Debt Maturity Structure and Credit Quality*

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Abstract

We examine whether a firm's debt maturity structure affects its credit quality. We find that firms with a larger proportion of their debt maturing within the year (short-term debt) are more likely to experience a severe fall in their credit quality in the following year, as measured by the severity of credit rating downgrades and the propensity to default. This effect is stronger for firms with declining profitability and during recession years. Our results are robust to instrumenting for the proportion of short-term debt and alternate measures of a firm's exposure to rollover risk. We also find that long-term bonds issued by firms with a larger proportion of short-term debt trade at higher yield spreads, ceteris paribus, which indicates that bond market investors are cognizant of rollover risk. Overall, our results are broadly consistent with theories which argue that short-term debt exposes a firm to rollover risk, thereby increasing the firm's overall credit risk.

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1 Introduction

The collapse of financial institutions such as Bear Stearns and Lehman Brothers during the recent financial crisis has once again focussed attention on the risks arising from short-term debt. It is now universally acknowledged that the proximate cause for the failure of the two institutions was their over-reliance on short-term debt which they were unable to roll over due to a fall in collateral values (Brunnermeier (2009)).[1] The theoretical literature has long recognized this "rollover" risk arising from short-term debt.[2] Diamond (1991) and Titman (1992) show that in the presence of credit market frictions, firms may face difficulty in rolling over short-term debt, especially if refinancing coincides with a deterioration in either firm fundamentals or credit market conditions. Recent theoretical literature argues that rollover risk may itself be an additional source of credit risk, because short-term debt increases the possibility of a run on the firm (He and Xiong (2011a) and Morris and Shin (2009)), and exacerbates the conflict of interest between shareholders and debtholders (He and Xiong (2011b)).

Are the collapses of Bear Stearns and Lehman Brothers isolated incidents that occurred during periods of unprecedented stress in credit markets, or is there a systematic *causal* relationship between a firm's reliance on short-term debt and subsequent deterioration in its credit quality? Despite a large body of theoretical literature which argues that the answer is yes, surprisingly there is no empirical paper that directly addresses this question. Identifying such a causal link is challenging because a firm's debt maturity structure is itself endogenous. For example, in our sample of Compustat firms that have long-term credit ratings from S&P, we find that firms with a larger proportion of short-term debt are actually less risky, based on observable risk characteristics such as size, leverage, credit rating, profitability, idiosyncratic volatility and industry volatility. Thus, without adequate controls for the endogeneity of the debt maturity structure, one might conclude that a larger proportion of short-term debt is

[1] Such risks are certainly not confined to financial firms alone, as there is a long history of high-profile bankruptcies involving non-financial firms, where the inability to roll over short-term debt compounded the effect of operating losses and led to sudden collapses (e.g., WorldCom, Enron, First Executive Corporation, and Penn Central).

[2] Other terms employed in the literature are liquidity risk, maturity risk, and refinancing risk.

associated with better credit outcomes. In this paper, we use a variety of empirical techniques to overcome the endogeneity problem and identify the causal relationship between a firm's reliance on short-term debt and subsequent deterioration in its credit quality.

Our sample spans the time period 1986–2010, 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 reliance on short-term debt or its 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 (henceforth, referred to as short-term debt).[3] A firm's operating risk characteristics may jointly determine both its reliance on short-term debt (see, for example, Barclay and Smith (1995), Stohs and Mauer (1996), and Titman and Wessels (1988)) and the subsequent change in its credit quality. In our baseline empirical analysis, we explicitly control for all observable firm characteristics that may affect the proportion of short-term debt, and that may also affect the firm's credit quality. We also include firm fixed effects to control for time-invariant risk characteristics, rating fixed effects to control for existing credit quality, and year fixed effects to control for systematic risk factors that may affect subsequent fall in credit quality.

We begin our analysis by examining whether firms with a larger proportion of short-term debt are more likely to experience a fall in credit quality in the following year. Our first measure of credit quality deterioration is the number of notches by which a firm's credit rating is downgraded during the year. Our second measure is whether the firm is downgraded to 'D' rating during the year. S&P assigns this rating to firms that are either in default or are expected to default on their debt obligations. Regardless of the measure used, we find that once we employ our extensive empirical specification with firm and rating fixed effects, firms with a larger proportion of short-term debt (higher *Rollover*) are more likely to experience a severe deterioration in their credit quality in the following year. This effect is also economically large: a one standard deviation increase in *Rollover*, which represents an increase in the proportion of short-term debt from the sample average of 15.9% to 37.2%, is associated with a 11.7% increase in the number of notches of rating downgrade, and a 66%

[3]Our results are robust to an alternative measure of exposure to rollover risk defined as the proportion of short-term debt to total assets.

increase in the likelihood of being downgraded to 'D' rating during the following year. While an average firm in our sample has a 1.2% chance of being downgraded to 'D' in any year, a one standard deviation increase in *Rollover* is associated with a 0.79% increase in this likelihood.

To better understand the relationship between *Rollover* and subsequent deterioration in credit quality, we perform a number of cross-sectional tests. When we differentiate between small and large firms, we find that the positive association between *Rollover* and subsequent deterioration in credit quality is present among both small and large firms with similar economic magnitudes. A 21.3% increase in *Rollover* (one standard deviation increase) is associated with a 0.83% (0.75%) increase in the likelihood of a downgrade to 'D' rating for large (small) firms. When we differentiate firms based on prior credit quality, we find that the positive association between *Rollover* and subsequent deterioration in credit quality is present only among firms with speculative grade credit rating (S&P rating below 'BBB-'). Moreover, consistent with theoretical predictions, we also find that the positive association between *Rollover* and subsequent deterioration in credit quality is stronger for firms that experience a year-on-year decline in operating profitability and during periods of economic recession. Interestingly, the positive association between *Rollover* and subsequent deterioration in credit quality is present during expansions as well.

Despite the rich empirical specification we employ, it is still possible that some unobserved time-varying risk characteristic can bias our estimates. This can happen if changes in the risk characteristic affects both the reliance on short-term debt as well as the subsequent change in credit rating. As we mentioned, based on observable risk characteristics, firms in our sample with higher values of *Rollover* are actually less risky. Presumably such firms are the ones with access to the commercial paper market. To this extent, if anything, we expect unobserved time-varying risk characteristic to have a downward bias on our OLS estimates. To identify the magnitude of this bias, we perform several tests. We highlight two of these tests here.

First, following Almeida et al. (2009), we use the ratio of long-term debt due within the year over total debt as an alternative measure of the firm's exposure to rollover risk. That is, we exclude from our measure any short-maturity debt that the firm may have issued in the previous year that is due in the current year. 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 time-varying variable should not affect this alternative measure. When we repeat our tests with this alternative measure, we continue to find a positive and significant association between a firm's exposure to rollover risk and the severity of rating downgrades. Consistent with our OLS estimates being downward biased, we find that a 21.3% increase in the proportion of long-term debt due within a year (corresponding to a one standard deviation increase in *Rollover*) is associated with a 1.02% increase in the annual likelihood of 'D' rating.

Second, we perform an instrumental variables (IV) estimation, where we instrument for *Rollover* using the fraction of current assets in the firm's total assets and the yield on the 10-year treasury bond. The use of the firm's asset structure as an instrument for its debt maturity structure is motivated by the idea that firms with more short-term assets tend to rely more on short-term borrowing, either to avoid mismatch between assets and liabilities or because they have fewer long-term assets that can be pledged as collateral for long-term borrowing. Consistent with this assumption we find that the proportion of current assets is strongly positively associated with the proportion of short-term debt. At the same time, the proportion of current assets on the firm's balance sheet should not directly affect subsequent deterioration in credit quality. The identifying assumption behind using the 10-year treasury yield as an instrument is that firms are more likely to issue short-term debt when long-term interest rates are high (based on the market-timing argument in, among others, 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.

We find that our results are robust to instrumenting for *Rollover*. The F-statistic of excluded instruments in the first stage is 52.42, which indicates that our instruments are strong. Moreover, consistent with the OLS estimates being downward biased, we find that the IV coefficient estimates are significantly larger than the corresponding OLS estimates. Based on the IV estimates, a one standard deviation increase in *Rollover* is associated with a 1.6% increase in the likelihood of being downgraded to a 'D' rating in the following year.

Long-term creditors will be adversely affected by the rollover risk of short-term debt, since short-term lenders get paid first. If long-term creditors recognize this risk, then firms with a larger proportion of short-term debt should *ceteris paribus* face a higher cost of long-term borrowing. In our final set of tests, we examine whether the yield spreads on a firm's long-term bonds are affected by the proportion of short-term debt on the firm's balance sheet. To do this, we replicate the bond yield spread model in Campbell and Taksler (2003) after adding the lagged value of *Rollover* as an additional regressor. We find that bonds issued by firms with higher values of *Rollover* have higher yield spreads. While our results are statistically significant, the economic magnitude appears small, especially in comparison to the effect of *Rollover* on default likelihood. We find that all else equal, a one standard deviation increase in *Rollover* is associated with a 4.5 basis point increase in the bond's yield spread.

