the day of the rating change, the CDS spread index changes to the new rating class:

$$ASC_{it} = \begin{cases} (CDS_{it} - CDS_{it-1}) - (I_{ot,gr} - I_{ot-1,gr}), & \text{if } t < 0 \\ (CDS_{it} - CDS_{it-1}) - (I_{nt,gr} - I_{nt-1,gr}), & \text{if } t \geq 0 \end{cases} \tag{2.1}$$

where ASC_{it} is the abnormal CDS spread change for firm i on day t, CDS_{it} is the observed CDS spread for firm i on day t, I_{ot} is the CDS spread index for rating class o (old) on day t and I_{nt} is the CDS spread index for rating class n (new) on day t of the same geographical region gr.

Note, that this adjustment for the event day is different to Hull et al. (2004), but follows the approach of Norden and Weber (2004), and more recently Imbierowicz and Wahrenburg (2013), using the new rating class for event day 0. Daily CDS spread index levels correspond to the equally weighted cross-sectional mean of all CDS spreads for an equal rating class in the sample. The data availability allows to differentiate between U.S. and European entities and within the 17 scale rating classes. cumulative abnormal returns (CASCs) are calculated by adding daily ASCs. Rating changes with insufficient CDS liquidity in the event window were removed. The non-parametric Wilcoxon signed-rank test and the cross-sectional t-test are used to test for statistical significance.

Event study on stocks

I use a four factor model based on Fama and French (1993) and Carhart (1997). Fama and French (1993) extended the single index model to form a 3-factor model that better explains stock returns.

Two additional factors, size and book-to-market are used in addition to the market proxy. Carhart (1997) extended this approach by adding a fourth factor that captures the momentum effect originally described by Jegadeesh and Titman (1993). The Fama and French (1993) and Carhart (1997) factors are obtained from the homepage of Andrea Frazzini.[1] The model is estimated using a 252-trading-day period (one whole year) prior to the first day of the event day. Abnormal returns are calculated as followed:

$$AR_{jt} = R_{jt} - (\alpha + \beta_{1j}MKT_t + \beta_{2j}SMB_t + \beta_{1j}MKT_t + \beta_{3j}HML_t + \beta_{4j}MOM_t) \qquad (2.2)$$

where R_{jt} is the market return of firm j on day t during the estimation period, MKT_t is the benchmark return on day t, SMB_t is the difference in return between a small cap portfolio and a large cap portfolio on day t, HML_t is the difference in return between a portfolio of high book-to-market stocks and a portfolio of low book-to-market stocks on day t, MOM_t is the difference in return between a portfolio of winners and a portfolio of losers on day t, and $\beta_{i,j}$ are coefficients for the firm j.

The parameters are estimated using the country specific return indexes. cumulative abnormal return (CARs) are calculated by adding daily ARs. In order to test whether the CARs are statistically different from zero, two different test procedures are used: *(i)* the non-parametric test statistic introduced by Corrado and Zivney (1992), the CZ-test, and *(ii)* the test statistic developed by Boehmer et al. (1991), the BMP-test. Results are interpreted along the lines of the non-parametric test statistics, as CDS spreads and daily stock returns do not follow a normal distribution. Parametric tests are only used as a robustness check. Differences between the periods are tested using the non-parametric Wilcoxon signed-rank test and the parametric two-sample t-test.

2.4 Empirical Results

2.4.1 Analyzing CDS spread and stock returns changes

This section provides the results for the CDS and stock market response to rating downgrades and upgrades since the global financial crisis. Table 2.3 summarizes the results on the CDS market from 2008 to 2013. Overall, I find for rating downgrades and upgrades significant market reactions. The results for rating downgrades are shown in Panel A. Mean and median CASCs are different from zero at the 5% level of significance for all event windows that include the announcement day. Downgrades lead to positive CASC because a downgrade signals an increase in default risk for investors. The CDS market already shows an abnormal performance two days before the actual downgrade. Highest median and mean CASCs can be observed during the $[-2;2]$ event window. The $[2;10]$ event window is not significant and suggests no market reaction afterwards. During the $[-10;10]$ event window the CASC is significant at least on the 5% level of significance.

Panel B of Table 2.3 reports the results for rating upgrades from 2008 to 2013. For rating upgrades, I find that the CASCs are significantly below zero for all event windows that include the day of the rating upgrade. Rating upgrades lead to negative CASC as the upgrade signals a reduction in default risk. During the $[-1;1]$ event window the mean CASC for rating downgrades is 4.6 bps, whereas rating upgrades show a mean CASC of -1.1 bps. This suggests that the CDS market reaction is economically larger for rating downgrades than for rating upgrades.

[1] `http://www.econ.yale.edu/~af227/data_library.htm`

Table 2.3: Cumulative abnormal CDS spread changes (CASC) between 2008 and 2013; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	[−10;10]	[−10;−2]	[−1;1]	[−2;2]	[2;10]
Panel A: Downgrades					
Median CASC (in bps)	0.2889	0.1760	0.5810	0.4413	0.1188
% of CASC >0	58.16	53.44	58.62	60.23	53.27
Signed Rank	−3.799***	−1.692*	−3.726***	−3.547***	−1.121
Mean CASC (in bps)	1.5238	0.3203	4.6288	5.2484	0.8188
t-test	2.342**	0.400	2.476**	2.554**	0.775
N	435	451	435	435	443
Panel B: Upgrades					
Median CASC (in bps)	−0.0697	−0.0105	−0.1802	−0.1523	−0.1020
% of CASC <0	56.84	50.90	57.14	56.23	55.49
Signed Rank	−3.237***	−0.268	−3.515***	−3.260***	−2.312**
Mean CASC (in bps)	−0.3153	−0.1324	−1.0704	−0.7950	−0.2171
t-test	−2.818***	−0.715	−3.133***	−3.056***	−1.473
N	329	332	329	329	337

Overall, the results for the CDS spread changes indicate that rating downgrades have a larger influence than rating upgrades, however both event types are significant. Compared to prior studies, the mean CASC is lower. Imbierowicz and Wahrenburg (2013) find for Moody's ratings in the $[-1;1]$ event window a mean CASC of 8.6 bps and Norden and Weber (2004) for S&P ratings a mean CASC of 6.7 bps.

The stock market response to rating downgrades (Panel A) and rating upgrades (Panel B) are shown in Table 2.4. In Panel A, all event windows except the post-period have significant and negative median and mean CARs. The $[-10;-2]$ event window is highly significant negative for the stock market. This suggests that the stock market anticipates the downgrade prior to the CDS markets. This is in stark contrast to Acharya and Johnson (2007) who conclude that information flows from the CDS market to the equity market. The reported percentages of negative returns is about 60% and close to the results of Hand et al. (1992) and Norden and Weber (2004). During the $[-1;1]$ event window I find negative abnormal returns of −1.78%. As the CDS market, the stock market does not show significant abnormal returns in the post-announcement period.

Table 2.4: Cumulative abnormal returns (CARs) between 2008 and 2013; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	[−10;10]	[−10;−2]	[−1;1]	[−2;2]	[2;10]
Panel A: Downgrades					
Median CAR	−1.63%	−1.08%	−0.80%	−1.02%	−0.10%
% of CAR <0	58.70	57.36	60.04	58.70	50.86
CZ Z-value	−3.876***	−2.435**	−5.330***	−5.340***	−0.409
Mean CAR	−3.02%	−1.50%	−1.78%	−2.36%	0.26%
BMP Z-value	−4.597***	−3.430***	−4.869***	−5.455***	−0.065
N	523	523	523	523	523
Panel B: Upgrades					
Median CAR (%)	−0.20%	−0.09%	0.08%	−0.18%	−0.40%
% of CAR >0	48.54	48.81	53.58	45.62	45.62
CZ Z-value	0.771	0.894	2.458**	0.751	−1.136
Mean CAR (%)	−0.11%	0.01%	0.30%	−0.03%	−0.42%
BMP Z-value	0.027	0.335	2.060**	0.133	−1.684*
N	377	377	377	377	377

The results for rating upgrades are shown in Panel B. The stock market does not show an anticipation effect for rating upgrades. The median CAR for rating upgrades is 0.08% and significant at the 5% level in the $[-1;1]$ event window, whereas in the same event window rating downgrades show a median CAR of −0.80%. These results support prior findings that rating downgrades have a meaningful impact on the stock price, but rating upgrades lead to a marginal reaction only (Holthausen and Leftwich, 1986; Kiesel and Schiereck, 2015). Summarizing, the results suggest that rating downgrades still have an impact on the CDS and stock market, whereas upgrades seem to be not important for the stock market and only have weak economic effects in the CDS market.

2.4.2 Rating downgrades during the global financial crisis and post-crisis period

Next, I divide the investigation period into two sub periods. The first period, the crisis period, is between 1st January 2008 and the 30th June 2009. The second period, from 1st July 2009 to 31st December 2013, is used to analyze whether the CDS and stock market react differently between the crisis period and the subsequent years.

Table 2.5 shows the CASC for rating downgrades during the financial crisis (Panel A) and the post-period (Panel B). During the global financial crisis the median and mean CASC are not significantly different from zero. However, since the financial crisis ended in June 2009 all event windows show a highly significant market reaction. The Wilcoxon signed-rank test indicates that the median of both samples is statistically different in the $[-2; 2]$ and $[-10; 10]$ event windows at least on the 5% level of significance and for the $[-10; -2]$ on the 10% level. Especially the pre-event days show different patterns. During the crisis, the pre-event days are below zero, whereas since the crisis the pre-event windows are highly significant positive. The mean CASC supports the findings that rating downgrades are not relevant for the CDS market during the crisis.

Table 2.5: Cumulative abnormal CDS spread changes (CASC) for rating downgrades during the global financial crisis and the post-period; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	[−10;10]	[−10;−2]	[−1;1]	[−2;2]	[2;10]
Panel A: Global financial crisis from January 2008 to June 2009					
Median CASC (in bps)	−1.1422	−1.7024	3.0164	1.4216	−1.5932
% of CASC >0	47.31	49.48	55.91	52.15	47.64
Signed Rank	−0.241	−0.394	−1.327	−0.217	−0.431
Mean CASC (in bps)	31.9715	−7.9374	16.7611	31.2611	10.8423
t-test	1.069	−0.564	1.417	1.539	0.586
N	186	194	186	186	191
Panel B: Post-crisis period from July 2009 to December 2013					
Median CASC (in bps)	9.0912	1.4557	1.5367	2.5987	1.3999
% of CASC >0	66.27	57.20	60.64	66.27	57.54
Signed Rank	−6.233***	−3.005***	−4.056***	−5.138***	−2.371**
Mean CASC (in bps)	32.0205	10.4877	11.7391	22.4927	3.2976
t-test	3.769***	2.891***	2.753***	2.335**	0.666
N	249	257	249	249	252
ΔCASC-median	−10.2334	−3.1581	1.4797	−1.1771	−2.9931
Wilcoxon-test	−3.087***	−1.905*	−0.438	−2.010**	−1.462
ΔCASC-mean	−0.0491	−18.4251	5.0220	8.7684	7.5447
t-test	−0.002	−1.427	0.443	0.422	0.442

The results for downgrades on the stock market are shown in Table 2.6. The results indicate that downgrades are highly statistically significant for both samples. The magnitude during the $[-1; 1]$ event window is higher during the global financial crisis, but not statistically different from zero as indicated by the Wilcoxon signed-rank test. An anticipation of rating downgrades by the stock market can be observed for both periods. During the $[-10; -2]$ event window the median CAR is -1.83% for the financial crisis period and since the crisis the median CAR is -0.67%. However, the CZ-test shows only significance on the 1% level during the crisis period. Both subsamples do not show any effects in the post-period window $[2; 10]$. The $[-10; 10]$ event window supports that rating downgrades during the crisis and since the crisis lead to similar market reactions.

Table 2.6: Cumulative abnormal returns (CAR) for rating downgrades during the global financial crisis and the post-period; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	[−10;10]	[−10;−2]	[−1;1]	[−2;2]	[2;10]
Panel A: Global financial crisis from January 2008 to June 2009					
Median CAR	−1.40%	−1.83%	−1.34%	−1.08%	−0.03%
% of CAR <0	57.48	57.87	59.84	57.09	50.00
CZ Z-value	−3.580***	−3.114***	−3.437***	−3.822***	−0.370
Mean CAR	−2.87%	−1.72%	−1.86%	−2.40%	0.71%
BMP Z-value	−2.604***	−2.147**	−3.003***	−3.308***	0.159
N	254	254	254	254	254
Panel B: Post-crisis period from July 2009 to December 2013					
Median CAR (%)	−1.78%	−0.67%	−0.65%	−0.99%	−0.16%
% of CAR <0	59.85	56.88	60.22	60.22	51.67
CZ Z-value	−2.314**	−0.581	−4.677***	−4.304***	−0.253
Mean CAR (%)	−3.17%	−1.30%	−1.71%	−2.32%	−0.16%
BMP Z-value	−4.535***	−3.073***	−4.025***	−4.580***	−0.431
N	269	269	269	269	269
ΔCAR-median	0.38%	−1.15%	−0.69%	−0.09%	0.13%
Wilcoxon-test	0.220	−1.157	−0.705	0.076	0.268
ΔCAR-mean	0.30%	−0.42%	−0.14%	−0.07%	0.87%
t-test	0.193	−0.404	−0.192	−0.079	0.795

2.4.3 Rating upgrades during the global financial crisis and post-crisis period

The CASC for rating upgrades during the crisis and for the post-period are shown in Table 2.7. Due to the small sample size of rating upgrades during the financial crisis, these results need to be interpreted carefully. During the global financial crisis the $[-1;1]$ event window shows abnormal CDS spreads on a 5% level of significance according to the signed-rank test. The magnitude of −4.05 bps in the $[-1;1]$ event window is even higher than for rating downgrades. The results suggest that rating upgrades have a statistical effect on the CDS market during the crisis. Both median CASCs are different from each other on the 10% level of significance as indicated by the signed-rank test. However, the parametric *t*-tests do not confirm these findings. The results for rating upgrades since the end of the global financial crisis show highly statistically significant CASC for all event windows except the pre-event period.

Table 2.7: Cumulative abnormal CDS spread changes for rating upgrades during the global financial crisis and the post-period; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	[−10;10]	[−10;−2]	[−1;1]	[−2;2]	[2;10]
Panel A: Global financial crisis from January 2008 to June 2009					
Median CASC (in bps)	−12.3001	−0.1029	−4.0453	−2.1925	−1.8302
% of CASC <0	62.86	52.78	71.43	60.00	52.78
Signed Rank	−1.491	−0.566	−2.113**	−1.032	−0.503
Mean CASC (in bps)	−7.5771	−3.9981	−4.3701	−3.5170	−1.2080
t-test	−0.859	−0.768	−1.621	−0.963	−0.283
N	35	36	35	35	36
Panel B: Post-crisis period from July 2009 to December 2013					
Median CASC (in bps)	−1.4034	−0.0580	−0.3705	−0.6951	−0.8012
% of CASC <0	56.12	50.68	55.44	55.78	55.81
Signed Rank	−2.794***	−0.093	−2.764***	−3.006***	−2.257**
Mean CASC (in bps)	−6.5075	−0.7019	−3.0732	−4.0294	−1.8002
t-test	−2.693	−0.456	−2.788	−2.896	−1.475
N	294	296	294	294	301
ΔCASC-median	−10.8967	−0.0449	−3.6748	−1.4974	−1.0290
Wilcoxon-test	−1.283	−0.389	−1.941*	−0.555	−0.334
ΔCASC-mean	−1.0695	−3.2961	−1.2969	0.5124	0.5922
t-test	−0.140	−0.691	−0.390	0.121	0.155

The upgrade results for abnormal stock returns are presented in Table 2.8. During the crisis, I find no significant abnormal returns, but in the subsequent years the stock market reaction is highly significant during the $[-1;1]$ event window. This indicates the CZ-test and the BMP-test at least on the 5% level. The results are in line with other findings prior to the crisis (Finnerty et al., 2013; Norden and Weber, 2004). However, the economic impact of rating upgrades is negligible.

Table 2.8: Cumulative abnormal returns (CAR) for rating upgrades during the global financial crisis and the post-period; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	[−10;10]	[−10;−2]	[−1;1]	[−2;2]	[2;10]
Panel A: Global financial crisis from January 2008 to June 2009					
Median CAR	−0.05%	0.33%	−0.53%	−0.08%	0.12%
% of CAR >0	49.02	50.98	37.25	47.06	50.98%
CZ Z-value	0.678	0.968	−0.552	0.672	0.386
Mean CAR	2.00%	1.37%	−0.06%	0.73%	0.69%
BMP Z-value	1.013	1.011	−0.218	0.929	0.646
N	51	51	51	51	51
Panel B: Post-crisis period from July 2009 to December 2013					
Median CAR (%)	−0.35%	−0.12%	0.18%	−0.19%	−0.40%
% of CAR >0	48.47	48.47	56.13	45.40	44.79
CZ Z-value	0.537	0.553	2.738***	0.518	−1.314
Mean CAR (%)	−0.44%	−0.21%	0.36%	−0.15%	−0.59%
BMP Z-value	−0.563	−0.269	2.423**	−0.341	−2.248**
N	326	326	326	326	326
ΔCAR-median	0.30%	0.45%	−0.71%	0.11%	0.52%
Wilcoxon-test	0.634	0.653	−2.209**	0.798	1.008
ΔCAR-mean	2.44%	1.58%	−0.42%	0.88%	1.28%
t-test	1.711*	1.673*	−0.891	1.481	1.738*

2.5 Summary and conclusion

During the global financial crises, ratings agencies business practices were critiqued extensively in the United States and Europe. Rating agencies bear at least some responsibility to the global financial crisis. Since then regulation in the United States and Europe tries to reduce the power of rating agencies on the financial markets. Hull et al. (2004), Norden and Weber (2004), Finnerty et al. (2013) and Imbierowicz and Wahrenburg (2013) find for downgrades a significant CDS spread increase. I find that these results cannot be confirmed for the period of the global financial crisis from 2008 to mid-2009. The findings suggest that rating agencies do not detect any deterioration of the issuer's credit quality in a timely fashion. During the financial crisis, rating downgrades are not a relevant market information as rating agencies merely follow markets in their downgrade decision. Since the end of the financial crisis, the results of the prior literature can be confirmed for the CDS market. However, the results show a tendency that rating upgrades are positive information for the CDS market during the crisis.

Chapter 3

The effect of rating announcements on firms in bank-based systems*

Abstract

Rating agencies act as intermediaries for investors in evaluating the creditworthiness of borrowers. The role of rating agencies is particularly crucial in market-based systems, because, in contrast to long-run bank relationships, outside investors are confronted with more difficulties to evaluate a firm's credit risk in depth and reliably. The financial intermediation in bank-based systems has implications for the role and the focus of credit rating agencies. This study examines the influence of rating announcements in Germany, one of the premier bank-based systems. During the investigation period from January 2000 to June 2014, 189 Standard & Poor's and 204 Moody's rating announcements are examined. The results show that rating announcements are of lower importance in the German market than in market-based systems such as the United States.

3.1 Introduction

In the relationship-oriented financial systems of continental Europe, banks are in direct long-run repeated contact with companies and use private and public information on various firm characteristics. In bank-based systems, financial institutions play a leading role in mobilizing savings and allocating capital. In market-based systems, however, firms primarily raise capital in the security market. Especially in the United States, borrowers directly tap the world's capital markets by issuing bonds, medium-term notes, or commercial paper. In this scenario, investors cannot make an internal credit assessment; instead, they rely on rating agencies to assess the firm's securities. For many years now, credit rating agencies have played an instrumental role in investor decision making, but research has rarely considered how the importance of rating agencies may differ across different financial systems. It is reasonable to assume that banks are much more precise than rating agencies in evaluating the creditworthiness of debtors. Differences in financial intermediation in Germany and the United States have import implications for the role and focus of credit rating agencies. In 2013, the ratio of domestic private bank debt to GDP was

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approximately 95.6% in Germany. Most companies still rely on bank loans, even though the share of securitizations in intermediation flows is expanding rapidly. By comparison, in the United States the ratio of domestic private bank debt to GDP is only 49.5%.

Kisgen (2006, 2009) finds a strong relationship between capital structure and credit ratings for listed firms in the United States. The close relationships to banks and the monitoring activities by banks replace the role of rating agencies. This assumption is supported by the relative weak relationship between credit ratings and changes in firms' leverage ratios in bank-based systems (Drobetz and Heller, 2014; Shen et al., 2012).

This study focuses on the value of rating agency announcements to equity investors in a leading bank-based system. In bank-based systems, such as in Germany, banks are the most important intermediaries to evaluate the creditworthiness of a given company. Therefore, we expect different market reactions in this system. In the United States, rating downgrades have a significant negative effect (Bannier and Hirsch, 2010; Holthausen and Leftwich, 1986; Jorion and Zhang, 2007b) and rating upgrades have a weak significant positive effect (Dichev and Piotroski, 2001; Jorion and Zhang, 2007b) or a non-significant effect (Bannier and Hirsch, 2010; Goh and Ederington, 1993, 1999) on the stock price of a company.

This article is structured as follows: The following section reviews the related literature. We then describe the data, methodology, and offers descriptive statistics. In the next section, we present the main findings of our empirical investigation. We then show the results of a cross-sectional regression analysis for multiple event windows. Finally, we briefly summarize our main results and offer our conclusion.

3.2 Literature review and hypotheses development

Empirical research can be roughly divided into two fields: *(i)* the impact of rating announcements on stock returns in market-based systems, and *(ii)* the merits of bank-based and market-based financial systems.

U.S. research history on the impact of credit rating announcements in market-based systems starts in the 1970s. Katz (1974) shows that, with a lag of six to ten weeks after the announcement, bond prices change significantly. Holthausen and Leftwich (1986) suggest that common stock returns depend on rating changes and their announcements. Hsueh and Liu (1992) find that stock prices adjust to rating changes, but only to an extent that depends on the degree of market participation. Bond and stock price effects due to downgrades are observed by Hand et al. (1992), who observe no significant stock price effects after S&P and Moody's rating upgrades. Goh and Ederington (1993) find significant negative returns for Moody's rating downgrades in the United States, but explain this impact with the different causes of downgrades. In a later study, they extend their study through a multivariate regression analysis (Goh and Ederington, 1999). The results largely confirm their prior findings. Jorion and Zhang (2007b) examine downgrade and upgrade announcements by S&P, Moody's and Fitch. They confirm the findings of negative abnormal returns for downgrades, and positive ones for upgrades. Bannier and Hirsch (2010) focus on the impact of Moody's rating reviews of U.S. issuers from 1982 to 2004. They suggest that, after the introduction of rating reviews, rating downgrades led to stronger market reactions than before. Outside the United States, studies on the effect of credit rating announcements are rare. Norden and Weber (2004) use a worldwide data set and obtain rating announcements from S&P, Moody's, and Fitch for the period 2000-2002. They report a significant effect for S&P and Moody's downgrades, but not for rating downgrades by Fitch.

Another strand of research addresses the question whether banking market structure affects economic growth. Cetorelli and Gambera (2001) provide evidence that bank concentration promotes the economic growth of industrial sectors that rely on external financing by facilitating credit access to younger firms. Beck and Levine (2002) analyze whether market-based or bank-based financial systems are better in regard to external financing. Their results show that the financial system does not explain industrial growth patterns or the efficiency of capital allocation. Demirgüç-Kunt and Maksimovic (2002) also find no evidence that firms' access to external financing is predicted by the banking system. Baum et al. (2011) examine the impact of the financial system's structure on firm financial constraints. They conclude that a bank-based financial system provides constrained firms with easier access to external financing. Bancel and Mittoo (2004) examine the link between theory and practice of capital structure across 16 European countries. They find that firm financing policies are influenced by the institutional environment and international operations. Bancel and Mittoo (2004) and also Booth et al. (2001) consider how institutional factors affect capital structure determinants, but they do not consider the influence of credit rating agencies. Drobetz and Heller (2014) investigate the impact of credit rating changes on the capital structure decisions of German firms. Changes in the capital structure and financing choices of highly creditworthy firms in Germany are more or less independent from changes in the credit rating. They suggest that bank relationships help firms to mitigate the otherwise potentially substantial effects of adverse changes in their creditworthiness.

Existing evidence overall indicates that the financial system does not impact the growth opportunities for industries, but bank concentration can change the firm's financial constraints. In market-based systems, such as in the United States, investors react to rating changes, and rating changes effect the capital structure (Kisgen, 2006, 2009). Rating agencies are the most visible option to determine a firm's creditworthiness. Individually negotiated loans with banks are rare, and firms primarily finance themselves via capital markets. In bank-based systems, such as Germany, banks have an important function in allocating credit. In comparison to market-based systems, ratings are less relevant for individually negotiated loans between banks and firms, since banks use an internal rating approach and their own credit rating methodology. We suggest that investors in Germany place more in banks than rating agencies to evaluate the creditworthiness of debtors, as banks potentially possess more relevant information. Therefore, rating changes in Germany should be less important to equity investors than in the United States.

Hypothesis 1. *Stock price reactions to rating changes and reviews are weaker in Germany than in the United States.*

Rating agencies announcements provide the agency's reasons of reviews and rating changes. Goh and Ederington (1993, 1999) find that, in the United States, market reaction is related to the reasons given by agencies. Gropp and Richards (2001) show that rating downgrades attributed to operating performance result in significant negative returns, whereas changes attributed to capital structure are followed by significant positive returns for European Banks. Rating upgrades attributed to operating performance are not significant, but rating upgrades attributed to capital structure are significant positive. We expect that rating changes attributed to operating performance lead to different market reactions. Banks especially know the capital structure of firms, but may poorly predict operating performance. Therefore, announcements in regard to operating performance should lead to stronger market reactions in bank-based systems.

Hypothesis 2. *Ratings attributed to operating performance lead to stronger negative stock market reaction than changes attributed to capital structure.*

3.3 Data and methodology

3.3.1 Data sample and selection

This study analyzes the impact of credit rating announcements by Moody's and S&P related to constituents of the HDAX index from January 2000 through June 2014. The HDAX includes the German stocks indices DAX, MDAX and TecDAX. The analysis includes all 110 stocks listed on the HDAX as of June 10, 2014. The data sample includes 252 S&P and 260 Moody's issuer ratings. Forty-seven of the 110 companies have a credit rating by Moody's and/or S&P. Except for two firms, all companies rated by S&P are also rated by Moody's. Moody's rates four firms that have no S&P rating. The calculation regarding the stock performance is conducted using total return data. Closing prices are from Thomson Reuters Financial Datastream. Moody's rating announcements are from the Moody's website, S&P announcements are obtained from Alacra[1].

Events that were preceded by other rating events during the $[-5; 5]$ event window were eliminated to control for confounding events. This assumes that, in case of a sudden and unexpected credit event, both rating agencies adjust their issuer rating immediately. Due to confounding events, 96 announcements were eliminated. This implies that in 18.8% of all rating actions by one agency, the other agency reacts within a period of five days prior or five days after the event. 33.3% of these rating events are on the same day, in 39.6% the S&P rating action was prior the Moody's rating action and in 27.1% S&P followed the announcement by Moody's.

