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Credit default swaps and stock market behavior in response to credit rating announcements

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Abstract

The purpose of this study is to investigate the behaviour of credit default swaps and stock markets in reaction to credit rating announcements made by Standard's & Poor Global during the period 2009-2019. This study applies traditional event study methodology and examines the speed and strength of reaction of both CDS and stock markets. First, it is found that both markets have a delayed reaction to rating announcements. Second, CDS markets tend to react faster when compared to stock markets. Third, the magnitude of abnormal performance in both markets is attributable to the type of event, the quality of a company's credit, the size, and the debt related to the reference entity.

1. Introduction

Over the past two decades, the market for derivatives has grown exponentially across the globe. It has evolved into being one of the principal trading markets with different participants such as banks, hedge funds, insurance companies, and pension funds.

The basic principle of derivatives is to some extent hedge and transfer credit risk. One of the most popular derivatives in the market is the Credit Default Swap (CDS). A credit default swap acts in essence as insurance, protecting the buyer in the form of a contract against default or another credit event concerning the other party. To maintain the contract, the buyer pays a fee known as the CDS spread, which reflects the cost of protection against default risk, or credit risk. Its popularity can be mainly attributed to the existence of a common risk regarding the uncertainty of the agent's ability to meet its financial obligations (Norden, 2017).

In order to mitigate and commonly measure this risk, credit rating agencies (CRA's) were created. These private entities are one of the most important pillars in financial markets since these provide information to the market participants. Most importantly, their opinions on the credit quality of an entity are thought to mitigate the information asymmetry regarding creditworthiness, which is constantly present in the market. An entity is assigned a rating according to a grading scale, specific for each credit rating agency, depending on the probability of default among other factors. Nowadays, there are mainly three private entities that control the market: Moody's, Standard's & Poor Global, and Fitch. The focus of this paper is S&P and it will be referred throughout the paper. These ratings only represent an opinion from the credit agency and naturally, throughout a company's lifetime, ratings can change.

Both CDS spread and credit rating agencies are ways to measure risk. The spread can be interpreted as an insurance premium against the likelihood of default, as an unambiguous reflection of the default risk of the firm. Thus, accordingly, a high spread implies that credit risk is also relatively high whereas a low spread indicates a relatively low credit risk. As closely related terms measuring the same risk, one should be able to find a relationship.

Given the value of credit rating agencies, it might be believed that rating releases have a significant market effect. As credit ratings disclose new details, markets for financial statements that contribute to the credit risk of an individual will respond considerably. Some examples of markets in which risk plays a pivotal role are those for bonds, stocks, and related derivatives. This paper will explore two of these examples: stocks and derivatives in the form of CDS.

This paper will explore the response of stocks and credit default swaps to rating announcements, in particular, analyzing upgrades and downgrades regarding the ratings given by the agency Standard & Poor's (S&P). The research question is the following:

How do stock and credit default swaps behave in response to credit rating events?

To answer the research question, the analysis will be performed in the form of an event study, pairing the credit default swap to its respective equity and credit event within an interval and testing their significance. This question will be focused on financial instruments traded entirely in the US market during the period between 2009 and 2019. Data regarding CDS spread is retrieved using a combination of Thomson Reuters and DataStream. Rating announcement events are collected exclusively from a major rating agency Standard & Poor’s due to data availability.

This is an important topic to research for different reasons. First, whereas stocks have been traded since the 19th century, CDS markets are relatively new, gaining popularity around the ’90s. As a result, there has been some considerable research on the relationship between rating announcements and stock returns, but there is very little knowledge about the credit derivatives markets. Hence, it is considered relevant adding some literature regarding comparative analysis between the two asset classes. Second, literature concerning this topic uses mostly investment-grade rating, so adding the factor of speculative-grade may give some variety. The question overall contributes to market efficiency research and may also be of interest to market agents since responses conditional of rating announcement may develop into investment opportunities. Agents can act earlier or later depending on the type of announcement and changes that affect credit quality. The assimilation of information and the speed of the reaction are important variables in the analysis presented in this paper.

The results show that credit default swaps and stock markets react to rating changes, in particular for downgrades. At a general level, evidence suggests a market reaction not anticipation of credit events. When taking into consideration the difference between investment graded and high yield obligations, anticipation results become mixed. In a comparative analysis regarding the speed of the reaction, it is found that CDS markets react earlier to stock markets. Possible explanations for abnormal performance are related to size and debt indicators concerning the reference entity.

The following sections are structured as follows. Section 2 and 3 provide an overview of related literature and proposes three hypotheses. Section 4 and 5 describe the data collected, subsequent transformations, and the event study methodology used. Section 6 discusses the results. The final section concludes.

2. Literature Review

The financial literature has long studied the issue of whether credit ratings have significant informational substance. These relevant studies can be divided into two sections, one studying the informational content of credit rating announcements on stock prices and the other section studying CDS spreads. The consensus is that both CDS and stock markets present anticipation to rating changes, especially for downgrades.

2.1. Credit rating announcements on stock prices

Previous literature regarding stock prices shows results that there is significant informational content related to rating changes, in particular to downgrades. One of the first studies that addressed the topic found that there is anticipation in the stock market before rating changes but no abnormal reaction afterward (Pinches & Singleton, 1978). Other studies show a significantly negative reaction after downgrades, but no significant abnormal performance for upgrades. The daily abnormal stock returns were found roughly between 10 months before and 2 months after the announcement. It uses both S&P and Moody's for credit rating data, adding the S&P watchlist, which is companies whose ratings might change in the following 90 days (Holthausen & Leftwich, 1986).

Such findings tend to be partly confirmed by another analysis, which built upon the work of Holthausen, indicating a statistically significant adverse stock return response in the event of a downgrade, but no substantial positive stock return in the event of an upgrade. The study includes, among other factors, the inclusion of fixed income to the analysis, the use of speculative-grade instruments, and the incorporation of S&P Watchlist. In line with previous studies, it concludes that there is a significantly negative abnormal stock and bond returns for downgrades, but no significant abnormal returns for an upgrade. Surprisingly, S&P Watchlist for negative credit watch produces a significantly negative stock market reaction (Hand et al., 1992).

In line with the aforementioned studies, Dichev & Piotroski (2001) found that after upgrades, there are no consistent abnormal returns while after downgrades there are significant negative abnormal returns. Information-processing biases were attributed as a reason for evidence of this asymmetry effect. In the first months after downgrades, the underperformance is more pronounced, lasts at least a year, and is on the one-year horizon at a magnitude of -10 to -14 percent. Furthermore, they found that for small and low-credit firms, weak returns from downgrade firms are more pronounced. While finding answers, the authors record downgrades as good predictors of potential earnings decline. Similar findings regarding earnings deterioration found significant abnormal returns for downgrades possibly due to increased leverage (Goh & Ederington, 1993).

Lastly, a more recent study that tries to apply a similar analysis to G7 countries stock markets, particularly on country-specific differences and industry-specific factors, found that their results regarding issuer rating upgrades clearly confirm the well-documented finding that these do not include any substantial information material about the stock price of the upgraded company. Significantly negative cumulative abnormal returns are found for companies experiencing a downgrade, under previous literature. Interestingly, downgrades across rating classes tend to be stronger than within-class downgrade, which presents evidence that experiencing a downgrade from investment grade to speculative grade should represent a stronger signal of creditworthiness (Hu et al., 2016).

In summary, most studies seem to agree on the informational content of rating changes on stock prices. There is a significant stock market reaction in the case of downgrades, while upgrades do not include any substantial information. There is evidence for a reaction in anticipation of a rating change in the case of a downgrade. Based on studies, this ranges from 8 to 1 month before the rating change.