Our paper contributes to both the literature on debt structure and the literature on credit risk by providing empirical validation to the theoretical predictions that reliance on short-term debt exposes a firm to rollover risk and increases its overall credit risk (e.g., He and Xiong (2011a), He and Xiong (2011b), and Morris and Shin (2009)). This is an important finding because it has practical implications for a firm's choice of its debt maturity structure. While theoretical literature identifies rollover risk as an important determinant of debt maturity choice (e.g., Diamond (1991), and Flannery (1986)), the empirical literature on debt maturity (e.g., Barclay and Smith (1995), Berger et al. (2005), Guedes and Opler (1996), and Stohs and Mauer (1996)) has largely sidestepped this issue: the focus of that strand of literature is on documenting the observable firm characteristics that can explain the firm's debt maturity choice.

Our paper also complements several recent studies that exploit the subprime crisis of 2007-09 to highlight the adverse real impact to firms of not being to roll over their maturing debt. 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. Duchin et al. (2010) find that the decline in corporate investment following the subprime crisis was more pronounced among firms that had more net short-term debt. Our paper differs from these papers in two important respects. First, while these papers examine the effect of debt maturity structure on firm investments, we examine the effect of debt maturity structure on credit risk. Our main conclusion is that rollover risk is an additional source of credit risk that needs to be recognized by rating agencies and bond market investors ex ante. Second, our sample period is not confined to just the crisis period and our results show that rollover risk contributes to credit risk even during benign credit market conditions. Our results do support the notion that rollover risk becomes more important during recessions when credit markets are likely to be stressed.

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 Sections 4, 5 and 6. Section 7 concludes the paper.

2 Theory and Hypotheses

In this section we outline the theoretical literature and draw the two hypothesis that we test in the subsequent section.

In an early study of optimal debt maturity structure, Diamond (1991) highlights that short-term borrowing may subject a firm to excessive liquidation when the firm attempts to refinance by rolling over its maturing debt, especially if the refinancing coincides with the release of bad news about the firm's prospects.[4] In a more recent study, Morris and Shin (2009) argue that, similar to bank deposits, short-term debt is prone to runs due to lack of coordination among creditors, which can undermine the firm's credit quality and its ability to service its long-term creditors. They further argue that a proper measure of a firm's credit risk should incorporate "the probability of a default due to a run on its short-term debt when the firm would otherwise have been solvent" (also see He and Xiong (2011a)). He and Xiong (2011b) show that short-term debt increases the likelihood of bankruptcy by exacerbating the conflict of interest between equity and debt holders (akin to the classic debt overhang problem coined by Myers (1977)). The idea is that maturing (short-term) debt holders get paid in full first whenever a firm experiences rollover losses (e.g., due to an overly high interest rate upon

[4]Froot et al. (1993), Sharpe (1991), and Titman (1992) show 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.

refinancing) when replacing its maturing debt with new (short-term) debt, whereas equity holders ultimately bear such losses. Recognizing this, equity holders will choose to default earlier at a higher fundamental firm value that the firm would otherwise have survived in the absence of rollover risk arising from short-term debt. Acharya et al. (2011) argue that when the current owners of assets and future buyers are all short of capital, high refinance frequency associated with short-term debt can lead to a market freeze and precipitate defaults.

One basic takeaway from all these theoretical papers is that the proportion of a firm's debt maturing in the short term (henceforth, referred to as short-term debt) can affect the firm's credit quality, aside from the firm's operating risk and leverage ratio. We refer to this as the *rollover risk hypothesis*, and test two of its key predictions.

First, firms with a larger proportion of short-term debt should, all else equal, be more likely to experience a fall in credit quality. The need to frequently roll over a large amount of short-term debt will increase the firm's exposure to negative operating shocks and possible deteriorations in credit market conditions. We use severity of rating downgrades and downgrade to 'D' rating as proxies to identify a fall in credit quality. Specifically, our first hypothesis is:

Hypothesis 1: *Firms with a larger proportion of short-term debt are ceteris paribus more likely to experience severe credit rating downgrades and are more likely to get their ratings downgraded to 'D'.*

Second, rollover risk of short-term debt will adversely affect long-term creditors, because any rollover losses resulting from refinancing of short-term debt (e.g., due to fire sales of assets under the pressure of short-term creditors) will ultimately jeopardize the firm's ability to repay its long-term creditors in future (Brunnermeier and Oehmke (2011) and Morris and Shin (2009)). If long-term creditors are cognizant of the rollover risk arising from short-term debt, then such risk should be reflected in the firm's cost of long-term borrowing. Thus, our second hypothesis is:

Hypothesis 2: *Firms with a larger proportion of short-term debt should, all else equal, face a higher cost of long-term borrowing, as manifested by a higher yield spread on their long-term bonds.*

3 Data and Sample Characterization

3.1 Data

We obtain data on firms' long-term credit ratings from Standard and Poor's (S&P); these ratings represent S&P's long-term assessment of a firm's overall credit quality but not specific to a particular security issued by the firm. This data is made available in Compustat on a monthly basis. We transform the credit ratings 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 the Appendix for details). We collect annual firm financial information from Compustat. Our sample spans the time period 1986-2010, and consists of all firms that have an S&P long-term credit rating and are covered by Compustat. Information on individual stock returns and returns on the CRSP value-weighted index comes from the Center for Research in Security Prices (CRSP).

We obtain data on long-term corporate bonds from the Mergent Fixed Income Securities Database (FISD). This database provides both issue characteristics and transaction information for all corporate bond trades among insurance companies from the National Association of Insurance Commissioners (NAIC) since 1995. Following Campbell and Taksler (2003), we take the following steps to filter the FISD sample to suit our purpose. First, given that insurance companies often limit their investments to investment-grade assets due to regulatory constraints, we exclude speculative-grade bonds from our sample because these trades in the FISD database are unlikely to be representative of the general market. Next, to ease the computation of yield to maturity for the bond, we restrict our sample to fixed-rate bonds that are not callable, puttable, convertible, substitutable, or exchangeable. To avoid dealing with currency exchange rates, we only consider U.S. dollar-denominated bonds issued by domestic issuers. We also drop defaulted bond issues. Finally, we exclude bonds that are asset-backed or include any credit-enhancement features because we want the estimated yield to maturity for the bond to be solely driven by the underlying issuer's creditworthiness, and not by credit enhancements that we cannot fully control for in the cross-section.

3.2 Key Variables

We measure a firm's exposure to rollover risk using the variable *Rollover*, which is defined as the proportion of the firm's total debt that is due within the year. Specifically, *Rollover* is the ratio of total debt in current liabilities (Compustat item *dlc*) to the sum of debt in current liabilities and long-term debt (sum of Compustat items *dlc* and *dltt*). Firms with higher values of *Rollover* have to refinance a larger proportion of their debt during the year, and hence are likely to be exposed to greater rollover risk. As mentioned before, to address the potential endogeneity problem, we also create an alternative measure of rollover risk, *Rollover-Alt*, which is defined as the ratio of long-term debt payable within a year (Compustat item *dd1*) to total debt (sum of Compustat items *dlc* and *dltt*). Note that the numerator in *Rollover-Alt* excludes any short-maturity debt that the firm may have issued in the past year that is due in the current year.

To test Hypothesis 1, we use downgrades in S&P credit rating to identify adverse changes in a firm's credit quality. Specifically, we employ the following measures:

1. *Notches downgrade*, which 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.

2. *Multi-notch downgrade*, a dummy variable that identifies firms whose credit rating is downgraded by more than one notch during any month of the year.

3. *Default*, a dummy variable that identifies firms whose credit rating is downgraded to 'D', during the year.[5] S&P assigns the 'D' rating either when a firm has actually defaulted on its obligations or if S&P believes that the firm will not be able to make such payments during the applicable grace period.

While *Default* represents an extreme event of credit quality deterioration, the other measures

[5]The following example illustrates how we construct those measures. Suppose a firm starts with a credit 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-notch downgrade from March), and stays at 'A-' until the end of the year. In this example, *Notches downgrade* $= 3$, *Multi-notch downgrade* $= 1$, and *Default* $= 0$.

capture a more general manifestation of deterioration in credit quality in the absence of outright default.

To test Hypothesis 2, we use the yield spreads on a firm's long-term bonds (*Yield spread*) as a measure of the bond market's perception of the firm's credit risk. We estimate the yield to maturity for each bond trade using its transaction price, time to maturity, coupon frequency (usually semi-annual), and coupon rate. We then obtain the bond's yield spread during a month as the difference between its average yield to maturity imputed from all trades during the month and the yield on a U.S. treasury security of comparable maturity. We obtain benchmark treasury yields from the website of the Federal Reserve Board. We winsorize the data on yield spreads at the 1% level on both sides to reduce the effect of outliers.