The final sample compromises 189 S&P and 204 Moody's rating announcements. Rating changes account for 137 of the S&P rating actions, and 52 are rating reviews. Moody's ratings contain 134 rating changes and 70 rating reviews. The distribution of rating announcements by the three different indexes listed in the HDAX is shown in Table 3.1. S&P and Moody's announcements are roughly equally distributed. The average number of announcements for a constituent of the DAX is 5.4 and 4.9, respectively. The average number of announcements for MDAX companies is 2.9 and 4.2, respectively.

Table 3.1: Distribution of rating announcements by index

	DAX	MDAX	TecDAX	Total
Firms	*26*	*19*	*1*	*46*
Standard & Poor's	26	15	1	42
Moody's	26	18	1	45
Announcements	*267*	*119*	*7*	*393*
Standard & Poor's	140	44	5	189
Moody's	127	75	2	204

Table 3.2 presents the distribution of the rating class prior to the rating change ("old rating") from January 2000 through June 2014. Moody's and S&P rating changes are almost equally distributed. There are a few exceptions: In the years 2003 and 2005, Moody's had ten more rating announcements than S&P, and in 2007, S&P had eight more rating announcements than Moody's. Only 13 rating announcements were made in 2010, and, not surprisingly, we observe the highest number of announcements during the financial crisis of 2007-2009.

The present study also analyzes the reasons for change or review that agencies provide in their announcements. Therefore, Moody's and S&P announcements are divided into two "reason" categories: "operating performance" and "capital structure". Operating performance events are those changes the rating agency attributes to a deterioration or improvement in the firm's financial prospect or the firm's performance. Capital structure events are those changes the agency attributes to an increase or decrease in leverage, e.g., leveraged buyouts, share repurchases, or

[1] http://www.alacrastore.com

Table 3.2: Distribution of the old rating category over the years 2000 and 2014

	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12	'13	'14	Total
S&P	*3*	*12*	*12*	*16*	*13*	*8*	*12*	*24*	*18*	*21*	*6*	*12*	*13*	*17*	*2*	*189*
AAA-AA	1	5	6	4	1	2	1	4	2	2	0	1	0	0	0	29
A	1	6	3	5	5	1	4	5	4	3	1	5	4	8	0	55
BBB	1	1	2	7	4	1	2	13	9	9	2	3	4	1	1	60
BB	0	0	1	0	1	2	3	0	3	2	0	2	4	6	1	25
B-C	0	0	0	0	2	2	2	2	0	5	3	1	1	2	0	20
Moody's	*4*	*14*	*10*	*27*	*18*	*19*	*10*	*16*	*14*	*22*	*7*	*11*	*12*	*15*	*5*	*204*
Aaa - Aa	1	7	3	6	0	1	2	3	1	2	1	2	2	0	0	31
A	2	5	5	8	7	3	3	3	3	7	1	4	4	2	2	59
Baa	1	2	1	10	6	6	2	4	4	5	3	1	3	5	1	54
Ba	0	0	1	3	5	5	3	4	5	3	2	2	3	7	1	44
B-C	0	0	0	0	0	4	0	2	1	5	0	2	0	1	1	16
Total	*7*	*26*	*22*	*43*	*31*	*27*	*22*	*40*	*32*	*43*	*13*	*23*	*25*	*32*	*7*	*393*

debt-financed expansions (Goh and Ederington, 1993; Imbierowicz and Wahrenburg, 2013). Table 3.3 shows the distribution of ratings by category. Using the key word approach by Imbierowicz and Wahrenburg (2013) 90.6% of the events are categorized as related to either operating performance or capital structure, with 55.7% of actual rating changes related to performance, and 34.7% related to capital structure.

Table 3.3: Distribution of rating actions by category

	Rating reviews			Rating actions		
	Down	Up	Total	Down	Up	Total
Performance	*65*	*10*	*75*	*101*	*50*	*151*
Standard & Poor's	23	5	28	44	25	69
Moody's	42	5	47	57	25	82
Capital Structure	*29*	*7*	*36*	*48*	*46*	*94*
Standard & Poor's	17	3	20	24	30	54
Moody's	12	4	16	24	16	40
Other reason	*10*	*1*	*11*	*17*	*9*	*26*
Standard & Poor's	4	0	4	12	2	14
Moody's	6	1	7	5	7	12
Total	*104*	*18*	*122*	*166*	*105*	*271*
Standard & Poor's	44	8	52	80	57	137
Moody's	60	10	70	86	48	134

3.3.2 Methodology

The study is based on the market model originally described by Dodd and Warner (1983) and Brown and Warner (1985). Fama and French (1993, 1996) extended the single index model to a three-factor model that better explains stock returns. Two additional factors, size and book-to-market, are used in addition to the market proxy. Carhart (1997) extended this approach by adding a fourth factor that captures the momentum effect originally described by Jegadeesh and Titman (1993). The model is estimated using a 252 non-trading-day-adjusted period prior to the event window with:

$$R_{jt} = \beta_0 + \beta_{1j} MKT_t + \beta_{2j} SMB_t + \beta_{3j} HML_t + \beta_{4j} MOM_t + \epsilon_{jt} \tag{3.1}$$

where R_{jt} is the market return of firm j on day t during the estimation period, MKT_t is the benchmark return on day t, SMB_t is the difference in return between a small-cap portfolio and a large-cap portfolio on day t, HML_t is the difference in return between a portfolio of high book-to-market stocks and one portfolio of low book-to-market stocks on day t, MOM_t is the difference in return between a portfolio of winners and a portfolio of losers on day t, β_{jt} are coefficients for the firm j, and ϵ_{jt} is the regression residual. The Carhart (1997) and Fama and French (1993, 1996) factors are obtained from Brückner et al. (2014). Daily abnormal returns (AR_{jt}) for firm j on day t during the event window are calculated using:

$$AR_{jt} = R_{jt} - [\beta_0 + \beta_{1j}MKT_t + \beta_{2j}SMB_t + \beta_{3j}HML_t + \beta_{4j}MOM_t] \tag{3.2}$$

The day on which a rating agency announcement is published is known precisely. In order to avoid confounding events around the day of the announcement, the event window contains five trading days, beginning two days prior to the press release, and ending two trading days after the announcement. The cumulative abnormal return (CAR) for firm j is calculated as the sum of the abnormal returns during the event window $[\tau_1; \tau_2] \in [-2; 2]$:

$$CAR_{j,[\tau_1,\tau_2]} = \sum_{i=\tau_1}^{\tau_2} AR_{jt} \tag{3.3}$$

Finally, for the sample of N firms, the average cumulative abnormal average returns (ACARs) are calculated as:

$$ACAR_{j,[\tau_1,\tau_2]} = \frac{1}{N}\sum_{i=1}^{N} CAR_{j,[\tau_1,\tau_2]} \tag{3.4}$$

Four different test procedures are used to test whether the ACARs are statistically different from zero: *(i)* the standard t-test *(ii)* the test statistic developed by Boehmer et al. (1991), BMP-test, *(iii)* the test statistic developed by Corrado and Zivney (1992), CZ-test, and *(iv)* the Wilcoxon sign rank test, SIGN-test. The BMP-test is a parametric test that re-standardizes the CAR with cross-sectional standard deviation. The CZ-test is a nonparametric rank test that applies re-standardized event windows and is robust against event-induced volatility and cross-correlation.

3.4 Empirical results

3.4.1 Stock returns analysis

The results of the stock market reaction after downgrades are shown in Table 3.4. The $[0; 1]$ event window is statistically significant for downgrades with an ACAR of -0.72%. Highly significant abnormal return can be measured only on the first trading day after the release. Weak significant effects can be observed on the event day 0. Rating announcements released after the close of the exchange are priced in the stock price with a lag of one day. During the $[-2; 2]$ event window, ACAR is -0.51%, but not significant. During the investigation period, 104 downgrade reviews are observed, and the results for downgrade reviews are shown in Panel B.

Downgrade reviews have a stronger impact on the stock market. Although Germany has a strong bank-customer relationship, rating reviews are new and relevant information for equity investors. The abnormal returns for rating reviews are -1.56% during the $[-2; 2]$ event window. All event windows that include the release day are statistically highly significant. The $[-2; -1]$ event window suggests that there is only small leakage prior to the announcement. Bannier and Hirsch (2010) find statistically highly significant negative effects for direct and watch-preceded U.S. downgrades in the $[-1; 1]$ window of -1.89% and -3.10%, respectively. Jorion and Zhang (2007b) even indicate CARs of -4.43% at the 1% level of significance for rating downgrades in the United States. Norden and Weber (2004) also find highly statistically significant and negative effects for their worldwide data set. Our analysis shows that market reaction to rating downgrades is considerably smaller in Germany. Therefore, the results for rating downgrades support the hypothesis that rating changes are less important to equity investors in Germany than in the

Table 3.4: Stock market reactions on downgrade actions and downgrade reviews; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

Event window	ACAR	Median CAR	*t*-test (t-value)	SIGN (Z-Score)	BMP-test (Z-score)	Corrado-test (Z-scroe)	Sample size
Panel A: Average abnormal stock returns by rating downgrade							
[−2;−1]	0.32%	0.13%	1.04	−1.26	1.29	1.48	166
[−1;0]	−0.09%	−0.04%	−0.32	−0.06	−0.25	0.21	166
{0}	−0.31%	−0.21%	−1.88*	−1.84*	−1.89*	−1.56	166
[0;1]	−0.72%	−0.72%	−2.71***	−2.90***	−2.61***	−2.62***	166
[−1;1]	−0.50%	−0.26%	−1.44	−1.22	−1.31	−1.08	166
[−2;2]	−0.51%	−0.20%	−1.04	−0.85	−0.95	−1.39	166
Panel B: Average abnormal stock returns by downgrade review							
[−2;−1]	−0.55%	−0.44%	−1.29	−1.64	−1.75*	−2.05**	104
[−1;0]	−0.92%	−0.92%	−2.33**	−3.24***	−2.65***	−3.49***	104
{0}	−0.60%	−0.54%	−2.06**	−3.05***	−2.23***	−3.24***	104
[0;1]	−1.23%	−1.30%	−3.14***	−3.52***	−3.30***	−4.52***	104
[−1;1]	−1.55%	−1.66%	−3.63***	−4.02***	−3.85***	−4.67***	104
[−2;2]	−1.56%	−1.73%	−2.82***	−3.54***	−3.24***	−4.22***	104
Panel C: Differences of downgrades and downgrade reviews							
Event window	D_ACAR	D_Median CAR	two-sample *t*-test (t-value)		Wilxocon rank-sum test (Z-score)		
[−2;−1]	0.87%	0.57%	1.69*		−2.05**		
[−1;0]	0.82%	0.89%	1.73*		−2.90***		
{0}	0.29%	0.34%	0.92		−1.80*		
[0;1]	0.51%	0.58%	1.11		−1.51		
[−1;1]	1.04%	1.40%	1.88*		−2.63***		
[−2;2]	1.06%	1.53%	1.40		−2.50**		

United States. Rating reviews are significant, because rating reviews reveal new information to the market.

The analysis is repeated for upgrades and upgrade reviews. Panel A of Table 3.5 shows the results for rating upgrades. The ACARs are negative and non-significant. These results suggest that upgrade information is not relevant to the stock market. Panel B reports results for upgrade reviews. Contrary to downgrade reviews, there are no statistically significant effects on upgrade reviews. The ACAR ranges from a positive value of 0.61% during the $[0;1]$ event window to 1.21% during the event windows $[-1;1]$ and $[-2;2]$. Overall, rating upgrades do not seem to be relevant information. The findings confirm prior results for U.S. firms (Goh and Ederington, 1993, 1999) and European banks (Gropp and Richards, 2001). Upgrade announcements are not relevant in market-based or bank-based systems.

Downgrade announcements are less relevant in bank-based systems. Rating announcements reveal new information to the market, so we find significant effects for rating reviews. Positive rating announcements show no significant effects.

3.4.2 Reason given in rating announcements

Prior studies provide evidence that the reason given by agencies for their rating actions is relevant for the stock market reaction (Goh and Ederington, 1993, 1999; Gropp and Richards, 2001). Table 3.4 presents the results for rating downgrades according to the categories defined earlier, operating performance and capital structure. The results support our prior results of rating downgrades.

Panel A shows the results for operating performance rating downgrades. ACAR is slightly lower in comparison with capital structure downgrades, and is significant at the 5% level of significance only during the $[0;1]$ event window.

Capital structure downgrades (Panel B) have no significant effect. During the $[-2;2]$ event window, the overall ACAR for capital structure downgrades is positive. We find results similar to those of Gropp and Richards (2001) for rating downgrades. Capital structure has a positive effect on stock prices during the $[-2;2]$ event window, whereas operating performance is negative. These

Table 3.5: Stock market reactions on upgrade actions and upgrade reviews; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

Event window	ACAR	Median CAR	*t*-test (t-value)	SIGN (Z-Score)	BMP-test (Z-score)	Corrado-test (Z-scroe)	Sample size
Panel A: Average abnormal stock returns by rating upgrade							
[−2;−1]	0.19%	0.18%	0.96	−1.02	1.21	1.02	105
[−1;0]	−0.05%	−0.20%	−0.27	−0.72	−0.14	−0.12	105
{0}	−0.03%	−0.20%	−0.25	−0.42	−0.17	−0.30	105
[0;1]	−0.13%	−0.26%	−0.71	−1.24	−0.59	−0.56	105
[−1;1]	−0.15%	−0.19%	−0.67	−0.86	−0.50	−0.38	105
[−2;2]	0.09%	−0.43%	0.25	−0.60	0.33	−0.04	105
Panel B: Average abnormal stock returns by upgrade review							
[−2;−1]	0.40%	0.81%	0.47	−0.41	0.84	1.11	18
[−1;0]	0.51%	0.23%	1.00	−0.94	1.31	0.81	18
{0}	−0.09%	−0.27%	−0.24	−0.24	−0.21	−0.01	18
[0;1]	0.61%	0.37%	0.74	−0.54	0.56	0.32	18
[−1;1]	1.21%	0.37%	1.57	−1.33	1.70*	0.93	18
[−2;2]	1.21%	2.16%	1.42	−1.50	1.49	1.44	18
Panel C: Differences of upgrades and upgrade reviews							
Event window	D_ACAR	D_Median CAR	two-sample *t*-test (t-value)		Wilxocon rank-sum test (Z-score)		
[−2;−1]	−0.21%	−0.62%	−0.34		0.54		
[−1;0]	−0.56%	−0.43%	−1.09		0.94		
{0}	0.06%	0.07%	0.19		−0.10		
[0;1]	−0.74%	−0.63%	−1.32		1.06		
[−1;1]	−1.36%	−0.57%	−2.14**		1.68*		
[−2;2]	−1.13%	−2.59%	−1.23		1.65		

results are not significant, but the difference the downgrade categories is weakly significant during the $[-2; 2]$ event window.

Our prior findings show that rating upgrades have no significant effect on the German stock market. This result is confirmed when the upgrades are divide into the two categories of rationales (Table 3.7). The value of the ACARs is very similar and not significantly different from zero. During the $[0; 1]$ event window, the average abnormal stock return due to an operating performance rating change is -0.21% and -0.19% for a capital structure change. In line with Bannier and Hirsch (2010) and Holthausen and Leftwich (1986), rating upgrades have no significant effect on the stock market.

3.5 Cross-sectional regression analysis

3.5.1 Model specifications

In order to more closely identifying the drivers of the stock market reactions following rating announcements, a cross-sectional regression analysis is conducted. The multivariate ordinary least squares (OLS) regression follows:

$$CAR_{j,[-1;1]} = \beta_0 + \sum_{i=1}^{n} \beta_i VAR_i + \epsilon \tag{3.5}$$

where $CAR_{j,[-1;1]}$ is the abnormal return of firm $j \in \{1, \ldots, m\}$, during the $[-1; 1]$ event window, β_0 is the regression constant, β_i are the regression coefficients for the independent variables with $i \in \{1, \ldots, m\}$, Var_i are the independent variables with $i \in \{1, \ldots, m\}$, and ϵ is the error term.

In order to explain the CARs during the $[-1; 1]$ event window, company and event specific variables are tested. The model tests whether the results from the univariate analysis are consistent in a cross-sectional analysis. In the univariate regression, when a rating review preceded an action, the review caused a higher ACAR than the actual rating action. Similar effects are observed by

Table 3.6: Stock market reactions on downgrade actions by rating reason; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

Event window	ACAR	Median CAR	*t*-test (t-value)	SIGN (Z-Score)	BMP-test (Z-score)	Corrado-test (Z-scroe)	Sample size
Panel A: Average abnormal stock returns by downgrades due to operating performance							
[−2;−1]	0.00%	0.19%	−0.01	−0.65	0.26	0.61	101
[−1;0]	−0.22%	−0.20%	−0.71	−0.61	−0.57	−0.09	101
{0}	−0.25%	−0.24%	−1.16	−1.40	−1.31	−1.43*	101
[0;1]	−0.76%	−0.82%	−2.36**	−2.84***	−2.37**	−2.32**	101
[−1;1]	−0.73%	−0.62%	−1.77*	−1.68*	−1.64	−1.14	101
[−2;2]	−0.96%	−0.51%	−1.65	−1.68*	−1.70*	−1.75*	101
Panel B: Average abnormal stock returns by downgrades due to capital structure							
[−2;−1]	1.22%	0.37%	2.59**	−1.84*	2.49**	2.09**	48
[−1;0]	0.47%	0.52%	1.31	−1.49	1.27	0.84	48
{0}	−0.28%	0.00%	−1.11	−0.57	−0.80	−0.21	48
[0;1]	−0.55%	0.31%	−1.04	−0.52	−0.82	0.37	48
[−1;1]	0.20%	0.10%	0.41	−0.55	0.58	0.51	48
[−2;2]	0.68%	0.68%	0.94	−1.24	1.10	1.06	48
Panel C: Differences of downgrades due to operating performance and capital structure							
Event window	D_ACAR	D_Median CAR	two-sample *t*-test (t-value)		Wilxocon rank-sum test (Z-score)		
[−2;−1]	−1.22%	−0.17%	−2.33**		1.95*		
[−1;0]	−0.69%	−0.72%	−1.33		1.28		
{0}	0.03%	−0.25%	0.08		1.32		
[0;1]	−0.21%	−1.13%	−0.36		0.38		
[−1;1]	−0.93%	−0.73%	−1.35		1.05		
[−2;2]	−1.64%	−1.19%	−1.67		1.47		

Table 3.7: Stock market reactions on upgrade actions by rating reason; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

Event window	ACAR	Median CAR	*t*-test (t-value)	SIGN (Z-Score)	BMP-test (Z-score)	Corrado-test (Z-scroe)	Sample size
Panel A: Average abnormal stock returns by upgrades due to operating performance							
[−2;−1]	−0.11%	−0.11%	−0.46	−0.21	−0.09	−0.26	50
[−1;0]	0.03%	−0.36%	0.10	−0.67	0.24	−0.05	50
{0}	0.06%	−0.13%	0.36	−0.05	0.44	0.28	50
[0;1]	−0.21%	−0.27%	−0.81	−1.03	−0.78	−0.42	50
[−1;1]	−0.24%	−0.32%	−0.72	−1.39	−0.61	−0.55	50
[−2;2]	−0.39%	−0.50%	−1.00	−1.23	−0.73	−0.65	50
Panel B: Average abnormal stock returns by upgrades due to capital structure							
[−2;−1]	0.40%	0.18%	1.12	−1.01	1.13	1.04	46
[−1;0]	−0.26%	−0.14%	−0.91	−0.74	−1.00	−0.67	46
{0}	−0.19%	−0.32%	−1.05	−0.97	−1.17	−1.14	46
[0;1]	−0.19%	−0.44%	−0.62	−1.15	−0.52	−1.01	46
[−1;1]	−0.25%	−0.05%	−0.74	−0.44	−0.67	−0.71	46
[−2;2]	0.38%	−0.55%	0.62	−0.02	0.57	−0.05	46
Panel C: Differences of upgrades due to operating performance and capital structure							
Event window	D_ACAR	D_Median CAR	two-sample *t*-test (t-value)		Wilxocon rank-sum test (Z-score)		
[−2;−1]	−0.51%	−0.29%	−1.19		0.90		
[−1;0]	0.29%	−0.22%	0.72		0.00		
{0}	0.25%	0.20%	1.03		−0.85		
[0;1]	−0.02%	0.18%	−0.05		−0.15		
[−1;1]	0.01%	−0.27%	0.03		0.66		
[−2;2]	−0.78%	0.05%	−1.08		0.77		

Norden and Weber (2004) and by Bannier and Hirsch (2010). A rating process usually starts with a review by one agency and ends with an action by a second agency. The rating always moves either down or up for all announcements. If no rating review is announced, the rating process starts with the first rating action. The variable $FIRST$ indicates whether the review or actual rating announcement is the first information available to the market. The variable $REVIEW$ indicates if the rating announcement is a rating review. The univariate results suggest that investors do not distinguish between rating announcements attributed to operating performance and those attributed to capital structure. The rating rationale is captured by the variable $REASON$ and is defined as 1 for changes in operating performance as rating reason. The variable $MOODYS$ is introduced as a dummy variable for the rating agency.

Besides these variables, other variables can potentially explain the size of the CAR, and our model controls for several additional variables. The regression examines the effect of the "old rating" category. Norden and Weber (2004) find in their cross-sectional analysis that the old rating level and previous rating events significantly influence the magnitude of the abnormal performance. The variable $RATING$ is based on a numerical 17 rating scale (AAA/Aaa=1, AA+/Aa1=2,. . . , CCC/Caa1 and below=17). For investors whose mandate limits them to holding only investment grade securities, downgrade events to non-investment grade can be highly problematic. Hite and Warga (1997) find that rating changes from investment grade to non-investment grade have a fatal effect on bond prices.

In addition, the variable INV_BORDER is introduced for the investment grade border. The size of the firm can be an important factor explaining the CAR. The size effects are measured by the market capitalization ($MCAP$) on the last trading day in the year prior to the year of the rating change.

For the firm's credit risk, two additional firm information categories are introduced. The variable $DEBT$ represents all interest-bearing and capitalized lease obligations as the sum of long- and short-term debt on the last trading day in the year prior to year of the rating change. Rising credit risk is also captured in the variable $DEBT\%$. The variable $DEBT\%$ is defined as the total debt ratio between the last trading day two years and one year prior to the rating change.

Finally, we introduce a variable to address one of the most discussed topics since the peak of the financial crisis: to what extent rating agencies failures are responsible for the crisis. Since rating agencies underestimated the credit risk associated with structured financed products and failed to adjust their ratings quickly enough, there is a broad consensus that credit agencies contributed to the financial crisis. In 2008 and 2009, credit rating agencies adjusted their firm's issuer credit ratings. The new probability of credit risk is also important for equity investors. Therefore, we introduce the variables $Y2008$ and $Y2009$ as dummy variables for the years with most rating announcements.

3.5.2 Multivariate results

Table 3.8 shows the results of the cross-sectional OLS regression analysis for three downgrade and three upgrade models. Panel A reports results for downgrades. The impact of rating reviews is much higher than that of actual downgrades. The coefficient of $REVIEW$ is highly statistically significant and negative. At the peak of the financial crisis, in 2008, the negative effect of downgrades on the stock market is statistically significantly higher. In contrast, the variables of $MOODYS$ and $REASON$ are not statistically significant.

Panel B reports results for a corresponding analysis of upgrade announcements. The coefficient of $FIRST$ is positive and significant on the 5% level of significance. Positive rating news is

Table 3.8: Results of the cross-sectional OLS regression. This table shows the results of the OLS regression run for $CARs$ during the $[-1;1]$ event window. T-values and F-values are controlled for heteroscedasticity using the White-statistic. $FIRST$ is a variable that is defined as 1, if the announcement is the first announcement of a rating process and 0 otherwise, $REVIEW$ is a variable that is defined as 1, if the rating announcement is a review without an actual change and 0 otherwise, INV_BORDER is a dummy variable if the new rating is out (downgrade) or in (upgrade) investment grade and 0 otherwise, $Y2008/Y2009$ is a dummy variable that is defined as 1 if the rating change was in 2008/2009 and 0 otherwise, P/E is the price-earnings ratio of a company on the last trading day in the year prior to year of the rating change, P2B is the price-to-book value of a company on the last trading day in the year prior to year of the rating change, $MOODYS$ is a dummy variable that is defined as 1 for Moody's ratings, $REASON$ is a dummy variables that is defined as 1, if the rating reason is a change in the operating performance and 0 otherwise, $RATING$ is defined as the old rating on a numerical 17 point scale, where AAA/Aaa=1, AA+/Aa1=2,..., CCC/Caa1 and below=17, $MCAP$ is defined as the natural logarithm of the market capitalization of a company in EUR on the last trading day in the year prior to year of the rating change, $DEBT$ is defined as the natural logarithm of the total debt of a company in EUR on the 31st December in the year prior to year of the rating change, $DEBT\%$ is defined as total debt increase ratio between the last trading day two years prior to and the year prior to the rating change; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	Panel A: Downgrade			Panel B: Upgrade		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
β_0	0.013	0.003	0.004	0.018	0.001	0.002
(t-value)	(0.259)	(0.334)	(0.756)	(0.371)	(0.283)	(0.483)
$FIRST$	−0.005	−0.004	−0.003	0.010**	0.010**	0.009**
(t-value)	(−0.829)	(−0.685)	(−0.456)	(2.367)	(2.235)	(2.191)
$REVIEW$	−0.018***	−0.018***	−0.018***	0.008	0.009	0.009
(t-value)	(−2.971)	(−3.051)	(−3.149)	(1.153)	(1.457)	(1.449)
INV_BORDER	−0.044	−0.038	−0.035	0.011	0.013**	0.012*
(t-value)	(−1.611)	(−1.475)	(−1.372)	(1.553)	(2.065)	(1.915)
$Y2008$	−0.026**	−0.028***	−0.027***	0.009	0.010	0.011
(t-value)	(−2.560)	(−2.713)	(−2.661)	(1.215)	(1.363)	(1.452)
$Y2009$	−0.011	−0.009	−0.008	0.043**	0.033**	0.033**
(t-value)	(−1.154)	(−0.943)	(−0.830)	(2.615)	(2.150)	(2.077)
P/E	−0.000	0.000	0.000	−0.001**	−0.001***	−0.001***
(t-value)	(−0.089)	(0.065)	(0.291)	(−2.393)	(−2.632)	(−2.776)
$P2B$	−0.000	0.001		−0.000	0.001	
(t-value)	(−0.257)	(0.482)		(−0.087)	(0.455)	
$MOODYS$	0.006	0.006		−0.001	−0.001	
(t-value)	(1.036)	(1.011)		(−0.153)	(−0.252)	
$REASON$	−0.003	−0.005		−0.001	0.000	
(t-value)	(−0.587)	(−0.894)		(−0.136)	(0.004)	
$RATING$	−0.000			−0.001		
(t-value)	(−0.098)			(−1.468)		
$MCAP$	0.003			0.003		
(t-value)	(0.721)			(0.601)		
$DEBT$	−0.003			−0.003		
(t-value)	(−1.413)			(−1.219)		
$DEBT\%$	0.000			−0.005		
(t-value)	(0.179)			(−0.938)		
n	219	227	232	102	106	108
R^2 / Adj. R^2	10.93 / 5.29	9.11 / 5.34	8.23 / 5.78	26.05 / 15.13	22.95 / 15.72	23.31 / 18.76
F-value	2.00**	2.54***	3.79***	2.89***	3.60***	4.20***

independent of the issuing agency, whereas negative announcements are significant for reviews. The P/E ratio is statistically highly significant for rating upgrades. If P/E is low and the firm's credit risk decrease, investors are likely to invest; consequently, stock prices rise. Rating agency and reason are also not statistically significant for rating upgrades. Overall, the results of the cross-sectional regression support the prior findings and confirm the hypotheses that the rating reason is not relevant for investors.