2.2. Credit rating announcements on credit default swaps

It is important to mention that one of the main reasons behind the use of CDS in this paper instead of other asset classes, such as bonds, is because prices reflect more than the risk of default from the issuer. Bonds yields reflect several other aspects of risk that need to be accounted for in its study methodology (Weinstein, 1977). According to Hull et al. (2004), bonds contrary to CDS require to assume the risk-free benchmark for the calculation of abnormal returns. For pricing models, in the case of bonds, a treasury zero curve risk-free is used; while for CDS, a LIBOR swap zero curve is used. Furthermore, the instruments present different characteristics such as the ability to short a CDS and a constant interest rate in the case of bonds. Nonetheless, using CDS convey possible disadvantages as prices may be substantially higher than credit spreads over a long period due to combinations of defects in the contract specification and measurement errors in the calculation of credit spread in comparison with other asset classes (Blanco et al., 2005).

Studies about the informational content of rating announcements on credit default swaps are slightly more mixed than for other asset classes. One example of a paper that focuses on the relationship between CDS and rating announcements using an event study concludes that default swaps indeed anticipate the rating changes up to 3 months before the event. CDS spreads fully adjust to the information in rating changes around the announcement date. Furthermore, their results determine positive adjusted CDS spread changes before negative rating events. Surprisingly, there was a significant informational content for reviews for downgrades, a warning for investors that the rating might change in the following 90 days, while downgrades do not convey significant information. This is in contrast with previous literature of other asset classes such as stocks, in which downgrades do have statistical significance. In the case of upgrades, their reaction was small and virtually insignificant. Both argue that positive ratings may be anticipated much more than negative rating changes, which corroborate previous research (Hull et al., 2004).

More recent studies like the article by Finnerty et al., (2013), focuses on how rating changes, credit watchlist, and outlook induce a response onto the credit default swaps. In this paper, the authors formulate several important questions regarding CDS spreads such as its effect by credit rating events and whether there is a systematic difference between upgrades and downgrades. Contrary to previous literature, they found evidence for significant announcement effects on positive rating changes, reviews, and outlooks. Although, downgrades are still largely significant due to, under earlier research, more constant and increasing monitoring of risk in the case of deteriorating credits in comparison to upgrades. In other words, rating upgrades are not as anticipated as downgrades. Thereafter, the authors focus on the informational content during a recession and the significance of a shift from an investment grade to a non-investment grade. Besides using an event study, the author proposes logistic and regression analysis to explore whether changes in CDS spreads can be useful for estimating the probability of a credit event happening. Finally, they conclude that the impact of an upgrade rating change is greater for lower-rated firms, while downgrades have a greater impact on investment-grade firms.

Another study that focuses on the content of information of rating changes on credit swaps with an interest in intra-industry effects, provides evidence for an asymmetric market reaction. In other words, significant abnormal returns in the case of negative events and non-significant returns for positive events. For upgrades, they found evidence for statistically significant positive cumulative abnormal changes in CDS spreads around the announcement date, and vice versa for downgrades. In regards to the industry effects, the authors find that there is a different market reaction across industries and that events provide information at a firm and industry level (Wengner et al., 2015).

Overall, the literature regarding CDS is mixed. While there is evidence for significant informational content, this is mainly found in the case of negative rating reviews, not for actual downgrades. As with other research areas, the articles discussed in this section appear to agree with the idea that adverse outcomes are related to a stronger abnormal performance. For the case of positive changes, the evidence is varied. Some studies, in the agreement of previous literature in different asset classes, argue for non-significance while more recent research argues for the contrary.

Crucially, one study has delved into the relationship of both asset classes and it has been used as the basis of this work. In 2004, Norden & Weber analyzed the response of CDS and stock to rating announcements using an event study methodology. First, it was found that both CDS and stock markets anticipate the rating downgrades in between 2 to 3 months before the credit event. This outcome is in line with the paper first mentioned in this section, which showed predictive power for negative rating changes. Second, the authors reached the same results as Finnerty, observing significant abnormal performance around negative events but insignificant when upgrades occur. Likewise, significant informational content for negative rating reviews not downgrades itself. This is evidence for an asymmetry effect, also found earlier in other asset classes such as bonds (Hite et al., 1997). Third, concerning the speed of reaction by both markets, CDS markets react faster than stock markets. As previously mentioned, they argue that anticipation may be a result of permanent market monitoring.

3. Hypotheses

As mentioned before the main purpose is to investigate the behavior of CDS and stocks to credit rating events. To investigate the research question, the following hypotheses are mainly based on Norden & Weber (2004) as this paper deeply researches both asset classes relevant to the scope of this paper.

H1: Markets react directly after or around rating changes because they provide significant informational content.

As discussed before, if rating announcements convey informational content on CDS and stock markets, in the case of downgrades, a significantly negative reaction by the stock market is expected. Likewise, a significantly positive CDS reaction during downgrades is expected. Given that literature is mixed, it may be possible to not observe any abnormal performance around the announcement date, also known as the announcement effect. It can be expected to find anticipation of the event. A statistical test will be carried out for each of the two mentioned markets. These tests are both parametric and non-parametric to account for non-normal distribution regarding the abnormal returns.

An asymmetry effect can be expected. As indicated by the literature, an asymmetry effect implies no significant abnormal returns for positive rating changes and significant abnormal returns for negative rating changes. Based on previous research for both asset classes, this is expected. Since reviews are not covered in this paper, they are not considered as a rating change, only actual downgrades or upgrades.

H2: CDS markets react faster than stock markets

Concerning both asset classes mentioned in this paper, it is expected for CDS to respond earlier to rating events due to several reasons. First, they are different instruments with vastly different characteristics such as liquidity, risk profile, the market they are traded in, etc. The research analyzes how public and private information affects the speed of information assimilation by the CDS markets. Among other explanations to why this market reacts faster, the author reached to the conclusion that firms with high news intensity react earlier and stronger before negative rating announcements, the anticipation of events relates to the number of relationships that firm has over the banking sector, liquidity transaction and information-based trading play an important role (Norden, 2017).

H3: Cumulative abnormal returns can be attributable to factors such as the size of the firm, debt, investment class, and whether a firm faces a downgrade or an upgrade.

It is important to investigate possible explanations for the cumulative abnormal returns that are expected to be found in the case of both asset classes. Previous literature executes this especially for stocks, however, there are cases in which regression can also be applied to find a possible explanation for cumulative abnormal spread changes in the case of CDS.

4. Data

The data sets consist of CDS spreads from multiple industries, their respective stock prices, and credit rating data.

First, CDS data is obtained using both Thomson Reuters and DataStream. It is important to mention that not all data available in Thomson Reuters is available in DataStream. The latter's database exists within the ecosystem of Thomson and only possesses a fraction of its catalog available. In other words, to select, transform and filter data codes from Thomson, first these must be are translated to DataStream identifiers. Data is not extracted following an index, instead, every single name CDS (roughly 7000 contracts) related to a reference entity, ruling out sovereign CDS, is taken and run through DataStream to see the availability of the data. It is filtered based on tenor, location, and structure. A contract included in the sample must adhere to the following conditions: have experienced a credit event during the period 2009 to 2019, contains daily CDS spreads throughout the period without missing quotations in any date, the tenor is 5 years, trading in the US market, and be denominated in U.S. dollars. 5 years contracts are the most traded and liquid. As contracts, credit default swaps face several restructuring events, for this dataset the denomination AX with the restructuring event occurring in 2014 is used due to the large availability of that particular denomination. Usually, a change in the denomination is insignificant and differences if occur are minimal, but to preserve the integrity of the data only this denomination is used throughout the dataset. During the data selection process, the identifier that is applied is the RIC (Reuters Instrument Codes) that can be used later in DataStream to extract the spreads of the contract. As an example, the RIC code MMM5YUSAX=R contains within the first letters the company it relates to (3M), the tenor (5 years), and the contract denotation (AX). Following this data specifications, 1653 contracts fit the requirements.

