Debt Maturity Structure and Credit Quality

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January 2013

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Abstract

We examine whether a firm's debt maturity structure affects its credit quality. Consistent with theory, we find that firms with greater exposure to rollover risk (measured by the amount of long-term debt payable within a year relative to assets) have lower credit quality; long-term bonds issued by those firms trade at higher yield spreads, indicating that bond market investors are cognizant of rollover risk arising from a firm's debt maturity structure. These effects are stronger among firms with a speculative grade rating, declining profitability, and during recessions.

JEL Classification: G32, G24, G12

I   Introduction

The collapse of financial institutions such as Bear Stearns and Lehman Brothers during the recent financial crisis has once again focused 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 (e.g., 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 maturing 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 it increases the possibility of a run on the firm (see He and Xiong (2012a), and Morris and Shin (2009)), and exacerbates the conflict of interests between shareholders and debtholders (He and Xiong (2012b)).

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 systemic *causal* relationship between a firm's debt maturity structure and its credit quality? Despite a large body of theoretical literature which argues that the answer is yes, surprisingly, there is no empirical study that directly addresses this question. Identifying such a causal link is challenging because a firm's debt maturity structure is itself endogenous, and may be determined by the same underlying risk characteristics that also affect the firm's credit quality. Moreover, the firm's credit quality may directly affect its debt maturity structure (see Diamond (1991)),

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[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 maturing 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 include liquidity risk, maturity risk, and refinancing risk.

giving rise to potential reverse causality concerns.

In this paper, we measure firms' exposure to rollover risk using the amount of their long-term debt due for repayment during the year, and use this to identify the causal impact of rollover risk on credit quality. This approach, which is similar to the one employed in Almeida, Campello, Laranjeira, and Weisbenner (2012), is based on the idea that long-term debt payable during the year depends on the past long-term debt maturity decisions made by the firm, and hence, is less likely to be correlated with the firm's current risk characteristics or credit quality. In other words, our empirical analysis exploits variation in rollover risk arising from decisions made by firms in the distant past.[3] However, we do recognize that firms' ability to refinance or repay their long-term debt depends on their current risk characteristics, and these risk characteristics may partly explain the relationship between long-term debt payable and credit quality that we document. We address this concern in a couple of different ways. First, we do a battery of additional tests and present evidence which in its entirety cannot just be explained by firms' current risk characteristics. Second, as we explain below, we exploit the detailed information on firms' long-term debt maturity structure available in Compustat to design robustness tests that further alleviate the endogeneity concerns.

Our sample spans the time period 1986-2010, and includes all firms that have a long-term credit rating from S&P and for which financial information is available in Compustat. Our main measure of rollover risk is $LT\text{-}1_{t-1}$, which is defined as the amount of the firm's long-term debt outstanding at the end of year $t-1$ that is due for repayment in year t (i.e., Compustat item $dd1$ in year $t-1$) scaled by the book value of total assets at the end of year $t-1$. In constructing this measure, we focus only on maturing long-term debt and explicitly ignore any short-term debt that the firm may have issued in year $t-1$ that is due for repayment in year t. This is because of the concern that the amount of short-term debt will be affected by the

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[3]Almeida et al. (2012) use a similar idea and use the variation in firms' long-term debt due for repayment just after onset of the financial crisis in August 2007 to identify the causal effects of financial contracting on firms' investments during the 2007 credit crisis.

firm's current credit quality. To the extent that short-term debt also contributes to rollover risk, $LT\text{-}1_{t-1}$ is likely to understate the firm's exposure to rollover risk in year t. Thus, our estimates are likely to provide a lower bound.

Another advantage of focusing on long-term debt due is that long-term debt maturities are largely concentrated in certain periods of time and hence there are sharp variations in $LT\text{-}1_{t-1}$ over time and across firms (see Almeida et al. (2012)). To take advantage of this feature of the maturity structure of long-term debt, we adopt a first-difference regression as our baseline specification, where the dependent variable is the year-on-year change in the firm's credit rating, and the key independent variable is the year-on-year change in $LT\text{-}1_{t-1}$ (i.e., $\Delta LT\text{-}1_{t-1}$). We include year fixed effects in our specification and explicitly control for all observable firm characteristics that may affect a firm's credit quality.

Theories on rollover risk suggest that firms with a larger increase in the amount of long-term debt payable within a year (i.e., higher $\Delta LT\text{-}1_{t-1}$) are *ceteris paribus* more likely to experience credit quality deterioration. To test this prediction, we first convert a firm's credit rating into an ordinal scale (ranging from 1 to 22), with a larger number indicating a worse rating. We then examine the relationship between $\Delta LT\text{-}1_{t-1}$ and change in the firm's credit rating during year, $\Delta Rating_t$, where a positive (negative) value of $\Delta Rating_t$ indicates an adverse (favorable) change in the firm's credit quality. Consistent with the prediction, we find a positive and statistically significant correlation between $\Delta Rating_t$ and $\Delta LT\text{-}1_{t-1}$. This effect is also economically large: a one standard deviation increase in $\Delta LT\text{-}1_{t-1}$ is associated with a 0.029 notch fall in the firm's credit rating. In comparison, the mean (median) annual change in our sample firm's credit rating is 0.109 notch (0 notch).

A positive correlation between $\Delta LT\text{-}1_{t-1}$ and $\Delta Rating_t$ can arise either from a correlation between increases in $LT\text{-}1_{t-1}$ and rating downgrades ($\Delta Rating_t > 0$) or from a correlation between decreases in $LT\text{-}1_{t-1}$ and rating upgrades ($\Delta Rating_t < 0$). While both are consistent with rollover risk contributing to credit risk, to understand which correlation is driving

our results, we repeat our tests after splitting $\Delta Rating_t$ into *Notches downgrade* and *Notches upgrade*, where *Notches downgrade* (*Notches upgrade*) is the number of notches by which a firm's rating is downgraded (upgraded) during the year, and takes a value zero in the years in which the firm does not experience a rating downgrade (upgrade). We find that $\Delta LT\text{-}1_{t-1}$ is positively associated with *Notches downgrade*, but there is no significant correlation between $\Delta LT\text{-}1_{t-1}$ and *Notches upgrade*, suggesting that our results are mainly driven by firms experiencing a rating downgrade during years in which there is an increase in the amount of long-term debt due.

To better understand the relationship between debt maturity structure and firm credit quality, we perform a number of cross-sectional tests. When we differentiate firms based on their prior credit quality, we find that the positive association between $\Delta LT\text{-}1_{t-1}$ and $\Delta Rating_t$ is present only for firms with speculative grade ratings (S&P rating below 'BBB-'). This is consistent with such firms facing greater difficulty in refinancing or repaying their maturing long-term debt. We also find that the positive correlation between $\Delta LT\text{-}1_{t-1}$ and $\Delta Rating_t$ is stronger for firms that experience a year-on-year decline in operating profitability, during periods of economic recession and during the 2007-2009 financial crisis. Interestingly, such positive correlation is present during periods of economic expansion as well.

Next, we conduct two further tests to address additional concerns and strengthen our findings from the baseline analysis. First, rollover risk may become an issue only when there is a large increase in the amount of long-term debt due, and not otherwise. That is, we may expect a non-linear relationship between $\Delta LT\text{-}1_{t-1}$ and $\Delta Rating_t$. To address this issue, we define a dummy variable to identify firm-years in which $LT\text{-}1_{t-1}$ exceeds 5% (which is equal to its sample mean plus one standard deviation), and find that our results are stronger when we use this dummy instead of $LT\text{-}1_{t-1}$ as the measure of rollover risk. In terms of economic magnitude, we find that an increase in $LT\text{-}1_{t-1}$ from under 5% to over 5% is associated with a 0.126 notch increase in $\Delta Rating_t$.

