Norwegian School of Economics
Bergen, Spring 2019

The Effect of Credit Ratings on Corporate Financing

Khurram Ibrahim & Jonas Pilath

Supervisor: Tommy Stamland

MSc in Economics and Business Administration

Major in Finance

Executive Summary

In this analysis, we test for potential causal effects of credit ratings on corporate financing behavior. We start by replicating the analysis of Kisgen (2006). Like him, we find significantly negative effects on debt financing for firms that are close to moving to another macro-rating. We are however not able to replicate his findings that also within a micro-rating, firms that are closer to being up- or downgraded are more prudent with regard to debt financing.

We then test for other elements that might influence the link between credit ratings and corporate financing. We find that firms that have a large amount of debt maturing in the near future issue less debt compared to equity than an average firm would do. This is potentially in order to obtain better terms when the reissuance of the outstanding debt takes place.

We also provide concrete estimates for the credit spread change of corporate debt after up- or downgrades at different rating levels. We find that firms who would face a stronger credit spread change after an up- or downgrade are more prudent with debt issuance. This effect is even stronger if we multiply the potential credit spread change with the total amount of debt outstanding. Even after controlling for the economic impact of a credit rating change, we find lower net debt issuance for firms close to moving to another macro-rating. After controlling for overall different levels of debt financing at different credit ratings, only the border between BB and B remains to show such an abnormal effect on financing.

In the last part of the analysis, we try to build a model which precisely values the cash flows implied in a credit rating change. This model does however not lead to a higher explanatory power, most likely due to unavailable data about firms' debt maturities after a five year horizon and the lack of an appropriate discount rate.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

Economic growth in the last two centuries has in particular been driven by large corporations. One important aspect that distinguishes them from traditional, family-owned firms is the requirement for capital from outside investors. Depending on which type of capital they hold, investors have very different interests in a firm. Debt holders are - given the same amount of return - interested in low bankruptcy risk.

Banks typically have the expertise and resources to carry out extensive analyses and monitoring, which allows them to observe the bankruptcy risk with reasonable accuracy. Other debt investors might however not be able to carry out these analyses. An analysis of debt instruments by to many individual investors can even be economically inefficient (Berk and DeMarzo, 2011, p. 235). This is where the credit rating industry steps in, which aims at mitigating the information asymmetry between the managers of a firm and current or potential debt holders by issuing a formal opinion about the likelihood of default and the corresponding expected recovered value under bankruptcy.

What does this imply for a firm? In an extreme case, outside investors only rely on credit ratings and do not perform any fundamental analyses of the issuing firm. Credit ratings are however no perfect measure of credit risk. One problem is that rating issuers are typically prudent and revise credit ratings with a lag compared to the real change in the firm's fundamentals (Kou and Varotto, 2005).

Another problem is that credit rating agencies use a discrete scale for their ratings. The three major rating agencies all subdivide the credit strength of firms which did not default on their credit obligations yet in 8 main categories with in total 20 subcategories (Baker and Martin, 2011, p. 300). This implies that small changes in credit risk within one of the 20 subcategories are not observed by outsiders that rely only on credit ratings.

This might change the capital structure incentives of a firm. While the cost of a firm of reducing marginally its outstanding debt is mostly continuous (for example due to a reduction of the obtained tax shield), the benefits will only discretely materialize when changing credit ratings. This distorts financing decisions compared to a perfect world where all information is shared between all agents.

That many firms do make credit rating considerations is known. For example, in a 2001 survey of 392 CEOs of Fortune 500 companies by Graham and Harvey, 57.1% stated that credit ratings are an important or very important factor that affect the choice of their firm's debt level. The first academic analysis to empirically test the influence of credit ratings on capital structure was Kisgen (2006), who analyzes in particular the behavior of firms which are located on the edges of credit ratings and finds that their behavior deviates from what one would expect without credit ratings.

His analysis focuses in particular on plus- and minus ratings, which refer to ratings that contain a plus (e.g. AA+) or a minus (e.g. AA-), respectively. He argues that due to the mentioned discrepancy between discrete benefits and continuous costs of changing credit ratings, firms with a plus-rating will reduce their debt issuance in order to obtain a relatively cheap upgrade, which will bring larger benefits in terms of financing costs. Likewise will a minus-rated firm reduce its debt issuance, in order to avoid the large discrete increases in financing costs from being downgraded. In his analysis, he does indeed find significantly negative debt issuance behaviors at plus and minus ratings, as well as for firms which inside their specific rating are located close to an up- or downgrade.

Other papers have tried to replicate Kisgen's analysis and taken into account other factors that might influence the relationship between credit ratings and capital structure. For example, Kemper and Rao (2013) expand the sample to find several points that make them conclude that the effect of credit ratings on capital structure is not as strong as Kisgen claimed. One point among others is that they find that the effect is not stronger for firms with higher external financing needs, although these should be the ones that are more subject to effects of credit ratings due to their larger amounts of outstanding debt.

Drobetz and Heller (2014) extend Kisgen's analysis to German firms and find ambiguous results. While replicating Kisgen's analysis on their new sample leads to similar results, the reaction of firms to changes in credit ratings suggests that only the financing behavior of low-rated firms is strongly influenced by credit ratings.

In this analysis, we will carry out a study based on the approach of Kisgen (2006). After introducing our sample and methodology, we will try to replicate the findings of Kisgen on a dataset covering a longer time span. Afterwards, we will consider other aspects which should have an influence on the relationship between credit ratings and capital structure which were not included in Kisgen's study, specifically the term structure of outstanding debt and the implied credit spread change at different credit rating levels.

Chapter 2

Methodological Framework

2.1 Data Source

Similarly to Kisgen's analysis, we will use company data from the Compustat database. It is operated by Standard & Poor's, but is in this case accessed through the Wharton Research Data Services from the Wharton School, which is the business school of the University of Pennsylvania.

All firms for which a credit rating is available are considered. The credit rating used is the Standard & Poor's Domestic Long-Term Issuer Credit Rating. The agency itself defines this rating as a "forward-looking opinion about an obligor's overall creditworthiness" (Standard & Poor's, 2018). This means that the credit rating does not refer to a specific debt obligation, but rather to the creditworthiness of a firm as a whole.

The earliest available credit ratings in Compustat date back to 1985. After 2017, the credit rating database has been discontinued. Since in this analysis we will match firm observations to lagged credit ratings from one year earlier, we are also able to use data from 2018. Thus, the total sample length ranges for the credit ratings from 1985 to 2017, and for the firm-fundamental data from 1986 to 2018.

2.2 Sample Selection Choices

As explained in the introduction, a part of the analysis will be carried out using the same tests as Kisgen (2006). Whenever our analysis yields different results than his study, it is important to understand why these differences arise. One obvious possibility is that the differences are due to the longer time horizon of this analysis, which covers data until 2018, while Kisgen's study's data stops in 2002. Not only does this study thus use 16 more years, but it also covers the financial crisis of 2008/09, which lead to some structural changes in the corporate debt and credit rating markets.

In order to attribute differences from Kisgen's findings to the longer time span, it is important that the methodological background is exactly equal. This can be tested by running the same tests as the author on the same dataset from Compustat, covering the exact same time span. Kisgen uses data from 1985 to 2002. In 2008, Compustat changed its data reporting structure, but legacy data following the old format for observations until 2008 included is available. This can be used to replicate the study of Kisgen, but does not allow to extend the analysis by more than 6 years.

The replication of Kisgen's analysis with the legacy data and the same time span should lead to the same results. However, we encountered difficulties in exactly replicating his findings. These difficulties may stem from sample composition choices, for example:

- **Geographical Composition:** Kisgen states that he uses "all firms with a credit rating in Compustat at the beginning of a particular year" (Kisgen, 2006, p. 1047). He does not state whether he uses the Compustat North America or the Compustat Global database, but only the Compustat North American database contains credit ratings. It is mostly composed of US-American firms, but approximately 8.9% of observations refer to non-US firms. It is not clear whether Kisgen excludes those firms since it is not explicitly stated in his paper.
- **Debt Ratio Restriction:** In the sample summary statistics, Kisgen states that he excludes observations where the book debt to book debt plus book equity ratio lies below 0 or above 1. For the analysis afterwards, it is not mentioned whether or not these observations are taken into account.
- **Firm Size Threshold:** Kisgen does not explain whether he restricts the firm-observations in his sample to having a minimum size. This sample choice consists of several sub-choices: Not only the minimal size has to be established, but also whether book or market values are used as size measure. Moreover, just the specific observations of a firm that fall below the threshold could be excluded, or alternatively all observations of a firm that at least once falls below the threshold.
- **Other Uncertainties:** Kisgen might have carried out other adjustments to the sample that are not specifically mentioned. An example could be controlling for extreme outliers, for example through winsorization.

All these different possibilities can be combined to numerous possible sets of choices, which strongly influence the obtained results. In order to test whether we are able to exactly replicated Kisgen's findings, we first decide on 448 possible and reasonable combinations of the above choices. Then, we automatically compute test results, following as close as possible the methodology described by the author, and compare the results to his findings.

We compute two different scores: One merely based on significance, where we count how many coefficients given the sample choices are obtained with the same sign and significance. For example, a coefficient counts as correct if it is significantly positive in both Kisgen's paper and our test case, while it does not count as correct if it is significantly positive in the paper but insignificant or significantly negative in our case.

A second sore takes into account also the accuracy of the coefficient: For values where the significance is correct, the closeness to the value from the paper is computed, where 100% means that the value is equal to the one from paper. When the obtained coefficient is lower than the one from the paper, we take as score the obtained coefficient divided by the original value. If the obtained coefficient is higher, we use the inverse of the fraction, in order to make sure that a higher accuracy score always implies a coefficient closer to the original value. The formal definition of our accuracy score is thus

$$\text{Accuracy Score} = \min\left(\frac{\hat{\beta}}{\beta_K}, \frac{\beta_K}{\hat{\beta}}\right) = \begin{cases} 1, & \text{if } \hat{\beta} = \beta_K \\ \frac{\hat{\beta}}{\beta_K}, & \text{if } \hat{\beta} < \beta_K \\ \frac{\beta_K}{\hat{\beta}}, & \text{if } \hat{\beta} > \beta_K \end{cases} \tag{2.1}$$

where β_K is a coefficient obtained by Kisgen and $\hat{\beta}$ is a coefficient obtained by us. Since the accuracy score is set equal to zero when the significance of our finding and Kisgen's value are different, the accuracy score has to be always equal or lower than the significance score.

Only American Data	Min Market Cap	Min Book Size	Exclude All	Significance	Accuracy
Yes	-	\$50m	Yes	66.2%	54.8%
Yes	-	\$50m	No	66.1%	56.9%
Yes	\$10m	-	No	65.8%	55.6%
No	-	\$50m	-	65.3%	53.9%

Table 2.1: Extract of the characteristics of the best-scoring replication cases of Kisgen (2006)

Table 2.1 shows the four best-scoring paper replication cases. Even in the best-fitting case, we obtain only roughly two thirds of the coefficients with the same significance as in Kisgen's paper. Among other choices, in this case, firms where the book value of assets falls at least once below \$50m are completely removed from the sample. Moreover, only US-American data is used and no data is winsorized.

It should however still be noted that even with the best-performing approach, we are not able to replicate at least the same significance of more than two thirds of Kisgen's obtained regression coefficients. When making our own sample selection choices, we therefore orient ourselves on what we found to be close to Kisgen's approach during the replication test, but also rely on which choices seem the most reasonable ones.

Among our choices is that we limit our analysis to only American firms. As shown before, the usable sample size is only reduced by 8.9%, but we avoid problems due to structurally different debt markets in different countries. Moreover, there is no need for currency conversion when relying only on US-American data. In addition, we exclude firms with negative book equity values from the analysis.

With regard to the size threshold, we decide to exclude firm-observations with a market capitalization below \$10m, since capital issuances of smaller firms will strongly depend on the possibility to access capital markets and the involved transaction costs. However, only the specific observations that fall beneath the size threshold are excluded, while other observations of the same firm that exceed the barrier are maintained. This is important in order to ensure that there are no biases in the sample that evolve from a certain company growth pattern being excluded.

2.3 Econometrical Approach

The basic empirical design of this study follows what is used by Kisgen (2006). He argues that the discrete changes in financing costs that firms are subject to when passing from one credit rating to another lead firms to adjust their financing behavior. In order to test this, he looks at the net debt issuance of firms in a specific year. He defines it as the net issuance of debt minus the net issuance of equity. This net debt issuance is expressed relatively to firm size, hence it is divided by the total assets of the firm before the beginning of the year.

The exact Compustat fields used in this analysis can be found in Appendix B. With these, the net debt issuance is formally computed as:

$$\Delta NetDebt_{i,t} = ((\underbrace{DLTIS_{i,t} - DLTR_{i,t} + DLCCH_{i,t}}_{\text{Net Debt Issuance}}) - (\underbrace{SSTK_{i,t} - PRSTKC_{i,t}}_{\text{Net Equity Issuance}}))\frac{1}{A_{i,t-1}}. \tag{2.2}$$

It is important to consider the *net* debt issuance instead of the "pure" debt issuance, because in terms of credit risk, the two capital issuances have opposite effects. While additional debt issuances generally speaking put the outstanding debt more at risk, equity issuance reduce the risk because of the higher capital available and the lower priority of equity under bankruptcy. Thus, in terms of credit risk, the effect of a debt issuance can be offset with a sufficiently large issuance of equity. For this analysis, it is however important to understand how firms adjust their financing behavior in terms of implied credit risk, which is the connection between capital structure and credit ratings.

Varying variables are used as dependent variables in order to try to explain the firms' financing decisions. The explanatory variables will typically be supplemented with a set of three control variables, which are supposed to control for structural differences between firms that affect their financing behavior. These are the leverage of a firm (defined as the outstanding debt divided by outstanding debt plus outstanding equity), the earnings before interest, taxes, depreciation and amortization relative to the total assets of a firm and finally the natural logarithm of total sales as a proxy for a firm's size. We decided to use the natural logarithm of sales in our analysis in order to have results comparable to Kisgen (2006). However, our results are robust to using assets instead of sales as proxy for firm size, independently of whether the absolute value or the logarithm is considered. For the sake of readability, the control variables will be aggregated to the vector $K_{i,t}$ when the equation form of a regression is shown.

Chapter 3

Analysis

3.1 Sample Analysis

The final sample that satisfies all requirements consists of 31 070 observations of 3 727 firms. This means that on average there are 8.3 yearly observations of each firm in the sample. 565 firms have only one observation available, while 41 firms are featured over the whole length of the 32 year sample period.

As explained, in this analysis we will focus on the net debt issuance of firms. In order to put this in perspective, it is useful to first look at the overall leverage of the firms in the sample. Leverage will be defined by the amount of outstanding book debt divided by outstanding book debt plus outstanding book equity. The average degree of leverage by credit rating is graphically depicted in Figure 3.1.

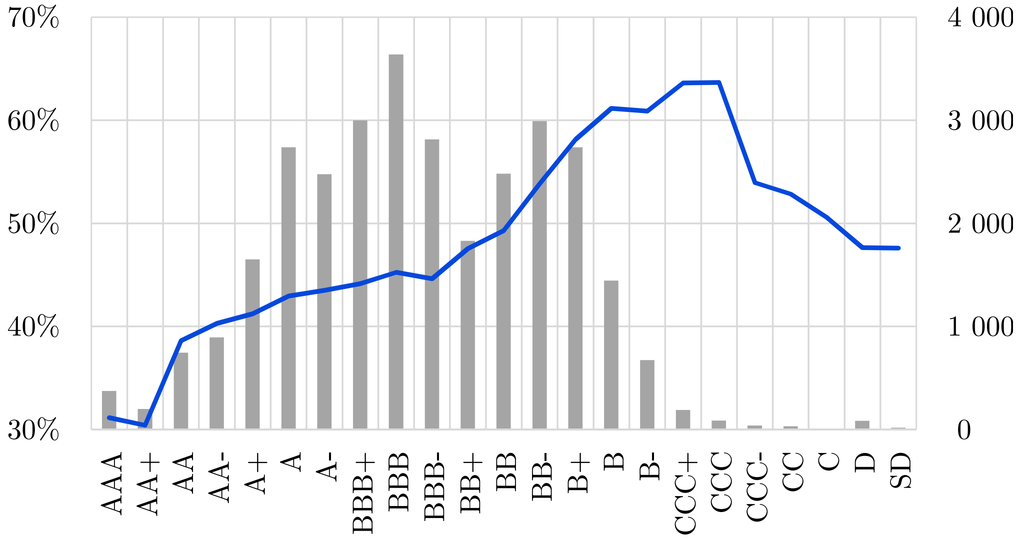

Figure 3.1: Mean leverage (blue line) defined as book $D/(D+E)$, and number of observations (gray bars) by credit rating. Numeric results in Table A.1 on page 55.

It can be seen that the mean leverage increases from sightly over 30% for AAA-rated firms up until over 60% at CCC ratings. Surprisingly, leverage decreases for ratings lower than CCC. This is most likely due to a more difficult access to debt financing markets due to a high bankruptcy risk or already running bankruptcy processes. Standard & Poor's states for example in its definition of the CC rating that it "expects default to be a virtual certainty" (Standard & Poor's, 2018), which explains why these companies struggle to issue debt.

It should also be noted that the amount of observations available (shown by the gray bars) is very low for ratings below B. This means that average statistics by single ratings for these low-rated firms are very vulnerable to single-firm outliers. Finally, there might be other mechanisms influencing the sample of low-rated firms. For example, given the large amount of bankruptcy cases in these rating regions, the sample could be biased due to the fact that it only contains "surviving" companies, which might have a lower amount of outstanding debt than a normal low-rated firm.

With this in mind, the next step is to start looking at the firms' financing behavior. As explained in section 2.3, the analysis focuses on *changes* in capital structure. A change in debt is thus defined as debt issuance minus debt reduction, and similarly for equity. The average amount of net debt and net equity issuance by credit rating is shown in Figure 3.2.

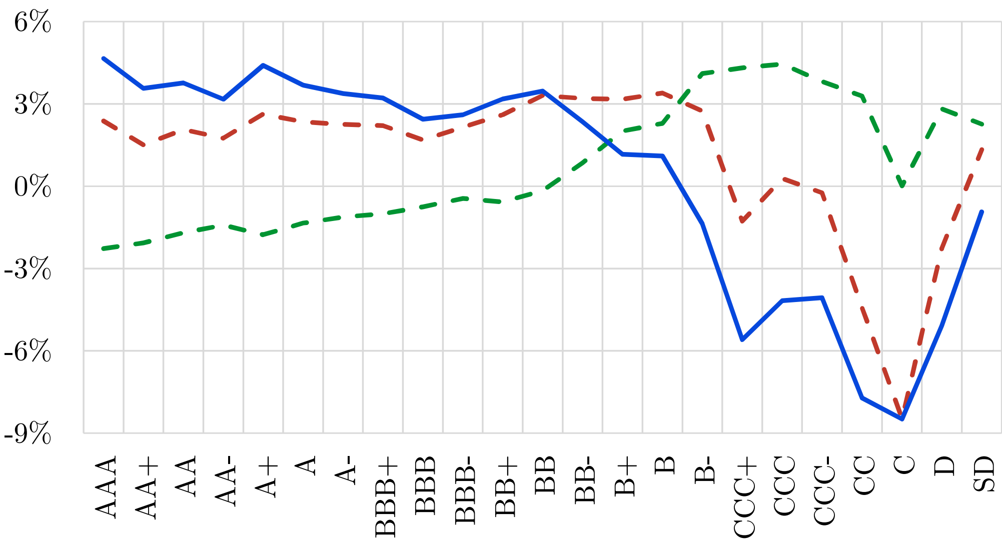

Figure 3.2: Debt issuance (red dashed), equity issuance (green dashed) and net debt issuance (blue) by credit rating. Numeric results in Table A.2 on page 56.

