Debt Maturity and the Cost of Bank Loans

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Abstract

We study the extent to which a firm’s debt maturity structure affects its borrowing costs from banks. By examining the syndicated loans from 1990 to 2014 in the U.S. market, we find that a firm’s short-maturity debt structure is a major determinant of loan spreads after accounting for firm- and loan-specific variables, and firm and year fixed effects. A one-standard-deviation increase in the ratio of short-term debts to total assets increases the mean loan spread by 11.44bps, representing an additional $0.643 million in total interest expense. The result supports the rollover risk hypothesis that short-term debts intensify shareholder and bondholder conflicts and lead to greater credit risk. In addition, we demonstrate that high-growth firms experience a significantly smaller increase in loan spread than low-growth firms as the short-term debt ratio increases. This finding is consistent with the asset substitution theory that short-term debts mitigate the overinvestment problem and therefore reducing firm risk.

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1. Introduction

A simple debt–equity choice does not entirely reflect a firm’s capital structure. Debt maturity is an attribute of debt structure that has received much attention, particularly after Myers (1977) suggested that short-term debt alleviates the underinvestment problem. Although the literature has established the linkage between debt maturity and investment policy, in this study, we examine the relation between corporate debt maturity and the cost of bank loans.

He and Xiong (2012) suggest that the rollover risk associated with short-term debt intensifies the shareholders–debtholders conflict in which shareholders are motivated to default earlier, leading to a higher probability of default. In contrast to the rollover risk explanation, short-term debt can alleviate the asset substitution problem as firms with more short-term debt are subject to frequent renegotiations and scrutiny of the borrowers (Jensen and Meckling, 1976), resulting in lower firm risk. The above theories imply that if creditors consider the rollover risk, they would require a higher risk premium on loans that compensates for both default and rollover risks; however if creditors recognize that short-term debt restrains managerial risk-seeking incentives, interest rates on loans may be reduced due to lower firm risk. Motivated by these theoretical predictions, we aim to provide empirical evidence on whether and how a firm’s debt maturity structure affects the banks’ decision on loan rates.

We study syndicated loans granted in the U.S. market from 1990 to 2014. Our results support the rollover risk hypothesis that short-maturity debt structure increases the cost of bank loans and this impact is economically and statistically significant. On average, a one-standard-deviation increase in short-term debt to total asset ratio increases the loan spread by 11.44 basis points, approximately 5.66% of
the average loan spreads and 0.644 million in interest expense.\textsuperscript{1} Our result is robust after controlling for various firm- and loan-specific variables, and firm and time fixed effects.\textsuperscript{2}

We also examine the asset substitution hypothesis that suggests that short-term debt helps lower the cost of bank loans. Literature suggests that the incentives to shift investments toward risky assets are contingent upon a firm’s growth opportunities. High-growth firms have the strongest incentives to engage in asset substitution behavior (e.g., Billett et al., 2007); therefore the mitigation effect of short-term debt on loan costs is likely to be most prominent for such firms. This hypothesis is strongly supported. For a high-growth firm, a one-standard-deviation increase in the short-term debt ratio increases the mean loan spread by 1.87%, whereas for a low-growth firm the mean loan spread increases by 8.75%. This result indicates a trade-off effect, especially for high-growth firms, when choosing a debt maturity structure. In particular, there is the counteraction of the rate-reducing effect on load spread from the alleviation of asset substitution and the rate-increasing effect from rollover risk. Low-growth firms may be better off choosing a longer debt structure as the rate-increasing effect of short-term debt from rollover risk dominates the rate-reducing effect from the asset substitution hypothesis.

We conduct additional tests for a more thorough understanding of the impact of debt maturity structure on loan contract rates. We reveal that this impact is more pronounced among firms with higher risk, greater dependence on bank financing,

\textsuperscript{1} Consistent with the literature, we use all-in-drawn loan spreads to capture the overall cost of bank loans.

\textsuperscript{2} Our sample is drawn from the Loan Pricing Corporation’s Dealscan database. Since this database focuses on large loans and firms that presumably suffer lower rollover risk compared with smaller firms; thus, the database should bias against emphasizing the prevalence of such monopolistic loan pricing behavior.
having speculative grades and more committed credit lines. Moreover, short-term
debs have an amplifying effect on not only the price of credit to corporations but
also the price paid by corporations to guarantee access to liquidity (i.e.,
all-in-undrawn fees).

The short-debt ratio used in the main analysis may be simultaneously
determined with the cost of bank loans or there are unobserved risks or factors that
affect both the short-term debt ratio and cost of bank loans, resulting in an issue with
endogeneity. To address these concerns, we first use the ratio of long-term debt
maturing in one year to total asset as a proxy for short-maturity debt. The proxy
substantially reduces the endogeneity concern because unlike short-term debt,
long-term debt is predetermined and less likely to be correlated with the firm’s
current risk characteristics (Almeida et al., 2012). The results based on the
alternative measure are qualitatively similar to our main findings. Second, relative to
other studies the endogeneity concern due to the simultaneity between short-term
debt and the cost of bank loans is minimized in our analysis because loan spreads
are set by a firm’s creditors under the competitive forces in the market (i.e., these are
observed outcomes rather than firms’ choices). We use a panel-data model with firm
and year fixed effects, and employ the clustered standard errors at the firm-level to
adjust for possible estimation biases. The literature suggests that this methodology is
preferred to the other methods because it reduces the endogeneity concern.
Furthermore, we use a system of simultaneous equations to address the endogeneity
concern that short-debt ratio, loan spreads, and leverage are simultaneously
determined. Results of the simultaneous model regressions support our conclusion
that banks consider the effects of rollover risk and alleviation of asset substitution in
determining loan rates.

Finally, we consider two model specifications: (1) the ordinary least squares
(OLS) regressions with standard errors adjusted for heteroskedasticity and within firm clustering; and (2) the random fixed effect models, in which we include industry dummies, and clustered standard errors at firm level. The results of these two models and other robustness checks further confirm our main findings.

The primary contribution of this study is to provide new insights into the loan pricing literature by highlighting that a firm’s short-term debt is a major determinant of the bank loan spreads, which complements recent empirical studies that document the amplifying mechanism of rollover risk on financing costs in public debt markets (Chen et al., 2012; Gopalan et al., 2014; Valenzuela, 2015). The second contribution is to provide evidence that banks recognize short-term debt may mitigate asset substitution problems and charge lower interest rates as a result. This finding expands the understanding of the impact of short-term debts on alleviating the debt overhang problem (e.g., Johnson, 2003). Finally, previous studies focus on the association between the duration of incremental debt issue and bank loan costs (e.g., Dennis et al., 2000) and their empirical findings are mixed (see Appendix A for a table summarizing the major findings in the literature). We provide new evidence that a firm’s overall debt maturity structure is more informative in predicting loan spreads than the duration of loan contracts. Our results suggest that rational creditors consider both the rollover risk associated with debt refinancing and the agency conflicts between shareholders and debtholders when setting the interest rates on bank loans.

The study is structured as follows. Section 2 presents theoretical arguments on how a firm’s debt maturity structure affects the cost of debt. Section 3 describes

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3 The weakness of the incremental approach is that it provides noisy tests of agency theories of maturity choice (which is the major theory in this study) that depend largely on gradually changing characteristics, such as asset lives and the investment opportunity set.
the data and variables. Section 4 discusses our empirical results on the interplay between debt maturity and loan spreads. Section 5 addresses the endogeneity problem and presents the results of robustness tests. Section 6 concludes.

2. **Theoretical background and hypotheses**

This study examines whether and how a firm’s debt maturity structure affects the cost of bank loans. The link between debt maturity structure and bank loan pricing is supported by the following theories: The rollover risk of short-term debt encourages banks to charge a higher premium in addition to the required credit premium. However, the agency theory postulates that short-maturity debt reduces a firm’s risk-seeking behaviors, and therefore banks should charge a lower interest rate on corporate loans. Below we discuss these theories and propose our hypotheses.

2.1. **Rollover risk**

He and Xiong (2012) argue that rollover risk can be a source of credit risk because it intensifies the shareholders–debtholders conflict, in which shareholders bear the refinancing costs, resulting in insolvency, even when the value of a firm’s assets is higher than the insolvency threshold without the rollover risk. Gopalan et al. (2014) provide empirical evidence that firms with a greater exposure to rollover risk are more likely to be downgraded than firms with similar risk characteristics. Chiu et al. (2015) reveal that the exposure to rollover risk increases the expected default probabilities of a company. This notion implies that if creditors recognize the weakening effect of rollover risk on the borrower’s credit worthiness, they should demand a higher risk premium to compensate for the increase in credit risk. Studies have supported this conjecture by examining the pricing of credit default swaps.
(Chen et al., 2012) and corporate bonds (Gopalan et al., 2014; Valenzuela, 2015).