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Second, although the exclusion of short-term debt from $LT\text{-}1_{t-1}$ mitigates endogeneity concerns, one can still argue that changes in $LT\text{-}1_{t-1}$ and changes in firm credit rating may be spuriously correlated due to reverse causality. For example, a large amount of long-term debt payable next year could be due to the firm not being able to roll over the debt because of an expected deterioration in its credit quality. To rule out such alternative explanations, we repeat our tests after replacing $LT\text{-}1_{t-1}$ with $LT\text{-}2_{t-2}$, which is defined as the amount of long-term debt due in year t as estimated two years ago (i.e., Compustat item $dd2$ at the end of year $t-2$) scaled by the book value of total assets at the end of year $t-1$. As $LT\text{-}2_{t-2}$ is estimated at the end of year $t-2$, it is unlikely to be correlated with changes in the firm's credit quality occurring around year t. But to the extent that the firm may renegotiate/settle its long-term debt between years $t-2$ and t, $\Delta LT\text{-}2_{t-2}$ is likely to be a noisy proxy for the amount of long-term debt due in year t. To this extent, we expect our results to be attenuated with $\Delta LT\text{-}2_{t-2}$. When we repeat our tests after replacing $\Delta LT\text{-}1_{t-1}$ with $\Delta LT\text{-}2_{t-2}$, we find that all our results are preserved. Consistent with $\Delta LT\text{-}2_{t-2}$ being a noisier proxy for the amount of long-term debt due, we find that a one standard deviation increase in $\Delta LT\text{-}2_{t-2}$ (0.06) is associated with a 0.016 notch increase in $\Delta Rating_t$, whereas the corresponding estimate using $\Delta LT\text{-}1_{t-1}$ is 0.029 notch. When we differentiate between downgrades and upgrades, we again find our results to be mainly driven by a positive correlation between $\Delta LT\text{-}2_{t-2}$ and *Notches downgrade*.

To shed further light on the impact of rollover risk arising from debt maturity structure, we next examine the relationship between a firm's rollover risk exposure and its cost of long-term borrowing. To the extent that long-term creditors recognize the rollover risk arising from a firm's maturing debt, they should demand a premium to lend to firms with a greater exposure to rollover risk. We test this hypothesis by examining whether the yield spreads on a firm's long-term bonds are affected by the fraction of the firm's long-term debt payable within a year over its total assets ($LT\text{-}1$). To achieve this, we modify the bond yield spread model in Campbell and Taksler (2003) and estimate a first-difference regression, where the

dependent variable is the year-on-year change in yield spread in the year *before* the long-term debt becomes due, and the main independent variable is the year-on-year change in *LT-1* ($\Delta LT\text{-}1_t$). The results confirm the hypothesis that long-term bonds of firms with a higher *LT-1* in the next year trade at higher yield spreads. This result is also economically significant: a one standard deviation increase in $\Delta LT\text{-}1_t$ is associated with a 18% increase in yield spreads relative to the sample mean value of change in yield spreads. The results are even stronger when we proxy for rollover risk using the dummy variable to identify firm-years in which *LT-1* exceeds the 5% threshold. We find that an increase in *LT-1* from under 5% to over 5% is associated with a 34% increase in yield spreads relative to the sample mean value of change in yield spreads.

Our paper contributes to both the literature on debt maturity and the literature on credit risk by providing empirical validation to the theoretical predictions that rollover risk, arising from a firm's debt maturity structure, increases the firm's overall credit risk (e.g., He and Xiong (2012a), He and Xiong (2012b), 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. Although the 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, Espinosa-Vega, Frame, and Miller (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 explain the firm's debt maturity choice.

Our paper also complements several recent studies that exploit the subprime crisis of 2007-2009 to highlight the adverse real impact to firms of not being able to roll over their maturing debt. Almeida et al. (2012) show that firms with a larger proportion of their long-term debt maturing right after August 2007 (when the subprime crisis unfolded) experienced larger drops in their real investment rates. Duchin, Ozbas, and Sensoy (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 aspects. First, whereas these papers examine the effect of debt maturity structure on firm investments, we examine its effect on firm 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 under 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 rest of the paper proceeds as follows. We discuss the theoretical literature and outline our key hypotheses in Section II. We provide a description of our data and summary statistics of our sample in Section III, and present the empirical results in Sections IV and V. Section VI concludes.

II Theory and Hypotheses

In this section, we outline the theoretical literature on rollover risk, and highlight the key empirical predictions of this literature that we subsequently test.

In an early study, 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 refinancing coincides with the release of bad news about the firm's prospects.[4] Recently, 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 a 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

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[4]Froot, Scharfstein, and Stein (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.

run on its short-term debt when the firm would otherwise have been solvent." See also He and Xiong (2012a). He and Xiong (2012b) show that short-term debt exacerbates the conflict of interests between shareholders and debtholders because shareholders bear rollover losses that arise when short-term debt is refinanced. Recognizing this, shareholders will choose to default 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, Gale, and Yorulmazer (2011) argue that when 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.

The main implication of these theoretical papers is that the amount of a firm's debt maturing in the short term can affect the firm's overall 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.

Our first hypothesis follows directly from theoretical predictions that greater exposure to rollover risk increases the probability of the firm defaulting on its debt obligations, all else equal.

Hypothesis 1: *Firms with higher exposure to rollover risk should ceteris paribus have lower credit quality.*

Second, rollover risk adversely affects a firm's long-term creditors, because any loss incurred while settling the maturing debt (e.g., due to higher interest payments/collateral requirements, fire sales of assets under the pressure of the creditors of maturing debt) will likely jeopardize the firm's ability to repay its long-term creditors in future (see Brunnermeier and Oehmke (2012), and Morris and Shin (2009)). If long-term creditors are aware of these risks, they should price these risks ex ante. Thus, our second hypothesis is:

Hypothesis 2: *Firms with higher exposure to rollover risk should ceteris paribus face a higher cost of long-term borrowing.*

III   Data and Sample Characterization

In this section, we describe the data, define the variables of interest, and provide descriptive statistics of our sample.

A   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 value-weighted index of all stocks 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.

B   Key Variables

We measure a firm's exposure to rollover risk using the variable $LT\text{-}1_{t-1}$, which is defined as the amount of the firm's long-term debt outstanding at the end of year $t-1$ due for repayment in year t (i.e., Compustat item $dd1$ in year $t-1$) scaled by its book value of total assets (Compustat item at) at the end of year $t-1$. Firms with a higher value of $LT\text{-}1_{t-1}$ have a larger amount of long-term debt (relative to their total assets) maturing within the year t, and hence are likely to be exposed to greater rollover risk. Our empirical analysis is focused on $\Delta LT\text{-}1_{t-1} \equiv LT\text{-}1_{t-1} - LT\text{-}1_{t-2}$, which is the year-on-year change in the $LT\text{-}1$ variable. Hence, a larger value of $\Delta LT\text{-}1_{t-1}$ denotes a larger increase in the firm's exposure to rollover risk. As explained in the Introduction, we focus on $\Delta LT\text{-}1$ in order to take advantage of the sharp variations in $LT\text{-}1$ over time and across firms.

Note that the numerator in $LT\text{-}1_{t-1}$ excludes any short-maturity debt that the firm may have issued in the year $t-1$ that is due in the current year t. The reason for this exclusion is that differences across firms in their reliance on short-term debt are likely to be driven by differences in their risk characteristics and credit quality, which gives rise to potential endogeneity concerns.[5] Instead, the use of $LT\text{-}1_{t-1}$ allows us to focus on variation in debt maturity arising from long-term debt due, which is plausibly more exogenous to the firm's

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[5]In fact, it has been theoretically predicted and empirically documented that low-risk and high-risk firms are more likely to issue short-term debt as compared to firms in the middle of the credit quality spectrum (e.g., Diamond (1991), and Stohs and Mauer (1996)).

current risk characteristics. In particular, the $\Delta LT\text{-}1_{t-1}$ variable is likely to be determined by the firm's long-term debt structure and repayment schedule, both of which are likely to have been determined in the distant past, and hence are less likely to be correlated with current firm risk characteristics.

We use a firm's S&P long-term credit rating as a measure of its credit quality. We use the ordinal variable, *Rating*, to denote the firm's S&P rating. As we explain in detail in the Appendix, *Rating* takes the value 1 through 22, where a smaller numerical value denotes a higher credit rating.

To test Hypothesis 1, we use changes in firms' long-term S&P ratings to identify changes in their credit quality. Specifically, we define the variable, $\Delta Rating_t \equiv Rating_t - Rating_{t-1}$, to measure the change in a firm's *Rating* during year t. Because a larger value of *Rating* denotes a lower credit quality, a positive value of $\Delta Rating_t$ signifies that the firm experiences a deterioration in its credit quality in year t. The larger the $\Delta Rating_t$, the more severe is the deterioration in the firm's credit quality. We test Hypothesis 1 by relating $\Delta Rating_t$ to $\Delta LT\text{-}1_{t-1}$.

We also use the following alternative measures of credit quality change: (i) *Notches downgrade*, which is defined as the number of notches by which a firm's credit rating is downgraded during the year (it takes the value zero if the firm's rating is not downgraded during the year); and (ii) *Notches upgrade*, which is defined as the number of notches by which a firm's credit rating is upgraded during the year (it takes the value zero if the firm's rating is not upgraded during the year).