The dashed red line shows the debt change of a firm relative to its outstanding assets. From AAA to B, it is roughly constant, but decreases sharply for firms with lower ratings. This is in line with the earlier claim that the decrease in leverage for low-rated firms might be due to difficulties in accessing corporate debt markets, since these firms do indeed also *issue* much less debt.

The equity change is depicted by the green dashed line. It increases from nearly -3% to over $+4\%$ for CCC-rated firms and decreases afterwards again. Thus, firms with credit ratings over BB do reduce their outstanding equity on average. The fact that lower-rated firms tend to issue more equity than higher-rated firms might also be influenced by the earlier mentioned potential survivorship effects: In order to avoid bankruptcy (which would make the firms drop out of our sample), additional equity might be issued in order to cover the debt holders' claims, coming for example from missing interest payments. This would then explain why the leverage ratio of low-rated firms decreases.

In Equation 2.2, we defined the difference between the debt and the equity issuance as net debt issuance, which will be investigated in this analysis. It is depicted by the solid blue line in the diagram. It decreases slightly between AAA and BB and plummets afterwards. Kisgen (2006) shows a similar diagram, in which he finds that firms with a plus or minus rating issue less net debt than firms with a sign-less rating. He argues that this is evidence of a modified financing behavior because of credit ratings. We cannot visually find a similar pattern here.

3.2 Plus or Minus Test

3.2.1 Aggregated

First, we test whether firms on the edge of being up- or downgraded to the next macro-rating change their financing behavior. With macro-ratings, we refer to the letter part of a credit rating, hence ignoring pluses or minuses. For example, the macro-rating AA coves the micro-ratings AA+, AA and AA-.

As already explained, the analysis is based on the assumption that there are discrete effects on a firm when changing macro-rating, which potentially weigh so strongly on a firm that it adjusts its financing behavior. This is because the benefit from moving to the next-higher macro-rating is claimed to be relatively high compared to the costs associated with reducing the net debt issuance slightly. Similarly, Kisgen (2006) claims that firms with a minus-rating fear to be downgraded to the next-lower macro-rating, since this is also connected to large costs. Firms with a plus or minus rating are thus expected to issue less net debt than firms with a sign-free rating in the middle of a macro-rating.

Whether a firm has a plus or minus in its credit rating will be captured with dummy variables: CR_{POM} is set equal to 1 when the credit rating includes a plus *or* a minus, while CR_{Plus} and CR_{Minus} equal 1 only when the rating features a plus and minus, respectively.

Both the effect of a credit rating with plus *or* minus as well as with distinct plus and minus dummy variables is tested with corresponding models. The earlier introduced control variables are included as well in order to control for confounding effects. In addition, we will also compute the first regression without control variables. From this follows the definition of three regression equations:

$$\Delta NetDebt_{i,t} = \alpha + \beta CR_{POM} + \phi K_{i,t} + \epsilon_{i,t} \tag{3.1}$$
$$\Delta NetDebt_{i,t} = \alpha + \beta_1 CR_{Plus} + \beta_2 CR_{Minus} + \phi K_{i,t} + \epsilon_{i,t} \tag{3.2}$$
$$\Delta NetDebt_{i,t} = \alpha + \beta CR_{POM} + \epsilon_{i,t} \tag{3.3}$$

The regression results are summarized in Table 3.1. At first, the regression is carried out on the entire sample for which the fields required for the computation are available. It is striking that no significant effect of the credit rating sign on financing behavior can be found, neither for aggregate plus and minus variables nor for separate plus and minus variables. Kisgen (2006) argues that this is because when issuing very large amounts of debt, any firm will experience a downgrade to the next macro-rating, no matter where in its macro-rating the firm is located. Therefore, the position of the firm in the macro-rating, approximated by the plus and/or minus variable, is less relevant.

	Full Sample	Excluding Large Debt Offerings	Excluding Large Debt And Equity Offerings
CR_{POM}	-0.0015	-0.0027^{**}	-0.0031^{***}
with controls	(0.0018)	(0.0011)	(0.0009)
CR_{POM}	-0.0023	-0.0053^{***}	-0.0051^{***}
w/o controls	(0.0018)	(0.0012)	(0.0010)
CR_{Plus}	-0.0013	-0.0017	-0.0014
	(0.0021)	(0.0014)	(0.0011)
CR_{Minus}	-0.0017	-0.0037^{***}	-0.0049^{***}
	(0.0021)	(0.0013)	(0.0011)

Table 3.1: Summary of regression results of plus or minus test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.3 on page 57 (unrestricted sample) and Table A.4 on page 57 (restricted sample).

However, it should be considered that a downgrade is not a binomial event. Instead, a firm could be downgraded by just one rating step or by multiple, and the effect of a downgrade is likely to be more significant when a firm jumps several rating steps. A firm located at a minus-rating might therefore fear that it will be downgraded several macro-ratings. Similarly, a firm with a plus-rating might have the chance to be upgraded over several macro-ratings when reducing its net debt issuance. These effects could potentially explain why the coefficients found on the plus and/or minus variables are all negative, even though none of these are significant at a 10% confidence level. We can however not exclude that these negative but insignificant coefficients are not due to other unknown mechanisms.

In order to overcome the issue of potentially very large capital offerings, Kisgen limits the sample to firm-year observations where the total debt issuance does not exceed 10% of total assets, as well as a setting where neither the debt nor the equity issuances account for more than 10% of total assets. The exclusion of large debt offerings reduces the sample size by approximately one third from 31 070 to 20 953. This also has a subtle effect on the composition of the sample: Tendentially, smaller firms seem to make more larger debt issuances compared to firm size. This is shown by a correlation coefficient of total assets with debt issuances divided by total assets of -5.0% and debt issuances to market capitalization of -6.9%. In fact, the average market capitalization in the entire sample is \$10.8b, while it is \$12.7b when omitting large debt offerings.

The exclusion of *equity* offerings exceeding 10% of total assets concerns fewer firms in the sample, precisely 1 085. Also here the excluded firms are on average smaller, but the effect is less strong than for the exclusion based on debt issuances. Combining the debt and equity exclusion leads to a sample size of 20 562, which is 391 less than when excluding only large debt issuances.

With regard to the regression results, the exclusion of large debt offerings leads to the combined plus or minus dummy variable being significantly negative, both when including or excluding the control variables. This seems to indicate that when a firm is closer to changing its macro-rating, it reduces its net debt issuance. When looking at the separate plus and minus variables, only the minus one is significantly negative, showing that the effect of a minus rating is likely to be what drives the combined variable to be significantly negative.

It seems that firms on the lower bound of macro-ratings are concerned about being downgraded and thus adjust their financing behavior, while firms closer to an upgrade to the next macro-rating perceive the potential upgrade to be less valuable. The stronger effect at minus-ratings could for example be because many debt contracts require a firm to maintain a minimum credit rating (Mittoo and Zhang, 2010, p. 585). Hence, being downgraded to a credit rating below what has to be maintained by the firm is connected to high costs, while achieving an upgrade might not have such discrete changes in financing costs.

Another aspect that has to be considered is that the size of the impact of a credit rating change on a firm's financing behavior depends on the amount of outstanding debt. The more outstanding debt a firm has, the more important it is for the firm to signal a low credit default risk to outsiders. A firm should thus be particularly careful about issuing more debt and being downgraded, because the negative effect of having a lower credit rating is enforced by the higher amount of debt. On the other hand, if a firm issues less debt in order to obtain an upgrade, the beneficial effect of a higher credit rating is dampened by the lower amount of outstanding debt. This could explain why the results suggest that firms are careful about being downgraded, but less influenced in their financing behavior when they are close to an upgrade.

When excluding also large equity offerings, the results obtained from the regression models are the same in terms of significances and also similar in terms of magnitude. This is in line with the earlier explanation that the sample composition does not significantly change when excluding also equity offerings, since these occur less frequently. In addition, roughly two thirds of the large equity offerings have already been excluded when excluding large debt offerings.

Kisgen (2006) runs the same test, but on his sample that ends in 2002. He obtains significantly negative coefficients on all credit rating dummy variables, so unlike our findings also on the plus rating variable. One reason why his findings on the smaller sample deviate from our findings with data until 2018 could be because of structural changes as a consequence of financial crises. In Figure 3.3, the annual percentage of up- and downgrades compared to the total credit ratings of Standard & Poor's is shown. Two periods stand out: A large amount of downgrades during the Dot-com crash from 2000 to 2002 as well as many downgrades during the 2008-2009 financial crisis.

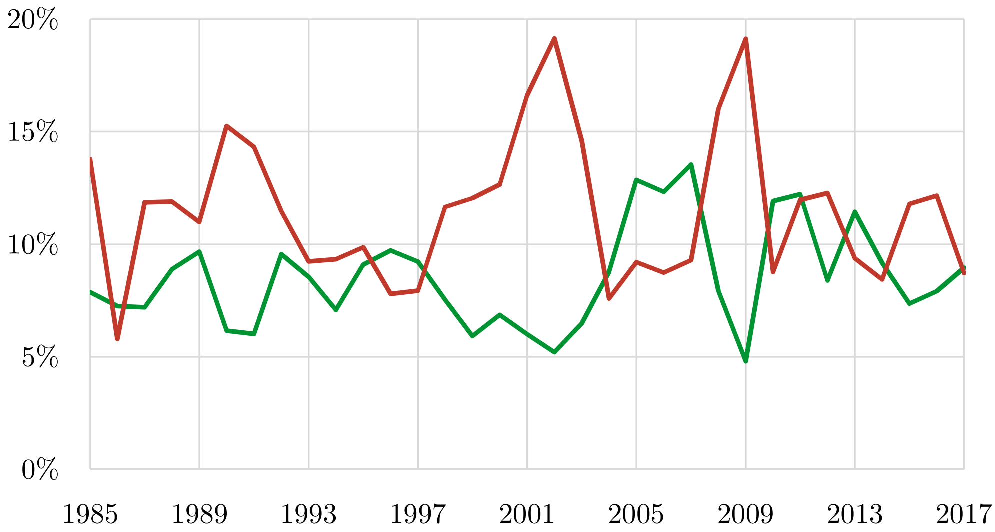

Figure 3.3: Annual percentage of credit rating upgrades (green) and downgrades (red) compared to total Standard & Poor's credit ratings. Data from Standard & Poor's (2019)

Kisgen's dataset stops in 2002, at the end of the Dot-com crash. Due to the large amount of downgrades during the two crises, firms might have anticipated a higher likelihood of downgrades than upgrades after the crises, even though the diagram shows that between the crises, the balance between up- and downgrades was not more unfavorable than before the Dot-com bubble. This could have lead firms to react less strongly to a potential upgrade, which could explain the difference between Kisgen's findings and ours. In addition, there could be other structural changes over time, which lead to our results being different from his.

3.2.2 By Macro-Rating

In order to being able to clearly interpret the obtained coefficients, it is important to understand what is driving these. In case of this credit rating test, it is thus important to understand whether the significantly negative coefficients are driven by the entire sample or rather by some specific credit rating groups. This is tested here by running the regression on samples restricted to the different macro-ratings. The test is run for all macro-ratings from AA to CCC, since AAA and ratings lower than CCC have a sample size which is too low to yield robust results.

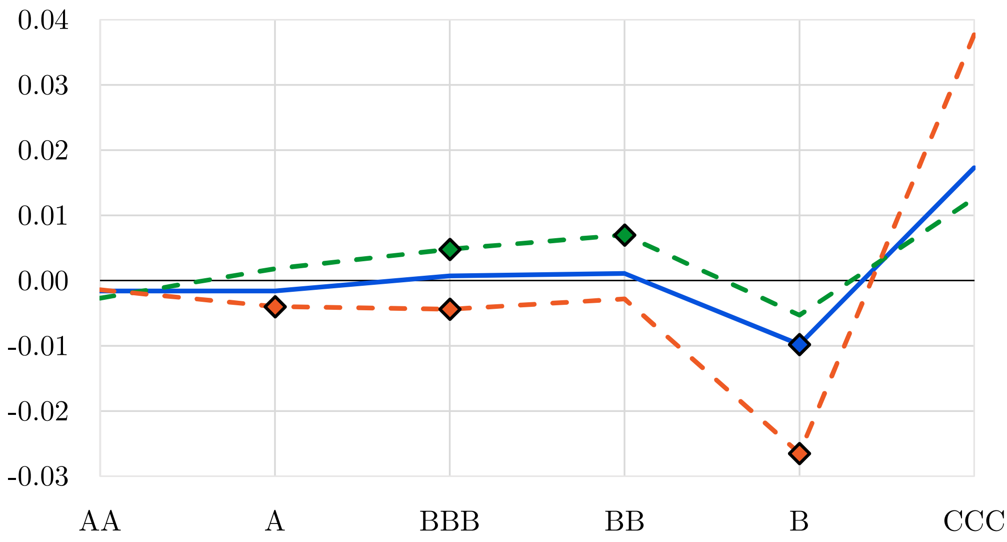

Figure 3.4: Coefficients on CR_{POM} (blue), CR_{Plus} (green dashed) and CR_{Minus} (orange dashed) by macro rating. Rhombuses indicate significance at 5% significance level. Numeric results in Table A.5 on page 58.

The results of this test can be graphically seen in Figure 3.4. The blue line, which illustrates the coefficient on the combined plus or minus dummy variable, is only significantly negative at the B macro-rating, while it is not significantly different from zero otherwise. The plus rating coefficient is larger than the combined one for all ratings between A and B, while the minus coefficient is lower than the combined one in the same rating range. This seems to explain why the combined coefficient levels out around zero. At B, all three coefficients are lower than at higher ratings, which also makes the combined plus or minus variable significantly negative. At CCC, all three increase again, exceeding by far the values reached at higher ratings.

To get a better understanding of the behavior at different macro-ratings, it is also useful to look at the overall net debt issuance pattern at different macro-ratings. In Figure 3.5, the intercepts of the plus or minus regressions for the different macro-ratings are shown. It can be seen that even after controlling for the effects of a plus or minus credit rating, firms below a BBB rating issue less debt the lower their rating. There is no outstanding

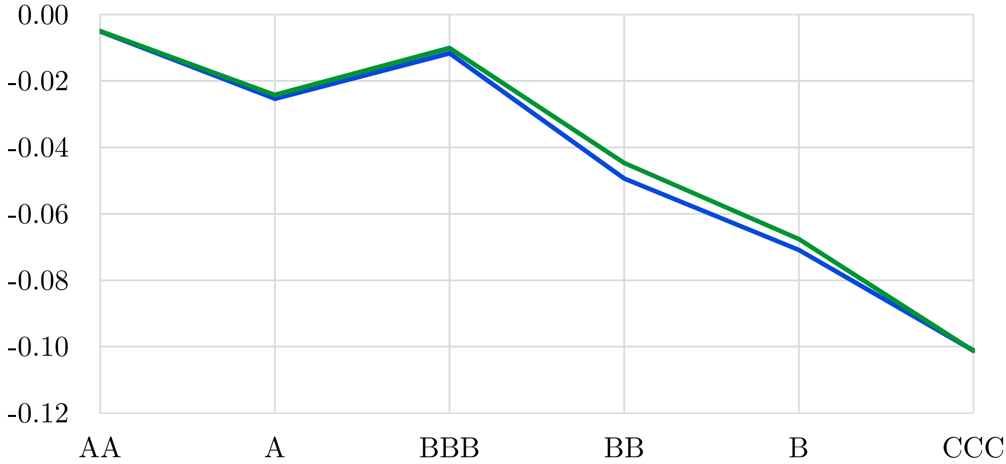

Figure 3.5: Intercepts of macro-rating plus or minus regressions with combined plus or minus variables (blue) and separate plus and minus variables (green). Numeric results in Table A.5 on page 58.

behavior at B or CCC ratings, which are the ones where the coefficients on the plus or minus dummy variables deviated significantly from the results for higher ratings.

At this point, it is therefore not clear why the B and CCC ratings show such different credit rating effects than higher ratings. Both ratings are not neighboring the investment-grade border, which is located between BBB- and BB+. We will discuss the border more in detail in section 3.5.

3.3 Credit Score Test

3.3.1 Aggregated

The analysis of a plus or minus rating on a firm's financing behavior is based on the assumption that a rating change from one macro-rating to another is associated with a stronger impact on a firm's financing costs. However, such a discrete change in financing costs can also be expected to take place at any credit rating change, which lies in the nature of credit ratings. As explained earlier, credit ratings have the function to allow potential investors to get a quick opinion about the expected credit risk of a bond without having to perform costly analyses and monitoring. The mere relying on credit ratings however implies that an outsider will not notice credit risk changes *within* the same credit rating.

Consequently, a firm that finds itself at the lower edge of a credit rating will try to maintain the current rating, since most likely the negative effect from being subject to a downgrade would exceed the positive benefits from issuing slightly more debt. This is because outsiders that rely entirely on credit ratings cannot distinguish between firms within the same micro-rating. As Kisgen (2006) states it, outsiders "pool" all firms within the same rating.

The opposite effect compared to being located in the lowest part of a micro-rating applies for a firm which is at the upper edge of a credit rating: With a relatively low amount of effort, the firm will be able to obtain an upgrade. The benefit of being pooled with the higher rating firms is likely to outweigh the cost of making the own debt slightly safer, for example through debt reductions.

To test whether this hypothesis can be confirmed in the data is more difficult, since we cannot easily observe which firms inside a credit rating are closer to being up- or downgraded than others. Kisgen (2006) uses a credit score model, where he firsts assigns to all firms a numerical rating, based on the credit rating obtained by Standard & Poor's. A AA+ rating corresponds to the numerical rating 18, while CCC- corresponds to 1.

In a second step, observable financial variables are regressed on the numerical equivalent of the firms' credit ratings, in order to understand what seems to drive credit ratings. Kisgen starts with a broad model including seven financial indicators and then iteratively drops variables until only significant ones remain. This results in a model where the credit score of a firm is explained by the natural logarithm of its assets, the EBITDA relative to its assets as well as the outstanding debt relative to the total capitalization.

From our sample, we compute our credit score model following the same procedure as Kisgen, which is:

$$CreditScore = 1.620 + 2.411 \log(A) + 7.125 EBITDA/A - 2.487 Debt/TotalCap. \quad (3.4)$$

The coefficients in our credit score model are different from the ones computed by Kisgen. However, the signs in the equation are equal. We further proceed with our own credit score model. Performing the analysis based on the same credit score equation as Kisgen leads however to similar results.

Using Equation 3.4, a credit score for each firm can be computed. Then, firms are sorted by their credit score within their micro-rating. The dummy variable CR_{High} will then be 1 for firms within the highest third of credit scores within their rating, while CR_{Low} is 1 for firms in the lowest third. Similarly to the plus or minus test, the dummy variable CR_{POM} will be 1 if a firm is in the highest *or* the lowest third.

With these new variables, a credit rating test similar to the one from the plus or minus test can be carried out. The corresponding regression equations are thus:

$$\Delta NetDebt_{i,t} = \alpha + \beta CR_{HOL} + \phi K_{i,t} + \epsilon_{i,t} \quad (3.5)$$

$$\Delta NetDebt_{i,t} = \alpha + \beta_1 CR_{High} + \beta_2 CR_{Low} + \phi K_{i,t} + \epsilon_{i,t} \quad (3.6)$$

$$\Delta NetDebt_{i,t} = \alpha + \beta CR_{HOL} + \epsilon_{i,t} \quad (3.7)$$

A summary of the estimated coefficients on the credit score dummy variables can be seen in Table 3.2. When carrying out the regressions on the unrestricted sample, none of the explanatory variables of interest are significantly different from zero, which is similar to the plus or minus test. The reason for this was that when large capital offerings take place, firms will be subject to a macro-rating change no matter where in their macro-rating they are located. In order to observe differences depending on where inside a micro-rating a firm is located, we have to again exclude large capital offerings from the sample.