Second, stock prices are extracted also using a combination of Thomson Reuters and DataStream. Since this paper looks at a comparison between stock prices and CDS, every contract is related to its respective equity through the RIC. The primary equity connected to that CDS is extracted. In a few cases, multiple contracts relate to only one stock since companies that established a credit default swap may have been delisted, merged, or are private companies. Some contracts relate to a specific subsidiary within the organizational structure of a corporation; if the primary equity was not available in those cases for the subsidiary, it traces back to the ultimate parent's stock. Like CDS, stock price data must adhere to the conditions relating to credit events, market, currency, and prices throughout the whole sample period.

Third, the concept of CDS-index is important. Apart from single-name CDS, CDS indices are the averages of the most liquid CDS within a portfolio. It is important since it is used to measure abnormal returns. The indexes used for CDS must follow the same conditions as single-name CDS, concerning the tenor, market, and currency. Through a credit default index swap (CDIS), the credit risk of a common basket of reference companies is exchanged between the buyer of security and the seller of security (Wang et al., 2009). Dow Jones CDX indexes are used in this research which includes firms in North America and emerging markets. North American firms with an investment-grade ranking are nominee comparison institutions for the former index. For all indices, there are 125 business names, and each name is weighted evenly within the table (i.e. weights 0.8 percent). In this article, our attention will be on the indices CDX NA IG and HY. The index measures the average credit default swap spread of all the index dealers. There are indices of different maturities. This empirical study relies on 5-year averages. Further importance and approach to the index are explained in the methodology section.

Fourth, credit ratings are extracted through Thomson. By linking back RIC codes of the CDS, historical ratings by the agency Standard and Poor's are obtained. No outlook or reviews are available for download in Thomson, therefore, only actual rating changes either downgrades or upgrades are evaluated. Only current ratings are available in Thomson for other rating agency, Moody's. Based on previous literature, Fitch agency does not produce significant results. In summary, due to data availability, only S&P long-term issuer ratings are extracted.

4.1. Descriptive Statistics

Each rating event is matched with its respective stock and CDS, in other words, the event occurs for both asset classes. In total, 1091 ratings are obtained. 618 are downgrades, while 474 are upgrades. The database is merged for both investment-grade and speculative-grade. The median credit rating in the sample is BB+. It is found that the average credit spreads are higher for downgrades than for upgrades as the mean value of downgrades is 376.600 in contrast to 333.624 by upgrades. On average, there is a higher risk associated with negatively affected default swaps.

Furthermore, ratings provided by S&P are translated into numbers for its processing. The highest bond rating in the sample, AA+, takes a numerical value of 22 and it descends as credit ratings decrease. The lowest rating D, signaling virtual default, is transformed into a 0. The frontier between investment grade and high yield is set up at 14, which translates to BBB-, the lowest rating in the investment class category. Equivalent ratings below 14 are speculative-grade obligations. It is observed that the CDS spread is higher when downgraded.

CDS spread react differently to downgrades in comparison to upgrades. In the sample, the greatest value for the spread at the lowest possible rating is 982.291. On the other hand, the highest value for spreads occurs close to the frontier between classes (12), at 1086.820. It is noteworthy to mention the reactions close to the investment class frontier. A bond that is downgraded from investment grade (14) to high yield (13) increases dramatically from 206.617 to 535.851. Under different conditions, a bond that upward crosses the frontier reduces drastically from 565.468 to 112.796. These results are presented in Table 1.

Table 1: Summary statistics of CDS spreads across numerical equivalent rating classes

Ratings	Downgrade		Upgrade		Total	
	Frequency	Mean	Frequency	Mean	Frequency	Mean
0.000	64.000	982.219			64.000	982.219
1.000	12.000	219.505			12.000	219.505
2.000	28.000	564.404			28.000	564.404
4.000	20.000	1040.094	3.000	91.120	23.000	916.315
5.000	8.000	336.616	1.000	119.270	9.000	312.466
6.000	18.000	536.195	11.000	999.226	29.000	711.827
7.000	16.000	369.993	18.000	251.620	34.000	307.325
8.000	28.000	436.403	18.000	348.027	46.000	401.821
9.000	37.000	502.264	21.000	743.581	58.000	589.637
10.000	36.000	698.915	38.000	279.931	74.000	483.761
11.000	42.000	530.347	41.000	630.006	83.000	579.576
12.000	26.000	434.684	46.000	1086.820	72.000	851.326
13.000	28.000	535.851	39.000	565.468	67.000	553.091
14.000	55.000	206.617	27.000	112.796	82.000	175.725
15.000	69.000	145.241	61.000	92.098	130.000	120.305
16.000	50.000	124.260	56.000	143.135	106.000	134.231
17.000	36.000	137.769	43.000	93.330	79.000	113.581
18.000	18.000	134.095	25.000	101.894	43.000	115.374
19.000	15.000	151.077	13.000	191.285	28.000	169.745
20.000	8.000	114.562	8.000	90.676	16.000	102.619
21.000	2.000	34.272	5.000	64.955	7.000	56.189
22.000	2.000	49.810			2.000	49.810
Total	618.000	376.600	474.000	333.624	1092.000	386.857

Moreover, credit default swaps within the investment grade class that have suffered a downgrade present on average a higher spread in comparison to upgrades, implying as mentioned before that higher risk conveys a higher price adjustment for the spread. Interestingly, within high yield class, obligations that have suffered a downgrade do not present a severe difference in comparison with upgrades. These results are displayed in table 2. A possible explanation may due to the spreads lower-rated obligations are already carrying, as observed in the previous table a bond that has suffered either an upgrade or a downgrade and is rated 4 has an average spread valued at 916.315.

Table 2: Summary statistics of CDS spreads sorted by class

Class	Event	Frequency	Mean	Std. Dev.
Investment	Downgrade	255.000	150.285	271.397
Grade	Upgrade	238.000	112.506	110.809
High	Downgrade	363.000	619.586	1583.587
Yield	Upgrade	236.000	619.947	1767.182

5. Methodology

The behavior of CDS and stock prices in response to credit ratings is analyzed in this paper through traditional event study methodology. This type of research is nowadays very common in economic academic literature. In summary, an event study measures the impact of a specific event on the value of a firm. Key to this research is the market efficiency theory that indicates that, given the rationality and full information availability, the effects of an event would be fully reflected immediately. Pioneering in this field, the paper by MacKinlay (1997) is crucial. In summary, the author establishes a guide for elaborating an event study, describing the steps, possible hypotheses, cases, the role of abnormal returns, and a different test for significance. In this paper, the author constructs an example using security prices, in that way measuring the event's economic impact. In contrast to that paper, this paper does not use security prices. There are other cases besides securities, such as analyzing a merger, earning announcements, etc. In general, one needs to match an event against a set of timeline series that reflects the value, in this case, a CDS spread and stock prices.

For the development of an event study one has two requisites based on previous literature: a period affected by an event or events and value that can be measured over time. Together, these requirements set the delimitations for my sample. In the case of the first requirement, a period needed to be chosen. Based on previous research it was recommended to pick a larger sample, hence a period of 10 years. While it is true that it does not contain many observations, it contains several credit events due to financial difficulties experienced by an economy in recovery. A credit event is defined as a change in the rating of the reference entity provided by the rating agency, either in the form of an upgrade or a downgrade. Previously, S&P ratings were transformed into numerical values to quantify the effects of an event study and define accurately what type of event the obligations were experiencing. The sample contains overall slightly more negative credit events in the presence of a struggling economy. These credit-rating events are used for both asset classes in the study, thus, establishing a relationship between CDS and stock markets.