3.3 Descriptive Statistics and Univariate Tests

We present the descriptive statistics for our full sample in Panel A of Table 1. Definitions of all the variables are in the Appendix. Recall that our sample only includes Compustat firms that have long-term credit ratings from S&P. The mean value of *Log(Total assets)* of 7.724 corresponds to an average book value of total assets of approximately $2.26 billion for our sample firms. The corresponding value for the full Compustat sample during the same time period is about $82 million. Thus, our sample of rated firms represents the subset of larger firms in Compustat.

The mean value of *Rollover* is 0.159, which means that the average firm in our sample has 15.9% of its total debt maturing within one year. The median value of *Rollover* is significantly lower at 0.072, suggesting an upward skewness in the distribution of *Rollover* in our sample. The median value of *Total debt/Mkt. Cap* of the firms in our sample is 0.299, and the median value of *Long-term debt/Total assets* is 0.264. Firms in our sample have an average interest coverage of 9.262. The median value of firm credit rating in our sample is about 10.6, which corresponds to a rating slightly below 'BBB-'. Consistent with this, we find that about 46.5% of the firms in our sample have investment-grade ratings ('BBB-' or above).

The average firm in our sample faces a 13% likelihood of experiencing a rating downgrade during the year, and a 4.3% chance of experiencing a multi-notch downgrade at some point during the year. The mean value of 1.577 on *Notches downgrade (Conditional)* indicates that, conditional on experiencing a downgrade during the year, the firm's credit rating is downgraded by 1.577 notches on average. The average annual default likelihood of firms in our sample is 1.2%.

Panel B provides a univariate comparison of the financial characteristics of high-*Rollover* and low-*Rollover* firms, where high-*Rollover* (low-*Rollover*) firms are defined as those with above (below) sample median value of *Rollover* and are expected to face relatively higher (lower) rollover risk. Observe that high-*Rollover* firms are on average significantly larger in size (higher *Log(Total assets)*), have lower leverage ratios (lower *Total debt/Mkt. Cap* and *Long term debt/Total assets*) and higher values of *Interest coverage* than low-*Rollover* firms. Moreover, we find that high-*Rollover* firms are more profitable (higher *Operating income/Sales* and *Taxes/Total assets*), have less volatile stock returns (lower *Idiosyncratic volatility*), and reside in industries with lower earnings volatility (lower *Industry volatility*) than low-*Rollover* firms. Consistent with high-*Rollover* firms being less risky, we also find their average credit rating to be 9.345 (slightly below 'BBB+') as compared to 11.456 (slightly below 'BBB-') for low-*Rollover* firms. Moreover, high-*Rollover* firms are on average significantly more likely to have an investment grade rating than low-*Rollover* firms (higher *Investment grade*). Thus, along multiple observable dimensions, the average low-*Rollover* firm is significantly riskier than the average high-*Rollover* firm in our sample. If unobservable risk characteristics vary in a similar manner, then lack of adequate controls for risk is likely to bias our estimates downward.

Interestingly, despite the fact that they are less risky on average, we find that high-*Rollover* firms are significantly more likely than low-*Rollover* firms to experience severe deterioration in credit quality, as evidenced by the higher average values of *Multi-notch downgrade*, *Notches downgrade*, and *Default*. While low-*Rollover* firms have a 3.8% probability of experiencing a multi-notch downgrade during a year, high-*Rollover* firms have a 4.8% probability of experiencing such severe downgrades. The differences in the mean values of *Default* are even more striking, suggesting that high-*Rollover* firms are almost twice as likely as low-*Rollover* firms to experience a *Default* during a year. These large differences suggest a significant relationship between the proportion of short-term debt and the propensity to experience a severe fall in credit quality.

In terms of other characteristics, we find that on average high-*Rollover* firms have a marginally higher market-to-book ratio (1.721 in comparison to 1.643), and invest more in R&D as a proportion of total assets (higher *R&D/Total assets*) than low-*Rollover* firms. While high-*Rollover* firms have slightly lower tangibility of assets than low-*Rollover* firms, there is no significant difference in the proportion of cash to total assets across the two subsamples. Finally, we find that as expected, high-*Rollover* firms have a significantly larger proportion of short-term current assets to total assets (higher *Current assets/Total assets*). In our IV regressions, we exploit this fact and use *Current assets/Total assets* to instrument for *Rollover*.

In Panel C, we compare the average yield spreads of bonds issued by high-*Rollover* and low-*Rollover* firms. Recall that we have information on yield spreads only for investment-grade bonds traded during the time period 1995-2010. We present the comparison separately for different sectors (utility, industrial, and financial firms), different rating categories, and different maturity categories. The rating categories are obtained by dividing investment-grade bonds into three subgroups: high-rated bonds (S&P rating $\in$ {AAA, AA+, AA, AA-}), medium-rated bonds (S&P rating $\in$ {A+, A, A-}), and low-rated bonds (S&P rating $\in$ {BBB+, BBB, BBB-}). Bonds are also classified as short-maturity bonds (maturity less than 7 years), medium-maturity bonds (maturity between 7 and 15 years), or long-maturity bonds (maturity between 15 and 30 years). There is significant evidence in Panel C that after controlling for sector, rating and maturity, bonds issued by high-*Rollover* firms on average trade at a higher yield spread as compared to bonds issued by low-*Rollover* firms. Of the 27 sector-rating-maturity buckets in the panel, the average bond yield spread is significantly higher for high-*Rollover* firms as compared to low-*Rollover* firms in 14 of them. This preliminary analysis suggests that bond market investors treat firms with a larger proportion of short-term debt as being riskier, and demand a higher yield on the long-term bonds of such firms.

[Insert Table 1 here]

4 Exposure to Rollover Risk and Deterioration in Credit Quality

We now proceed to formal multivariate analysis where we can control for firm characteristics that are likely to determine the choice of the firm's debt maturity structure. We begin our empirical analysis by testing Hypothesis 1, which predicts that firms with a larger proportion of short-term debt should, all else equal, be more likely to experience a fall in their credit quality.

4.1 Baseline Analysis to Test Hypothesis 1

To test Hypothesis 1, we estimate variants of the following OLS model:

$$y_{i,t} = \alpha + \beta \times \text{Rollover}_{i,t-1} + \gamma \times X_{i,t-1} + \text{Rating FE} + \text{Firm FE} + \text{Year FE}, \qquad (1)$$

where the dependent variable $y_{i,t}$ measures the deterioration of firm i's credit quality in year t, and is either *Notches downgrade* or *Default*. Recall that *Notches downgrade* is the maximum number of notches by which a firm's credit rating is downgraded during any month of the year, and *Default* is a dummy variable that identifies firms that have been downgraded to a rating of 'D' during the year. The key independent variable is the lagged value of *Rollover* during the previous year, $Rollover_{i,t-1}$. We estimate regression (1) on a panel that has one observation for each firm-year combination.

We control the regression for the following lagged firm characteristics ($X_{i,t-1}$) that may affect a firm's choice of debt maturity structure as well as the likelihood of deterioration in credit quality: size using *Log(Total assets)*, leverage using *Total debt/Mkt. cap*, *Interest coverage*, profitability using *Operating income/Sales* and *Taxes/Total assets*, growth opportunities using *Market to book* and *R&D/Total assets*, operating risk using *Industry volatility* and *Idiosyncratic volatility*, and asset composition using *Tangibility* and *Cash/Total assets*. Details on the definition of the variables are provided in the Appendix. In all the specifications, we also include rating fixed effects along with firm fixed effects to control for unobserved heterogeneities across firms, and year fixed effects to control for any macroeconomic variables that may affect credit quality. The standard errors are robust to heteroscedasticity and are clustered at the industry level, where we define industry at the level of Fama-French 48 industry category.

The key empirical challenge we face is that some unobserved factor may affect both *Rollover* and subsequent deterioration in credit quality and thus bias our estimates. In our baseline specification, we employ firm fixed effects that will control for all time invariant observed and unobserved factors. But some time varying unobserved factor may still bias our baseline estimates. In Section 5 we describe a number of alternative tests we perform to control for such unobserved time varying factors.

[Insert Table 2 here.]

We present the results of the panel OLS regression (1) in Panel A of Table 2. The dependent variable in Columns (1) through (3) is *Notches downgrade*. The positive and significant coefficient on *Rollover* in Column (1) indicates that firms with a larger proportion of short-term debt are likely to experience more severe rating downgrades in the following year. Since we have firm fixed effects in the specification, the coefficient measures the within-firm increase in severity of downgrades when the firm has a larger proportion of short-term debt. The coefficient is also economically significant: a one standard deviation increase in *Rollover* (.213) is associated with a 0.024 increase in *Notches downgrade*, which represents a 11.7% increase as compared to the sample mean of *Notches downgrade* of .205 (See Panel A of Table 1).