Most studies in the literature focus on the public debt and swap markets. However, we argue that the rollover risk, through which creditors demand a higher rate on corporate loans, is crucial in the pricing of private debt. As private debt issues are usually structured with a shorter maturity than public debt issues are, the effect of rollover risk is expected to be more prominent in the private debt market than that in the public debt market. Furthermore, the majority of private debt is in the form of syndicated bank loans; we are motivated to focus on the impact of debt maturity on bank borrowing costs.

A firm with a shorter debt maturity has a higher likelihood of refinancing, resulting in greater exposure to rollover risk and stronger interdependence between rollover risk and credit risk, which subsequently results in a higher level of credit risk. If banks recognize this increase in credit risk and price the loans accordingly, firms with a shorter debt structure might incur a higher bank loan rate. On the basis of the foregoing discussion, we propose the following hypothesis:

**Hypothesis 1:** Firms with a shorter debt maturity structure pay a higher premium when obtaining bank loans.

2.2. *Asset substitution*

In contrast to the rollover risk explanation, the asset substitution problem in agency theory suggests that short-term debt may reduce the cost of bank loans. Jensen and Meckling (1976) argue that shareholders prefer investments in risky projects because their payoffs increase when a firm’s volatility increases. However, debtholders who are fixed income claimants may be negatively affected by firms’ riskier investments that increase likelihoods of default. The asset substitution
problem emerges when shareholders have the incentives to exploit bondholder wealth by replacing low-risk investments with high-risk investments.

Short-term debts can be used to alleviate the asset substitution problem. The investment policy of firms with more short-term debt is closely monitored; such firms are subject to more frequent renegotiations and scrutiny of the borrowers (Jensen and Meckling, 1976). Substantial evidence suggests that banks demand higher loan interest rates in anticipation of the potential risks that they might encounter in debt contracting (Bharath et al., 2008; Graham et al., 2008; Hasan et al., 2014). If banks recognize that short-term debts restrain managerial risk-seeking incentives, they must price loans rationally, demanding lower interest rates on loans extended to firms with a shorter debt maturity in their capital structure. In addition, the literature suggests that the incentives to shift investments toward risky assets vary across firms. More specifically, firms with more growth options have the strongest incentives to engage in asset substitution behavior (Johnson, 2003; Billett et al., 2007; and Eisdorfer, 2008). Therefore, the mitigation effect of short-term debt on loan costs is likely to be most prominent in high-growth firms. Thus, we propose the following hypothesis:

\[ \text{Hypothesis 2: High-growth firms pay lower loan spreads than low-growth firms given a similar increase on short-maturity debts.} \]

3. Sample data and variable construction

3.1. Sample construction

Information on all U.S. syndicated loans for the sample period of 1990–2014
is collected from the Dealscan LPC database.\textsuperscript{4} We perform the following sample screening process. First, we exclude firms from highly regulated industries, including financial firms (standard industrial classification [SIC] codes of 6000–6999), utilities (SIC codes of 4900–4999), and quasi-public firms (SIC codes more than 8999). Second, we exclude privately held firms from our sample because we require accounting and equity information to measure debt maturity and other firm characteristics. Thereafter, we merge the loan sample with Compustat and the Center for Research on Securities Prices (CRSP) using the conversion table provided by Chava and Roberts (2008). This process generates our initial sample of bank loans.

For the cost of bank loans, we follow the literature and adopt the all-in-drawn spreads (Spread) as the overall cost of loan (e.g., Santos, 2011). We require nonmissing values of the main variables of interest: Spread, short-term debt, and long-term debt that matures in a year. We also exclude observations with missing values for firm- and loan-specific variables. We particularly focus on unrated firms and exclude the rated firms from our main analysis because the unrated firms face difficulties in accessing public debt markets, rendering them highly dependent on bank borrowing. Because the major premise of the rollover risk theory is that banks determine costs of loans to borrowers, we contemplate revealing evidence that supports the rollover risk theory in the category of unrated firms. On the other hand, rated firms are not dependent on bank borrowing because they have a wider choice of obtaining funds; therefore, we do not expect any support for the rollover risk theory in this category of rated firms.

To minimize the effects of outliers, Spread and all explanatory variables are

\textsuperscript{4} The data in Dealscan LPC database is considered to be more comprehensive after 1990 as suggested in Santos and Winton (2008) that Dealscan’s coverage of the loan market improved markedly into the early 1990s, the loans from the 1980s may not be very representative.
winsorized at the 1st and 99th percentiles. Our final sample contains 9,941 loan facilities and 2,754 unique firms. Fig. 1 presents Spread (solid line scaled toward the left of the Y axis) and the total number of loans (dotted line scaled toward the right of the Y axis). Spread exhibits a significant increase during the 2007–2010 financial crisis, as expected. The number of loans has increased steadily since 1992, except for a significant drop during the financial crisis.

3.2. Variable construction

3.2.1. Debt maturity structure

This study investigates whether a firm’s debt maturity structure is associated with costs when the firm borrows from banks. Our hypotheses highlight the importance of short-term debt. We use the ratio of firms’ short-term debts to total assets (ST) as the main measure of their debt maturity structure.\(^5\) However, a concern regarding ST is that the level of short-term debt may be simultaneously determined with the cost of bank loans or there are unobserved risks or factors that affect both (the ratio and cost), resulting in an endogeneity problem. To address this issue, we consider the ratio of long-term debt that matures in a year to total asset (LT1AT) as the second proxy for debt maturity. Evidence suggests that LT1AT is appropriate for testing the rollover risk theory (e.g., Almeida et al., 2012; Gopalan et al., 2014) because unlike short-term debt, long-term debt is predetermined and less likely to be correlated with the firm’s current risk characteristics. Finally, we use the ratio of short-term debt to total debt as the third debt maturity proxy (STDEBT).

3.2.2. Control variables

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\(^5\) Short-term debt comprises all current liabilities, namely, loans, trade credits, and other current liabilities, with maturities of less than one year.
Consistent with the literature on loan contracting, we consider the following firm- and loan-specific variables as determinants of loan spreads (e.g., Santos and Winton, 2008; Santos, 2011). Firm-specific variables include age (log of age) and size (log of total sales). Both variables are expected to be negatively associated with loan spreads because older or larger firms are typically well established and more diversified and, therefore, are considered less risky. In addition, we use leverage as a control variable because a higher level of firm leverage is associated with greater default risk and expected to have a positive effect on loan spreads. To measure a firm’s capability to service debt, we include profit margin and interest coverage. Improved profitability or a higher interest coverage ratio indicate lower credit risk and are expected to have a negative effect on loan spreads.

To examine the impact of credit risk, we control for the size and quality of the assets, which debt holders can draw upon default. Tangible assets (tangibility) provide more satisfactory protection for debtholder wealth in the event of default and are expected to have a negative effect on loan spreads. However, R&D and advertising proxy for a firm’s brand equity, which is less likely to protect debtholders from default loss, are expected to be positively related to loan spreads. Furthermore, we include net working capital to reflect liquid assets, which help reduce value loss during default events, and expect it to negatively affect loan spreads. Furthermore, we use market-to-book (MTB) ratio as a proxy for firm growth, which is expected to be negatively related to loan spreads.

In addition to the aforementioned accounting-based measures, we control for two market-based risk indicators: excess stock return and stock volatility. Excess stock return represents a firm’s financial performance relative to the market and is expected to have a negative impact on loan spreads. Stock volatility measures stock return volatility, which is positively linked to default risk and, therefore, we expect it
to positively affect loan spreads. Finally, we include a forward-looking default risk indicator, *distance-to-default*, based on KMV model.\(^6\) This measure is widely used in the literature as a proxy for the likelihood of a borrower’s default. A higher value of this variable indicates that a firm has a greater difference for the firm to reach its default threshold. We expect it to be negatively related to the loan spreads.