3.6 Summary and conclusion

This study examines stock market reactions following credit rating announcements in Germany, one of the premier examples of a bank-based system. The study investigates 189 S&P and 204 Moody's announcements from January 2000 through June 2014. Using the Carhart (1997) four-factor model, the empirical analysis shows that rating downgrades do not have a significant effect during the $[-2; 2]$ event window. The day subsequent to the day of a rating change is the only day where we find a highly significant influence of rating downgrades on the stock price. Rating upgrades do not seem to be important for the German stock market. The rating reason is only weakly statistically different from upgrades attributed to operating performance versus capital structure. The results are similar to Gropp and Richards (2001) and Ory et al. (2011) for European bond spreads. However, we cannot confirm the influence of the rating reason in our multivariate analysis. The analysis shows that neither S&P nor Moody's is a market leader in Germany. The number of rating announcements issued is almost equally distributed among agencies, and the market reaction to announcements is not significantly different.

The results suggest that the German stock market reacts differently to rating announcements than the U.S. stock market. Companies listed in the German stock market with issuer ratings from Moody's and S&P are internationally orientated firms, which ought to be comparable to international companies. Moreover, the ratio of domestic credit to private sectors by banks to GDP has declined continuously in Germany, from 113.4% in 2009 to 95.6% in 2013, and refinancing through capital markets is becoming increasingly important for German companies. However, the stock price reaction to rating announcements is lower there than in the United States.

Chapter 4

Market integration and efficiency of CDS and equity markets*

Abstract

We test the market integration and efficiency of credit default swap (CDS) and equity markets by examining the CDS spreads of 538 U.S. and European firms around unanticipated and sudden credit events (CEs) from 2010 to 2013. We find evidence that stock markets react prior to CDS markets, anticipating CEs to a certain extent. In particular, we find that equity returns during the two days prior to a CE have a highly significant influence on the observed CDS spread change on the day of the CE, indicating that both markets are not fully integrated yet. In addition, we find evidence that CDS spread changes display continuation patterns following positive CEs and reversal patterns following negative CEs. These patterns are in line with the Uncertain Information Hypothesis, suggesting that CDS markets are efficient, albeit lagging equity markets to a certain extent.

4.1 Introduction

Credit default swaps (CDS) rank among the most widely used types of credit derivative instruments and are an integral part of financial markets. Due to their comparatively high liquidity, CDS provide an accurate reflection of the market's current perception of the default risk of an issuer. CDS spreads therefore possess important information for bondholders and shareholders alike, as the default risk of a firm plays an important role in the valuation of a firm's equity as well as its debt.

Yet, the empirical evidence on parallel information processing in equity and credit markets is still incomplete and offers a conflicting picture. While there are stable results that stock markets are processing information faster than CDS markets (e.g. Forte and Peña, 2009; Norden and Weber, 2009; Trutwein and Schiereck, 2011; Wang and Bhar, 2014), the announcement effects of credit rating changes show that there are also significant information spillovers from credit to equity markets, particularly for negative rating events (e.g. Imbierowicz and Wahrenburg, 2013; Norden and Weber, 2004). As a consequence of these findings, the impression arises that stock markets have the ability to process information more quickly than debt and credit markets. However, the

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stock market efficiency still remains incomplete, as large debt valuation adjustments, credit rating news, and credit risk changes exert a significant influence on stock prices.

In contrast to stock and bond markets, the CDS market is still a comparatively unregulated OTC market, dominated by large institutional investors, such as banks, insurance firms, and hedge funds. It is therefore possible that these investors possess informational advantages that stem from trading in an opaque market with relatively few market participants. As a result, it is likely that the CDS market is used as a preferred channel for informed trading. The findings of Acharya and Johnson (2007) support this assumption, as they document information flows from CDS to stock markets.

However, beyond the questions of informed trading in CDS markets and the informational efficiency of stock markets, at least two more questions remain to be addressed. First, if stock markets react significantly to rating changes, and to negative rating changes in particular, are there similar observable effects to large changes in CDS spreads? And second, if generally credit markets are slower in information processing than equity capital markets, does uncertainty still need to be resolved once CDS markets adjust their valuation levels for corporate debt? This paper shows that equity markets react to large CDS spread changes and that they at least partially anticipate both, negative and positive CEs. In addition, we find evidence that CDS markets overreact to unanticipated credit changes. Equity markets appear to lead CDS markets by at least two days. It therefore seems as if CDS markets do not process the arrival of negative information as quickly as equity markets as they take longer to determine the actual ramifications of the CE.

In order to answer these questions in more detail, we use a twofold research approach. First, we apply a research design for stock price jumps and drops to significant CDS spread changes in order to examine whether similar observable return patterns exist. Second, we test the integration of CDS and equity markets following the approach of Wang and Bhar (2014). We analyze the CDS and stock market reaction and their integration following significant CEs, defined as being in the 1% (positive CE) and 99% (negative CE) quantile of CDS spread changes for a given rating class. As our sample consists of single-name CDS spreads of U.S. and European firms, we also test whether firms from these two regions show different market reactions. As a result of the ongoing sovereign debt crisis in Europe, European debt and equity markets are potentially under more stress than U.S. ones, which began to normalize in mid-2009, following the end of the 2007 financial crisis. Our results therefore complement the research of Trutwein and Schiereck (2011) and Wang and Bhar (2014), as we investigate whether markets that are under stress are better integrated than the ones in a normal market environment. Furthermore, we use multiple cross-sectional regressions to identify the drivers of CDS spread changes around unanticipated CEs and during the subsequent days.

Overall, our results suggest that stock markets react prior to CDS markets, anticipating CEs to a certain extent. In particular, we find that equity returns during the two days prior to a CE have a highly significant influence on the observed CDS spread change on the day of the CE, indicating that both markets are not fully integrated yet. In addition, we find evidence that CDS markets display continuation patterns following positive CEs and reversal patterns following negative CEs. These patterns are in line with the Uncertain Information Hypothesis (UIH) of Brown et al. (1988), suggesting that CDS markets are efficient, albeit lagging equity markets to a certain extent. Moreover, the findings show that the market response to sudden CEs differs depending on the credit risk of a firm, as measured by its S&P credit rating. In addition, the results of the lead-lag analysis suggest that the integration between CDS and equity markets in Europe is higher than in the U.S. The likely reason for this is that European credit markets are still under stress as a result of the ongoing European sovereign debt crisis. U.S. markets, on the other hand, are under considerably less stress, as credit markets already normalized following the 2007 financial crisis.

The rest of this article is structured as follows. Section 4.2 gives an overview of the research on CDS markets and their relationship to equity markets. It also briefly outlines the related literature on the efficiency of stock markets. Section 4.3 describes the data selection process and the sample, as well as the empirical methodology for the CDS and stock event study. Section 4.4 presents the results of the CDS and equity market reactions to sudden CEs. Section 4.5 splits the sample into CDS of U.S. and European firms and analyzes whether the CDS market reactions to positive and negative CEs differ significantly from one another. Section 4.6 analysis the drivers of the CDS spread changes, while Section 4.7 examines the lead-lag relationship of CDS and equity markets. Section 4.8 offers multiple robustness checks and Section 4.9 concludes the paper.

4.2 Related literature

There is an extensive and still growing literature on the efficiency of stock markets, yet few studies address the efficiency of CDS markets as a whole. Most research on CDS markets focuses on the effect of rating changes on CDS spreads and stock prices and whether or not CDS spread changes can predict rating changes (e.g. Finnerty et al., 2013; Galil and Soffer, 2011; Hull et al., 2004; Norden and Weber, 2004). Ratings are an important determinant of CDS spread levels, and a rating change can signal either a decrease or increase in the default probability of a firm, depending on whether an upgrade or downgrade occurs. Longstaff et al. (2005) show that approximately 50% of a CDS spread is determined by the default probability of a company. Another important factor that determines CDS spread levels is a non-default component related to measures of bond liquidity risks, such as the size of the bid-ask spread.

Hull et al. (2004) and Norden and Weber (2004) are among the first to show that rating announcements, such as changes in rating outlooks and actual rating changes, have a significant impact on CDS spreads. Both studies show that positive rating announcements and rating upgrades have little influence on CDS spreads at best. Only the more recent study of Finnerty et al. (2013) finds that rating upgrades are associated with a significant reduction in CDS spreads. On the other hand, negative rating announcements and rating downgrades have a decisive impact on CDS spreads. CDS spreads show a marked increase following such an announcement (Finnerty et al., 2013; Galil and Soffer, 2011; Hull et al., 2004; Norden and Weber, 2004). This suggests that there is an asymmetric response to positive and negative rating announcements, as the increase in CDS spread levels following a negative rating announcement is more pronounced than the decrease following a positive one (Galil and Soffer, 2011).

Trutwein and Schiereck (2011) analyze the interdependence of CDS spread changes and equity returns for 13 of the biggest U.S. financial institutions. They show that CDS spread changes and equity returns are inversely related as increases and decreases in stock prices lead to subsequent decreases and increases in CDS markets. Moreover, they show that equity markets react faster than CDS markets, which in turn leads to comparatively severe adjustments in CDS spread levels. They also show that during times of heightened stress, as financial institutions experienced during 2008, equity and CDS markets become much more closely integrated than during times in which the economic situation is more benign. Falling stock prices can lead to a higher perceived default risk, which in turn leads to higher CDS spreads, which then again depress stock prices even further. This pattern can eventually result in a downward spiral, where a company will default. As the CDS spread of a firm rises, refinancing its debt will become increasingly costly, potentially leading to a default of the firm. Jorion and Zhang (2007a) investigate the impact of CEs on the default risk of industry rivals. They analyze a sample of 820 single-name CDS from North America from January 2001 to December 2004. Besides bankruptcy filings, as extreme CEs, Jorion and Zhang (2007a) define large increases in the CDS spread level as unanticipated CEs and show that sudden CDS spread increases also have strong effects on the CDS spreads of the firm's peers. A widening of a company's CDS spread is accompanied by similar increases in the CDS spreads of its peers. Wang and Bhar (2014) analyze the market integration of CDS and equity returns for 252 U.S. firms between 2004 and 2010. They use panel data regression to estimate the CDS spreads and find that the stock returns during the previous five days have an influence on the CDS spread on a given day. They interpret this finding as equity markets leading CDS markets.

One of the first to investigate the effects that large and sudden changes in CDS spreads have on equity markets are Trutwein et al. (2011). Based on all available historic data in a given time series, they define a large change in a CDS spread as any change in excess of three standard deviations. Such large and sudden changes in the spread level lead to very strong equity market reactions. This reaction is asymmetric in nature, depending on whether CDS spreads tightened or widened. During the more benign market conditions prior to the 2007 financial crisis, sudden increases and decreases in CDS spreads were followed by positive equity returns. Especially for non-investment grade companies the link between a sudden contraction in CDS spreads and subsequent increases in the company's share price was particularly pronounced. It appears that during this time equity markets did not view a deterioration in the debt position of a company as implying a similar deterioration in the equity value of a firm. However, during times of crisis the equity market response to changes in CDS spreads is markedly different. A tightening of CDS spreads is no longer followed by any discernable pattern in the equity market. Moreover, a sudden widening leads to a significant reduction in the stock price of the affected company. It therefore appears as if CDS and equity markets become more integrated during times of crisis, as the equity market's response to a deteriorating debt position is negative. Positive changes in the debt position, on the other hand, are not followed by a significant equity market response. This result is largely in line with negative rating announcements and downgrades having a significantly negative effect on stock prices, while positive rating announcements and upgrades have little effect (see e.g. Norden and Weber, 2004). In addition, non-investment grade rated companies generally show a more pronounced equity market response to both, widening and tightening of CDS spreads, than their investment grade rated peers (Trutwein et al., 2011).

There are a multitude of articles studying the capital market reaction to sudden increases or decreases in stock prices (for a comprehensive overview see Amini et al., 2013). The ultimate goal of this strand of research is to investigate whether markets are efficient and security prices reflect new information immediately, as suggested by the Efficient Market Hypothesis of Fama (1970). The capital market reaction prior to and following a large price shock is a valuable indication whether capital markets are able to process information efficiently. A price shock, in most cases, is a sudden deterioration or surge in the security price. The seminal work of De Bondt and Thaler (1985) documents that stock price changes can be predicted. In particular, stocks appear to overreact in the very long run to negative news announcements, leading to subsequent return reversals in the period following the negative announcement. A similar market reaction can also be detected for positive news announcements, albeit in the opposite direction. The observation that stock prices appear to overreact to the arrival of new information resulted in the formulation of the Overreaction Hypothesis. The Overreaction Hypothesis is incompatible with the Efficient Market Hypothesis as it violates one of its pillars, namely the unpredictability of stock returns. Later studies that report short-run evidence in favor of the Overreaction Hypothesis include, among others, Benou and Richie (2003), Lobe and Rieks (2011), and Choi and Jayaraman (2009), albeit the latter only for non-optional stocks. Ising et al. (2006) also find overreaction patterns, but only after large price increases.

In an attempt to reconcile the Efficient Market Hypothesis with the observed overreaction in stock markets, particularly to the arrival of negative information, Brown et al. (1988) develop the UIH. This hypothesis postulates that the arrival of new information will lead to substantial uncertainty and consequently the risk and expected return of a security will have to increase systematically. Under the assumption that investors are risk averse, they will set the security price below their conditional expected value. Then, as soon as the uncertainty surrounding the new information is resolved, positive price changes will be observed, irrespective of whether the nature of the information was positive or negative. As a result, negative new information will be followed by return reversals, while positive new information will lead to continuation patterns. In addition, the price reversal patterns ought to be more pronounced than the continuation patterns. Other studies, besides Brown et al. (1988), which provide support for the UIH include Schnusenberg and Madura (2001) and more recently Yu et al. (2010).

Overall, the empirical literature until now provides only limited evidence on the efficiency of CDS markets. In addition, research so far neglects to investigate the patterns observed in the CDS market prior to and following large and unexpected changes in CDS spreads and the integration of CDS and equity markets in this context. The present study addresses this issue by analyzing the CDS and equity market response to sudden CEs. In addition, by examining equity and CDS markets together, it is possible to draw conclusions on the influence these markets have on each other. We therefore significantly extend the work of Trutwein et al. (2011) and provide first evidence on the patterns of CDS spread changes surrounding large and unanticipated CEs.

4.3 Data and methodology

4.3.1 Data selection and sample description

The present study analyzes CDS spreads of U.S. and European single-name CDS and the underlying entity's equity prices prior to and following unanticipated and sudden positive and negative CEs from January 2010 to December 2013.

In this context a positive CE represents a tightening or decrease in CDS spread levels, while a negative CE indicates a widening or increase in spread levels. In line with the majority of prior research on CDS (e.g. Finnerty et al., 2013; Hull et al., 2004; Norden and Weber, 2004; Trutwein and Schiereck, 2011), we use the five-year senior CDS mid spread in U.S. dollars. We retrieve CDS data from Thomson Reuters End-of-Day (EOD), which collects CDS quotes each day from multiple contributors and applies a rigorous screening procedure to eliminate outliers prior to calculating daily composite spreads.[1]

In a first step, all U.S. and European single-name CDS are collected from Thomson Reuters EOD[2] for which a S&P long-term credit rating is available for at least some time during the investigation period.[3] This resulted in 617 different single-name CDS quotations. In a next step,

[1] Thomson Reuters EOD offers quotes for four different structuring types: *(i)* full restructuring (CR), *(ii)* modified restructuring (MR), *(iii)* modified-modified restructuring (MM), and *(iv)* no restructuring (XR). In its guidelines, Thomson Reuters EOD points out that the structuring type is based on regional preference. In line with the suggestion in these guidelines, we use MM for European firms and XR for U.S. companies.

[2] Mayordomo et al. (2014) show that between January 2004 and March 2010 the CDS data quality can vary across different sources. Nonetheless, they concede that Thomson Reuters EOD is a viable source. It should also be noted that the investigation period of Mayordomo et al. (2014) ends in March 2010, whereas ours begins in January 2010.

[3] We use S&P as our primary rating agency with regard to categorizing the sample companies into different rating categories. S&P is arguably the biggest and most influential rating agency and has a market share in corporate issuer ratings of approximately 46% in the United States and 35% in Europe. In addition, Gande and Parsley (2005)

all entities for which daily spread changes are missing for more than 35% of the days during the period for which CDS data is available for a given entity are dropped from the sample.[4] Single-name CDS have generally become more liquid instruments and we therefore forego the common practice of linearly interpolating daily mid CDS spreads between missing spread change observations (e.g. Finnerty et al., 2013; Hull et al., 2004; Norden and Weber, 2004). Furthermore, all non-exchange listed companies are dropped from the sample. All stock prices and S&P long-term issuer ratings are taken from Thomson Reuters Financial Datastream.

The final sample consists of 538 firms from multiple industries, including the financial sector. Of these 538 firms, 344 (63.94%) are from the U.S. and 194 (36.06%) from Europe. The European sample consists of companies from 17 countries, the majority being from the United Kingdom (46), France (37), Germany (29), and Italy (17). The remaining firms are from the Netherlands (13), Spain and Sweden (11 each), Finland (6), Austria and Ireland (4 each), Belgium, Greece, Portugal (3 each), Denmark, Luxembourg, Switzerland (2 each), and Norway (1).

Unanticipated and sudden CEs are determined as being in the 1% (positive CE) and 99% (negative CE) quantile of CDS spread changes for each of the five letter rating classes AAA/AA, A, BBB, BB, B.[5] The CCC and lower classes are excluded, as their sample size is comparatively small and the data of rather poor quality. Determining CDS spread change quantiles for the different rating classes separately is a necessary prerequisite to examining the effect of sudden CEs, as the spread changes in each rating class differ markedly from each other, with the lower rating classes showing on average the most severe spread changes. If this separation was not undertaken, the lowest rating class would dominate the entire sample of CEs. Figure 4.1 illustrates the average CDS spread for each rating class during the investigation period from January 2010 to December 2013. CDS in higher rating classes (e.g. AAA/AA) generally have lower CDS spreads than those in the lower ones. The three investment grade classes AAA/AA, A and BBB have remarkably stable CDS spreads during the investigation period. The non-investment grade classes BB and B, on the other hand, have much higher CDS spreads, which display a somewhat more erratic behavior.

In order to avoid confounding events, all CE that had another CE during the 30 day period prior to or the 30 day period following a CE, are dropped from the sample. In addition, in order to ensure that a CE is not the response to an earlier or anticipated rating event, all CEs that were preceded by a S&P creditwatch, outlook, or rating change announcement 30 days prior to a CE and up to 5 days following a CE are dropped from the sample. Applying these selection criteria, leaves us with a sample of sudden and unanticipated CEs, which are not a reaction to changes in the firms rating or to prior CEs.

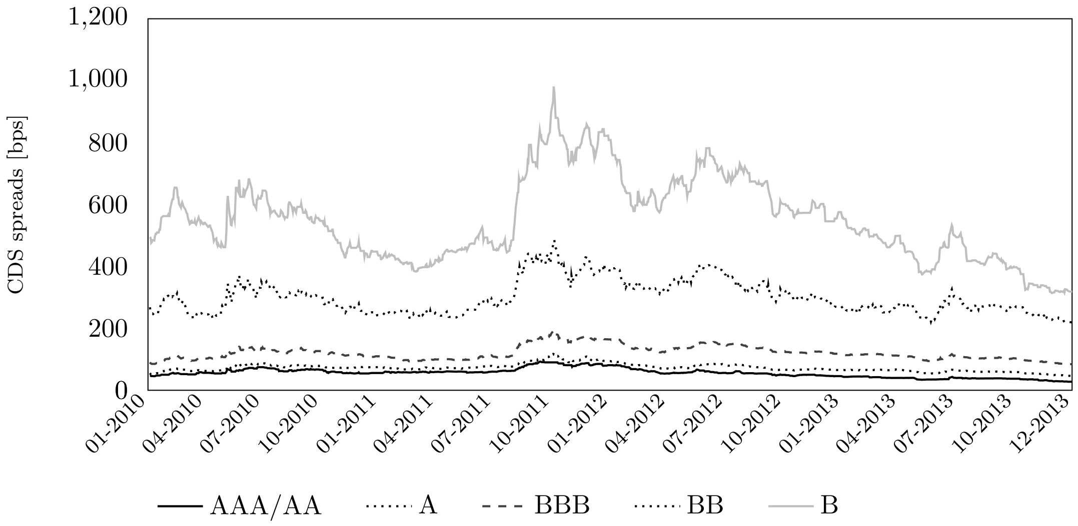
The final sample consists of 647 CEs, which is almost balanced between positive and negative ones, having a total of 323 positive and 324 negative CEs. Table 4.1 reports the quantiles of the CDS spread changes that constitute a CE across the different rating classes. The 1% quantile for positive CEs decreases from -12.02 bps for rating class AAA/AA to -62.80 bps for rating class B. The largest decrease in credit spreads can also be observed for the lowest rating class, where a maximum spread reduction of 136.59 bps can be observed. This is more than five times higher than the maximum spread reduction observed for the highest rating class. The border for the 99% quantile rises from 14.20 bps for the AAA/AA rating class to 66.07 bps for the B rating class. The

show that, at least for sovereigns, S&P rating changes are on average more frequent and occur earlier than those of other rating agencies. The recent study by Finnerty et al. (2013) also exclusively focuses on the impact of S&P rating announcements on CDS spreads.

[4]The literature using CDS event studies does not make any clear statements in this regard to liquidity thresholds. We therefore apply a threshold similar to those of stock event studies, where the threshold is usually set between 10% and 20%. However, as the CDS market is still less liquid than the stock market, we decided to use a threshold of 35%, which offers a good tradeoff between liquidity and the number of observations in our sample.

[5]Due to the small sample size of AAA and AA rated companies, these two classes are combined into one.

Figure 4.1: CDS spreads by rating class from January 2010 to December 2013



largest single-day spread increase of the lowest rating class is 150.66 bps, more than 8 times higher than the largest spread increase observed for the highest rating class. Most CEs are observed for the BBB rating class, the rating class into which most of the sample companies fall. In line with Figure 4.1, higher CDS spreads are associated with lower rating classes.

Table 4.1: Quantile border and average portfolio size for each letter rating class.

	AAA/AA	A	BBB	BB	B
1% quantile (bps)	−12.02	−13.73	−14.50	−31.77	−62.80
Min. change 1% quantile (bps)	−12.16	−13.77	−14.52	−31.85	−63.09
Max. change 1% quantile (bps)	−25.34	−34.61	−59.84	−95.29	−136.59
99% quantile (bps)	14.20	14.87	15.48	33.95	66.07
Min. change 99% quantile (bps)	14.44	14.87	15.49	34.12	68.94
Max. change 99% quantile (bps)	18.36	34.44	106.00	84.57	150.66
Mean index size (number of firms)	25.88	143.25	206.77	71.32	31.32
Median index size (number of firms)	25.00	132.00	209.00	73.00	31.00
Mean CDS spread (bps)	71.63	98.09	142.65	334.98	614.75

Table 4.2 describes the data with regard to the distribution of CEs by region, years, and industry. The number of CEs per year almost constantly decreases from 2010 to 2013. Most events are observed for 2010 with 233 CEs, 132 positive ones and 101 negative ones, considerably more than during the subsequent years. This might reflect the still somewhat weak economic conditions in the U.S. and Europe in the wake of the 2007 financial crisis. However, the rather large number of positive CEs can also be seen as an indication of the improving debt situation of many firms. In line with the ratio of U.S. to European companies in the sample, approximately two thirds of all CEs are observed for U.S. firms, and only one third for European ones. This distribution holds through the entire investigation period, with the exception of 2013, where CEs by European companies represent almost half of all observations. This may be due to the ongoing sovereign debt crisis in Europe. In particular, EU firms experience almost three times as many negative CEs than positive ones during 2013.

Most CEs are observed for the manufacturing industry, with 201 CEs, 100 positive and 101 negative ones, followed by firms from the financial sector with a total of 132 events, 67 positive and 65 negative ones. For the financial sector, more events can be observed for European companies than for U.S. ones. In particular, there are 33% more negative CEs observed for European institutions than for U.S. ones. This is most likely due to the European sovereign debt crisis, which

Table 4.2: Distribution of credit events by region, year, and industry.

	Year				Primary industry				
	2010	2011	2012	2013	Manufacturing	Financials	Services	Other	Total
Panel A: Total									
Total CE	233	138	155	121	201	132	63	251	647
Positive CE	132	48	97	46	100	67	27	129	323
Negative CE	101	90	58	75	101	65	36	122	324
Panel B: USA									
Total CE	162	92	104	75	135	64	53	92	433
Positive CE	90	29	63	34	63	38	23	92	216
Negative CE	72	63	41	41	72	26	30	89	217
Panel C: EU									
Total CE	71	46	51	46	66	68	10	70	214
Positive CE	42	19	34	12	37	29	4	37	107
Negative CE	29	27	17	34	29	39	6	33	107

rapidly evolved into banking sector crisis in multiple European countries. European institutions are much more severely affected than their U.S. counterparts, which probably explains the higher frequency of negative CEs for European financial firms. Otherwise there appear to be no specific trends with regard to the distribution of CEs among the different industries in the sample.

4.3.2 Methodology

In order to analyze the CDS spread changes around positive or negative CEs, we follow the event study approach for CDS pioneered by Hull et al. (2004) and Norden and Weber (2004). CDS spread changes are adjusted by spread changes of a CDS benchmark with the same rating class as the firm experiencing the CE. The benchmark includes all companies in the same long-term S&P rating class, excluding the company that has the CE.[6] We then define a positive or negative CE to be day zero ($t = 0$) and calculate the adjusted spread changes (ASC) for each day during the event window $[\tau_1; \tau_2 \in -30; 30]$ as follows:

$$ASC_{i,t} = (CDS_{i,t} - CDS_{i,t-1}) - (I_{r,t} - I_{r,t-1}), \tag{4.1}$$

where $ASC_{i,t}$ is the adjusted (abnormal) spread change on day t and $CDS_{i,t}$ is the observed spread change for firm i on day t, r is the letter rating class of firm i on the day of the CE, and $I_{r,t}$ is the CDS spread index for rating class r on day t.

Cumulative adjusted spread changes (CASCs) are calculated by adding daily $ASC_{i,t}$ from day τ_1 to τ_2:

$$CASC_{[\tau_1;\tau_2]} = \sum_{t=\tau_1}^{\tau_2} ASC_{i,t}. \tag{4.2}$$

In order to test whether the adjusted CDS spread changes differ significantly from zero, we use the standard cross-sectional parametric t-test, as well as the nonparametric Wilcoxon sign test and the Wilcoxon signed-rank test. The Wilcoxon sign test analyzes whether the median of a sample is equal to zero. It examines the signs of the individual values in a given sample. If the median equals zero, positive and negative values should be equally distributed. Like the sign test, the Wilcoxon signed-rank test examines the sign of the individual values, but also takes into account the actual value by ranking it according to its absolute value in the sample. It then sums the ranks of the absolute differences between the observations and the hypothesized median value, which is zero in our case, in order to estimate whether the median is significantly different from zero.