For the second requirement, both stock prices and CDS spreads were obtained. In an event study it is common to use equity prices, however, CDS spreads have slightly different assumptions. Spreads serve as a proxy for recognizing value so it can be used as part of an event study. To some extent, the second condition is more challenging, since not all companies present complete quotations. The latter situation particularly important when dealing with indexes. In the case of missing values, there are approaches for an exemption to be made. One can assume CDS constant using the latest value and applying it for the missing days. Another option assumes CDS spread to be linear thus, using linear regression to estimate the intermediate values as a form of data imputation. The latter method is preferred, but both method are established as valid by Hull et al. (2004).

5.1. Design of event study

First, the event time day zero is defined as a day in which a particular type of rating event occurs, downgrade, or upgrade. For example, the downgrade experienced by 3M to AA- on the 18 of March 2009.

Second, event windows are constructed. Based on previous literature, these are wide enough to cover a diverse array of effects. It is opted for a period of 90 days before and 90 days after the event. The procedure is duplicated for every sample firm containing an event.

Third, an estimation window needs to be constructed. Traditionally, this is done by taking observations 200 days before the event windows itself begins. The importance of estimation windows in some cases is overstated given that no significant change can be derived out of a change in the length of the estimation window nor closeness to the event window (Krivin et al., 2005). The day of the event is not included in the estimation window. In the sampling period, it is only analyzed event windows that display different event types at an individual firm level. Hence, the risk of overlap between two subsequent windows is minimized. According to Norden & Weber (2004), one reason why overlapping windows should not be problematic is that it is expected for announcement effects to exist around the event at day zero, not at the boundaries of the event window.

The most important phase of the event study is the calculation of abnormal returns. For every time interval, abnormal stock returns are calculated together with mean adjusted CDS spread changes sorted by event type. Abnormal returns are calculated following two interchangeable methods: index-adjusted and market model adjusted. The equations are shown below. The first method is calculated as the difference between observed returns for the instrument and benchmark returns from an index (1). The second method utilizes alpha and beta factors to capture the residual part of the returns. Strictly speaking, to observe what part of the returns are attributable only to the reference entity (2). Both processes can be applied to both asset classes.

Stock-index adjustment: $AR_i = R_i - R_{bm}$ (1)

Market-model adjustment: $AR_{it} = R_{it} - \alpha_i - \beta_i R_{mt}$ (2)

For equity, in both processes, the index used is the S&P 500, representative of North American companies. The parameters α and β were calculated using closing prices and closing index prices. For CDS, the methodology is slightly more complicated.

In contrast to Hull et al. (2004) that uses the average of the daily CDS spread throughout the period as an index, this study uses an index for the rating class extracted by Thomson Reuters directly, adjusted for missing values and relating to either investment grade or high yield provided by Dow Jones CDX. It is applied to the period, in line with the previous methodology used by Norden & Weber, that proposed this method as an alternative. After abnormal returns are calculated, cumulative abnormal returns (CAR) for stocks are calculated adding the daily abnormal returns to draw inferences for the event of interest and for observations regarding gain or loss over multiple period event windows. Cumulative abnormal spread changes (CASC) are calculated following the same procedure but in this case for abnormal spread changes. Equations for CAR and CASC are shown below.

$$CAR_{i[t_1;t_2]} = \sum_{t_1}^{t_2} AR_{it}$$

$$CASC_{i[t_1;t_2]} = \sum_{t_1}^{t_2} ASC_{it}$$

Per previous literature, multiple time windows are constructed. The windows used are [-90, -61], [-60, -31], [-30,2], [-1,1], [2,30], [31,60] and [61,90]. These windows were also utilized in research made by Norden & Weber in 2004 and Finnerty in 2013. As can be seen, these windows are constructed in this way to show the development of both markets (CDS and stocks) at a monthly period. It also allows for observation of the reaction of prices and spread changes both before and after the event in question.

Regarding operationalization, multiple variables are created. A dummy variable is created for the type of event the obligations are facing. The variable takes the value 0 for upgrades and 1 for downgrades. Likewise, a dummy variable is created to distinguish investment tranches and see effects by class. The variable takes the value of 0 if the obligation takes on a rating within the investment grade class, and 1, if taken within the speculative range. As specified before, the barrier of classes is established at an S&P equivalent rating of 13 (BB+) for the highest-rated high yield bonds, and at a rating equivalent of 14 (BBB-) for the lowest-rated investment-grade obligations.

5.2. Univariate testing

To test the significance of the abnormal returns in my event study and analyze the size and direction of the reaction, a one-sample t-test, Wilcoxon sign test, and sign rank test are conducted. As a parametric test, the t-test assumes normal distribution for the returns, in practice, this does not happen often and to account for that, non-parametric tests are used. Nonparametric tests offer a more relaxed assumption in case these are not met. The most concerning assumption is the normality assumption, given the sample is random and the dependent variable is continuous. As the sample is large enough, this assumption should present a problem, nonetheless, it is noteworthy to present the significant value these non-parametric tests bring to the research.

The null hypothesis to test is that the cumulative abnormal returns (CAR) and the cumulative abnormal spread change (CASC) equal 0. For the parametric t-test, the null hypothesis states that the cumulative abnormal returns mean are equal to zero. The alternative hypothesis states that mean of CAR is different from zero. A two-tailed t-test is used. For Wilcoxon non-parametric, I categorize the credit events in upgrades and downgrades.

5.3. Regressions

Cumulative abnormal returns are used as the dependent variable different factors that may provide a significant explanation. The model is built using the variables that establish whether a downgrade or an upgrade has occurred, which class they belong to, and several indicators for size and debt. The last variable is introduced to give insight into the intuition regarding spreads and risk, which can be applied to stock for motives of consistency. Attributes such as the size of firms, determined by either market capitalization or total assets, their outstanding debt, capture by several financial ratios can be an explanation for cumulative abnormal returns in the case for both asset classes.

The model to analyze is the following, containing multiple sizes and debt indicators for stock markets:

$$CAR_i = \beta_0 + \beta_1 DOWNGRADE + \beta_2 DTAR + \beta_3 MARKETCAP + \beta_4 TOTALASSETS \\ + \beta_5 NDTE + \beta_6 TDTE + \beta_7 DTTC + \epsilon_i$$

The model for CDS markets is the following, with the inclusion of rating class:

$$CASC_i = \beta_0 + \beta_1 DOWNGRADE + \beta_2 CLASS + \beta_3 MARKETCAP + \beta_4 TOTALASSETS + \beta_5 DTAR + \beta_6 NDTE + \beta_7 TDTE + \beta_8 DTTC + \epsilon_i$$

The variables are added stepwise to both models to explain the CAR and CASC over the significant event windows.

6. Results

6.1. Univariate results for CDS spreads

In this section, the results for the CDS behavior in response to credit rating announcements are reported. Overall, mixed evidence is found for the first and second hypotheses. The expectations were set to find significant abnormal returns in the case of downgrades and a smaller, possibly non-significant abnormal returns in the case of upgrades. The evidence found at a superficial level is shown in Table 3. Downgrades throughout the sample have negative mean cumulative abnormal spread changes, except for the window capturing the announcement effect around the event. Likewise, upgrades have a positive mean CASC, apart from the event window [2,30].