	Full Sample	Excluding Debt Offerings > 10%	Excluding Debt Offerings > 5%	Excluding Debt & Equity Offerings
CR_{HOL}	-0.0020	0.0001	0.0006	-0.0019^{*}
with controls	(0.0018)	(0.0014)	(0.0015)	(0.0010)
CR_{HOL}	-0.0027	-0.0001	0.0007	-0.0021^{*}
w/o controls	(0.0019)	(0.0014)	(0.0016)	(0.0011)
CR_{High}	-0.0031	-0.0076^{***}	-0.0061^{***}	-0.0048^{***}
	(0.0025)	(0.0016)	(0.0017)	(0.0013)
CR_{Low}	-0.0009	0.0080^{***}	0.0074^{***}	0.0012
	(0.0024)	(0.0020)	(0.0022)	(0.0014)

Table 3.2: Summary of regression results of high or low test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.6 on page 59 (unrestricted sample), Table A.7 on page 59 (excluding debt offerings) and Table A.8 on page 60 (excluding debt and equity offerings).

An important difference between this test and the plus or minus test is that here, we exploit differences between micro-ratings instead of macro-ratings. Again, we have to exclude large capital offerings so that a firm does not change its rating after an offerings independently from where within it it is located. But now, the size threshold is much smaller, since we look at micro-ratings, which are by definition only one third as "wide" as macro-ratings. Therefore, Kisgen (2006) suggests to exclude not only debt offerings exceeding 10% of total assets as in the plus or minus test, but also those exceeding 5%.

The regression results obtained when excluding debt offerings over 10% of total assets compared to excluding at 5% are similar in terms of significances and close in terms of size. The combined high and low variable is found to be insignificant, which seems to be due to the fact that the high variable is significantly negative, while the low variable is significantly positive.

The significantly negative coefficients for the high variable confirms what we have expected, since following the reasoning a firm close to being upgraded might be willing to take the small extra effort in order to benefiting from the higher credit rating. However, it seems surprising that the findings suggest that a firm close to being downgraded issues significantly more debt, which would put the firm at an even higher risk of obtaining the lower credit rating.

The significantly positive coefficient on the low credit score had not been found by Kisgen. We were not able to replicate his result, even after limiting the sample to the same time span as he has and following closely what the replication test from section 2.2 had shown to yield the closest results to his. Moreover, we tried to construct the credit scores both from the model we obtained in Equation 3.4 as well as the credit score model reported in his paper. We can therefore not conclude that the difference between our results and his results are due to structural changes after his sample end in 2002, for example due to the financial crisis.

Unlike Kisgen, we also construct a sample where debt and equity offerings larger than 10% of total assets are excluded, in order to compute results given the same restrictions as in the plus or minus test. By doing so, the sample size is reduced by only roughly 2% comparing to excluding only debt offerings larger than 10% of total assets, because large equity offerings are much less frequent than large debt offerings. Furthermore, large equity offerings that occur in the same year as large debt offerings have already been removed when large debt offerings were removed.

Unlike the samples where only large debt offerings where excluded, the combined high or low credit score variable is now significantly negative, which indicates that firms closer to being up- or downgraded are more prudent when issuing net debt. The earlier result that firms at the lower end of a credit rating issue significantly *more* net debt is also not found again, since the coefficient now results insignificant.

It might seem counter-intuitive that the net debt issuance decreases after excluding large equity offerings, since large equity offerings reduce the net debt issuance. However, it has to be considered that the intercept is higher after excluding large equity offerings, which implies that firms overall issue more net debt after excluding large equity offerings, which again is consistent with what one would expect.

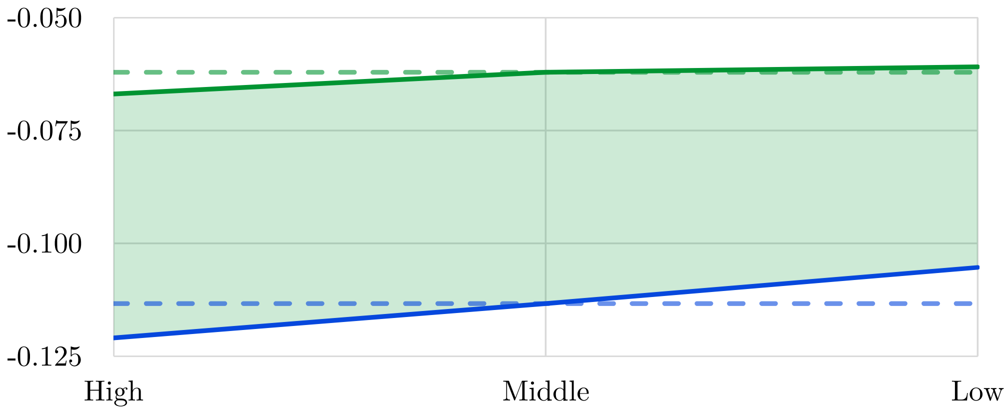

Figure 3.6: Change of net debt issuance (sum of high or low variables and intercept) from sample excluding only large debt offerings (lower blue line) to sample excluding both large debt and equity offerings (upper green line).

In order to understand better what the change in coefficients based on the sample specification implies, it is beneficial to make use of a visualization. In Figure 3.6, net debt issuance at high, middle and low credit rating thirds is shown. The blue line on the bottom refers to the sample where only large debt offerings are excluded, while the green line shows the sample which excludes also large equity offerings.

We consider here the sum of the intercept plus the high or low coefficients, since this allows us to see what effect the exclusion of large equity offerings has from the sample. In fact, we see that the net debt issuance increases for all three thirds when excluding also large equity offerings. This makes sense, since equity offerings *reduce* the net debt issuance.

The effect of the sample restriction on the high or middle third credit score thirds is relatively similar. This can be seen on the dashed lines, which allow to compare the high and low thirds with the middle one. The distance between the high value and the dashed line does not change by much between the two sample specifications. On the low third credit ratings, the effect of the sample restriction is much smaller, as can be seen by the difference between the two values shown by the light green area, which is thinner at the low credit third. Large equity offerings seem to be less prominent for firms which have a low position in their credit rating and are hence close to being downgraded. This is exactly against the intuition, since one would expect that those firms are more worried about being downgraded and thus have a stronger preference for equity rather than debt offerings compared to firms positioned higher in their credit rating. This shows again that our results from the credit score test are not in line with what Kisgen (2006) has first hypothesized and then empirically found.

3.3.2 By Macro-Rating

Similarly to the plus and minus test, it is also for the credit score test beneficial to understand whether the found effect on the financing behavior is caused by all credit ratings in the same way, or rather heterogeneously from just some macro-ratings. In order to test this, the sample is again subdivided into subsamples based on the different macro-ratings and the regressions are carried out on these. The regression results are graphically presented in Figure 3.7 on page 25.

It can be seen that the results are very different depending on which macro-rating is considered. The coefficients on high credit scores are shown by the green dashed line. At AA, firms seem to issue less net debt when they are close to being upgraded. At A and BBB, the effect is the opposite: Firms which are close to being upgraded issue actually *more* net debt, which in practice reduces their chance of obtaining an upgrade.

For firms in the lowest credit score third (shown by the red dashed line), the found coefficients move in the opposite direction. At A and BBB, firms issue significantly less net debt when being close to a downgrade, while firms rated BB and below issue

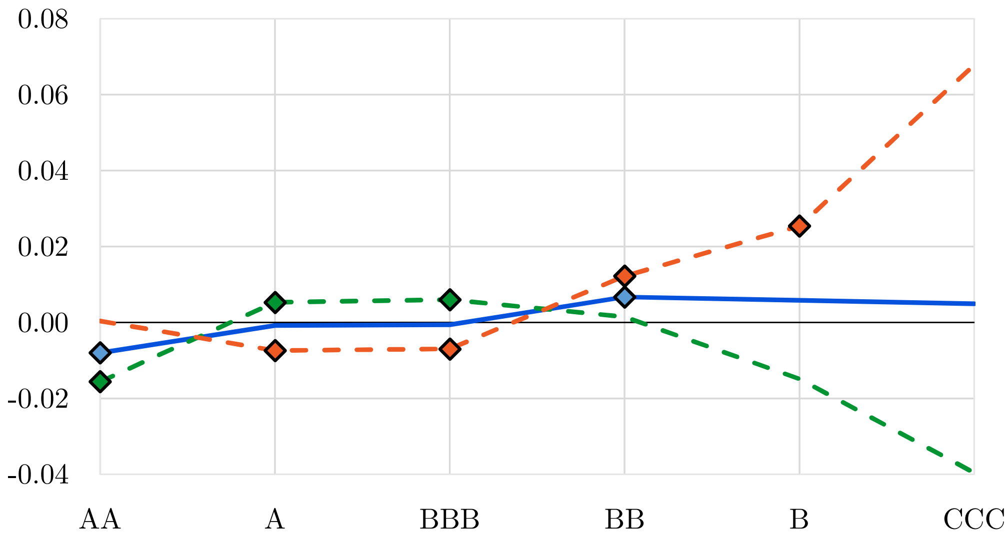

Figure 3.7: Coefficients on CR_{HOL} (blue), CR_{High} (green dashed) and CR_{Low} (orange dashed) by macro rating. Rhombuses indicate significance at 10% significance level. Numeric results in Table A.5 on page 58.

significantly more net debt. Also here, our results deviate from the ones from Kisgen, who found all credit score third coefficients for the different macro-ratings to be either insignificant or significantly negative.

3.4 Interaction of POM and HOL

As explained earlier, the plus or minus test is based on the assumption that there is a discrete change in financing costs that a firm incurs when moving from one *macro*-rating to another, while the high or low test exploits potential discrete changes between *micro*-ratings.

If firms really take these changes into account and adjust financing behavior accordingly, they should be especially careful about financing when being very close to an upgrade to the next macro-rating. This applies especially to firms which have a plus rating and are in the highest third of their micro-rating. Similarly, firms in the lowest third of a minus rating should also be particularly careful, since they seem to be positioned on the edge of a downgrade to the next macro-rating level.

Contrarily, firms in the lowest third of a plus rating and in the highest third of a minus rating should be less concerned about financing than the earlier mentioned ones, since for them a credit rating change would only imply a *micro*-rating change, which is expected to have a smaller impact on financing costs than a *macro*-rating change.

Whether there really is a difference in financing behavior between these types of situations can easily be tested in the data with the usual framework. Interaction terms between the plus and/or minus variables with the high and/or low variables are introduced in the regression equations. Hence, we also compute now coefficients for firms in the highest third of plus rating, in the lowest third of a plus rating, in the highest third of minus rating and in the lowest third of a minus rating.

	With controls			Without controls		
	CR_{HOL}	CR_{High}	CR_{Low}	CR_{HOL}	CR_{High}	CR_{Low}
CR_{POM}	0.0017			0.0006		
	(0.0028)			(0.0029)		
CR_{Plus}		0.0060	0.0024		0.0034	0.0037
		(0.0037)	(0.0040)		(0.0034)	(0.0037)
CR_{Minus}		−0.0010	0.0006		−0.0042	−0.0010
		(0.0035)	(0.0038)		(0.0036)	(0.0039)

Table 3.3: Summary of regression results of interaction test with plus or minus variables and high or low variables. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.9 on page 61.

As before, we compute regression results with and without control variables on a sample that excludes debt offerings larger than 10% of outstanding assets. The obtained results are summarized in Table 3.3. It can be seen that none of the interaction terms results statistically significant. The one which is closest to reaching statistical significance is the interaction of a plus credit rating with a high third credit score, which accounts for a p-value of 0.1025. However, this coefficient is close to being significantly *positive*, which is against what has been expected beforehand. These results seem to confirm the earlier finding that the inclusion of the high or low credit score test did not give any new meaningful insights.

3.5 Investment-Grade Border Test

It could be seen in the macro-rating tests carried out so far that the effects of credit ratings on financing vary heavily by rating. Hence, it is important to look at differences between different credit ratings. One border between two macro-ratings stands out from the others, which is the so-called investment-grade border between BBB- and BB+. Firms with a credit rating of BBB- or above benefit from a so-called investment-grade credit rating, while lower ratings are called speculative-grade rating.

The difference between the two rating classes is not a merely quantitative one, indicating that one simply has a lower default probability than the other. There are also structural differences. For example, many institutional investors, like pension funds, are subject to a regulatory framework that does not allow them to invest in speculative-grade bonds (Langohr and Langohr, 2008). Hence, firms are not only expected to have a lower bankruptcy risk by outsiders when having at least a BBB- rating, but the firms' access to financing as a whole is also facilitated.

It could thus be expected that firms have a stronger incentive to stay at BBB- instead of BB+ than staying at the next-higher rating at any other macro-rating border. In order to test whether this can be found in the data, Kisgen (2006) tests for abnormal net debt issuances at the investment grade border. The regression setting is the same as used earlier, however instead of including dummy variables for *any* plus or minus ratings, just ratings around the investment-grade border are included in the dummy variable. The specification is first held narrowly at BBB- and BB+, which are the credit ratings just around the border. In a second step, the analysis is slightly widened, taking into account the ratings BBB, BBB-, BB+ and BB, hence accounting for two ratings at each side of the investment grade border.

It could be though that an eventual negative coefficient on the investment-grade border dummy variable is simply negative because the corresponding ratings contain a plus or minus, since it was shown in the plus or minus test in subsection 3.2.1 that a plus or minus rating generally corresponds to a lower net debt issuance. Therefore, the regressions are also computed including the combined plus or minus dummy variable from before, which is supposed to control for generally negative net debt issuance behaviors at plus or minus ratings. Taking this into account, the regression equations are thus

$$\Delta NetDebt_{i,t} = \alpha + \beta CR_{IG/SG} + \phi K_{i,t} + \epsilon_{i,t} \tag{3.8}$$

$$\Delta NetDebt_{i,t} = \alpha + \beta_1 CR_{IG/SG} + \beta_2 CR_{POM} + \phi K_{i,t} + \epsilon_{i,t}, \tag{3.9}$$

where $CR_{IG/SG}$ corresponds either to the narrow or the wide specification of the investment grade border ratings.

	BBB- and BB+		BBB to BB	
$SR_{IG/SG}$	-0.0038^{**}	-0.0028^{*}	-0.0045^{***}	-0.0057^{***}
	(0.0015)	(0.0016)	(0.0011)	(0.0012)
CR_{POM}		-0.0021^{*}		-0.0043^{***}
		(0.0012)		(0.0012)

Table 3.4: Summary of regression results of investment-grade border test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.10 on page 62.

Table 3.4 summarizes the regression results. The investment-grade border coefficient always results significantly negative, independently of whether it is specified narrowly or widely. This also holds when it is controlled for the overall negative net debt issuance behavior at plus or minus ratings. It seems thus that firms are really more careful about their debt issuance behavior around the investment-grade border than at other macro-rating borders.

Despite the obtained results, it is unclear whether this is a qualitative difference because of the structural differences mentioned earlier that take place at this border, or whether the difference is only quantitatively large because of higher financing costs below the border. In subsection 3.7.4, we will try to test which of these applies.

3.6 Term Structure Tests

3.6.1 Including in Regression

A very well-known capital structure theory is the so-called trade-off theory. Myers (1984) explains that following the theory, a firm chooses its optimal level of debt by balancing the positive effects of leverage, in particular the interest tax shield, with the downsides of leverage, in particular bankruptcy costs. Myers states that after having reached the optimal debt-equity ratio, there is no incentive anymore for a firm to change its debt level.

If it holds that firms keep their debt level constant, and it is assumed that firms did already reach their target debt level in the past, then firms will only issue debt each year at the same amount as the debt that matures in that specific year. By doing so, the overall outstanding debt is kept constant. This of course holds only if also the amount of equity is kept constant and there are no other underlying changes in the firm, such as size and risk of future cash flows. By assuming that this holds, the only issuances of debt will occur at maturity of the already outstanding debt to replace it. Hence, firms can perfectly anticipate how large the required debt issuances in the future will be and when they take place, since the term structure of the own debt is known already before maturity.

How does this relate to the analysis of credit ratings? This can be understood when looking at the mechanism through which one would expect that credit ratings influence a firm's financing behavior. When the credit rating of a firm changes, a firm is likely to having to pay a different credit spread afterwards. The credit spread that a firm pays on already issued debt is instead normally fixed. The credit spread can either be implicit, for example in zero-coupon bonds through the issuance price, or explicit, for example in bank loans.

Hence, the credit spread that a firm pays will only change when the debt is re-issued, unless specific debt covenants are part of the corresponding contracts, which for example require the involved parties to renegotiate the debt terms. This means that under the assumptions given earlier, firms with significant amounts of debt maturing soon will be more concerned about having a high credit rating, since the change in financial cash flows will occur earlier. Due to discounting, the effect of a rating change will therefore be larger with more debt maturing soon.

This analysis crucially relies on the assumption that there is actually a causal effect of credit ratings on the credit spread of a debt instrument. Moreira and Zhao (2018) find such a causal relationship. They explain that the effect exists in particular at the issuance of the debt instrument, and not so much during the subsequent trading phase. This is sufficient for this analysis, since we do in fact consider the effect of the credit rating at the issuance of the (refinanced) debt.

It will be tested whether the data confirms that firms with more debt outstanding have a stronger link between credit ratings and financing behavior. To do so, the amount of debt maturing in one year, abbreviated as $DD1$, is introduced as explanatory variable into the usual regression setting. In order to put the maturing debt level into perspective with regard to the firm, it is divided by the total outstanding assets. $DD1$ is not only used as standalone explanatory variable, but also as interaction term with plus and / or minus as well as high and / or low dummy variables, since also the effect of a certain credit rating on financing should depend on the amount of debt maturing soon.

Plus or Minus Test	1	2	3	4
Separate Plus / Minus	Yes	No	Yes	No
$DD1/A$	-0.1346^{***}	-0.1346^{***}	-0.0102^{**}	-0.1022^{**}
	(0.0309)	(0.0309)	(0.0408)	(0.0408)
$CR_{POM} * DD1/A$			-0.0549	
			(0.0533)	
$CR_{Plus} * DD1/A$				-0.0894
				(0.0737)
$CR_{Minus} * DD1/A$				-0.0163
				(0.0507)
High or Low Test	**1**	**2**	**3**	**4**
Separate High / Low	Yes	No	Yes	No
$DD1/A$	-0.1195^{***}	-0.1117^{***}	-0.1226^{**}	-0.1198^{*}
	(0.0341)	(0.0341)	(0.0619)	(0.0621)
$CR_{HOL} * DD1/A$			0.0053	
			(0.0696)	
$CR_{High} * DD1/A$				0.0007
				(0.0695)
$CR_{Low} * DD1/A$				0.0300
				(0.0877)

Table 3.5: Summary of regression results of term structure test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.11 on page 63 (Plus or minus test) and Table A.12 on page 64 (High or low test).

The results of these tests are summarized in Table 3.5. The coefficient found on $DD1/A$ is significantly negative, indicating that firms tend to reduce their net debt issuance in a year when they have large amounts of debt maturing in the period afterwards. The interaction term with a plus or minus rating is however insignificant, which implies that the reduction takes places at all kinds of ratings, and not just at border to other macro-ratings.

We also compute the regression in combination with the high or low credit score test, in order to test for potential different influences of large amounts of debt maturing soon on current net debt issuances when a firm is close to a micro-rating change. The respective results are shown in Table A.12 on page 64. Also in this case, the amount of debt maturing in the next year has a significantly negative coefficient on the current net debt issuance. The interaction term with the position within the micro-rating is however again insignificant. This could be because there is simply no influence of whether a firm is close to a rating change, or because of general difficulties in computing a meaningful credit score, as already experienced earlier.