In terms of the coefficient estimates on the control variables, we find that rating downgrades are more severe for firms that are smaller (negative coefficient on *Log(Total Assets)*), highly levered (positive coefficient on *Total debt/Mkt. Cap*), less profitable (negative coefficient on *Operating income/Sales* and *Taxes/Total assets*), have less cash on their balance sheet (negative coefficient on *Cash/Total assets*), and are from riskier industries (positive coefficient on *Industry volatility*).

In Column (2), we repeat the regression after replacing *Rollover* with two interaction terms, *Rollover* $\times$ *Small* and *Rollover* $\times$ $[1 - \textit{Small}]$, where *Small* is a dummy variable that identifies firms with below sample-median values of *Log(Total assets)*. We do this to examine if the effect of *Rollover* on the severity of rating downgrades varies between small and large firms. We find that the coefficients on both interaction terms are positive and significant, which indicates that a larger proportion of short-term debt is associated with severe rating downgrades for both small and large firms. In Column (3), we repeat the regression after replacing *Rollover* with the other two interaction terms, *Rollover* $\times$ *Investment grade* and *Rollover* $\times$ $[1 - \textit{Investment grade}]$, where *Investment grade* is a dummy variable that identifies firms with an investment grade rating (S&P rating 'BBB-' or above). We find that, not surprisingly, a larger proportion of short-term debt is associated with severe rating downgrades only for firms with below investment grade ratings.

In Columns (4) through (6), we repeat our analysis with *Default* as the dependent variable. The positive and significant coefficient on *Rollover* in Column (4) indicates that firms with a larger proportion of debt maturing within the year have a higher default likelihood. The results are economically significant: a one standard deviation increase in *Rollover* (0.213) is associated with a 0.79% increase in the propensity to default, which is large compared to the sample-mean probability of default of 1.2% (see Panel A of Table 1). When we distinguish between small and large firms in Column (5), we find that the effect is present for both small and large firms. However, when we distinguish between investment grade and below-investment grade firms in Column (6), we find that the positive association between *Rollover* and *Default* is present only in the sample of below-investment grade firms.

Overall, the results in Panel A indicate that firms with a larger proportion of short-term debt are likely to experience more severe deterioration in their credit quality. We obtain these results after controlling for observable measures of firm risk including credit ratings. This result is consistent with the rollover risk hypothesis, and highlights the effect of debt maturity structure on a firm's overall credit risk. In unreported tests, we obtain similar results when we estimate the regressions with *Multi-notch downgrade* instead of *Notches downgrade* as the dependent variable. We also repeat our tests with the ratio of total debt due within the year (Compustat item *dlc*) over total assets (Compustat item *at*, instead of over total debt) as our alternative measure of rollover risk, and obtain results similar to the ones reported. Our results are also robust to controlling for rating outlooks issued by S&P.

4.2 Further Tests to Hypothesis 1

To better understand the association between the proportion of short-term debt and fall in credit quality, we do additional tests which are reported in Panel B of Table 2. One major concern with our empirical specification is that some recent unobserved change in firm risk (that firm fixed effects will not control for) may lead to both an increase in the proportion of short-term debt and a severe fall in credit quality. To test this alternative explanation, we repeat our regression from Column (1) of Panel A after splitting $Rollover_{t-1}$ into two variables, $Rollover_{t-2}$ and $\Delta Rollover$, where $Rollover_{t-2}$ is the value of *Rollover* two years ago, and $\Delta Rollover$ measures the change in *Rollover* during the year $t-1$. If a recent change in firm risk is causing an increase in both *Rollover* and *Notches downgrade*, then only $\Delta Rollover$ should be significantly associated with *Notches downgrade*. However, we find that both $Rollover_{t-2}$ and $\Delta Rollover$ are significantly positively associated with *Notches downgrade*, which indicates that our results in Panel A are not being driven only by recent changes in firm risk. Note that the positive association between $Rollover_{t-2}$ and *Notches downgrade* is consistent with the rollover risk hypothesis because firms' debt structure tends to be sticky, i.e., $Rollover_{t-2}$ is likely to be strongly correlated with $Rollover_{t-1}$.

Theory also predicts that rollover risk is more pronounced for firms with declining profitability. We test this prediction in Column (2) of Panel B by estimating the regression after replacing *Rollover* with two interaction terms, $Rollover \times Decline$ and $Rollover \times [1 - Decline]$, where *Decline* is a dummy variable that identifies firms that experience a decline in year-on-year profitability (*Operating income/Sales*). Consistent with theory, we find that *Rollover* is associated with more severe rating downgrades only for firms that experience a decline in profitability. In Column (3), we examine if economic conditions affect the relation between *Rollover* and severity of rating downgrades. To do this, we estimate our regression by replacing *Rollover* with two interaction terms, $Rollover \times Recession$ and $Rollover \times [1 - Recession]$, where *Recession* identifies the years classified by the NBER as recessionary. We find that while *Rollover* is positively associated with severe rating downgrades both during recessions and expansions, the magnitude of the effect is greater during recessions. Since credit market conditions are likely to be related to economic conditions, this result highlights that rollover risk is important both during periods of benign and stressed credit market conditions.

In Columns (4) through (6), we repeat our analysis in Columns (1) through (3) after replacing *Notches downgrade* with *Default* as the dependent variable. As can be seen, the results are qualitatively similar. From Column (4), we find that both $Rollover_{t-2}$ and $\Delta Rollover$ are significantly positively associated with *Default*, which indicates that our results in Panel A are not being driven only by recent changes in firm risk. The positive association between *Rollover* and *Default* is present both in firms that experience a decline in profitability and those that do not, but the effect is stronger in the former category. Similarly, the positive association between *Rollover* and *Default* is present both in recessionary and non-recessionary years, but the effect is stronger in recession years.

5 Addressing Alternative Explanations

The important identification challenge we face is the that the proportion of short-term debt in a firm's debt structure is endogenous. This has been theoretically argued and empirically documented. Extant empirical research documents that small firms, firms with more growth opportunities, riskier firms, and firms with larger information asymmetry rely more on short-term debt (e.g., Barclay and Smith (1995), Stohs and Mauer (1996), and Titman and Wessels (1988)).[6] In our empirical analysis in Section 4, we explicitly control for all observable firm characteristics that have been shown to affect the proportion of short-term debt, and that may also affect the firm's credit quality. We also include rating fixed effects to control for credit quality, firm fixed effects to control for all time-invariant risk characteristics, and year fixed effects to control for systematic risk factors.

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

Despite the rich empirical specification we employ, some unobserved time-varying risk factor may affect both the increase in the proportion of short-term debt and the deterioration in credit quality. In this regard, our finding that even lagged values of *Rollover* two years ago are significantly positively associated with *Notches downgrade* and *Default* (Columns (1) and (4) of Panel B in Table 2) provide some comfort that the positive association between *Rollover* and fall in credit quality is not a result of recent changes in firm risk alone. In this section, we perform three additional sets of tests to address the identification problem. Results are reported in Table 3.

[Insert Table 3 here]

5.1 Rollover Risk from Refinancing of Long-term Debt

Our first set of tests are based on the idea that firms are exposed to rollover risk whenever they refinance debt, regardless of whether the debt was issued recently or in the distant past. Thus, firms that need to refinance a significant amount of long-term debt (i.e., firms with a high value of *Rollover-Alt.*) also face high rollover risk. However, 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-Alt* and severity of rating downgrades. This idea is similar to the one employed by Almeida et al. (2009).

In Panel A of Table 3, we repeat all the regressions in Panel A of Table 2 after replacing *Rollover* with *Rollover-Alt*. The positive and significant coefficient on *Rollover-Alt* in Column (1) shows that firms with greater proportion of long-term debt due within a year are also likely to experience more severe deterioration in credit quality. Consistent with our OLS estimates being biased downward, we find that the economic magnitude of the effect is greater with *Rollover-Alt*. The coefficient on *Rollover-Alt* of 0.132 is larger than the coefficient on *Rollover* of 0.112 (See Column (1) in Panel A of Table 2). Our estimates indicate that a one standard deviation increase in *Rollover-Alt* (.127) is associated with a .017 increase in *Notches* *downgrade*, which represents an increase of 8.2% over the sample mean of *Notches downgrade* (.205).

In Column (2), we replace *Rollover-Alt* with two interaction terms, *Rollover-Alt*×*Small* and *Rollover-Alt*×[1−*Small*], to differentiate between small and large firms. While the coefficients on both interaction terms are positive, they are not significant at conventional levels. When we differentiate between investment grade and speculative grade firms in Column (3), we find that the positive association between *Rollover-Alt* and *Notches downgrade* is confined to speculative grade firms only.

In Columns (4) through (6), we repeat the regressions in Columns (1) through (3) with *Default* as the dependent variable. As can be seen, our results are qualitatively similar. There is a positive relationship between *Rollover-Alt* and *Default* that is economically large. Here again the coefficient on *Rollover-Alt* of 0.048 is larger than the coefficient on *Rollover* of 0.037 (See Column (4) in Panel A of Table 2). Our estimates indicate that a one standard deviation increase in *Rollover-Alt* is associated with a 0.61% increase in annual default likelihood. The positive association between *Rollover-Alt* and *Default* is present for both small and large firms (Column (5)), but is only confined to speculative grade firms (Column (6)). Overall, the evidence is consistent with the rollover risk hypothesis.

