Debt Maturity Structure and Credit Quality*

Radhakrishnan Gopalan† *Fenghua Song*‡ *Vijay Yerramilli*§

August 18, 2010

Abstract

We examine whether a firm's debt maturity structure affects its credit quality. We find that long-term bonds issued by firms that have a higher proportion of their debt maturing within the year trade at higher yield spreads, even after controlling for the firm's credit rating and all other known determinants of yield spreads. All else equal, firms that have a higher proportion of their debt maturing within the year are also more likely to experience deterioration in their credit quality, as measured by their propensity to experience multi-notch rating downgrades. This effect is present in both small and large firms, in both investment-grade and below investment-grade firms, is stronger when the firm's fundamentals are weaker and when credit market conditions are tougher, and is robust to instrumenting for the proportion of short-maturity debt. Our results are broadly consistent with theories that argue that short-maturity debt exposes the firm to rollover risk, which increases the firm's overall credit risk. Our results also highlight that credit ratings do not adequately account for rollover risk, which may explain their failure to predict the collapse of firms like Bear Stearns and Lehman Brothers that had high exposures to rollover risk.

*We thank Bruce Arnold, Wolfgang Buehler, Long Chen, Vic Edwards, David Feldman, Paolo Fulghieri, Ning Gong, Murali Jagannathan, Donghui Li, Vikram Nanda, Jianfeng Shen, Garry Twite, Wei Xiong, Bohui Zhang, and seminar participants at Washington University in St. Louis, Georgia Tech, Binghamton University, Hong Kong University of Science and Technology, University of New South Wales, University of Sydney, University of Technology Sydney, and Australia National University for helpful comments. An earlier version of the paper was titled "Do Credit Rating Agencies Underestimate Liquidity Risk?"

†Olin Business School, Washington University in St. Louis. Email: gopalan@wustl.edu.

‡Smeal College of Business, Pennsylvania State University. Email: song@psu.edu.

§C. T. Bauer College of Business, University of Houston. Email: vyerramilli@bauer.uh.edu.

1 Introduction

The collapse of financial institutions such as Bear Stearns and Lehman Brothers during the recent financial crisis has starkly highlighted the risk of financing long-term assets with short-term debt, which exposes the firm to the risk that it may not be able to roll over its maturing debt if its fundamentals or market conditions deteriorate. The collapse of these institutions was all the more spectacular because it wasn't anticipated by any of the three major credit rating agencies.[1] The problem is not just confined to banks and investment banks. There is a long history of high-profile bankruptcies involving non-banking firms, where the inability to roll over short-term debt compounded the effect of operating losses, and led to sudden collapses that the credit rating agencies failed to anticipate; e.g., WorldCom (2002), Enron (2001), First Executive Corporation (1991), and Penn Central (1970).

The above evidence raises two important and related questions which are the focus of our paper: Does the debt maturity structure of a firm affect its overall credit risk? If so, do credit ratings adequately capture this effect? An emerging theoretical literature argues that the rollover risk emanating from a firm's reliance on short-term debt increases the firm's overall credit risk, because rollover risk makes the firm susceptible to a run by its creditors (Morris and Shin (2009), He and Xiong (2010b)) and diminishes its debt capacity (Acharya et al. (2010)). If these theoretical predictions are correct, then firms with greater exposure to rollover risk should, all else equal, face a higher cost of debt and should be more susceptible to a deterioration in their credit quality. Ours is the first paper that empirically investigates whether these predictions are true.

Our sample spans the time period 1980–2008, and includes all firms that have a long-term credit rating from Standard and Poor's (S&P) and for which financial information is available in the Compustat database. We measure a firm's exposure to rollover risk using the variable *Rollover*, which we define as the proportion of the firm's total debt that is maturing within the year. We begin our analysis by examining whether the yield spreads on a firm's bonds are affected by the maturity structure of its debt, after controlling for all other factors that the existing literature has shown to affect bond yields, including the firm's credit rating. To do this, we follow Campbell and Taksler

[1] All three major rating agencies were caught by surprise when Bear Stearns announced on March 14, 2008 that it had obtained emergency funding from J. P. Morgan Chase, and all three agencies continued to give a safe rating to Lehman Brothers right until the day it filed for bankruptcy. For more details, see "Bear Stearns Has Credit Ratings Slashed After Bailout" (Bloomberg News, March 14, 2008) and "Flawed Credit Ratings Reap Profits as Regulators Fail" (Bloomberg News, April 29, 2009).

(2003) and model a bond's yield spread as a function of the issuing firms's idiosyncratic volatility, average return, credit rating, various financial ratios including *Rollover*, and macroeconomic variables such as market volatility and average market return. We find that bonds issued by firms with higher values of *Rollover* have higher yield spreads, even after controlling for the firm's credit rating: a one-standard-deviation increase in *Rollover* is associated with a 5 basis point increase in the bond's yield spread. This finding highlights that rollover risk increases a firm's overall credit risk, over and above what is captured by its credit rating.[2]

A sharper test of the rollover risk hypothesis is whether firms with a higher proportion of debt maturing in the short term are, all else equal, more likely to experience a deterioration in their credit quality. One way to identify deterioration in credit quality is using the 'D' rating which is assigned to firms that have defaulted on their debt obligations. However, a more common form of deterioration in credit quality is when firms experience rating downgrades, but do not actually default on their obligations. Thus, we measure deterioration in credit quality using the number of notches by which the firm's credit rating has been downgraded during the year, and by using a dummy variable that identifies firms that have experienced multi-notch downgrades, i.e., downgrades of more than one notch during the year.

Regardless of the measure employed, we find that firms with a higher proportion of debt maturing within the year are more likely to experience a deterioration in their credit quality, even after controlling for the firm's credit rating, financial condition, and firm and year fixed effects. The finding is economically significant: a one-standard-deviation increase in *Rollover* is associated with a 2.1% increase in the annual probability of a multi-notch downgrade, which is large in comparison to the sample average probability of 4.4% that the firm will experience a multi-notch downgrade. The result holds for both small and large firms, and for both investment-grade firms (those with S&P rating of BBB- or above) and speculative-grade firms (those with S&P rating below BBB-). Consistent with the rollover risk hypothesis, we also find that the positive association between *Rollover* and deterioration in credit quality is stronger when the firm's fundamentals are weaker and when credit market conditions are tougher.

We recognize that the maturity structure of corporate debt is endogenous. It is, therefore, possible to argue that our results are being driven by some time-varying omitted variable – e.g., operating

[2]This result is consistent with previous studies that show that bond markets reflect credit risk information not fully captured by ratings (Grier and Katz (1976), Hettenhouse and Sartoris (1976), and Pinches and Singleton (1978)).

risk – that affects both the firm's reliance on short-maturity debt and its propensity to experience a deterioration in credit quality.[3] Here, we must note that, based on observable risk characteristics such as size, leverage and idiosyncratic volatility, firms in our sample with higher values of *Rollover* are actually less risky, presumably because these are the firms that issue commercial paper. So we expect endogeneity to have a downward bias on our coefficient estimate on *Rollover*. Nonetheless, we perform three sets of tests to distinguish the rollover risk hypothesis from alternative explanations.

First, if firms with a higher proportion of short-term debt are riskier firms that tend to have more volatile credit ratings, then we should also expect a symmetric positive association between *Rollover* and multi-notch rating *upgrades*. By contrast, the impact of rollover risk on credit risk is asymmetric in nature, because rollover risk exacerbates the affect of negative shocks but does not affect credit quality following positive shocks. Consistent with the rollover risk hypothesis, we do not find a positive association between *Rollover* and multi-notch rating upgrades.

In our second robustness test, we follow Almeida et al. (2009) and identify the firm's exposure to rollover risk only on account of long-term debt issued in the past that is maturing within the year (*Rollover (L.T. Debt)*); i.e., we exclude short-term debt from this measure of rollover risk. The underlying idea is that since *Rollover (L.T. Debt)* depends on the firm's long-term debt structure and repayment schedule, both of which are likely to have been determined in the past, this measure is less likely to depend on any time-varying omitted variable from the current year. When we estimate our regressions after replacing *Rollover* with *Rollover (L.T.Debt)*, we continue to find a positive association between *Rollover (L.T.Debt)* and deterioration in credit quality, which suggests that our results are in fact driven by the firm's exposure to rollover risk.

Finally, we employ instrumental variable (IV) regressions to control for any possible endogeneity bias. We instrument for *Rollover* using the following variables: the yield on the 10-year treasury bond, the Delta of the compensation (i.e., sensitivity of compensation to the firm's share price) of the firm's Chief Financial Officer (CFO), and the Vega of compensation (the sensitivity of compensation to the firm's stock return volatility) of the firm's CFO. The use of the 10-year treasury yield as an instrument is motivated by the market timing argument which suggests that firms tend to borrow short term when long-term interest rates are high (Baker et al. (2003), Barclay and Smith (1995), and Guedes and Opler (1996)). The use of Delta and Vega of the CFO's compensation as

[3]Theory suggests that high-risk and low-risk firms may pool together to issue more short-term debt as compared to medium-risk firms (Diamond (1991)).

instruments is motivated by Chava and Purnanandum (2009), who find that the structure of the CFO's compensation affects the firm's debt maturity choice. Specifically, they find that CFOs with higher Delta choose significantly less short-term debt, whereas CFOs with higher Vega choose significantly more short-term debt. The identifying assumption is that the 10-year treasury rate and the structure of the CFO's compensation package do not directly affect the severity of rating downgrades, and only have an indirect effect through the firm's debt maturity choice. This is a reasonable assumption because the CFO of a firm mainly influences the firm's financing policies, and is likely to have less direct influence on the firm's investment policy and hence operational risk (see Chava and Purnanandum (2009) for empirical evidence). We find that our results continue to hold even in our IV estimation. In fact, the coefficient estimates in the IV estimation are significantly larger than our OLS estimates, which underscores our earlier observation that endogeneity has a downward bias on our estimates.

Our paper contributes to the literature on debt structure by providing empirical validation to theoretical predictions that reliance on short-term debt exposes the firm to rollover risk and increases the firm's overall credit risk (see e.g., He and Xiong (2010b)). This is an important finding because it has implications for firms' debt maturity choice. While theoretical literature identifies rollover risk as an important determinant of debt maturity choice (Diamond (1991, 1993), Flannery (1986)), the empirical literature on debt maturity choice (Barclay and Smith (1995), Berger et al. (2005), Guedes and Opler (1996), Stohs and Mauer (1994)) largely sidesteps this issue because of the difficulty of measuring liquidity risk. Our paper complements recent studies that exploit the subprime crisis of 2007 to highlight the adverse real impact to firms of not being to roll over their maturing debt. For example, Almeida et al. (2009) show that firms with a large proportion of their long-term debt maturing right after August 2007 (when the subprime crisis unfolded) experienced large drops in their real investment rates. Similarly, Duchin et al. (2009) find that the decline in corporate investment following the subprime crisis was more pronounced for firms that had more net short-term debt.