Table 3: Mean cumulative abnormal spread changes for event windows classified by event

	Downgrades		**Upgrades**	
Event Windows	**Mean**	**Std. Err.**	**Mean**	**Std. Err.**
[-90,-61]	-0.0056	0.0085	0.0128	0.0130
[-60,-31]	-0.0022	0.0152	0.0160	0.0126
[-30,-2]	-0.0268	0.0095	0.0221	0.0196
[-1,1]	0.0041	0.0066	0.0179	0.0103
[2,30]	-0.0465	0.0099	-0.0039	0.0085
[31,60]	-0.0503	0.0100	0.0017	0.0084
[61,90]	-0.0120	0.0135	0.0101	0.0083

Concerning the CDS market, with a focus on downgrades, the evidence is mixed for hypotheses 1 and 3. This is expected to be significant compared to a positive rating as a result of the existence of an asymmetry effect. Cumulative abnormal spread changes are tested using t-test, non-parametric Wilcoxon sign tests, and Wilcoxon sign rank tests to analyze whether abnormal returns are significantly different than zero. The null hypothesis under the t-test is that CASC is equal to 0. The null under Wilcoxon's test is that the median equals 0.

On one hand, CASC is significant for most windows, however, these are located mostly after the event. CDS market shows significant abnormal performance for downgrades 30 to 2 days before the event. Table 4 shows contradicting results regarding the announcement effect, as significant abnormal performance is found in the window [-1,1], only when using non-parametric tests. Based on previous literature, this market was expected to some degree to anticipate the credit rating event. And while true, since markets anticipate rating changes 30 to 2 days before the event, most of the significant abnormal performance is focus on the period posterior to the event. This evidence weighs in by implying that markets react after rating changes. CASCs are significantly different than zero in the event windows [2,30], [31,60], and [61,90] at a 5% significance level minimum for most of the tests. CDS markets exhibit significant abnormal performance within all interval posterior to the event.

Table 4: CDS reaction around downgrades

	[-90,-61]	**[-60,-31]**	**[-30,-2]**	**[-1,1]**	**[2,30]**	**[31,60]**	**[61,90]**
N	618	618	618	618	618	618	618
Mean	-0.0056	-0.0022	-0.0268	0.0041	-0.0465	-0.0503	-0.0120
Std. Err.	0.0085	0.0152	0.0095	0.0066	0.0099	0.0100	0.0135
Std. Dev.	0.2125	0.3772	0.2350	0.1649	0.2460	0.2481	0.3347
t-test	-0.6498	-0.1459	-2.8340	0.6200	-4.6966	-5.0416	-0.8945
p-value	0.5161	0.8841	0.0047***	0.5355	0.0000***	0.0000***	0.3714
Sign test p-value	0.7769	0.8085	0.0001***	0.0430**	0.0099***	0.0001***	0.0195**
Sign rank p-value	0.8897	0.1892	0.0023***	0.0127**	0.0001***	0.0000***	0.007***

***p<=0.01 **p<=0.05 *p<=0.1

For the case of upgrades, expectations were low since most research agrees with the fact that upgrades do not carry any significant informational content. As table 5 shows, in line with previous research, interval windows are not significant at any level in the case of upgrades. It can argue that this provides evidence into the asymmetry effect since reactions for downgrades are larger and significantly different than zero in contrast to upgrades.

Table 5: CDS reaction around upgrades

	[-90,-61]	[-60,-31]	[-30,-2]	[-1,1]	[2,30]	[31,60]	[61,90]
N	474	474	474	474	474	474	474
Mean	0.0128	0.0160	0.0221	0.0179	-0.0039	0.0017	0.0101
Std. Err.	0.0130	0.0126	0.0196	0.0103	0.0085	0.0084	0.0083
Std. Dev.	0.2832	0.2737	0.4273	0.2239	0.1847	0.1839	0.1811
t-test	0.9805	1.2712	1.1282	1.7397	-0.4594	0.2064	1.2116
p-value	0.3274	0.2043	0.2598	0.0826	0.6461	0.8366	0.2263
Sign test p-value	0.8169	1.0000	1.0000	0.0949	0.3097	1.0000	0.3568
Sign rank p-value	0.5161	0.794	0.7561	0.4716	0.445	0.6068	0.1788

***p<=0.01 **p<=0.05 *p<=0.1

Given that expectations from the literature review were for the CDS market to anticipate the effects of credit ratings, this research delves into investment classes and separates both downgrades and upgrades responses by class. This is done in order to show possibly different reactions in the case of a downgrade and upgrade for differently rated obligations. The null hypothesis for the t-test used in this section is as before, CASC equal to 0.

Table 6: High yield rated CDS behavior around downgrades

Windows	[-90,-61]	[-60,-31]	[-30,-2]	[-1,1]	[2,30]	[31,60]	[61,90]
N	363	363	363	363	363	363	363
Mean	-0.0203	-0.0134	-0.0484	-0.0084	-0.0674	-0.0619	-0.0214
Std. Err.	0.0112	0.0239	0.0115	0.0028	0.0129	0.0139	0.0198
Std. Dev.	0.2131	0.4550	0.2187	0.0526	0.2461	0.2648	0.3774
t-test	-1.8194	-0.5608	-4.2187	-3.0510	-5.2138	-4.4560	-1.0807
p-value	0.0697*	0.5753	0.0000***	0.0024***	0.0000***	0.0000***	0.2805

***p<=0.01 **p<=0.05 *p<=0.1

Table 7: Investment-grade rated CDS behavior around downgrades

	[-90,-61]	[-60,-31]	[-30,-2]	[-1,1]	[2,30]	[31,60]	[61,90]
N	255	255	255	255	255	255	255
Mean	0.0155	0.0137	0.0040	0.0220	-0.0168	-0.0338	0.0013
Std. Err.	0.0132	0.0140	0.0159	0.0155	0.0152	0.0139	0.0164
Std. Dev.	0.2103	0.2239	0.2537	0.2481	0.2432	0.2215	0.2623
t-test	1.1771	0.9771	0.2526	1.4137	-1.1003	-2.4334	0.0785
p-value	0.2402	0.3294	0.8008	0.1587	0.2722	0.0156**	0.9375

***p<=0.01 **p<=0.05 *p<=0.1

When divided between investment grade and high yield rated obligations, results are slightly in accordance with expectations for downgrades. For HY obligations, CASC in the interval [-90,-61] shows significantly abnormal performance under a 10% significance level. More importantly, HY registers an announcement effect under a 1% significance level. CDS markets seem to anticipate rating announcements up 90 to 60 days before the announcement and present announcement effect for high yield rated obligations. For IG obligations, results slide towards market reaction, not anticipation. No event windows are significantly different than zero, except for [31,60].

Table 8: High yield rated CDS behavior around upgrades

Windows	[-90,-61]	[-60,-31]	[-30,-2]	[-1,1]	[2,30]	[31,60]	[61,90]
N	236	236	236	236	236	236	236
Mean	-0.0051	-0.0129	0.0139	-0.0022	-0.0135	0.0057	0.0132
Std. Err.	0.0143	0.0132	0.0329	0.0034	0.0131	0.0136	0.0137
Std. Dev.	0.2192	0.2033	0.5057	0.0527	0.2018	0.2087	0.2110
t-test	-0.3543	-0.9773	0.4232	-0.6526	-1.0303	0.4181	0.9577
p-value	0.7234	0.3294	0.6726	0.5147	0.3039	0.6763	0.3392

***p<=0.01 **p<=0.05 *p<=0.1

Table 9: Investment-grade rated CDS behavior around upgrades

	[-90,-61]	[-60,-31]	[-30,-2]	[-1,1]	[2,30]	[31,60]	[61,90]
N	238	238	238	238	238	238	238
Mean	0.0304	0.0447	0.0303	0.0378	0.0057	-0.0022	0.0070
Std. Err.	0.0217	0.0212	0.0216	0.0201	0.0107	0.0101	0.0095
Std. Dev.	0.3344	0.3269	0.3327	0.3106	0.1658	0.1558	0.1460
t-test	1.4032	2.1071	1.4043	1.8799	0.5268	-0.2140	0.7430
p-value	0.1619	0.0362**	0.1615	0.0614*	0.5988	0.8307	0.4582

***p<=0.01 **p<=0.05 *p<=0.1

Concerning the response of obligations to upgrades, the results follow the previous outlook. HY obligations do not provide any significant window. Investment-grade obligations show significance over the interval [-60,31] at a 5% significance level. This can be considered evidence in favor of anticipation by the CD markets.