The question is now whether the significantly negative coefficient of debt maturing in one year can really be attributed to a firm's hope to obtain favorable terms in the subsequent year. In order to get closer to the answer, we have to look also at alternative possibilities. One is that debt maturities in firms could simply be "cyclical", which means that firms would have years of large debt amounts maturing following years with much lower amounts reaching maturity. Assuming that firms refinance their debt immediately, this would lead to a situation where large amounts of debt maturing next year negatively correlate to debt issuances in the previous year, which could explain the coefficient found.

Whether this is the case can be tested by regressing the amount of debt maturing in a year on the amount maturing the year afterwards, while controlling for firm fixed effects and scaling by total assets. The latter one is necessary since different firms have different levels of debt, which in itself will influence how much debt matures each year. This corresponds to the regression equation

$$\underbrace{\frac{DD1_{i,t}}{A_{i,t}}}_{\text{Debt maturing}} = \alpha + \beta \underbrace{\frac{DD1_{i,t-1}}{A_{i,t-1}}}_{\text{Debt maturing in previous year}} + \underbrace{\sum \gamma_i X_i}_{\text{Firm-fixed effects}} + \epsilon_{i,t}. \tag{3.10}$$

The regression results are shown in Table 3.6 on page 31. The coefficient found on the previous year debt maturing is significantly positive even after controlling for firm-fixed effects. This rules out the possibility explained before, which implied that the negative coefficient found on the amount of debt maturing next period on the net debt issuance in the previous period could simply be a result of negatively correlated debt maturities in consecutive periods. The finding makes it more likely that the negative effect of debt maturing next period on the current period's net debt issuance is really caused by financial considerations of the respective firm.

Moreover, in order to test the validity of our term structure test, we can look at whether it really holds that firms issue more debt in years where more debt matures, which is suggested by our earlier-mentioned immediate-refinancing assumption. To test this, we can compute a regression similar to the previous one, where we include the amount of debt issued in a year as dependent variable. We use the one-period lagged amount of debt maturing, since maturing debt is a forward-looking measure. Therefore, the lagged

Firm-fixed effects	No	Yes
Intercept	0.0184^{***}	0.0233^{**}
	(0.0002)	(0.0095)
$DD1_{t-1}/A$	0.1977^{***}	0.0482^{***}
	(0.0043)	(0.0047)

Table 3.6: Regression results of debt maturity autocorrelation test from Equation 3.10. Dependent variable: $DD1_t/A_t$. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

amount of maturing debt in one period and the not-lagged (backward-looking) amount of debt issued together cover the same period. The resulting regression equation is hence:

$$\underbrace{\frac{DLTIS_{i,t}}{A_{i,t}}}_{\text{Debt issued}} = \alpha + \beta \underbrace{\frac{DD1_{i,t-1}}{A_{i,t-1}}}_{\text{Debt maturing}} + \underbrace{\sum \gamma_i X_i}_{\text{Firm-fixed effects}} + \epsilon_{i,t} \tag{3.11}$$

As can be seen in the regression results in Table 3.7, the coefficient of debt maturing on debt issued in the corresponding year is significantly positive. However, after controlling for firm-fixed effects, the coefficient decreases to 0.0515, implying that if a firm has \$100m of debt maturing in one year, it will on average only issue additional debt worth \$5.15m in that period.

Firm-fixed effects	No	Yes
Intercept	0.1276^{***}	0.0737
	(0.0018)	(0.0584)
$DD1_{t-1}/A$	0.2701^{***}	0.0515^{*}
	(0.0286)	(0.0286)

Table 3.7: Regression results of debt issuance and maturity test from Equation 3.11. Dependent variable: $DLTIS_t/A$. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

The link between debt maturing and new debt issuances is therefore not as direct as stylized before. One reason could be that firms maybe not always refinance immediately. When for example debt matures in December, but the refinancing takes place in January, the operations do not occur in the same year and are thus not captured by the regression. Moreover, there are many other factors that influence debt issuance behavior, for example the existence and size of profitable investment opportunities.

Still, there is a positive effect of debt maturing on debt issued. That the relationship is not 1:1 does not remove the validity from our earlier analysis of the effect of future debt maturing on present net debt issuance under consideration of the credit rating. Since there is a positive relationship, firms will on average still account for future debt refinancing when taking financing decisions, which was confirmed by our earlier analysis. This takes place even though on average only around 5% of debt is refinanced immediately, because still there is a higher expected debt issuance when debt matures and firms can thus be expected to aim at achieving favorable financing conditions.

3.6.2 Division in Subsamples

Now, an alternative way of controlling for the amount of debt maturing soon is considered. Instead of including the amount of maturing debt as regression coefficient, the dataset can be subdivided in two subsamples based on whether the amount of debt maturing next year divided by total assets is lower or higher than the total sample's median. By doing so, separate coefficients on the effect of credit ratings on capital structure can be computed and interpreted. For the two separate subsamples, the regressions of the plus or minus test from Equation 3.2 and the high or low test from Equation 3.6 can be estimated as before.

	Plus or Minus Test			High or Low Test	
$DD1/A$ above median	No	Yes		No	Yes
Intercept	-0.0692^{***}	-0.0998^{***}	Intercept	-0.1005^{***}	-0.1439^{***}
	(0.0096)	(0.0075)		(0.0123)	(0.0114)
CR_{Plus}	-0.0015	-0.0016	CR_{High}	-0.0051^{**}	-0.0109^{***}
	(0.0020)	(0.0020)		(0.0023)	(0.0022)
CR_{Minus}	-0.0051^{***}	-0.0024	CR_{Low}	0.0081^{***}	0.0124^{***}
	(0.0019)	(0.0018)		(0.0025)	(0.0033)

Table 3.8: Summary of regression results of plus or minus and high or low test, where sample is subdivided firms with lower and higher than median long-term debt maturing in one year divided by total assets. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.13 on page 65.

The respective regression results are summarized in Table 3.8. The plus coefficient does not substantially change from one to the other subsample, but the minus coefficient is only half as strong in the subsample with above median debt maturing next period. These results are in contrast to what one would expect, since firms should care more about their credit rating when they will have to refinance large amounts of debt soon.

In the high or low test, the coefficient on the high third credit score variable doubles in magnitude and becomes more strongly negative, which is in line with what would be expected. However, the low third coefficient, which was already surprisingly positive in the aggregate dataset, is now approximately 50% larger and thus even more positive.

These findings show that the amount of debt maturing soon seems not to influence how much firms consider their credit rating when making financing decisions. This is the same what had already been found before when including the amount of debt maturing in one year as interaction term with the credit rating dummy variables, which had been found to be insignificant. However, the earlier test had found a significantly negative effect of the debt maturing next period on net debt issuance as stand-alone explanatory variable, without considering the credit rating. This is also reflected in the subsample test shown in Table 3.5, since the intercept for firms with above median debt maturing soon is for both tests significantly lower than for firms below the median.

3.7 Credit Spread Test

3.7.1 Spread Curve Construction

Most of the tests carried out so far treated all credit ratings equally, implying that a (macro-)credit rating change would have the same impact on a firm, no matter at what rating. Only the investment-grade border test in section 3.5 focused specifically on the change from BBB- to BB+ ratings and viceversa. The question remains whether there is only this qualitative difference due to investment restrictions for speculative-graded firms and there is thus no difference between the other rating changes.

In this section, we will construct an approximation variable of the economic impact of a credit rating change, in order to account for potential differences in impact on a firm's financing costs at different ratings. We will then test whether this is a significant driver of financing behavior. We will start by computing the average credit spread that firms at different credit ratings pay.

The first step that we have to take is computing an implicit interest rate that a firm pays for every observation in the dataset. This is more difficult than it might seem, since the paid interest can take many different forms. For example, a classic bank loan will normally require a periodic interest payment throughout the whole lifetime of the obligation, while a zero-coupon bond does not pay any interest after its issuance, but its interest arises "implicitly" from the difference between issuance price and face value.

Without data on the debt structure of the different firms in the sample, it is not possible to precisely classify and treat all outstanding debt. Since we will only use the implicit interest as regression variable to test whether it is a significant driver of financing behavior, the computation of it will be simplified here in order to make it possible given the data that is available. We will treat all outstanding debt equally for the sake of computing the implicit interest rate, without considering its type of maturity structure.

We use the Compustat field *XINT*, which states the total interest incurred by a firm in a given period. This should be divided by the average outstanding debt of a firm during the respective year, but this value is not available. We therefore use the arithmetic average between the outstanding debt before the year and after the year. The field *XINT* covers interest both on long-term and short-term interest, so we also divide by the sum of outstanding long-term and short-term debt. Compustat allows also to extract the separate long-term debt interest, but the field is only available for a very small sample of firms, which is not large enough in order to robustly estimate results.

Given this approach, we estimate the implicit interest rate incurred by a firm in a specific year as

$$IntR_{it} = \frac{2 * XINT_{it}}{LongDebt_{it} + LongDebt_{it-1} + ShortDebt_{it} + ShortDebt_{it-1}}. \tag{3.12}$$

We now compute a linear regression model on the implicit interest rates with dummy variables for all credit ratings. We control for year-fixed effects in order to account for different general interest levels in different years, for example through changes in government bond rates as base levels for interest computation. Technically, it would be more correct to compute time-varying rating effects, since not only the risk-free rate changes over time, but also the specific credit spread by rating. However, this would lead to a too low sample size for robust coefficient estimation. The respective regression model we use is thus:

$$IntR_{it} = \alpha + \sum_{R=AA+}^{D} \beta_R X_R + \sum_{t=1985}^{2018} \gamma_t X_t + \epsilon_{i,t} \tag{3.13}$$

The rating AAA is omitted as dummy variable in order to choose it as base level for the other dummy variable estimates. The other ratings' coefficients thus reflect the time-fixed average credit spread relative to AAA. In the following, we only consider ratings of CCC- and above, since lower ratings have a too low number of observations in order to estimate reasonable coefficients. The estimated credit spreads are visually shown by the green line in Figure 3.8, while the number of observations per rating is indicated by the gray bars.

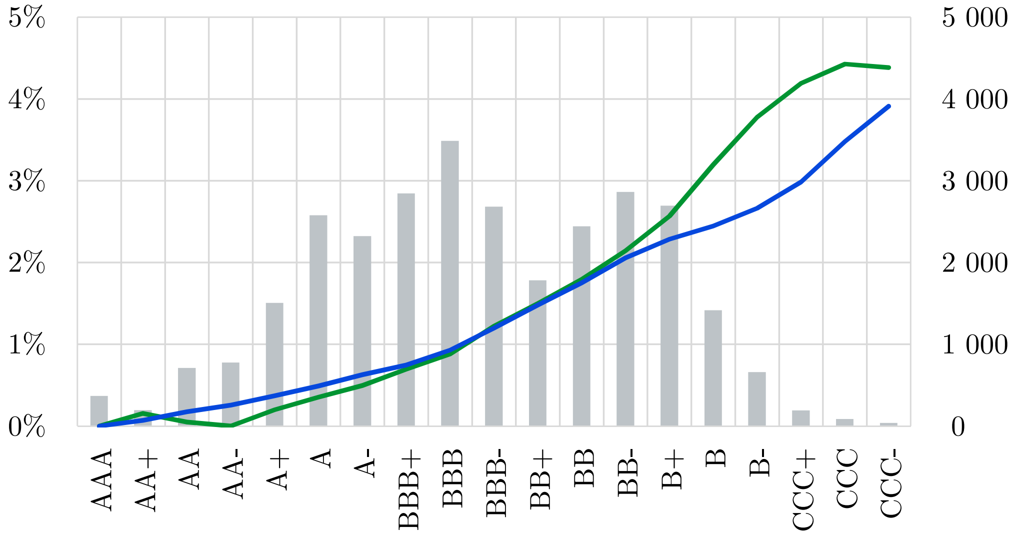

Figure 3.8: Raw (green) and smoothed (blue) credit spread curve and number of observations (gray bars) by micro-rating. Numeric results in Table A.14 on page 66.

What can be seen in the diagram is that the obtained unadjusted credit spread does not strictly increase by rating. The ratings at which this applies are tendentially the ones with a lower amount of observations. The irregular shape of the credit spread curve might therefore be caused by measurement inaccuracies due to small samples.

For the analysis, it will be important to have a strictly increasing credit spread curve, since it is assumed that a firm will have to pay a higher credit spread after being downgraded, not a lower one. We therefore smooth the credit spread curve using a rolling average which uses the number of observations as weight. We use a width of 3 to both sides, which in this specific situation seems to provide the best trade-off between large samples (and thus a smooth and strictly increasing curve) and small enough samples in order to allow for differences in the slope of the curve, which will be exploited later on. The equation used to compute the smoothed credit spread can be expressed as:

$$SmoothedSpread_R = \frac{1}{\sum n_r} \sum_{r=R-3}^{R+3} Spread_r * n_r \tag{3.14}$$

When there are not three observations available to the side, the spreads taken into account are reduced accordingly. As an example, the spreads taken into account to compute the smoothed AA+ spread range from AAA (AA+ plus one) to A+ (AA+ minus three).

In a second step, we subtract the smoothed credit spread of AAA from all smoothed credit spreads, so that the smoothed AAA spread is equal to zero, and the other spreads are again expressed relatively to AAA. The respective results are depicted by the blue line in Figure 3.8 on page 34. It can be seen that the blue smoothed curve is strictly increasing, which is what we wanted to achieve.

3.7.2 Spread Change Test

When analyzing the effect of a possible future credit rating change on financing behavior, the absolute value of the credit spread is irrelevant, because only the *change* in credit spread will be reflected in incremental or decremental financing cash flows of a firm. The possible spread changes to the next higher and next lower rating can easily be computed by subtracting the respective spreads from each other. In order to facilitate interpretations, we use the absolute value of all credit spread changes. A credit spread change to the next higher rating is therefore expressed as positive number, even though the spread decreases. The obtained credit spread changes are depicted in Figure 3.9 on page 36.

The green curve in the diagram shows the potential upwards change of a credit spread (hence the difference between the next higher rating and the current rating) by rating, while the red line shows the same for downwards changes. What is striking is that the credit spread change is relatively constant from AAA to A- and then more than doubles in size for ratings from BBB+ to B+. After B, the credit spread change increase again and reaches the highest values.

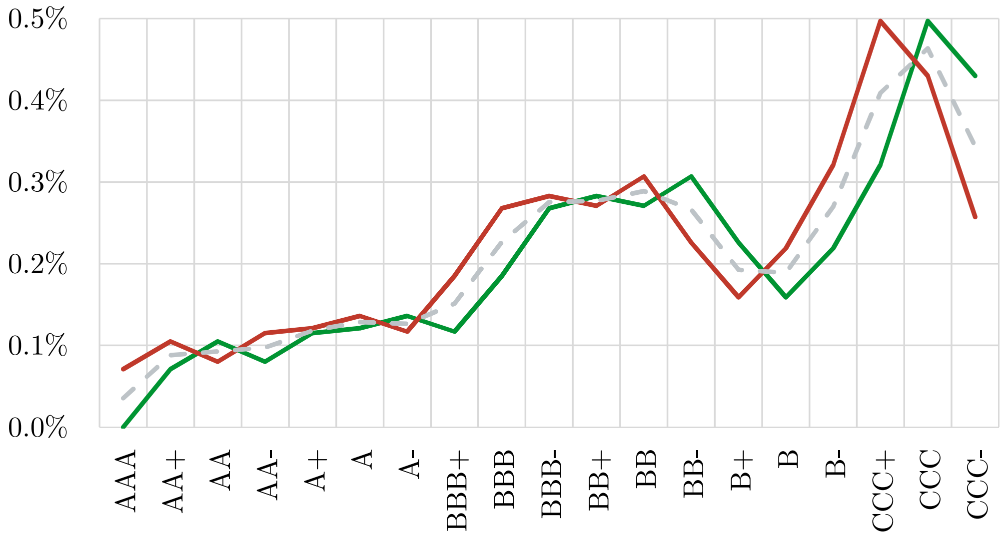

Figure 3.9: Upwards (green), downwards (red) and average (gray dashed) credit spread change by micro-rating. Numeric results in Table A.14 on page 66.

It can thus be seen that at the investment-grade border between BBB- and BB+ credit spread changes are indeed higher than average. However, the high change in credit spread does not only occur at the border itself, but also at neighboring ratings from roughly BBB to BB-. Moreover, the credit spread change for CCC ratings is even higher than around the investment-grade border. If we ignore for a moment eventual qualitative effects of credit rating changes (for example the earlier mentioned investment restrictions for speculative-grade ratings), then there seems to be no reason why a firm should be more worried to cross the investment-grade border at BBB- to BB+ than being downgraded for example from BB+ to BB.

The larger the credit spread change is at a certain rating, the stronger should the incentive of a firm be to obtain a higher rating or at least maintain the current one. This is because of two reasons. On the one hand, a large potential upside change provides an incentive to obtain an upgrade and benefit from a significantly lower credit spread. On the other hand, a large downside change presents a threat of incurring a significantly higher credit spread when being downgraded, and firms should thus be particularly careful about worsening their creditworthiness.

Plus or Minus Test

In order to test whether this holds in the data, we regress the net debt issuance of firms in the sample on their respective potential credit spread change. We are also interested in understanding whether the credit spread change might explain why we found out with the plus or minus test in section 3.2 that firms tend to issue less net debt when they have a plus or a minus in their credit rating. We therefore include also the plus or minus dummy variables in the regression models. Furthermore, we also compute interaction terms between these dummy variables and the credit spread change variables, in order to see whether an eventual effect of a plus or minus rating is stronger when the credit spread change is large.

We compute the regressions first with the combined plus or minus dummy variable. Corresponding to that, we use the average credit spread change, which we define as the arithmetic mean between an upwards and downwards credit spread change. It is shown by the gray dashed line in Figure 3.9. In a second step, we compute the regression with separate plus or minus dummy variables and thus also separate upwards or downwards credit spread changes. We compute the interaction terms for plus ratings with upwards credit spread changes and minus ratings with downwards credit spread changes. By doing so, we test for firms' financing incentives at macro-rating borders taking into account the expected credit spread change when crossing such a border. We finally also compute the combined regression without control variables, in order to test whether the control variables maybe drive eventual significant coefficients. Similarly to the earlier tests we carried out, we first compute the regression on a sample in which only large debt offerings are excluded, while we afterwards use a sample which excludes both large debt and large equity offerings.

The regression results are summarized in Table 3.9 on page 38. It is important to note that we rescale the credit spread changes by multiplying with 100. This facilitates interpretation, since now a coefficient of 0.01 means that with a one percentage point spread change, net debt issuance is increased by one percentage point relative to total assets.

The average credit spread change (denoted as $\bar{\Delta}s_{up,down}$) always results strongly significantly negative, independently of the exact regression specification. This means that firms which would incur a strong credit spread change following a rating change will be more prudent with their net debt issuances. This is completely in line with what was hypothesized before.

When the upwards and downwards credit spread changes are included separately from each other, the upwards credit spread change results again strongly significantly negative, while the downwards change does not reach significance. This however does not automatically mean that firms do not consider a potential downwards credit spread change when taking financing decisions. The upside and downside spread changes are strongly correlated, which is reflected by a correlation coefficient of 0.8431. It seems likely that the upside change variable takes on the entire effect on the net debt issuance. In fact, the separate downside change variable is strongly significant when computing the regression without the upside change variable.

It is also interesting to look at what happens to the plus or minus variables. In the initial plus or minus test in subsection 3.2.1, the combined plus or minus variable as well as the separate minus variable had been found to be significantly negative, while the plus variable was negative but not significant. Now, none of these variables results significant anymore, apart from the combined plus or minus variable when omitting control variables.