For loan characteristics, we first include *log loan size* and *log loan duration*. The effects of the two variables on loan spreads are ambiguous. Although a larger loan size may lead to greater credit risk, it may facilitate the processing and monitoring of the economies of scale. Similarly, although loans with a longer maturity are characterized by greater credit and term risks, they are more likely to be granted to borrowers with more favorable credit score. We also include dummy variables to indicate dividend restrictions, seniority, and security. Because the purpose of the loan may also affect its spreads, we include dummy variables to distinguish among loans for general corporate purposes, loans for repaying existing debt, and working capital loans. Moreover, we consider the type of the loan contract by indicating whether a loan is a term loan, bridge loan, and line of credit.\(^7\) Finally, in addition to variables suggested by Santos (2011), we include the logarithm *number of lenders*. Santos and Winton (2008) suggest that this measure can proxy for the hold-up effect and is expected to have a negative effect on loan spreads. Detailed descriptions of the aforementioned variables are provided in Appendix B.

3.3. *Descriptive statistics*

Table 1 presents the descriptive statistics of the variables. The mean value of

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\(^6\) A detailed description of the KMV-Merton model is provided by Vassalou and Xing (2004).

\(^7\) Chava et al. (2008) suggest that the pricing of term loans can be very different from that of revolving loans, and therefore we include dummy variables for each loan type.
ST is 0.051, suggesting that for an average firm, the amount of short-term debt is 5.1% of the total assets. As expected, LT/AT is lower than ST with a mean value of 0.027, indicating that a maturing long-term debt accounts for nearly half of the short-term debt. The mean value of ST/DEBT is 0.25, suggesting that on average, a quarter of the debt matures in a year. Table 1 also reports the summary statistics of loan characteristics. On average, bank loans have an issue size of $140.67 million, a spread of 202 basis points over the London interbank offered rate (LIBOR), and a duration of 4 years. Approximately 25.7% of the loans in our sample are term loans.

3.4. Variable correlation

Table 2 presents the correlations among loan spreads, debt maturity measures, leverage, and loan duration. The positive correlations between short-term debt ratios and loan spreads provide preliminary support for the rollover risk hypothesis. In particular, the correlations between Spread and short-term debt ratios range from 0.03 to 0.17. Interestingly, the correlation between Spread and loan duration is 0.01. Despite the extensive literature on the strong link between loan duration and spreads, the preliminary result suggests that the balance-sheet debt maturity structure may be more significant in determining the cost of bank loans than the incremental debt maturity reflected in loan duration. Therefore, examining the impact of the balance-sheet debt maturity structure on loan spreads is imperative. Finally, the correlations between leverage and short-term debt variables are relatively weak, suggesting that a firm’s capital structure does not completely explain its debt maturity structure. In the following sections, we provide an in-depth investigation of the effect of a firm’s debt maturity structure on its cost of bank loans after controlling for leverage and other risk factors.
4. **Empirical results**

This section presents the results of univariate and multivariate analyses and those of the additional tests conducted to investigate a thorough understanding of the relation between debt maturity structure and the costs of bank loans.

4.1. **Univariate analysis of loan spreads**

Using a univariate analysis, we examine *Spread* across quartiles of short-maturity debt proxies (i.e., *ST*, *LT1AT*, and *STDEBT*). In a given year, firms are classified into one of the four quartiles; we report the mean and median *Spread* by quartile. Panel A of Table 3 presents the results for the entire sample. *Spread* monotonically increases with an increase in *ST* from the lowest to the highest quartile. The mean (median) comparison between the lowest and highest quartiles indicates a difference in loan spread of 43 basis points (62 basis points), which is significant at the 1% level. We observe similar patterns when using *LT1AT* or *STDBET* as an alternative debt maturity proxy.\(^8\) These preliminary results support **Hypothesis 1**: banks charge a higher loan rate for firms with shorter debt maturity

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\(^8\) The debt maturity literature considers relatively longer debt ratios as a proxy for short-term debts, such as *ST3* (the percentage of total debt that matures in less than 3 years), *ST5* (the ratio of debts within 5 years to the total debt) (refer to Datta et al., 2005; Billett et al., 2007; Brockman et al., 2010). However, short-term debts that mature within a year are more appropriate proxies for our study because we focus on “unrated firms”; 3-year (or longer) debt proxies are probably more suitable for “rated firms.” The reason for such difference is that loans are the main financing sources for unrated firms and the duration of loans are typically shorter than that of corporate bonds. Nevertheless, we acknowledge that no perfect debt maturity proxy exists. Therefore, we use *ST3*, *ST5*, and *MAT* (book-value weighted numerical estimate of debt maturity; refer to the Appendix for a detailed definition) as complementary measures to our benchmark measures. We analyze Table 3 using these alternative proxies. Although the results are generally consistent with our benchmark debt maturity proxies, they are weaker. It implies that in our study, the short-maturity proxies dominate the relatively longer short-term debt proxies. The results are not included in this manuscript, but presented in Table OA1 of our Online Appendix.
due to a greater rollover risk. Interestingly, for loan duration, we observe a U-shape pattern, suggesting that firms pay a lower interest rate when obtaining loans with an intermediate duration; however, they pay a higher rate for loans with the shortest or longest duration. This result may explain why the literature documents the ambiguous effect of loan duration on loan spreads highlighted in the literature.

To gain insights on Hypothesis 2, we perform the same analysis on low-growth (Panel B) and high-growth (Panel C) firms. For low-growth firms, we continue to observe a strong and positive relationship between the short-term debt ratios and loan spreads across all proxies. However, for high-growth firms, this positive relation no longer exists for \( STDEBT \) and becomes weaker for \( ST \), based on the magnitude of the difference in mean (or median) spread between the highest and lowest quartiles. The nonsignificant or weaker relation between short-term debt ratios and loan spreads for high-growth firms reflects the counteraction of the negative effect based on asset substitution argument and the positive effect based on the rollover risk explanation. This result provides preliminary evidence for Hypothesis 2.

Overall, the univariate results on the relation between short-term debt ratios and loan spreads strongly support our hypotheses that firms with more short-term debt pay higher loan spreads to banks. Furthermore, the results support that short-term debt reduces loan spreads by mitigating the asset substitution problem particularly for high-growth firms.

4.2. Multivariate analysis of loan spreads and debt maturity structure

This section discusses the relation between loan spreads and debt maturity structure in a multivariate framework. In particular, we regress loan spreads on short-maturity debt proxies after controlling for firm- and loan-specific variables,
which the literature emphasizes as crucial determinants of loan spreads.

4.2.1. Empirical methodology

To investigate the impact of short-term debts on loan spreads, we estimate the following model:

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Spread_{i,j,t,d} = c + \beta \times ST_{i,j,t-1} + X_{i,j,t-1} + Y_{i,j,t,d} + LIBOR_d + \text{Firm Fixed Effects} + \text{Year Fixed Effects} + \epsilon_{i,j,t,d}
\]

(1)

where \(i,j,t,\) and \(d\) denote the \(i^{th}\) firm and \(j^{th}\) loan for year \(t\) and day \(d\). \(Spread\) is the loan interest payment over LIBOR (i.e., the all-in-drawn spread) for a loan facility \(j\) of firm \(i\) on date \(d\) in year \(t\). \(ST\) is our main variable of interest. We use two alternative short-term debt proxies: \(LT1AT\) (the ratio of long-term debts maturing within a year) and \(STDEBT\) (the ratio of short-term debts to total debt). Consistent with Hypothesis 1, a firm with a shorter debt maturity structure should be charged a higher loan spread and, therefore, we expect that \(\beta > 0\).

\(X\) represents a vector of firm-level control variables and \(Y\) represents a vector of contemporaneous loan-level control variables that are expected to affect the loan spreads. All firm-level variables are measured at the fiscal year-end, immediately before the origination of the loan contract. We follow Santos (2011) to include the firm fixed effects. The loan spread is also likely to be affected by time fixed effects, wherein certain unobserved factors systematically influence loan spreads across the firms at a specific time. To address this concern, we estimate the models by including the year fixed effects. We include LIBOR to account for the effects of any intertemporal economic shocks (Acharya et al., 2013). Finally, we

\footnote{For the data on LIBOR, refer to the level of LIBOR in the month when a firm initiates the loans.}
estimate all models with clustered standard errors at the firm level, as suggested by Petersen (2009).

4.2.2. The relation between short-term debt and the cost of bank loans

Table 4 presents the regression results of loan spreads on short-term debt ratio and control variables. We estimate six models of different combinations of short-term debt ratios and control variables. All models include the firm and year fixed effects. We reveal that $ST$ is positive and highly significant at the 1% level for the first four models, indicating that firms with a higher level of short-maturity debt pay a higher loan rate after controlling for firm- and loan-level characteristics, providing strong support for Hypothesis 1.