5.2 Instrumental Variables Regression

Our second set of tests use an instrumental variables (IV) regression approach. The ideal instruments should affect *Rollover* but must not have a direct effect on changes in firm's credit quality. We use the proportion of current assets in total assets (*Current assets/Total assets*) and the yield to maturity on 10-year treasury bonds (*Ten year*) as instruments for *Rollover*. The use of *Current assets/Total assets* as an instrument is motivated by the idea that firms with more short-term assets tend to rely more on short-term borrowing. They do this either to avoid mismatch between assets and liabilities or because they have fewer long-term assets that can be offered as collateral for long-term loans. Our univariate analysis shows that high-*Rollover* firms do have a larger proportion of current assets in total assets (see Panel B of Table 1). At the same time, the proportion of short-term current assets on the balance sheet should not directly affect changes in firm's credit risk. The identifying assumption behind using 10-year treasury rate (*Ten year*) as an instrument is that firms are more likely to issue short-term debt when long-term interest rates are high (based on 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.

We present the results of the IV regression implemented using the two-stage least squares (2SLS) estimator in Panel B of Table 3. In order to ensure that the IV estimation converges, we make two important changes to the empirical specification. First, instead of firm fixed effects, we include industry fixed effects at the level of the Fama-French 48 industry category. Second, instead of the rating category fixed effects, we include a dummy variable, *Investment grade*, that identifies firms with an investment grade rating. The results of the first-stage regression with *Rollover* as the dependent variable are in Column (1). The positive and significant coefficient on *Current assets/Total assets* indicates that firms with a larger proportion of short-term assets rely more on short-term debt. On the other hand, the coefficient on *Ten year* is insignificant. Our instruments are strong, as seen from the F-statistic for the excluded instruments in the first stage. From the coefficient on the other variables, we find that firms with a larger proportion of short-term debt are large (positive coefficient on *Log(Total assets)*), have higher leverage (positive coefficient on *Total debt/Mkt. Cap*), have a higher interest coverage (positive coefficient on *Interest coverage*), are more likely to have investment grade rating (positive coefficient on *Investment grade*), invest more in research and development (positive coefficient on *R&D/Total assets*), and have a lower proportion of cash (negative coefficient on *Cash/Total assets*).

In Column (2), we present the results of the second-stage regression with *Notches downgrade* as the dependent variable and the instrumented value of *Rollover* as the main regressor. As can be seen, the coefficient on *Rollover* is positive and significant. Moreover, the coefficient of 0.397 is more than three times as large as the OLS coefficient of 0.112 (see Column 1 in Panel A of Table 2). This is consistent with our argument that the OLS regression underestimates the true effect of *Rollover* on subsequent deterioration in credit quality.

In Column (3), we present the results of the second-stage regression with *Default* as the dependent variable. Note that the first stage for this is similar to the one reported in Column (1). Our results again show that firms with a larger proportion of short-term debt are more likely to default during the year. Here again, we find that the coefficient estimate of 0.077 from the IV estimation is much larger than the OLS estimate of 0.037.

Overall, the results in Panel B indicate that the positive association between *Rollover* and deterioration in credit quality is not being driven by unobserved time-varying risk factors.

5.3 Operating Risk versus Rollover Risk

It is possible that the firm's operating risk jointly determines both the firm's reliance on short-term debt (see Stohs and Mauer (1996)) and subsequent fall in credit quality. Our third test relies on the idea that the impact of rollover risk on credit quality is asymmetric in nature: rollover risk could lead to a fall in credit quality by exacerbating the impact of negative shocks, but does not lead to improvements in credit quality if the firm experiences positive shocks. 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 explanations, we estimate the panel regression (1), 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 Panel C of Table 3. The empirical specification in each column of Panel C is exactly the same as the corresponding column in Panel A of Table 2. As can be seen, the coefficient estimate on *Rollover* is statistically insignificant in all specifications, and is close to zero in magnitude. This indicates that our earlier finding of a positive association between *Rollover* and *Notches downgrade* is more likely driven by rollover risk rather than operating risk.

Our results indicate that firms with larger proportion of short-term debt are more likely to experience a deterioration in credit quality. A natural question to ask is if credit rating agencies take this into account when assigning the initial credit rating. In other words, ceteris paribus, do firms with a larger proportion of short-term debt have lower credit ratings? Unfortunately our ability to answer this question is affected by the endogenity of firm's debt maturity structure choice. As we mentioned, firms with a larger proportion of short-term debt are observationally less risky. Consistent with this, in unreported tests, when we employ an ordered logit specification to model the firm's credit rating, we find that firms with a larger proportion of short-term debt are associated with a better credit rating. In the specification we do not include firm fixed effects because of the non-linear nature of the ordered logit model and the incidental parameters problem (Neyman and Scott (1948)). Alternatively when we employ an OLS specification to model credit ratings and include firm fixed effects, we do not find a significant relationship between *Rollover* and credit rating. Since an OLS specification is inappropriate to model a firm's credit rating, we do not take these results to be conclusive.

To address the question of whether the proportion of short-term debt affects the firm's ex ante credit risk, we test Hypothesis 2 to see if the proportion of short-term debt affects the cost of long-term borrowing.

6 Exposure to Rollover Risk and Cost of Long-Term Bonds

We now test Hypothesis 2 by examining whether the proportion of short-term debt on the firm's balance sheet affects the yield spreads on a firm's long-term bonds. We do this by replicating the regression 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:

$$\text{Yield Spread}_{b,\tau} = \alpha + \beta \times \text{Rollover}_{i,t-1} + \gamma_1 \times X_{i,t-1} + \gamma_2 \times X_b + \gamma_3 \times X_{m,\tau} + \text{Issue rating FE} + \text{Industry or Firm FE} + \text{Year FE}. \quad (2)$$

In equation (2), the subscripts b, i, m, τ and t indicate the bond, the firm, the market, the month, and the year, respectively. The dependent variable *Yield spread*$_{b,\tau}$ is the yield spread for bond (b) measured over the month (τ).

The firm characteristics ($X_{i,t-1}$) that we control for are: *Average excess return* and *Idiosyncratic 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 the bond trade; *Mkt. 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* 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 preceding 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 4. In Column (1), we estimate the regression on all the bonds in our sample, and include issue rating, year and industry fixed effects, where industry is identified at the level of the Fama-French 48 industry category. The positive and significant coefficient on *Rollover* indicates that bonds issued by firms that have a larger 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 bond'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.

[Insert Table 4 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 when market returns are high (negative coefficients on *Average index*). Bond yield spreads are also lower for large bond offerings and for bonds offered by large firms (negative coefficient on *Log(Amount)* and *Mkt. Cap/Index*), and are higher for longer maturity bonds (positive coefficient on *Maturity*) and for bonds with a higher offering yield (positive coefficient on *Offering yield*).

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 not very different from that in Column (1). While the coefficients are statistically significant, they are not large in economic terms. The coefficient estimate from Column (2) indicates that a one standard deviation increase in *Rollover* (0.244 for the sample of bond issues) is associated with a higher bond yield spread of 4.5 basis points, which represents a 3.5% increase over the sample mean bond yield spread of 129 basis points.

In Column (3), we repeat the regression in Column (2) after replacing *Rollover* with the two interaction terms, *Rollover* $\times$ *Small* and *Rollover* $\times$ [1−*Small*]. The coefficients on both interaction terms are positive and significant, which indicates that a larger proportion of short-term debt is associated with higher yields on long-term bonds for both small and large firms. In Column (4) we repeat the regression with the interaction terms, *Rollover*$\times$*High rated* and *Rollover*$\times$ [1−*High rated*], where *High rated* is a dummy variable that identifies bonds with credit rating above the sample median. As can be seen, the positive association between *Rollover* and yield spreads on long-term bonds is confined to the low rated firms.

Overall, the evidence in Table 4 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-term debt increases the firm's overall credit risk, but this is not captured by the firm's credit rating.

7 Conclusion

The collapse of financial institutions such as Bear Stearns and Lehman Brothers during the recent financial crisis focussed attention on the risks arising from short-term debt. In this paper, we examine whether a firm's debt maturity structure affects its overall credit risk. Our analysis is also motivated by a large body of theoretical research which argues that, in the presence of credit market imperfections, short-term debt exposes a firm to rollover risk of not being able to refinance its maturing debt, especially if refinancing coincides with a deterioration in either firm fundamentals or credit market conditions. Recent theories argue that rollover risk is an additional source of credit risk, which we refer to as the rollover risk hypothesis.