[6]For the different rating classes, AAA/AA, A, BBB, BB, and B, we disregard the plus and minus suffix that S&P awards for a more detailed evaluation of a company's overall creditworthiness.

The stock price performance surrounding positive and negative CEs is analyzed using the market model event study introduced by Dodd and Warner (1983) and Brown and Warner (1985). The market model is estimated using a 252-trading-day period (one whole trading year) from 282 days prior to the event day ($t = -282$) to 31 days prior to the event day ($t = -31$) with:

$$R_{i,t} = \hat{\alpha}_i + \hat{\beta}_i R_{m,t} + \epsilon_{i,t}, \tag{4.3}$$

where $R_{i,t}$ is the return of stock i on day t during the estimation period, $R_{m,t}$ is the return of the benchmark index of company i on day t, $\hat{\alpha}_i$ and $\hat{\beta}_i$ are the regression coefficients of stock i. Datastream's value-weighted total return national stock market index of company i's country of origin is used as the benchmark index.

The cumulative abnormal return (CAR) for stock i during the event window is calculated as:

$$CAR_{i,[\tau_1;\tau_2]} = \sum_{t=\tau_1}^{\tau_2} [R_{i,t} - (\hat{\alpha}_i + \hat{\beta}_i R_{m,t})]. \tag{4.4}$$

Finally, for a sample of N CEs, the ACAR for a given event window is calculated by:

$$ACAR_{[\tau_1;\tau_2]} = \frac{1}{N} \sum_{i=1}^{N} CAR_{i,[\tau_1;\tau_2]}. \tag{4.5}$$

To test whether the ACARs are statistically different from zero, we use the parametric test statistic developed by Boehmer et al. (1991), the BMP-test, which controls for event induced volatility. In addition, we also use two nonparametric test statistics: the Wilcoxon signed-rank test and the rank test introduced by Corrado (1989), which was later refined by Corrado and Zivney (1992), the CZ-test. We interpret our results along the lines of the nonparametric test statistics, as daily stock returns do not follow a normal distribution. The parametric BMP-test is used as a robustness test and we indicate any stark discrepancies between the nonparametric and parametric test statistics.

4.4 Results

4.4.1 CDS market reaction to positive and negative credit events

We first report the results for sudden and unanticipated CEs for the CDS market and focus on the equity market in the following section. Table 4.3 summarizes the spread changes prior to and following positive CEs, where a positive CE is defined as a tightening of the CDS spread for a given company on the event day $t = 0$. In line with expectations, the results on the event day are statistically highly significant, not only for the overall sample, but also for the different rating categories. Furthermore, the results of the total sample in Table 4.3 Panel A suggest that positive CEs are largely unanticipated by the CDS market, as neither the $[-30; -16]$ nor the $[-15; -1]$ day event windows show any statistical significance. For the post-event window $[1; 15]$ there is some evidence of continuation patterns, as CDS spreads continue to significantly decrease. However, even though the spread changes seem to continue to be negative over the $[16; 30]$ day event window, they are no longer significantly different from zero.

As documented in Table 4.1, the CEs differ distinctly between the different rating categories in terms of bps changes. We therefore split the entire sample into five different rating categories. The results are presented in Table 4.3 Panel B through F. There are some significant reductions in CDS spreads prior to a positive CE for the rating classes A and BB, but these only occur during the $[-30;-16]$ day event window and not during the $[-15;-1]$ day event window. There is no indication of an anticipation effect of positive CEs for the other rating classes.

The continuation patterns previously observed for the entire sample during the $[1;15]$ day event window appear to be largely driven by the higher rating classes A and BBB. The continuation patterns appear to be particularly pronounced for rating class A, where the significant continuation patterns extend throughout the $[16;30]$ day event window. On the other hand, the AAA/AA rating class shows some weakly significant reversal patterns following a positive CE. Due to the small sample size, these patterns need to be interpreted carefully and may not represent a general trend. Remarkably, the CDS market appears to react efficiently to sudden and unanticipated positive CEs in the lowest, non-investment grade rating classes BB and B. Neither prior to nor following a positive CE can any significant patterns be observed.

Table 4.3: Changes in CDS spreads prior to and following positive credit events.

	[−30;−16]	[−15;−1]	[0]	[1;15]	[16;30]
Panel A: Total sample					
N	323	323	323	322	322
CASC-mean	−1.23	0.24	−24.14	−1.71	−1.90
CASC-median	−0.21	1.16	−16.94	−1.79	−0.98
Negative%	50.77	48.92	99.38	55.59	54.35
p Value *t*-test	0.39	0.88	0.00	0.28	0.15
p Value rank test	0.46	0.37	0.00	0.10	0.15
p Value sign test	0.82	0.74	0.00	0.05	0.13
Panel B: Rating class AAA/AA					
N	7	7	7	7	7
CASC-mean	4.29	−1.35	−10.82	6.09	−7.13
CASC-median	1.80	1.16	−10.40	6.45	−4.25
Negative%	42.86	42.86	85.71	28.57	85.71
p Value *t*-test	0.40	0.76	0.01	0.09	0.33
p Value rank test	0.69	0.94	0.02	0.16	0.22
p Value sign test	1.00	1.00	0.02	0.45	0.13
Panel C: Rating class A					
N	50	50	50	50	50
CASC-mean	−3.87	2.36	−12.52	−2.64	−1.57
CASC-median	−2.43	2.07	−12.79	−3.14	−1.15
Negative%	64.00	44.00	98.00	66.00	62.00
p Value *t*-test	0.03	0.27	0.00	0.09	0.17
p Value rank test	0.03	0.30	0.00	0.02	0.13
p Value sign test	0.06	0.48	0.00	0.03	0.12
Panel D: Rating class BBB					
N	173	173	173	172	172
CASC-mean	0.93	1.28	−16.54	−1.59	−0.70
CASC-median	0.98	−0.27	−14.70	−1.66	−0.51
Negative%	43.35	50.29	100.00	56.98	51.74
p Value *t*-test	0.28	0.25	0.00	0.11	0.43
p Value rank test	0.22	0.55	0.00	0.10	0.50
p Value sign test	0.09	1.00	0.00	0.08	0.70
Panel E: Rating class BB					
N	67	67	67	67	67
CASC-mean	−7.50	0.95	−40.24	−4.61	−0.52
CASC-median	−6.67	4.39	−35.31	−0.23	−1.95
Negative%	65.67	44.78	100.00	50.75	53.73
p Value *t*-test	0.04	0.81	0.00	0.29	0.88
p Value rank test	0.02	0.45	0.00	0.48	0.48
p Value sign test	0.01	0.46	0.00	1.00	0.63
Panel F: Rating class B					
N	26	26	26	26	26
CASC-mean	4.13	−12.19	−59.15	4.66	−12.71
CASC-median	15.79	−7.82	−63.14	8.07	0.00
Negative%	38.46	61.54	100.00	46.15	50.00
p Value *t*-test	0.76	0.38	0.00	0.75	0.33
p Value rank test	0.42	0.22	0.00	0.85	0.60
p Value sign test	0.33	0.33	0.00	0.85	1.00

Overall, the results of the CDS spread changes following positive CEs appear to follow patterns that are in line with those predicted by the UIH of Brown et al. (1988). The continuation patterns in the wake of positive CEs during the 15 days following the event indicate an initial underreaction of CDS market participants. Investors take some time to assess the true impact of the CE, which leads to a subsequent decrease in the perceived default risk of the firm.

Table 4.4: Changes in CDS spreads prior to and following negative credit events.

	[−30;−16]	[−15;−1]	[0]	[1;15]	[16;30]
Panel A: Total sample					
N	324	324	324	323	323
CASC-mean	−1.38	−0.90	23.42	−6.95	−4.64
CASC-median	0.30	1.53	17.53	−5.90	−3.97
Positive%	51.85	54.32	100.00	35.91	34.06
p Value *t*-test	0.26	0.54	0.00	0.00	0.00
p Value rank test	0.86	0.62	0.00	0.00	0.00
p Value sign test	0.54	0.13	0.00	0.00	0.00
Panel B: Rating class AAA/AA					
N	10	10	10	10	10
CASC-mean	2.82	−0.32	13.81	−1.73	−3.57
CASC-median	4.11	2.99	14.28	−2.74	0.12
Positive%	80.00	60.00	100.00	40.00	50.00
p Value *t*-test	0.30	0.93	0.00	0.55	0.20
p Value rank test	0.28	0.92	0.00	0.56	0.70
p Value sign test	0.11	0.75	0.00	0.75	1.00
Panel C: Rating class A					
N	75	75	75	75	75
CASC-mean	1.76	−1.49	14.81	−3.67	−5.09
CASC-median	1.28	0.72	14.97	−5.13	−5.83
Positive%	58.67	53.33	100.00	34.67	24.00
p Value *t*-test	0.12	0.34	0.00	0.00	0.00
p Value rank test	0.08	0.57	0.00	0.00	0.00
p Value sign test	0.17	0.64	0.00	0.01	0.00
Panel D: Rating class BBB					
N	145	145	145	145	145
CASC-mean	−1.15	1.61	17.83	−4.75	−3.65
CASC-median	−0.75	2.05	16.41	−5.87	−3.06
Positive%	48.28	56.55	100.00	33.79	34.48
p Value *t*-test	0.24	0.18	0.00	0.00	0.00
p Value rank test	0.11	0.20	0.00	0.00	0.00
p Value sign test	0.74	0.13	0.00	0.00	0.00
Panel E: Rating class BB					
N	68	68	68	67	67
CASC-mean	−0.06	2.83	31.72	−1.50	−5.95
CASC-median	0.46	2.40	31.53	−2.16	−7.11
Positive%	51.47	57.35	100.00	44.78	37.31
p Value *t*-test	0.98	0.51	0.00	0.71	0.07
p Value rank test	0.78	0.38	0.00	0.51	0.05
p Value sign test	0.90	0.27	0.00	0.46	0.05
Panel F: Rating class B					
N	26	26	26	26	26
CASC-mean	−16.82	−23.24	61.39	−44.69	−5.89
CASC-median	−8.38	−17.56	67.06	−42.93	−7.50
Positive%	42.31	34.62	100.00	26.92	46.15
p Value *t*-test	0.16	0.05	0.00	0.01	0.54
p Value rank test	0.34	0.09	0.00	0.01	0.50
p Value sign test	0.56	0.17	0.00	0.03	0.85

Table 4.4 shows the spread changes prior to and following negative CEs, where a negative CE is defined as a widening of the CDS spread for a given company on the event day $t = 0$. As with the CDS market reaction to positive CEs, the reaction on the event day is highly significant, again, not only for the overall sample, but for all five rating classes as well. Negative CEs are not anticipated by CDS markets, as for the total sample of all negative CEs, the pre-event windows $[-30, -16]$ and $[-15; -1]$ show no significance. However, during the two post-event windows $[1; 15]$ and $[16; 30]$ very clear reversal patterns can be observed, resulting in highly significant mean CASCs of -6.95 bps and -4.64 for the $[1; 15]$ and $[16; 30]$ day event window, respectively. Therefore, the reversals are not confined to a short time period after the initial event, but rather continue for at least 30 days following the event. This can be interpreted as a strong initial overreaction by market

participants as a result of an unexpected negative CE.

Table 4.4 Panel B through F separate the results into the different rating categories again. It can be seen that the reversal patterns observed for the entire sample are largely driven by those of the A and BBB rating classes and to some extent by the BB and B rating classes. For the A and BBB rating classes the reversal patterns are particularly pronounced and extend through the entire 30 day period following a negative CE. For the highest rating class AAA/AA the reversal patterns lack any statistical significance. For the two non-investment grade rating classes BB and B reversals are also significant, albeit during different post-event windows. The results of the patterns following negative CEs suggest that markets initially overreact to unanticipated changes in the default risk of companies. This initial overreaction is followed by significant reversals in the CDS level of a company during the subsequent days. This can be viewed as an indication that debt markets do not process the arrival of negative information in a timely fashion and take longer to determine the actual ramifications of the event. In line with the UIH, this initial underreaction may also be driven by an increase in the uncertainty following a negative CE, which then becomes resolved during the subsequent days, leading to significant reversal patterns.

Combining the CDS market reactions to positive and negative CEs, the observed patterns are in line with those hypothesized by the UIH, suggesting that CDS markets by themselves are largely efficient. Figure 4.2 gives a detailed picture of the changes in CDS spreads surrounding positive and negative CEs for the entire sample and the different rating categories. The continuation patterns following positive CEs are less pronounced than the reversal patterns following negative CEs. This again is in line with the expectations put forward by the UIH. Furthermore, the observed CDS market reactions to CEs are stronger for lower rating classes, which is an indication that the response to positive and negative CEs is asymmetric in nature. This is also in line with the prior literature on rating changes, where negative rating changes lead to a stronger market reaction than positive ones (e.g. Norden and Weber, 2004; Finnerty et al., 2013).

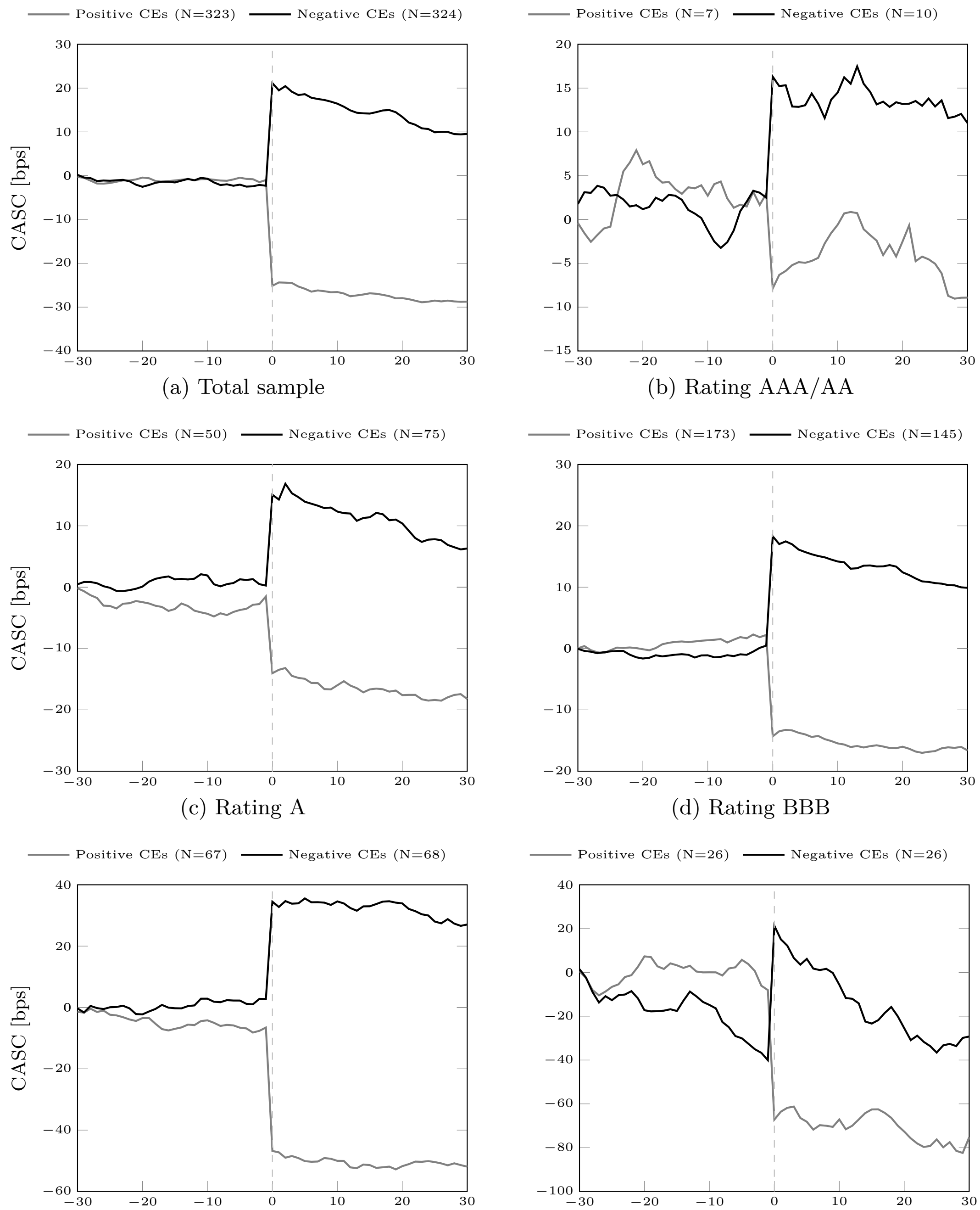
4.4.2 Equity market reaction to positive and negative credit events

In order to obtain a more comprehensive understanding of the way capital markets react to CEs, we also examine the stock return patterns prior to and following positive and negative CEs. This approach gives us the opportunity to draw some tentative conclusions on the way debt and equity markets affect each other and on the integration and interdependence between them. In particular, if equity markets react prior to the CDS market, as the results by Trutwein and Schiereck (2011) suggest, then positive and negative CEs should be a result of significantly rising or declining stock prices prior to the event. As in the previous section, we first discuss the impact positive CEs have on stock returns, followed by the effect of negative CEs on stock prices.

Table 4.5 Panel A shows the overall results of the equity market reactions prior to and following positive CEs. For the total sample, there appears to be some anticipation by equity markets of a positive CE, as stock prices already increase prior to the event. On the event day itself, the stock market reaction is also positive and significant with an ACAR of 0.78%. Following the CE, stock prices again decrease during the $[1;15]$ day event window. However, these results are only significant according to the BMP-test statistic. It nonetheless appears as if there is some anticipation by equity markets of a positive CE.

Table 4.5 Panel B through F split the sample into the different rating categories. The anticipation observed for the entire sample is not significant for any single rating class, except for the lowest rating class B during the $[-15;-1]$ day event window. The overall effect observed on the event day is significant for rating classes A, BBB, and B. This suggests that equity and debt markets

Figure 4.2: CASC surrounding positive and negative CEs for the entire sample and by rating class.



(a) Total sample

(b) Rating AAA/AA

(c) Rating A

(d) Rating BBB

(e) Rating BB

(f) Rating B

Table 4.5: Equity market reactions prior to and following positive credit events.

	[−30;−16]	[−15;−1]	[0]	[1;15]	[16;30]
Panel A: Total sample					
N	323	323	323	323	323
ACAR-mean (%)	0.65	0.84	0.78	−0.63	0.06
ACAR-median (%)	0.66	0.35	0.27	−0.53	0.03
Positive%	55.42	53.25	59.13	45.20	50.46
p Value BMP-test	0.05	0.12	0.00	0.05	0.97
p Value rank test	0.05	0.12	0.00	0.12	0.88
p Value CZ-test	0.14	0.15	0.00	0.51	0.88
Panel B: Rating class AAA/AA					
N	7	7	7	7	7
ACAR-mean (%)	2.79	−1.39	1.10	−1.32	−2.25
ACAR-median (%)	0.37	−2.28	0.61	−0.74	−1.37
Positive%	57.14	42.86	57.14	28.57	14.29
p Value BMP-test	0.43	0.53	0.08	0.58	0.04
p Value rank test	0.47	0.69	0.30	0.47	0.11
p Value CZ-test	0.46	0.54	0.07	0.76	0.13
Panel C: Rating class A					
N	50	50	50	50	50
ACAR-mean (%)	0.66	−0.52	0.61	−0.28	−0.28
ACAR-median (%)	0.66	−0.22	0.22	−0.59	0.13
Positive%	60.00	48.00	60.00	48.00	52.00
p Value BMP-test	0.33	0.26	0.12	0.44	0.49
p Value rank test	0.19	0.33	0.07	0.68	0.64
p Value CZ-test	0.43	0.69	0.06	0.97	0.98
Panel D: Rating class BBB					
N	173	173	173	173	173
ACAR-mean (%)	0.56	0.43	0.54	−0.29	0.14
ACAR-median (%)	0.69	0.35	0.25	−0.21	−0.28
Positive%	56.07	53.18	57.23	47.40	49.13
p Value BMP-test	0.14	0.45	0.01	0.36	0.85
p Value rank test	0.18	0.45	0.01	0.78	0.87
p Value CZ-test	0.27	0.81	0.02	0.96	0.72
Panel E: Rating class BB					
N	67	67	67	67	67
ACAR-mean (%)	0.43	0.84	0.62	−1.55	0.13
ACAR-median (%)	0.75	0.09	0.16	−1.56	0.36
Positive%	53.73	50.75	58.21	40.30	55.22
p Value BMP-test	0.61	0.30	0.12	0.09	0.56
p Value rank test	0.46	0.61	0.10	0.07	0.77
p Value CZ-test	0.75	0.10	0.08	0.20	0.93
Panel F: Rating class B					
N	26	26	26	26	26
ACAR-mean (%)	1.21	6.78	2.98	−1.03	0.63
ACAR-median (%)	−1.16	6.28	2.15	−0.61	0.19
Positive%	46.15	73.08	73.08	42.31	53.85
p Value BMP-test	0.53	0.00	0.01	0.55	0.58
p Value rank test	0.68	0.00	0.01	0.53	0.71
p Value CZ-test	0.68	0.01	0.00	0.79	0.69

react almost simultaneously in these rating classes. We interpret this finding as an indication that equity and debt markets are better integrated for lower rating classes than for higher ones. During the post event period stock prices generally decrease again, but this decrease is only significant for the rating class BB. The other rating classes show no significant reactions following a positive CE. Overall, equity markets clearly react to changes in the default risk of a company. This reaction appears to be more pronounced for firms in the lower rating classes. This can be viewed as evidence of a high integration of debt and equity markets, especially at the lower end of the rating scale, where default risk is more pronounced. Nevertheless, there also appears to be some anticipation in the stock market prior to a positive CE, which may suggest that stock markets process information more quickly than credit markets.

Table 4.6: Equity market reactions prior to and following negative credit events.

	[−30;−16]	[−15;−1]	[0]	[1;15]	[16;30]
Panel A: Total sample					
N	324	324	324	324	324
ACAR-mean (%)	−0.42	−1.23	−0.46	0.06	−0.41
ACAR-median (%)	−0.63	−0.93	−0.11	0.05	−0.17
Negative%	56.79	54.63	53.40	49.38	52.16
p Value BMP-test	0.02	0.01	0.04	0.49	0.54
p Value rank test	0.05	0.00	0.16	0.98	0.15
p Value CZ-test	0.24	0.14	0.27	0.87	0.54
Panel B: Rating class AAA/AA					
N	10	10	10	10	10
ACAR-mean (%)	−1.18	−2.27	−0.55	1.64	−0.29
ACAR-median (%)	−1.27	−2.43	−0.20	1.51	0.49
Negative%	70.00	70.00	70.00	20.00	40.00
p Value BMP-test	0.15	0.07	0.15	0.12	0.77
p Value rank test	0.19	0.13	0.16	0.23	1.00
p Value CZ-test	0.64	0.39	0.30	0.22	0.85
Panel C: Rating class A					
N	75	75	75	75	75
ACAR-mean (%)	−0.46	−0.78	−0.12	−1.24	−0.29
ACAR-median (%)	−0.53	−0.37	−0.42	−1.16	−0.08
Negative%	57.33	50.67	56.00	64.00	52.00
p Value BMP-test	0.08	0.26	0.64	0.17	0.90
p Value rank test	0.29	0.31	0.50	0.05	0.68
p Value CZ-test	0.22	0.49	0.57	0.19	0.65
Panel D: Rating class BBB					
N	145	145	145	145	145
ACAR-mean (%)	−0.26	−0.22	−0.11	0.46	0.27
ACAR-median (%)	−0.33	0.84	0.03	0.12	−0.02
Negative%	55.17	45.52	49.66	46.90	50.34
p Value BMP-test	0.52	0.91	0.93	0.29	0.65
p Value rank test	0.46	0.90	0.93	0.78	0.89
p Value CZ-test	0.75	0.48	0.79	0.60	0.96
Panel E: Rating class BB					
N	68	68	68	68	68
ACAR-mean (%)	−0.67	−2.64	−0.83	−0.19	−0.89
ACAR-median (%)	−1.21	−3.16	−0.55	0.14	−0.30
Negative%	58.82	69.12	60.29	47.06	52.94
p Value BMP-test	0.16	0.00	0.02	0.72	0.57
p Value rank test	0.17	0.00	0.05	0.92	0.27
p Value CZ-test	0.59	0.08	0.06	0.94	0.35
Panel F: Rating class B					
N	26	26	26	26	26
ACAR-mean (%)	−0.26	−4.09	−2.34	1.59	−3.38
ACAR-median (%)	−2.40	−5.23	0.09	2.31	−1.86
Negative%	53.85	73.08	42.31	38.46	65.38
p Value BMP-test	0.52	0.02	0.17	0.39	0.07
p Value rank test	0.91	0.00	0.93	0.28	0.07
p Value CZ-test	0.97	0.05	0.82	0.32	0.23

The equity market response to negative CEs is presented in Table 4.6. For the entire sample of negative CEs it again appears as if equity markets are able to at least weakly anticipate the CEs, as the stock returns are already negative during the 30 days leading up to the event. On the event day, the returns are significant with an ACAR of -0.46%, but only according to the BMP-test statistic. The nonparametric test statistics show no significance. There also appears to be no discernible pattern during the 30 days following a negative CE.

Table 4.6 Panel B through F again separate the results into the five different rating classes in order to examine the impact negative CEs have on firms depending on their rating. Similar to the results for positive CEs, once the entire sample of negative CEs is divided into the different rating classes, the event windows prior to the CE cease to be significant, except for the lowest rating classes BB and B during the $[-15; -1]$ day event window. Returns on the event day itself are significant for the non-investment grade rated class BB. In this case, the ACARs are -0.83%. This can be seen as an indication that for lower rating classes debt and equity markets appear to be better integrated. The other rating classes do not show any significant reaction on the day of a negative CE. During the 30 days following a negative CE, equity returns continue to be negative for the A and BB rating classes, but generally lack significance. The other rating classes appear to experience slight price reversals, but they also generally lack significance. Equity markets appear to remain critical of the performance of companies following a negative CE, even though significant reversal patterns can be observed in the CDS market. The equity market reactions following negative CEs suggest that, as with positive CEs, the integration between equity and debt markets is more pronounced for non-investment grade firms. In line with the research for markets under stress (e.g. Trutwein and Schiereck, 2011), it can reasonably be assumed that lower rated firms, especially those in the non-investment grade category, are under considerably more stress and react more sensitively to changes in their stock prices. Therefore, equity markets appear to anticipate negative CEs to a certain extent.