Our paper also contributes to the credit risk literature by identifying debt maturity structure as an important determinant of credit risk, that is not fully captured by credit ratings. Thus, our paper complements the findings in Campbell and Taksler (2003) who show that idiosyncratic firm-level volatility can explain variation in bond yields even after controlling for credit ratings. We also show that the credit ratings of firms that have a larger proportion of their debt maturing in the short term are more likely to be downgraded, which again suggests that rating agencies did not fully account for the impact of rollover risk on credit risk. This is likely to have been a serious problem in case of financial institutions, which have much larger exposure to rollover risk than non-financial firms, and might go some way towards explaining the well-documented failures of rating agencies in rating structured products issued by financial institutions.[4] As the following quote from "S&P's Rating Direct" issued on May 13, 2008 suggests, S&P seems to recognize this shortcoming and promises to correct for it:

> "Although we believe that our enhanced analytics will not have a material effect on the majority of our current ratings, individual ratings may be revised. For example, a company with heavy debt maturities over the near term (especially considering the current market conditions) would face more credit risk, notwithstanding benign long-term prospects."

The paper proceeds as follows. We discuss the theoretical literature and outline our key hypotheses in Section 2. We provide a description of data and summary statistics in Section 3, and present the empirical results in Section 4. Section 5 concludes the paper.

2 Theory and Hypotheses

There is a large theoretical literature which argues that short-term debt exposes the firm to rollover risk. Diamond (1991) argues that if there are constraints on pledging future rents to lenders, then short-term debt exposes the firm to the risk that if bad news arrives, the lender may refuse to roll over the loan, forcing the firm into inefficient liquidation even when it is solvent in the long run. Froot et al. (1993), Sharpe (1991), and Titman (1992) highlight that, in the presence of credit market imperfections, short-term debt can lower firm value if it has to be refinanced at an overly high interest rate. Morris and Shin (2009) and He and Xiong (2010a) argue that short-term debt can lead to a run on the firm and undermine its long-term creditors. They argue that a measure of an institution's credit risk should incorporate "the probability of a default due to a run on its short-term debt when the institution would otherwise have been solvent." He and Xiong (2010b) argue that short-term debt exacerbates the conflict of interest between shareholders and debtholders, and consequently precipitates bankruptcy at higher fundamental thresholds. Acharya et al. (2010) argue that when

[4] Other explanations for the failure of rating agencies focus on problems with the issuer-pay model of credit ratings, and the structure of the rating agency (e.g., Benmelech and Dlugosz (2009), Bolton et al. (2009), Skreta and Veldkamp (2009), and White (2001, 2009)).

the current owners of assets and future buyers are all short of capital, high rollover frequency can lead to a market freeze which diminishes debt capacity of risky assets.

The upshot of this theoretical literature is that the frequency with which a firm needs to rollover its debt, which depends on the proportion of the firm's debt maturing in the short term, can itself affect the firm's credit quality, independent of the firm's operating risk and leverage ratio. We refer to this as the *rollover risk hypothesis*, and highlight two of its key predictions which we test in this paper: First, firms with a higher proportion of short-term debt should, all else qual, face a higher cost of long-term debt because short-term debt exposes long-term debtholders to rollover risk. Second, firms with a higher proportion of short-term debt should, all else equal, be more susceptible to a deterioration in their credit quality because rollover risk exacerbates the impact of negative operating shocks and tight credit market conditions.

A positive association between reliance on short-term debt and deterioration in credit quality may arise for reasons other than exposure to rollover risk. In particular, it is possible that the firm's operating risk jointly determines both the firm's reliance on short-term debt (see Stohs and Mauer (1994)) and the possibility of a deterioration in credit quality. This would certainly be consistent with the empirical evidence that small firms, which are riskier than large firms, rely more on short-term debt (Barclay and Smith (1995)) and are also more financially constrained (Rauh (2006)), especially in downturns. We refer to this alternative hypothesis as the *operating risk hypothesis*. While the operating risk hypothesis and the rollover risk hypothesis are not mutually exclusive (because rollover risk exacerbates the impact of negative operating shocks), in our empirical tests, we do additional tests to distinguish between the two hypotheses.

It is important to recognize that debt maturity structure is endogenous. Theory predicts that the choice between short-term and long-term debt is determined by firm characteristics such as size, growth opportunities (Myers (1977)) and the extent of information asymmetry (Diamond (1993), Flannery (1986), and Kale and Noe (1990)) surrounding the firm. The empirical literature documents that small firms, firms with more growth opportunities, riskier firms, and firms with larger information asymmetry rely more on short-term debt (Barclay and Smith (1995), Stohs and Mauer (1994), Titman and Wessels (1988)).[5] Apart from explicitly controlling for all known determinants of

[5]Examining new bond issues, Guedes and Opler (1996) come to a somewhat different conclusion from Barclay and Smith (1995) and Stohs and Mauer (1994). They find that large firms with investment-grade credit ratings typically borrow both at the short end and at the long end of the maturity spectrum, whereas firms with speculative-grade credit ratings typically borrow in the middle of the maturity spectrum.

debt maturity structure that may also affect the firm's credit quality, including firm fixed effects and year fixed effects, we also perform instrumental variable (IV) regressions to correct for any potential endogeneity bias.

3 Data and Descriptive Statistics

3.1 Data Sources

We obtain data on long-term credit ratings assigned to firms from Standard and Poor (S&P). This data is available on a monthly basis. We transform the credit rating into an ordinal scale ranging from 1 to 22, where 1 represents a rating of AAA and 22 represents a rating of D; i.e., a smaller numerical value represents a higher rating (see Appendix for details). We align the monthly credit rating data from S&P with annual firm financial information from Compustat. Our sample spans the time period 1980–2008, and consists of all firms that have an S&P long-term credit rating and are covered by Compustat. We drop those firm-year observations in which a firm changes its fiscal year end.

We obtain data on long-term corporate bond yields from two modules of the Mergent Fixed Income Securities Database (FISD). The first module provides issue characteristics, while the second module provides transaction prices for all bond trades since 1995 among insurance companies from the National Association of Insurance Commissioners (NAIC). We focus on trades for investment-grade bonds because, by regulation, insurance companies often limit their investment to investment-grade bonds; hence, speculative-grade bond trades in the FISD database are unlikely to be representative of the general market (see Campbell and Taksler (2003)). We estimate the yield to maturity for each bond trade using the transaction price, time to maturity and coupon rate. We then calculate the yield spread for a bond during a month by subtracting the yield to maturity on a U. S. treasury bond of similar maturity from the average yield to maturity on all transactions for the bond during the month. We obtain benchmark treasury yields from the website of the Federal Reserve Board. We winsorize the data on yield spreads at the 1% level to reduce apparent data recording error in FISD.

We obtain information on individual stock returns and returns on the CRSP value-weighted index from the CRSP database, and use these to compute firm-specific volatility, market volatility, and average returns on stocks and the market index in each year. Finally, we obtain information on compensation of the firm's Chief Financial Officer (CFO) from the S&P's Execucomp database.

3.2 Key Variables

Our analysis is aimed at understanding whether the rollover risk arising from a firm's reliance on short-maturity debt affects its overall credit quality, independent of its operating risk, leverage and credit rating. Accordingly, our main independent variable of interest is *Rollover*, the proportion of the firm's debt due within one year. We define *Rollover* as the ratio of total debt in current liabilities (Compustat item *dlc*) to total debt (the sum of *dlc* and long-term debt *dltt*). Thus, firms with higher value of *Rollover* are exposed to greater rollover risk, all else equal. In our empirical tests, we examine whether firms with high lagged values of *Rollover*, have higher bond yield spreads, and are more likely to experience a deterioration in their credit quality, all else equal.

We use *Yield Spread*, defined as the difference between the average yield to maturity on all transactions for a bond during the month and the yield on a U. S. government treasury with the same maturity, as a market measure of the bond's credit risk. We estimate the yield to maturity for each bond trade using the transaction price, time to maturity and coupon rate obtained from FISD. We winsorize the data on yield spreads at the 1% level to reduce apparent data recording error in FISD.

We use downgrades in credit rating to identify deterioration in a firm's credit risk. The dummy variable *Downgrade* identifies firms whose credit rating has been downgraded during the year. The variable *Notches Downgrade* is defined as the maximum number of notches by which a firm's credit rating is downgraded during any month of the year; it takes the value zero if the firm's rating is not downgraded during the year. The dummy variable, *Multi-notch Downgrade* identifies firms whose credit rating has been downgraded by more than one notch during the year; i.e., it identifies a more severe deterioration in credit quality.[6] The dummy variable *Default* identifies firms whose credit rating has been downgraded to a 'D'.

[6] The following example illustrates how we construct the two measures. Suppose a firm starts with a rating of AA in January. In March during the same year, its rating drops to AA- (1-notch downgrade), and in August the rating continues to drop to A- (3-notche downgrade from March), and stays at A- until the end of the year. In this example, *Notches Downgrade* = 3, and *Multi-notch Downgrade* = 1.

3.3 Descriptive Statistics and Univariate Tests

In Panel A of Table 1, we divide the firms into two sub-samples based on whether *Rollover* is above or below the sample median, and compare the average yield spreads of bonds issued by the firms in the two sub-samples. We present this comparison separately for the different sectors (financial firms, utilities and industrial firms), rating categories and maturity categories. We classify firms into three rating categories: High-Rated firms (those with S&P rating $\in$ {AAA, AA+, AA, AA-}), Medium-Rated firms (S&P rating $\in$ {A+, A, A-}), and Low-Rated firms (S&P rating $\in$ {BBB+, BBB, BBB-}). Recall that we limit bond transaction data to only that investment-grade bonds. In terms of maturity categories, we classify bonds as short-maturity bonds (maturity less than 7 years), medium-maturity bonds (maturity between 7 and 15 years) and long-maturity bonds (maturity between 15 and 30 years). As can be seen from Panel A, regardless of the sector, rating category or maturity category, bonds issued by firms with above median values of *Rollover* on average trade at higher yield spreads as compared to bonds issued by firms with below median values of *Rollover*.

[Insert Table 1 here.]