The effect of $ST$ on the cost of bank loans is both statistically and economically significant. To illustrate the economic impacts, we consider the results of Model 4, where $ST$ is the main interested variable and all control variables are included. From the estimates in Model 4, a one-standard-deviation increase in $ST$ leads to an increase in loan spread by 11.44 basis points, which is 5.66% of the average loan spread under the average loan spread of 202 basis points.10 The measure in dollars of this effect is also substantial. A one-standard-deviation increase in $ST$ results in an increase of $0.644$ million (= $140.67$ million $\times 0.001144 \times 4$) in interest expense, given that the average loan size and time to maturity are $140.67$ million and 4 years respectively.

We observe similar results when the two alternative short-term debt proxies,

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10 The detailed calculation is as follows. Given that the standard deviation of $ST$ is 0.086 (refer to the summary statistics in Table 1) and the estimated coefficient of $ST$ in the Model 4 of Table 4 is 133, a one-standard-deviation increase in $ST$ leads to an increase of $Spread$ by $0.086 \times 133 = 11.44$ basis points. Because the mean value of $Spread$ is 202 basis points (Table 1), the percentage increase is $11.44/202 = 5.66\%$. 
"LT1AT" and "STDEBT", are employed. The estimated coefficients are positive and highly significant (Models 5 and 6). The impact of "LT1AT" or "STDEBT" on Spread is also economically significant. A one-standard-deviation increase in "LT1AT" ("STDEBT") leads to an increase in loan spreads by 6.32 (4.41) basis points. Collectively, our results suggest that firms with a higher level of short-maturity debt pay a much higher loan spread when borrowing from banks.

Our results suggest that the short-term debt ratio, "ST", may have a stronger impact on loan spreads compared with the other factors suggested in the literature. As previously stated, a one-standard-deviation increase in "ST" is associated with an estimated increase of 11.44 basis points in loan spread. Bharath et al. (2008), Francis et al. (2012), and Hasan et al. (2014, 2016) reveal that in their respective samples a one-standard-deviation increase in accounting quality, board independence, cash effective tax rate, social capital reduces bank loan spread by 6.65, 5.50, 4.87, and 4.33 basis points, respectively.

For firm-specific variables, the results are generally significant and are consistent with expectations. First, firms with higher stock return volatility have greater default risk, leading to a positive effect on spreads. By contrast, firms that outperform the market or their asset value is larger than the default barrier are expected to pay lower loan spreads. Second, results on firm size, leverage,

11 We also reexamine the impact of short-term debts on loan spreads by replacing "ST" with other alternative short-maturity proxies of "ST3", "ST5", and "MAT" in the baseline regression (Model 4 of Table 4). The results are generally consistent with the main analysis that the coefficients of "ST5" and "MAT" are significant and support the hypotheses. Detailed results are presented in Table OA2 of the Online Appendix.

12 We also test our central hypotheses using a sample of rated firms. We exclude rated firms from our main analysis because as we argued before, they do not support our central hypotheses. According to the results presented in Table OA3 of the Online Appendix, only "LT1AT" short-maturity measure is relatively significant, thereby confirming that the evidence is weak.
profitability, and growth are consistent with those of Santos (2011). In particular, larger, less levered, more profitable and high-growth firms pay significantly lower loan spreads. Interestingly, in certain models, firm age is positively related to loan spreads.13

The coefficients on loan characteristics (e.g., loan amount, loan type, purpose dummies, and number of leaders) are generally significant. We focus the discussion on loan duration for two reasons. First, the duration of newly issued loans contributes to a firm’s debt maturity structure and it represents the concept of incremental debt maturity. Second, the literature on loan contracting widely accepts that loan duration is an essential determinant of loan spreads; however, its impact on loan spread is ambiguous.14 Our results indicate that the estimated coefficient of log loan duration is not significant across models, implying that a firm’s overall debt maturity (as measured by short-term debt ratio proxies) is more informative than the incremental debt maturity (i.e., loan duration) in terms of explaining loan spreads. LIBOR is negatively associated with spreads, which is consistent with the results of Acharya et al. (2013). Overall, Hypothesis 1 is strongly supported: the rollover risk associated with firms with short-maturity debt structure is recognized and priced in corporate loan rates.

4.2.3. Effect of short-term debt on loan spreads conditional on growth opportunities

To elucidate the importance of asset substitution theory in explaining the relation between debt maturity structure and loan spreads, we perform a regression

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13 In the study of Santos (2011), the log age variable is also positive.
14 On the one hand, loans with longer durations may face greater credit risk and banks may charge higher spreads. On the other hand, banks may grant loans to firms that are considered creditworthy, which leads to a negative relationship (e.g., Santos, 2011; Goss and Roberts, 2011).
analysis to examine whether the effect of rollover risk on loan spreads varies systematically by growth opportunities. We hypothesize that if short-term debt mitigates the asset substitution problem, the net effect of short-term debt on spreads is the result of the positive effect based on rollover risk and the negative effect based on the alleviation of asset substitution. Because asset substitution is the most severe problem for *high-growth* firms, we expect to observe significantly smaller or minimal effect of short-term debt on loan spreads for such firms. On the other hand, the effect of short-term debt on spreads is expected to attribute mainly to the rollover risk for *low-growth* firms, indicating a strongly positive effect.

To test this prediction, we use the *MTB* ratio as a proxy for a firm’s growth options. We create a dummy variable, *High_MTB*, to identify firms with a *MTB* ratio greater than the median value of all firms in a given year. We modify our baseline model in Eq. (1) to test *Hypothesis 2*, in which we replace $ST_{i,t-1}$ with $ST_{i,t-1} \times High\_MTB$ and $ST_{i,t-1} \times (1 - High\_MTB)$. These interaction variables are structured to test the possibility that the effect of short-term debt on loan spreads is conditioned on a firm’s growth opportunities. The model is specified as follows:

$$
Spread_{i,j,t,d} = c + \beta_1 \times (ST_{i,t-1} \times High\_MTB) + \beta_2 \times (ST_{i,t-1} \times (1 - High\_MTB))
$$

$$
+ X_{i,t-1} + Y_{i,j,t,d} + LIBOR_d + \text{Firm Fixed Effects} + \text{Year Fixed Effects} + \epsilon_{i,j,t,d}
$$

As previously discussed, we expect $\beta_1$ to be nonsignificant because for *high-growth* firms, the net effect of short-term debt on loan spreads is jointly determined by the increasing impact from rollover risk and the decreasing effect from the mitigation of the asset substitution problem. Conversely, the $\beta_2$ is expected to be significantly positive as predicted in *Hypothesis 1* mainly due to rollover risk, because *low-growth* firms have little or no incentives in using short-term debt to
mitigate the asset substitution problem.

We present the regression results in Table 5. For $ST$ (Model 1), we observe that the coefficient of $ST_{i,t-1} \times \text{High}_\text{MTB}$ is positive but weakly significant, whereas the coefficient of $ST_{i,t-1} \times (1 - \text{High}_\text{MTB})$ is positive and highly significant at the 1% level. The difference in coefficient (the row titled $\Delta \text{Coef.}$) is significantly different from 0, indicating a significant difference between the two coefficients. Models 2 and 3 suggest similar results when $\text{LT1AT}$ and $\text{STDEBT}$ are used.

The economic impact of $ST$ on $\text{Spread}$ is quite substantial for low-growth firms. According to Model 1, a one-standard-deviation increase in $ST$ leads to an increase of 19.44 basis points in loan spread ($= 0.0957 \times 203.18$), which is approximately 8.75% ($= 19.44/222$) of the average $\text{Spread}$.15 However, for a high-growth firm, the same increase in $ST$ indicates an increase in $\text{Spread}$ by 3.4 basis points ($= 0.0738 \times 46.19$), which is approximately 1.87% ($= 3.4/182$) of the average $\text{Spread}$. In addition, the difference in economic impact in terms of dollars between the high- and low-growth firms is also significant. For low-growth firms, a one-standard-deviation increase in $ST$ increases the total interest expense per loan facility by $0.94$ million ($= 120.8 \times 0.001944 \times 4$). By contrast, for high-growth firms, the same increase in $ST$ increases the total interest expense per loan facility by merely $0.22$ million ($= 160.3 \times 0.00034 \times 4$). These results strongly support Hypothesis 2: high-growth firms experience the two contradicting effects of short-maturity debt and the net effect on loan spreads becomes nonsignificant. On

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15 In computing economic impacts in Eq. (2), instead of using the summary statistics on the entire sample (as shown in Table 1), we use summary statistics on low- and high-growth firms separately. The standard deviation of $ST$ on low-growth (high-growth) firms is 0.0957 (0.0738) and the average $\text{Spread}$ is about 222 basis points (182 basis points). The loan size in the sample, on average, is $120.8$ million for low-growth firms and $160.3$ million for high-growth firms, and the time to maturity of a loan is 4 years for both firm types.
the other hand, for low-growth firms, the rollover risk effect outweighs the attenuation of asset substitution problem. Therefore, the net effect of short-term debt on loan spreads is significantly positive.