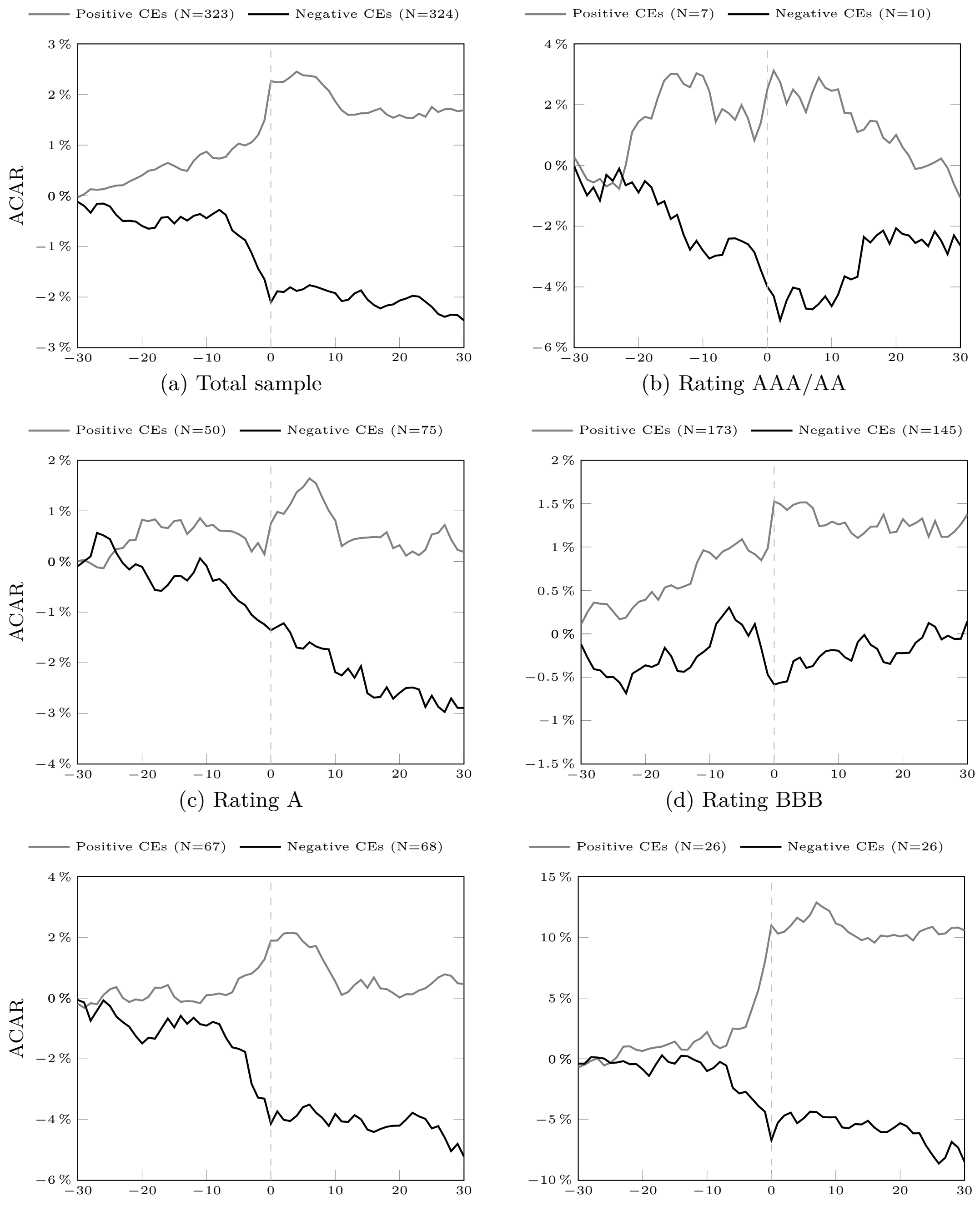
Figure 4.3 gives a detailed view of the equity market reactions prior to and following positive and negative CEs. Overall, the equity market reactions to negative and positive CEs suggest that these markets are integrated. This integration appears to be more pronounced at the lower end of the rating scale, as equity and debt markets react simultaneously. For higher rating classes, the reactions appear to be far less pronounced. There even appears to be a slight tendency towards reversal patterns following a positive CE as firms in the BB rating category experience a significant reduction in stock prices during the $[1; 15]$ day event window. Otherwise, the stock market appears to be largely informational efficient, as no discernible return patterns follow a CE.

Combining the results of the CDS and equity market responses to unanticipated large CEs, it can be seen that the equity and debt markets respond in kind, as a deterioration of the debt situation of a company is likely accompanied by negative stock returns, while an improvement in debt quality leads to positive stock returns. This result is in line with the ones Trutwein and Schiereck (2011) observed for the equity market as a response to sudden CDS spread increases or decreases at the beginning of the 2007 financial crisis. In addition, there appears to be weak evidence that equity markets anticipate negative and positive CEs, particularly for the lower rating classes. As our investigation covers the time period from 2010 to 2013, it appears as if the recent financial crisis has led to a closer integration of debt and equity markets. However, since European markets are still under stress due to the sovereign debt crisis, the results of European firms may differ from those of the U.S., as the U.S. market began to normalize in mid-2009 following the 2007 financial crisis. The next section explores this subject.

4.5 Differences between U.S. and European CDS Markets

The sample of CEs is composed to two thirds of U.S. firms and to one third of European companies (see also Table 4.2). It stands to reason that these two markets react differently to positive and

Figure 4.3: ACAR surrounding positive and negative CEs for the entire sample and by rating class.



(a) Total sample

(b) Rating AAA/AA

(c) Rating A

(d) Rating BBB

(e) Rating BB

(f) Rating B

negative CEs. Overall, the CDS market in the U.S. is larger and possesses more depth than the European one. In addition, the recent recession due to the financial crisis of 2007 ended in June 2009 in the U.S. (National Bureau of Economic Research, 2010), while Europe went almost seamlessly from the financial crisis to a sovereign debt crisis. It may therefore very well be that the European CDS market shows a weaker reaction to positive CEs and a stronger reaction to negative CEs than the U.S. market during our investigation period. We therefore split our sample into CDS of U.S. and European firms and analyze whether the CDS market reactions to positive and negative CEs differ significantly from one another.

4.5.1 US and European firms' reaction to positive credit events

Table 4.7 presents the results of the CDS market reaction of U.S. and European firms to positive CEs. As expected, the day of a positive CE is always significant, for U.S. as well as for European firms, regardless of their rating class.[7] However, positive CEs for U.S. firms are significantly higher than those for European ones, particularly for investment grade rated companies (see Table 4.7 Panel G, H, and I).

Moreover, for investment grade rated U.S. firms significant continuation patterns can be observed during the $[1; 15]$ day event window following a positive CE, leading to even lower spread levels. Yet, the difference to European firms is not significant. For European firms, on the other hand, continuation patterns can be observed during the $[16; 30]$ day event window, which are significantly more pronounced than those of U.S. firms. However, no such differences can be observed between U.S. and European non-investment grade rated firms and there are no significant patterns prior to a positive CE.

Overall, the CDS market in the U.S. appears to react more strongly to positive CEs than the one in Europe. This may indicate that investors in Europe are more cautious than those in the U.S., as the European market is still under stress due to the ongoing sovereign debt crisis. This may also explain why significant continuation patterns in the U.S. are observed during the $[1; 15]$ day event window, while for Europe they are observed during the $[16; 30]$ day event window. The CDS market in Europe may take longer to properly assess the true extent of the positive CE and therefore the market reacts later than in the U.S. However, this can also be seen as an indication that the European CDS market has less depth than the U.S. one, as it takes longer to process the new information a positive CE brings into the market. In this case, it may take longer for the uncertainty introduced by a CE to be resolved completely.

4.5.2 US and European firms' reaction to negative credit events

Table 4.8 shows the results for CDS spread changes prior to and following negative CEs. Similar to positive CEs, negative CEs for U.S. companies are significantly higher than for European firms. This difference, however, appears to be driven by differences in the reaction of investment grade rated firms. Following a negative CE, significant reversal patterns can be observed for investment grade and non-investment grade rated U.S. and European firms. However, there is no significant difference in these reversal patterns between U.S. and European companies. It should be noted that the reversal patterns for investment grade rated firms are significant during the entire 30 day event window following the negative CE, while for non-investment grade rated firms the reversal patterns appear to be largely confined to the $[1; 15]$ day event window. This suggests that the CDS market reacts faster for lower rated firms.

[7] For reasons of succinctness and clarity of notation, we divide the sample of positive and negative CEs for European and U.S. firms only into investment and non-investment grade rated firms.

Table 4.7: US vs EU Changes in CDS spreads prior to and following positive credit events.

	[−30;−16]	[−15;−1]	[0]	[1;15]	[16;30]
United States					
Panel A: Total sample					
N	216	216	216	215	215
CASC-mean	−0.79	0.18	−26.80	−2.11	−2.01
CASC-median	0.28	1.24	−18.14	−2.05	−0.48
Negative%	48.15	48.15	100.00	56.28	50.70
p Value *t*-test	0.67	0.93	0.00	0.33	0.27
p Value rank test	0.97	0.50	0.00	0.10	0.68
p Value sign test	0.63	0.63	0.00	0.08	0.89
Panel B: Investment grade only					
N	147	147	147	146	146
CASC-mean	0.63	0.40	−17.25	−2.49	0.00
CASC-median	0.98	0.51	−15.08	−2.13	−0.05
Negative%	43.54	48.98	100.00	58.90	50.00
p Value *t*-test	0.50	0.74	0.00	0.02	1.00
p Value rank test	0.39	0.89	0.00	0.02	0.96
p Value sign test	0.14	0.87	0.00	0.04	1.00
Panel C: Non-investment grade only					
N	69	69	69	69	69
CASC-mean	−3.82	−0.30	−47.16	−1.30	−6.25
CASC-median	−3.11	2.68	−41.57	−0.23	−1.47
Negative%	57.97	46.38	100.00	50.72	52.17
p Value *t*-test	0.49	0.96	0.00	0.84	0.24
p Value rank test	0.43	0.65	0.00	0.81	0.51
p Value sign test	0.23	0.63	0.00	1.00	0.81
Europe					
Panel D: Total Sample					
N	107	107	107	107	107
CASC-mean	−2.11	0.35	−18.76	−0.92	−1.70
CASC-median	−1.68	−0.27	−13.48	−1.12	−2.66
Negative%	56.07	50.47	98.13	54.21	61.68
p Value *t*-test	0.31	0.87	0.00	0.65	0.32
p Value rank test	0.24	0.57	0.00	0.65	0.05
p Value sign test	0.25	1.00	0.00	0.44	0.02
Panel E: Investment grade only					
N	83	83	83	83	83
CASC-mean	−1.14	3.26	−12.38	0.00	−2.99
CASC-median	−0.58	1.27	−12.81	−1.22	−2.53
Negative%	55.42	48.19	97.59	56.63	63.86
p Value *t*-test	0.40	0.05	0.00	1.00	0.02
p Value rank test	0.40	0.18	0.00	0.66	0.02
p Value sign test	0.38	0.83	0.00	0.27	0.02
Panel F: Non-investment grade only					
N	24	24	24	24	24
CASC-mean	−5.46	−9.71	−40.82	−4.08	2.76
CASC-median	−17.10	−6.13	−32.37	2.66	−2.97
Negative%	58.33	58.33	100.00	45.83	54.17
p Value *t*-test	0.51	0.21	0.00	0.60	0.67
p Value rank test	0.51	0.27	0.00	0.73	0.98
p Value sign test	0.54	0.54	0.00	0.84	0.84
Difference					
Panel G: Total Sample					
ΔCASC-mean	1.31	−0.17	−8.04	−1.19	−0.31
ΔCASC-median	1.95	1.51	−4.66	−0.92	2.18
p Value *t*-test	0.67	0.96	0.00	0.72	0.91
p Value Wilcoxon	0.31	0.88	0.00	0.51	0.16
Panel H: Investment grade only					
ΔCASC-mean	1.77	−2.86	−4.87	−2.49	2.99
ΔCASC-median	1.56	−0.76	−2.27	−0.91	2.49
p Value *t*-test	0.27	0.15	0.00	0.15	0.05
p Value Wilcoxon	0.23	0.24	0.00	0.31	0.06
Panel I: Non-investment grade only					
ΔCASC-mean	1.64	9.42	−6.34	2.79	−9.02
ΔCASC-median	13.99	8.81	−9.20	−2.88	1.50
p Value *t*-test	0.88	0.38	0.21	0.81	0.36
p Value Wilcoxon	0.52	0.28	0.10	0.82	0.81

Table 4.8: US vs EU Changes in CDS spreads prior to and following negative credit events.

	[−30;−16]	[−15;−1]	[0]	[1;15]	[16;30]
United States					
Panel A: Total sample					
N	217	217	217	216	216
CASC-mean	−2.92	−3.16	25.63	−7.03	−4.57
CASC-median	−0.35	0.36	18.90	−4.00	−3.94
Positive%	49.31	50.23	100.00	38.89	34.26
p Value *t*-test	0.09	0.12	0.00	0.00	0.00
p Value rank test	0.22	0.34	0.00	0.00	0.00
p Value sign test	0.89	1.00	0.00	0.00	0.00
Panel B: Investment grade only					
N	141	141	141	141	141
CASC-mean	−1.96	−0.89	17.36	−3.64	−4.13
CASC-median	−0.75	0.41	17.48	−3.66	−3.68
Positive%	47.52	51.06	100.00	36.88	31.91
p Value *t*-test	0.03	0.48	0.00	0.00	0.00
p Value rank test	0.04	0.44	0.00	0.00	0.00
p Value sign test	0.61	0.87	0.00	0.00	0.00
Panel C: Non-investment grade only					
N	76	76	76	76	76
CASC-mean	−4.71	−7.38	40.97	−13.40	−5.41
CASC-median	1.70	−2.26	34.88	−6.05	−7.37
Positive%	52.63	48.68	100.00	42.67	38.67
p Value *t*-test	0.31	0.17	0.00	0.04	0.19
p Value rank test	0.99	0.38	0.00	0.12	0.14
p Value sign test	0.73	0.91	0.00	0.25	0.06
Europe					
Panel D: Total Sample					
N	107	107	107	107	107
CASC-mean	1.74	3.67	18.94	−6.78	−4.77
CASC-median	1.51	2.90	14.97	−6.88	−4.54
Positive%	57.01	62.62	100.00	29.91	33.64
p Value *t*-test	0.22	0.03	0.00	0.00	0.00
p Value rank test	0.11	0.01	0.00	0.00	0.00
p Value sign test	0.18	0.01	0.00	0.00	0.00
Panel E: Investment grade only					
N	89	89	89	89	89
CASC-mean	3.03	2.74	15.58	−5.26	−4.10
CASC-median	1.99	2.90	14.30	−6.40	−4.54
Positive%	61.80	62.92	100.00	30.34	31.46
p Value *t*-test	0.01	0.04	0.00	0.00	0.00
p Value rank test	0.01	0.02	0.00	0.00	0.00
p Value sign test	0.03	0.02	0.00	0.00	0.00
Panel F: Non-investment grade only					
N	18	18	18	18	18
CASC-mean	−4.64	8.27	35.53	−14.31	−8.10
CASC-median	−4.61	4.48	29.63	−16.79	−4.47
Positive%	33.33	61.11	100.00	27.78	44.44
p Value *t*-test	0.45	0.26	0.00	0.05	0.22
p Value rank test	0.42	0.31	0.00	0.03	0.21
p Value sign test	0.24	0.48	0.00	0.10	0.81
Difference					
Panel G: Total Sample					
ΔCASC-mean	−4.67	−6.83	6.69	−0.25	0.20
ΔCASC-median	−1.86	−2.54	3.94	2.88	0.60
p Value *t*-test	0.07	0.03	0.00	0.94	0.94
p Value Wilcoxon	0.06	0.02	0.00	0.29	0.93
Panel H: Investment grade only					
ΔCASC-mean	−4.99	−3.63	1.77	1.62	−0.03
ΔCASC-median	−2.74	−2.50	3.18	2.74	0.86
p Value *t*-test	0.00	0.05	0.16	0.36	0.98
p Value Wilcoxon	0.00	0.03	0.00	0.32	0.68
Panel I: Non-investment grade only					
ΔCASC-mean	−0.07	−15.64	5.44	0.90	2.69
ΔCASC-median	6.32	−6.74	5.25	10.74	−2.91
p Value *t*-test	0.99	0.18	0.45	0.95	0.77
p Value Wilcoxon	0.44	0.20	0.49	0.52	0.96

Prior to a negative CE, significant differences between European and U.S. firms can be observed. The CDS market in Europe appears to anticipate a negative CE, as CDS spreads significantly increase during the days leading to a negative CE. The observed increase is driven by investment grade rated European corporations, which experience a significant increase in their CDS spread levels during the 30 days prior to a negative CE. The difference to U.S. firms is significant during this time period as well. Investment grade rated U.S. firms, on the other hand, appear to experience a significant reduction in their spread levels during the $[-30; -16]$ day event window. However, not all tests show that this reduction is significant and therefore this result does not appear to be robust. That the European CDS market appears to anticipate negative CEs may indicate that investors in this market are more sensitive to negative developments in a firm's risk, as European firms are under more stress due to the sovereign debt crisis in Europe.

Overall, the patterns following positive and negative CEs in the U.S. as well as in Europe give support to the UIH. Continuation patterns are observed following positive CEs, indicating an initial underreaction, while significant reversal patterns are observed following negative CEs, indicating an initial overreaction by investors. Yet, the strength of these return patterns appears to be more pronounced for the European CDS market than for the U.S. market.

4.6 Factors influencing credit events and subsequent spread changes

In order to determine which factors influence the CDS spread changes observed on the event day and during the days following a CE, we use a multivariate OLS regression of the following form:

$$CASC_{i,[\tau_1;\tau_2]} = \delta_0 + \sum_{j=1}^{m} \delta_j X_j + \epsilon \tag{4.6}$$

where $CASC_{i,[\tau_1;\tau_2]}$ is the cumulative abnormal spread change of firm i during the $[\tau_1; \tau_2]$ event window, δ_0 is the regression constant, δ_j are the regression coefficients for the independent variables, X_j are the dependent variables with $j \in [1, \ldots, m]$ and ϵ is the error term. In order to explain the CASC on the event day [0] and during the 15 days following the event, the $[1; 15]$ day event window, several company and event specific variables are tested. We perform four regressions for sudden positive and negative CEs separately.

4.6.1 Choice of variables

The results of Table 4.3 and Table 4.4 already indicate that the results may well differ, depending on the rating class. We therefore use a dummy variable for each of the four rating classes AAA/AA, A, BB and B, using the rating class BBB as our reference. Besides the firm's rating class we focus on six independent variables. The prior analysis of positive and negative CEs suggests that the stock market may anticipate CEs. To test to what degree stock returns influence the CDS spreads on the event day or during the post event period we introduce the variable $Stock$. This variable is defined as the cumulative abnormal stock return during the $[-15; -1]$ event window. The size of the company is captured by the variable $MCap$. $MCap$ is defined as the natural logarithm of the market capitalization of a company in USD on the last trading day in the year prior to the CE. The motivation for the size variable is that larger firms are typically more closely followed by financial analysts and CEs should therefore be less pronounced, as more detailed information is available for these firms. In addition, in line with the investigation in Section 4.5, we analyze to what extent the CDS spread changes of U.S. and European entities differ. Section 4.5 already shows that there are slight differences in the market reactions of CDS of U.S. and European firms following negative and positive CEs. In order to investigate whether the observed differences are robust, we introduce the variable *EU*, which is defined as 1 for European companies and 0 for U.S. ones.

CDS spreads are generally recognized as indicators of credit risk. Leverage, as measured by the ratio of total debt to total assets, may also be used as a proxy for credit risk. If a company's leverage ratio is high, the possibility of default is likely to increase in case of adverse shocks to its refinancing capabilities. We expect that leverage influences the CASC on the event day and the subsequent days. Higher leverage results in a higher risk of default and therefore a negative CE should cause a higher CASC on the event day and during the subsequent days. In addition, Kapadia and Pu (2012) show that firms with lower levels of liquidity, as measured by having a larger fraction of zero spread changes, have less integrated equity and credit markets. We therefore control for liquidity by introducing the variable *Liquidity*, which is defined as the ratio of zero daily spread changes to the number of non-missing daily CDS changes over 252 trading days prior to the CE. Finally, we also examine the effect the initial jump has on the spread changes during the post event period. The initial jump is defined as the difference in the absolute CDS spread change of a company on the event day minus the corresponding quantile border. In line with the prior observations (see also Figure 4.2), we expect that sudden negative CEs are associated with strong reversal patterns during the day following a negative CE.

4.6.2 Regression results

Table 4.9 presents the results of the multivariate cross-sectional regression analysis. In a first step, we analyze which factors influence the CDS spread changes observed on the event day. In a second step, we examine factors that potentially influence the CDS spread changes observed during the days following the event.

For positive CEs, the CE itself depends significantly on the rating class. Relative to the omitted rating class BBB, lower rating classes experience significantly larger reduction in their CDS spread than higher rated companies. This result is in line with the observation in Table 4.1 that the positive CEs for lower rated companies are associated with larger CDS spread changes as those for highly rated companies. We do not find a significant effect for the coefficient of the variable *EU*. The results that the U.S. spread changes are stronger cannot be confirmed in this context. However, the market capitalization of a company appears to determine the height of the positive CE. The reduction associated in the CDS spread for larger companies tends to be less pronounced than for smaller companies. The stock performance prior to a positive CE appears to only weakly influence the CE at best, with a positive pre-event stock price performance resulting in a larger positive CE. Nevertheless, it appears as if equity markets influence CDS markets to a certain degree. Leverage, on the other hand, does not appear to play a role. In addition, including year and industry fixed effects does improve the overall explanatory power of the model, but only slightly. However, the coefficient for *Liquidity* becomes significant, indicating that CDS with lower levels of liquidity experience larger positive CEs. It may be that CDS with fewer quotations experience more pronounced positive CEs as the market depth for those CDS is lower and therefore the reaction is stronger.

For negative CEs the rating class matters as well. Firms in the two non-investment grade classes BB and B experience significantly higher increases in their CDS spread than the investment grade rated companies. In addition, the coefficient for *Liquidity* is positive and significant in all model

Table 4.9: Results of the cross-sectional OLS regression. * , ** , *** denotes statistical significance at the 1%, 5%, and 10% level, respectively. This table shows the results of the OLS regression run for the dependent variable CASCs during the event window [0] and the post event window [1; 15]. Standard errors are corrected for heteroskedasticity and clustering at the firm level and associated t-statistics are in parentheses. *AAA/AA*, *A*, *BB* and *B* are dummy variables for the rating class, *Stock* is the stock return during in the [−15; −1] event window, *MCap* is defined as the natural logarithm of the market capitalization of a company in USD on the last trading day in the year prior to the CE, *EU* is a dummy variable defined as 1 if the company is from a European country, *Leverage* is the total debt to total assets ratio of company on the last trading day in the year prior to the event, *InitialJump* is the is difference of the absolute CDS spread change of a company on the event day and the corresponding quantile border, *Liquidity* is the ratio of zero daily spread changes to the number of non-missing daily CDS changes over 252 trading days prior to the initial jump. Year fixed effects are controlled for with year dummy variables for the years 2011, 2012, and 2013, industry fixed effects are controlled for with dummy variables for manufacturing, financials, and services.

Dependent	Positive CE				Negative CE			
variable	Day [0]	Day [0]	Post-[1;15]	Post-[1;15]	Day [0]	Day [0]	Post-[1;15]	Post-[1;15]
Constant	−66.204***	−60.336***	−36.622	−30.968	47.573*	42.778*	−23.238	−29.644
	(−3.174)	(−2.800)	(−0.828)	(−0.676)	(1.908)	(1.792)	(−0.460)	(−0.566)
AAA/AA	−0.982	0.430	1.074	2.592	−2.268	−2.798	5.551	5.263
	(−0.233)	(0.112)	(0.177)	(0.399)	(−0.865)	(−0.974)	(1.279)	(0.846)
A	0.659	1.024	−4.518	−2.445	−1.211	−1.491	2.390	1.756
	(0.433)	(0.695)	(−1.421)	(−0.676)	(−0.614)	(−0.783)	(0.762)	(0.427)
BB	−22.985***	−22.277***	−1.149	−1.923	12.806***	13.565***	−2.495	−1.886
	(−8.195)	(−7.940)	(−0.164)	(−0.262)	(5.730)	(6.013)	(−0.308)	(−0.237)
B	−38.832***	−38.503***	14.266	15.423	39.797***	41.409***	−63.774***	−61.177***
	(−6.899)	(−7.090)	(0.750)	(0.825)	(4.373)	(4.615)	(−2.876)	(−2.796)
Stock	−22.289**	−15.877	−95.962***	−103.853***	−23.729	−21.389	−23.919	−23.642
	(−2.020)	(−1.557)	(−3.030)	(−3.273)	(−1.541)	(−1.382)	(−0.775)	(−0.780)
MCap	2.038**	1.960**	1.746	1.428	−1.426	−1.296	0.422	0.907
	(2.321)	(2.170)	(0.906)	(0.722)	(−1.309)	(−1.262)	(0.202)	(0.417)
EU	2.611	2.510	−0.881	−0.994	0.401	0.209	−2.878	−2.929
	(1.584)	(1.573)	(−0.307)	(−0.337)	(0.218)	(0.126)	(−1.277)	(−1.298)
Leverage	9.832	10.416	−13.416	−11.576	1.467	1.617	−10.436	−9.983
	(1.524)	(1.474)	(−1.495)	(−1.214)	(0.329)	(0.318)	(−1.141)	(−1.024)
Liquidity	−3.657	−10.003**	−13.416	3.597	15.502**	20.362**	34.003***	27.561*
	(−0.791)	(−2.057)	(−1.495)	(0.381)	(2.412)	(2.147)	(2.985)	(1.954)
InitialJump	NO	NO	−0.026	−0.003	NO	NO	0.358	0.374
			(−0.114)	(−0.013)			(1.031)	(1.074)
Year fixed &	NO	YES	NO	YES	NO	YES	NO	YES
Industry fixed effects	NO	YES	NO	YES	NO	YES	NO	YES
Adj. R^2	59.41%	62.42%	3.35%	2.61%	43.23%	43.56%	16.14%	16.33%
F-value	33.76***	25.49***	2.20**	2.19***	21.61***	17.69***	3.73***	2.59***
N	323	323	322	322	324	324	323	323

specifications. Lower levels of liquidity lead to a stronger reaction in the case of a negative CE. Since these CDS have fewer quotations, the market may not properly adjust the CDS spread level of a firm prior to a negative CE, leading to a more pronounced negative reaction as a result. Contrary to expectations, company size, leverage, or the origin of a company do not appear to determine the height of the negative CE, as their coefficients generally lack significance. Adding year and industry fixed effects improves the overall explanatory power of the model minimally.

Examining the changes in CDS spreads following a positive CE, it becomes apparent that the rating class of a company does not significantly influence CDS spreads any more. However, the stock price performance during the $[-15, -1]$ day event window has a significant influence on the CDS spread changes during the $[1; 15]$ day event window. If the stock price increased during the pre-event period, the CDS spread most likely continues to fall, even after the original CE. Again, this can be regarded as an indication that equity prices possess valuable information for CDS markets. Neither the height of the CE nor the company size influences the post event CDS spread changes, as the coefficient for $MCap$ ceases to be significant. Moreover, contrary to the results of the regression for the positive CE itself, the coefficient for the variable *Liquidity* is not significant. In addition, industry and year fixed effects do not improve the overall explanatory power of the model and the model generally only explains a very small portion of the variation in the CASC during the 15 days after a positive CE.

Looking at the spread changes following a negative CE, the rating class of a company still appears to play a role in the observed post-event CDS spread changes. The coefficient for the lowest rating class B is negative and highly significant, indicating that firms can expect to experience falling CDS spreads following a negative CE, compared to BBB rated firms. This is in line with the patterns displayed in Figure 4.2 Panel F. We do not find evidence that the reversal patterns are more pronounced for European firms, as the coefficient for EU is not significant. This supports our prior results in Table 4.7 and 4.8.