We present the descriptive statistics for our full sample in Panel B of Table 1. The mean value of *Size* of 8.015 in our sample corresponds to an average book value of total assets of approximately $3 billion. The corresponding value for the full Compustat sample during the same time period is $82 million. Thus, our sample of rated firms includes the larger firms in Compustat. Firms in our sample have an average market-to-book ratio of 1.456 and spend about 1% of their total assets in R&D. The median value of firm credit rating in our sample is 9 which corresponds to a rating of BBB. Consistent with this, we find that about 64% of the firms in our sample have investment-grade ratings (BBB- or above). The average firm in our sample has a 13.3% likelihood of experiencing a rating downgrade during the year, and a 4.4% likelihood of experiencing a multi-notch downgrade. The mean value of 0.317 for *Multi-notch Downgrade* (*Conditional*) indicates that, conditional on experiencing a downgrade during the year, there is a 32% chance that the firm's credit rating is downgraded by two notches or more. Similarly, the mean of 1.55 on *Notches Downgrade (Conditional)* indicates that, conditional on experiencing a downgrade during the year, the firm's credit rating is downgraded by 1.55 notches on average. The mean value of *Rollover* is 0.19, which means that the average firm in our sample has 19% of its total debt maturing within one year. As can be seen, the median of *Rollover* is significantly lower at 0.093, which suggests an upward skew in the distribution of *Rollover*.

In Panel C of Table 1, we provide a univariate comparison of the financial characteristics of the high-rollover and low-rollover firms, where high-rollover (low-rollover) firms are defined as those which have a larger (lower) fraction of short-maturity debt compared with the median firm. As can be seen, in our sample, firms with a higher proportion of short-maturity debt tend to be larger in size, have marginally lower market-to-book ratios, have significantly better credit ratings (i.e., lower value of *Rating*), are more profitable, have higher interest coverage ratios and lower leverage ratios, are in industries with lower volatility of earnings, and have less volatile stock return compared to firms with low proportion of short-maturity debt; i.e., *high-rollover firms are observably less risky than low-rollover firms, on average.* Despite this, high-rollover firms are more likely to experience severe rating downgrades, as evidenced by the higher average values of *Multi-notch Downgrade* and *Notches Downgrade*, both unconditionally and conditional on a downgrade. This is consistent with the key prediction of the rollover risk hypothesis that firms that rely more on short-maturity debt are more likely to experience a deterioration in their credit quality.

4 Empirical Results

4.1 Exposure to Rollover Risk and Yield Spreads on Long-Term Bonds

We begin our analysis by examining whether the yield spreads on a firm's bonds are affected by the maturity structure of its debt, after controlling for all the other factors that the existing literature has shown to affect bond yield spreads. We do this by replicating the bond return model in Campbell and Taksler (2003), after including the lagged value of *Rollover* as an additional regressor. Specifically, we estimate the following panel regression on a panel with one observation for each bond-month pair:

$$\begin{aligned} \text{Yield Spread}_{b,\tau} \quad &= \quad \alpha + \beta \times \text{Short}_{i,t-1} + \gamma_1 \times X_{i,t-1} + \gamma_2 \times X_b + \gamma_3 \times X_{m,\tau} \\ &\quad + \text{Rating FE} + \text{Industry or Firm FE} + \text{Year FE}, \end{aligned} \tag{1}$$

In equation (1), the subscripts b, i, m, τ and t indicate the bond, the firm, the market, the month and the year, respectively, and the term FE denotes fixed effect. The dependent variable *Yield Spread*$_{b,\tau}$ is the yield spread for bond (b) measured over the month (τ). Our sample selection criteria mirrors that of Campbell and Taksler (2003). Specifically, we focus on trades for investment-grade bonds because, by regulation, insurance companies often limit their investment to investment-grade bonds; hence, non-investment-grade bond trades in the FISD database are unlikely to be representative of the general market. We restrict our sample to fixed-rate U.S. dollar-denominated bonds in the industrial, financial and utility sectors that are not defeased, defaulted or in default process. We exclude any bonds that are callable, puttable, convertible, exchangeable, with sinking fund or with refund protection. We also exclude issues that are asset-backed or include credit-enhancement features to ensure that the bonds are backed solely by the creditworthiness of the issuer.

The firm characteristics ($X_{i,t}$) that we control for are: *Average Excess Return* and *Equity Volatility*, defined as the mean and standard deviation, respectively, of the firm's daily excess return (i.e., return on the firm's stock minus the return on the CRSP value-weighted index) over the 180 days preceding (not including) the bond trade; *Market Cap/ Index*, defined as the ratio of the firm's market capitalization to the market capitalization of the CRSP value-weighted index; the ratio of total long-term debt to the book value of total assets (*Long-Term Debt/Assets*); the ratio of total debt to the sum of the market value of equity and book value of total liabilities (*Total Debt/Market Value*); the ratio of operating income before depreciation to net sales (*Operating Income/Sales*); and four dummy variables that identify firms with *Interest Coverage* (the ratio of the sum of operating income after depreciation and interest expense to interest expense) below 5, between 5 and 10, between 10 and 20, and above 20, respectively. The bond characteristics (X_b) that we control for are the bond's remaining maturity in years (*Maturity*), the yield offered at the time of the bond's issue (*Offering Yield*), and the natural logarithm of the dollar size of the issue (*Log (Amount)*). The market characteristics ($X_{m,\tau}$) that we control for are: *Average Index* and *Systematic Volatility*, defined as the mean and standard deviation, respectively, of the daily return on the CRSP value-weighted index over the 180 days prior to (not including) the bond transaction date; and *Treasury Slope*, defined as the difference in yield between a 10-year treasury and a 2-year treasury.

The results of our estimation are presented in Table 2. In Column (1), we estimate the regression on all the bonds in our sample, and include year and industry fixed effects, where industry is identified at the level of the four-digit SIC code. The positive and significant coefficient on *Rollover* indicates that bonds issued by firms that have a higher proportion of debt maturing within the year trade at higher yield spreads, even after controlling for all the other factors that are known to affect bond yields, including the firm's credit rating. This result highlights that reliance on short-maturity debt increases a firm's overall credit risk, over and above what is captured by its credit rating. Equivalently, credit ratings do not seem to adequately account for the rollover risk emanating from the firm's reliance on short-maturity debt.

[Insert Table 2 here.]

The coefficients on the control variables are consistent with those in Campbell and Taksler (2003). In particular, bond yield spreads are higher for firms with higher idiosyncratic volatility and during periods of high market volatility (positive coefficients on *Idiosyncratic Volatility* and *Systematic Volatility*), and are lower for firms with higher excess return and when market returns are high (negative coefficients on *Average Excess Return* and *Average Index*). Bond yield spreads are also lower for large bond offerings and for bonds offered by large firms, and are higher for longer maturity bonds.

Our results are economically significant. The coefficient estimate in Column (1) indicates that a one standard-deviation increase in *Rollover* is associated with a higher bond yield spread of 5 basis points. In comparison, the average bond yield spread in our sample is 113 basis points. In Column (2), we repeat our estimation with firm fixed effects instead of industry fixed effects, and obtain similar results. As can be seen, the magnitude of the coefficient on *Rollover* is the same as in Column (1).

In Columns (3) and (4), we repeat the regression separately on the subsamples of bonds issued by small and large firms, respectively, where small (large) firms are defined as those whose size, in terms of the book value of total assets, is lower (higher) than the median size during the year. As can be seen, the coefficient on *Rollover* is significant in Column (3) but not in Column (4), which indicates that the return premium we identified in Column (2) is confined only to bonds issued by small firms. This may be because large firms have better access to the commercial paper market, which enables them to roll over their maturing debt more easily.

In Columns (5) and (6), we repeat the regression separately on the subsamples of high-rated bonds (i.e., bonds with credit rating $\in$ {AAA, AA+, AA, AA-}) and low-rated bonds (i.e., bonds with credit rating $\in$ {BBB+, BBB, BBB-}). We find that in both subsamples, bonds issued by firms that have a higher proportion of debt maturing within the year trade at higher yield spreads. Moreover, the magnitude of the coefficient on *Rollover* is similar in both subsamples. This is important because it highlights that our finding is not being driven by firms of poor credit quality.

Overall, the evidence in Table 2 indicates that bond market investors seek a premium for investing in bonds issued by firms with a high proportion of debt maturing in the short term, even after controlling for the firm's credit rating. This result suggests that debt maturity structure matters independent of the credit rating. All else equal, greater reliance on short-maturity debt increases the firm's overall credit risk, but this is not captured by the firm's credit rating.

4.2 Exposure to Rollover Risk and Deterioration in Credit Quality

So far, we have shown that firms with a higher proportion of debt maturing within the year have higher credit risk, as proxied by their bond yield spreads. This finding is consistent with the idea that exposure to rollover risk increases the firm's overall credit risk, because the risk of rollover is borne by long-term bondholders (Morris and Shin (2009)). However, a sharper and more direct test for the rollover risk hypothesis is to examine whether firms with a higher proportion of debt maturing within the year are more likely to experience deterioration in their credit quality, all else equal. This would directly test theoretical predictions that exposure to rollover risk exacerbates the impact of negative shocks.

We estimate panel regressions that are variants of the following form:

$$y_{i,t} = \alpha + \beta \times \text{Short}_{i,t-1} + \gamma \times X_{i,t-1} + \text{Industry or Firm FE} + \text{Year FE}. \qquad (2)$$

where the dependent variable $y_{i,t}$ measures deterioration in the firm's credit quality, and is one of the following: *Default*, *Notches Downgrade* and *Multi-notch Downgrade*. Recall that *Default* is a dummy variable that identifies firms that have been downgraded to a rating of 'D', *Notches Downgrade* is the maximum number of notches by which a firm's credit rating is downgraded during any month of the year, and *Multi-notch Downgrade* is a dummy variable that identifies firms whose credit rating has been downgraded by more than one notch during the year. We estimate regression (2) on a panel that has one observation for each firm-year combination.

We control the regression for a number of firm characteristics ($X_{i,t}$) that may affect the likelihood of a deterioration in credit quality. We control for firm size using the logarithm of the book value of total assets, and for credit quality using *Investment Grade*, a dummy variable that identifies firms with investment-grade ratings (BBB- or better) at the end of the previous year. We control for size in a piecewise-linear manner because prior literature has identified a nonlinear relationship between size, reliance on short-term debt and credit quality (Barclay and Smith (1995), Guedes and Opler (1996)). Specifically, we divide our sample into three terciles based on the book value of total assets, and include three interaction terms between *Size* and dummy variables identifying firms belonging to these terciles. We also control for *Long-Term Debt/TA*, *Total Debt/Market Value*, *Operating Income/Sales* and *Interest Coverage*, because these accounting ratios have been shown to affect credit ratings (Blume et al. (1998), Pinches and Mingo (1973), and Pogue and Poldofsky (1969)). In addition, we also control for the firm's growth opportunities using *Market-to-Book* and *R&D/TA*; for the firm's operating risk using *Industry Volatility* and *Idiosyncratic Volatility*; and for the firm's asset composition using *Tangibility* and *Cash/TA*. All variables are defined in the Appendix.