4.3. Additional tests

We offer additional tests for a more thorough understanding of the impact of debt maturity structure on loan contract rates. In particular, we examine whether this impact is more pronounced among firms with higher risk, greater dependence on bank financing, having speculative grades, more committed credit lines.

4.3.1. Debt maturity, loan spreads, and firm risk

In this section, we investigate how firm risk affects the link between short-term debt and the cost of bank loans. He and Xiong (2012) highlight that when a firm is sensitive to negative shocks and short-term debt accounts for a significant portion of its capital structure, an unfavorable event may lead to a large drop in liquid reserves, which causes the firm considerable refinancing losses in rolling over its short-term debt. Accordingly, in a same debt maturity structure, a high-risk firm is likely to face greater rollover (and therefore credit) risk than a low-risk firm. In addition, compared with less-risky borrowers, riskier borrowers have stronger incentives to engage in asset substitution behaviors (Campbell and Kracaw, 1990). Thus, the use of short-term debt to reduce the risk-taking behaviors is expected to be more effective for riskier firms, resulting in banks charging lower loan rates. Given

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16 Campbell and Kracaw (1990) demonstrate how the incentive of manager–equityholders to substitute toward riskier assets is related to the level of observable risk in the firm. When observable and unobservable risks are positively correlated sufficiently, increases (decreases) in observable risk generate the incentive for manager-equityholders to increase (decrease) unobservable risk. In other words, risker firms have more incentives to engage in risky asset substitution.
the foregoing argument, our baseline results are expected to be more pronounced for high-risk firms than for low-risk firms.

To test this prediction, we distinguish high-risk firms from low-risk firms by considering a set of risk indicators. The first one is defined as $STOCKVOL-A50$, which equals to one if a firm’s equity volatility is higher than the median of the sample firms in a given year and zero otherwise. We create three additional risk indicators using the Altman Z-score, distance-to-default, and interest coverage. In contrast to stock volatility, these variables are inversely related to the level of risk.\(^\text{17}\) Therefore, for each indicator, we create a dummy variable ($ZSCORE-B50$, $DTD-B50$, or $INTCOVERAGE-B50$) that assumes a value of 1 for firms with the variable lower than the median of all sample firms in a given year to indicate high risk and 0 otherwise. We replace $ST$ in the baseline regression (Eq. 1) with two interaction terms: $ST \times Risk\_dummy$ and $ST \times (1 - Risk\_dummy)$, where $Risk\_dummy$ is a dummy variable that equals to 1 if the firm is identified as high-risk and 0 otherwise. We expect that the coefficient on $ST \times Risk\_dummy$ is positive and more significant than the coefficient on $ST \times (1 - Risk\_dummy)$.

Table 6 reports the estimation results for the three short-term debt ratios ($ST$, $LT1AT$, and $STDEBT$) in Panels A, B, and C, respectively. The coefficient on the interaction of the short-term debt ratio and high-risk dummy is greater than that of the low-risk dummy across all model specifications. Our tests reveal that the coefficients on the two interaction terms are significantly different from each other at the 10% (or lower) level in 9 of the 12 models.

On the basis of the risk indicators, we divide the firms in our sample into high-risk and low-risk subsamples. We rerun individual regressions according to the

\(^\text{17}\) The interest coverage ratio indicates a firm’s capability to pay interests, and thus a lower value of this ratio renders the firm’s debt more risky.
model specified in Eq. (2) on the high- and low-risk subsamples; the results are presented in Table 7. Across all risk indicators, in the high-risk subsample the coefficient of the interaction between short-term debt and $1 - \text{High}_{\text{MTB}}$ (i.e., the effect of short-term debt on loan spreads for low-growth firms) is systematically positive and significant. The coefficient of the interaction between short-term debt and $\text{High}_{\text{MTB}}$ (i.e., the effect of short-term debt on loan spreads for high-growth firms) is not significant in almost all models. Furthermore, the difference in the coefficients of the two main interaction variables (i.e., $\Delta\text{Coef.}$) is only significant in the case of high-risk firms.

Overall, the results support our predictions. Given the same increase in the short-term debt ratio, the increase in loan spread is greater for high-risk firms than that for low-risk firms. The mitigation effect of short-term debts on costs of bank loans for high-growth firms is more pronounced among high-risk firms.

4.3.2. Bank dependence

Hypothesis 1 states that banks perceive borrowers’ debt maturity structure and decide the interest rates to be charged, which is mainly driven by the supply side effects. Therefore, the amplifying effect of short-term debt on loan spreads is expected to be more pronounced for firms that are highly dependent on bank debt financing. To identify bank-dependent firms, we collect information from the Capital IQ database. For each firm, we compute the bank debt to total assets ratio, and classify a firm as a bank dependent firm if it has the ratio higher than the median ratio of all firms in a given year. We create a dummy variable, $\text{Bank}_{\text{Dep}}$, which equals to one if a firm is bank-dependent and zero otherwise. The Capital IQ database only provides reliable information from 2002 and onward; thus, the sample period for the analysis in this subsection is from 2002 to 2014 (hereafter, referred to
as “CIQ-based sample”), which contains 3,557 observations.

Columns 1–3 of Table 8 report the regression results that examine the rollover risk effect conditional on bank dependence. The coefficients of interaction variables between short-term debt and Bank_Dep are highly significant at the 1% level, whereas the coefficients of interaction variables between short-term debt and \((1 - \text{Bank_Dep})\) are not significant. The results clearly indicate that the rollover risk effect is more pronounced for bank-dependent firms. Overall, the results confirm that given the same increase in short-term debt, bank-dependent borrowers pay higher interest to banks than firms that are less bank-dependent, further supporting Hypothesis 1.\(^{18}\)

4.3.3. Speculative-grade firms

Although we focus on unrated firms in our main analysis, we acknowledge

\(^{18}\) We rerun our baseline regressions using the CIQ-based sample (starting from year 2002) and confirm that the results are consistent with the main findings discussed in this study. Remarkably, the amplification effect of short-term debts on loan spreads is strongly positive for all short-term debt proxies and is more prominent than the baseline regression results reported in Table 4. For example, in the CIQ-based sample, the coefficients of \(ST, LT1AT, \text{ and } STDEBT\) are 252, 223, and 24, whereas in the main sample, the values are 133, 134, and 19, respectively (refer to Model 4 in Table 4). These results may also reflect that the amplification effect of short-term debt structure on the cost of bank loans has become more significant in recent years (from 2002 to 2014). The economic impact is also more sizable compared with that revealed by the results of the main analysis. A one-standard-deviation increase of short-term debt proxy leads to an increase in loan spreads by 21, 12, and 8 basis points when we use \(ST, LT1AT, \text{ and } STDEBT\) respectively, whereas in the main analysis, the same increase in the short-term debt proxy increases loan spreads by 11, 6, and 4 basis points, respectively. In addition, the results confirm that the reduction effect of short-term debt on loan rate due to the alleviation of asset substitution is more significant for high-growth firms. We reveal that the difference in coefficient between \(ST \times \text{High_MTB}\) and \(ST \times (1 - \text{High_MTB})\) is \(-207\) in the CIQ-based sample versus \(-156\) in the main sample. For \(LT1AT\), the difference in coefficient is \(-329\) in the CIQ-based sample versus \(-224\) in the main sample. Finally, for \(STDEBT\) the difference is \(-32\) versus \(-19\) in the main sample. The results are presented in Table OA4 of the Online Appendix.
that rated firms may also rely on bank financing, indicating that rollover risk may affect loan spreads for rated firms. We compute the bank debt to total assets ratios\textsuperscript{19} for the unrated sample, the speculative-grade sample (i.e., firms with ratings lower than BBB−), and investment grade sample. The distributions on these three subsamples is plotted and presented in Fig. 2.\textsuperscript{20} As expected, unrated firms have the highest ratio of bank debt to total assets. A similar pattern is observed in the speculative-grade subsample, indicating a certain level of demand for bank financing by the speculative-grade firms. Investment grade firms have minimal levels of bank debt to total assets ratios. Consequently, we focus on the speculative-grade firms in the following analysis of rated firms.