In summary, the observed CDS market behavior partially consistent with H1 since most interval windows are found to be significant at a general level. Therefore, implying a market reaction response to downgrades. Nonetheless, significantly abnormal performance is already registered up to 30 to 2 days before the event at a general level. When decomposing among IG and HY obligations, the evidence turns mixed. High yield obligations affected by negative ratings show signs of anticipation up to 90 days; while in the case for upgrades, investment-grade CDS show anticipation up to 60 days before the event. In general, the sample implies a reaction partially consistent with H1, when accounting for class differences, this consistency is increased and behaves slightly in line with previous research.

6.2. Univariate results for stock prices

Table 10:Stock market reactions around downgrades

	[-90,-61]	[-60,-31]	[-30,-2]	[-1,1]	[2,30]	[31,60]	[61,90]
N	625	625	625	625	625	625	625
Mean	-0.0019	0.0111	0.0060	-0.0015	0.0174	0.0118	0.0133
Std. Err.	0.0056	0.0057	0.0054	0.0015	0.0054	0.0058	0.0081
Std. Dev.	0.1389	0.1425	0.1348	0.0376	0.1362	0.1459	0.2030
t test	-0.3383	1.9552	1.1050	-1.0162	3.1968	2.0232	1.6398
p-value	0.7353	0.0510*	0.2696	0.3099	0.0015**	0.0435**	0.1016
Sign test p-value	0.8104	0.8729	0.0929*	0.3371	0.0783*	0.3789	0.7490
Sign rank p-value	0.5444	0.6987	0.2612	0.0755*	0.0072***	0.3212	0.5208

***p<=0.01 **p<=0.05 *p<=0.1

In this section, the results for the stock market behavior in response to credit rating announcements are reported. Overall, mixed evidence is found for the first and second hypotheses. The expectations were the same as for CDS spread set to find significant negative abnormal returns in the case of downgrades and the opposite for upgrades.

Table 10 reports the abnormal stock market returns in response to downgrades, like CDS, CAR tested using t-test, non-parametric Wilcoxon sign tests, and Wilcoxon sign rank. The null hypothesis under the t-test is that CASC is equal to 0. The null under Wilcoxon's test is that the median equals 0.

CARs are significant for downgrades in windows [-60,31] at a 5% significance level under non-parametric tests. There is weak evidence for announcement effect, as abnormal performance is significant at a 10% significance level. Posterior event windows show significant cumulative abnormal returns, particularly in a period 2 to 60 days after the event in the case of negative events. These results are in line with Holthausen & Leftwich (1986) and Dichev & Piotroski (2001), both reporting a significant reaction from the stock market in response to downgrades, the latter showing significant abnormal returns during the first 30 days after a downgrade.

Table 11: Stock market reactions around upgrades

	[-90,-61]	[-60,-31]	[-30,-2]	[-1,1]	[2,30]	[31,60]	[61,90]
N	497	497	497	497	497	497	497
Mean	0.0008	-0.0079	-0.0011	0.0024	-0.0109	-0.0091	-0.0086
Std. Err.	0.0053	0.0054	0.0050	0.0013	0.0044	0.0045	0.0045
Std. Dev.	0.1183	0.1214	0.1118	0.0298	0.0984	0.0997	0.1013
t test	0.1450	-1.4502	-0.2198	1.7911	-2.4591	-2.0441	-1.8899
p-value	0.8848	0.1476	0.8261	0.0739*	0.0143**	0.0415**	0.0594*
Sign test p-value	0.2091	0.039**	0.7197	0.2091	0.1063	0.0727*	0.1783
Sign rank p-value	0.5231	0.0158**	0.9482	0.1342	0.0053***	0.038**	0.0658*

***p<=0.01 **p<=0.05 *p<=0.1

Regarding positive events, literature has been clear with the fact that upgrades do not provide any significant abnormal performance. For the sample, that is simply not the case. As seen in Table 11, upgrades provide informational content around and between 2 to 60 days after the event under the t-test. When accounting for non-parametric tests, significant abnormal performance is seen in between 60 to 30 days before the event and in posterior event windows. These results are partially unexpected since previous research such as Pinches & Singleton (1978) has shown anticipation before rating changes as seen in the aforementioned table, most posterior research reaches a consensus that upgrades are simply not significant.

Regarding the first hypothesis testing, evidence partially confirms that markets react directly after or around rating changes because they provide significant informational content. As seen in the tables above, CDS markets at a general level provide a delayed reaction to rating changes, especially for downgrades. However, evidence also suggests abnormal significant performance up to 30 days before the event, partially suggest anticipation. When sorted by investment class, high yield obligations, as well as investment grade, show signs of anticipation up to 90 and 60 days before the event, respectively. Likewise, the stock market partially follows expectations. Stock prices have a delayed reaction particularly to downgrades as previous literature remarks. Overall, H1 cannot be rejected nor accepted.

Regarding the second hypothesis that establishes a comparison of asset classes in terms of speed of reaction, the results are more favorable in comparison. CDS markets react up to 30 days before the event at a general level, and there is slight evidence for reaction up to 90 days before the event for high yield obligations facing downgrades. In comparison, stock prices have a much more delayed reaction between 2 to 30 days after the event, which is significant solely under the t-test at a 5% significance level. There is an abnormal performance around upgrades for stock prices, however, only non-parametric tests capture this significance, which was in the first place unexpected. CDS reaction shows significant performance up to 30 days before the event for both parametric and non-parametric tests under a 1% significance level. These results confirm hypothesis three regarding a faster reaction of the CDS market in comparison to stock.

6.3. Regression results

The following linear regression models have the cumulative abnormal returns in the event window as the dependent variable. The variables used for the different models are based on whether the event experienced is a downgrade, the investment class it belongs to (in case of CDS), market capitalization, total assets, debt to asset ratio, net debt to equity ratio, total debt to equity ratio and debt to total capital ratio. The latter variables are used to search for results concerning the second hypothesis in this research, whether cumulative abnormal returns can be explained in the function of size or debt. Size is captured by variables of market capitalization and total assets extracted through the primary equity related to the obligations. Size indicators are based on the reference entity for both stocks and credit default swaps. Debt is captured by using ratios used to assess the debt capacity of a reference entity. These latter variables are transformed by using the natural logarithm. The most complete model is analyzed for multicollinearity, as the ratio for the VIF index is lower than 10, there is no evidence of multicollinearity.

Regarding stock market reactions after the event, most of the variables are insignificant, apart from DOWNGRADE and DTAR. The event window taken for this regression is [2,30]. The coefficient for the significant variables is 0.0257 and -0.102 respectively. The significance for the variable DOWNGRADE is expected as previous literature emphasized on downgrades carrying informational content to the stock market. For Model 4, which considers the size, debt and downgrades, the indicator for debt in the form of debt to asset ratio (DTAR) and size (MARKETCAP) are significant at a 5% and 10% level respectively. The adjusted R-squared of the models displayed is extremely low overall. The model has low explanatory power as evidence by the mixed R-squared. The results are shown in Table 12.