To test Hypothesis 2, we use the yield spread on a firm's long-term bonds (*Yield spread*) as a measure of the cost of its long-term borrowing. 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.

C Descriptive Statistics

We present the descriptive statistics for our full sample in 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 $LT\text{-}1_{t-1}$ is 0.019, which means that for the average firm in our sample the amount of long-term debt payable within a year is 1.9% of its total assets. The median value of $LT\text{-}1_{t-1}$ is significantly lower at 0.007, suggesting an upward skewness in the distribution of $LT\text{-}1_{t-1}$ 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 10.636, 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 a year. On average, firms in our sample experience a 0.13 notch upgrade in any year (as reflected in the mean value of *Notches upgrade*). Consistent with firms experiencing more severe downgrades as compared to upgrades, we find that the mean value of *Notches downgrade* in our sample is 0.239.

IV Exposure to Rollover Risk and Credit Quality

We now proceed to formal multivariate analysis. In this section, we test Hypothesis 1, which predicts that firms with greater exposure to rollover risk should, all else equal, have lower credit quality.

A Baseline Regressions

To test Hypothesis 1, we begin by estimating variants of the following first-difference regression:

$$(1) \qquad \Delta Rating_{i,t} = \alpha + \beta \times \Delta LT\text{-}1_{i,t-1} + \gamma \times \Delta X_{i,t} + \text{Year FE}.$$

The dependent variable, $\Delta Rating_{i,t}$, represents the change in firm i's credit rating during year t, with a positive (negative) value of $\Delta Rating_{i,t}$ denoting that firm i experienced a deterioration (improvement) in its credit quality during the year. The key independent variable, $\Delta LT\text{-}1_{i,t-1} \equiv LT\text{-}1_{i,t-1} - LT\text{-}1_{i,t-2}$, denotes the change in the amount of long-term debt payable in year t (scaled by book value of total assets) relative to year $t-1$. Thus, a positive value of $\Delta LT\text{-}1_{i,t-1}$ implies that firm i's exposure to rollover risk has increased in year t. We estimate regression (1) on a panel that has one observation for each firm-year combination, spans the time period 1986-2010, and includes all Compustat firms with an S&P long-term credit rating.

We control the regression for changes (during year t) in important firm characteristics ($\Delta X_{i,t} \equiv X_{i,t} - X_{i,t-1}$) that may affect the likelihood of a change in the firm's credit quality. The firm characteristics that we control for are: size using $Log(Total\ assets)$, leverage using $Total\ debt/Mkt.\ Cap$ and $Interest\ coverage$, 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*. Detailed definitions of all these variables are provided in the Appendix. In all the specifications, we also include year fixed effects to control for any macroeconomic variables that may affect changes in firm 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.

We present the results in Panel A of Table 2. In Table 2 and the rest of Section IV where we describe our results, to ease exposition we drop the subscripts of the variables where there is no cause of confusion. For example, we refer to $\Delta LT\text{-}1_{i,t-1}$ as simply $\Delta LT\text{-}1$. The positive and significant coefficient on $\Delta LT\text{-}1$ in Column (1) indicates that firms with a larger increase in the amount of maturing long-term debt during the year (larger $\Delta LT\text{-}1$) are more likely to experience a deterioration in their credit quality (larger $\Delta Rating$) during the same year. The result is also economically significant: a one standard deviation increase in $\Delta LT\text{-}1$ (0.09) is associated with an increase of 0.029 in $\Delta Rating$, which represents a 27% increase relative to the sample mean of $\Delta Rating$ (0.109). Since this is a first-difference specification, the result implies that, all else equal, firms with greater rollover risk exposure, as measured by the amount of long-term debt due within a year, have lower credit quality.

In terms of the coefficient estimates on the control variables, we find that credit quality is lower for firms that are smaller (negative coefficient on $\Delta Log(Total\ Assets)$), highly levered (positive coefficient on $\Delta Total\ debt/Mkt.\ Cap$), less profitable (negative coefficients on $\Delta Operating\ income/Sales$ and $\Delta Taxes/Total\ assets$), have lower interest coverage (negative coefficient on $\Delta Interest\ Coverage$), and have higher volatility (positive coefficient on $\Delta Idiosyncratic\ Volatility$). Also, to ensure that our results are not biased due to inclusion of too many control variables, in unreported tests, we repeat the estimation in Column (1) after dropping one control variable at a time and find our results to be robust.

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In Column (2), we repeat the regression in Column (1) after replacing $\Delta LT\text{-}1$ with two interaction terms, $\Delta LT\text{-}1 \times Small$ and $\Delta LT\text{-}1 \times (1 - Small)$, where $Small$ is a dummy variable that identifies firms with below sample median values of *Total assets*. We do this to examine whether the effect of rollover risk on credit quality varies between small and large firms. We find that the coefficients on both interaction terms are positive and significant, which indicates that an increase in the amount of long-term debt due during the year is associated with a deterioration in credit quality for both small and large firms. When we compare the coefficients on the two interaction terms (see the row titled $\Delta Coef.$), we find that the two coefficients are not significantly different from each other.

In Column (3), we repeat the regression after replacing $\Delta LT\text{-}1$ with $\Delta LT\text{-}1 \times Investment$ and $\Delta LT\text{-}1 \times (1 - Investment)$, where $Investment$ is a dummy variable that identifies firms with an investment grade rating (S&P rating 'BBB-' or above). Not surprisingly, we find that an increase in the amount of long-term debt due within the year is associated with a deterioration in credit quality only for firms with speculative grade ratings. We find that the coefficients on the two interaction terms are significantly different from each other (see the row titled $\Delta Coef.$).

In Column (4), we examine whether economic conditions affect the relation between $\Delta LT\text{-}1$ and $\Delta Rating$. We achieve this by estimating the regression after replacing $\Delta LT\text{-}1$ with two interaction terms, $\Delta LT\text{-}1 \times Recession$ and $\Delta LT\text{-}1 \times (1 - Recession)$, where $Recession$ identifies the years classified by the NBER as recessionary. We find that while $\Delta LT\text{-}1$ is positively associated with rating downgrades both during recessions and expansions, the magnitude of the effect is greater during recessions; note the the coefficient on $\Delta LT\text{-}1 \times Recession$ is significantly greater than that on $\Delta LT\text{-}1 \times (1 - Recession)$ (see the row titled $\Delta Coef.$). Since credit market conditions are likely to be related to economic conditions, this result highlights that rollover risk is important during both periods of benign and stressed credit market conditions (albeit the effect is stronger during stressed conditions). In unreported tests, we obtain similar findings when we differentiate between the recent financial crisis period (2007-2009) and other

years.

Theories on rollover risk also suggest that rollover risk should be more pronounced for firms with declining profitability. We test this prediction in Column (5) by estimating the regression (1) after replacing $\Delta LT\text{-}1$ with $\Delta LT\text{-}1 \times Decline$ and $\Delta LT\text{-}1 \times (1 - Decline)$, where $Decline$ is a dummy variable that identifies firms that experience a year-on-year decline in profitability (measured using $Operating\ income/Sales$). Consistent with theory, we find that the coefficient on $\Delta LT\text{-}1 \times Decline$ is significantly larger than that on $\Delta LT\text{-}1 \times (1 - Decline)$, suggesting that $\Delta LT\text{-}1$ is associated with *more* severe rating downgrades for firms that experience a decline in profitability.

[Insert Table 2 here]

B   Credit Quality Improvement versus Deterioration

The positive correlation between $\Delta Rating$ and $\Delta LT\text{-}1$ can arise either from increases in $LT\text{-}1$ being associated with rating downgrades ($\Delta Rating > 0$) or from decreases in $LT\text{-}1$ being associated with rating upgrades ($\Delta Rating < 0$). While both are consistent with Hypothesis 1, we perform further tests to examine which correlation drives our results. In Panel B of Table 2, we repeat all our tests in Panel A with *Notches upgrade* as the dependent variable. Recall *Notches upgrade* is the number of notches by which a firm's credit rating is upgraded during the year; it takes a value zero if the firm's rating is not upgraded during the year. The empirical specification and control variables are exactly same as those in Panel A.

As can be seen from Column (1) of Panel B, we do not find any significant correlation between $\Delta LT\text{-}1$ and *Notches upgrade*. This indicates that firms with less long-term debt payable during the year (relative to total assets) as compared to the previous year do not experience a rating upgrade. In Columns (2) to (5) where we differentiate across firms and economic conditions, we continue to find an insignificant relationship.