	Excluding Large Debt Offerings			Excluding Large Debt & Equity Offerings		
	1	2	3	4	5	6
CR_{POM}	-0.0028		-0.0065^{**}	-0.0031		-0.0062^{**}
	(0.0029)		(0.0029)	(0.0025)		(0.0025)
$CR_{POM} * \bar{\Delta s}_{up,down}$	-0.0029		0.0041	-0.0005		0.0070
	(0.0156)		(0.0160)	(0.0128)		(0.0130)
CR_{Plus}		0.0045			0.0015	
		(0.0031)			(0.0025)	
$CR_{Plus} * \Delta s_{up}$		-0.0444^{**}			-0.0191	
		(0.0200)			(0.0151)	
CR_{Minus}		0.0009			-0.0017	
		(0.0032)			(0.0027)	
$CR_{Minus} * \Delta s_{down}$		-0.0067			0.0065	
		(0.0179)			(0.0136)	
$\Delta \bar{s}_{up,down}$	-0.1284^{***}		-0.2302^{***}	-0.1199^{***}		-0.1960^{***}
	(0.0139)		(0.0117)	(0.0123)		(0.0100)
Δs_{up}		-0.1001^{***}			-0.1100^{***}	
		(0.0197)			(0.0137)	
Δs_{down}		-0.0216			-0.0107	
		(0.0170)			(0.0124)	
Controls	Yes	Yes	No	Yes	Yes	No

Table 3.9: Summary of regression results of plus or minus credit spread change test, with spread change under upgrade Δs_{up}, Δs_{down} and average spread change $\Delta \bar{s}_{up,down}$. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.15 on page 67.

The interaction terms of the average credit spread change with the plus or minus variables are in nearly all cases insignificant. The only significant interaction term is between the separate plus variable and the upwards credit spread change, which is significantly negative. It could indicate that there are some discrete macro-rating effects that are not explained by the credit spread change. However, since these are interaction terms, the effects only apply in combination with high credit spread changes.

One aspect that one could think of here are debt contracts whose implied interest rate only changes when a macro-rating border is crossed, which might be the case when specific covenants are part of the debt contract. In such a case, a firm would significantly adjust its financing behavior if it is close to being upgraded to the next-higher macro-rating (and is hence located at a plus-rating) *and* the credit spread change when crossing the macro-rating border is large. Still, this is mostly likely not a frequent case, since normally debt covenants regard downgrades, not upgrades.

All in all, it seems that whether a firm is close to crossing the border between two macro-ratings does not have a large effect on its financing behavior. It rather seems to be the rating-specific potential change in credit spread that determines whether a firm is more or less likely to issue debt instead of equity.

High or Low Test

We would expect that the effect of a high credit spread change is higher when a firm is actually close to being up- or downgraded. Whether the latter one is the case is covered by the high or low credit score test, which was originally carried out in section 3.3. We can carry out a test similar to the plus or minus test with credit spread changes from before, but this time including the high or low dummy variables. We are in particular interested in the interaction terms, since they reflect the underlying hypothesis that the effect of the credit spread change should have the most influence on a firm's financing behavior when the firm is actually also likely to incur the change due to being up- or downgraded.

	Excluding Large Debt Offerings			Excluding Large Debt & Equity Offerings		
	1	2	3	4	5	6
CR_{HOL}	−0.0049		−0.0058	−0.0039		−0.0046
	(0.0036)		(0.0037)	(0.0029)		(0.0029)
$CR_{HOL} * \bar{\Delta} s_{up,down}$	0.0244		0.0254	0.0120		0.0125
	(0.0207)		(0.0214)	(0.0155)		(0.0158)
CR_{High}		-0.0096^{***}			0.0012	
		(0.0034)			(0.0029)	
$CR_{High} * \Delta s_{up}$		0.0325^{*}			−0.0109	
		(0.0196)			(0.0163)	
CR_{Low}		0.0121^{**}			−0.0010	
		(0.0048)			(0.0033)	
$CR_{Low} * \Delta s_{down}$		-0.0453^{*}			−0.0083	
		(0.0236)			(0.0162)	
$\Delta \bar{s}_{up,down}$	-0.1557^{***}		-0.2525^{***}	-0.1316^{***}		-0.1962^{***}
	(0.0188)		(0.0184)	(0.0145)		(0.0132)
Δs_{up}		-0.1327^{***}			-0.1257^{***}	
		(0.0184)			(0.0137)	
Δs_{down}		0.0058			0.0052	
		(0.0184)			(0.0130)	
Controls	Yes	Yes	No	Yes	Yes	No

Table 3.10: Summary of regression results of high or low credit spread change test, with spread change under upgrade Δs_{up}, Δs_{down} and average spread change $\Delta \bar{s}_{up,down}$. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.16 on page 68.

The results of this test are summarized in Table 3.10. As in the plus or minus test, the credit spread change is strongly significantly negative. The only exception is again the downwards change when including also the upwards change, which again is most likely caused by the high correlation of the two variables.

Most of the coefficients on the high or low variables are not statistically different from zero. Exceptions are the high third coefficient when excluding only large debt offerings, which is significantly negative, as well as the low third coefficient under the same sample specification, which is significantly positive. Similar coefficients had already been found in the first high or low test in section 3.3, where the credit spread change was not included

The interaction terms between the credit score variables and the credit spread change are also mostly insignificant. The high third variable interacted with the upwards credit spread results significantly positive at a 10% confidence level. This is counter-intuitive, since firms are more likely to obtain an upgrade and thus benefit from the upside change when they are in the high third of their micro-rating. Thus, these firms should have a stronger incentive not to issue debt, but the coefficient indicates the opposite. The other significant interaction term concerns the low third credit score together with the downwards credit spread change. This value results significantly negative, which is in line with what one would expect.

Overall, the interaction terms obtained in the high or low test did not follow the expected format. This could be because the computed credit score model does not accurately predict the position of a firm inside a micro-rating or because there is simply no effect of the position of a firm inside a credit rating on its financing behavior.

3.7.3 Spread Change and Outstanding Debt Test

Plus or Minus Test

The inclusion of the potential credit spread change already lead to very significant results. The question is now how this model can be further expanded in order to capture the firms' decision making realities even better.

In the earlier model, we treated all firms within a micro-rating equally, since the respective computed credit spread change is the same for all firms within the same micro-rating. However, the degree to which a firm is vulnerable to credit spread changes depends strongly on the amount of debt in a firm. In an over-simplifying example, a firm with a very low amount of outstanding debt will not notice a significant difference in financing cost if the credit spread on its debt will change, whereas a highly leveraged firm will be subject to large financing cost changes when a similar credit spread change takes place.

In order to account for this, we will in this subsection compute a model similar to the earlier one, but multiply the credit spread change with the total amount of outstanding long-term debt divided by outstanding assets. This combined variable will serve as proxy for the degree to which a firm's financing cost will change following a rating change. The rest of the model will be built exactly as in the previous analysis.

	Excluding Large Debt & Equity Offerings		
	1	2	3
CR_{POM}	-0.0050^{***}		-0.0071^{***}
	(0.0015)		(0.0015)
CR_{Plus}		-0.0028^{*}	
		(0.0016)	
CR_{Minus}		-0.0043^{***}	
		(0.0017)	
$\Delta\bar{s}_{up,down} * {}^{D}/_{A}$	-0.3322^{***}		-0.4665^{***}
	(0.0418)		(0.0220)
$\Delta s_{up} * {}^{D}/_{A}$		-0.2722^{***}	
		(0.0440)	
$\Delta s_{down} * {}^{D}/_{A}$		-0.0628^{*}	
		(0.0378)	
$CR_{POM} * \bar{\Delta} s_{up,down} * {}^{D}/_{A}$	0.0411		0.0609^{**}
	(0.0270)		(0.0269)
$CR_{Plus} * \Delta s_{up} * {}^{D}/_{A}$		0.0298	
		(0.0326)	
$CR_{Minus} * \Delta s_{down} * {}^{D}/_{A}$		0.0499	
		(0.0322)	
Controls	Yes	Yes	No

Table 3.11: Summary of regression results of plus or minus credit spread change multiplied with outstanding debt test, with spread change under upgrade Δs_{up}, Δs_{down} and average spread change $\Delta\bar{s}_{up,down}$. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.17 on page 69.

The regression results are summarized in Table 3.11. We have shown before that even after including the credit spread change in our models, there is no large difference between excluding only large debt or also large equity offerings. For better readability, only the results for a sample which excludes large debt and large equity offerings will be shown from now on. In the appendix, the results for both samples will be shown.

The rating impact variable results significantly negative, both when taken as the average of an up- and downgrade as well as when considering separate up- and downgrades. This is different from the specification before, where the downwards credit spread change was found to be negative, but not significant.

What is striking is that unlike in the earlier tests, all plus or minus rating variables result significantly negative, whereas in the earlier test, only the combined plus or minus variable was found to be significantly negative and only when the control variables were omitted. The interaction terms result again all insignificant with one exception, which this time is the coefficient on the combined plus or minus variable with the average rating impact proxy variable, which is found to be significantly positive.

	Excluding Large Debt Offerings			Excluding Large Debt & Equity Offerings		
	1	2	3	4	5	6
Δs	0.1023	0.1034	0.0432	0.1045	0.1060	0.0454
$\Delta s * {}^{D}/_{A}$	0.1118	0.1122	0.0764	0.1125	0.1129	0.0751

Table 3.12: Adjusted R^2 compared between model with only credit spread change (see Table A.15 on page 67) versus model with credit spread change multiplied with outstanding debt (see Table A.17 on page 69).

In order to understand whether this modified model can explain better how firms take their financing decisions, we should also consider the development of the model fit, measured by R^2. It is shown in Table 3.12 for all six model specifications. It can easily be seen that no matter how the model is precisely constructed, R^2 always increases compared to when only the credit spread change was included in the model.

It could be argued that this increase in R^2 is simply because with the inclusion of the firm's debt in the credit rating impact variable, another variable is included in the model, which maybe generally increases the model fit without giving a better insight on underlying fundamentals. However, the debt level of a firm was already included in the control variables before. In the specifications *without* control variables, which are equations 3 and 6 in Table 3.12, R^2 does indeed increase the most from the earlier model to the current one. However, there is still an increase in the other equations, where the debt level was already included in the control variables. This means that additional explanatory power is given by the interaction of the debt level with the credit spread change, which is exactly in line with what had been hypothesized before.

It should however not be not be ignored that also the plus or minus variables all result significantly negative now. This is especially surprising since they did not all result significantly negative in the earlier "pure" plus or minus tests, which had been carried out exactly as suggested by Kisgen (2006). It seems that while the quantitative measure of financing cost changes play an important role in financing behavior, there are also qualitative benefits from passing to a higher macro-rating, which are not covered by the credit spread change itself. We will later on try to identify where these apply the most and whether the investment-grade border might have something to do with this.

High or Low Test

Also in the extended rating change model, we can include the dummy variables for high or low credit scores in order to test the effect of the position of a firm within its micro-rating. As before, we would expect that in particular the interaction term between the position of a firm inside a micro-rating and the impact of a rating change has a significant effect on the financing behavior of a firm.

	Excluding Large Debt & Equity Offerings		
	1	2	3
CR_{HOL}	-0.0029^{*}		-0.0022
	(0.0017)		(0.0017)
CR_{High}		0.0014	
		(0.0019)	
CR_{Low}		-0.0038^{*}	
		(0.0023)	
$\Delta\bar{s}_{up,down} * {}^{D}/{}_{A}$	-0.4238^{***}		-0.4993^{***}
	(0.0498)		(0.0298)
$\Delta s_{up} * {}^{D}/{}_{A}$		-0.3254^{***}	
		(0.0477)	
$\Delta s_{down} * {}^{D}/{}_{A}$		-0.0740	
		(0.0512)	
$CR_{HOL} * \bar{\Delta} s_{up,down} * {}^{D}/{}_{A}$	0.0414		0.0194
	(0.0372)		(0.0372)
$CR_{High} * \Delta s_{up} * {}^{D}/{}_{A}$		-0.0860^{**}	
		(0.0398)	
$CR_{Low} * \Delta s_{down} * {}^{D}/{}_{A}$		0.0633	
		(0.0422)	
Controls	Yes	Yes	No

Table 3.13: Summary of regression results of high or low credit spread change multiplied with outstanding debt test, with spread change under upgrade Δs_{up}, Δs_{down} and average spread change $\Delta\bar{s}_{up,down}$. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.18 on page 70.

The results of the high or low test are summarized in Table 3.13. Here, the rating change impact variable results significantly negative when looking at the average of an up- and downgrade as well as a separate upgrade variable, while it is negative but not significant when looking at a downgrade. This is similar to the what had been found in the credit spread change test without the outstanding debt, where the downgrade variable was not significant either. Already there, it had been explained that this is most likely due to the significant correlation between the upwards- and downwards-directed spread change variables. Here, both variables are multiplied with the same quantity (the outstanding debt divided by assets), so the correlation between the two measures does not change. Hence, the insignificant downwards coefficients are again probably caused by the fact that the upwards variable takes on the largest part of the effect.

What is new is that the high or low variables are now all insignificant or significantly negative. This had not been the case in the credit spread change test as well as the original high or low test. The same applies for the interaction terms of the rating change impact with the amount of debt, where again all are either insignificant or significantly negative. Potentially, the unexpected results we obtained earlier, in particular in the high or low test, resulted from overlapping effects from the potential rating change impact, which the regression now controls for.

3.7.4 Investment-Grade Border Test with Rating Change Impact

We found before that even after controlling for the credit rating change impact, there still seem to be abnormal financing effects around macro-rating borders. We will now test whether these can be explained by the investment-grade border.

We could see before that there is no substantial difference between including the average rating change impact or distinguishing between an upwards or downwards directed change. We will therefore only include the average rating change impact in this test. In order to test for abnormal financing behavior around the investment grade border, we include the investment grade border dummy variable introduced in section 3.5. It is again either 1 for the credit ratings BBB- and BB+ (narrow definition) or for the ratings BBB to BB (wide definition). Moreover, the usual control variables are included. This yields the following regression equation:

$$\Delta NetDebt_{i,t} = \alpha + \beta_1 \Delta \bar{s}_{up,down} * {}^{D}/_{A} + \beta_2 CR_{IG/SG} + \phi K_{i,t} + \epsilon_{i,t} \tag{3.15}$$

We carry out the regression both on a sample excluding only large debt offerings as well as excluding large debt and equity offerings. The results are summarized in Table 3.14.

	Excluding Large Debt Offerings		Excluding Large Debt & Equity Offerings	
	BBB- and BB+	BBB to BB	BBB- and BB+	BBB to BB
$\Delta \bar{s}_{up,down} * {}^{D}/_{A}$	-0.3661^{***}	-0.3732^{***}	-0.3054^{***}	-0.3082^{***}
	(0.0399)	(0.0418)	(0.0378)	(0.0397)
$CR_{IG/SG}$	0.0037^{**}	0.0035^{**}	0.0002	0.0007
	(0.0017)	(0.0014)	(0.0015)	(0.0013)

Table 3.14: Summary of regression results of credit spread change multiplied with outstanding debt and investment-grade border test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.19 on page 71.

The credit spread change results again strongly significantly negative, as had been found in the tests before. Surprisingly, the investment grade border variable has a significantly *positive* effect on net debt issuances when only large debt offerings are excluded, while it results insignificant when both large debt and equity offerings are excluded. This is exactly the opposite of what had been found in the investment grade border test in section 3.5, where the investment grade border variable was found to be significantly *negative*.

This change is caused by the inclusion of the credit spread change. As shown by the graphical representation of the credit spread changes in Figure 3.9 on page 36, the spread change is particularly high in the range roughly between BBB and BB-. The spread change coefficient thus seems to take on the abnormal negative net debt issuances around the investment grade border which we had found earlier, but there seems to be no abnormal negative effect that *exceeds* what is predicted by the spread change.

3.7.5 Macro-Rating Border Test

Controlling only for Rating Change Impact

It had been found by the plus or minus test in subsection 3.7.3 that there is a significantly negative net debt issuance around broad rating borders even when controlling for the expected rating change impact. The test for the investment grade border in subsection 3.7.4 had however shown that the investment-grade border is not the cause of that behavior. Surprisingly, it might even have an effect in the opposite direction.

The question is thus at which broad rating borders this negative effect is the strongest, in order to eventually gain insights on what might drive the effect. To do so, a test similar to the one with the investment-grade border is carried out, but this time dummy variables for all macro-rating borders are included. As an example, the broad rating border variable "AAA" will capture effects at the credit ratings AAA[1] and AA+, the variable "AA" will capture the ratings AA- and A+, and so on. The specification is alway chosen narrowly, hence covering only one micro-rating to each side, since otherwise the dummy variables would overlap at the middle micro-ratings without plus or minus.

Moreover, we again control for the credit rating change impact in order to see at which macro-rating borders the effect *exceeds* what is predicted by the numerical rating change impact. The regression model is thus:

$$\Delta NetDebt_{i,t} = \alpha + \underbrace{\beta_1 \Delta \bar{s}_{up,down} * {}^{D}/{}_{A}}_{\text{Rating Change Impact}} + \underbrace{\sum_{R=AAA/AA}^{B/CCC} \beta CR_R}_{\text{Macro-Rating Borders}} + \phi K_{i,t} + \epsilon_{i,t} \qquad (3.16)$$

Figure 3.10 on page 46 shows graphically the found coefficients of abnormal net debt issuances at the macro-rating borders for a sample excluding only large debt issuance in green and excluding both large debt and equity issuances in blue.

The obtained abnormal net debt issuance behavior around macro-rating borders is significantly positive at the borders from AAA to AA+ and AA- to A+, and significantly negative from BB- to B+ and B- to CCC+. It seems reasonable that firms at low ratings pay particular attention to having a better macro-rating than at higher ratings. However,

[1]Standard & Poors does not state micro-ratings for AAA-rated firms, which is why the micro-rating close to the AAA border is not AAA-, but AAA.

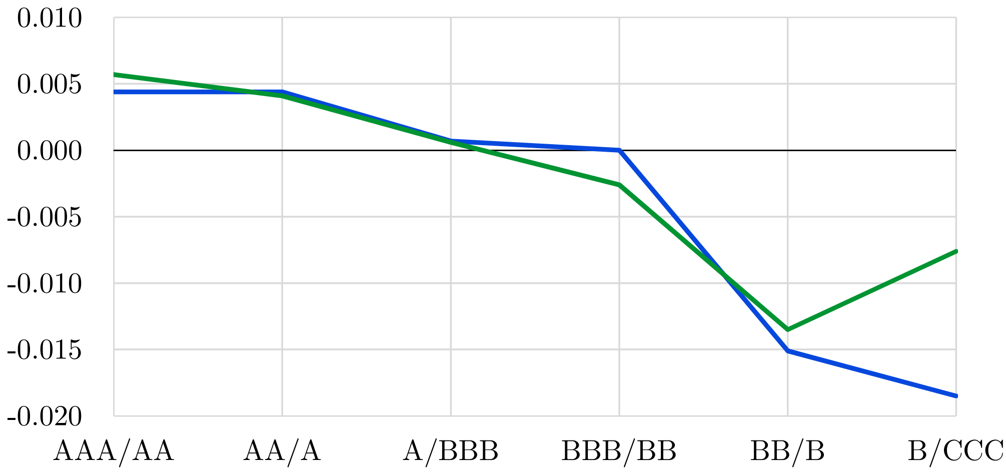

Figure 3.10: Macro-rating border coefficients, controlling for economic impact of rating changes, excluding large debt offerings (green) as well as large debt and equity offerings (blue). Numeric results in Table A.20 on page 72.

it appears odd that at high ratings, firms seem to issue even *more* net debt when being close to a macro-rating border. It seems likely that there are other factors not included in our analysis that cause this behavior.