The identifying assumption in the panel regression (2) is that *Rollover* is exogenous, after controlling for all the covariates described above and including firm fixed effects. We deal with any potential endogeneity bias in Section 4.3, where we also discuss and rule out alternative explanations for our findings.

4.2.1 Exposure to Rollover Risk and Severity of Rating Downgrades

A firm's credit rating is widely viewed by investors as the key measure of its credit quality. Thus, a downgrade of the firm's credit rating is the most visible evidence of a deterioration in its credit quality. In this section, we examine whether firms that have a higher proportion of debt maturing within the year are more likely to experience severe rating downgrades. The results of our estimation are in Table 3. We include firm and year fixed effects in all specifications. The standard errors are robust to heteroscedasticity and are clustered at the individual firm level.

[Insert Table 3 here.]

In Panel A, we present the results of the panel regression (2) with *Notches Downgrade* as the dependent variable. In Column (1), we estimate the regression on all the firms in our sample. The positive and significant coefficient on *Rollover* indicates that firms with a higher proportion of debt maturing within the year experience more severe rating downgrades. Since we have firm fixed effects in the specification, the coefficient measures the within-firm increase in downgrades when the firm has a higher proportion of debt maturing within the year. The coefficient is also economically significant: a one-standard-deviation increase in *Rollover* is associated with an increase of 0.0714 in the number of notches downgrade. In comparison, the sample mean value of *Notches Downgrade* is 0.205.

In terms of the coefficients on the control variables, the insignificant coefficients on *Size*Tercile 1*, *Size*Tercile 2* and *Size*Tercile 3* indicate that firm size does not affect the severity of rating downgrades in any of the size terciles. There is no evidence to suggest that observably riskier firms experience more severe rating downgrades. On the contrary, we find that firms that seem less risky – those with smaller market-to-book ratios, lower idiosyncratic risk, and investment-grade ratings – are likely to experience more severe rating downgrades. We also find that firms with lower cash balance (negative coefficient on *Cash/TA*), lower profitability (negative coefficient on *Operating Income/Sales*), higher leverage (positive coefficient on *Total Debt/Market Value*) and lower interest coverage (negative coefficient on *Interest Coverage*) are more likely to experience rating downgrades.

In Column (2), we repeat the estimation in Column (1) after also including credit rating fixed effects, i.e., dummy variables to represent the 22 rating categories. As can be seen, the coefficient on *Rollover* continues to be positive and significant, and has a similar magnitude as in Column (1). To conserve space, we do not report the coefficients on the rating dummies.

As noted earlier, the choice of debt maturity structure is likely to be determined by firm characteristics such as firm size and credit quality, which may also affect the severity of a rating downgrade. For instance, small firms rely more on short-term debt (Barclay and Smith (1995)) and are also more likely to be financially constrained (Rauh (2006)), which may make them more likely to experience severe rating downgrades. Note that we do control for firm size in Column (1) and find the coefficient to be insignificant. Nonetheless, to ensure that our results are not being driven by a subset of firms, we repeat our estimation separately on the sub-sample of small and large firms in Columns (3) and (4), respectively. Recall that we define small (large) firms as those whose size, in terms of the book value of total assets, is below (above) the median size during the year. As can be seen, the positive association between *Rollover* and the severity of rating downgrades is present for both small and large firms.

In a similar vein, we repeat the estimation separately on the sub-samples of investment-grade firms (those with S&P credit rating of BBB- or better) and below investment-grade firms in Columns

(5) and (6), respectively. As can be seen, the positive association between *Rollover* and the severity of rating downgrades is present for both investment-grade and below investment-grade firms, although the effect is stronger in the latter category.

In Panel B of Table 3, we repeat our estimation with *Multi-notch Downgrade* as the dependent variable. Recall that *Multi-notch Downgrade* is a dummy variable that identifies instances where a firm's credit rating is downgraded by two notches or more. The results in Panel B are qualitatively similar to those in Panel A, and indicate that firms with a higher proportion of debt maturing within the year are more likely to experience severe rating downgrades. The results are again economically significant. The coefficient of 0.087 in Column (2) indicates that a one-standard-deviation increase in *Rollover* is associated with a 2.1% increase in the likelihood of a multi-notch downgrade, which is large in comparison to the sample average likelihood of 4.4% that a firm will experience a multi-notch downgrade during the year. In unreported tests, we find similar results when we repeat the regression with *Triple-notch Downgrade*, a dummy variable that identifies downgrades of at least three notches, as the dependent variable.

To summarize, the main result in Panels A and B is that firms with a higher proportion of debt maturing within the year are more likely to experience a deterioration in their credit quality, even after controlling for their existing credit rating and other observable measures of risk and credit quality. Moreover, the result holds both for small firms and large firms, as well for investment-grade firms and below investment-grade firms. This result is consistent with the prediction of the rollover risk hypothesis, and highlights the effect of debt maturity structure on credit risk.

We explore the rollover risk hypothesis further in Panel C, where we examine whether the positive association between *Rollover* and the severity of rating downgrades is stronger under circumstances when rolling over debt is likely to be more difficult; e.g., when the firm's industry experiences a negative profitability shock, when the economy is in recession, and when credit market conditions are tight. The empirical specification and other control variables are the same as in Panel A. To conserve space, we do not report the coefficients on all the control variables.

In Column (1), we repeat the estimation from Panel A after including two new regressors, *Profit Decline* and *Rollover*×*Profit Decline*, where *Profit Decline* is a dummy variable that identifies whether the firm's industry (at the 2-digit SIC level) experienced a decline in its median operating profitability (measured using the ratio *Operating Income/Sales*) over the previous year.

As can be seen, a negative shock to industry profitability not only increases the severity of rating downgrades (positive coefficient on *Profit Decline*), but this increase is higher for firms with a higher proportion of debt maturing within the year (positive coefficient on *Profit Decline* × *Rollover*). This is consistent with the idea that rollover risk exacerbates the impact of negative operating shocks.

On a similar note, in Column (2), we examine whether the positive association between *Rollover* and severity of rating downgrades is stronger during recessions. We use the NBER's classification of recessions to code the years 1981, 1982, 1990, 1991 and 2001 as recession years during our sample period. We then repeat our estimation after including a dummy variable *Recession* that identifies the recession years, and an interaction term *Recession* × *Rollover.* Our results in Column (2) indicate that while rating downgrades are no more severe during recessions, the effect of *Rollover* on the severity of rating downgrade is greater during recessions (positive coefficient on *Recession* × *Rollover*).

In Column (3), we examine the impact of credit market conditions on the association between *Rollover* and the severity of rating downgrades. Following Hartford (2005), we measure credit market conditions using the spread between the prime rate on bank loans and the federal funds rate. We obtain data for both variables from the Federal Reserve Board's website. We code the variable *High Bank Spread* equal to one for the years in which the bank spread is above the sample median. We repeat our estimation after including *High Bank Spread* and the interaction term *High Bank Spread*×*Rollover* as additional regressors. We find that rating downgrades are more severe during years when the bank spread is high, and that this effect is stronger for firms that have a higher proportion of debt maturing within the year.

4.2.2 Exposure to Rollover Risk and Propensity to Default

In this section, we examine whether firms that have a higher proportion of debt maturing within the year are also more likely to default on their long-term debt obligations, all else equal. To do this, we estimate the panel regression (2) with *Default* as the dependent variable. Note that, unlike with other rating categories, the rating agency has no discretion when assigning a 'D' rating, which is assigned automatically when the firm defaults on its debt obligations. So by using *Default* as the dependent variable, we can abstract away from the rating agency's choice of whether to downgrade the firm's rating or not. However, *Default* is an extreme form of deterioration in credit quality, and is very uncommon as evidenced by its sample mean of 0.5%. The results of our estimation are presented in Table 4.

[Insert Table 4 here.]

In Columns (1) and (2), we estimate panel OLS regressions on our entire sample of firms. We include year fixed effects in both columns, industry fixed effects (at the 4-digit SIC code level) in Column (1) and firm fixed effects in Column (2). The positive and significant coefficient estimates on *Rollover* indicate that firms with a higher proportion of debt maturing within the year are more likely to default on their debt, all else equal. The results are also highly economically significant: the coefficient estimate in Column (2) indicates that a one standard-deviation increase in *Rollover* is associated with a 0.52% increase in the propensity to default, as against the sample average probability of default of 0.5%.

In Columns (3) and (4), we repeat the estimation in Column (2) separately on the subsamples of small and large firms, respectively. As with our findings in Table 2, we find that the coefficient on *Rollover* is positive only for the sub-sample of small firms. As we argued earlier, this may be because large firms have better access to the commercial paper market, which enables them to roll over their debt more easily and forestall default.

In Column (5), we estimate a Cox proportional hazards model as an alternative specification. As can be seen, the positive coefficient on *Rollover* is robust to this alternative specification. In unreported tests, we obtain similar results when we estimate a logit regression. Overall, the results in Table 4 indicate that firms with a higher proportion of debt maturing within the year are more likely to default on their debt obligations, even after controlling for their current credit rating and other known determinants of default.

4.3 Ruling out Alternative Explanations

We showed in Section 4.2 that firms with a higher proportion of their debt maturing within the year are more likely to experience a deterioration in their credit quality, even after controlling for their credit rating and other observable measures of risk. This interpretation relies on the identifying assumption that *Rollover* is exogenous, once we control for credit rating, observable measures of risk, and firm fixed effects. However, our identifying assumption may not be valid if some unobserved time-varying omitted variable affects both the debt maturity structure and the likelihood of a deterioration in credit quality. In this section, we perform additional robustness tests to rule out alternative explanations for our findings.

4.3.1 Operating Risk versus Rollover Risk

One potential alternative explanation for our findings is that they reflect the impact of operating risk or business risk, and not rollover risk arising from the firm's debt maturity structure; i.e., it is possible that riskier firms both rely more on short-term debt and also experience more severe rating downgrades because they are more risky. We believe that this is unlikely for two reasons. First, in our sample, which comprises only the large Compustat firms, the firms that rely more on short-term debt tend to be larger and less risky, presumably because these are the firms that issue commercial paper. Second, as we have shown, our results hold both for small and large firms, as well as for both investment-grade and below investment-grade firms. Nonetheless, we perform an additional test specifically to confront this alternative explanation.

Our test relies on the idea that the impact of rollover risk on credit risk is asymmetric in nature: rollover risk exacerbates the impact of negative shocks but does not affect credit quality following a positive shock to the firm. Thus, the rollover risk hypothesis predicts a positive association between *Rollover* and rating downgrades, but no association between *Rollover* and rating upgrades. On the other hand, operating risk should make both upgrades and downgrades more likely. Therefore, if the positive association between *Rollover* and rating downgrades is being driven by operating risk, then we should find a similar positive association between *Rollover* and rating upgrades.