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In Panel C of Table 2, we repeat all our tests in Panel A with *Notches downgrade* as the dependent variable with the same empirical specification and control variables. Recall *Notches downgrade* is the number of notches by which a firm's rating is downgraded during the year; it takes a value zero if the firm's rating is not downgraded during the year.

From Column (1) of Panel C, we find that firms with an increase in the amount of long-term debt payable during the year experience a more severe rating downgrade. Our results are also economically significant: a one standard deviation increase in $\Delta LT\text{-}1$ (0.09) is associated with an increase of 0.028 in *Notches downgrade*, which represents a 12% increase relative to the sample mean value of *Notches downgrade* (0.239). Column (2) shows that the correlation between $\Delta LT\text{-}1$ and *Notches downgrade* is present both among small and large firms, although there is some weak evidence that the effect is stronger for large firms. From Column (3), we find that not surprisingly, only speculative grade firms experience more severe rating downgrades when they have a large amount of long-term debt due. The coefficients on the two interaction terms are significantly different from each other (see the row titled $\Delta Coef.$). In Column (4), we differentiate between recessions and expansions and find that the effect of $\Delta LT\text{-}1$ on *Notches downgrade* is significantly greater during recessions. Finally, from Column (5) we find that the positive correlation between $\Delta LT\text{-}1$ and *Notches downgrade* is significantly greater for firms that experience a decline in operating profitability.

To summarize, the results in Table 2 indicate that firms with a larger increase in long-term debt due within a year are more likely to experience rating downgrades during the year. This effect is present for both small and large firms, firms with and without declining profitability, is confined to firms with speculative grade ratings, and is present both during recessions and expansions. These are consistent with Hypothesis 1 that predicts that greater exposure to rollover risk will lower a firm's credit quality.

C   Additional Tests

We now perform two sets of further tests to strengthen our findings from the baseline analysis.

1   Non-Linear Effect of Long-Term Debt Payable on Credit Quality

In practice, firms' long-term debt maturities tend to be concentrated in a few periods of time (see Almeida et al. (2012)), which would cause their $\Delta LT\text{-}1$ to increase sharply during such periods as compared to other time periods. This raises the possibility that the effect of $\Delta LT\text{-}1$ on deterioration in firm credit quality may be non-linear in nature. That is, small increases in $LT\text{-}1$ may have no impact on firm credit quality, while only large increases in $LT\text{-}1$ do.

To identify such potential non-linear effects, we define the dummy variable, $LT\text{-}1\ Dummy$, to identify firm-year observations in which $LT\text{-}1 \geq 5\%$. Thus, $LT\text{-}1\ Dummy$ identifies firms with a large amount of long-term debt due within a year. We choose a cutoff of 5% in defining $LT\text{-}1\ Dummy$ because the mean value of $LT\text{-}1$ (0.019) plus its standard deviation (0.031) equals 5%. In unreported tests, we show that our results are robust to using other cutoff values. We then re-estimate regression (1) after replacing $LT\text{-}1$ with the dummy variable $LT\text{-}1\ Dummy$. Thus, our main independent variable in this specification is $\Delta LT\text{-}1\ Dummy_{t-1} \equiv LT\text{-}1\ Dummy_{t-1} - LT\text{-}1\ Dummy_{t-2}$. Note that $\Delta LT\text{-}1\ Dummy_{t-1}$ takes the value 1 (-1) if the firm's $LT\text{-}1$ increases (decreases) from less (more) than 5% in the previous year to more (less) than 5% in the current year; $\Delta LT\text{-}1\ Dummy_{t-1} = 0$ if the firm's $LT\text{-}1$ was either greater or less than 5% in both years. In other words, $\Delta LT\text{-}1\ Dummy_{t-1} = 1$ ($\Delta LT\text{-}1\ Dummy_{t-1} = -1$) identifies firms that experience a sharp increase (decrease) in their rollover risk exposure in the current year compared with the previous year, whereas $\Delta LT\text{-}1\ Dummy_{t-1} = 0$ identifies firms without a sharp change in their rollover risk exposure.

The results are presented in Panel A of Table 3. In these regressions, we include all the control variables in Table 2. However, to conserve space we do not report the coefficients on

those controls in Table 3. The positive and significant coefficient on $\Delta LT\text{-}1\ Dummy$ in Column (1) indicates that our results are robust to this alternative construction of the independent variable. Moreover, the economic magnitude is larger than the corresponding result in Column (1) of Panel A in Table 2: the coefficient of 0.126 on $\Delta LT\text{-}1\ Dummy$ indicates that a firm whose amount of long-term debt due within a year (scaled by assets) increases beyond the 5% threshold during the year is likely to experience a rating downgrade of 0.126 notch, which represents a 116% increase relative to the sample mean value of 0.109 for $\Delta Rating$. Such impact of long-term debt due on firm credit quality continues to hold when we differentiate across firm and economic conditions in Columns (2) to (5). In unreported tests, we differentiate between downgrades and upgrades, and find that the results in Panel A are mainly driven by a positive correlation between $\Delta LT\text{-}1\ Dummy$ and *Notches downgrade*.

In unreported tests, we use an alternative method to identify the non-linearity in the relationship between $LT\text{-}1$ and firm credit quality. Specifically, we construct a dummy variable $\Delta LT\text{-}1\ \widehat{Dummy}$ to identify the years in which $\Delta LT\text{-}1$ is greater than the 95th percentile. We then repeat our tests after replacing $\Delta LT\text{-}1\ Dummy$ with $\Delta LT\text{-}1\ \widehat{Dummy}$. Note the main difference between $\Delta LT\text{-}1\ Dummy$ and $\Delta LT\text{-}1\ \widehat{Dummy}$ is that while the latter cleanly identifies the years in which there is a significant increase in $\Delta LT\text{-}1$, it does not identify the years in which there is a significant decrease in $\Delta LT\text{-}1$ (while the former does). When we repeat our tests with this alternative measure, we obtain results similar to the ones reported in Panel A of Table 3.

2 Exposure to Rollover Risk Measured with Longer Lags

Our baseline regression in (1) uses long-term debt payable in the next year ($LT\text{-}1$) as a measure of a firm's exposure to rollover risk. While $LT\text{-}1$ is less subject to endogeneity concerns, one can still argue that firms may try to settle their long-term debt prior to their maturities and that firms with a large amount of long-term debt due within a year (large $LT\text{-}1$) are

the ones that may face difficulty in settling their debt. This may be due to concerns about a deterioration in their credit quality. To assuage such endogeneity concerns with *LT-1*, in the next set of tests we use an alternative measure of a firm's exposure to rollover risk. The long-term debt information in Compustat allows us to identify the amount of long-term debt due not only in the next year but also up to five years out. We exploit this feature of Compustat data and construct $LT\text{-}2_{t-2}$ as the ratio of the total long-term debt payable in year t based on information in the firm's year $t-2$ balance sheet (Compustat item *dd2*) over the book value of total assets at the beginning of year t. We then repeat our tests using $\Delta LT\text{-}2_{t-2} \equiv LT\text{-}2_{t-2} - LT\text{-}2_{t-3}$ as our main independent variable.[6] Note that similar to $\Delta LT\text{-}1_{t-1}$, $\Delta LT\text{-}2_{t-2}$ measures the change in the amount of long-term debt due in year t as compared to year $t-1$. The main difference between the two measures is that while the former uses information available as of the end of year $t-1$, the latter uses information available as of the end of year $t-2$, which is less likely to be correlated with changes in the firm's credit quality around year t. This enables us to make a stronger argument of exogeneity with $\Delta LT\text{-}2_{t-2}$. On the other hand, to the extent that the firm may settle part of its long-term debt during year $t-1$, $\Delta LT\text{-}2_{t-2}$ is likely to be a less precise proxy for the extent of rollover risk faced by the firm as compared to $\Delta LT\text{-}1_{t-1}$.

In Panel B of Table 3, we re-estimate all the regressions in Panel A of Table 2 using $\Delta LT\text{-}2_{t-2}$ as the main independent variable.[7] The result from Column (1) indicates a strong positive association between $\Delta LT\text{-}2_{i,t-2}$ and $\Delta Rating_{i,t}$. Consistent with $\Delta LT\text{-}2_{i,t-2}$ being a noisier measure of rollover risk, we find the magnitude of the effect to be smaller. A one standard deviation increase in $\Delta LT\text{-}2_{i,t-2}$ (0.06) is associated with a 0.016 notch increase $\Delta Rating_{i,t}$; in comparison, the corresponding estimate using $\Delta LT\text{-}1_{i,t-1}$ is 0.029.[8] From Col-

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[6]We thank an anonymous referee for suggesting this test.