3.7.6 Controlling for Rating Change Impact and Macro-Rating Differences

The macro-rating test has shown that firms at lower macro-rating borders issue significantly less net debt. These lower coefficients could however also be due to lower overall net debt issuances at lower ratings. This was already found in the beginning of our analysis: Figure 3.2 on page 14 shows that in particular firms with a credit rating lower than BB have a low net debt issuance. We thus want to test whether the abnormal net debt issuance behavior at macro-ratings is due to a specific pattern around just these macro-rating borders or whether it can be explained with overall net debt issuance behaviors at in particular lower macro-ratings.

In the following test, we will thus not only include dummy variables covering the macro-rating borders, but also control for overall net debt issuance levels at macro-ratings. Hence, we include a dummy variable AAA which covers AAA, a variable AA which covers AA+, AA and AA- and so on. We do not include an intercept in order to being able to compute coefficients on all macro-ratings. Our regression equation is thus:

$$\Delta NetDebt_{i,t} = \underbrace{\beta_1 \Delta \bar{s}_{up,down} * {}^{D}/_{A}}_{\text{Rating Change Impact}} + \underbrace{\sum_{R=AAA}^{CCC} \beta CR_R}_{\text{Macro-Ratings}} + \underbrace{\sum_{R=AAA/AA}^{B/CCC} \beta CR_R}_{\text{Macro-Rating Borders}} + \phi K_{i,t} + \epsilon_{i,t} \tag{3.17}$$

What should be noted is that the middle micro-rating of each macro-rating, hence the one without plus or minus, is not covered by the border dummy variables. This means that the overall lower net debt issuances at lower ratings should be covered by the macro-rating dummy variables, because otherwise the middle micro-ratings would be left out. Consequently, the remaining effect captured by the border dummy variables should really be attributable to specific border behavior.

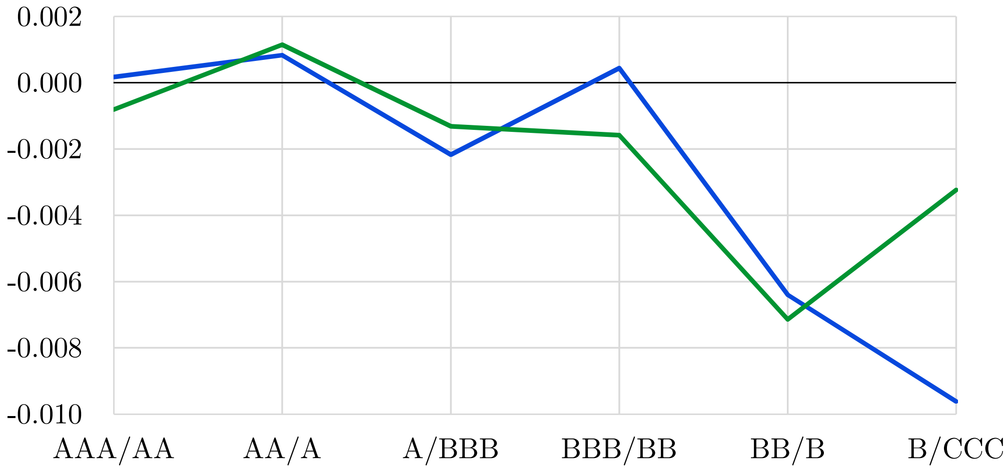

Figure 3.11: Macro-rating border coefficients, controlling for economic impact of rating changes and overall differences between macro-ratings, excluding large debt offerings (green) as well as large debt and equity offerings (blue). Numeric results in Table A.21 on page 73.

The obtained coefficients on the border dummy variables are shown in Figure 3.11 on page 47. As expected, controlling for overall macro-rating differences reduces the size of the border coefficients significantly. Apart from the BB/B border coefficient, none of the coefficients results significantly different from zero. The coefficient on the BB/B is significantly negative at a 5% level, both when excluding only large debt issuances or both large debt and equity issuances.

It is not clear whether the negative coefficient on the BB/B border is a pure statistical coincidence or whether there really is some kind of incentive for a firm to pass this macro-rating border, which is a stronger incentive than at any other border. According to the credit rating agency itself, there is no qualitative difference between the two ratings, but firms rated B are "more vulnerable than the obligors rated BB" (Standard & Poor's, 2018). One possibility would thus be that some firms have specific debt covenants in place that require them to maintain a BB rating, which is why they would be particularly careful when issuing net debt around the respective rating border.

In addition, there could be other effects that cause this specific border to show an abnormally negative debt issuance behavior. These could include in particular difficulties to issue debt in general due to the low credit ratings. We would however expect that such overall different debt issuance levels are captured by the macro-rating dummy variables, since these capture not only micro-ratings with a plus or minus, but also the ones in the middle without sign. We can therefore not finally conclude whether the negative issuance behavior between BB and B is really caused by some underlying mechanism or whether it is just a statistical coincidence.

3.7.7 Controlling for PV of debt

In the final section of our analysis, we will try to combine several aspects of our analysis. We have seen that the credit spread change does play an important role when deciding on the amount of net debt to issue, and even more so if also the amount of outstanding debt is considered as well. Moreover, we have seen in section 3.6 that also the term structure of the outstanding debt influences the financing decision. We therefore want to try to connect these aspects in a combined model.

The link between the maturity of a debt instrument and a change in its credit spread is that since normally the credit spread on the obligation is fixed throughout the whole lifetime, the credit spread will only change when the obligation has to be refinanced at its maturity. This means that the maturity of a debt instrument determines when the new credit spread will materialize in incremental or decremental cash flows for a firm. After the respective instrument has been refinanced, the new credit spread will have to be paid in every subsequent period[2]. We can therefore value the credit spread change of a debt instrument as perpetual cash flow. For a separate debt instrument, we could therefore compute the present value of a credit spread change Δs given a discount rate r as:

$$PV = \frac{D * \Delta s}{r} * \frac{1}{(1+r)^{(t-1)}} \tag{3.18}$$

Given the available data, we are not able to distinguish between specific debt instruments of firms. However, Compustat provides for each of the five years subsequent to an observation the amount of debt that will mature. We can use this together with the expected credit spread change to value the impact of a credit rating change for these five years.

[2]This assumes that the credit rating will remain stable after a rating change. Since credit ratings have been shown to be tendentially sticky (e.g. Posch, 2011), it seems reasonable that credit ratings do not change twice in a short timespan, unless the firm takes a new decision to change its net debt issuance and hence capital structure.

We have to consider however that in our dataset, debt that matures in the next five years covers only about 43% of total outstanding debt. It is therefore important not to ignore the impact of a credit rating change on debt that will mature after the five year horizon. In order to correctly discount effects on this debt we need to know when such a change takes place. In their analysis of corporate long-term debt issuances, Badoer and James (2016) state the average maturity as well as the number of number of occurrences of corporate debt issuances of US-American firms between 1987 and 2009 for maturities between 5 and 10 years, 10 and 20 years and longer than 20 years.

It is important to highlight that the maturities stated by Badoer and James are maturities at issuance. We however need the average maturity of already outstanding debt. These two numbers are not the same, since the maturity of debt issued in the past will obviously decrease every year by 1 until it matures. We will assume here that debt issuances are not grouped together in time, hence every year the same amount of debt for each maturity is issued. This issuance is assumed to be equal to the amount of debt maturing, which is the same assumption that has already been made earlier. We further assume that the maturity structure of the debt is kept constant, hence if for example a 10 year bond matures, a new 10 year bond with the same face value and maturity is issued immediately in order to replace the old one.

This implies that if we consider all outstanding debt of a firm with a specific (initial) maturity, the single debt instruments will have remaining maturities distributed evenly between zero and and the initial maturity. For example, out of the debt of a firm with an initial maturity of three years, one third will mature in one year, one third in two years and one third in three years.

For our analysis, we only need the average maturity of debt with a residual maturity larger than five years, because we have precise data on debt with remaining maturities of less than five years. We therefore compute from the maturities at issuance from Badoer and James the average remaining maturities of debt instruments with a remaining maturity larger than five years. Since the maturity of a debt instrument decreases linearly, we can take the arithmetic average between the lowest and highest possible residual maturity as residual maturity, since we assume that the residual maturities are distributed evenly. The lowest possible residual maturity is five, since as explained we do not consider maturities below five years since they are covered by the Compustat data. For each debt group of Badoer and James, we thus compute the average residual maturity as:

$$\text{Residual Maturity} = \frac{\text{Maturity at Issuance} + 5}{2} \tag{3.19}$$

In order to compute the correct weighted average of the residual maturity, we also need the number of debt issuances per maturity group. Also here, we have to adjust the data from Badoer and James, since a portion of the debt already has a residual maturity below five years. Again, we can exploit the assumption of even distribution of residual debt maturities. We therefore compute the adjusted amount of observations as:

$$\text{Observations}' = \frac{\text{Observations}}{\text{Maturity at Issuance}} * (\text{Maturity at Issuance} - 5) \tag{3.20}$$

From this, we can then compute an adjusted weighted average of the residual maturity of debt with a maturity of more than five years. The computation with the data from Badoer and James can be seen in Table 3.15. We arrive at an average residual maturity of 9.41 years.

Group	N	Maturity at Issuance	N T > 5	Residual Maturity
5-10y	10 158	6.62	2 485	5.81
10-20y	3 868	11.06	2 119	8.03
> 20y	1 620	31.23	1 361	18.11
Total	15 646	10.26	5 965	9.41

Table 3.15: Corporate debt maturities at issuance and observations according to Badoer and James (2016) as well as adjusted observations (according to Equation 3.19) and residual maturities (according to Equation 3.20)

With this value, we now have a reasonable estimate of the term structure of the debt of the firms in our sample. In Equation 3.18, we had stated how the impact of a credit spread change on a single debt instrument can be valued. With this, we can compute the entire impact of a credit rating change as the sum of the impact on all maturities, thus for the maturities of one to five years (for which we have the specific data) as well as the remaining debt with an assumed average residual maturity of 9.41 years. All in all, the valuation of a credit rating change is thus:

$$PV = \underbrace{\sum_{t=1}^{5} \frac{DD_t * \Delta s}{r} * \frac{1}{(1+r)^{(t-1)}}}_{\text{Debt maturing in first five years}} + \underbrace{\frac{\left(D - \sum_{t=1}^{5} DD_t\right) * \Delta s}{r} * \frac{1}{(1+r)^{9.41-1}}}_{\text{Remaining debt not maturing in next five years}} \tag{3.21}$$

One more parameter is however missing for the valuation of a credit rating change, which is the correct discount rate to use. An appropriate discount rate accounts for the riskiness of the involved cash flows. The incremental or decremental cash flows from a credit rating change will only take place as long as the debt of the respective firm still pays interest. The riskiness of the credit spread change cash flows can therefore be assumed to be similar to the riskiness of the underlying debt. In efficient capital markets, the interest rate that a debt obligation bears should reflect its risk level. We therefore use the interest rate that a firm pays as discount rate for the valuation.

We use the same computation method for the implied interest rate of a firm as used for the credit spread curve construction. Its computation is shown in Equation 3.12 on page 34. In order to control for outliers and in order to use only reasonable discount rates, we winsorize the implied interest rates at 5% and 95%. By doing so, we obtain a mean discount rate of 7.34%. The lowest and highest value are 3.10% and 12.74%, respectively. All in all, we seem to achieve reasonable discount rates.

With this information, we can now compute the present value of a credit rating change for every firm in the sample for which the necessary fields are available. Then, we can compute a plus or minus test as had been done for the earlier tests.

	Excluding Large Debt & Equity Offerings		
	4	5	6
CR_{POM}	-0.0044^{**}		-0.0071^{***}
	(0.0018)		(0.0017)
$CR_{POM} * \bar{PV}_{up,down}$	0.0018		0.0030
	(0.0029)		(0.0026)
CR_{Plus}		-0.0046^{**}	
		(0.0023)	
$CR_{Plus} * PV_{up}$		0.0076^{*}	
		(0.0041)	
CR_{Minus}		-0.0043^{**}	
		(0.0019)	
$CR_{Minus} * PV_{down}$		0.0036	
		(0.0032)	
$\Delta\bar{PV}_{up,down}$	-0.0149^{***}		-0.0269^{***}
	(0.0033)		(0.0019)
ΔPV_{up}		-0.0227^{***}	
		(0.0050)	
ΔPV_{down}		0.0050	
		(0.0048)	
Controls	Yes	Yes	No

Table 3.16: Summary of regression results of plus or minus impact valuation test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.22 on page 74.

The results from the test are summarized in Table 3.16. As in the earlier test of the credit spread change multiplied with the amount of total outstanding debt, the credit rating change impact as well as the plus or minus variables are all significantly negative. The only exception is the downwards change impact variable, which is most likely insignificant because of the overlapping effect with the upwards change variable. The interaction terms between plus or minus variables with the rating change valuation are mostly insignificant, with the exception of the plus rating variable with the upgrade valuation, which is significantly positive at a 10% level.

Summarizing, we see that the results are very similar to what we had already achieved by simply multiplying the credit spread change with the amount of total outstanding debt. In order to understand whether we gained additional explanatory power by enhancing our

	1	2	3	4	5	6
With $\Delta s * D$	0.1118	0.1122	0.0764	0.1125	0.1129	0.0751
With PV	0.1010	0.1016	0.0341	0.0979	0.0992	0.0361

Table 3.17: Adjusted R^2 compared between model with credit spread change multiplied with total outstanding debt (see Table A.17 on page 69) versus model with credit rating change impact valuation (see Table A.22 on page 74).

model, we can compare the model fit of the different models. In Table 3.17, the adjusted R^2 of the two approaches is shown. It can be seen that for every of the six model specifications, the model fit was higher when using the credit spread change multiplied with the total outstanding debt.

It seems that the more complicated approach to precisely value the impact of a credit rating change did not pay out. It has to be considered however that we had to take some limiting assumptions due to data unavailabilities. These include the appropriate discount rate, which we approximated with the implied interest rate of a firm, as well as the term structure of the debt after a five year horizon, where we used an average value for all firms, without taking into account firm-individual differences in debt with a long maturity. Moreover, we had seen in the term structure analysis that there is no 1:1 link between debt that matures and debt that is reissued, even though firms tend to issue more debt when more debt matures. This missing direct mechanism hinders however the precise valuation of a potential credit rating change.

Chapter 4

Conclusion

In the beginning of the analysis, we tried to replicate the main findings of Kisgen (2006) on the same sample. While the plus or minus test yielded similar results, we struggled in particular to replicate his credit score test. These difficulties might come especially from sample selection choices. We then expanded the analysis to a longer time horizon, covering 16 additional years. Our findings in the plus or minus test were relatively similar, even though we could not confirm the significantly negative effect of a plus-rating on a firm's net debt issuance behavior. We explained that this could have something to do with a higher difficulty of obtaining an upgrade after the financial crises of the 2000's.

In the high or low test, we were not able to replicate the results of Kisgen. It seems that the obtained results depend strongly on the sample specification. We found that firms even issue significantly *more* net debt when being close to a downgrade, but this finding vanished when excluding large equity offerings from the sample, which is a modification that Kisgen has not carried out.

We then assumed that the effect of a being close to an up- or downgrade on financing should be even stronger when such a rating change would lead to a new macro-rating, but were not able to prove that in the data using our interaction test between the the plus or minus and high or low variables. We then looked isolatedly at abnormal financing behavior around the investment-grade border, where we found a significantly negative effect on net debt issuance, which is in line with Kisgen's findings.

In the later parts of the analysis, we include elements in the analysis that had not been included in Kisgen's work. We first took into consideration the term structure of a firm's outstanding debt. We used two different test specifications and found in both that firms finance tendentially more with equity rather than with debt if large amounts of debt will mature soon, but this happens independently from what credit rating a firm has or how close it seems to be to an up- or downgrade.

We then started to account for the concrete economic impact of a credit rating change on a firm. We found the credit spread change at a certain credit rating to be a significantly negative driver of net debt issuances. This is potentially because of a two-sided effect:

On the one hand, a large credit spread change encourages a firm to obtain an upgrade, since the interest rate burden after such an upgrade would decrease more strongly. On the other hand, a downgrade has a stronger impact on a firm if the credit spread change is expected to be large, which makes a firm again more prudent when issuing debt rather than equity.

Subsequently, we considered the credit rating change multiplied with the amount of outstanding debt of a firm, in order to better account for what economic impact a credit rating change would have on a firm. We still found abnormal negative net debt issuance when a firm has a plus or minus rating, which exceeds what can be explained using the pure economic impact of a rating change through the credit spread change mechanism. This finding could also not be explained with the investment-grade border. The earlier found prudent debt issuance around that border seems to be explainable by the relatively high credit spread change in that rating region.

The significant effect of plus or minus ratings on financing was found to be driven in particular by low-rated firms. After controlling for overall lower net debt issuances at lower credit ratings, only an abnormal negative effect at the border between BB and B ratings persisted. It is not clear whether this is really caused by a stronger incentive of firms to stay ahead of this border or whether this result can be considered a statistical coincidence.

Finally, we tried to built a model which precisely values the impact of a credit rating change for each firm, but encountered difficulties, in particular with regard to lacking information about the precise debt maturity structure of a firm after a five year horizon as well as the absence of an appropriate discount rate for the future cash flows. Even though the results of this test confirmed that firms consider the economic impact of a potential credit rating change, we did not gain more explanatory power compared to the more simplified model with the potential credit spread change multiplied with the total amount of outstanding debt.

All in all, it seems that there is a connection between credit ratings and corporate financing behavior, but this link does not have the same strength at all credit ratings. It is particularly strong whenever the discrepancy between the credit spread levels of two credit ratings is large as well. We cannot exclude however that there are some discrete benefits of staying ahead of certain macro-rating borders, as we found at the BB and B border. It is however counter-intuitive that such an effect is not found at the investment-grade border.

Starting from this analysis, an appropriate next step could be to try to build a more robust valuation model of the economic impact of a credit rating change on firms and test for residual effects at credit rating borders. Also, a different specification of the high or low credit score test could lead to results that are in line with Kisgen's findings.