To distinguish between these two hypotheses, we estimate the panel regression (2), with *Notches Upgrade* as the dependent variable, where *Notches Upgrade* is the maximum number of notches by which a firm's credit rating is upgraded during any month of the year. The results of our estimation are presented in Table 5. The empirical specification in each column of Table 5 is exactly as the same as the corresponding column of Table 3, Panel A. As can be seen, in all but one specification, the coefficient on *Rollover* is either insignificant or negative. This indicates that our earlier finding, that firms with a higher proportion of debt maturing within the year are more likely to experience deterioration in credit quality, is more consistent with rollover risk than operating risk.

[Insert Table 5 here.]

4.3.2 Addressing Potential Endogeneity Problems

As we noted earlier, the maturity structure of corporate debt is endogenous. While we control for all observable firm characteristics that past literature has shown to affect firms' debt maturity choice, and also include firm fixed effects to control for time-invariant omitted variables, it is possible to argue that our results are being driven by some time-varying omitted variable that determines both the proportion of debt that needs to be rolled over and deterioration in credit quality. In this section, we do two sets of tests to address potential endogeneity problems.

Our first set of tests are based on the idea (used in Almeida et al. (2009)) that rollover risk depends only on the amount of debt that needs to be rolled over, regardless of whether the debt being rolled over is short-term debt that was issued recently or is long-term debt issued in the past that happens to mature in the current year. Recognizing this, we repeat the panel regression (2) with *Multi-notch Downgrade* as the dependent variable after replacing *Rollover* with *Rollover (L.T.Debt)*, which is defined as the ratio of long-term debt due within the year (Compustat item 'dd1') to total debt. Since the amount of long-term debt due within the year depends on the firm's long-term debt structure and its repayment schedule, both of which are likely to have been determined in the past, any omitted variable that is not captured by firm fixed effects cannot cause a positive association between *Rollover (L.T.Debt)* and severity of rating downgrades.

The results of our estimation are presented in Panel A of Table 6. As can be seen, the coefficient on *Rollover (L.T.Debt)* is positive and significant in the specifications where we include all the firms in our sample (Columns (1) and (2)). When we repeat the regression separately on the sub-samples of small and large firms, we fail to detect any relationship between *Rollover (L.T.Debt)* and deterioration in credit quality for the large firms, presumably because large firms are better able to roll over any long-term debt that is maturing in the current year. On a similar note, and presumably for the same reason, there is no relationship between *Rollover (L.T. Debt)* and deterioration in credit quality for the investment-grade firms.

[Insert Table 6 here.]

In Panel B of Table 6, we present the results of an instrumental variables (IV) regression, where we instrument for *Rollover* using the following three variables: *10-Year T-Rate*, which is the yield to maturity on a U. S. Treasury bond with a 10-year maturity; *Log(CFO Delta)*, where *CFO Delta* measures the sensitivity of the Chief Financial Officer's total compensation to stock price; and *Log(CFO Vega)*, where *CFO Vega* measures the sensitivity of the CFO's total compensation to stock price volatility.[7] The identifying assumption behind using *10-Year T-Rate* as an instrument is that firms are more likely to issue short-term debt when long-term interest rates are high (by the market timing argument of Baker et al. (2003), Barclay and Smith (1995), and Guedes and Opler (1996)), but that high long-term interest rates do not directly lead to deterioration in credit quality. The identifying assumption behind *Log(CFO Delta)* and *Log(CFO Vega)* as instruments is that low *CFO Delta* and high *CFO Vega* incentivize the CFO to take on more short-term debt (see Chava and Purnanandum (2009)), but otherwise, do not directly lead to deterioration in credit quality.

In Column (1), we reproduce the results of the OLS regression with *Multi-notch Downgrade* as dependent variable, for ease of comparison. The results of the IV regression are reported in Column (2). As can be seen, the coefficient on *Rollover* in Column (2) is not only positive and significant, but is much larger in magnitude compared with the OLS coefficient in Column (1). This is to be expected because, as we pointed out earlier in Section 3.3, in our sample, firms that have a higher proportion of their debt maturing within the year are also less risky, and hence, less likely to experience a deterioration in their credit quality. Therefore, OLS estimation, which does not correct for the endogeneity of *Rollover*, will underestimate the true impact of *Rollover* on deterioration in credit quality.

5 Conclusion

In this paper, we examine whether a firm's debt maturity structure affects its credit risk, independent of its credit rating, leverage and other known risk factors. Our analysis is motivated by a large body of theoretical research which argues that the rollover risk arising out of a firm's reliance on short-maturity debt increases its overall credit risk by making the firm susceptible to a run by its creditors, especially when firm fundamentals are weak and when credit market conditions are tough. We refer to this as the rollover risk hypothesis.

Our empirical findings offer strong support to the rollover risk hypothesis. We find that long-

[7] We obtain data on CFO compensation from the Standard and Poor's Execucomp database, for the time period 1992-2008. We identify the CFO from the annual title of the top 5 officers (Execucomp item 'titleann'). Specifically, we classify an executive officer as the CFO is his/ her annual title matches one of the following: treasurer, finance controller, VP-finance, or CFO. We then estimate the CFO's Delta and Vega following the procedure in Core and Guay (1999).

term bonds of firms that have a higher proportion of debt maturing within the year trade at higher yield spreads, even after controlling for all known determinants of bond yield spreads including the firm's credit rating. Firms with a higher proportion of short-maturity debt are also more likely to default on their debt obligations, all else equal. These findings on bond yield spreads and default probabilities suggest that firms with high exposure to rollover risk have higher default risk.

Using credit rating downgrades to identify deterioration in a firm's credit quality, we find that firms with a higher proportion of debt maturing within the year are more likely to experience larger rating downgrades and multi-notch downgrades. This effect is stronger when the firm's operating profits are under pressure and when credit market conditions are tight. The positive association between the proportion of short-maturity debt and deterioration in credit quality is present in both small and large firms, in both investment-grade and below investment-grade firms, and is robust to instrumenting for the proportion of short-maturity debt.

Our results also suggest that credit rating agencies do not adequately account for rollover risk. This is highlighted by our findings that firms with a high proportion of short-maturity debt have higher bond yield spreads and are more likely to experience severe rating downgrades, even after controlling for the firm's credit rating. Failure to fully account for rollover risk can lead to inflated ratings, especially for entities like structured investment vehicles and special purpose entities that are financed to a large extent with short-maturity debt. Thus, our findings suggest another potential explanation for the failure of rating agencies to correctly evaluate the default risks of such special financing entities, that were at the heart of the recent financial crisis.

References

Acharya, V., D. Gale, and T. Yorulmazer (2010). Rollover risk and market freezes. Working Paper, New York University.

Almeida, H., M. Campello, B. Laranjeira, and S. Weisbenner (2009). Corporate debt maturity and the real effects of the 2007 credit crisis. NBER working paper no. 14990.

Baker, M., R. Greenwood, and J. Wurgler (2003). The maturity of debt issues and predictable variation in bond returns. *Journal of Financial Economics 70*, 261–291.

Barclay, M. J. and C. W. Smith (1995). The maturity structure of corporate debt. *Journal of Finance 50*, 609–631.

Benmelech, E. and J. Dlugosz (2009). The credit rating crisis. NBER Working Paper Series.

Berger, A. N., M. Espinosa-Vega, S. Frame, and N. Miller (2005). Debt maturity, risk, and asymmetric information. *Journal of Finance 60*, 2895–2923.

Blume, M. E., F. Lim, and A. C. Mackinlay (1998). The declining credit quality of u.s. corporate debt: Myth or reality? *Journal of Finance 53*, 1389–1413.

Bolton, P., X. Freixas, and J. Shapiro (2009). The credit ratings game. NBER Working Paper.

Campbell, J. Y. and G. B. Taksler (2003). Equity volatility and corporate bond yields. *Journal of Finance 58*, 2321–2349.

Chava, S. and A. Purnanandum (2009). Ceos vs. cfos: Incentives and corporate policies. *Journal of Financial Economics*.

Core, J. and W. Guay (1999). The use of equity grants to manage optimal equity incentive levels. *Journal of Accounting and Economics 28*, 151–184.

Diamond, D. (1991). Debt maturity structure and liquidity risk. *Quarterly Journal of Economics 106*, 709–38.

Diamond, D. (1993). Seniority and maturity of debt contracts. *Journal of Financial Economics 33*, 341–368.

Duchin, R., O. Ozbas, and B. A. Sensoy (2009). Costly external finance, corporate investment, and the subprime mortgage credit crisis. Forthcoming, Journal of Financial Economics.

Flannery, M. J. (1986). Asymmetric information and risky debt maturity choice. *Journal of Finance 41*, 19–37.

Froot, K., D. Scharfstein, and J. Stein (1993). Risk management : Coordinating corporate investment and financing policies. *Journal of Finance 48*, 1629–1658.

Grier, P. and S. Katz (1976). The differential effects of bond rating changes among industrial and public utility bonds by maturity. *Journal of Business 49*, 226–239.

Guedes, J. and T. Opler (1996). The determinants of the maturity of corporate debt issues. *Journal of Finance 51*, 1809–1833.

Hartford, J. (2005). What drives merger waves? *Journal of Financial Economics 77*, 529–560.

He, Z. and W. Xiong (2010a). Dynamic debt runs. Working Paper, Princeton University.

He, Z. and W. Xiong (2010b). Rollover risk and credit risk. Working Paper, Princeton University.

Hettenhouse, G. and W. Sartoris (1976). An analysis of the informational value of bond rating changes. *Quarterly Review of Economics and Business 16*, 65–78.

Kale, J. R. and T. H. Noe (1990). Risky debt maturity choice in a sequential game equilibrium. *Journal of Financial Research*.

Morris, S. and H. S. Shin (2009). Illiquidity component of credit risk. Working Paper, Princeton University.

Myers, S. (1977). Determinants of corporate borrowing. *Journal of Financial Economics 2*, 147–175.

Pinches, G. E. and K. A. Mingo (1973). A multivariate analysis of industrial bond ratings. *Journal of Finance 28*, 1–16.

Pinches, G. E. and J. C. Singleton (1978). The adjustment of stock prices to bond rating changes. *Journal of Finance 33*, 29–44.

Pogue, T. F. and R. M. Poldofsky (1969). What's in a bond rating? *Journal of Financial and Quantitative Analysis 4*, 201–228.

Rauh, J. (2006). Investment and financing constraints: Evidence from the funding of corporate pension plans. *Journal of Finance 61*, 33–71.

Sharpe, S. A. (1991). Credit rationing, concessionary lending, and debt maturity. *Journal of Banking and Finance 15*, 581–604.