[7]Specially, the regression in Panel B of Table 3 is $\Delta Rating_{i,t} = \alpha + \beta \times \Delta LT\text{-}2_{i,t-2} + \gamma \times \Delta X_{i,t} + \text{Year FE}$.

[8]When we regress $\Delta LT\text{-}1_{i,t-1}$ on $\Delta LT\text{-}2_{i,t-2}$, we obtain a coefficient estimate of 0.48. This indicates that a $1 change in $\Delta LT\text{-}2_{i,t-2}$ is associated with only a $0.48 change in $\Delta LT\text{-}1_{i,t-1}$. This confirms that $\Delta LT\text{-}2_{i,t-2}$ is a noisier proxy for rollover risk as compared to $\Delta LT\text{-}1_{i,t-1}$ and helps reconcile the difference in economic

umn (2), we find that the positive correlation between $\Delta LT\text{-}2_{i,t-2}$ and $\Delta Rating_{i,t}$ is present only for small firms, although the coefficients on the two interaction terms are not significantly different from each other. The results in other columns indicate that the positive association between $\Delta LT\text{-}2_{i,t-2}$ and $\Delta Rating_{i,t}$ is present among firms with speculative grade rating and for firms that experience a decline in their operating profitability. Somewhat surprisingly, in Column (4) we find that the positive association between $\Delta LT\text{-}2_{i,t-2}$ and $\Delta Rating_{i,t}$ is not statistically significant during recessions, but is significant outside recessions; however, the coefficients on the two interaction terms are not significantly different from each other. Overall, our results here are consistent with our earlier results in Table 2.

[Insert Table 3 here]

In unreported tests, we take further lags and construct $LT\text{-}3_{t-3}$ as the ratio of the total long-term debt payable in year t based on information in the firms' year $t-3$ balance sheet (Compustat item $dd3$) over total assets at the beginning of year t. The idea is that $LT\text{-}3_{t-3}$ uses information in year $t-3$, and hence is even less likely to be correlated with changes in firm credit quality around year t. We then repeat our tests using $\Delta LT\text{-}3_{t-3} \equiv LT\text{-}3_{t-3} - LT\text{-}3_{t-4}$ as our main independent variable, and find our results to be robust to this alternative measure of rollover risk.

V   Exposure to Rollover Risk and Cost of Long-Term Debt

In this section we turn to Hypothesis 2, which states that firms with greater exposure to rollover risk should *ceteris paribus* have higher cost of long-term borrowing. This is because any rollover losses resulting from the firm's maturing debt will likely jeopardize the firm's

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magnitudes across the two variables.

ability to repay its long-term creditors in future, who will have to be compensated through higher yields ex ante.

To test this prediction, we use the yield spreads on firms' long-term bonds as a measure of their cost of long-term borrowing. We then estimate the following first-difference model which is adapted from bond yield spread model in Campbell and Taksler (2003):

$$(2) \qquad \Delta \textit{Yield spread}_{b,t} = \alpha + \beta \times \Delta \textit{LT-1}_{i,t} + \gamma_1 \times \Delta X_{i,t} + \gamma_2 \times \Delta X_{m,t} + \text{Year FE}.$$

In equation (2), subscript b denotes the bond, subscript i denotes the firm that has issued the bond, subscript m denotes the market, and subscript t denotes the year. *Yield spread*$_{b,t}$ denotes the average yield spread on bond b in December of year t. Therefore, the dependent variable in regression (2), $\Delta \textit{Yield spread}_{b,t} \equiv \textit{Yield spread}_{b,t} - \textit{Yield spread}_{b,t-1}$, is the year-on-year change in yield spreads on bond b over year t (specifically, from December of year $t-1$ to December of year t). The key independent variable, $\Delta \textit{LT-1}_{i,t} \equiv \textit{LT-1}_{i,t} - \textit{LT-1}_{i,t-1}$, is the change in the amount of long-term debt payable (scaled by assets) in year $t+1$ relative to that in year t. In other words, regression (2) examines whether the yield spreads on a firm's bonds change by the end of year t *in anticipation of* the firm's changing exposure to rollover risk in year $t+1$. By contrast, regression (1) examines whether the firm's credit rating changes *during* the year in which it experiences a change in its exposure to rollover risk. The reason we use a different specification for yield spreads is as follows. If bond market investors expect the firm's rollover risk exposure to increase in the coming year, then they should price the risk right away, causing yield spreads to increase during the current year.

We control regression (2) for the first-differences in all the firm characteristics ($\Delta X_{i,t} \equiv X_{i,t} - X_{i,t-1}$) and market characteristics ($\Delta X_{m,t} \equiv X_{m,t} - X_{m,t-1}$) employed in the Campbell and Taksler (2003) model. The firm characteristics 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 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/Total assets*); the ratio of total debt to the sum of the market value of equity and book value of total liabilities (*Total debt/Mkt. Cap*); the ratio of operating income before depreciation to net sales (*Operating income/Sales*); and three dummy variables that identify firms with *Interest coverage* below 5, between 5 and 10, and above 10, respectively. We also control for the bond's credit rating, *Bond rating*. The market characteristics 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 *Slope*, defined as the difference in yield between a 10-year treasury and a 2-year treasury. We include year fixed effects in all regressions. The standard errors are robust to heteroscedasticity and are clustered at the individual bond issue level.

The results are presented in Panel A of Table 4. As in Section IV, to ease exposition, in our following discussions we drop the subscripts of the variables where there is no cause of confusion. In Column (1), the positive and significant coefficient on $\Delta LT\text{-}1$ indicates that bonds issued by firms with a larger fraction of long-term debt maturing within the next year over total assets trade at higher yield spreads in the current year, even after we control for all the other factors that are known to affect bond yields, including the bond's credit rating. This result highlights that rollover risk arising from maturing long-term debt increases a firm's overall credit risk, over and above what is captured by the credit rating. The economic magnitude is also sizable: a one standard deviation increase in $\Delta LT\text{-}1$ (0.09) is associated with a 18% increase in Δ *Yield spread* (38.6 basis points).

In Column (2), we repeat the regression in Column (1) after replacing $\Delta LT\text{-}1$ with $\Delta LT\text{-}1 \times$ *Small* and $\Delta LT\text{-}1 \times (1 - Small)$. Only the coefficient on $\Delta LT\text{-}1 \times Small$ is positive and significant, indicating that the positive association between the amount of maturing long-

term debt within the next year and yield spreads on long-term bonds is confined to small firms. Although the coefficient on ΔLT-$1 \times (1 - Small)$ is insignificant, due to noise in our estimation, from the row titled Δ *Coef.* we find that the coefficients on the two interaction terms are not significantly different from each other. In Column (3), we repeat the regression in Column (1) after replacing ΔLT-1 with ΔLT-$1 \times Investment$ and ΔLT-$1 \times (1 - Investment)$. The coefficients on both terms are positive and significant, indicating that a greater exposure to rollover risk is associated with higher yields both for firms with investment grade and speculative grade ratings.

In Column (4), we replace ΔLT-1 with ΔLT-$1 \times Recession$ and ΔLT-$1 \times (1 - Recession)$. We find that although ΔLT-1 is positively associated with yield spreads both during recessions and expansions, the magnitude of the effect is much greater during recessions: as can be seen from the row titled $\Delta Coef.$, the coefficients on the two interaction terms are significantly different from each other. In Column (5), we replace ΔLT-1 with ΔLT-$1 \times Decline$ and ΔLT-$1 \times (1 - Decline)$, and find that the positive association between ΔLT-1 and $\Delta Yield\ Spread$ is stronger for firms with declining profitability.

To identify potential non-linear effects of LT-1 on yield spreads, we replicate the analysis in Panel A after using LT-1 *Dummy* instead of LT-1 as a measure of the firm's exposure to rollover risk. Recall that LT-1 *Dummy* is a dummy variable that identifies firm-year observations with LT-$1 \geq 5\%$, i.e., with large levels of exposure to rollover risk. The results are presented in Panel B of Table 4. As is evident from Panel B, not only are our results largely robust to this alternative construction of the independent variable, but also the economic magnitude of the effect is much larger: the coefficient on ΔLT-1 *Dummy* of 0.133 in Column (1) indicates that a firm whose amount of long-term debt due within a year (scaled by assets) increases to more than the 5% threshold during the year experiences a 34% increase in yield spread (relative to the sample mean of $\Delta Yield\ spread$ of 38.6 basis points) one year before the debt becomes due. The results of the cross-sectional tests in Columns (2), (4) and (5) are also consistent with the corresponding tests in Panel A. The only inconsistent result is in Column

(3), where we find that the positive association between $\Delta LT\text{-}1\ Dummy$ and $\Delta Yield\ spread$ is statistically significant only for investment grade firms. One possible explanation for the lack of statistical significance on the interaction between $\Delta LT\text{-}1\ Dummy$ and $(1 - Investment)$ is that speculative grade ratings largely capture the potential non-linear effect of $LT\text{-}1$ on yield spreads.