Appendix A

Complete Result Tables

	AAA	AA+	AA	AA-	A+	A
Number of Observations	374	199	744	894	1 650	2 737
D/(D+E)						
Mean	31.1%	30.4%	38.6%	40.3%	41.2%	43.0%
Median	26.8%	25.0%	38.0%	38.9%	40.8%	41.8%
Std Dev.	21.3%	22.1%	18.3%	21.5%	21.1%	20.4%
	A-	BBB+	BBB	BBB-	BB+	BB
Number of Observations	2 475	2 997	3 638	2 814	1 829	2 481
D/(D+E)						
Mean	43.5%	44.1%	45.3%	44.6%	47.5%	49.3%
Median	43.3%	44.8%	45.2%	44.4%	47.4%	48.6%
Std Dev.	18.7%	18.8%	18.9%	19.0%	20.5%	20.0%
	BB-	B+	B	B-	CCC+ or Below	
Number of Observations	2 935	2 737	1 445	673	448	
D/(D+E)						
Mean	53.9%	58.1%	61.1%	60.9%	58.1%	
Median	54.3%	59.0%	62.8%	63.3%	62.5%	
Std Dev.	21.6%	21.9%	22.7%	24.3%	26.5%	

Table A.1: Mean, median and standard deviation of leverage by credit rating

Rating	Observations	Debt Issuance	Equity Issuance	Net Debt Issuance
AAA	374	2.38%	−2.28%	4.65%
AA+	199	1.50%	−2.06%	3.57%
AA	744	2.06%	−1.70%	3.76%
AA-	894	1.75%	−1.42%	3.17%
A+	1 650	2.63%	−1.77%	4.40%
A	2 737	2.34%	−1.35%	3.69%
A-	2 475	2.25%	−1.13%	3.37%
BBB+	2 997	2.21%	−1.00%	3.21%
BBB	3 638	1.68%	−0.75%	2.44%
BBB-	2 814	2.15%	−0.45%	2.60%
BB+	1 829	2.61%	−0.57%	3.18%
BB	2 481	3.30%	−0.16%	3.47%
BB-	2 935	3.19%	0.85%	2.35%
B+	2 737	3.17%	2.01%	1.16%
B	1 445	3.39%	2.29%	1.10%
B-	673	2.74%	4.10%	−1.37%
CCC+	190	−1.28%	4.31%	−5.59%
CCC	87	0.28%	4.45%	−4.17%
CCC-	38	−0.24%	3.82%	−4.06%
CC	31	−4.43%	3.29%	−7.72%
C	1	−8.47%	0.01%	−8.49%
D	83	−2.27%	2.82%	−5.08%
SD	18	1.33%	2.26%	−0.93%

Table A.2: Debt issuance, equity issuance and net debt issuance as well as observations by credit rating

	1	2	3
Intercept	0.0002	0.0002	0.0279***
	(0.0077)	(0.0077)	(0.0014)
CR_{POM}	−0.0015		−0.0023
	(0.0018)		(0.0018)
CR_{Plus}		−0.0013	
		(0.0022)	
CR_{Minus}		−0.0017	
		(0.0021)	
$D/(D+E)$	−0.0086	−0.0086	
	(0.0056)	(0.0056)	
$EBITDA/A$	0.2465***	0.2464***	
	(0.0330)	(0.0330)	
ln($Sales$)	0.0002	0.0002	
	(0.0007)	(0.0007)	
Adj. R^2	0.0211	0.0210	0.0000
N	31 070	31 070	31 070

Table A.3: Regression results of plus or minus test with unrestricted sample. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Panel A: Excluding Large Debt Offerings			Panel B: Excluding Large Debt and Equity Offerings		
	1	2	3	1	2	3
Intercept	−0.0818***	−0.0818***	0.0007	−0.0516***	−0.0516***	0.0055***
	(0.0074)	(0.0074)	(0.0009)	(0.0060)	(0.0060)	(0.0007)
CR_{POM}	−0.0027**		−0.0053***	−0.0031***		−0.0051***
	(0.0011)		(0.0012)	(0.0009)		(0.0010)
CR_{Plus}		−0.0017			−0.0014	
		(0.0014)			(0.0011)	
CR_{Minus}		−0.0037***			−0.0049***	
		(0.0013)			(0.0011)	
$D/(D+E)$	−0.0162	−0.0162		−0.0135	−0.0135	
	(0.0110)	(0.0110)		(0.0094)	(0.0094)	
$EBITDA/A$	0.1262***	0.1259***		0.1234***	0.1229***	
	(0.0197)	(0.0197)		(0.0182)	(0.0182)	
ln($Sales$)	0.0092***	0.0092***		0.0059***	0.0059***	
	(0.0005)	(0.0005)		(0.0003)	(0.0003)	
Adj. R^2	0.0709	0.0709	0.0010	0.0661	0.0665	0.0013
N	20 953	20 953	20 953	20 562	20 562	20 562

Table A.4: Regression results of plus or minus test with restricted samples. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	AA	A	BBB	BB	B	CCC
Panel A: Plus or Minus Tests						
Regression 1						
Intercept	-0.0051	-0.0253	-0.0116	-0.0494	-0.0709^{**}	-0.1012
	(0.0028)	(0.0017)	(0.0017)	(0.0029)	(0.0050)	(0.0207)
CR_{POM}	-0.0016	-0.0016	0.0007	0.0011	-0.0098^{**}	0.0173
	(0.0028)	(0.0017)	(0.0017)	(0.0030)	(0.0050)	(0.0207)
Regression 2						
Intercept	-0.0049	-0.0242	-0.0101^{**}	-0.0447^{**}	-0.0676	-0.1012
	(0.0043)	(0.0022)	(0.0019)	(0.0033)	(0.0053)	(0.0212)
CR_{Plus}	-0.0027	0.0018	0.0048^{**}	0.0070^{**}	-0.0053	0.0126
	(0.0043)	(0.0022)	(0.0020)	(0.0033)	(0.0053)	(0.0212)
CR_{Minus}	-0.0014	-0.0040^{**}	-0.0044^{**}	-0.0028	-0.0265^{***}	0.0377
	(0.0030)	(0.0018)	(0.0021)	(0.0034)	(0.0082)	(0.0418)
Descriptive Statistics						
N	1 575	5 492	6 733	3 791	2 708	202
Panel B: Credit Score Tests						
Regression 1						
CR_{HOL}	-0.0080^{**}	-0.0008	-0.0006	0.0067^{*}	0.0058	0.0049
	(0.0032)	(0.0018)	(0.0019)	(0.0034)	(0.0090)	(0.0572)
Regression 2						
CR_{High}	-0.0156^{***}	0.0053^{**}	0.0060^{**}	0.0015	-0.0149	-0.0396
	(0.0042)	(0.0024)	(0.0024)	(0.0041)	(0.0138)	(0.0551)
CR_{Low}	0.0004	-0.0074^{***}	-0.0070^{***}	0.0122^{***}	0.0254^{**}	0.0678
	(0.0050)	(0.0025)	(0.0025)	(0.0044)	(0.0107)	(0.0800)
Descriptive Statistics						
N	1 473	5 100	5 964	2 911	1 587	88

Table A.5: Regression results of plus or minus test and high or low test for separate macro-ratings. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	1	2	3
Intercept	-0.0359^{***}	-0.0386^{***}	0.0255^{***}
	(0.0080)	(0.0104)	(0.0015)
CR_{HOL}	-0.0020		-0.0027
	(0.0018)		(0.0019)
CR_{High}		-0.0031	
		(0.0025)	
CR_{Low}		-0.0009	
		(0.0024)	
$D/(D+E)$	-0.0085	-0.0085	
	(0.0058)	(0.0058)	
$EBITDA/A$	0.2349^{***}	0.2350^{***}	
	(0.0374)	(0.0374)	
$\ln(Sales)$	0.0043^{***}	0.0047^{***}	
	(0.0008)	(0.0011)	
Adj. R^2	0.0322	0.0322	0.0001
N	24 787	24 787	24 787

Table A.6: Regression results of high or low test with unrestricted sample. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Panel A: Excluding Debt Offerings > 10%			Panel B: Excluding Debt Offerings > 5%		
	1	2	3	1	2	3
Intercept	-0.0934^{***}	-0.1133^{***}	0.0005	-0.0958^{***}	-0.1127^{***}	-0.0061^{***}
	(0.0069)	(0.0082)	(0.0012)	(0.0070)	(0.0087)	(0.0014)
CR_{HOL}	0.0001		-0.0001	0.0006		0.0007
	(0.0014)		(0.0014)	(0.0015)		(0.0016)
CR_{High}		-0.0076^{***}			-0.0061^{***}	
		(0.0016)			(0.0017)	
CR_{Low}		0.0080^{***}			0.0074^{***}	
		(0.0020)			(0.0022)	
$D/(D+E)$	-0.0132	-0.0133		-0.0111	-0.0111	
	(0.0099)	(0.0099)		(0.0087)	(0.0086)	
$EBITDA/A$	0.1334^{***}	0.1326^{***}		0.1076^{***}	0.1065^{***}	
	(0.0225)	(0.0226)		(0.0238)	(0.0239)	
$\ln(Sales)$	0.0102^{***}	0.0127^{***}		0.0101^{***}	0.0122^{***}	
	(0.0005)	(0.0008)		(0.0006)	(0.0009)	
Adj. R^2	0.0712	0.0746	-0.0001	0.0655	0.0682	-0.0001
N	17 530	17 530	17 530	13 659	13 659	13 659

Table A.7: Regression results of high or low test with sample excluding debt offerings larger than 10% and 5% of total assets. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	1	2	3
Intercept	-0.0543^{***}	-0.0621^{***}	0.0074^{***}
	(0.0046)	(0.0052)	(0.0009)
CR_{HOL}	-0.0019^{*}		-0.0021^{*}
	(0.0010)		(0.0011)
CR_{High}		-0.0048^{***}	
		(0.0013)	
CR_{Low}		0.0012	
		(0.0014)	
$D/(D+E)$	-0.0096	-0.0096	
	(0.0075)	(0.0075)	
$EBITDA/A$	0.1271^{***}	0.1269^{***}	
	(0.0205)	(0.0206)	
$\ln(Sales)$	0.0061^{***}	0.0070^{***}	
	(0.0003)	(0.0004)	
Adj. R^2	0.0610	0.0618	0.0002
N	17 178	17 178	17 178

Table A.8: Regression results of high or low test with sample excluding debt and equity offerings larger than 10% of total assets. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	1	2	3	4
Intercept	-0.0909^{***}	0.0038^{**}	-0.1107^{***}	0.0038^{**}
	(0.0070)	(0.0020)	(0.0083)	(0.0020)
CR_{POM}	-0.0038	-0.0054^{**}		
	(0.0024)	(0.0025)		
CR_{Plus}			-0.0040	-0.0057^{*}
			(0.0030)	(0.0031)
CR_{Minus}			-0.0032	-0.0052^{*}
			(0.0027)	(0.0028)
CR_{HOL}	-0.0010	-0.0004		
	(0.0021)	(0.0022)		
CR_{High}			-0.0091^{***}	0.0089^{***}
			(0.0024)	(0.0024)
CR_{Low}			0.0070^{**}	-0.0102^{***}
			(0.0028)	(0.0026)
$CR_{POM} * CR_{HOL}$	0.0017	0.0006		
	(0.0028)	(0.0029)		
$CR_{Plus} * CR_{High}$			0.0060	0.0034
			(0.0037)	(0.0038)
$CR_{Minus} * CR_{High}$			-0.0010	-0.0042
			(0.0035)	(0.0036)
$CR_{Plus} * CR_{Low}$			0.0024	0.0037
			(0.0040)	(0.0042)
$CR_{Minus} * CR_{Low}$			0.0006	-0.0010
			(0.0038)	(0.0039)
$D/(D+E)$	-0.0132		-0.0132	
	(0.0100)		(0.0100)	
$EBITDA/A$	0.1332^{***}		0.1321^{***}	
	(0.0225)		(0.0226)	
$\ln(Sales)$	0.0102^{***}		0.0126^{***}	
	(0.0010)		(0.0010)	
Adj. R^2	0.0713	0.0007	0.0748	0.0084
N	17 530	17 530	17 530	17 530

Table A.9: Regression results of interaction test with plus or minus variables and high or low variables. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Panel A: BBB- and BB+		Panel B: BBB to BB	
	1	2	1	2
Intercept	-0.0833^{***}	-0.0820^{***}	-0.0823^{***}	-0.0788^{***}
	(0.0075)	(0.0074)	(0.0075)	(0.0076)
$SR_{IG/SG}$	-0.0038^{**}	-0.0028^{*}	-0.0045^{***}	-0.0057^{***}
	(0.0015)	(0.0016)	(0.0011)	(0.0012)
CR_{POM}		-0.0021^{*}		-0.0043^{***}
		(0.0012)		(0.0012)
$D/(D+E)$	-0.0163	-0.0162	-0.0162	-0.0162
	(0.0110)	(0.0110)	(0.0110)	(0.0110)
$EBITDA/A$	0.1260^{***}	0.1259^{***}	0.1258^{***}	0.1251^{***}
	(0.0197)	(0.0197)	(0.0196)	(0.0196)
$\ln(Sales)$	0.0092^{***}	0.0092^{***}	0.0092^{***}	0.0092^{***}
	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Adj. R^2	0.0708	0.0709	0.0712	0.0718
N	20 953	20 953	20 953	20 953

Table A.10: Regression results of investment-grade border test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	1	2	3	4
Intercept	-0.0822^{***}	-0.0823^{***}	-0.0830^{***}	-0.0830^{***}
	(0.0071)	(0.0071)	(0.0071)	(0.0071)
CR_{POM}	-0.0029^{**}		-0.0018	
	(0.0011)		(0.0014)	
CR_{Plus}		-0.0018		-0.0001
		(0.0014)		(0.0018)
CR_{Minus}		-0.0039^{***}		-0.0036^{**}
		(0.0013)		(0.0016)
$DD1/A$	-0.1346^{***}	-0.1346^{***}	-0.0102^{**}	-0.1022^{**}
	(0.0309)	(0.0309)	(0.0408)	(0.0408)
$CR_{POM} * DD1/A$			-0.0549	
			(0.0533)	
$CR_{Plus} * DD1/A$				-0.0894
				(0.0737)
$CR_{Minus} * DD1/A$				-0.0163
				(0.0507)
$D/(D+E)$	-0.0149	-0.0149	-0.0149	-0.0149
	(0.0103)	(0.0103)	(0.0103)	(0.0103)
$EBITDA/A$	0.1269^{***}	0.1266^{***}	0.1268^{***}	0.1265^{***}
	(0.0204)	(0.0204)	(0.0204)	(0.0204)
$\ln(Sales)$	0.0094^{***}	0.0095^{***}	0.0095^{***}	0.0095^{***}
	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Adj. R^2	0.0749	0.0750	0.0750	0.0752
N	19 996	19 996	19 996	19 996

Table A.11: Regression results of plus or minus term structure test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	1	2	3	4
Intercept	-0.0941^{***}	-0.1148^{***}	-0.0940^{***}	-0.1147^{***}
	(0.0067)	(0.0081)	(0.0017)	(0.0081)
CR_{HOL}	-0.0001		-0.0002	
	(0.0014)		(0.0017)	
CR_{High}		-0.0081^{***}		-0.0081^{***}
		(0.0016)		(0.0019)
CR_{Low}		0.0081^{***}		0.0076^{***}
		(0.0020)		(0.0023)
$DD1/A$	-0.1195^{***}	-0.1117^{***}	-0.1226^{**}	-0.1198^{*}
	(0.0341)	(0.0341)	(0.0619)	(0.0621)
$CR_{HOL} * DD1/A$			0.0053	
			(0.0696)	
$CR_{High} * DD1/A$				0.0007
				(0.0695)
$CR_{Low} * DD1/A$				0.0300
				(0.0877)
$D/(D+E)$	-0.0123	-0.0124	-0.0123	-0.0124
	(0.0093)	(0.0094)	(0.0093)	(0.0094)
$EBITDA/A$	0.1345^{***}	0.1334^{***}	0.1345^{***}	0.1335^{***}
	(0.0234)	(0.0235)	(0.0234)	(0.0235)
$\ln(Sales)$	0.0104^{***}	0.0130^{***}	0.0104^{***}	0.0130^{***}
	(0.0006)	(0.0008)	(0.0006)	(0.0695)
Adj. R^2	0.0741	0.0778	0.0741	0.0777
N	16 819	16 819	16 819	16 819

Table A.12: Regression results of high or low term structure test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Plus or Minus Test		High or Low Test	
	1	2	1	2
Intercept	-0.0692^{***}	-0.0998^{***}	-0.1005^{***}	-0.1439^{***}
	(0.0096)	(0.0075)	(0.0123)	(0.0114)
CR_{Plus}	-0.0015	-0.0016		
	(0.0020)	(0.0020)		
CR_{Minus}	-0.0051^{***}	-0.0024		
	(0.0019)	(0.0018)		
CR_{High}			-0.0051^{**}	-0.0109^{***}
			(0.0023)	(0.0022)
CR_{Low}			0.0081^{***}	0.0124^{***}
			(0.0025)	(0.0033)
$D/(D+E)$	-0.0373^{***}	-0.0085	-0.0337^{**}	-0.0077
	(0.0128)	(0.0074)	(0.0168)	(0.0068)
$EBITDA/A$	0.0957^{***}	0.1643^{***}	0.0994^{***}	0.1824^{***}
	(0.0310)	(0.0190)	(0.0335)	(0.0204)
ln($Sales$)	0.0098^{***}	0.0096^{***}	0.0131^{***}	0.1045^{***}
	(0.0010)	(0.0006)	(0.0012)	(0.0012)
Above median	No	Yes	No	Yes
Adj. R^2	0.0835	0.0750	0.0836	0.0847
N	9 999	9 999	8 411	8 410

Table A.13: Regression results of plus or minus and high or low test, where sample is subdivided firms with lower and higher than median long-term debt maturing in one year divided by total assets. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively. Complete results in Table A.13 on page 65.

Rating	Observations	Raw Spread	Spread	Upside Change	Downside Change
AAA	369	0.00%	0.00%	0.00%	0.07%
AA+	194	0.16%	0.07%	0.07%	0.11%
AA	711	0.05%	0.18%	0.11%	0.08%
AA-	775	0.00%	0.26%	0.08%	0.12%
A+	1 506	0.20%	0.37%	0.12%	0.12%
A	2 576	0.35%	0.49%	0.12%	0.14%
A-	2 323	0.50%	0.63%	0.14%	0.12%
BBB+	2 844	0.69%	0.75%	0.12%	0.19%
BBB	3 485	0.88%	0.93%	0.19%	0.27%
BBB-	2 683	1.22%	1.20%	0.27%	0.28%
BB+	1 782	1.50%	1.48%	0.28%	0.27%
BB	2 442	1.79%	1.75%	0.27%	0.31%
BB-	2 863	2.14%	2.06%	0.31%	0.23%
B+	2 694	2.57%	2.29%	0.23%	0.16%
B	1 416	3.19%	2.44%	0.16%	0.22%
B-	658	3.78%	2.66%	0.22%	0.32%
CCC+	190	4.19%	2.98%	0.32%	0.50%
CCC	87	4.43%	3.48%	0.50%	0.43%
CCC-	38	4.38%	3.91%	0.43%	0.26%

Table A.14: Observations, computed raw and smoothed credit spread and potential upside and downside changes by credit rating

	Excluding Large Debt Offerings			Excluding Large Debt & Equity Offerings		
	1	2	3	4	5	6
Intercept	-0.0204^{***}	-0.0217^{***}	0.0453^{***}	0.0031	0.0026	0.0428^{***}
	(0.0056)	(0.0057)	(0.0022)	(0.0043)	(0.0044)	(0.0020)
CR_{POM}	-0.0028		-0.0065^{**}	-0.0031		-0.0062^{**}
	(0.0029)		(0.0029)	(0.0025)		(0.0025)
$CR_{POM} * \bar{\Delta} s_{up,down}$	-0.0029		0.0041	-0.0005		0.0070
	(0.0156)		(0.0160)	(0.0128)		(0.0130)
CR_{Plus}		0.0045			0.0015	
		(0.0031)			(0.0025)	
$CR_{Plus} * \Delta s_{up}$		-0.0444^{**}			-0.0191	
		(0.0200)			(0.0151)	
CR_{Minus}		0.0009			-0.0017	
		(0.0032)			(0.0027)	
$CR_{Minus} * \Delta s_{down}$		-0.0067			0.0065	
		(0.0179)			(0.0136)	
$\Delta \bar{s}_{up,down}$	-0.1284^{***}		-0.2302^{***}	-0.1199^{***}		-0.1960^{***}
	(0.0139)		(0.0117)	(0.0123)		(0.0100)
Δs_{up}		-0.1001^{***}			-0.1100^{***}	
		(0.0197)			(0.0137)	
Δs_{down}		-0.0216			-0.0107	
		(0.0170)			(0.0124)	
$D/(D+E)$	-0.0480^{***}	-0.0472^{***}		-0.0431^{***}	-0.0424^{***}	
	(0.0094)	(0.0094)		(0.0087)	(0.0087)	
$EBITDA/A$	0.1018^{***}	0.1037^{***}		0.0989^{***}	0.1009^{***}	
	(0.0208)	(0.0210)		(0.0194)	(0.0196)	
$\ln(Sales)$	0.0068^{***}	0.0065^{***}		0.0040^{***}	0.0037^{***}	
	(0.0004)	(0.0004)		(0.0003)	(0.0003)	
Adj. R^2	0.1023	0.1034	0.0432	0.1045	0.1060	0.0454
N	20 835	20 835	20 835	20 455	20 455	20 455