Table 12: Regression results for stock market reactions for [2,30]. There is evidence in favor of DOWNGRADE and DTAR.

	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6	(7) Model 7
DOWN GRADE	0.0283***	0.0301***	0.0291***	0.0257***	0.0232***	0.0233***	0.0241***
	(0.0070)	(0.0079)	(0.0079)	(0.0083)	(0.0090)	(0.0090)	(0.0091)
DTAR		-0.0033	-0.0050	-0.0102**	0.0005	-0.0010	0.0060
		(0.0031)	(0.0034)	(0.0048)	(0.0132)	(0.0141)	(0.0147)
MARKET CAP			-0.0021	-0.0044*	-0.0047	-0.0045	-0.0039
			(0.0016)	(0.0024)	(0.0033)	(0.0032)	(0.0042)
TOTAL ASSETS				0.0048	0.0052	0.0049	0.0035
				(0.0042)	(0.0050)	(0.0050)	(0.0056)
NDTE					-0.0015	0.0037	0.0014
					(0.0062)	(0.0099)	(0.0100)
TDTE						-0.0063	-0.0012
						(0.0094)	(0.0102)
DTTC							-0.0188*
							(0.0108)
Constant	-0.0109**	-0.0155***	0.0314	-0.0319	-0.0249	0.0082	0.0803
	(0.0044)	(0.0053)	(0.0350)	(0.0729)	(0.0801)	(0.0919)	(0.0974)
N	1,122	878	878	794	651	651	640
R-squared	0.0133	0.0161	0.0175	0.0186	0.0144	0.0149	0.0226

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Other variables are significant between 30 to 60 days after the event. Model 7 contains the highest explanatory power and shows significance for DOWNGRADE, MARKETCAP, DTAR, and TOTALASSETS at a minimum of a 5% level. Other ratios such as net debt to equity ratio (NDTE), total debt to equity ratio (TDTE), and debt to total capital (DTTC) show significance only under a 10% significance level. This is evidence to attribute cumulative abnormal returns posterior to the event to size, debt, and whether concerning the event is a downgrade or an upgrade. Table 13 shows the corresponding results.

Table 13: Regression result for stock market reaction for [31,60]. There is evidence in favor of DOWNGRADE, DTAR, MARKETCAP, and TOTALASSETS.

	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6	(7) Model 7
DOWN GRADE	0.0209***	0.0265***	0.0285***	0.0257***	0.0269***	0.0271***	0.0277***
	(0.0074)	(0.0086)	(0.0087)	(0.0088)	(0.0094)	(0.0094)	(0.0095)
DTAR		-0.0081**	-0.0049	-0.0081*	-0.0444***	-0.0471***	-0.0592***
		(0.0035)	(0.0037)	(0.0046)	(0.0165)	(0.0181)	(0.0199)
MARKET CAP			0.0041**	0.0003	-0.0022	-0.0020	-0.0088**
			(0.0020)	(0.0030)	(0.0041)	(0.0041)	(0.0045)
TOTAL ASSETS				0.0094**	0.0112**	0.0107**	0.0175***
				(0.0045)	(0.0052)	(0.0051)	(0.0055)
NDTE					0.0165*	0.0258*	0.0289*
					(0.0085)	(0.0145)	(0.0147)
TDTE						-0.0111	-0.0231*
						(0.0118)	(0.0134)
DTTC							0.0368*
							(0.0189)
Constant	-0.0091**	-0.0169***	-0.1066**	-0.2426***	-0.2657***	-0.2067**	-0.3055***
	(0.0045)	(0.0060)	(0.0444)	(0.0787)	(0.0833)	(0.0997)	(0.1179)
N	1,122	878	878	794	651	651	640
R-squared	0.0066	0.0139	0.0182	0.0236	0.0338	0.0354	0.0457

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Regarding the CDS markets reaction around the events, an important role is played by the variables that capture the effect of a downgrade and the class of the respective obligation. DOWNGRADE captures the former while the variable CLASS captures the latter. In referring to Model 8, the one with the most explanatory power, both variables present a significant coefficient of 0.0512 and 0.00580, respectively. This is initial evidence that CASC is dependent on downgrades and ratings. The results are presented in Table 14.

Table 14: Regression results for CD reactions for [2,30]

	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6	(7) Model 7	(8) Model 8
DOWNGRADE	-0.0426***	-0.0393***	-0.0484***	-0.0452***	-0.0540***	-0.0507***	-0.0503***	-0.0512***
	(0.0130)	(0.0131)	(0.0137)	(0.0147)	(0.0156)	(0.0170)	(0.0172)	(0.0173)
CLASS		0.0367***	0.0562***	0.0573***	0.0653***	0.0566***	0.0560***	0.0580***
		(0.0134)	(0.0177)	(0.0187)	(0.0186)	(0.0210)	(0.0208)	(0.0208)
MARKETCAP			-0.0052*	-0.0069	-0.0058	-0.0053	-0.0047	-0.0116
			(0.0031)	(0.0042)	(0.0048)	(0.0062)	(0.0062)	(0.0074)
TOTALASSETS				0.0009	-0.0056	-0.0088	-0.0089	-0.0028
				(0.0059)	(0.0075)	(0.0095)	(0.0095)	(0.0100)
DTAR					0.0161*	0.0251	0.0358	0.0294
					(0.0090)	(0.0195)	(0.0224)	(0.0225)
NDTE						-0.0104	-0.0129*	-0.0162**
						(0.0075)	(0.0078)	(0.0081)
TDTE							-0.0052	-0.0097
							(0.0077)	(0.0082)
DTTC								0.0299*
								(0.0169)
Constant	-0.0039	-0.0223*	0.0865	0.0994	0.2377*	0.3222**	0.3452**	0.2605
	(0.0085)	(0.0114)	(0.0657)	(0.1082)	(0.1387)	(0.1627)	(0.1673)	(0.1711)
N	1,092	1,092	1,005	868	722	583	583	572
R-squared	0.0090	0.0157	0.0228	0.0220	0.0365	0.0386	0.0394	0.0421

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

CASC presents different significant independent variables for window [31,61]. There statistically significant evidence for DOWNGRADE throughout the several models. Model 5 shows significance under a 5% level for variables DOWNGRADE, CLASS, and MARKETCAP. Models that incorporate debt ratios carry a particularly bad performance. Ratios for debt are most insignificant, apart from total debt to equity, however, only displaying significant under an α<0.1. Generally speaking, CASC reports favorable results towards variables capturing the event in question, the rating class, and the size of the reference entity.