Overall, the evidence in Table 4 indicates that bond investors seek a premium for investing in bonds issued by firms with a high proportion of long-debt maturing in a year, even after controlling for the bond's credit rating. This suggests that debt maturity structure matters independent of the credit rating. All else equal, shorter debt maturity increases a firm's overall credit risk, but this seems to be not fully captured by the bond's credit rating.

[Insert Table 4 here]

In unreported tests, following the spirit of the tests in Section IV.C.2, we take further lags and use long-term debt payable within the second year and the third year as a measure of a firm's exposure to rollover risk. We find our results to be robust to these alternative measures.

VI   Conclusion

In this paper, we examine whether a firm's debt maturity structure affects its overall credit risk. Our analysis is motivated by the collapse of financial institutions such as Bear Stearns and Lehman Brothers during the recent financial crisis as well as 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 settle its maturing debt, especially if the settlement coincides with a deterioration in either firm fundamentals or credit market conditions. Recent theoretical advances argue that rollover risk is an additional source of credit risk. We refer to as the rollover risk hypothesis, and test its key predictions.

Our empirical findings offer strong support to the rollover risk hypothesis. We find that firms that experience a large increase in the amount of their long-term debt (scaled by assets) payable within the year are *ceteris paribus* likely to experience a more severe deterioration in their credit quality during the year, as measured by downgrades to their credit ratings. Bond market investors seem to recognize the effect of rollover risk because bonds issued by firms with a larger amount of long-term debt (scaled by assets) payable within a year trade at higher yield spreads. These effects are stronger for firms with declining profitability and during recession years.

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 we control for firms' and bonds' credit ratings. The following quote from "S&P's Rating Direct" issued on May 13, 2008 seems to also acknowledge some shortcomings of ratings 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."

However, further research is needed before we can draw stronger conclusions.

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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.

- *Bond rating* is the issue rating of the bond from the FISD database.

- *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*).

- *Decline* is a dummy variable that takes the value one if a firm experiences a decline in profitability (*Operating income/Sales*) during the year as compared to the previous 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.

- *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*). *Interest coverage-1*, *Interest*

coverage-2, and *Interest coverage-3* are dummy variables that identify firms with *Interest coverage* below 5, between 5 and 10, and above 10, respectively.

- *Investment* is a dummy variable that takes the value one if a firm's S&P's long-term credit rating is BBB- or above, 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.

- *Notches downgrade* (*Notches upgrade*) is the number of notches by which a firm's credit rating is downgraded (upgraded) during the year; it takes the value zero if the rating is not downgraded (upgraded).

- *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 *xrd* as zero.

- *Rating* is an ordinal variable that indicates the S&P long-term credit rating of the firm. 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. $\Delta Rating_t$ is the change of *Rating* during year t.

- *Recession* is a dummy variable that takes the value one for years 1981, 1982, 1990, 1991 and 2001, 2007-08, and zero otherwise.

- *LT-1$_{t-i}$*, $i \in \{1, 2, 3\}$, is the ratio of long-term debt due in year t as estimated from the firm's year $t - i$ balance sheet (Compustat item *ddi*) to total assets at the beginning of year t (Compustat items *at*).

- Δ*LT-i Dummy*, $i \in \{1, 2, 3\}$, is defined as the year-on-year change in *LT-i Dummy*, where *LT-i Dummy* $= 1$ if *LT-i* $\geq 5\%$, and *LT-i Dummy* $= 0$ if *LT-i* $< 5\%$.

- *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*).

- *Total debt/Mkt. Cap* is the ratio of total debt (Compustat items *dlc* + *dltt*) to the market value of equity.

- *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

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

Variable	N	Mean	Median	S.D.
$LT\text{-}1_{t-1}$	22,131	0.019	0.007	0.031
Rating	22,131	10.400	10.636	3.906
Investment	22,131	0.465	0	0.499
Downgrade	22,131	0.130	0	0.336
Notches upgrade	19,623	0.130	0	0.402
Notches downgrade	19,623	0.239	0	0.688
Log(Total assets)	22,131	7.724	7.602	1.513
Market to book	21,640	1.682	1.415	0.878
R&D/Total assets	22,131	0.017	0.000	0.034
Operating income/Sales	22,110	0.085	0.091	0.173
Total debt/Mkt. Cap	21,648	0.817	0.299	1.769
Long-term debt/Total assets	22,131	0.302	0.264	0.206
Interest coverage	22,131	9.262	4.542	17.158
Industry volatility	21,962	0.124	0.080	0.103
Taxes/Total assets	22,131	0.022	0.020	0.028
Idiosyncratic volatility	20,320	0.029	0.026	0.013
Tangibility	22,131	0.362	0.319	0.234
Cash/Total assets	22,127	0.088	0.048	0.108

Table 2
Rollover Risk and Firm Credit Quality

This table reports the results of regressions aimed at understanding the effect of firms' long-term debt (scaled by total assets) payable during the year on their credit quality. We estimate variants of the following first-difference regression specification:

$$\Delta Y_{i,t} = \alpha + \beta \times \Delta LT\text{-}1_{i,t-1} + \gamma \times \Delta X_{i,t} + \text{Year FE}.$$

The dependent variable is $\Delta Rating_{i,t}$ in Panel A, *Notches upgrade*$_{i,t}$ in Panel B, and *Notches downgrade*$_{i,t}$ in Panel C. The main independent variable is $\Delta LT\text{-}1_{i,t-1}$ in all panels. Results of the tests of the differences between the interaction terms in Columns (2) to (5) are presented in the row titled $\Delta Coef.$ in each panel. Definitions of all the variables are provided in the Appendix. In all panels, 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 categories. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel A: Effect of $\Delta LT\text{-}1$ on $\Delta Rating$

	ΔRating				
	(1)	(2)	(3)	(4)	(5)
ΔLT-1	0.326 (0.090)***				
ΔLT-1 $\times$ Small		0.272 (0.112)**			
ΔLT-1 $\times$ (1 − Small)		0.385 (0.102)***			
ΔLT-1 $\times$ Investment			-0.040 (0.059)		
ΔLT-1 $\times$ (1 − Investment)			0.601 (0.151)***		
ΔLT-1 $\times$ Recession				0.479 (0.129)***	
ΔLT-1 $\times$ (1 − Recession)				0.264 (0.099)***	
ΔLT-1 $\times$ Decline					0.488 (0.106)***
ΔLT-1 $\times$ (1 − Decline)					0.221 (0.090)**
ΔCash/Total assets	0.155 (0.117)	0.154 (0.116)	0.161 (0.118)	0.156 (0.116)	0.156 (0.116)
ΔMarket to book	-0.143 (0.020)***	-0.143 (0.020)***	-0.144 (0.020)***	-0.142 (0.020)***	-0.140 (0.020)***
ΔIndustry volatility	-0.344 (0.246)	-0.344 (0.246)	-0.335 (0.244)	-0.346 (0.247)	-0.327 (0.250)
ΔIdiosyncratic volatility	26.200 (6.362)***	26.140 (6.336)***	26.632 (6.324)***	26.308 (6.434)***	26.302 (6.375)***
ΔTangibility	-0.172 (0.204)	-0.174 (0.203)	-0.160 (0.205)	-0.172 (0.204)	-0.180 (0.205)
ΔLog(Total assets)	-0.498 (0.037)***	-0.502 (0.037)***	-0.484 (0.037)***	-0.499 (0.037)***	-0.499 (0.037)***
ΔR&D/Total assets	-0.758 (0.427)*	-0.744 (0.429)*	-0.806 (0.417)*	-0.770 (0.434)*	-0.758 (0.422)*
ΔTaxes/Total assets	-1.159 (0.468)**	-1.157 (0.468)**	-1.168 (0.459)**	-1.149 (0.465)**	-1.104 (0.454)**
ΔOperating income/Sales	-0.462 (0.240)*	-0.464 (0.240)*	-0.454 (0.237)*	-0.462 (0.239)*	-0.434 (0.232)*
ΔTotal debt/Mkt. Cap	0.175 (0.010)***	0.175 (0.010)***	0.173 (0.010)***	0.175 (0.010)***	0.174 (0.010)***
ΔInterest coverage	-0.003 (0.0008)***	-0.003 (0.0008)***	-0.003 (0.0008)***	-0.003 (0.0008)***	-0.002 (0.0008)***
Const.	0.092 (0.061)	0.093 (0.061)	0.089 (0.061)	0.092 (0.061)	0.093 (0.061)
ΔCoef.		-0.113 (0.122)	-0.641 (0.148)***	0.215 (0.132)*	0.267 (0.08)***
Obs.	17,457	17,457	17,457	17,457	17,457
R^2	0.152	0.152	0.155	0.152	0.153
Year FE	Yes	Yes	Yes	Yes	Yes