We perform the bank dependence analysis using the speculative-grade subsample and report the regression results in Columns 4–6 of Table 8. The coefficient of \( ST \times Bank\_Dep \) (representing the bank-dependent firms) is positively significant, whereas the coefficient of \( ST \times (1 - Bank\_Dep) \) is negatively significant (Column 4). In addition, the difference in coefficient between the two interaction variables (shown in \( \Delta Coef. \)) is highly significant at the 5\% (or better) level. Replacing \( ST \) with \( LT1AT \) or \( STDEBT \), we find similar results as shown in Columns 5–6: Bank-dependent, speculative-grade firms pay significantly higher interests on bank loans when they have a shorter debt maturity structure, further supporting Hypothesis 1.

4.3.4. All-in-undrawn spreads and credit lines

\textsuperscript{19} As previously mentioned, the data on the amount of bank debts for a firm are obtained from the Capital IQ database.

\textsuperscript{20} Because the data used in this part of the analysis is obtained from the Capital IQ database, the sample period for the subsamples is from 2002 to 2014. Of the total loan level observations, 3,949 are for unrated firms, 4,183 for speculative grade firms, and 2,330 for investment grade firms.
Different from all-in-drawn spreads, undrawn fees include both the commitment and annual fees that the borrower must pay to the banks for funds committed for credit lines but not taken down. Consequently, undrawn fees compensate banks for the liquidity risks it incurs by guaranteeing borrowers access to funding, at its discretion over the life of credit lines. Therefore, we expect that the rollover risk hypothesis is supported when we focus on the undrawn fee. We rerun Hypothesis 1 tests by replacing all-in-drawn spreads with undrawn fees (i.e., all-in-undrawn spread in the Dealscan database). The results are presented in Panel A of Table 9. The coefficients of \( ST \), \( LT1AT \), and \( STDEBT \) are positive and highly significant, implying that the short-term debt ratio has an amplifying effect not only on the cost of credit to corporations but also on the cost they pay to guarantee access to liquidity.

Furthermore, all-in-drawn spreads on credit lines compensate the bank for the credit risk it incurs when the borrower draws down on its credit line in the future. The rollover risk hypothesis essentially postulates that the conflict between shareholders and debtholders would increase the likelihood of default \textit{in the future}, but not necessarily at the current time. Given a similar increase in short-term debt, if all-in-drawn spreads are significantly higher for credit lines than for the other types of loans, Hypothesis 1 is further supported. We examine this prediction by including two interaction terms in which the debt maturity proxy interacts with the dummy \textit{CREDITLINE} and \((1 - \text{CREDITLINE})\) variables. The results, reported in Panel B of Table 9, confirm our prediction.

5. Endogeneity concern and robustness tests

In this section, we address the endogeneity problem and perform robustness checks.
5.1. **Endogeneity**

The empirical results so far show a strong and consistent association between short-term debt and loan pricing. However, like other empirical studies, our study is vulnerable to endogeneity concerns. For example, firms with higher borrowing costs are likely to be restricted to longer maturity debt, indicating a reverse causality problem. Another possible issue is that loan spreads and short-term debt are determined simultaneously by unobserved risk factors.

We emphasize that relative to other studies, the simultaneity issue is minimized in our tests because loan spreads are set by the firms’ creditors under competitive forces in the market (i.e., these are observed outcomes rather than firms’ choices). Furthermore, we include firm and time fixed effects in our regressions to control for the time-invariant and time-varying factors that may affect both the debt maturity structure and loan spreads. However, completely eliminating the endogeneity bias in empirical studies is extremely unlikely. We address the endogeneity problem by using a system simultaneous equations model (SEM) approach. The SEM analysis is employed to reduce the potential concern of reverse causality and the fact that loan spreads, debt maturity, and leverage are simultaneously determined.

We apply the SEM model on the consolidated sample (i.e., firm-year observations) because the short-maturity debt variables and leverage are measured at firm level. Consistent with Graham et al. (2008), we construct the consolidated sample by aggregating loan facilities to deals using loan-size-weighted averages of the relevant terms, comprising 5,946 firm-year observations. We expand the loan spread equation model by adding the debt maturity and leverage equations, presented as follows.
\[ \text{Spread}_{it} = \alpha_{10} + \alpha_{11} \times ST_{it} + X_{i,t-1} + \text{LIBOR}_t + \text{Industry Fixed Effects} + \text{Year Fixed Effects} + \epsilon_{i,t} \]  

(3)

\[ ST_{it} = \alpha_{20} + \alpha_{21} \times \text{Spread}_{it} + \alpha_{22} \times \text{leverage}_{it} + \alpha_{23} \times \text{ASSET\_MAT}_{it} \]
\[ + \alpha_{24} \times \left( \text{stock volatility} \right)_{it} + \alpha_{25} \times \left( \log \text{sales} \right)_{it} + \alpha_{26} \times \text{LSALES\_squared}_{it} \]
\[ + \alpha_{27} \times \text{MTB}_{it} + \alpha_{28} \times \left( \text{excess stock return} \right)_{it} + \text{LIBOR}_t + \text{Industry Fixed Effects} + \text{Year Fixed Effects} + \epsilon_{i,t} \]  

(4)

\[ \text{Leverage}_{it} = \alpha_{30} + \alpha_{31} \times \text{Spread}_{it} + \alpha_{32} \times ST_{it} + \alpha_{33} \times \left( \text{Profit margin} \right)_{it} \]
\[ + \alpha_{34} \times \left( \text{stock volatility} \right)_{it} + \alpha_{35} \times \left( \log \text{sales} \right)_{it} + \alpha_{36} \times \text{MTB}_{it} \]
\[ + \alpha_{37} \times \left( \text{excess stock return} \right)_{it} + \alpha_{38} \times \text{FIXED\_ASSET}_{it} \]  

(5)

where \( \text{Spread}_{it} \) is the weighted average all-in-drawn spreads based on loan size in a given year and for a given firm. \( X \) represents a vector of firm-level control variables, as described in Eq. (1). \( \text{ASSET\_MAT} \) is the measure of asset maturity, \( \text{LSALES\_squared} \) is the squared of \( \log \text{sales} \), \( \text{FIXED\_ASSET} \) represents a firm’s fixed asset, and other variables are defined in Appendix B. The industry fixed effects are captured using the single-digit SIC dummies, which are consistent with those used by Acharya et al. (2013). We follow Johnson (2003) and other similar studies in the debt maturity literature (e.g., Datta et al., 2005; Billett et al., 2007) to jointly estimate leverage and debt maturity. We estimate the SEM model by the generalized method of moments (GMM), using the exogenous variables as instruments in the moment conditions. Thus, GMM ensures that the standard errors of the estimates are heteroskedasticity and autocorrelation consistent.\textsuperscript{21}

\textsuperscript{21} We do not report the R\textsuperscript{2} values for our estimated equations, because as Goldberger (1991) observes, the R\textsuperscript{2} values reported in system estimation techniques may not necessarily be between zero and one. Unfortunately, there is no widely accepted goodness of fit measure for nonlinear system estimation. Moreover, other instrumental variables techniques, such as two-stage least squares (2SLS), are special cases of GMM. For example, Greene (2002) and Kennedy (2003) have reported that compared with 2SLS estimates, GMM estimates are more efficient when regression errors are heteroskedastic and/or autocorrelated and that GMM estimates coincide with 2SLS estimates
We first estimate a two-equation SEM, which includes the loan spread and the debt maturity equations. The results are reported in Table 10. Short-term debts and loan spreads have a significant bi-directional relation. Moreover, the amplifying effect of the short-term debt on the cost of bank loans remains robust after accounting for endogeneity. Thereafter, we perform a three-equation SEM by adding the leverage equation; a positive and significant bi-directional relation between the short-term debt ratios and loan spreads is continually observed. Furthermore in the leverage equation, the coefficients on short-term debt variables are negative and significantly different from zero, which is consistent with the liquidity risk effect suggested by Johnson (2003) and the single-equation results of Barclay and Smith (1995) that firms with longer maturity debt have higher leverage. Additionally, in the short-maturity debt equation, the proportion of short-term debt is positively related to the MTB ratio; this result is consistent with the predicted positive relation documented by Barclay et al. (2003). Finally, the coefficients on the other variables in the leverage and maturity equations are generally consistent with those reported by Johnson (2003) and Barclay et al. (2003).\footnote{We also re-examine our Hypothesis 2 based on the SEM approach. The results continue to support the hypothesis that short-term debt is crucial in alleviating asset substitution problem and banks perceive this effect by charging lower interest rates when firms borrow from banks. The detailed tables are presented in Table OA5 of the Online Appendix.}

In sum, we use the SEM framework to examine whether short-term debt ratios are positively associated with the costs of bank loans. This framework controls for the possible effects of unobservable factors and the potential reverse causality bias. Our results strongly confirm that short-term debt ratios are positively associated with loan spreads, reinforcing our conclusion that a firm’s short-maturity debt structure is significant in determining the cost of bank loans.
5.2. *Robustness Checks*

5.2.1. *Alternative model specifications*

Our baseline regressions are estimated using the panel data model with time and firm fixed effects. For robustness, we consider other model specifications in this section. First, we estimate the baseline model using the pooled ordinary least squares (Pool-OLS) regressions using standard errors adjusted for heteroskedasticity and firm clustering, and adjusting for the industry fixed effect. Second, we adopt the random fixed effect model, in which we include industry dummies and clustered standard errors at the firm level. Table 11 presents the results of these alternative models. Overall, the estimated coefficients are systematically significant for all debt maturity proxies and models, implying that our results are robust to various model specifications.