Skreta, V. and L. Veldkamp (2009). Ratings shopping and asset complexity: A theory of ratings inflation. NBER Working Paper Series.

Stohs, M. H. and D. C. Mauer (1994). The determinants of corporate debt maturity structure. Unpublished manuscript, University of Wisconsin, Madison, WI.

Titman, S. (1992). Interest rate swaps and corporate financing choices. *Journal of Finance 47*, 1503–1516.

Titman, S. and R. Wessels (1988). The determinants of capital structure choice. *Journal of Finance 43*, 1–20.

Appendix: Variable Definitions

The variables used in the empirical analysis are defined as follows:

- Size: natural logarithm of book value of total assets.
- Size (i), $i \in \{1, 2, 3\}$: size $\times$ d_i, where d_i is a dummy variable that takes the value 1 if the firm's book value of total assets belongs to the ith's tercile of its distribution, and 0 otherwise.
- Market-to-Book: $\frac{\text{book value of total assets} - \text{book value of equity} + \text{market value of equity}}{\text{book value of total assets}}$.
- R&D/TA: $\frac{\text{R\&D expenditures}}{\text{book value of total assets}}$.
- Investment Grade: dummy variable that takes the value 1 if a firm's credit rating is BBB- or better, and 0 otherwise.
- Rating$_{t-1}$: S&P long-term credit rating of the firm in the previous year coded as follows: AAA = 1, AA+ = 2, AA = 3, AA- = 4, A+ = 5, A = 6, A- = 7, BBB+ = 8, BBB = 9, BBB- = 10, BB+ = 11, BB = 12, BB- = 13, B+ = 14, B = 15, B- = 16, CCC+ = 17, CCC = 18, CCC- = 19, CC = 20, C = 21, D = 22.
- Downgrade: dummy variable that takes the value 1 if Rating$_t$ > Rating$_{t-1}$.
- Short: $\frac{\text{current liabilities}}{\text{current liabilities} + \text{long-term debt}}$.
- Notches Downgrade: maximum number of notches by which a firm's credit rating is downgraded during any month of a year.
- Multi-notch Downgrade: dummy variable that takes the value 1 if Notches Downgrade $\geq$ 2, and 0 otherwise.
- Notches Downgrade (Conditional): maximum number of notches by which a firm's credit rating is downgraded during the year conditional on there being a downgrade.
- Multi-notch Downgrade (Conditional): the value of Multi-notch Downgrade conditional on there being downgrade during the year.
- Operating Income/Sales: $\frac{\text{operating income after depreciation}}{\text{sales}}$.
- Total Debt/Market Value: $\frac{\text{total debt}}{\text{market value of equity} + \text{book value of total liabilities}}$.
- Long-Term Debt/TA: $\frac{\text{long-term debt}}{\text{book value of total assets}}$.
- Interest Coverage: $\frac{\text{operating income after depreciation} + \text{interest and related expense}}{\text{interest and related expense}}$.
- Industry Volatility: standard deviation of cross-sectional operating incomes of all firms in the same industry, where industry is defined at the level of two-digit SIC code..
- Idiosyncratic Volatility: standard deviation of daily excess returns relative to the CRSP value-weighted index for each firm's equity during a year.
- Tangibility: $\frac{\text{property, plant and equipment}}{\text{book value of total assets}}$.
- Cash/TA: $\frac{\text{cash}}{\text{book value of total assets}}$.

- Profit Decline: dummy variable that takes the value 1 if the firm's residing industry experiences a decline in profitability from the previous year, where industry is defined at the two-digit SIC code level and profitability is measured as the median value of $\frac{\text{operating income after depreciation}}{\text{sales}}$ of all firms in that industry, and 0 otherwise.
- Recession: dummy variable that takes the value 1 for years 1981, 1982, 1990, 1991 and 2001, and 0 otherwise.
- High Bank Spread: dummy variable that takes the value 1 for the years when the spread between the prime rate on bank loans and the federal funds rate is above its sample median, and 0 otherwise.
- Improve: dummy variable that takes the value 1 if the firm's rating improves from below investment grade to investment grade, and 0 otherwise.
- Negative Outlook: dummy variable that takes the value 1 if S&P's rating outlook for the firm is negative, and 0 otherwise.
- CP Spread: spread of commercial paper over (3-month) treasury bill rate.
- CP Rating: dummy variable that takes the value 1 if the S&P short-term issuer credit rating is higher than C, and 0 otherwise.
- Average Excess Return: mean of daily excess returns relative to the CRSP value-weighted index for each firm's equity over the 180 days prior to (not including) the bond transaction date.
- Equity Volatility: standard deviation of daily excess returns relative to the CRSP value-weighted index for each firm's equity over the 180 days prior to (not including) the bond transaction date.
- Average Index: mean of the CRSP value-weighted index returns over the 180 days prior to (not including) the bond transaction date.
- Systematic Volatility: standard deviation of the CRSP value-weighted index returns over the 180 days prior to (not including) the bond transaction date.
- Market Cap/Index: $\frac{\text{market value of equity}}{\text{CRSP valued-weighted index}}$.
- Treasury Slope: 10-year treasury rate $-$ 2-year treasury rate.
- Maturity: years to maturity.
- Offering Yield: yield to maturity at the time of bond issuance.
- Log(Amount): natural logarithm of bond issue size.
- Debt Due in One Year: $\frac{\text{long-term debt due in one year}}{\text{total debt}}$.

Table 1: Summary Statistics

Panel A provides descriptive statistics of yield spreads (in basis points) for three categories of firms: financial, utilities and industrial. The data are collected from the Mergent Fixed Income Securities Database (FISD) for the period 1995-2008. For each category, we split the sample into three subcategories depending on the rating of the firm: High-Rated (AAA, AA+, AA, AA-), Medium-Rated (A+, A, A-) and Low-Rated (BBB+, BBB, BBB-). For each subcategory, we report the mean yield spread of debts with short-term (maturity $\leq$ 7 years), Medium-Maturity (maturity $\in$ (7 years, 15 years]) and Long-Maturity (maturity $\in$ (15 years, 30 years]), for subsamples of firms with proportion of short-term debt, as measured by *Rollover*, above or below its sample median (High-Short and Low-Short, respectively). Panels B and C provide descriptive statistics of the firms. The data are collected from Compustat and CRSP for the period 1980-2008. Panel B summarizes the full sample. Panel C divides the full sample into two subsamples depending on whether the variable *Rollover* is below or above its sample median (Low-Short and High-Short, respectively) and compares the two subsamples, unconditional and conditional on there being a rating downgrade. Details on the definition of the variables are provided in the Appendix. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel A: Yield Spread

		High-Rollover	Low-Rollover	High − Low
Financial Firms				
High-Rated	short-Maturity	74.583	72.810	1.773
High-Rated	Medium-Maturity	97.138	92.111	5.027**
High-Rated	Long-Maturity	138.551	118.417	20.134***
Medium-Rated	Short-Maturity	89.397	77.638	11.759***
Medium-Rated	Medium-Maturity	108.407	108.412	-0.005
Medium-Rated	Long-Maturity	147.204	135.428	11.776***
Low-Rated	Short-Maturity	154.589	133.548	21.041***
Low-Rated	Medium-Maturity	158.324	151.037	7.287*
Low-Rated	Long-Maturity	167.362	172.610	-5.248
Utilities				
		High-Rollover	Low-Rollover	High − Low
High-Rated	Short-Maturity	82.800	68.596	14.204***
High-Rated	Medium-Maturity	70.275	64.816	5.458
High-Rated	Long-Maturity	147.484	125.078	22.406
Medium-Rated	Short-Maturity	114.070	96.270	17.799***
Medium-Rated	Medium-Maturity	120.591	112.993	7.598**
Medium-Rated	Long-Maturity	165.186	137.516	27.670***
Low-Rated	Short-Maturity	120.017	121.353	-1.336
Low-Rated	Medium-Maturity	144.010	131.332	12.678***
Low-Rated	Long-Maturity	176.548	156.339	20.209***
Industrial Firms				
		High-Rollover	Low-Rollover	High − Low
High-Rated	Short-Maturity	60.701	51.444	9.257***
High-Rated	Medium-Maturity	66.218	57.784	8.433***
High-Rated	Long-Maturity	98.177	82.928	15.249***
Medium-Rated	Short-Maturity	83.735	77.970	5.765***
Medium-Rated	Medium-Maturity	92.849	91.658	1.191
Medium-Rated	Long-Maturity	134.181	125.781	8.400***
Low-Rated	Short-Maturity	141.781	135.131	6.651**
Low-Rated	Medium-Maturity	148.373	149.551	-1.178
Low-Rated	Long-Maturity	205.143	194.037	11.106**

Panel B: Descriptive Statistics for the Full Sample

	N	Mean	Median	S.D.
Size	25142	8.015	7.864	1.661
Market-to-Book	25140	1.456	1.218	0.759
R&D/TA	25142	0.012	0	0.029
Rating$_{t-1}$	25142	9.245	9	3.764
Investment Grade	25142	0.626	1	0.484
Downgrade	25142	0.133	0	0.339
Multi-notch Downgrade	25142	0.044	0	0.206
Notches Downgrade	25084	0.205	0	0.669
Multi-notch Downgrade (Conditional)	3332	0.317	0	0.465
Notches Downgrade (Conditional)	3332	1.547	1	1.137
Rollover	24801	0.190	0.093	0.236
Operating Income/Sales	25103	0.135	0.113	0.170
Total Debt/Market Value	24956	2.122	0.448	7.512
Long-Term Debt/TA	25133	0.282	0.260	0.195
Interest Coverage	23142	7.194	4.119	11.723
Industry Volatility	23908	0.114	0.091	0.076
Idiosyncratic Volatility	23459	0.023	0.019	0.014
Tangibility	25142	0.311	0.255	0.272
Cash/TA	25082	0.079	0.041	0.101

Panel C: Low-Rollover Firms versus High-Rollover Firms

	Low-Rollover	High-Rollover	Low − High
Size	7.440	8.606	-1.166***
Market-to-Book	1.539	1.504	0.035***
Rating$_{t-1}$	10.470	7.985	2.485***
Downgrade	0.131	0.136	-0.005
Multi-notch Downgrade	0.040	0.049	-0.009***
Notches Downgrade (Conditional)	1.498	1.595	-0.097***
Operating Income/Sales	0.119	0.152	-0.033***
Total Debt/Market Value	0.916	0.922	-0.006
Long-Term Debt/TA	0.360	0.203	0.157***
Interest Coverage	6.287	8.254	-1.967***
Industry Volatility	.117	.112	.005***
Idiosyncratic Volatility	.025	.021	.004***
Tangibility	.343	.277	.066***
Cash/TA	.081	.077	.004***