In line with the regression results for the negative CE itself, the coefficient for the variable *Liquidity* is also significant when analyzing the CDS spread changes during the $[1; 15]$ day event window. The coefficient is positive, indicating that less liquid CDS experience a further increase in the CDS level subsequent to a negative CE. This can be interpreted as markets not properly adjusting to the initial negative CE and therefore taking longer to fully assess its overall impact. Company size, leverage, prior stock performance, and the height of the negative CE do not significantly influence the CDS spread changes following a negative CE. Adding year and industry fixed effects to the regression model improves the overall explanatory power of the CDS spread changes subsequent to a negative CE.

The regression results suggest that equity markets overall anticipate positive CEs, as an increase in the equity price of a company has a significant influence not only on the positive CE itself, but for the spread changes following a positive CE as well. In this case, equity markets appear to react prior to the CDS markets, indicating that the positive CE was an adjustment to the increase in the equity price. This is in line with Trutwein and Schiereck (2011), who also find that equity markets react faster than CDS markets, leading to sudden adjustments in the latter. For negative CEs the stock price performance prior to the CE appears to play a limited role only.

4.7 The lead-lag relationship between CDS and equity markets

The results so far suggest that equity markets at least partially anticipate CEs. In order to determine the lead-lag relationship between CDS and equity markets, we apply two regression models similar to those of Wang and Bhar (2014).[8] We run one regression model to examine whether equity returns prior to positive and negative CEs have an influence on CEs and one model to analyze whether prior CDS spread changes have an impact on the stock market response to CEs. The regressions take the following form:

$$\Delta CDS_{i,t=0} = \beta_0 + \sum_{p=1}^{15} \beta_{1,CDS,p} \Delta CDS_{i,t=0-p} + \sum_{s=1}^{15} \beta_{2,Stock,s} R_{i,t=0-s} + \epsilon \tag{4.7}$$

$$R_{i,t=0} = \beta_0 + \sum_{s=1}^{15} \beta_{1,Stock,s} R_{i,t=0-s} + \sum_{p=1}^{15} \beta_{2,CDS,p} \Delta CDS_{i,t=0-p} + \epsilon \tag{4.8}$$

where $\Delta CDS_{i,t=0}$ is the observed change in the CDS spread level on the event day $t = 0$ for company i, $R_{i,t=0}$ is the observed return of stock i on the event day $t = 0$, $\Delta CDS_{i,t=0-p}$ is the CDS spread change during the days prior to the CE, where p ranges from 1 to 15 days, $R_{i,t=0-s}$ is the equity return of company i during the days prior to the CE, where s takes a value from 1 to 15 days, $\beta_{1/2,CDS,p}$ and $\beta_{1/2,Stock,s}$ are the coefficients for the CDS and equity returns during the days prior to the event, and β_0 is the constant. We expect the coefficients $\beta_{1/2,Stock,s}$ to be negative if CDS and equity markets move in the expected direction, i.e. an increase in CDS spread levels leads to negative stock returns and vice versa. Moreover, we anticipate that the more closely integrated the two markets are, the higher the level of significance will be for the days closer to the CE. We run the same models for investment and non-investment grade firms, as our prior results suggest that the effects are more pronounced for companies classified non-investment grade. In addition, we split the sample into U.S. and European firms and analyze whether the market integration differs between the two samples, as we expect that European firms are under more stress due to the sovereign debt crisis and therefore integration may be higher.

Table 4.10 presents the results of the regression analyses.[9] Panel A through E document the influence of stock returns during the 15 days prior to a CE on the CDS spread change on the event day. Panel F through J show the influence of CDS spread changes during the 15 days prior to a CE on the stock returns on the event day.

Panel A of Table 4.10 shows that, overall, the stock returns during the 15 days leading to a CE have a significant influence on the height of the CDS spread change on the day of a CE. Especially the two days directly prior to the CE have a highly significant influence on the observed CDS spread change. In addition, it also appears as if the returns six and seven days prior to the CE also have an influence on the height of the CE. This can be viewed as a confirmation of our prior results, as the previous analyses suggest that stock returns can significantly influence the CDS spread change on the day of the CE. Dividing the sample into investment and non-investment grade rated firms (Table 4.10 Panel B and C) indicates that equity returns during the two days

[8] Acharya and Johnson (2007) and Xiang et al. (2013) show that an inverse relationship exists between CDS levels and equity returns, where CDS levels are calculated as mid-prices based on the bid-ask quotes. They also find evidence that this relationship is non-linear. However, since we do not estimate CDS levels, but CDS spread changes, controlling for non-linear effects does not appear to be appropriate.

[9] For reasons of succinctness of notation we do not report the results of the CDS spread changes during the 15 days prior to the CE on the observed CDS spread change on the day of the CE (Table 4.10 Panel A to C). Similarly, we do not report the influence of the equity returns during the 15 days prior to a CE on the observed equity return on the day of the CE (Table 4.10 Panel D to F).

prior to a CE strongly influence both investment grade as well as non-investment grade rated firms.

Table 4.10 Panel F through J show the effect that CDS spread changes have on the observed equity returns during the 15 days prior to a CE. Overall, we find little evidence at best that the CDS spread changes have a significant influence on equity returns. Furthermore, there does not appear to be much difference between investment grade and non-investment grade rated firms, even though spread changes during six, seven, and eight days prior to an event appear to have a marginal influence on investment grade rated corporations. For CDS of European firms, our results suggest that the day preceding a CE has a highly significant influence, while other days lack significance with a few notable exceptions ten, eleven, and twelve days before the CE. In this case, the influence of the equity return on the CDS spread change differs to the U.S. market, where, generally, equity returns up to six days prior to the CE have a significant influence. Yet, for European firms we also find that CDS spread changes appear to significantly influence equity returns. Spread changes of four of the five days prior to a CE have at least a weak influence on the observed equity return. It appears as if the interaction between CDS spread changes and stock returns is more pronounced for the European market than for the U.S. one. We interpret this result along the lines of Trutwein and Schiereck (2011), who also find that during times of heightened stress the interaction between the CDS and equity market increases and it appears as if markets become more closely integrated. Particularly for European markets, this appears to be the case. During a more benign market environment, on the other hand, integration seems to be somewhat lower as indicated by the results for U.S. firms.

Overall, this further supports our results that equity and CDS markets are integrated in the case of sudden and unexpected CEs, albeit with equity markets leading CDS markets to a certain extent. The results indicate that equity returns preceding a CE have a significant influence on the CDS spread changes on the day of a CEs, while prior CDS spread changes show no tendency to influence the equity markets. We interpret this result as evidence that equity markets are leading CDS markets and that equity price changes potentially indicate CDS spread changes. This result is in contrast to CDS markets being a preferred channel of informed trading. Rather, it may be that lower levels of liquidity in the CDS market compared to the equity prices lead to equity markets possessing significant information for CDS markets. However, European companies, still being under stress as a result of the ongoing European sovereign debt crisis, appear to have a different level of market integration than the U.S. market. This finding is in line with Trutwein and Schiereck (2011), who also show that during times of heightened stress markets tend to integrate further. In addition, we document that equity returns two days prior to a CE have a highly significant influence on the CDS spread change observed on the day of a CE for non-investment grade firms and investment grade firms. This result is similar to Wang and Bhar (2014), who document that equity returns have significant information content for CDS spread changes. Our results also indicate that equity returns on the day of a CE are not influenced by CDS spread changes, unless markets are under stress. We view this as further evidence that, even though equity and CDS markets are integrated, CDS spread changes lag equity returns when the market environment is more benign.

4.8 Robustness checks

The UIH predicts that the arrival of new information, in our case sudden CDS spread changes, leads to higher levels of uncertainty and should therefore also lead to higher levels of volatility. Once the uncertainty is resolved, the CDS spreads should decrease again following a negative CE and continue to decrease, following a positive CE. This, in turn, should also have an effect on

Table 4.10: Response of CDS spread changes and equity returns to credit events. * , ** , *** denotes statistical significance at the 1%, 5%, and 10% level, respectively. This table shows the results of the OLS regression run for the dependent variables CDS spread and stock return on the event day [0]. Panel A to C report the CDS spread changes on its 15 lags (not reported) and lagged ($lag = 1$ to $lag = 15$) daily equity returns. Panel D to F report the daily equity returns on its 15 lags (not reported) and lagged ($lag = 1$ to $lag = 15$) CDS spread changes. Standard errors are corrected for heteroskedasticity and clustering at the firm level and associated t-statistics are in parentheses.

Constant	lag 1	lag 2	lag 3	lag 4	lag 5	lag 6	lag 7	lag 8	lag 9	lag 10	lag 11	lag 12	lag 13	lag 14	lag 15	N	Adj.R2 F-value
Panel A:Dependent variable $\Delta CDS_{i,t=0}$, total sample																	
-2.831**	-243.239***	-262.277***	-114.161	-91.978	-110.584	-255.281***	-202.964***	-67.306	65.932	-135.603**	-169.330**	51.383	38.832	-80.056	-67.953	647	27.69%
(-1.986)	(-4.202)	(-3.927)	(-1.611)	(-1.119)	(-1.486)	(-3.414)	(-3.093)	(-0.847)	(1.140)	(-2.317)	(-2.198)	(0.564)	(0.515)	(-1.103)	(-0.972)		8.82***
Panel B: Dependent variable $\Delta CDS_{i,t=0}$, investment grade only																	
-0.486	-151.926***	-138.877***	12.038	1.727	-1.809	-47.023	-47.760	-35.012	24.347	-95.445**	-129.374**	95.110	1.074	-156.453***	-19.967	460	16.76%
(-0.407)	(-3.592)	(-2.718)	(0.195)	(0.018)	(-0.031)	(-0.954)	(-0.848)	(-0.702)	(0.617)	(-2.048)	(-2.420)	(1.647)	(0.020)	(-2868)	(-0.378)		7.31***
Panel C: Dependent variable $\Delta CDS_{i,t=0}$, non-investment grade only																	
-5.685	-385.301***	-427.597***	-241.991	-207.845	-218.897	-617.128***	-218.897	-111.012	-84.152	-151.729	-176.465	26.191	57.679	10.290	-174.478	187	36.58%
(-1.329)	(-3.428)	(-3.612)	(-1.654)	(-1.505)	(-1.317)	(-4.265)	(-1.317)	(-0.728)	(-0.524)	(-1.130)	(-1.140)	(0.140)	(0.342)	(0.058)	(-1.070)		13.74***
Panel D: Dependent variable $\Delta CDS_{i,t=0}$, U.S. firms only																	
-2.246	-259.322***	-251.978***	-129.714	-157.481*	-90.693	-286.512***	-193.446	-89.161	90.443	-106.948	-206.420**	17.309	-43.631	-133.349	-14.550	433	37.88%
(-1.296)	(-3.558)	(-3.291)	(-1.526)	(-1.946)	(-0.965)	(-2.998)	(-2.473)	(-0.944)	(1.375)	(-1.395)	(-2.467)	(0.164)	(-0.474)	(-1.596)	(-0.173)		15.91***
Panel E: Dependent variable $\Delta CDS_{i,t=0}$, European firms only																	
-2.955	-295.626***	-33.162	-100.570	52.935	-161.330	-196.561*	67.709	86.617	-6.901	-185.588**	-234.916**	231.048***	119.546	-33.134	-174.661*	214	35.97%
(-1.254)	(-2.743)	(-0.351)	(-1.028)	(0.267)	(-1.414)	(-1.660)	(0.528)	(0.823)	(-0.102)	(-2.601)	(-2.496)	(2.716)	(1.384)	(-0.289)	(-1.844)		13.77***
Panel F: Dependent variable $R_{i,t=0}$, total sample																	
0.000	-0.000	0.000	0.000	0.000	0.001**	-0.001*	-0.000	0.000	0.000	-0.000	-0.000	0.000	-0.000	-0.000	-0.000	647	10.89%
(0.133)	(-0.745)	(0.465)	(0.056)	(0.867)	(2.313)	(-1.858)	(-1.343)	(0.107)	(0.827)	(-1.091)	(-0.729)	(0.558)	(-0.845)	(-0.324)	(-0.875)		3.72***
Panel G: Dependent variable $R_{i,t=0}$, investment grade only																	
0.001	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.002***	0.001*	0.001**	-0.000	-0.001*	0.001	0.001	0.000	-0.001	460	11.15%
(0.785)	(0.606)	(0.705)	(0.255)	(0.007)	(-0.331)	(-0.206)	(-3.287)	(1.721)	(2.006)	(-0.069)	(-1.925)	(1.253)	(1.538)	(0.121)	(-1.241)		4.57***
Panel H: Dependent variable $R_{i,t=0}$, non-investment grade only																	
-0.005	-0.000	0.001	-0.000	0.001	0.001*	-0.001**	0.000	-0.000	-0.000	-0.000	-0.000	0.000	-0.001	-0.000	-0.000	187	14.92%
(-0.911)	(-0.195)	(1.647)	(-0.633)	(1.390)	(1.955)	(-1.979)	(0.061)	(-0.711)	(-0.873)	(-0.866)	(-0.946)	(0.214)	(-1.376)	(-0.756)	(-0.650)		3.17***
Panel I: Dependent variable $R_{i,t=0}$, U.S. firms only																	
0.001	-0.001	0.000	-0.001	0.000	0.001**	-0.001*	-0.000	0.000	0.000	-0.000	-0.000	0.000	-0.001	0.000	-0.001	433	14.99%
(0.638)	(-1.528)	(0.151)	(-1.306)	(1.090)	(2.517)	(-1.946)	(-0.068)	(0.066)	(0.689)	(-0.662)	(-0.180)	(0.286)	(-0.935)	(0.251)	(-1.093)		5.32***
Panel J: Dependent variable $R_{i,t=0}$, European firms only																	
-0.000	0.001*	0.001**	0.001**	-0.001	0.001*	-0.000	-0.001**	-0.000	0.001**	0.000	-0.000	-0.001	-0.001	-0.001	0.000	214	26.87%
(-0.067)	(1.584)	(2.186)	(2.101)	(-0.993)	(1.666)	(-0.730)	(-2.373)	(-0.490)	(2.334)	(0.168)	(-0.839)	(-1.063)	(-1.526)	(-1.419)	(0.956)		8.28***

the volatility of CDS spread changes, leading to increased volatility immediately following the event, which should decrease again once the uncertainty surrounding the CE is resolved. In order to further test our prior findings that CDS spread changes subsequent to large CEs follow the patterns predicted by the UIH, we examine the volatility during the 15 days prior to a CE and compare it to the volatility during our two event windows following the CE, namely the $[1; 15]$ and $[16; 30]$ day event window. We test the results for statistical difference using the parametric two-sample t-test and the nonparametric Wilcoxon signed-ranked test. The results of the analysis are presented in Panel A of Table 4.11.

Table 4.11 Panel A documents the changes in volatility for the entire sample of CEs, as well as for positive and negative CEs. The results for all CEs show that the volatility during the $[1; 15]$ day event window following a CE significantly increases compared to the $[-15; -1]$ day pre-event period. Moreover, the volatility again drops during the $[16; 30]$ day event window compared to the $[1; 15]$ day event window. This sudden increase, followed by a decrease is in line with the predictions of the UIH. The uncertainty due to the CE leads to higher volatility levels, followed by a decrease in the volatility levels, once the uncertainty is being resolved during the post-event period. It should also be noted that the increase and subsequent decrease in the volatility of the CDS spread changes is much more pronounced for negative CEs than for positive ones, indicating that negative CEs are associated with higher levels of uncertainty. This is in line with the observed significant reversal patterns during the $[1; 15]$ and $[16; 30]$ day event window (Table 4.4). Nonetheless, the uncertainty appears to be resolved rather quickly, as the volatility levels during the $[16; 30]$ day event window are lower than during the $[-15; -1]$ day pre-event window. Overall, we interpret this finding as giving additional strong support to the UIH.

Table 4.11 Panel B shows the volatility of stock price returns prior to and subsequent to a CE. Overall, a decrease in the volatility can be observed for the entire sample of all CEs. In particular, the decrease in the stock return volatility between the $[1; 15]$ and $[16; 30]$ day event window is statistically significant. Furthermore, while the volatility prior to and following a positive CE continuously decreases, for negative CEs the volatility following the event first significantly increases during the $[1; 15]$ day event window and again significantly decreases during the $[16; 30]$ day event window. This can be viewed as a confirmation of our prior results, as the previous equity analysis suggests that stock returns react to changes in the default risk of a company immediately following a CE. The increase and subsequent decrease in the volatility is in line with the rise and subsequent reduction in uncertainty following a CE, as predicted by the UIH. Therefore, overall there still appears to be a certain degree of interdependence between equity and CDS markets, particularly for negative CEs. In addition, we conduct several analyses using alternatives methodologies for calculating abnormal CDS spread changes in order to test whether our results are robust to different empirical approaches. First, we use the median spread change of the benchmark CDS index instead of the mean spread change. This approach has previously been used by Micu et al. (2004, 2006) as well as Galil and Soffer (2011). Using this alternative index calculation procedure minimizes the effect of outliers. Second, we calculate the percentage change of the event firm CDS spread and subtract the average daily percentage change of the benchmark index composed of firms with the same rating category as the event firm. This approach is also applied by Lehnert and Neske (2006). Third, we follow Micu et al. (2006) and apply a single-factor event study model of the form:

$$CAR^{CDS}_{i,[\tau_1;\tau_2]} = \sum_{t=\tau_1}^{\tau_2} [R^{CDS}_{i,t} - (\hat{\alpha}^{CDS}_i + \hat{\beta}^{CDS}_i R^{CDS}_{k,t})] \tag{4.9}$$

Table 4.11: Differences in the volatility of CDS spread changes and stock returns prior to and following credit events; * , ** , *** denotes statistical significance at the 1%, 5%, and 10% level, respectively.

	Mean σ_i	Median σ_i	$\Delta\sigma$ $(\sigma_i - \sigma_{i-1})$	$\Delta\sigma$ Median $(\sigma_i - \sigma_{i-1})$	t-test (t-value)	Wilcoxon (Z-score)
Panel A: CDS spread volatility						
Total sample (n=646)						
$\sigma_{1,[-15;-1]}$	4.72	3.75				
$\sigma_{2,[1;15]}$	5.27	3.92	0.54	0.17	3.86***	−3.71***
$\sigma_{3,[16;30]}$	4.45	3.34	−0.82	−0.59	−5.83***	−7.81***
Positive CEs (n=323)						
$\sigma_{1,[-15;-1]}$	4.78	3.85				
$\sigma_{2,[1;15]}$	4.75	3.62	−0.03	−0.23	0.16	−1.08
$\sigma_{3,[16;30]}$	4.48	3.29	−0.27	−0.33	−1.22	−2.72***
Negative CEs (n=323)						
$\sigma_{1,[-15;-1]}$	4.67	3.67				
$\sigma_{2,[1;15]}$	5.79	4.28	1.12	0.61	6.22***	−6.17***
$\sigma_{3,[16;30]}$	4.42	3.43	−1.37	−0.85	−8.25***	−7.96***
Panel B: Stock return volatility						
Total sample (n=646)						
$\sigma_{1,[-15;-1]}$	2.06%	1.81%				
$\sigma_{2,[1;15]}$	2.06%	1.88%	−0.01%	−0.08%	−0.14	−0.73
$\sigma_{3,[16;30]}$	1.93%	1.71%	−0.13%	−0.17%	−4.19***	−5.39***
Positive CEs (n=324)						
$\sigma_{1,[-15;-1]}$	1.95%	1.73%				
$\sigma_{2,[1;15]}$	1.89%	1.71%	−0.06%	−0.01%	−1.29	−1.27
$\sigma_{3,[16;30]}$	1.86%	1.71%	−0.03%	0.00%	−0.64	−1.11
Negative CEs (n=323)						
$\sigma_{1,[-15;-1]}$	2.16%	1.90%				
$\sigma_{2,[1;15]}$	2.23%	2.08%	0.07%	0.18%	1.22	−2.11**
$\sigma_{3,[16;30]}$	1.99%	1.74%	−0.24%	−0.35%	−5.06***	−6.38***

where $CAR^{CDS}_{i,[\tau_1;\tau_2]}$ is the cumulative abnormal CDS return of firm i during the event window, $R^{CDS}_{k,t}$ is the benchmark index return, which is equal to the median CDS return of the firms in the relevant regional benchmark and $\hat{\alpha}^{CDS}_i$ and $\hat{\beta}^{CDS}_i$ are the regression parameters, estimated over a 126 day estimation period (i.e. six-months) from 156 day prior to the event window ($t = -156$) until 31 days prior to the event day ($t = -31$). Two different regional benchmarks are constructed, one for the U.S. and one for Europe. Depending on the region of the issuer, the appropriate regional benchmark is selected.[10] The results of the three robustness tests are presented for the entire sample of positive and negative CEs in Table 4.12.

The robustness tests largely confirm our prior results. For the entire sample of negative CEs, reversal patterns can be observed, independent of the methodology used. At the same time, a tendency for continuation patterns can still be observed following positive CEs. The results for the different rating categories are largely in line with our prior results.[11] Depending on the methodology, there appear some weak tendencies in a few rating categories for an anticipation of a CE, which is also largely in line with our prior results. Overall, our results are therefore robust to different model specifications and the observed return patterns are still in line with those predicted by the UIH.

Furthermore, as an additional robustness test, instead of dropping all entities for which daily spread changes are missing for more than 35% of the days during the period for which CDS data is available for a given entity, we drop all entities for which daily spread changes are missing for more than 20% of the days during the period for which CDS data is available for a given entity. This resulted in a sample of 275 positive and 286 negative CEs.

[10] Due to missing data during the estimation period, the number of positive CEs dropped from 323 to 318 and the ones for negative CEs from 324 to 319.

[11] The detailed results for the different rating categories are not shown in the paper for reasons of brevity.

Table 4.12: Robustness of CDS event study. This table shows the changes in CDS spreads prior to and following credit events using the *(i)* median as benchmark, *(ii)* relative CDS spreads and *(iii)* using a single-factor market model.

	[−30;−16]	[−15;−1]	[0]	[1;15]	[16;30]
Panel A: CDS spreads prior to positive CEs using median as benchmark					
N	323	323	323	322	322
CASC-mean	−1.23	0.24	−24.14	−1.71	−1.90
CASC-median	−0.21	1.16	−16.94	−1.79	−0.98
Negative%	50.77	48.92	99.38	55.59	54.35
p Value *t*-test	0.39	0.88	0.00	0.28	0.15
p Value rank test	0.46	0.37	0.00	0.10	0.15
p Value sign test	0.82	0.74	0.00	0.05	0.13
Panel B: CDS spreads prior to negative CEs using median as benchmark					
N	324	324	324	323	323
CASC-mean	−1.68	3.19	25.65	−5.19	−4.84
CASC-median	0.09	2.89	19.13	−4.06	−4.29
Positive%	50.31	59.26	100.00	38.08	36.84
p Value *t*-test	0.20	0.02	0.00	0.00	0.00
p Value rank test	0.82	0.00	0.00	0.00	0.00
p Value sign test	0.96	0.00	0.00	0.00	0.00
Panel C: CDS spreads prior to positive CEs using relative spreads					
N	323	323	323	322	322
CASC-mean	0.09	2.11	−10.39	−0.54	−0.92
CASC-median	−0.12	1.58	−9.19	−0.68	−0.52
Negative%	50.77	43.96	100.00	53.11	53.73
p Value *t*-test	0.81	0.00	0.00	0.27	0.03
p Value rank test	0.89	0.00	0.00	0.13	0.06
p Value sign test	0.82	0.03	0.00	0.29	0.20
Panel D: CDS spreads prior to negative CEs using relative spreads					
N	324	324	324	323	323
CASC-mean	0.14	0.60	14.55	−2.81	−2.29
CASC-median	0.00	0.80	11.48	−2.80	−2.16
Positive%	50.00	53.70	99.07	35.91	36.22
p Value *t*-test	0.75	0.29	0.00	0.00	0.00
p Value rank test	0.74	0.11	0.00	0.00	0.00
p Value sign test	1.00	0.20	0.00	0.00	0.00
Panel E: CDS spreads prior to positive CEs using a single-factor market model					
N	318	318	318	318	318
CASC-mean	−0.66	0.02	−10.17	−0.80	−0.58
CASC-median	−0.90	−0.89	−9.22	−0.52	−0.66
Negative%	57.23	54.40	96.86	52.52	53.77
p Value *t*-test	0.17	0.98	0.00	0.16	0.26
p Value rank test	0.05	0.21	0.00	0.12	0.15
p Value sign test	0.01	0.12	0.00	0.40	0.20
Panel F: CDS spreads prior to negative CEs using a single-factor market model					
N	319	319	319	319	319
CASC-mean	0.34	1.90	12.51	−1.36	−1.35
CASC-median	0.32	2.26	11.25	−1.69	−1.02
Positive%	52.66	59.25	88.40	41.38	43.26
p Value *t*-test	0.50	0.01	0.00	0.01	0.00
p Value rank test	0.49	0.00	0.00	0.00	0.01
p Value sign test	0.37	0.00	0.00	0.00	0.02

The results of this analysis also confirm our prior findings.[12] Overall, the previously observed continuation patterns following positive CEs are more pronounced using this sample, particularly during the $[1; 15]$ event window for rating classes A and BBB. For the lowest rating class B, there appears to be a tendency towards the anticipation of a positive CE. For negative CEs, on the other hand, the previously observed reversal patterns are more pronounced, largely driven by the rating classes A and BBB. The reversals are also particularly pronounced for the lowest rating class B. The results of this analysis give again additional support to our prior findings and lend further support to the UIH.

4.9 Summary and conclusion

The CDS market has the potential to complement stock and bond markets and can serve as an additional risk indicator that reflects market participants' current view of the default probability of a firm. We conduct multiple analyses exploring the efficiency of the single-name CDS market and its integration with the equity market for U.S. and European firms. We examine CDS spreads around unanticipated CEs, defined as being in the 1% (positive CE) and 99% (negative CE) quantile of CDS spread changes in the corresponding letter rating class, AAA/AA, A, BBB, BB, and B. In total, we identify 647 events, 323 positive and 324 negative ones. Positive CEs are followed by continuation patterns indicating a further decrease in the default risk of a company. The patterns following negative CEs show that CDS markets overreact to unanticipated credit changes. CDS markets do not process the arrival of negative information immediately and take longer to determine the actual ramifications of the event. Nonetheless, the observed patterns in the spread changes following positive and negative CEs are in line with those predicted by the UIH. Yet, the reaction to CEs differs distinctly between the different credit rating categories and the reversal patterns observed for the entire sample are at least partially driven by those of the non-investment grade classes. For rating class B, the results following negative CEs show a stronger overreaction than for those of other rating classes. The results also indicate that the strength of CEs differ between U.S. and European firms. Furthermore, the lead-lag analysis suggests that the market integration between CDS and equity markets in Europe is higher than in the U.S. This may be due to European companies still being under stress as a result of the ongoing European sovereign debt crisis, while CDS of U.S. firms are somewhat less sensitive since the U.S. market already normalized following the 2007 financial crisis.