Our empirical findings offer strong support to the rollover risk hypothesis. We find that firms that have a larger proportion of their debt maturing within the year are *ceteris paribus* more likely to experience a severe fall in their credit quality in the following year, as measured by downgrades in their credit ratings and the propensity to default. This effect is stronger for firms with declining profitability and during recession years. Our results are robust to instrumenting for the proportion of short-maturity debt and alternative measures of a firm's exposure to rollover risk. Bond market investors seem to recognize the effect of rollover risk because long-term bonds issued by firms that have a larger proportion of short-term debt trade at higher yield spreads, all else equal.

An interesting avenue for future research is to explore whether credit rating agencies adequately account for the effect of rollover risk on credit risk. Our results seem to suggest that they do not, because we obtain our results even after controlling for firms' credit ratings. However, this requires further exploration, especially with regard to ratings of structured products issued by financial institutions, that were largely financed with short-term debt and were at the heart of the recent financial crisis. The following quote from "S&P's Rating Direct" issued on May 13, 2008 seems to acknowledge some shortcomings in accounting for rollover risk 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."

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Appendix: Variable Definitions

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

- *Average excess return* is the 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.
- *Average index* is the mean of the CRSP value-weighted index returns over the 180 days prior to (not including) the bond transaction date.
- *Cash/Total assets* is the ratio of book value of cash and marketable securities (Compustat item *che*) to the book value of total assets (Compustat item *at*).
- *Current assets/Total assets* is the ratio of book value of current assets (Compustat item *act*) to the book value of total assets (Compustat item *at*).
- *Decline* is a dummy variable that takes the value one if a firm experiences a decline in profitability during the year as compared to the previous year, and zero otherwise. We measure profitability using *Operating income/Sales*.
- *Default* is a dummy variable that takes the value one for firms whose rating is downgraded to 'D' during the year, and zero otherwise.
- *Downgrade* is a dummy variable that takes the value one if the firm experiences a rating downgrade during the year, and zero otherwise.
- *High rated* is a dummy variable that takes the value one if a bond's credit rating is above the sample median, and zero otherwise.
- *Equity volatility* is the 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.
- *Idiosyncratic volatility* is the standard deviation of daily excess returns relative to the CRSP value-weighted index for each firm's equity during a year.
- *Industry volatility* is the standard deviation of the operating income of all firms in the same industry during the year. We define industry at the level of two-digit SIC code.
- *Interest coverage* is the ratio of operating income after depreciation (Compustat items *oiadp* + *xint*) to the total interest expenditure (Compustat item *xint*).
- *Investment grade* is a dummy variable that takes the value one if a firm's credit rating is BBB- or better, and zero otherwise.

- *Log(Amount)* is the natural logarithm of bond issue size.
- *Large* is a dummy variable that takes the value one for firms with book value of total assets (Compustat item *at*) above the sample median, and zero otherwise.
- *Log(Total assets)* is the natural logarithm of the book value of total assets (Compustat item *at*).
- *Long term debt/Total assets* is the ratio of total long-term debt (Compustat item *dltt*) to the book value of total assets (Compustat item *at*).
- *Mkt. Cap/Index* is the ratio of the market value of equity to the value of CRSP value weighted index of all stocks listed in NYSE, AMEX and NASDAQ.
- *Market to book* is the ratio of market value of total assets to the book value of total assets. We calculate the market value of total assets as the sum of book value of total assets and the market value of equity less the book value of equity.
- *Maturity* is the remaining years to final maturity of the bond.
- *Multi-notch downgrade* is a dummy variable that takes the value one if the firm's long-term rating is downgraded by more than one notch during any month of the year, and zero otherwise.
- *Notches downgrade* indicates the maximum number of notches by which a firm's credit rating is downgraded during any month of the year.
- *Notches downgrade (Conditional)* indicates the maximum number of notches by which a firm's credit rating is downgraded during the year conditional on there being a downgrade. This variable is missing for firms that do not experience a downgrade during the year.
- *Offering yield* is the yield to maturity at the time of bond issuance.
- *Operating income/Sales* is the ratio of operating income after depreciation (Compustat item *oiadp*) to total sales (Compustat item *sale*).
- *R&D/Total assets* is the ratio of research and development expenditure (Compustat item *xrd*) to book value of total assets (Compustat item *at*). We replace missing values of research and development expenditure as zero.
- $Rating_{t-1}$ is an ordinal variable that indicates the S&P long-term credit rating of the firm in the previous year. The variable is 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.
- *Recession* is a dummy variable that takes the value one for years 1981, 1982, 1990, 1991 and 2001, 2007-08, and zero otherwise.

- *Rollover* is the ratio of total debt in current liabilities (Compustat item *dlc*) to the sum of debt in current liabilities and long-term debt (Compustat items *dlc* + *dltt*).
- *Rollover-Alt* is the ratio of total long-term debt due within one year (Compustat item *dd1*) to the sum of debt in current liabilities and long-term debt (Compustat items *dlc* + *dltt*).
- *Small* is a dummy variable that takes the value one for firms with book value of total assets (Compustat item *at*) below the sample median, and zero otherwise.
- *Systematic volatility* is the standard deviation of the CRSP value-weighted index returns over the 180 days prior to (not including) the bond transaction date.
- *Tangibility* is the ratio of book value of property plant and equipment (Compustat item *ppent*) to the book value of total assets (Compustat item *at*).
- *Taxes/Total assets* is the ratio of tax expenditure (Compustat item *txt*) to book value of total assets (Compustat item *at*).
- *Ten year* is the 10-year treasury yield.
- *Total debt/Mkt. Cap* is the ratio of total debt (Compustat items *dlc* + *dltt*) to the market value of equity.
- *Treasury slope* is the difference between the 10-year treasury yield and the 2-year treasury yield.
- *Yield spread* is the difference between the average yield to maturity for all bond trades during the month and the yield to maturity on a treasury with comparable maturity.

Table 1: Summary Statistics

Panel A: Descriptive statistics for the full sample

	N	Mean	Median	S.D.
Log(Total assets)	22131	7.724	7.602	1.513
Rollover	22131	0.159	0.072	0.213
Total debt/Mkt. Cap	21648	0.817	0.299	1.769
Long term debt/Total assets	22131	0.302	0.264	0.206
Interest coverage	22131	9.262	4.542	17.158
Rating	22131	10.401	10.636	3.905
Investment grade	22131	0.465	0	0.499
Downgrade	22131	0.13	0	0.336
Multi-notch downgrade	22131	0.043	0	0.203
Notches downgrade	22131	0.205	0	0.668
Notches downgrade (Conditional)	2870	1.577	1	1.131
Default	22131	0.012	0	0.108
Operating income/Sales	22110	0.085	0.091	0.173
Taxes/Total assets	22131	0.022	0.02	0.028
Market to book	21640	1.682	1.415	0.878
R&D/Total assets	22131	0.017	0	0.034
Industry volatility	21962	0.124	0.08	0.103
Idiosyncratic volatility	20320	0.029	0.026	0.013
Tangibility	22131	0.362	0.319	0.234
Cash/Total assets	22127	0.088	0.048	0.108
Current assets/Total assets	21144	0.377	0.366	0.195

This panel provides the descriptive statistics of our rating sample, which includes all firms with an S&P long-term credit rating during the time period 1986-2010. Details on the definition of the variables are provided in the Appendix.

Panel B: Low-rollover firms versus High-rollover firms

	High-rollover	Low-rollover	High − Low
Log(Total assets)	8.127	7.323	0.804***
Total debt/Mkt. Cap	0.685	0.95	-0.265***
Long term debt/Total assets	0.219	0.385	-0.166***
Interest coverage	11.252	7.274	3.978***
Rating	9.345	11.456	-2.111***
Investment grade	0.588	0.342	0.246***
Downgrade	0.133	0.126	0.007
Multi-notch downgrade	0.048	0.038	0.010***
Notches downgrade	0.216	0.193	0.023***
Default	0.015	0.008	0.007***
Operating income/Sales	0.094	0.076	0.018***
Taxes/Total assets	0.026	0.019	0.007***
Market to book	1.721	1.643	0.078***
R&D/Total assets	0.021	0.013	0.008***
Industry volatility	0.116	0.131	-0.015***
Idiosyncratic volatility	0.026	0.032	-0.006***
Tangibility	0.337	0.388	-0.051***
Cash/Total assets	0.087	0.089	-0.002
Current assets/Total assets	0.411	0.344	0.067***

This panel compares the mean values of the variables used in our analysis across two subsamples identified based on whether *Rollover* is below or above its sample median, Low-rollover and High-rollover, respectively. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel C: Yield spread