Table 2: Debt Maturity Structure and Bond Yield Spreads

This table reports the results of the regressions relating yield spread to the proportion of short-term debt: $\text{Spread}_{b,t} = \beta_0 + \beta_1 \times \text{Rollover}_{i,t} + \beta_2 \times \text{Controls} + \text{Firm or Industry FE} + \text{Year FE}$. Details on the definition of the variables are provided in the Appendix. Columns (1) and (2) report the results for the full sample, with Column (1) including year and industry fixed effects and Column (2) including year and firm fixed effects. Columns (3) and (4) report the results for the subsamples of small firms and large firms, respectively, where small (large) firms are those with size (as measured by book value of total assets) below (above) the sample median. Columns (5) and (6) report the results for the subsamples of firms with high ratings (ratings better than sample median) and low ratings (ratings worse than sample median), respectively. Robust standard errors, reported in parentheses, are clustered at individual firm level. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

	All Firms - OLS		Small	Large	High-Rated	Low-Rated
	(1)	(2)	(3)	(4)	(5)	(6)
Rollover	.002	.002	.004	.0008	.003	.003
	(.0009)**	(.0008)***	(.001)***	(.001)	(.0007)***	(.001)**
Idiosyncratic Volatility	.154	.065	.043	.024	-.002	.032
	(.034)***	(.038)*	(.057)	(.072)	(.048)	(.069)
Systematic Volatility	.319	.326	.333	.278	.174	.535
	(.039)***	(.038)***	(.050)***	(.047)***	(.035)***	(.058)***
Long-Term Debt/TA	-.002	.003	.010	-.003	.004	-.0003
	(.002)	(.002)*	(.004)**	(.002)	(.002)**	(.003)
Average Index	-1.273	-1.338	-1.115	-1.637	-1.206	-1.636
	(.112)***	(.106)***	(.130)***	(.163)***	(.116)***	(.208)***
Average Excess Return	-.720	-.123	-.195	.036	-.190	-.034
	(.208)***	(.105)	(.154)	(.147)	(.126)	(.146)
Market Cap/Index	-.146	-.404	-.343	-1.270	-.234	-1.540
	(.035)***	(.075)***	(.076)***	(.197)***	(.046)***	(.293)***
Operating Income/Sales	-.002	-.002	-.004	-.0009	-.003	-.001
	(.001)	(.002)	(.003)	(.002)	(.002)	(.003)
Total Debt/Market Value	.00004	.0006	.0004	.002	.0003	.0007
	(.0002)	(.0002)***	(.0002)*	(.0007)***	(.0001)**	(.0003)**
Treasury Slope	-.0005	-.0006	-.0004	-.0007	-.0005	-.0009
	(.0003)*	(.0002)**	(.0003)	(.0003)***	(.0002)**	(.0003)***
Maturity	.0002	.0002	.0002	.0002	.0002	.0002
	(1.00e-05)***	(7.81e-06)***	(1.00e-05)***	(1.00e-05)***	(1.00e-05)***	(1.00e-05)***
Offering Yield	.0009	.0007	.0006	.0008	.0006	.0007
	(.00009)***	(.00006)***	(.00008)***	(.00008)***	(.00007)***	(.00008)***
Log(Amount)	-.0006	-.0002	-.0001	-.0002	-.0002	-.0002
	(.0002)***	(.0001)	(.0001)	(.0002)	(.0001)	(.0002)
Const.	.001	-.003	-.004	-.0001	.0002	.002
	(.003)	(.002)*	(.003)	(.003)	(.002)	(.003)
Obs.	49098	49098	24271	24827	28875	20223
R^2	.519	.631	.648	.625	.581	.642

Table 3: Debt Maturity Structure and Severity of Rating Downgrades

This table reports the results of the regressions relating rating downgrade to the proportion of short-term debt: $y_{i,t} = \beta_0 + \beta_1 \times \text{Rollover}_{i,t-1} + \beta_2 \times X_{i,t} + \text{Firm FE} + \text{Year FE}$, where $y_{i,t}$ is Notches Downgrade in Panel A, and Multi-notch Downgrade in Panels B and C. Details on the definition of the variables are provided in the Appendix. In Panels A and B, Columns (1) and (2) report the results for the full sample, Columns (3) and (4) report the results for the subsamples of small firms and large firms, respectively, where small (large) firms are those with firm size (as measured by book value of total assets) below (above) the sample median, and Columns (5) and (6) report the results for the subsamples of firm with investment-grade (rating BBB- or above) and below investment-grade (rating below BBB-) ratings, respectively. Robust standard errors, reported in parentheses, are clustered at individual firm level. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel A: Notches Downgrade

	All Firms	All Firms	Small	Large	Investment	Below-Investment
	(1)	(2)	(3)	(4)	(5)	(6)
Rollover	.301	.298	.302	.257	.224	.369
	(.046)***	(.045)***	(.071)***	(.065)***	(.052)***	(.101)***
Size (1)	-.0004	-.081	.004		-.004	.040
	(.019)	(.021)***	(.027)		(.025)	(.030)
Size (2)	.003	-.081	.008	.027	.0005	.044
	(.018)	(.020)***	(.026)	(.028)	(.024)	(.028)
Size (3)	.005	-.074		.030	.004	.039
	(.017)	(.019)***		(.027)	(.022)	(.026)
Market-to-Book	-.085	-.107	-.085	-.096	-.080	-.081
	(.012)***	(.013)***	(.020)***	(.016)***	(.016)***	(.019)***
Industry Volatility	-.053	-.029	-.131	-.008	.014	-.075
	(.107)	(.106)	(.152)	(.163)	(.128)	(.171)
Idiosyncratic Volatility	-3.682	.122	-3.260	-4.757	-.644	-3.943
	(1.018)***	(.684)	(1.013)***	(1.477)***	(1.670)	(1.233)***
Tangibility	-.017	-.077	.0008	-.027	-.014	.0004
	(.044)	(.047)	(.060)	(.063)	(.055)	(.072)
R&D/TA	.178	-.424	-.794	.402	.344	-.729
	(.595)	(.589)	(.939)	(.850)	(.896)	(.922)
Long-Term Debt/TA	.089	.268	.096	.106	.111	.149
	(.074)	(.078)***	(.092)	(.149)	(.121)	(.095)
Investment Grade	.288		.231	.422		
	(.030)***		(.038)***	(.051)***		
Cash/TA	-.288	-.207	-.357	-.119	-.034	-.359
	(.093)***	(.094)**	(.114)***	(.174)	(.131)	(.126)***
Operating Income/Sales	-.442	-.524	-.423	-.563	-.870	-.253
	(.097)***	(.094)***	(.105)***	(.206)***	(.205)***	(.096)***
Total Debt/Market Value	.006	.010	.011	.004	.004	.009
	(.002)***	(.002)***	(.005)**	(.002)	(.002)**	(.004)**
Interest Coverage	-.002	-.003	-.001	-.001	-.001	-.002
	(.0005)***	(.0006)***	(.0008)*	(.0008)*	(.0007)*	(.0009)**
Const.	.257	1.936	.366	-.189	.303	.124
	(.155)*	(.233)***	(.209)*	(.251)	(.198)	(.231)
Obs.	20258	20258	10481	9777	12592	7666
R^2	.223	.268	.314	.201	.212	.361

Panel B: Multi-notch Downgrade

	All Firms	All Firms	Small	Large	Investment	Below-Investment
	(1)	(2)	(3)	(4)	(5)	(6)
Rollover	.091 (.015)***	.087 (.015)***	.095 (.023)***	.075 (.021)***	.065 (.018)***	.114 (.031)***
Market-to-Book	-.019 (.004)***	-.024 (.004)***	-.019 (.007)***	-.021 (.005)***	-.019 (.005)***	-.018 (.008)**
Industry Volatility	-.049 (.034)	-.042 (.034)	-.074 (.048)	-.049 (.054)	-.046 (.042)	-.059 (.056)
Idiosyncratic Volatility	-.690 (.236)***	-.039 (.269)	-.662 (.244)***	-1.086 (.433)**	.512 (.520)	-.821 (.272)***
Tangibility	.005 (.014)	-.010 (.014)	.014 (.018)	-.003 (.019)	.012 (.016)	.015 (.024)
R&D/TA	.016 (.195)	-.141 (.202)	-.224 (.264)	.374 (.368)	-.076 (.287)	-.197 (.244)
Long-Term Debt/TA	.019 (.023)	.061 (.025)**	.031 (.032)	.029 (.044)	.021 (.042)	.036 (.032)
Investment Grade	.075 (.010)***		.059 (.014)***	.116 (.017)***		
Cash/TA	-.069 (.032)**	-.052 (.032)	-.095 (.042)**	-.009 (.054)	.034 (.046)	-.106 (.043)**
Operating Income/Sales	-.103 (.025)***	-.119 (.025)***	-.106 (.032)***	-.087 (.043)**	-.174 (.049)***	-.052 (.032)
Total Debt/Market Value	.001 (.0006)**	.002 (.0006)***	.002 (.001)	.0008 (.0006)	.0008 (.0007)	.002 (.001)
Interest Coverage	-.0003 (.0002)	-.0006 (.0002)***	-.00009 (.0003)	-.0003 (.0003)	-.0002 (.0002)	-.0003 (.0003)
Const.	.063 (.044)	.418 (.057)***	.125 (.057)**	-.096 (.084)	.103 (.072)	.068 (.061)
Obs.	20286	20286	10502	9784	12606	7680
R^2	.203	.24	.278	.194	.201	.332

Panel C: Notches Downgrade

	(1)	(2)	(3)	(4)
Rollover	.301 (.046)***	.264 (.047)***	.270 (.044)***	.186 (.068)***
Profit Decline		.019 (.010)*		
Profit Decline×Rollover		.087 (.052)*		
Recession			-.035 (.040)	
Recession×Rollover			.156 (.078)**	
High Bank Spread				.090 (.044)**
High Bank Spread×Rollover				.148 (.064)**
Const.	.257 (.155)*	.259 (.154)*	.253 (.155)	.201 (.136)
Obs.	20258	20258	20258	20258
R^2	.223	.223	.223	.223

Table 4: Debt Maturity Structure and Propensity to Default

This table reports the results of the regressions relating default to short-term debt. Column (1) estimates: $\text{Default}_{i,t} = \beta_0 + \beta_1 \times \text{Rollover}_{i,t-1} + \beta_2 \times \text{Controls}_{i,t} + \text{Industry FE} + \text{Year FE}$ for all firms. Column (2) estimates the same OLS regression, except that firm fixed effect instead of industry fixed effect is applied. Columns (3) and (4) perform the same estimation as in Column (2) for small and large firms, respectively, where small (large) firms are those with size (as measured by book value of total assets) below (above) the sample median. Cox-hazard model is used in Column (5), and Logit model is applied in Column (6). *Default* is a dummy variable that takes the value 1 if the firm defaults, and 0 otherwise. Details on the definition of other variables are provided in the Appendix. Robust standard errors, reported in parentheses, are clustered at individual firm level. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