Panel B: Effect of ΔLT-1 on *Notches upgrade*

	Notches upgrade				
	(1)	(2)	(3)	(4)	(5)
ΔLT-1	0.018 (0.026)				
ΔLT-1 × Small		0.042 (0.044)			
ΔLT-1 × (1 − Small)		-0.007 (0.040)			
ΔLT-1 × Investment			-0.014 (0.020)		
ΔLT-1 × (1 − Investment)			0.042 (0.038)		
ΔLT-1 × Recession				0.004 (0.045)	
ΔLT-1 × (1 − Recession)				0.024 (0.029)	
ΔLT-1 × Decline					0.041 (0.033)
ΔLT-1 × (1 − Decline)					0.004 (0.029)
ΔCash/Total assets	-0.086 (0.058)	-0.085 (0.058)	-0.085 (0.058)	-0.086 (0.058)	-0.085 (0.058)
ΔMarket to book	-0.068 (0.014)***	-0.068 (0.014)***	-0.068 (0.014)***	-0.068 (0.014)***	-0.068 (0.014)***
ΔIndustry volatility	-0.095 (0.062)	-0.095 (0.062)	-0.094 (0.062)	-0.095 (0.062)	-0.093 (0.062)
ΔIdiosyncratic volatility	6.404 (4.308)	6.430 (4.319)	6.442 (4.320)	6.394 (4.290)	6.419 (4.328)
ΔTangibility	-0.072 (0.070)	-0.071 (0.070)	-0.071 (0.070)	-0.072 (0.070)	-0.073 (0.070)
ΔSize	-0.151 (0.019)***	-0.149 (0.019)***	-0.150 (0.019)***	-0.151 (0.019)***	-0.151 (0.019)***
ΔR&D/Total assets	-0.249 (0.341)	-0.255 (0.336)	-0.253 (0.338)	-0.248 (0.341)	-0.249 (0.340)
ΔTaxes/Total assets	-0.389 (0.192)**	-0.390 (0.191)**	-0.390 (0.191)**	-0.390 (0.192)**	-0.381 (0.189)**
ΔOperating income/Sales	-0.104 (0.054)*	-0.103 (0.054)*	-0.103 (0.054)*	-0.104 (0.054)*	-0.100 (0.055)*
ΔDebt/Market capitalization	0.036 (0.006)***	0.036 (0.006)***	0.036 (0.006)***	0.036 (0.006)***	0.036 (0.006)***
ΔInterest coverage	-0.0008 (0.0003)***	-0.0008 (0.0003)***	-0.0008 (0.0003)***	-0.0008 (0.0003)***	-0.0007 (0.0003)***
Const.	-0.144 (0.028)***	-0.144 (0.028)***	-0.144 (0.028)***	-0.144 (0.028)***	-0.144 (0.028)***
ΔCoef.		0.049 (0.066)	-0.056 (0.039)	-0.020 (0.051)	0.037 (0.034)
Obs.	17,457	17,457	17,457	17,457	17,457
R^2	0.044	0.044	0.044	0.044	0.044
Year FE	Yes	Yes	Yes	Yes	Yes

Panel C: Effect of ΔLT-1 on *Notches downgrade*

	Notches downgrade				
	(1)	(2)	(3)	(4)	(5)
ΔLT-1	0.308 (0.083)***				
ΔLT-1 $\times$ Small		0.230 (0.107)**			
ΔLT-1 $\times$ (1 $-$ Small)		0.393 (0.088)***			
ΔLT-1 $\times$ Investment			-0.027 (0.051)		
ΔLT-1 $\times$ (1 $-$ Investment)			0.558 (0.142)***		
ΔLT-1 $\times$ Recession				0.476 (0.123)***	
ΔLT-1 $\times$ (1 $-$ Recession)				0.240 (0.084)***	
ΔLT-1 $\times$ Decline					0.446 (0.107)***
ΔLT-1 $\times$ (1 $-$ Decline)					0.218 (0.073)***
ΔCash/Total assets	0.240 (0.077)***	0.239 (0.078)***	0.246 (0.079)***	0.242 (0.077)***	0.242 (0.077)***
ΔMarket to book	-0.075 (0.011)***	-0.075 (0.011)***	-0.076 (0.010)***	-0.074 (0.011)***	-0.073 (0.010)***
ΔIndustry volatility	-0.249 (0.219)	-0.249 (0.219)	-0.241 (0.217)	-0.251 (0.221)	-0.234 (0.221)
ΔIdiosyncratic volatility	19.795 (6.253)***	19.709 (6.267)***	20.190 (6.129)***	19.914 (6.264)***	19.884 (6.182)***
ΔTangibility	-0.100 (0.164)	-0.103 (0.164)	-0.088 (0.165)	-0.099 (0.164)	-0.107 (0.165)
ΔSize	-0.347 (0.030)***	-0.352 (0.031)***	-0.335 (0.030)***	-0.348 (0.030)***	-0.348 (0.030)***
ΔR&D/Total assets	-0.509 (0.527)	-0.488 (0.517)	-0.553 (0.536)	-0.522 (0.542)	-0.510 (0.528)
ΔTaxes/Total assets	-0.770 (0.375)**	-0.767 (0.376)**	-0.778 (0.368)**	-0.759 (0.372)**	-0.723 (0.364)**
ΔOperating income/Sales	-0.359 (0.194)*	-0.360 (0.194)*	-0.351 (0.192)*	-0.359 (0.194)*	-0.334 (0.187)*
ΔDebt/Market capitalization	0.139 (0.007)***	0.139 (0.007)***	0.137 (0.007)***	0.139 (0.007)***	0.139 (0.007)***
ΔInterest coverage	-0.002 (0.0007)***	-0.002 (0.0007)***	-0.002 (0.0007)***	-0.002 (0.0007)***	-0.002 (0.0007)**
Const0.	0.236 (0.049)***	0.237 (0.049)***	0.234 (0.049)***	0.236 (0.049)***	0.237 (0.049)***
ΔCoef.		0.163 (0.115)	-0.585 (0.137)***	0.236 (0.108)**	0.228 (0.071)***
Obs.	17,457	17,457	17,457	17,457	17,457
R^2	0.129	0.130	0.133	0.130	0.130
Year FE	Yes	Yes	Yes	Yes	Yes

Table 3
Further Tests of the Relation between Long-term Debt Payable and Firm Credit Quality

This table reports the results of additional regressions aimed at understanding the effect of firms' long-term debt (scaled by total assets) payable during the year on their credit quality. In Panel A, we estimate the following first-difference regression:

$$\Delta Rating_{i,t} = \alpha + \beta \times \Delta LT\text{-}1\ Dummy_{i,t-1} + \gamma \times \Delta X_{i,t} + \text{Year FE},$$

where *LT-1 Dummy* is a dummy variable that identifies firm-year observations for which *LT-1* exceeds 5%. In Panel B, we estimate the following first-difference regression:

$$\Delta Rating_{i,t} = \alpha + \beta \times \Delta LT\text{-}2_{i,t-2} + \gamma \times \Delta X_{i,t} + \text{Year FE}.$$

In both panels, the dependent variable is $\Delta Rating_{i,t}$. Results of the tests of the differences between the coefficients on the interaction terms in Columns (2) to (5) are presented in the row titled $\Delta Coef.$ in each panel. Definitions of all the variables are provided in the Appendix. In all panels, 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 categories. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel A: Non-Linear Effect of $\Delta LT\text{-}1$ on $\Delta Rating$