		High-Rollover	Low-Rollover	High − Low
Utilities				
High Rated	Short maturity	79.63	79.56	0.06
High Rated	Medium maturity	85.21	52.78	32.43***
High Rated	Long maturity	158.32	93.47	64.85***
Medium Rated	Short maturity	116.01	109.52	6.49*
Medium Rated	Medium maturity	130.32	118.96	11.37***
Medium Rated	Long maturity	180.59	144.46	36.12***
Low Rated	Short maturity	148.16	129.10	19.07***
Low Rated	Medium maturity	151.54	151.70	-0.16
Low Rated	Long maturity	212.23	170.88	41.35***
Industrial firms				
High Rated	Short maturity	68.22	70.58	-2.35
High Rated	Medium maturity	71.24	74.73	-3.49
High Rated	Long maturity	102.25	97.55	4.70
Medium Rated	Short maturity	101.12	96.18	4.94***
Medium Rated	Medium maturity	107.70	107.56	0.14
Medium Rated	Long maturity	143.77	129.01	14.76***
Low Rated	Short maturity	165.45	140.87	24.58***
Low Rated	Medium maturity	169.91	155.60	14.32***
Low Rated	Long maturity	196.77	190.28	6.49
Finance firms				
High Rated	Short maturity	93.33	103.04	-9.71
High Rated	Medium maturity	119.90	89.74	30.16***
High Rated	Long maturity	145.98	140.41	5.58
Medium Rated	Short maturity	91.53	126.65	-35.11***
Medium Rated	Medium maturity	122.91	143.41	-20.50***
Medium Rated	Long maturity	170.86	183.39	-12.54**
Low Rated	Short maturity	161.42	150.89	10.53**
Low Rated	Medium maturity	160.64	170.52	-9.88**
Low Rated	Long maturity	199.78	174.83	24.95***

This panel provides the average yield spreads (in basis points) of the bonds in our sample for firms in three industries: utilities, industrial and financial. The data are collected from the Mergent Fixed Income Securities Database (FISD) for the time period 1995-2010. For each category, we split the sample into three subcategories depending on the rating of the bond: 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-Rollover and Low-Rollover, respectively. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Table 2: Debt Maturity Structure and Deterioration in Credit Quality

Panel A: Debt maturity structure and deterioration in credit quality

	Notches downgrade			Default		
	(1)	(2)	(3)	(4)	(5)	(6)
Rollover	.112 (.036)***			.037 (.008)***		
Rollover × Small		.095 (.048)**			.035 (.012)***	
Rollover × [1-Small]		.131 (.054)**			.039 (.012)***	
Rollover × Investment grade			.065 (.041)			.003 (.002)
Rollover × [1 − Investment grade]			.160 (.072)**			.071 (.017)***
Log(Total assets)	-.080 (.020)***	-.082 (.020)***	-.079 (.020)***	-.004 (.002)**	-.004 (.002)**	-.003 (.002)*
Total debt/Mkt. Cap	.062 (.011)***	.062 (.011)***	.061 (.011)***	.010 (.002)***	.010 (.002)***	.009 (.002)***
Interest coverage	-.0007 (.0004)	-.0007 (.0004)	-.0007 (.0004)	-.00005 (.00003)*	-.00005 (.00003)	-.00005 (.00003)
Operating income/Sales	-.144 (.060)**	-.144 (.060)**	-.144 (.060)**	-.024 (.010)**	-.024 (.011)**	-.025 (.011)**
Taxes/Total assets	-1.184 (.374)***	-1.181 (.375)***	-1.190 (.370)***	.067 (.041)	.068 (.041)*	.063 (.041)
Market to book	-.070 (.012)***	-.070 (.012)***	-.069 (.012)***	.0007 (.001)	.0007 (.001)	.0008 (.001)
R&D/Total assets	-.623 (.524)	-.624 (.524)	-.605 (.523)	-.043 (.048)	-.043 (.048)	-.030 (.044)
Industry volatility	.195 (.099)**	.196 (.098)**	.197 (.098)**	-.020 (.012)*	-.020 (.011)*	-.018 (.011)*
Idiosyncratic volatility	5.085 (5.782)	5.032 (5.742)	5.054 (5.751)	-.771 (1.094)	-.778 (1.086)	-.794 (1.068)
Tangibility	.100 (.111)	.099 (.112)	.100 (.111)	.012 (.012)	.012 (.012)	.012 (.011)
Cash/Total assets	-.237 (.102)**	-.238 (.102)**	-.241 (.102)**	.006 (.012)	.006 (.012)	.004 (.012)
Const.	1.552 (.232)***	1.561 (.231)***	1.562 (.231)***	.046 (.040)	.047 (.039)	.053 (.039)
Obs.	18669	18669	18669	18669	18669	18669
R^2	.246	.246	.246	.67	.67	.672

This panel reports the results of a panel regression relating the proportion of short-term debt in the firm's debt structure to a deterioration in credit quality. Specifically, we estimate the following panel regression model:

$$y_{i,t} = \alpha + \beta \times \text{Rollover}_{i,t-1} + \gamma \times X_{i,t-1} + \text{Rating FE} + \text{Firm FE} + \text{Year FE},$$

where the dependent variable y is *Notches downgrade* in columns (1)- (3) and *Default* in columns (4) and (6). Details on the definition of the variables are provided in the Appendix. The standard errors are robust to heteroscedasticity and are clustered at the industry level, where we define industry at the level of Fama-French 48 industry category. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel B: Debt maturity structure and deterioration in credit quality - additional tests

	Notches downgrade			Default		
	(1)	(2)	(3)	(4)	(5)	(6)
Rollover_{t-2}	.093			.027		
	(.045)**			(.006)***		
ΔRollover	.122			.042		
	(.041)***			(.010)***		
Rollover × Decline		.229			.054	
		(.050)***			(.012)***	
Rollover × [1-Decline]		.012			.023	
		(.034)			(.007)***	
Rollover × Recession			.163			.055
			(.071)**			(.014)***
Rollover × [1-Recession]			.090			.029
			(.040)**			(.009)***
Log(Total assets)	-.081	-.081	-.080	-.004	-.004	-.003
	(.020)***	(.020)***	(.020)***	(.002)**	(.002)**	(.002)**
Total debt/Mkt. Cap	.061	.061	.062	.010	.010	.010
	(.011)***	(.011)***	(.011)***	(.002)***	(.002)***	(.002)***
Interest coverage	-.0007	-.0006	-.0007	-.00003	-.00004	-.00006
	(.0005)	(.0004)	(.0004)	(.00004)	(.00003)	(.00003)*
Operating income/Sales	-.151	-.126	-.143	-.026	-.022	-.024
	(.061)**	(.058)**	(.060)**	(.011)**	(.010)**	(.010)**
Taxes/Total assets	-1.205	-1.082	-1.179	.066	.082	.069
	(.381)***	(.373)***	(.376)***	(.043)	(.041)**	(.041)*
Market to book	-.071	-.067	-.069	.0007	.001	.0008
	(.012)***	(.012)***	(.012)***	(.001)	(.001)	(.001)
R&D/Total assets	-.682	-.615	-.620	-.036	-.042	-.041
	(.525)	(.522)	(.521)	(.050)	(.049)	(.047)
Industry volatility	.193	.194	.195	-.020	-.020	-.020
	(.100)*	(.097)**	(.097)**	(.012)*	(.012)*	(.012)
Idiosyncratic volatility	5.022	5.017	5.092	-.741	-.781	-.769
	(5.808)	(5.660)	(5.761)	(1.113)	(1.076)	(1.087)
Tangibility	.081	.094	.101	.012	.011	.012
	(.112)	(.111)	(.111)	(.012)	(.012)	(.012)
Cash/Total assets	-.245	-.227	-.238	.006	.008	.006
	(.107)**	(.100)**	(.101)**	(.011)	(.011)	(.012)
Const.	1.582	1.544	1.551	.048	.045	.046
	(.231)***	(.230)***	(.232)***	(.040)	(.039)	(.040)
Obs.	18512	18669	18669	18512	18669	18669
R^2	.247	.247	.246	.667	.671	.67

Table 3: Addressing Alternate Explanations

Panel A: Long-term debt payable in one year and deterioration in credit quality

	Notches downgrade			Default		
	(1)	(2)	(3)	(4)	(5)	(6)
Rollover-Alt	.132 (.071)*			.048 (.011)***		
Rollover-Alt × Small		.146 (.091)			.052 (.016)***	
Rollover-Alt × [1-Small]		.116 (.088)			.044 (.015)***	
Rollover-Alt × Investment grade			.033 (.080)			.003 (.004)
Rollover-Alt × [1-Investment grade]			.205 (.119)*			.082 (.019)***
Log(Total assets)	-.082 (.020)***	-.081 (.020)***	-.081 (.020)***	-.004 (.002)**	-.004 (.002)**	-.004 (.002)**
Total debt/Mkt. Cap	.062 (.011)***	.062 (.011)***	.061 (.011)***	.010 (.002)***	.010 (.002)***	.010 (.002)***
Interest coverage	-.0006 (.0004)	-.0006 (.0004)	-.0006 (.0004)	-.00003 (.00003)	-.00003 (.00003)	-.00003 (.00003)
Operating income/Sales	-.146 (.061)**	-.145 (.061)**	-.145 (.061)**	-.025 (.011)**	-.025 (.011)**	-.025 (.011)**
Taxes/Total assets	-1.173 (.376)***	-1.175 (.376)***	-1.179 (.373)***	.071 (.041)*	.070 (.041)*	.068 (.041)*
Market to book	-.070 (.012)***	-.070 (.012)***	-.069 (.012)***	.0007 (.001)	.0007 (.001)	.0008 (.001)
R&D/Total assets	-.599 (.512)	-.600 (.513)	-.590 (.507)	-.036 (.042)	-.036 (.041)	-.032 (.039)
Industry volatility	.193 (.099)**	.193 (.099)*	.197 (.097)**	-.020 (.011)*	-.020 (.011)*	-.018 (.011)*
Idiosyncratic volatility	5.201 (5.887)	5.226 (5.876)	5.262 (5.904)	-.729 (1.127)	-.723 (1.121)	-.701 (1.132)
Tangibility	.096 (.110)	.097 (.110)	.096 (.110)	.011 (.011)	.011 (.012)	.011 (.011)
Cash/Total assets	-.256 (.101)**	-.255 (.101)**	-.255 (.102)**	-.0005 (.012)	-.0003 (.012)	-.0003 (.012)
Const.	1.595 (.232)***	1.588 (.226)***	1.585 (.234)***	.059 (.039)	.057 (.038)	.054 (.039)
Obs.	18669	18669	18669	18669	18669	18669
R^2	.245	.245	.246	.669	.669	.671