Table 15: Regression results for CD reactions for [30,61]

	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4	(5) Model 5	(6) Model 6	(7) Model 7	(8) Model 8
DOWNGRADE	-0.0521***	-0.0510***	-0.0597***	-0.0583***	-0.0601***	-0.0603***	-0.0599***	-0.0615***
	(0.0131)	(0.0131)	(0.0141)	(0.0157)	(0.0178)	(0.0200)	(0.0203)	(0.0205)
CLASS		0.0123	0.0365**	0.0394**	0.0461**	0.0318	0.0314	0.0318
		(0.0133)	(0.0174)	(0.0188)	(0.0208)	(0.0230)	(0.0230)	(0.0240)
MARKET CAP			-0.0051*	-0.0115***	-0.0117**	-0.0108	-0.0103	-0.0103
			(0.0030)	(0.0043)	(0.0055)	(0.0074)	(0.0076)	(0.0102)
TOTAL ASSETS				0.0034	-0.0002	0.0011	0.0010	0.0009
				(0.0064)	(0.0093)	(0.0123)	(0.0123)	(0.0133)
DTAR					0.0093	0.0289	0.0376	0.0366
					(0.0105)	(0.0245)	(0.0275)	(0.0286)
NDTE						-0.0171	-0.0191*	-0.0192*
						(0.0106)	(0.0099)	(0.0099)
TDTE							-0.0042	-0.0046
							(0.0100)	(0.0105)
DTTC								0.0045
								(0.0208)
Constant	0.0017	-0.0044	0.0969	0.1642	0.2621	0.2435	0.2621	0.2472
	(0.0084)	(0.0116)	(0.0646)	(0.1215)	(0.1735)	(0.2110)	(0.2121)	(0.2185)
N	1,092	1,092	1,005	868	722	583	583	572
R-squared	0.0133	0.0140	0.0213	0.0225	0.0257	0.0318	0.0321	0.0314

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In summary, taking both markets into account, H3 cannot be rejected. Data confirms that cumulative abnormal returns and cumulative abnormal spread changes are initially dependent on downgrades and rating classification up to a month after the event. However, and possibly due to a market delayed reaction, the dependent variables present sensibility towards variables capturing size between 30 and 60 days after the event. Size plays a stronger role in abnormal performance in stock markets. Variables referring to debt are significantly higher for CDS markets early on. This last result is consistent with previous results concerning H2, that CDS markets react early on, as variables capturing debt are significant 2 to 30 days after the event, while size variables are highly significant only in the posterior event window in the case of stock markets.

7. Conclusions and limitations

In this paper, the behavior of credit default swaps and stock markets in response to credit ratings is investigated during the period 2009-2019. First, it is found that both markets react to announcement ratings, particularly in the case of downgrades. This is partially consistent with previous research, as while ratings carry new information, this was expected to be anticipated and not reacted to according to Hull et al. (2004). When sorting by rating class, results assimilate previous literature as high yield obligations present anticipation effects up to 90 days before the event in the case of downgrades. In general, results are mixed, while there is evidence confirming reaction, anticipation cannot be ruled out.

Comparative analysis for asset classes confirms the hypothesis that CDS markets tend to react faster than stock markets. This is in accordance with previous research presented by Norden & Weber (2004). CDS markets react up to 30 days before the event at a general level, and there is slight evidence for reaction up to 90 days before the event for high yield obligations facing downgrades. In comparison, stock prices have a much more delayed reaction between 2 to 30 days after the event, which is significant solely under the t-test at a 5% significance level. CDS reaction demonstrates success for both parametric and non-parametric experiments under a 1 percent significance range up to 30 days before the case. This result confirms the hypothesis regarding a faster CDS market reaction compared to stock.

Lastly, results regarding attributable explanations for cumulative abnormal returns and spread changes are favorable. The output confirms significant coefficients for both downgrades and rating classifications initially at a range between 2 to 30 days after. Significant coefficients for variables that capture size are shown in posterior event windows. The evidence regarding debt indicators is less significant. Both CASC and CAR can be, to some extent explained, by changes in size indicators, whether the event is a downgrade and the rating class.

It is believed that some of the results may have been unexpected due to data collection. Results presented in the paper only partially follow previous literature. Indicators for size and debt are not available for all reference entities within the sample. Other indicators could have been used. Variables accounting for industry-specific effects could be implemented, as proposed in previous research by Wengner et al. (2015). Spread changes could have been used to forecast possible future credit rating events.

Bibliography

Blanco, R., Brennan, S., & Marsh, I. W. (2005). An empirical analysis of the dynamic relation between investment-grade bonds and credit default swaps. *Journal of Finance*, *60*(5), 2255–2281. https://doi.org/10.1111/j.1540-6261.2005.00798.x

Dichev, I. D., & Piotroski, J. D. (2001). The long-run stock returns following bond ratings changes. *Journal of Finance*, *56*(1), 173–203. https://doi.org/10.1111/0022-1082.00322

Finnerty, J. D., Miller, C. D., & Chen, R. R. (2013). The impact of credit rating announcements on credit default swap spreads. *Journal of Banking and Finance*, *37*(6), 2011–2030. https://doi.org/10.1016/j.jbankfin.2013.01.028

Goh, J. C., & Ederington, L. H. (1993). American Finance Association Is a Bond Rating Downgrade Bad News , Good News , or No News for Stockholders ? Author (s): Jeremy C . Goh and Louis H . Ederington Source : The Journal of Finance , Vol . 48 , No . 5 (Dec ., 1993), pp . 2001-2008 Publishe. *Wiley for the American Finance Association*, *48*(5), 2001–2008.

Hand, J. R. M., Holthausen, R. W., & Leftwich, R. W. (1992). The Effect of Bond Rating Agency Announcements on Bond and Stock Prices. *The Journal of Finance*, *47*(2), 733–752. https://doi.org/10.1111/j.1540-6261.1992.tb04407.x

Hite, G., Warga, A., Financial, S., Journal, A., Jun, M., Jun, N. M., Hite, G., & Warga, A. (1997). *The Effect of Bond-Rating Changes on Bond Price Performance The Effect of Bond Rating Changes on Bond Price Performance*. *53*(3), 35–51.

Holthausen, R. W., & Leftwich, R. W. (1986). The effect of bond rating changes on common stock prices. *Journal of Financial Economics*, *17*(1), 57–89. https://doi.org/10.1016/0304-405X(86)90006-1

Hu, H., Kaspereit, T., & Prokop, J. (2016). The information content of issuer rating changes: Evidence for the G7 stock markets. *International Review of Financial Analysis*, *47*, 99–108. https://doi.org/10.1016/j.irfa.2016.06.012

Hull, J. C., Predescu, M., & White, A. (2004). The Relationship between Credit Default Swap Spreads, Bond Yields, and Credit Rating Announcements. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2173171

Krivin, D., Patton, R., Rose, E., & Tabak, D. (2005). Determination of the Appropriate Event Window Length in Individual Stock Event Studies. *SSRN Electronic Journal*, *February 2018*. https://doi.org/10.2139/ssrn.466161

MacKinlay, A. C. (1997). Event Studies in Economics and Finance. *Journal of Economic Literature*, *35*(1), 13–39.

Norden, L. (2017). Information in CDS spreads. *Journal of Banking and Finance*, *75*, 118–135. https://doi.org/10.1016/j.jbankfin.2016.11.007

Norden, L., & Weber, M. (2004). Informational efficiency of credit default swap and stock markets:

The impact of credit rating announcements. *Journal of Banking and Finance*, *28*(11), 2813–2843. https://doi.org/10.1016/j.jbankfin.2004.06.011

Pinches, G. E., & Singleton, J. C. (1978). The Adjustment of Stock Prices to Bond Rating Changes. *The Journal of Finance*, *33*(1), 29. https://doi.org/10.2307/2326348

Wang, D., Rachev, S. T., & Fabozzi, F. J. (2009). Pricing of credit default index swap tranches with one-factor heavy-tailed copula models. *Journal of Empirical Finance*, *16*(2), 201–215. https://doi.org/10.1016/j.jempfin.2008.08.003

Weinstein, M. I. (1977). The effect of a rating change announcement on bond price. *Journal of Financial Economics*, *5*(3), 329–350. https://doi.org/10.1016/0304-405X(77)90042-3

Wengner, A., Burghof, H. P., & Schneider, J. (2015). The impact of credit rating announcements on corporate CDS markets-Are intra-industry effects observable? *Journal of Economics and Business*, *78*, 79–91. https://doi.org/10.1016/j.jeconbus.2014.11.003