	ΔRating				
	(1)	(2)	(3)	(4)	(5)
ΔLT-1 Dummy	0.126 (0.020)***				
ΔLT-1 Dummy $\times$ (1 − Small)		0.133 (0.026)***			
ΔLT-1 Dummy $\times$ Small		0.119 (0.032)***			
ΔLT-1 Dummy $\times$ Investment			0.054 (0.024)**		
ΔLT-1 Dummy $\times$ (1 − Investment)			0.189 (0.033)***		
ΔLT-1 Dummy $\times$ Recession				0.163 (0.032)***	
ΔLT-1 Dummy $\times$ (1 − Recession)				0.114 (0.023)***	
ΔLT-1 Dummy $\times$ Decline					0.184 (0.025)***
ΔLT-1 Dummy $\times$ (1 − Decline)					0.076 (0.028)***
Const.	0.093 (0.062)	0.093 (0.062)	0.092 (0.062)	0.093 (0.062)	0.091 (0.062)
ΔCoef.		0.014 (0.042)	-0.135 (0.04)***	0.049 (0.036)	0.108 (0.035)***
Obs.	17,457	17,457	17,457	17,457	17,457
R^2	0.152	0.152	0.153	0.152	0.153
Year FE	Yes	Yes	Yes	Yes	Yes

Panel B: Further Lags – Effect of $\Delta LT\text{-}2$ on $\Delta Rating$

	ΔRating				
	(1)	(2)	(3)	(4)	(5)
ΔLT-2	0.268 (0.122)**				
ΔLT-2 $\times$ Small		0.535 (0.155)***			
ΔLT-2 $\times$ (1 − Small)		0.186 (0.160)			
ΔLT-2 $\times$ Investment			-0.099 (0.218)		
ΔLT-2 $\times$ (1 − Investment)			0.357 (0.147)**		
ΔLT-2 $\times$ Recession				0.254 (0.164)	
ΔLT-2 $\times$ (1 − Recession)				0.273 (0.139)**	
ΔLT-2 $\times$ Decline					0.496 (0.191)***
ΔLT-2 $\times$ (1 − Decline)					0.152 (0.125)
Const.	0.109 (0.066)*	0.109 (0.066)*	0.109 (0.066)*	0.109 (0.066)*	0.110 (0.066)*
ΔCoef.		0.349 (0.243)	-0.456 (0.276)	-0.019 (0.185)	0.344 (0.189)*
Obs.	16,402	16,402	16,402	16,402	16,402
R^2	0.156	0.156	0.156	0.156	0.156
Year FE	Yes	Yes	Yes	Yes	Yes

Table 4

Table 4
Rollover Risk and Cost of Long-Term Debt

This table reports the results of regressions aimed at understanding the effect of firms' long-term debt (scaled by total assets) payable during the year on the cost of its long-term borrowing. In Panel A, we estimate the following first-difference regression:

$$\Delta \, Yield \; spread_{b,t} = \alpha + \beta \times \Delta LT\text{-}1_{i,t} + \gamma_1 \times \Delta X_{i,t} + \gamma_2 \times \Delta X_{m,t} + \text{Year FE.}$$

In Panel B, we estimate the following first-difference regression:

$$\Delta \, Yield \; spread_{b,t} = \alpha + \beta \times \Delta LT\text{-}1 \; Dummy_{i,t} + \gamma_1 \times \Delta X_{i,t} + \gamma_2 \times \Delta X_{m,t} + \text{Year FE,}$$

where *LT-1 Dummy* is a dummy variable that identifies firm-year observations for which *LT-1* exceeds 5%. Results of the tests of the differences between the interaction terms in Columns (2) to (5) are presented in the row titled $\Delta \, Coef.$ in each panel. Definitions of all the variables are provided in the Appendix. In all panels, the standard errors are robust to heteroscedasticity and are clustered at the individual bond level. Asterisks denote statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Panel A: Effect of $\Delta LT\text{-}1$ on $\Delta Yield\ spread$

	ΔYield spread			
	(1)	(2)	(3)	(4)	(5)
ΔLT-1	0.768 (0.210)***				
ΔLT-1 $\times$ Small		0.868 (0.218)***			
ΔLT-1 $\times$ (1 − Small)		0.384 (0.569)			
ΔLT-1 $\times$ Investment			0.634 (0.192)***		
ΔLT-1 $\times$ (1 − Investment)			1.239 (0.620)**		
ΔLT-1 $\times$ Recession				1.487 (0.372)***	
ΔLT-1 $\times$ (1 − Recession)				0.585 (0.228)**	
ΔLT-1 $\times$ Decline					1.095 (0.254)***
ΔLT-1 $\times$ (1 − Decline)					0.534 (0.233)**
ΔAverage index	509.519 (1025.380)	510.897 (1025.632)	516.306 (1022.583)	527.300 (1023.810)	485.794 (1029.231)
ΔAverage excess return	-57.181 (92.221)	-57.186 (92.391)	-52.167 (91.599)	-53.385 (92.158)	-59.518 (92.301)
ΔEquity volatility	38.547 (28.762)	38.734 (28.763)	36.963 (28.493)	38.517 (28.785)	39.631 (28.739)
ΔSystematic volatility	-167.731 (153.374)	-168.779 (153.369)	-175.025 (151.875)	-169.986 (153.356)	-169.972 (153.282)
ΔMkt. Cap/Index	-23.975 (22.446)	-23.937 (22.465)	-24.119 (22.385)	-24.601 (22.479)	-21.103 (22.288)
ΔBond rating	0.209 (0.024)***	0.210 (0.024)***	0.207 (0.024)***	0.209 (0.024)***	0.211 (0.024)***
ΔLong-term debt/Total assets	0.342 (0.346)	0.302 (0.344)	0.379 (0.344)	0.353 (0.346)	0.338 (0.346)
ΔInterest coverage-1	-0.103 (0.097)	-0.100 (0.096)	-0.106 (0.097)	-0.106 (0.096)	-0.115 (0.097)
ΔInterest coverage-2	-0.124 (0.087)	-0.121 (0.087)	-0.127 (0.087)	-0.125 (0.087)	-0.132 (0.087)
ΔInterest coverage-3	-0.121 (0.066)*	-0.119 (0.066)*	-0.122 (0.066)*	-0.121 (0.065)*	-0.124 (0.066)*
ΔOperating income/Sales	-2.373 (0.349)***	-2.373 (0.349)***	-2.371 (0.349)***	-2.382 (0.349)***	-2.321 (0.350)***
ΔTotal debt/Mkt. Cap	0.258 (0.032)***	0.258 (0.032)***	0.258 (0.032)***	0.258 (0.031)***	0.258 (0.032)***
ΔSlope	0.177 (0.389)	0.179 (0.389)	0.184 (0.388)	0.165 (0.388)	0.170 (0.391)
Const.	0.289 (0.684)	0.290 (0.684)	0.293 (0.682)	0.274 (0.683)	0.270 (0.687)
ΔCoef.		0.484 (0.61)	-0.605 (0.637)	0.902 (0.395)**	0.561 (0.245)**
Obs.	13,905	13,905	13,905	13,905	13,905
R^2	0.385	0.385	0.386	0.386	0.386
Year FE	Yes	Yes	Yes	Yes	Yes

Panel B: Non-Linear Effect of $\Delta LT\text{-}1$ on $\Delta Yield\ spread$

	ΔYield spread				
	(1)	(2)	(3)	(4)	(5)
ΔLT-1 Dummy	0.133 (0.052)**				
ΔLT-1 Dummy $\times$ Small		0.143 (0.052)***			
ΔLT-1 Dummy $\times$ (1 $-$ Small)		0.081 (0.156)			
ΔLT-1 Dummy $\times$ Investment			0.158 (0.051)***		
ΔLT-1 Dummy $\times$ (1 $-$ Investment)			0.028 (0.171)		
ΔLT-1 Dummy $\times$ Recession				0.287 (0.101)***	
ΔLT-1 Dummy $\times$ (1 $-$ Recession)				0.075 (0.051)	
ΔLT-1 Dummy $\times$ Decline					0.205 (0.063)***
ΔLT-1 Dummy $\times$ (1 $-$ Decline)					0.049 (0.064)
Const.	0.281 (0.682)	0.281 (0.683)	0.263 (0.692)	0.272 (0.683)	0.260 (0.690)
ΔCoef.		0.062 (0.161)	0.130 (0.18)	0.212 (0.101)**	0.156 (0.07)**
Obs.	13,905	13,905	13,905	13,905	13,905
R^2	0.385	0.385	0.385	0.385	0.385
Year FE	Yes	Yes	Yes	Yes	Yes