This panel reports the results of a panel regression relating the firm's ratio of long-term debt due within the year to total debt to the firm's deterioration in credit quality. Specifically, we estimate the following panel regression model:

$$y_{i,t} = \alpha + \beta \times \text{Rollover-Alt}_{i,t-1} + \gamma \times X_{i,t-1} + \text{Rating FE} + \text{Firm FE} + \text{Year FE},$$

where the dependent variable y is *Notches downgrade* in columns (1)- (3) and *Default* in columns (4) and (6). Details on the definition of the variables are provided in the Appendix. The standard errors are robust to heteroscedasticity and are clustered at the industry level, where we define industry at the level of Fama-French 48 industry category. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel B: Instrumental variable regression

	Short	Notches downgrade	Default
	(1)	(2)	(3)
Current assets/Total assets	.321		
	(.033)***		
Ten year	.01		
	(.009)		
Rollover		.397	.077
		(.158)**	(.041)*
Log(Total assets)	.022	.022	-.004
	(.004)***	(.007)***	(.002)**
Total debt/Mkt. Cap	.009	.043	.011
	(.002)***	(.008)***	(.002)***
Interest coverage	.002	-.001	-.00005
	(.0002)***	(.0004)***	(.0001)
Investment grade	.024	.131	.005
	(.009)**	(.013)***	(.002)**
Operating income/Sales	-.018	-.119	-.015
	(.023)	(.038)***	(.008)*
Taxes/Total assets	.04	-.773	.079
	(.14)	(.224)***	(.049)
Market to book	.003	-.033	-.002
	(.005)	(.006)***	(.001)*
R&D/Total assets	.545	-.037	-.070
	(.141)***	(.210)	(.045)
Industry volatility	-.06	.178	-.026
	(.034)*	(.085)**	(.016)
Idiosyncratic volatility	.357	8.805	.923
	(.26)	(.736)***	(.234)***
Tangibility	.037	.062	.022
	(.032)	(.053)	(.010)**
Cash/Total assets	-.189	-.274	.020
	(.045)***	(.048)***	(.011)*
F-Statistic of excluded instruments	52.42		
Obs.	18553	18553	18553
R^2	.113	.056	.078

This panel reports the results of a instrumental variables estimation relating the proportion of short-term debt to a deterioration in credit quality. Specifically, we estimate the following panel regression model:

$$y_{i,t} = \alpha + \beta \times \text{Rollover}_{i,t-1} + \gamma \times X_{i,t-1} + \text{Rating FE} + \text{Firm FE} + \text{Year FE},$$

after instrumenting for *Rollover* using the variables, *Current assets/Total assets* and *Ten year*. Column (1) provides the results of the first stage regression with *Rollover* as the dependent variables. Column (2) provides the results of the second stage regression with *Notches downgrade* as the dependent variable, and column (3) provides the results of the second stage regression with *Default* as the dependent variable. All variables are defined in the Appendix. The standard errors are robust to heteroscedasticity and are clustered at the industry level, where we define industry at the level of Fama-French 48 industry category. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel C: Debt maturity structure and improvement in credit quality

	All Firms		
	(1)	(2)	(3)
Rollover	-.021 (.030)		
Rollover × Small		-.026 (.038)	
Rollover × [1-Small]		-.015 (.033)	
Rollover × Investment grade			.015 (.018)
Rollover × [1 − Investment grade]			-.057 (.052)
Log(Total assets)	.055 (.010)***	.054 (.010)***	.054 (.010)***
Total debt/Mkt. Cap	-.002 (.009)	-.002 (.009)	-.002 (.009)
Interest coverage	-.00009 (.0004)	-.00009 (.0004)	-.0001 (.0004)
Operating income/Sales	.149 (.031)***	.149 (.031)***	.149 (.031)***
Taxes/Total assets	.883 (.243)***	.884 (.243)***	.886 (.242)***
Market to book	.047 (.011)***	.047 (.011)***	.047 (.011)***
R&D/Total assets	.132 (.356)	.132 (.357)	.119 (.352)
Industry volatility	.069 (.059)	.069 (.059)	.068 (.059)
Idiosyncratic volatility	-9.694 (3.242)***	-9.710 (3.250)***	-9.669 (3.246)***
Tangibility	.074 (.052)	.073 (.051)	.074 (.052)
Cash/Total assets	-.093 (.066)	-.094 (.066)	-.091 (.065)
Const.	-.888 (.154)***	-.885 (.156)***	-.895 (.152)***
Obs.	18655	18655	18655
R^2	.206	.206	.206

This panel reports the results of a panel data regression relating the proportion of short-term debt in the firm's debt structure to a likelihood of rating upgrade. Specifically, we estimate the following panel regression model:

$$y_{i,t} = \alpha + \beta \times \text{Rollover}_{i,t-1} + \gamma \times X_{i,t-1} + \text{Rating FE} + \text{Firm FE} + \text{Year FE},$$

where the dependent variable y is *Notches upgrade*. *Notches upgrade* is the maximum number of notches by which a firm's credit rating is upgraded during any month of the year. All other variables are defined in the Appendix. The standard errors are robust to heteroscedasticity and are clustered at the industry level, where we define industry at the level of Fama-French 48 industry category. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Table 4: Debt maturity structure and bond yield spreads

	All Firms - OLS			
	(1)	(2)	(3)	(4)
Rollover	.147	.186		
	(.080)*	(.079)**		
Rollover × Small			.199	
			(.084)**	
Rollover × Large			.168	
			(.091)*	
Rollover × High rated				.117
				(.080)
Rollover × [1- High rated]				.229
				(.082)***
Equity volatility	7.186	4.655	4.633	4.436
	(2.171)***	(2.928)	(2.977)	(2.986)
Systematic volatility	96.681	97.845	97.854	97.980
	(5.732)***	(5.695)***	(5.697)***	(5.681)***
Long term debt/Total assets	.014	.460	.459	.467
	(.154)	(.190)**	(.190)**	(.191)**
Average index	-128.515	-133.777	-133.656	-133.261
	(15.168)***	(13.459)***	(13.422)***	(13.475)***
Average excess return	1.112	-3.313	-3.420	-2.905
	(15.535)	(10.162)	(10.115)	(10.245)
Mkt. Cap/Index	-23.411	-68.740	-68.887	-67.908
	(4.912)***	(10.707)***	(10.712)***	(10.580)***
Operating income/Sales	-.064	.280	.286	.281
	(.118)	(.188)	(.188)	(.191)
Debt/Mkt. Cap	.003	.037	.037	.039
	(.009)	(.015)**	(.014)***	(.015)***
Treasury slope	.033	.048	.048	.047
	(.023)	(.020)**	(.020)**	(.020)**
Maturity	.014	.014	.014	.014
	(.0009)***	(.0009)***	(.0009)***	(.0009)***
Offering yield	.107	.088	.088	.088
	(.008)***	(.007)***	(.007)***	(.007)***
Log(Amount)	-.042	-.023	-.024	-.024
	(.015)***	(.012)**	(.012)**	(.012)**
Const.	-.695	-.817	-.812	-.779
	(.223)***	(.181)***	(.183)***	(.179)***
Obs.	60386	61114	61114	61114
R^2	.592	.657	.657	.657
Fixed effects	Industry and time	Firm and time	Firm and time	Firm and time

This table reports the results of the regressions relating yield spread to the proportion of short-term debt:

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

where the dependent variable *Yield spread* is the difference between the average yield to maturity for all bond trades during the month and the yield to maturity on a treasury with comparable maturity. All other variables are defined in the Appendix. The data cover the period 1995-2010. The standard errors are robust to heteroscedasticity and are clustered at the industry level, where we define industry at the level of Fama-French 48 industry category. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.