	All Firms - OLS	All Firms - OLS	Small Firms - OLS	Large Firms - OLS	All Firms - Cox Hazard Model	Small Firms - Logit
	(1)	(2)	(3)	(4)	(5)	(6)
Rollover	.026	.022	.025	.013	3.928	3.679
	(.007)***	(.007)***	(.012)**	(.009)	(.899)***	(.606)***
Market-to-Book	.002	.0005	.002	-.0007	-.759	-1.442
	(.0007)***	(.001)	(.002)	(.0009)	(.453)*	(.419)***
Industry Volatility	.0002	-.015	-.030	-.002	.619	2.269
	(.019)	(.009)	(.013)**	(.015)	(1.905)	(1.302)*
Idiosyncratic Volatility	.881	.674	.788	.239	17.627	29.049
	(.189)***	(.217)***	(.233)***	(.161)	(8.616)**	(5.895)***
Tangibility	.009	.007	.007	.006	.740	.759
	(.005)*	(.004)*	(.006)	(.003)*	(.692)	(.460)*
R&D/TA	-.074	-.081	-.114	-.044	-9.410	-17.115
	(.025)***	(.028)***	(.046)**	(.030)	(13.311)	(8.511)**
Long-Term Debt/TA	-.019	-.022	-.014	-.039	2.328	.877
	(.009)**	(.011)**	(.014)	(.016)**	(1.144)**	(.847)
Investment Grade	-.005	-.005	-.004	-.011	-.447	-2.039
	(.003)*	(.004)	(.005)	(.006)*	(.613)	(.493)***
Cash/TA	-.003	.007	.005	.024	-3.042	.421
	(.008)	(.012)	(.017)	(.016)	(2.816)	(1.378)
Operating Income/Sales	-.019	-.040	-.056	-.018	1.518	1.201
	(.011)*	(.015)***	(.023)**	(.011)	(1.101)	(.655)*
Total Debt/Market Value	.001	.002	.004	.0004	.034	.040
	(.0004)***	(.0006)***	(.001)***	(.0002)*	(.010)***	(.008)***
Interest Coverage	-1.00e-05	4.07e-07	.00003	-.00007	-.237	-.220
	(.00006)	(.00007)	(.0001)	(.00005)	(.115)**	(.063)***
Const.	.005	.004	-.007	.012		-3.573
	(.011)	(.017)	(.025)	(.021)		(1.439)**
Obs.	20985	20985	10738	10247	18105	19844
R^2	.08	.502	.586	.38		

Table 5: Debt Maturity Structure and Rating Upgrades

This table reports the results of the regressions relating rating upgrade to short-term debt: $y_{i,t} = \beta_0 + \beta_1 \times \text{Rollover}_{i,t-1} + \beta_2 \times \text{Controls}_{it} + \text{Firm F.E.} + \text{Year F.E.}$, where $y_{i,t}$ is Notches Upgrade. Details on the definition of the variables are provided in the Appendix. Columns (1) and (2) report the results for the full sample. Columns (3) and (4) report the results for the subsamples of small firms and large firms, respectively, where small (large) firms are those with size (as measured by book value of total assets) below (above) the sample median. Columns (5) and (6) report the results for the subsamples of firm with investment-grade (rating BBB- or above) and below investment-grade (rating below BBB-) ratings, respectively. Robust standard errors, reported in parentheses, are clustered at individual firm level. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

	All Firms	All Firms	Small	Large	Investment	Below-Investment
	(1)	(2)	(3)	(4)	(5)	(6)
Rollover	-.005	-.042	.049	-.042	-.095	.167
	(.033)	(.026)	(.057)	(.037)	(.023)***	(.096)*
Market-to-Book	.055	.079	.078	.035	.037	.068
	(.010)***	(.009)***	(.016)***	(.011)***	(.009)***	(.021)***
Industry Volatility	.051	.023	.127	-.009	.051	.170
	(.078)	(.071)	(.111)	(.118)	(.082)	(.155)
Idiosyncratic Volatility	1.845	-1.771	1.336	2.631	2.025	1.466
	(.889)**	(.693)**	(.892)	(1.280)**	(.825)**	(1.016)
Tangibility	-.050	-.004	.007	-.074	-.065	-.027
	(.030)*	(.027)	(.041)	(.042)*	(.026)**	(.057)
R&D/TA	-.159	.186	-.152	-.007	-.393	-.103
	(.432)	(.374)	(.721)	(.502)	(.376)	(.890)
Long-Term Debt/TA	-.150	-.324	-.155	-.111	-.150	-.094
	(.054)***	(.048)***	(.069)**	(.099)	(.052)***	(.082)
Investment Grade	-.338		-.316	-.316		
	(.028)***		(.035)***	(.050)***		
Cash/TA	.128	.004	-.023	.370	.037	.098
	(.074)*	(.063)	(.098)	(.133)***	(.064)	(.129)
Operating Income/Sales	.219	.262	.206	.242	.151	.254
	(.042)***	(.044)***	(.053)***	(.084)***	(.045)***	(.063)***
Total Debt/Market Value	-.001	-.003	-.003	-.0007	-.0009	-.003
	(.0009)	(.001)***	(.001)**	(.001)	(.0008)	(.002)
Interest Coverage	-.0009	.0003	-.001	-.0008	-.0007	-.0007
	(.0005)*	(.0004)	(.001)	(.0005)	(.0003)*	(.002)
Const.	.267	-1.276	.098	.301	.332	.155
	(.122)**	(.137)***	(.172)	(.137)**	(.101)***	(.219)
Obs.	20258	20258	10481	9777	12592	7666
R^2	.204	.357	.278	.195	.134	.296

Table 6: Addressing Potential Endogeneity Problem

We address potential endogeneity problem in this table. Panel A reports the results of the regressions relating rating downgrade to the proportion of a firm's long-term debt maturing within one year: $y_{i,t} = \beta_0 + \beta_1 \times \text{Rollover (L.T.Debt)}_{i,t-1} + \beta_2 \times \text{Controls}_{it} + \text{Firm F.E.} + \text{Year F.E.}$, where $y_{i,t}$ is *Multi-notch Downgrade*. Columns (1) and (2) report the results for the full sample. Columns (3) and (4) report the results for the subsamples of small firms and large firms, respectively, where small (large) firms are those with size (as measured by book value of total assets) below (above) the sample median. Columns (5) and (6) report the results for the subsamples of firm with investment-grade (rating BBB- or above) and below investment-grade (rating below BBB-) ratings, respectively. In Panel B, we run instrumental variable regressions. Column (1) of Panel B displays the results of the OLS regression performed in Column (1) of Panel B in Table 2. In Column (2), we use 10-year treasury rate, natural logarithm of the delta of CFO compensation and natural logarithm of the vega of CFO compensation to instrument for the variable *Rollover*. The regression in Column (2) apply industry and year fixed effects, and he results are for all firms in our sample. Details on the definition of the variables are provided in the Appendix. Robust standard errors, reported in parentheses, are clustered at individual firm level. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel A: L. T. Debt Due within One Year and Multi-notch Downgrades

	All Firms	All Firms	Small	Large	Investment	Below-Investment
	(1)	(2)	(3)	(4)	(5)	(6)
Rollover (L.T.Debt)	.059	.079	.100	.005	.0009	.150
	(.023)**	(.023)***	(.038)***	(.026)	(.023)	(.048)***
Market-to-Book	-.020	-.025	-.019	-.021	-.020	-.018
	(.004)***	(.004)***	(.007)***	(.006)***	(.005)***	(.008)**
Industry Volatility	-.057	-.049	-.083	-.053	-.058	-.043
	(.036)	(.036)	(.051)	(.056)	(.047)	(.055)
Idiosyncratic Volatility	-.515	.003	-.500	-.845	.848	-.637
	(.229)**	(.282)	(.242)**	(.455)*	(.549)	(.267)**
Tangibility	.003	-.012	.013	-.005	.007	.014
	(.014)	(.014)	(.019)	(.020)	(.016)	(.025)
R&D/TA	.0007	-.192	-.193	.118	-.038	-.144
	(.194)	(.199)	(.268)	(.325)	(.309)	(.249)
Long-Term Debt/TA	-.029	.025	-.006	-.031	-.033	.008
	(.025)	(.025)	(.034)	(.044)	(.042)	(.035)
Investment Grade	.079		.062	.119		
	(.010)***		(.014)***	(.017)***		
Cash/TA	-.107	-.098	-.112	-.085	-.026	-.097
	(.033)***	(.033)***	(.042)***	(.056)	(.046)	(.044)**
Operating Income/Sales	-.117	-.129	-.130	-.081	-.188	-.065
	(.028)***	(.028)***	(.034)***	(.048)*	(.057)***	(.033)*
Total Debt/Market Value	.002	.003	.003	.001	.0009	.003
	(.0007)***	(.0007)***	(.002)**	(.0007)	(.0008)	(.001)**
Interest Coverage	-.0003	-.0006	-.00005	-.0002	-.0002	-.0004
	(.0002)	(.0002)***	(.0003)	(.0003)	(.0002)	(.0003)
Const.	.106	.543	.124	-.027	.120	.061
	(.053)**	(.067)***	(.060)**	(.084)	(.070)*	(.063)
Obs.	18965	18965	9982	8983	11634	7331
R^2	.204	.243	.276	.2	.204	.335

Panel B: Instrumental Variables Regression

	Multi-notch Downgrade	
	All Firms	
	OLS	IV
	(1)	(2)
Rollover	.091	.537
	(.015)***	(.242)**
Market-to-Book	-.019	-.023
	(.004)***	(.007)***
Industry Volatility	-.049	-.130
	(.034)	(.069)*
Idiosyncratic Volatility	-.690	.210
	(.236)***	(.444)
Tangibility	.005	.028
	(.014)	(.021)
R&D/TA	.016	.010
	(.195)	(.183)
Long-Term Debt/TA	.019	.296
	(.023)	(.142)**
Investment Grade	.075	.017
	(.010)***	(.009)*
Cash/TA	-.069	.0003
	(.032)**	(.043)
Operating Income/Sales	-.103	-.071
	(.025)***	(.032)**
Total Debt/Market Value	.001	-.003
	(.0006)**	(.004)
Interest Coverage	-.0003	-.0002
	(.0002)	(.0003)
Const.	.063	.064
	(.044)	(.136)
Obs.	20286	5311
R^2	.203	.
Fixed Effects	Firm and Year	Industry and Year