5.2.2. *Largest facility and consolidated sample*

In our main analysis, each observation represents a single loan facility. We acknowledge that a deal package can contain multiple loan facilities, which might simply reflect the deal structure and, therefore, are not entirely independent observations. Considering these loans to be independent facilities could bias toward inflating the statistical significance of our results. To address this possibility, we employ two approaches.

First, we use the *largest* facility the borrower receives in a specific year, as suggested in Hertzel and Officer (2012) and Houston et al. (2014). The sample size reduces from 9,941 to 5,940. The results are reported in Table 12. Panel A suggests that a one-standard-deviation increase in \( ST \) leads to an increase in loan spreads by 4.98% (or 10.01 basis points). This coefficient is significant at the 1% level and the
economic impact is similar to the increase of 5.66% (or 11.44 basis points) in the baseline analysis presented in Model 4 of Table 4. Panels B and C confirm that the results based on $LT1AT$ and $STDEBT$ are robust.

Second, we follow Graham et al. (2008) and aggregate loan facilities to deals using loan-size-weighted averages of the relevant terms. This consolidated sample contains 5,946 firm-year observations. The estimated results are presented in Table 12. Short-term debt proxies are positive and highly significant in Column 3, and as short-term debt increases, low-growth firms experience a greater increase in loan spreads than high-growth firms (Column 4). Overall, the results based on the largest facility and consolidated samples indicate that our main findings and implications remain robust at the deal level.23

5.2.3. Logarithm loan spreads and newly listed firms

Previous studies have suggested that the logarithm of loan spread can mitigate the effect of data skewness (e.g., Campello et al., 2011). For robustness, we rerun the baseline regressions by replacing the raw spreads with the natural logarithm of spreads. Furthermore, Custódio et al. (2013) document that the use of short-term debts is higher among recently listed firms. Because such firms are less transparent, our results may be subject to a sample selection bias that supports the rollover risk hypothesis. For robustness, we exclude firms that are 4 years or younger and rerun our baseline regressions. We report results that use the natural logarithm of spread and exclude newly listed firms in Table OA8 of the Online

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23 We also rerun regressions with alternative model specifications (i.e., Pool-OLS and random effects) by using the largest loan facility and consolidated samples. The results are qualitatively similar to our main findings. For conciseness, we present the results in Tables OA6 and OA7 of the Online Appendix.
Appendix. The results are qualitatively similar to our main findings.

6. Conclusion

Do banks charge higher loan rates to compensate for the rollover risk? We address this question by examining syndicated loans from 1990 to 2014 in the U.S. market and provide strong empirical evidence to reveal that short-debt ratio is a critical determinant of loan spreads after accounting for various firm- and loan-specific variables, and firm and year fixed effects. In addition, we examine the asset substitution explanation that short-term debts may lead to safer investments, lower firm risk, and therefore reducing bank loan spreads especially for firms with strong incentives to pursue risky investments. We find that given the same increase in short-maturity debt ratio, high-growth firms (with high risk-shifting incentives) experience a significantly smaller increase in loan spread than low-growth firms. The findings support that short term debts help alleviate the asset substitution problem and reduce corporate loan rates, especially for high-growth firms.

Additional tests suggest that longer debt maturity structure is particularly imperative for firms that are high-risk, bank-dependent, committed to credit lines, to reduce borrowing costs. These results further support our main findings. We find that our results remain consistent when we use alternative debt maturity proxies, conduct various analysis to address the issue of endogeneity, and conduct a variety of robustness tests. Collectively, we confirm that banks consider a firm’s debt maturity structure to set the pricing of bank loans, in addition to commonly-known pricing factors. Future research may explore the effects of other attributes of debt maturity (e.g., debt concentration) on the cost of bank loans.
Appendices

Appendix A Summary of the literature on the determinant of loan duration on loan spreads

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<td>(1) Campello, Lin, Ma, Zou</td>
<td>+</td>
<td>Single equation</td>
<td>All loans / 1996‒2002</td>
<td>Positive (not significant)</td>
</tr>
<tr>
<td>(2) Houston, Jiang, Lin, and Ma</td>
<td>+</td>
<td>Single equation</td>
<td>All loans on S&amp;P 500 companies / 2003‒2008</td>
<td>Positive (significant)</td>
</tr>
<tr>
<td>(2014, <em>Journal of Accounting Research</em>)</td>
<td></td>
<td></td>
<td></td>
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<td>(4) Santos</td>
<td>(+/‒)</td>
<td>Single equation</td>
<td>All loans / 2002‒2008</td>
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<tr>
<td>(6) Goss and Roberts</td>
<td>‒</td>
<td>Single equation</td>
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<tr>
<td>(7) Santos and Winton</td>
<td>(+/‒)</td>
<td>Single equation</td>
<td>All loans / 1987–2002</td>
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## Appendix B Variable description

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<td>DealScan</td>
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<td>LT1AT</td>
<td>Proportion of long-term debts maturing in 1 year to the total assets</td>
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<td>STDEBT</td>
<td>Proportion of short-term debts to the total debts</td>
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<td>Proportion of total debt that matures within 3 years</td>
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<td>Proportion of total debt that matures within 4 years</td>
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<tr>
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<td>Proportion of total debt that matures within than 5 years</td>
<td>Compustat</td>
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<td>Book-value weighted numerical estimate of debt maturity, based on the assumption that the average maturities of the 6 Compustat maturity categories are 0.5 year, 1.5 years, 2.5 years, 3.5 years, 4.5 years, and 10 years.</td>
<td>Compustat</td>
</tr>
<tr>
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</tr>
<tr>
<td>Log age</td>
<td>Logarithm of age</td>
<td>Compustat</td>
</tr>
<tr>
<td>Log sales</td>
<td>Logarithm of sales</td>
<td>Compustat</td>
</tr>
<tr>
<td>Leverage</td>
<td>Ratio of total debts to total assets</td>
<td>Compustat</td>
</tr>
<tr>
<td>MTB (market-to-book)</td>
<td>Ratio of market value to book value</td>
<td>Compustat</td>
</tr>
<tr>
<td>Profit margin</td>
<td>Ratio of net income to sales</td>
<td>Compustat</td>
</tr>
<tr>
<td>Interest coverage</td>
<td>Logarithm of 1 plus ( EBITDA ) divided by interest expense truncated at 0</td>
<td>Compustat</td>
</tr>
<tr>
<td>Tangibility</td>
<td>Ratio of inventories plus plant, property, and equipment to total assets</td>
<td>Compustat</td>
</tr>
<tr>
<td>Net working capital</td>
<td>Ratio of networking capital (current assets less current liabilities) to total debt</td>
<td>Compustat</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and development expense divided by sales</td>
<td>Compustat</td>
</tr>
<tr>
<td>Advertising</td>
<td>Advertising expense divided by sales</td>
<td>Compustat</td>
</tr>
<tr>
<td>Excess stock return</td>
<td>Excess stock return (relative to the market) over the past 12 months</td>
<td>Compustat / CRSP</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>Standard deviation of a firm’s excess stock returns over the past 12 months</td>
<td>Compustat / CRSP</td>
</tr>
<tr>
<td>Distance-to-default</td>
<td>KMV distance-to-default based on Vassalou and Xing (2004)</td>
<td>Compustat / CRSP</td>
</tr>
<tr>
<td>ASSET_MAT</td>
<td>The weighted average of the maturity of long-term assets and current assets. The maturity of long-term assets is</td>
<td>Compustat</td>
</tr>
</tbody>
</table>
measured as gross property, plant, and equipment divided by depreciation; the maturity of current assets is defined as current assets divided by the cost of goods. The weight for long-term assets is the share of gross property, plant, and equipment in total assets, and the weight for current assets is the share of current assets in total assets.