The results of the equity market reaction to CEs show that equity markets at least partially anticipate negative as well as positive CEs. Overall, equity markets appear to lead CDS markets by at least two days. Changes in CDS spread levels, on the other hand, have very limited influence on the equity returns observed on the day of CE. This finding is consistent with Trutwein and Schiereck (2011) and Wang and Bhar (2014). CDS and equity markets appear to be integrated, but not fully yet, as our results suggest that equity markets still lead CDS markets. As a consequence stock returns can potentially serve to forecast future CDS spread changes, indicating that CDS markets are not yet truly efficient and dependent on equity markets.

[12]The results of this analysis are not presented in the paper for reasons of brevity.

Chapter 5

Regulation of uncovered sovereign credit default swaps - Evidence from the European Union*

Abstract

Purpose: This study aims to analyze the impact and effectiveness of the regulation on the European sovereign credit default swap (CDS) market. The European sovereign debt crisis has drawn considerable attention to the CDS market. CDS have the ability of a speculative instrument to bet against a sovereign default. Therefore, the Regulation (EU) No. 236/2012 was introduced as the worldwide first uncovered CDS regulation. It prohibits buying uncovered sovereign CDS contracts in the European Union (EU).

Design: First, this paper measures spread changes of sovereign CDS of the EU member states around regulation specific event dates to detect whether and when European sovereign CDS reacts to regulation announcements and the enforcement of regulation. Second, it compares the CDS long-term stability of the EU sample with a non-EU sample based on 44 non-EU sovereign CDS entities.

Findings: The results indicate widening CDS spreads prior to the regulation, and stable CDS spreads following the introduction of the regulation. In particular, sovereign CDS of European crisis-hit entities are stable since the regulation was introduced.

Originality/value: The results show that since the regulation of uncovered CDS in the EU has been enacted, the sovereign CDS market is stable and less volatile. Based on the theory about speculation on uncovered sovereign CDS by betting on the reference entity's default, the introduction of Regulation (EU) No. 236/2012 appears to be an appropriate measure to stabilize markets and reduce speculation on sovereign defaults.

5.1 Introduction

During the European sovereign debt crisis, the CDS market in Europe was perceived to show market anomalies. CDS spreads of entities increased remarkably. The government of the European Union (EU) found that one cause of rising CDS spreads was the speculation on the default of sovereign

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entities. CDS were used for speculation rather than hedging against the entity's default. Since the financial crisis with its peak in 2008 and the European debt crisis beginning in 2009, CDS have had a bad reputation. Authorities blamed the OTC traded instrument for causing systemic risk and being one trigger of the crisis (Barnier, 2010; Das, 2010). This led to a prominent discussion on restricting CDS. In particular, the EU identified speculations on uncovered CDS as an important factor for apparent market failures during the sovereign debt crisis. The EU does not totally prohibit CDS, but they should not be used as a speculative instrument (e.g. for short selling). The idea is to prevent speculative traders from betting on a default without actually being a creditor. The regulation bans uncovered short positions on EU sovereign debt through CDS and requires real net (short) positions to be privately notified to the relevant national regulator. To establish a permitted sovereign CDS position, investors must now hold offsetting risk, such as the underlying sovereign bond or other exposures related to the sovereign's debt.

The EU enacted Regulation (EU) No. 236/2012 for banning short sells and uncovered sovereign CDS in 2012. The idea of short sell bans is not new. The first bans were already established in national laws in year 1609. However, the EU regulation represents one of the first restrictions on CDS by national or supranational authorities. The aim of the CDS restriction, in combination with additional measures, is to reduce the CDS spread level and rein in the increasing costs of debt of sovereign issuer. Although the discussion about restrictions on the market differs, the literature about the market impact of CDS regulations by authorities is scarce. This study analyzes the impact and effectiveness of the EU regulation on the European sovereign CDS market. Considering the characteristics of this sensitive market for credit risk, one may ask how CDS spreads react to regulations, and whether the ban contributes to the intended reduction in systemic risk, an increase in market efficiency and safety. These questions consider CDS research but are also of interest for market participants.

We compare sovereign CDS spread changes with their historical mean and with non-EU entities to detect whether and when European sovereign CDS react to regulation announcements and the enforcement of the regulation. The remainder of this study is organized as follows. Section 5.2 briefly provides an overview of the related literature and develops the research hypotheses. The data set and an explanation of the used methodology are provided in Section 5.3. The results of our analysis are described in Section 5.4. Section 5.5 interprets the results and concludes the article.

5.2 Literature review and hypotheses development

In comparison to stocks and bonds, CDS are relatively new financial products that were conceived in the 1990s. Studies on CDS do not have a long history, primarily starting in the year 2000, but its importance as a subject of empirical research rose considerably with the expansion of the CDS market. The CDS market has been shown to lead stock markets (Acharya and Johnson, 2007), bond markets (Blanco et al., 2005) and even rating agencies (Norden and Weber, 2004) in terms of information discovery. Pollege and Posch (2013) find that the CDS market is faster in anticipating risks than the bond market, not only for corporate but also for sovereign entities. Norden and Weber (2009), Trutwein et al. (2011), Trutwein and Schiereck (2011) and Imbierowicz and Wahrenburg (2013) analyze the relationship between equity and debt markets, and Cao et al. (2010) analyze the information content of option-implied volatility for CDS, whereas the impact of rating announcements on CDS is another strand of research (Hull et al., 2004; Norden and Weber, 2004; Galil and Soffer, 2011; Finnerty et al., 2013).

Until 2007, literature on CDS primarily focused on market efficiency in comparison to stock and bond markets and its impact for protection buyers and sellers as hedging or investment instrument. Packer and Suthiphongchai (2003), Hull et al. (2004), Norden and Weber (2004), Bystöm (2006) and Wagner (2008) investigate the relationship among CDS, stock and bond markets. Hull et al. (2004) find a significant relation between rating changes of a firm by rating agencies and the movement of CDS spreads. The results of Hull et al. (2004) are confirmed by Norden and Weber (2004) and Wagner (2008).

Packer and Suthiphongchai (2003) show that sovereign CDS constitutes only a small part of the CDS market with 7.4 per cent in comparison to corporates, which compromised 78.6 per cent of the CDS market between 2002 and 2003. In contrast to other studies, Bystöm (2006) opposes the theory of efficient CDS markets. His analysis of the European iTraxx, CDS index market and the corresponding bond market shows that stock markets anticipate information before it affects CDS markets.

Research about the impact of regulation on CDS is scarce. Possible market implication can be identified by comparable restriction on short sells. Diamond and Verrecchia (1987) show that by preventing informed investors to trade on bad news, short selling bans reduce the speed of stock price discovery. Bris et al. (2007) find that prices incorporate information faster in countries where short sales are allowed and practiced. These findings are in line with the evidence by Saffi and Sigurdsson (2010), who show that the ability to short sell stocks increases the informational efficiency of market prices. Beber and Pagano (2013) analyze the effect of various short sell bans for 16.491 stocks in 30 countries between 2008 and 2009. The study's focus lays on the impact of short sell bans on stock market liquidity, price discovery and stock price performance. Their findings suggest that bans imposed during the financial crisis led to statistically and economically significant liquidity disruptions. This causes a reduction in price information and increases the risk for uninformed market participants. Moreover, the results exhibit a slowdown in price discovery and no evidence of an increased stock performance. The results are in accordance with the findings of Boehmer et al. (2013), who detect negative effects by banning short selling on several equities during the financial crisis. Similar results are provided by Boehmer and Wu (2013). Hence, short sell bans lead to market inefficiency and damage market participants.

Since the financial crisis of 2007 and 2008 and the European debt crisis, beginning in 2009, the focus of CDS research expanded. The new focus is on CDS' impact on the stability of the global financial system. Studies address the question whether CDS are responsible for the crisis, their potential for causing economic distress or if it is still a viable financial product. Increasing transparency and reducing counterparty risk of CDS markets are major subjects in research. The EU Commission expects that a lack of transparency to the regulators and the market has hindered regulators from efficiently supervising CDS markets and created difficulties in accessing reliable prices, assessing risks, valuing positions and checking best execution (Barnier, 2010). This is because CDS are traded OTC. According to Hull (2010), counterparty risk leads to systemic risk, because CDS counterparties generally serve as reference entities in a highly concentrated CDS market.

According to the EU Parliament and Council, uncovered sovereign CDS have a harmful influence on market stability of sovereign issuers by increasing a sovereign's default risk and generally leading to a lower creditworthiness of countries. This is based on the theory about speculation on uncovered sovereign CDS by betting on the reference entity's default. In this regard, the EU identified speculation on sovereign CDS as a major reason for market failure during the European debt crisis (Meyer, 2011). Anderson (2010), Duffie (2010) and Meyer (2011) conducted studies dealing with the issue of speculation and price manipulation on sovereign CDS. Meyer (2011) argues in favor of uncovered sovereign CDS. Speculation with uncovered CDS increases welfare by creating liquidity and enabling risk transfer and distribution among market participants. Only under specific market conditions (e.g. lack of market information) speculations would have destabilizing effects (Meyer, 2011). Anderson (2010) views uncovered CDS as a factor to keep the market attractive, and a liquid market for sovereign CDS should help to lower the cost of debt for sovereign borrowers. Duffie (2010) expects, similar to short-selling bans, a reduction in market liquidity, higher debt costs and less information in case of restrictions on uncovered sovereign CDS.

These arguments in the CDS literature are in contrast to the idea of the EU authorities to prevent speculative traders from betting on a default without actually being a creditor. The EU authorities argue that price manipulations on CDS with a high-purchase volume would lead to increasing CDS spread levels. Based on the CDS spread function as an indicator of default risk, sovereign bond prices are expected to rise. This would impair country's possibility to borrow new funds and cause a deterioration in creditworthiness due to higher financing costs (Anderson, 2010). For this reason, the main purpose of Regulation (EU) No. 236/2012 is to prevent the European financial markets from distress caused by speculations with uncovered sovereign CDS. The restrictions and transparency measures on CDS of Regulation (EU) No. 236/2012 should decrease the risk of financial market instability and decrease information asymmetry between regulators and market participants. As a result, it is to be expected that the announcement of the regulation and its subsequent introduction will have a positive effect on CDS spreads, summarized in the following hypotheses:

Hypothesis 1. *The announcement of Regulation (EU) No. 236/2012 leads to a reduction in CDS spreads of European sovereign entities.*

Hypothesis 2. *Since Regulation (EU) No. 236/2012 came into force, the European sovereign CDS market is more stable and less volatile.*

The supposed role of uncovered CDS in pushing up spreads of entities in distress is highly problematic. In particular, Greece, Ireland, Italy, Portugal and Spain ("GIIPS") have had high levels of national debt since the financial crisis. Investors have become increasingly wary of these distressed European countries. They have elevated debt levels and investors do not believe in the countries' ability to service their debt obligations. Allowing speculators to bet on and profit from a sovereign default without owning underlying bonds is more profitable for CDS of countries with higher default probability. If the CDS ban can reduce the CDS spreads, the stabilizing effect of the regulation should be stronger for crisis-hit countries. This leads to our third hypothesis:

Hypothesis 3. *The stabilizing effect of Regulation (EU) No. 236/2012 is more pronounced for crisis-hit countries.*

5.3 Data and methodology

5.3.1 Data sample

This study analyzes the effect of the Regulation (EU) No. 236/2012 and the impact of the CDS ban on uncovered sovereign CDS in the EU. The data set consists of CDS spreads of 27 European sovereign entities and covers the time period from January 1, 2010, to December 31, 2013. Referring to the space of time where the CDS regulation was elaborated and enacted, this period includes every possible effect on CDS regulation. CDS data are obtained from Reuters EOD, which collects CDS quotes each day from multiple contributors. We focus on sovereign CDS spreads corresponding to senior sovereign bonds of the member states of the EU. The EU is a politico-economic union of

28 member states. Luxembourg is the only member state without a CDS. Due the semi-default and the aid package for Greece, we exclude the Greece CDS from January 2012. Croatia finished accession negotiations on June 30, 2011, and signed the Treaty of Accession on December 9, 2011. Croatia officially entered the EU on July 1, 2013, and became the 28th member state of the EU. We include Croatia in the EU sample because Croatia ultimately finished its accession negotiations before the CDS regulation process initially started.[1]

Like Daniels and Shin-Jensen (2005) and Longstaff et al. (2005), the tenor of five years CDS is our main data set, because it is the most liquid CDS. Three- and ten-year tenor CDS, as the next liquid markets, are used for comparison and as an indicator for the robustness of our results. Table 5.1 shows all CDS of EU member entities in our data set. The table includes average CDS spreads for three different periods. We divide our investigation in the period without CDS regulation (Period 1), between the first announcement and the begin of the regulation (Period 2), and finally the period since the regulation (Period 3). The CDS spreads indicate a high volatility in European CDS spreads.

Table 5.1: Average CDS spread of EU sovereigns. This table lists the sovereign of the EU, their CDS level before the announcement of Regulation (EU) No. 236/2012 (January 1, 2010-July 4, 2011), between the announcement of the regulation and its coming into force (July 5, 2011-October 31, 2012) and when Regulation (EU) No. 236/2012 came into force (November 1, 2012-December 31, 2013).

CDS spreads of European Union entities	Period 1 01/01/2010 – 04/07/2011	Period 2 05/07/2011 – 31/10/2012	Period 3 01/11/2012 – 31/12/2013
Austria	57.52	94.52	20.46
Belgium	104.08	172.08	37.26
Bulgaria	237.54	268.34	101.47
Croatia	240.84	407.53	295.16
Cyprus	191.28	1,161.27	939.33
Czech Republic	83.36	114.82	57.07
Denmark	29.39	93.92	18.19
Estonia	98.39	113.68	60.51
Finland	30.44	63.47	25.63
France	60.75	106.57	39.83
Germany	32.37	43.77	15.08
Greece	847.19	–	–
Hungary	274.61	440.64	268.61
Ireland	372.68	571.56	124.77
Italy	131.46	351.56	202.31
Latvia	307.46	243.50	111.39
Lithuania	241.74	237.39	107.42
Malta	177.65	–	–
Netherlands	43.96	92.97	48.21
Poland	129.84	186.06	77.16
Portugal	338.78	946.72	369.13
Romania	276.72	329.39	183.87
Slovak	77.72	203.67	85.91
Slovenia	73.54	308.11	268.70
Spain	175.77	331.06	193.07
Sweden	28.09	43.97	14.33
United Kingdom	63.13	63.45	33.87

We compare the EU CDS with sovereign reference entities outside the EU. As a benchmark, we use all five-year sovereign CDS spreads corresponding to senior sovereign bonds outside the EU. In all, 44 sovereign entities outside the EU have a liquid CDS spread. The benchmark sample includes countries from non-EU Europe (e.g. Swiss), North America, South America, the Asia-Pacific region and Africa. All available CDS of non-EU entities are listed in Table 5.2.

[1]The results are similar excluding Croatia from the European Union sample.

Table 5.2: Average CDS spreads of the non-European union sovereign sample. This table lists the sample of non-EU sovereigns, including their CDS level before the announcement of Regulation (EU) No. 236/2012 (January 1, 2010-July 4, 2011), between the announcement of the regulation and its coming into force (July 5, 2011-October 31, 2012) and since Regulation (EU) No. 236/2012 came into force (November 1, 2012-December 31, 2013).

CDS spreads of non-European Union entities	Period 1 01/01/2010 – 04/07/2011	Period 2 05/07/2011 – 31/10/2012	Period 3 01/11/2012 – 31/12/2013
Abu Dhabi	109.01	115.29	66.88
Argentina	781.45	947.71	2,559.82
Australia	48.66	72.58	43.86
Bahrain	199.72	330.93	220.50
Bolivia	1,075.76	896.60	854.82
Brazil	118.07	140.91	148.76
Chile	77.27	105.10	79.36
China	73.51	117.84	78.66
Colombia	126.14	133.34	110.97
Costa Rica	160.51	208.36	251.43
Dominican Republic	319.12	400.76	408.87
Egypt	263.06	513.46	611.67
Guatemala	185.22	181.03	226.21
Iceland	339.22	266.11	160.72
Indonesia	157.54	185.03	184.22
Iraq	381.04	406.60	442.84
Israel	121.19	163.02	115.85
Jamaica	724.54	619.42	751.00
Japan	65.09	55.00	55.00
Kazakhstan	172.36	211.87	157.57
Korea	101.13	128.31	71.04
Lebanon	301.61	438.68	413.39
Malaysia	93.56	–	–
New Zealand	62.41	83.88	45.72
Pakistan	1,347.54	910.61	867.89
Panama	110.08	129.73	108.28
Peru	123.41	143.08	114.61
Philippines	149.23	160.03	106.48
Qatar	91.42	106.48	65.79
Russia	149.90	189.57	140.13
Salvador	263.13	406.49	435.62
Saudi Arabia	113.50	113.86	66.76
Serbia	306.90	411.16	367.94
Singapore	42.80	79.79	82.99
South Africa	130.99	147.63	166.54
Sri Lanka	283.29	361.33	339.20
Switzerland	43.54	59.39	36.86
Thailand	114.46	147.16	104.80
Trinidad & Tobago	117.75	117.09	127.67
Turkey	156.01	206.52	111.69
Ukraine	563.87	727.19	711.36
United States	42.83	43.65	31.65
Uruguay	159.81	179.07	172.65
Vietnam	277.25	347.42	237.89

5.3.2 Methodology

To determine whether the CDS regulation of the EU had a significant impact on the behavior of CDS spreads, we investigate regulation specific announcement effects and analyze the long-term stability since the introduction of Regulation (EU) No. 236/2012. The analysis of the announcement events is based on a CDS event study originally introduced by Hull et al. (2004) and Norden and Weber (2004). The applied spread change measure is absolute as in the studies of Micu et al. (2004) or Galil and Soffer (2011):

$$\delta_{i,t} \equiv CDS_{i,t} - CDS_{i,t-1}, \tag{5.1}$$

where $CDS_{i,t}$ is the CDS spread, expressed in basis points, for the sovereign CDS i on a given day t. We use a constant mean model to analyze abnormal spread returns, as abnormal CDS spread changes are then independent of those of other countries.

The abnormal spread change is the realized spread change minus the normal spread change:

$$ASC_{i,t} = \delta_{i,t} - \mu[\delta_{i,t}|\Omega_T], \tag{5.2}$$

where $ASC_{i,t}$, $\delta_{i,t}$ and $\mu[\delta_{i,t}|\Omega_T]$ are the abnormal, realized, and normal spread changes, respectively, for sovereign CDS i on date t. The normal spread change is the expected spread change conditional on the information set Ω_T and is estimated using a 250-trading-day period (one whole year) prior to the first day of the event day:

$$\mu[\delta_{i,t}|\Omega_T] = \bar{\delta}_{i,t} = \frac{1}{250}\sum_{i=-11}^{-260} \delta_{i,t}. \tag{5.3}$$

We calculate CASCs by adding daily ASCs from day τ_1 to day τ_2. CASC are assessed for each day of the event window $[\tau_1; \tau_2 \in -10; 10]$ as follows:

$$CASC_{i,[\tau_1;\tau_2]} = \frac{1}{T}\sum_{t=\tau_1}^{\tau_2} ASC_{i,t}, \tag{5.4}$$

where T is the number of days in the event window. Finally, for a sample of N CDS spreads, the mean cumulative abnormal CDS spread change (MCASC) is calculated as:

$$MCASC_{[\tau_1;\tau_2]} = \frac{1}{N}\sum_{i=1}^{N} CASC_{i,[\tau_1;\tau_2]}. \tag{5.5}$$

To test the MCASC for statistical significance, this study applies the standard t-test.

Event days are days with possible effects on the European sovereign CDS market caused by the regulation. The examined days are July 5, 2011, October 19, 2011 and November 1, 2012. On October 19, 2011, the ban on uncovered sovereign CDS through Regulation (EU) No. 236/2012 became public. As restrictions on uncovered sovereign CDS were already agreed internally between EU authorities on July 5, 2011, the day is considered to be an event day as well. The regulation's measures against CDS came into force on November 1, 2012.

The long-term analysis follows a similar approach. We build an equally-weighted portfolio of EU sovereign CDS entities on the one hand, and an equally-weighted non-EU sovereign CDS entity portfolio on the other hand. The abnormal spread change of the portfolio is then calculated as follows:

$$ASC_t^* = \frac{1}{N}\sum_{i=1}^{N}\delta_{i,t} - \frac{1}{M}\sum_{j=1}^{M}\delta_{j,t}^*, \tag{5.6}$$

where $\delta_{i,t}$ is the absolute spread change of the EU portfolio i, including N EU sovereign CDS, $\delta_{j,t}^*$ is the absolute spread change of the non-EU portfolio j with M non-EU sovereign CDS on day t. In analogy to the analysis of regulation specific announcements, the mean average spread changes between both portfolios are calculated as cumulative average spread changes for each day of the event window $[\tau_1;\tau_2]$ divided by the number of days T in the event window:

$$MCASC_{LT} = \frac{1}{T}\sum_{t=\tau_1}^{\tau_2} ASC_t^*. \tag{5.7}$$

In addition, we measure the volatility as the ratio between the standard deviation of the EU entities portfolio and the non-EU portfolio:

$$vola_{ratio} = \frac{\sigma_{EU}}{\sigma_{non-EU}}, \tag{5.8}$$

where σ_{EU} is the standard deviation of the equally weighted European portfolio, and σ_{non-EU} is the standard deviation of the equally-weighted non-European portfolio. If the ratio $vola_{ratio}$ is greater than 1, the standard deviation of the EU portfolio is larger, indicating that the European CDS market is more volatile. Lower levels of market volatility are indicated by a $vola_{ratio}$ below 1.

In a second step, we divide the EU sample in a sample of crisis-hit countries and stable countries. To detect whether a country is a crisis-hit country, we use the mean CDS spread of the EU sample during the $[-260;-11]$ estimation period. Countries with an average spread above the average CDS are defined as crisis-hit countries, and countries below the average spread are defined as stable countries. For the long-term analysis, the mean CDS spreads on July 5, 2011 (equals the first period), are used. Greece had a very unique process; therefore, we exclude Greece in the long-term analysis. Non-EU crisis-hit countries are defined as entities with a CDS spread that is also above the average EU CDS spread level.

5.4 Results

5.4.1 Regulation (EU) No. 236/2012 specific announcements

Table 5.3 reports MCASC of five-year CDS for the announcements days July 5, 2011, and October 19, 2011, and the enforcement day of the uncovered CDS ban on November 1, 2012. Spread reactions for the $[-10;-2]$ event window of the July 5, 2011, exhibit that market participants did not anticipate restrictions in CDS trading. The pre-event window $[-10;-2]$ leads to insignificant MCASC. The results change notably for the event window $[-1;1]$ of the event day and post-event window $[2;10]$. Remarkably, the CDS spreads increase after the pre-event window, which indicates a general risk shift as a short-term reaction to the ban. The mean average spread change of the event window $[-1;1]$ is 11.471 bps, at the 5 per cent level. The MCASC value for event window $[2;10]$ is 7.045 bps. Hence, the growth in CDS spreads remains on a significant level for the following days. In total, CDS spreads increase by 3.805 bps per day for the period $[-10;10]$. Despite the intention of the ban, the CDS spreads did not stabilize.

On October 19, 2011, the ban on uncovered sovereign CDS was officially published. The

Table 5.3: Results of the regulation-specific announcement analysis for the event days. This table reports the MCASC of European entities calculated as realized minus the expected CDS spread change for the days the regulation has agreed unofficially (July 5, 2011), the announcement became public (October 19, 2011) and since the regulation came into force (November 1, 2012); * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	July 5, 2011			October 19, 2011			November 1, 2012		
Event window	MCASC	*t*-test	n	MCASC	*t*-test	n	MCASC	*t*-test	n
[−10;10]	3.805	3.118***	27	−3.538	−3.064***	26	1.138	2.088**	25
[−1;1]	11.471	2.266**	27	−1.598	−1.071	26	1.427	2.103**	25
[−10;−2]	−1.990	−1.677	27	−3.645	−4.396***	26	0.807	1.612	25
[2;10]	7.045	3.164***	27	−4.078	−1.505	26	1.372	2.049*	25

concrete information on the regulation lead to a reduction in spreads, comparable in height to the event day July 5, 2011. All event windows show negative spread changes. The MCASC of $[-10;10]$ is significant at the 1 per cent level with -3.538 bps. The reaction is mainly triggered through event window $[-10;-2]$. In comparison to the $[2;10]$ event window, the results of the pre-event window are highly significant at the 1 per cent level. These findings suggest that information about banning CDS was not sooner incorporated into prices as two weeks before the ban started.

The ban on uncovered sovereign CDS became mandatory on November 1, 2012. For this event day, MCASC values are notably lower with positive sign in comparison to the previous announcement days. The observed event windows provide an increase in spreads only at the 5 per cent level of significance for event windows $[-10;10]$ and $[-1;1]$. The MCASC of the post-event period shows low significance. This might be caused by increased hedging cost through the ban, because it reduced the possibility in trading CDS. However, the MCASC results for this event day are notably lower in comparison to the other observed event days.

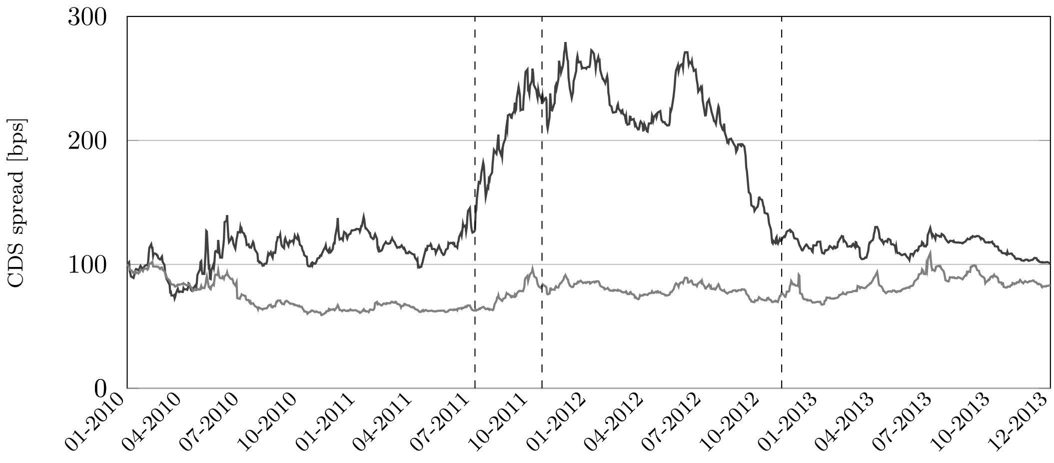
Overall, the findings indicate that the ban affected spreads on a significant level. The following long-term analysis examines whether the regulation on uncovered sovereign CDS was appropriate in general.

5.4.2 Long-term analysis for abnormal European Union CDS spread changes

Figure 5.1 shows standardized CDS spreads of European and non-European countries with a tenor of five years between 2010 and 2013. The figure illustrates that EU CDS spreads are notably more volatile than non-EU spreads during the observed period. A possible reason is the economic and financial distress of EU countries caused by the European debt crisis starting in 2009. In particular, discussions and measurements (e.g. rescue packages, bail outs) on the situation in crisis-hit countries, such as Greece, have influenced spreads. The first information of a CDS ban and the official announcement of the regulation did not cause an immediate reduction in CDS spreads. Besides the regulation, additional measures in the context of the European debt crisis were introduced during this time. However, the CDS spreads of EU entities show that the increase in spread levels halted around the official announcement day. The CDS regulation should reduce speculation on sovereign defaults. The CDS spreads support that the regulation helped to reduce this speculation and that CDS were used primary as an insurance for a potential default.