Table A.15: Regression results of plus or minus credit spread change test, with spread change under upgrade Δs_{up}, Δs_{down} and average spread change $\Delta \bar{s}_{up,down}$. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Excluding Large Debt Offerings			Excluding Large Debt & Equity Offerings		
	1	2	3	4	5	6
Intercept	-0.0262^{***}	-0.0430^{***}	0.0482^{***}	0.0000	0.0013	0.0437^{***}
	(0.0071)	(0.0088)	(0.0032)	(0.0052)	(0.0056)	(0.0025)
CR_{HOL}	-0.0049		-0.0058	-0.0039		-0.0046
	(0.0036)		(0.0037)	(0.0029)		(0.0029)
$CR_{HOL} * \bar{\Delta} s_{up,down}$	0.0244		0.0254	0.0120		0.0125
	(0.0207)		(0.0214)	(0.0155)		(0.0158)
CR_{High}		-0.0096^{***}			0.0012	
		(0.0034)			(0.0029)	
$CR_{High} * \Delta s_{up}$		0.0325^{*}			-0.0109	
		(0.0196)			(0.0163)	
CR_{Low}		0.0121^{**}			-0.0010	
		(0.0048)			(0.0033)	
$CR_{Low} * \Delta s_{down}$		-0.0453^{*}			-0.0083	
		(0.0236)			(0.0162)	
$\Delta \bar{s}_{up,down}$	-0.1557^{***}		-0.2525^{***}	-0.1316^{***}		-0.1962^{***}
	(0.0188)		(0.0184)	(0.0145)		(0.0132)
Δs_{up}		-0.1327^{***}			-0.1257^{***}	
		(0.0184)			(0.0137)	
Δs_{down}		0.0058			0.0052	
		(0.0184)			(0.0130)	
$D/(D+E)$	-0.0519^{***}	-0.0514^{***}		-0.0418^{***}	-0.0413^{***}	
	(0.0144)	(0.0145)		(0.0127)	(0.0127)	
$EBITDA/A$	0.1105^{***}	0.1113^{***}		0.1057^{***}	0.1077^{***}	
	(0.0254)	(0.0258)		(0.0230)	(0.0233)	
$\ln(Sales)$	0.0078^{***}	0.0090^{***}		0.0043^{***}	0.0037^{***}	
	(0.0005)	(0.0008)		(0.0003)	(0.0004)	
Adj. R^2	0.1033	0.1058	0.0414	0.0965	0.0987	0.0412
N	17 456	17 456	17 456	17 115	17 115	17 115

Table A.16: Regression results of high or low credit spread change test, with spread change under upgrade Δs_{up}, Δs_{down} and average spread change $\Delta \bar{s}_{up,down}$. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Excluding Large Debt Offerings			Excluding Large Debt & Equity Offerings		
	1	2	3	4	5	6
Intercept	-0.0292^{***}	-0.0297^{***}	0.0289^{***}	-0.0071^{**}	-0.0075^{**}	-0.0283^{***}
	(0.0041)	(0.0041)	(0.0014)	(0.0030)	(0.0030)	(0.0012)
CR_{POM}	-0.0050^{***}		-0.0076^{***}	-0.0050^{***}		-0.0071^{***}
	(0.0018)		(0.0018)	(0.0015)		(0.0015)
$CR_{POM} * \bar{\Delta} s_{up,down} * {}^{D}/{}_{A}$	0.0386		0.0609	0.0411		0.0609^{**}
	(0.0371)		(0.0374)	(0.0270)		(0.0269)
CR_{Plus}		-0.0016			-0.0028^{*}	
		(0.0020)			(0.0016)	
$CR_{Plus} * \Delta s_{up} * {}^{D}/{}_{A}$		-0.0208			0.0298	
		(0.0489)			(0.0326)	
CR_{Minus}		-0.0039^{*}			-0.0043^{***}	
		(0.0021)			(0.0017)	
$CR_{Minus} * \Delta s_{down} * {}^{D}/{}_{A}$		0.0505			0.0499	
		(0.0425)			(0.0322)	
$\Delta \bar{s}_{up,down} * {}^{D}/{}_{A}$	-0.3828^{***}		-0.5588^{***}	-0.3322^{***}		-0.4665^{***}
	(0.0462)		(0.0290)	(0.0418)		(0.0220)
$\Delta s_{up} * {}^{D}/{}_{A}$		-0.2715^{***}			-0.2722^{***}	
		(0.0628)			(0.0440)	
$\Delta s_{down} * {}^{D}/{}_{A}$		-0.1033^{*}			-0.0628^{*}	
		(0.0536)			(0.0378)	
$D/(D+E)$	-0.0216^{**}	-0.0212^{**}		-0.0213^{**}	-0.0213^{**}	
	(0.0094)	(0.0094)		(0.0092)	(0.0093)	
$EBITDA/A$	0.1270^{***}	0.1286^{***}		0.1215^{***}	0.1227^{***}	
	(0.0177)	(0.0177)		(0.0166)	(0.0167)	
$\ln(Sales)$	0.0054^{***}	0.0052^{***}		0.0029^{***}	0.0028^{***}	
	(0.0004)	(0.0004)		(0.0003)	(0.0003)	
Adj. R^2	0.1118	0.1122	0.0764	0.1125	0.1129	0.0751
N	20 835	20 835	20 835	20 455	20 455	20 455

Table A.17: Regression results of plus or minus credit spread change multiplied with outstanding debt test, with spread change under upgrade Δs_{up}, Δs_{down} and average spread change $\Delta \bar{s}_{up,down}$. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Excluding Large Debt Offerings			Excluding Large Debt & Equity Offerings		
	1	2	3	4	5	6
Intercept	-0.0370^{***}	-0.0494^{***}	0.0304^{***}	-0.0130^{***}	-0.0141^{***}	-0.0283^{***}
	(0.0050)	(0.0067)	(0.0022)	(0.0031)	(0.0040)	(0.0014)
CR_{HOL}	-0.0039		-0.0025	-0.0029^{*}		-0.0022
	(0.0025)		(0.0026)	(0.0017)		(0.0017)
$CR_{HOL} * \bar{\Delta} s_{up,down} * {}^{D}/_{A}$	0.0975		0.0613	0.0414		0.0194
	(0.0639)		(0.0652)	(0.0372)		(0.0372)
CR_{High}		-0.0048^{*}			0.0014	
		(0.0025)			(0.0019)	
$CR_{High} * \Delta s_{up} * {}^{D}/_{A}$		0.0203			-0.0860^{**}	
		(0.0619)			(0.0398)	
CR_{Low}		0.0032			-0.0038^{*}	
		(0.0035)			(0.0023)	
$CR_{Low} * \Delta s_{down} * {}^{D}/_{A}$		0.0320			0.0633	
		(0.0727)			(0.0422)	
$\Delta \bar{s}_{up,down} * {}^{D}/_{A}$	-0.5712^{***}		-0.6866^{***}	-0.4238^{***}		-0.4993^{***}
	(0.0663)		(0.0561)	(0.0498)		(0.0298)
$\Delta s_{up} * {}^{D}/_{A}$		-0.3922^{***}			-0.3254^{***}	
		(0.0735)			(0.0477)	
$\Delta s_{down} * {}^{D}/_{A}$		-0.1252			-0.0740	
		(0.0816)			(0.0512)	
$D/(D+E)$	-0.0141	-0.0153		-0.0134	-0.0132	
	(0.0121)	(0.0125)		(0.0116)	(0.0117)	
$EBITDA/A$	0.1445^{***}	0.1449^{***}		0.1343^{***}	0.1377^{***}	
	(0.0201)	(0.0203)		(0.0185)	(0.0186)	
$\ln(Sales)$	0.0062^{***}	0.0074^{***}		0.0033^{***}	0.0031^{***}	
	(0.0005)	(0.0008)		(0.0003)	(0.0005)	
Adj. R^2	0.1209	0.1224	0.0797	0.1092	0.1111	0.0680
N	17 456	17 456	17 456	17 115	17 115	17 115

Table A.18: Regression results of high or low credit spread change multiplied with outstanding debt test, with spread change under upgrade Δs_{up}, Δs_{down} and average spread change $\Delta \bar{s}_{up,down}$. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Excluding Large Debt Offerings		Excluding Large Debt & Equity Offerings	
	BBB- and BB+	BBB to BB	BBB- and BB+	BBB to BB
Intercept	-0.0326^{***}	-0.0327^{***}	-0.0106^{***}	-0.0106^{***}
	(0.0040)	(0.0040)	(0.0028)	(0.0028)
$\Delta \bar{s}_{up,down} * {}^{D}/{}_{A}$	-0.3661^{***}	-0.3732^{***}	-0.3054^{***}	-0.3082^{***}
	(0.0399)	(0.0418)	(0.0378)	(0.0397)
$CR_{IG/SG}$	0.0037^{**}	0.0035^{**}	0.0002	0.0007
	(0.0017)	(0.0014)	(0.0015)	(0.0013)
$D/(D+E)$	-0.0209^{**}	-0.0203^{**}	-0.0215^{**}	-0.0212^{**}
	(0.0096)	(0.0097)	(0.0094)	(0.0096)
$EBITDA/A$	0.1284^{***}	0.1288^{***}	0.1220^{***}	0.1222^{***}
	(0.0176)	(0.0175)	(0.0165)	(0.0165)
$\ln(Sales)$	0.0053^{***}	0.0053^{***}	0.0030^{***}	0.0029^{***}
	(0.0004)	(0.0004)	(0.0003)	(0.0003)
Adj. R^2	0.1117	0.1118	0.1119	0.1119
N	20 835	20 835	20 455	20 455

Table A.19: Regression results of credit spread change multiplied with outstanding debt and investment-grade border test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Excluding Large Debt Offerings	Excluding Large Debt & Equity Offerings
Intercept	-0.0247^{***}	-0.0044
	(0.0039)	(0.0029)
$\Delta\bar{s}_{up,down} * {}^{D}/{}_{A}$	-0.3011^{***}	-0.2555^{***}
	(0.0432)	(0.0402)
$CR_{AAA\,Border}$	0.0044	0.0057^{**}
	(0.0028)	(0.0027)
$CR_{AA\,Border}$	0.0044^{***}	0.0041^{***}
	(0.0017)	(0.0016)
$CR_{A\,Border}$	0.0007	0.0006
	(0.0014)	(0.0012)
$CR_{BBB\,Border}$	-0.0000	-0.0026
	(0.0018)	(0.0016)
$CR_{BB\,Border}$	-0.0151^{***}	-0.0135^{***}
	(0.0022)	(0.0017)
$CR_{B\,Border}$	-0.0185^{***}	-0.0076^{*}
	(0.0066)	(0.0039)
$D/(D+E)$	-0.0226^{**}	-0.0225^{**}
	(0.0096)	(0.0095)
$EBITDA/A$	0.1209^{***}	0.1171^{***}
	(0.0178)	(0.0168)
$\ln(Sales)$	0.0045^{***}	0.0022^{***}
	(0.0004)	(0.0003)
Adj. R^2	0.1158	0.1163
N	20 835	20 455

Table A.20: Regression results of credit spread change multiplied with outstanding debt and macro-rating border test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Excluding Large Debt Offerings	Excluding Large Debt & Equity Offerings
$\Delta\bar{s}_{up,down} * {}^{D}/_{A}$	-0.2722^{***}	-0.0084^{***}
	(0.0482)	(0.0456)
CR_{AAA}	-0.0112^{*}	0.0099
	(0.0067)	(0.0062)
CR_{AA}	-0.0163^{***}	0.0019
	(0.0043)	(0.0035)
CR_{A}	-0.0137^{***}	0.0035
	(0.0039)	(0.0030)
CR_{BBB}	-0.0181^{***}	-0.0006
	(0.0039)	(0.0030)
CR_{BB}	-0.0258^{***}	-0.0071^{**}
	(0.0043)	(0.0033)
CR_{B}	-0.0352^{***}	-0.0113^{***}
	(0.0046)	(0.0033)
CR_{CCC}	-0.0251^{**}	-0.0005
	(0.0122)	(0.0092)
$CR_{AAA\,Border}$	0.0002	-0.0008
	(0.0040)	(0.0040)
$CR_{AA\,Border}$	0.0008	0.0011
	(0.0017)	(0.0016)
$CR_{A\,Border}$	-0.0022	-0.0013
	(0.0014)	(0.0013)
$CR_{BBB\,Border}$	0.0004	-0.0016
	(0.0017)	(0.0015)
$CR_{BB\,Border}$	-0.0064^{**}	-0.0071^{***}
	(0.0025)	(0.0020)
$CR_{B\,Border}$	-0.0096	-0.0032
	(0.0074)	(0.0045)
$D/(D+E)$	-0.0221^{**}	-0.0227^{**}
	(0.0098)	(0.0099)
$EBITDA/A$	0.1150^{***}	0.1128^{***}
	(0.0177)	(0.0168)
$\ln(Sales)$	0.0037^{***}	0.0017^{***}
	(0.0004)	(0.0003)
Adj. R^2	0.1192	0.1198
N	20 835	20 455

Table A.21: Regression results of credit spread change multiplied with outstanding debt and macro-rating border test, controlling for macro-rating differences. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

	Excluding Large Debt Offerings			Excluding Large Debt & Equity Offerings		
	1	2	3	4	5	6
Intercept	-0.0556^{***}	-0.0551^{***}	0.0206^{***}	-0.0300^{***}	-0.0290^{***}	0.0214^{***}
	(0.0060)	(0.0061)	(0.0017)	(0.0046)	(0.0047)	(0.0012)
CR_{POM}	-0.0060^{***}		-0.0097^{***}	-0.0044^{**}		-0.0071^{***}
	(0.0023)		(0.0022)	(0.0018)		(0.0017)
$CR_{POM} * \bar{PV}_{up,down}$	0.0047		0.0061	0.0018		0.0030
	(0.0040)		(0.0039)	(0.0029)		(0.0026)
CR_{Plus}		-0.0055^{**}			-0.0046^{**}	
		(0.0027)			(0.0023)	
$CR_{Plus} * PV_{up}$		0.0081			0.0076^{*}	
		(0.0054)			(0.0041)	
CR_{Minus}		-0.0052^{**}			-0.0043^{**}	
		(0.0024)			(0.0019)	
$CR_{Minus} * PV_{down}$		0.0065			0.0036	
		(0.0046)			(0.0032)	
$\Delta\bar{PV}_{up,down}$	-0.0185^{***}		-0.0332^{***}	-0.0149^{***}		-0.0269^{***}
	(0.0044)		(0.0032)	(0.0033)		(0.0019)
ΔPV_{up}		-0.0247^{***}			-0.0227^{***}	
		(0.0068)			(0.0050)	
ΔPV_{down}		0.0040			0.0050	
		(0.0059)			(0.0048)	
$D/(D+E)$	-0.0361^{***}	-0.0361^{***}		-0.0316^{***}	-0.0318^{***}	
	(0.0120)	(0.0119)		(0.0111)	(0.0110)	
$EBITDA/A$	0.1394^{***}	0.1408^{***}		0.1303^{***}	0.1314^{***}	
	(0.0308)	(0.0312)		(0.0289)	(0.0292)	
$\ln(Sales)$	0.0082^{***}	0.0080^{***}		0.0052^{***}	0.0050^{***}	
	(0.0006)	(0.0006)		(0.0004)	(0.0005)	
Adj. R^2	0.1010	0.1016	0.0341	0.0979	0.0992	0.0361
N	16 272	16 272	16 272	15 979	15 979	15 979

Table A.22: Regression results of plus or minus rating change valuation test. Dependent variable: net debt issuance. ***, ** and * denote significance at 10%, 5% and 1% levels, respectively.

Appendix B

Used Compustat Data Fields

Field	New Item Name	Old Compustat Number
Used in Basic Analysis:		
S&P Domestic Long-Term Issuer Credit Rating	SPLTICRM	280
Long-Term Book Debt	DLTT	9
Long-Term Debt Issuance	DLTIS	111
Long-Term Debt Reduction	DLTR	114
Current Debt Change	DLCCH	301
Stockholders' Equity	SEQ	216
Sale of Common and Preferred Stock	SSTK	108
Purchase of Common and Preferred Stock	PRSTKC	115
Total Assets	AT	6
Used as Control Variables:		
EBITDA	OIBDP	13
Sales	SALE	12
Used in Credit Score Computation:		
Stock Price Close	PRCC_C	24
Outstanding Shares	CSHO	25
Used in Implied Interest Rate Computation:		
Total Interest Expense	XINT	15
Used in Debt Term Structure Tests:		
Long-Term Debt maturing in 1 Year	DD1	44
Long-Term Debt maturing in 2 Years	DD2	91
Long-Term Debt maturing in 3 Years	DD3	92
Long-Term Debt maturing in 4 Years	DD4	93
Long-Term Debt maturing in 5 Years	DD5	94

Appendix C

Bibliography

Dominique C. Badoer and Christopher M. James. The determinants of long-term corporate debt issuances. *The Journal of Finance*, 71(1):457–492, 2016. ISSN 00221082.

Harold Kent Baker and Gerald S. Martin, editors. *Capital structure and corporate financing decisions: Theory, evidence, and practice*. Robert W. Kolb series in finance. John Wiley & Sons, Hoboken, N.J, 2011. ISBN 9780470569528.

Jonathan B. Berk and Peter M. DeMarzo. *Corporate finance*. The Prentice Hall series in finance. Pearson, Boston, second edition, global edition, 2011. ISBN 9780273756033.

Wolfgang Drobetz and Sascha Heller. The impact of credit rating changes on capital structure decisions: Evidence from non-listed firms in germany. 2014, 2014.

John R. Graham and Campbell R. Harvey. The theory and practice of corporate finance: evidence from the field. *Journal of Financial Economics*, 60(1):187–243, 2001.

Kristopher J. Kemper and Ramesh P. Rao. Do credit ratings really affect capital structure. *Financial Review*, 48(1):579–595, 2013.

Darren J. Kisgen. Credit ratings and capital structure. *Journal of Finance*, 61(3):1035–1072, 2006.

Jianming Kou and Simone Varotto. Predicting agency rating migrations with spread implied ratings. *ISMA Centre Discussion Papers in Finance*, 2005.

Herwig M. Langohr and Patricia T. Langohr. *The rating agencies and their credit ratings: What they are, how they work and why they are relevant*. Wiley finance series. Wiley, Chichester, England and Hoboken, N.J, 2008. ISBN 9780470018002.

Usha R. Mittoo and Zhou Zhang. Bond market access, credit qualiy, and capital structure: Canadian evidence. *The Financial Review*, 45(1):579–602, 2010.

Fernando Moreira and Sheng Zhao. Do credit ratings affect spread and return? a study of structured finance products. *International Journal of Finance & Economics*, 23(2): 205–217, 2018.

Stewart C. Myers. Determinants of corporate borrowing. *Journal of Financial Economics*, 5(1):147–175, 1977.

Stewart C. Myers. The capital structure puzzle. *Journal of Finance*, 39(3):575–592, 1984.

Peter N. Posch. Time to change. rating changes and policy implications. *Journal of Economic Behavior & Organization*, 80(3):641–656, 2011. ISSN 01672681.

Standard & Poor's. S&p global ratings definitions, 2018. URL `https://www.standardandpoors.com/en_EU/web/guest/article/-/view/sourceId/504352`.

Standard & Poor's. 2018 annual global corporate default and rating transition study, 2019. URL `https://www.spratings.com/documents/20184/774196/2018AnnualGlobalCorporateDefaultAndRatingTransitionStudy.pdf`.