Table 5.4 provides the results of the long-term reaction in CDS spreads for EU and non-EU countries, divided into the three observation periods of the regulation. The analysis shows an increase in European sovereign CDS spreads compared to non-European spreads before any activity in the context of the regulation (pre-regulation period). The MCASC value for the period prior to the ban is 0.362 bps with high significance at the 1 per cent level. Concurrently to the

Figure 5.1: Long-term trend of European sovereign CDS spreads. This figure shows the mean CDS spreads from January 2010 to December 2013 for EU entities and non-EU entities. CDS are standardized to 100 on January 2010.



low increase in EU spreads, the average spreads of non-EU countries slightly decreased by −0.271 bps. Referring to Figure 5.1, during the period between the first information on the regulation and its enforcement, European CDS spreads reacted significantly (announcement period). The EU CDS spreads more than doubled in height during the first two observation periods. At the end of the period between announcement and enforcement, values declined to the level before the ban. A possible explanation for this is a stabilizing effect of the Regulation (EU) No. 236/2012, reducing the default risk of EU countries in combination with additional successful measures by EU authorities and national governments against the European debt crisis. Despite the notable increase and decrease, t-test for the period between the announcement and enforcement of the ban provides no significant difference between European and non-European CDS spreads.

Table 5.4: Results for the long-term stability analysis. This table reports the long-term MCASC of European entities calculated as the absolute spread change of the EU portfolio minus the non-EU portfolio before the announcement of Regulation (EU) No. 236/2012 (01/01/2010 – 04/07/2011), between the announcement of the regulation and the regulation coming into force (05/07/2011 – 31/10/2012) and since the regulation came into force (01/11/2012 – 31/12/2013). $vola_{ratio}$ is the ratio of the standard deviation between the EU portfolio and non-EU portfolio; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

Time period	Before Announcement 01/01/2010 – 02/07/2011	Between Announcement and Regulation 05/07/2011 – 31/10/2012	Since Regulation 01/11/2012 – 31/12/2013
$MCASC_{LT}$	0.362	−0.182	−0.169
t-test	3.594***	−1.637	−5.232***
Average spread EU	0.091	−0.047	−0.079
Average spread non-EU	−0.271	0.136	0.090
$vola_{ratio}$	1.00	1.48	0.33
days	392	347	304
n	25	25	25

Using the ratio of standard deviations as a measure for volatility, values before the November 1, 2012, exhibit higher deviations in European CDS spreads. After the anticipation of information about the ban on October 19, 2011, spreads stabilized for the first time. Since the November 1, 2012, the deviation of spreads reduced. With a ratio of 0.33, standard deviation for EU CDS is 1.97 compared to non-EU CDS with 5.95. Furthermore, t-test for the period since the regulation exhibit that EU spreads perform significantly below the non-EU sample at the 1 per cent level of significance. Hence, EU spreads are appreciably more robust than the non-EU spreads.

The overall results of the long-term analysis show an increase in EU spreads prior to the official announcement of the regulation and a subsequent decline with lower levels of volatility since November 2012. One possible explanation of the reduction in CDS spreads may be Regulation (EU) No. 236/2012. Speculators possibly abandoned these markets and the market activity declined due to banning the trade of uncovered sovereign CDS. However, it can be assumed that additional measures and actions of the EU government and the national authorities also influenced the CDS spreads during this time (e.g. rescue packages, bail out of Greece, European Central Bank policy).

5.4.3 Stability of crisis-hit countries

Results of the announcement-specific days and the long-term analysis find strong spread reactions of European CDS. This leads to the assumption that EU crisis-hit countries are the main reason for the observed effects, while countries with a low-default probability were less affected. Therefore, the European member states are divided into two sample groups: countries whose CDS spread in the estimation window is above the European average CDS spread, which are defined as crisis-hit countries, and those with CDS spreads below the European average, defined as stable countries. The sample of crisis-hit countries is compared to non-European countries, which also have CDS spreads above the European average in the estimation window. Stable countries are compared to stable countries outside the EU. Figure 5.2 illustrates the development of the four groups. Both stable country portfolios run close together and show less volatility during the investigation period. Meanwhile, both EU and non-EU crisis-hit country portfolios move with appreciably higher fluctuation and jumps in spreads. Hence, the spread developments indicate that EU crisis-hit countries have a large influence on the overall European spread reactions. To deeply investigate this effect, we repeat the analysis focusing on crisis-hit countries.

Table 5.5 reports MCASC of EU crisis-hit countries for the announcement days and enforcement day of the CDS ban. The table shows a notable spread increase already prior to the unofficial announcement on July 5, 2011, for crisis-hit countries. Compared to the European average, the MCASC value of 32.778 bps shows a highly statistically significant spread increase. In contrast, for the event windows $[-1;1]$ and $[2;10]$, the MCASC are not significant. Both event windows offer no significant results. The announcement is one possible explanation why the increase of CDS spreads stopped. A further line of explanation is an additional event influencing the spreads and credit risk of crisis-hit countries. However, spreads generally increase after July 5, 2011. The trend changes for the event day October 19, 2011. The concrete information of the CDS ban lowered the previous market reaction. While CDS spreads in the pre-event window still rise, CDS spreads for the $[-1;1]$ event window and the post-event window decline by -43.000 bps and -114.763 bps, respectively. The reaction is significant at the 1 per cent level of significance.

Table 5.5: Short-term MCASC of the European crisis-hit countries. This table reports the MCASC of the European crisis-hit countries calculated as the realized minus the expected CDS spread change for the days, the regulation has agreed unofficially (July 5, 2011), the announcement became public (October 19, 2011) and when the regulation came into force (November 1, 2012); *, **, *** denote significance at the 10, 5 and 1% level, respectively.

	July 5, 2011			October 19, 2011			November 1, 2012		
Event window	MCASC	*t*-test	n	MCASC	*t*-test	n	MCASC	*t*-test	n
[−10;10]	12.893	4.332***	12	−47.378	−27.804***	7	1.718	1.455	9
[−1;1]	5.926	0.531	12	−43.000	−11.759***	7	2.309	1.623	9
[−10;−2]	32.778	16.157***	12	18.547	3.961***	7	1.784	1.738	9
[2;10]	−4.669	−0.942	12	−114.763	−16.115***	7	2.059	1.326	9

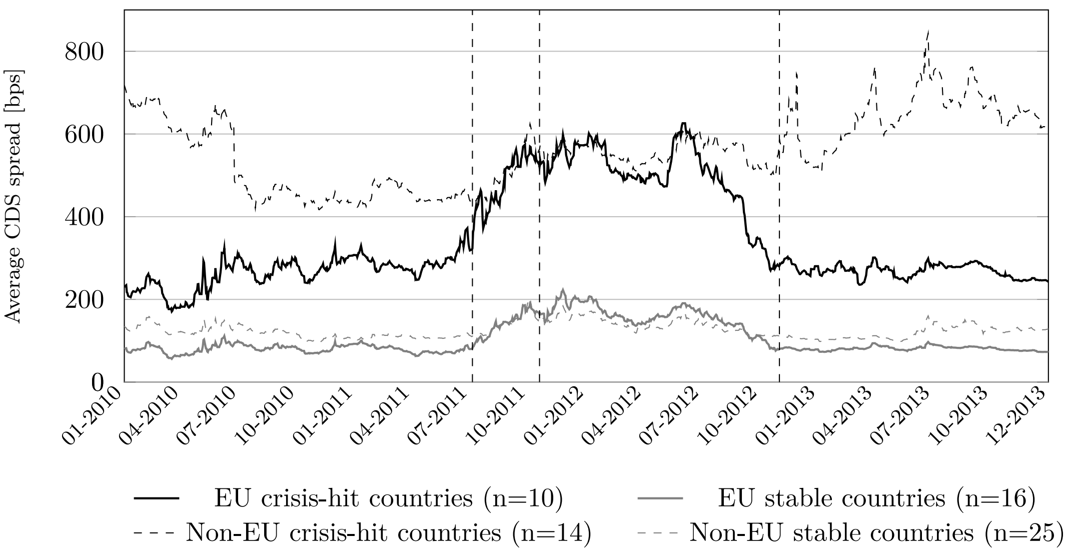
The main intention of banning uncovered sovereign CDS was to prohibit the betting on declining bond prices and the countries' default, especially for crisis-hit countries. On November 1, 2012, there was no evidence for significant abnormal spread changes for these countries. Hence, since the regulation came into force, the spreads are stable and the default risk for crisis-hit countries is lower.

Table 5.6: Results for the long-term stability analysis of the European crisis-hit countries entities. This table reports the MCASC of the European crisis-hit countries calculated as the absolute spread change of the EU portfolio minus the non-EU portfolio before the announcement of Regulation (EU) No. 236/2012 (01/01/2010 – 04/07/2011), between the announcement of the regulation and the regulation coming into force (05/07/2011 – 31/10/2012) and since the regulation came into force (01/11/2012 – 31/12/2013). $vola_{ratio}$ is the ratio of the standard deviation between the EU portfolio and non-EU portfolio; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

Time period	Before Announcement 01/01/2010 – 02/07/2011	Between Announcement and Regulation 05/07/2011 – 31/10/2012	Since Regulation 01/11/2012 – 31/12/2013
$MCASC_{LT}$	0.945	−0.481	−0.307
t-test	3.780***	−1.720	−3.996***
Average spread EU	0.230	−0.115	−0.126
Average spread non-EU	−0.715	0.365	0.181
$vola_{ratio}$	0.87	1.50	0.25
days	392	347	304
n	10	10	10

Table 5.6 contains the long-term analysis between EU and non-EU crisis-hit countries. The results are similar to our prior findings of the long-term reactions between EU and non-EU countries. The CDS of EU crisis-hit countries exhibit significantly higher spreads than non-EU countries already before any information about the regulation entered into the market. According to Figure 5.2, European spread reactions show a high increase and decrease between the first information and the enforcement of the regulation. However, the t-test for this period does not show significance. Hence, the spreads of EU and non-EU crisis-hit countries show no significant deviation from each other. This is consistent with our prior findings for all EU member states regarding the stabilizing effect of the regulation. Moreover, EU spreads decline below the comparison sample since the

Figure 5.2: Long-term trend of European sovereign CDS spreads. This figure shows the mean CDS spreads from January 2010 to December 2013 for EU entities and non-EU entities. CDS are standardized to 100 on January 2010.



enforcement, significant at a 1 per cent level. The ratio of standard deviation exhibits a reduction in volatility for EU crisis-hit countries comparing the periods before and after the regulation. This is consistent with the findings of the more robust European spreads as a result of the CDS ban.

The findings of this analysis indicate that European crisis-hit countries significantly influence the European spread reactions in general. Moreover, we find that since Regulation (EU) No. 236/2012 came into force, CDS spreads stabilized, especially for crisis-hit countries.

5.4.4 Robustness checks

To test the validity of the results achieved so far, multiple robustness checks are applied. Table 5.7 contains three- and ten-year CDS for the observed event days in comparison to the five-year tenor benchmark. The results are robust for all investigated event days. Panel C shows the five-year tenor MCASC calculated with a benchmark of non-EU entities. Comparative calculations exhibit a high, significant increase in CDS spreads for the first announcement of the regulation.

Table 5.7: Robustness checks. Panels A und B report the short-term MCASC calculated as the realized minus the expected CDS spread change for three- and ten-year tenor CDS; Panel C reports the MCASC calculated with a benchmark of non-EU entities; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	July 5, 2011			October 19, 2011			November 1, 2012		
Event window	MCASC	*t*-test	n	MCASC	*t*-test	n	MCASC	*t*-test	n
Panel A: 3 Year CDS tenor									
[−10;10]	4.144	3.044***	27	−3.288	−3.641***	26	1.452	2.137**	25
[−1;1]	12.311	2.266**	27	−2.060	−1.038	26	1.972	2.653**	25
[−10;−2]	−1.968	−1.247	27	−3.180	−2.769**	26	1.375	2.438**	25
[2;10]	7.535	3.048***	27	−3.805	−1.577	26	1.356	1.566	25
Panel B: 10 Year CDS tenor									
[−10;10]	3.621	3.040***	27	−3.586	−2.831***	26	1.103	2.268**	25
[−1;1]	11.459	2.241**	27	−1.159	−0.999	26	1.508	2.240**	25
[−10;−2]	−2.128	−1.967*	27	−3.851	−4.798***	26	0.675	1.229	25
[2;10]	6.757	3.121***	27	−4.129	−1.455	26	1.397	2.676***	25
Panel C: Benchmark model									
[−10;10]	3.759	2.624**	27	0.649	1.259	26	−1.877	−4.192***	25
[−1;1]	11.350	2.148**	27	−3.821	−3.719***	26	−1.848	−3.167***	25
[−10;−2]	−1.481	−1.506	27	4.058	3.062***	26	−0.979	−2.394**	25
[2;10]	6.468	2.651**	27	−1.270	−0.622	26	−1.996	−3.473***	25

Furthermore, all three panels show that banning uncovered sovereign CDS was not expected by market participants. Calculations using a constant mean model show MCASC values above the average when the regulation came into force. However, comparing the results with the portfolio of non-EU countries, the results lead to significant decreases in CDS spreads for this day (Panel C). The $[-10; 10]$ and $[-1; 1]$ event windows provide negative MCASC values, significant at the 1per cent level. The findings are corroborated by Figure 5.3. The spread movements of all three CDS tenors are very similar and follow the same pattern. They only differ in the height of the spread level, while five-year CDS mainly running between the three- and ten-year CDS.

As a further robustness check, we define the GIIPS countries group as crisis-hit countries. We again exclude the Greece CDS from January 2012 and in the stability analysis due the semi-default and the aid packages. The results shown in Table 5.8 support the prior findings for the regulation-specific announcements. The CDS spreads of the GIIPS countries group significantly increased prior to the unofficial announcement on July 5, 2011. The press release of the CDS ban announced on October 19, 2011, significantly lowered the CDS spreads. On November 1, 2012, we only find significant MCASC in the $[-1; 1]$ event window. However, the MCASC is very small compared to the prior announcements. Overall, the results for the event specific announcements are robust for crisis-hit countries.

Figure 5.3: Three-, five- and ten-year CDS spreads of the European Union sample. The figure shows the five-year tenor average CDS spread compared to the three- and ten-year CDS tenor.

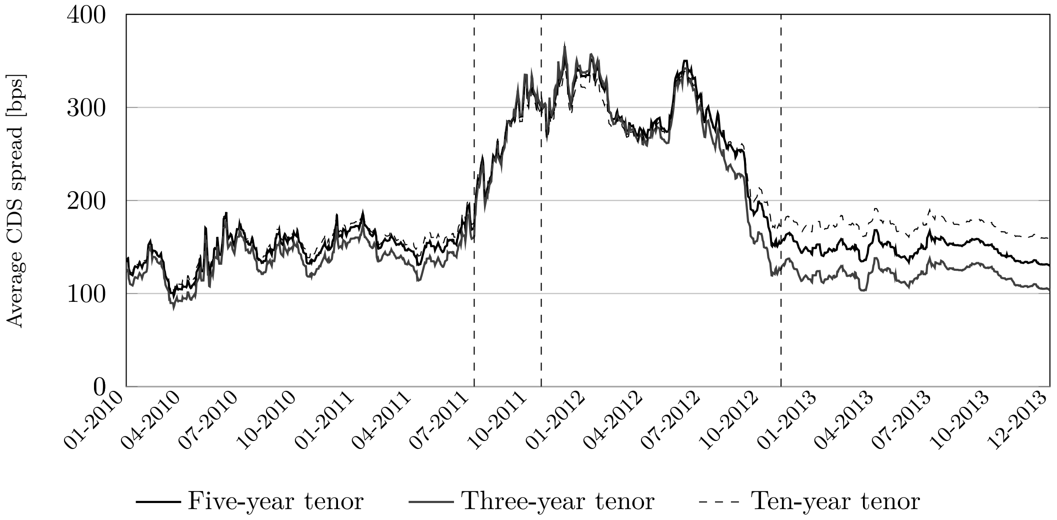


Table 5.8: Short-term analysis of the GIIPS countries group. This table reports the MCASC of GIIPS countries group calculated as the realized minus the expected CDS spread change for the days the regulation has agreed unofficially (July 5, 2011), the announcement became public (October 19, 2011) and since the regulation came into force (November 1, 2012); * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

	July 5, 2011			October 19, 2011			November 1, 2012		
Event window	MCASC	*t*-test	n	MCASC	*t*-test	n	MCASC	*t*-test	n
[−10;10]	21.751	4.419**	5	−46.912	−18.741***	5	3.888	2.008	4
[−1;1]	35.071	1.641	5	−42.051	−9.009***	5	6.128	3.818**	4
[−10;−2]	29.955	6.183***	5	20.742	3.392**	5	3.685	2.120	4
[2;10]	9.108	1.045	5	−116.186	−11.194***	5	4.790	1.914	4

The results of the GIIPS countries group in the long-run are reported in Table 5.9. The $MCASC_{LT}$ increased significantly before the uncovered CDS ban and decreased as the regulation came into force. In the period between announcement and regulation, we find no significant effect. The results for the GIIPS countries group are similar to the previous findings for European entities in distress. Before the announcement, the $MCASC_{LT}$ is even 1.6 bps for GIIPS countries compared with 0.9 bps for the previous sample of entities in distress. As the regulation came into force, the $MCASC_{LT}$ is -0.4 bps, indicating a decrease of CDS spreads at the 1 per cent level of significance. The ratio $vola_{ratio}$ indicates that the CDS spreads are even more volatile. In summary, the results of the regulation announcement days and the stability analysis are robust for European countries which are in distress.

Table 5.9: Results for the long-term stability analysis of the GIIPS countries group. This table reports the MCASC of the GIIPS countries group calculated as the absolute spread change of the EU portfolio minus the non-EU portfolio before the announcement of Regulation (EU) No. 236/2012 (01/01/2010 – 04/07/2011), between the announcement of the regulation and the regulation coming into force (05/07/2011 – 31/10/2012) and since the regulation came into force (01/11/2012 – 31/12/2013). $vola_{ratio}$ is the ratio of the standard deviation between the EU portfolio and non-EU portfolio; * , ** , *** denote significance at the 10, 5 and 1% level, respectively.

Time period	Before Announcement 01/01/2010 – 02/07/2011	Between Announcement and Regulation 05/07/2011 – 31/10/2012	Since Regulation 01/11/2012 – 31/12/2013
$MCASC_{LT}$	1.577	-0.929	-0.440
t-test	3.966**	-2.109	-7.320***
Average spread EU	0.862	-0.563	-0.259
Average spread non-EU	-0.715	0.365	0.181
$vola_{ratio}$	1.35	2.75	0.34
days	392	347	304
n	4	4	4

5.5 Summary and conclusion

Since the financial crisis with its peak in 2008 and the European debt crisis beginning in 2009, CDS spreads of EU member countries were highly volatile. The EU adopted multiple legislations with the objective to reduce the volatility. Since the year 2008, bailout programs have been initiated to support European entities in distress, for example, GIIPS countries. In October 2010, it was decided to create a permanent rescue mechanism, the European Stability Mechanism, which aims at preserving the financial stability of the European Monetary Union. In July 2012, Mario Draghi, President of the European Central Bank, has pledged to do “whatever it takes” to protect the Eurozone from collapse. The main objective of these measures is to reduce the default probability of the members of the European Monetary Union. Among these measures, the EU introduced Regulation (EU) No. 236/2012. The aim of this regulation is to reduce the CDS spread level and to rein in the increasing costs of sovereign issuers by reducing speculation in the sovereign CDS market.

On July 5, 2011, the European Parliament modified their new short-selling restriction and included articles about a prohibition of uncovered sovereign CDS. Our results indicate that CDS spreads of sovereigns increased significantly after this date. The pre-event window suggests that these changes were not anticipated by market participants. The CDS spreads still increased, presumably due to uncertainty in the market. The first announcement of a regulation banning uncovered CDS did not stabilize EU sovereign CDS spreads. The changes in the regulation became public on October 19, 2011. Our findings show that the market already anticipated the precise laws and the CDS spreads decreased prior to the official statement. On November 1, 2012, the

CDS regulation came into force. The CDS spreads increased only marginally around this date and the economic impact appears to be comparatively small.

The introduction of a regulation banning uncovered CDS is frequently criticized, because CDS possess important information for investors about the creditworthiness and the default risk of an entity. However, in times of economic and financial distress, CDS allow speculation on the probability of a borrower's default. On November 1, 2012, the uncovered CDS ban came into force, and the CDS of the EU sample subsequently shows less volatility than the benchmark sample consisting of non-EU entities.

The low-average CDS volume obtained from Depository Trust and Clearing Corporation Trade Information Warehouse and the trade count for Western Europe indicates that speculators abandoned the European CDS market. Since the regulation came into force, the trading volume in European sovereign CDS fell markedly. Moreover, CDS spreads of emerging markets entities, which experienced large volume increases, indicate that speculators left the European sovereign CDS market and migrated to these markets.

However, additionally to the Regulation (EU) No. 236/2012, EU authorities and national governments enacted several other measures to stabilize the CDS of EU member states. Due to the variety of measures during this time, it is not possible to properly distinguish the effects due to Regulation (EU) No. 236/2012 and the additional measures enacted by the EU authorities. This unresolved question could provide a promising avenue for future research. Regulation (EU) No. 236/2012 appears to achieve its objectives and the regulation of uncovered sovereign CDS seems to be the most important instrument. But due to the number of additional measures enacted by the EU, Regulation (EU) No. 236/2012 may not be the sole reason for the observed results.

Chapter 6

Concluding remarks

The present thesis offers a comprehensive analysis of the effect of credit rating adjustments on the debt and equity markets and the efficiency of the CDS market. By not only examining the impact of rating changes in general, but also in different regions and during the financial crisis, clearer conclusions can be drawn in the importance of rating changes. In addition, the efficiency of the CDS market and one of the first worldwide CDS regulations offer valuable insights in the understanding of credit valuation.

The results of Chapter 2 show that there is no CDS market response to rating announcements during the crisis, but that the stock market anticipates downgrade announcements. The sample included 542 companies from the U.S. and 15 European countries and examined 915 corporate issuer ratings. Hull et al. (2004), Norden and Weber (2004), Finnerty et al. (2013) and Imbierowicz and Wahrenburg (2013) find for downgrades a significant CDS spread increase. I find that these results cannot be confirmed for the period of the global financial crisis from 2008 to mid-2009. These findings suggest that rating agencies do not detect any deterioration of the issuer's credit quality in a timely fashion. During the financial crisis, rating downgrades are not a relevant market information as rating agencies merely follow markets in their downgrade decision. Since the end of the financial crisis, the results of the prior literature can be confirmed for the CDS market. However, the results show a tendency that rating upgrades are positive information for the CDS market during the crisis. These findings helps to resolve whether and when rating agencies provide new information to financial markets. The results suggest that during crisis periods, credit rating agencies do no provide new information to market participants.

Chapter 3 analyzes the role of rating agencies in market-based systems. In contrast to long-run bank relationships, outside investors are confronted with more difficulties to evaluate a firm's credit risk in depth and reliably. The financial intermediation in bank-based systems has implications for the role and the focus of credit rating agencies. This chapter examined the influence of rating announcements in Germany, one of the premier bank-based systems. During the investigation period from January 2000 to June 2014, 189 S&P and 204 Moody's rating announcements were examined. The results show that rating announcements are of lower importance in the German market than in market-based systems such as the United States. In bank-based systems, such as in Germany, banks are the most important intermediaries to evaluate the creditworthiness of a given company, and therefore credit rating agencies provide less information than in other markets.

Chapter 4 analyzed the market integration and efficiency of CDS and equity markets by examining the CDS spreads of 538 U.S. and European firms around unanticipated and sudden credit events (CEs) from 2010 to 2013. In particular, this chapter answered two questions: First, if stock markets react significantly to rating changes, and to negative rating changes in particular, are there similar observable effects to large changes in CDS spreads? And second, if generally credit markets are slower in information processing than equity capital markets, does uncertainty still need to be resolved once CDS markets adjust their valuation levels for corporate debt? The outcome of this chapter is that stock markets react prior to CDS markets, anticipating CEs to a certain extent. In particular, the results of this chapter show that equity returns during the two days prior to a CE have a highly significant influence on the observed CDS spread change on the day of the CE, indicating that both markets are not fully integrated yet. In addition, the study found evidence that CDS spread changes display continuation patterns following positive CEs and reversal patterns following negative CEs. These patterns are in line with the Uncertain Information Hypothesis, suggesting that CDS markets are efficient, albeit lagging equity markets to a certain extent.

In Chapter 5 the first worldwide CDS regulation was examined. The European sovereign debt crisis has drawn considerable attention to the CDS market. Uncovered CDS have the ability of a speculative instrument to bet against a sovereign default. Therefore, the EU introduced Regulation (EU) No. 236/2012as one of the worldwide uncovered CDS regulation. This regulation prohibits buying uncovered sovereign CDS contracts in the European Union. The aim of this chapter is to analyze the impact and effectiveness of the regulation on the European sovereign CDS market. Therefore, spread changes of sovereign CDS of the EU member states around regulation specific event dates were measured to detect whether and when European sovereign CDS react to regulation announcements and the enforcement of regulation. Second, the CDS long-term stability of the EU sample was compared with a non-EU sample based on 44 non-EU sovereign CDS entities. The results show widening CDS spreads prior to the regulation and stable CDS spreads following the introduction of the regulation. In particular, sovereign CDS of European crisis-hit entities are stable since the regulation was introduced. Moreover, the results show that since the regulation of uncovered CDS in the European Union has been enacted, the sovereign CDS market is stable and less volatile. Based on the theory about speculation on uncovered sovereign CDS by betting on the reference entity's default the introduction of Regulation (EU) No. 236/2012 appears to be an appropriate measure to stabilize markets and reduce speculation on sovereign defaults. This study additionally analyze the CDS market efficiency. The results suggest that the European sovereign CDS market is efficient as the regulation is introduced.

Overall, this thesis have shown that financial markets react differently to credit events, such as ratings provided by credit rating agencies. The market reaction depends on several factors, namely the date of the announcement, the concentration of banks in the market, and whether the equity or the debt market is under consideration. During times of market distress, rating agencies do not offer new information. In bank-based systems, the information requested by market participants is also smaller. Second, the thesis shows that the CDS market seems to be efficient, albeit lagging the equity market to a certain extent. Regulation of the trading in CDS increases the efficiency of the market.

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Declaration of Honor

I declare upon my word of honor that the doctoral thesis submitted herewith is my own work. All sources and aids used have been listed. All references or quotations in any form and their use have been clearly identified. The dissertation has not been submitted for examination purposes to any institution before.

Ich erkläre hiermit ehrenwörtlich, dass ich die vorliegende Arbeit selbstständig angefertigt habe. Sämtliche aus fremden Quellen direkt und indirekt übernommene Gedanken sind als solche kenntlich gemacht. Die Dissertation wurde bisher keiner anderen Prüfungsbehörde vorgelegt und noch nicht veröffentlicht.

Florian Kiesel
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