<table>
<thead>
<tr>
<th>FIXED ASSET</th>
<th>Ratio of net property, plant, and equipment to the book value of total assets.</th>
<th>Compustat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loan Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log loan size</td>
<td>Loan facility amount in $ millions (DealScan item Tranche Amount (Converted)).</td>
<td>DealScan</td>
</tr>
<tr>
<td>Log loan duration</td>
<td>Logarithm of duration of the loan in years.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Secure</td>
<td>Dummy variable that takes the value of one if loan is secured by collateral.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Senior</td>
<td>Dummy variable that takes the value of one if loan is senior.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Dividend rest</td>
<td>Dummy variable that takes the value of one if loan has restrictions on paying dividends.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Corporate purposes</td>
<td>Dummy variable that takes the value of one if loan is for corporate purposes.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Debt repay</td>
<td>Dummy variable that takes the value of one if loan is to repay existing debt.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Working capital</td>
<td>Dummy variable that takes the value of one if loan is for working capital purposes.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Term loan</td>
<td>Dummy variable that takes the value of one if loan is a term loan.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Bridge loan</td>
<td>Dummy variable that takes the value of one if loan is a bridge loan.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Credit line</td>
<td>Dummy variable that takes the value of one if loan is a credit line.</td>
<td>DealScan</td>
</tr>
<tr>
<td>Log number of lenders</td>
<td>Logarithm of number of lenders.</td>
<td>DealScan</td>
</tr>
<tr>
<td><strong>Other variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIBOR</td>
<td>Three-month US London Interbank Offer Rate at the end of the month of deal signing.</td>
<td>British Banker’s Association</td>
</tr>
<tr>
<td>High_MTB</td>
<td>Dummy variable that takes the value of one if a firm has MTB value above the median value of MTB among all firms in a given year and 0 otherwise.</td>
<td>Compustat / CRSP</td>
</tr>
<tr>
<td>STOCKVOL-A50</td>
<td>Dummy variable that takes the value of one if a firm has the value of stock volatility above the median value of the variable among firms for a given year (higher-risky firms) and 0 otherwise.</td>
<td>CRSP</td>
</tr>
<tr>
<td>ZSCORE-B50</td>
<td>Dummy variable that takes the value of one if a firm has Altman Z-score below the median value of the variable among firms for a given year (higher-risky firms) and 0 otherwise.</td>
<td>Compustat</td>
</tr>
<tr>
<td>DTD-B50</td>
<td>Dummy variable that takes the value of one if a firm has the value of distance-to-default below the median value of the variable among firms for a given year (higher-risky firms) and 0 otherwise.</td>
<td>Compustat / CRSP</td>
</tr>
<tr>
<td>LINTEREST_COV-B50</td>
<td>Dummy variable that takes the value of one if a firm has the value of interest coverage below the median value of the variable among firms for a given year (higher-risky firms) and 0 otherwise.</td>
<td>Compustat</td>
</tr>
</tbody>
</table>
References


Table 1 Summary statistics  
This table presents the summary statistics for the study variables: short-term debt variables and firm- and loan-level control variables. The short-term debt variables are (1) \( ST \), the ratio of short-term debts to total asset values; (2) \( LT1AT \), the ratio of long-term debts that mature within a year to total asset values; and (3) \( STDEBT \), the ratio of short-term debts to total debts. The variable “Spread” is the all-in-drawn spreads, representing banks’ overall borrowing costs over LIBOR. The detailed construction of other variables is provided in Appendix B.

<table>
<thead>
<tr>
<th></th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>p25</th>
<th>Median</th>
<th>p75</th>
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</thead>
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<tr>
<td><strong>Short-Term Debt Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>( ST )</td>
<td>9,941</td>
<td>0.051</td>
<td>0.086</td>
<td>0.003</td>
<td>0.020</td>
<td>0.058</td>
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<tr>
<td>( LT1AT )</td>
<td>9,941</td>
<td>0.027</td>
<td>0.053</td>
<td>0.001</td>
<td>0.009</td>
<td>0.031</td>
</tr>
<tr>
<td>( STDEBT )</td>
<td>9,941</td>
<td>0.253</td>
<td>0.311</td>
<td>0.023</td>
<td>0.116</td>
<td>0.361</td>
</tr>
<tr>
<td><strong>Firm Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log age</td>
<td>9,941</td>
<td>2.516</td>
<td>0.773</td>
<td>1.946</td>
<td>2.485</td>
<td>3.091</td>
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<td>Log sales</td>
<td>9,941</td>
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<td>1.286</td>
<td>4.999</td>
<td>5.884</td>
<td>6.733</td>
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<td>Leverage</td>
<td>9,941</td>
<td>0.268</td>
<td>0.206</td>
<td>0.111</td>
<td>0.237</td>
<td>0.377</td>
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<td>MTB (market-to-book)</td>
<td>9,941</td>
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<td>1.002</td>
<td>1.123</td>
<td>1.451</td>
<td>2.001</td>
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<td>Profit margin</td>
<td>9,941</td>
<td>0.223</td>
<td>0.005</td>
<td>0.035</td>
<td>0.035</td>
<td>0.070</td>
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<td>Interest coverage</td>
<td>9,941</td>
<td>23.854</td>
<td>57.083</td>
<td>3.524</td>
<td>7.221</td>
<td>17.481</td>
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<td>Tangibility</td>
<td>9,941</td>
<td>0.296</td>
<td>0.120</td>
<td>0.233</td>
<td>0.361</td>
<td>0.417</td>
</tr>
<tr>
<td>Net working capital</td>
<td>9,941</td>
<td>11.911</td>
<td>55.99</td>
<td>0.22</td>
<td>0.834</td>
<td>2.147</td>
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<td>R&amp;D</td>
<td>9,941</td>
<td>0.019</td>
<td>0.052</td>
<td>0</td>
<td>0</td>
<td>0.013</td>
</tr>
<tr>
<td>Advertising</td>
<td>9,941</td>
<td>0.009</td>
<td>0.024</td>
<td>0</td>
<td>0</td>
<td>0.005</td>
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<td>Excess stock return</td>
<td>9,941</td>
<td>0.083</td>
<td>0.625</td>
<td>-0.264</td>
<td>0.058</td>
<td>0.389</td>
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<td>Stock volatility</td>
<td>9,941</td>
<td>0.476</td>
<td>0.259</td>
<td>0.304</td>
<td>0.414</td>
<td>0.575</td>
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<td>Distance-to-default</td>
<td>8,888</td>
<td>6.401</td>
<td>5.009</td>
<td>2.934</td>
<td>5.330</td>
<td>8.556</td>
</tr>
<tr>
<td><strong>Loan Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spread (all-in-drawn spread)</td>
<td>9,941</td>
<td>202.045</td>
<td>120.322</td>
<td>115</td>
<td>175</td>
<td>275</td>
</tr>
<tr>
<td>Log loan spread (all-in-drawn spread)</td>
<td>9,941</td>
<td>5.123</td>
<td>0.645</td>
<td>4.745</td>
<td>5.165</td>
<td>5.617</td>
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<tr>
<td>All-in-undrawn spread</td>
<td>6,347</td>
<td>33.035</td>
<td>16.700</td>
<td>22.500</td>
<td>30</td>
<td>47.500</td>
</tr>
<tr>
<td>Log loan size (Smillion)</td>
<td>9,941</td>
<td>18.022</td>
<td>12.282</td>
<td>17.217</td>
<td>18.133</td>
<td>18.859</td>
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<tr>
<td>Loan size (Smillion)</td>
<td>9,941</td>
<td>140.672</td>
<td>235.847</td>
<td>30</td>
<td>75</td>
<td>155</td>
</tr>
<tr>
<td>Log loan duration (months)</td>
<td>9,941</td>
<td>3.735</td>
<td>0.596</td>
<td>3.584</td>
<td>3.970</td>
<td>4.094</td>
</tr>
<tr>
<td>Loan duration (years)</td>
<td>9,941</td>
<td>3.998</td>
<td>1.735</td>
<td>3</td>
<td>4.417</td>
<td>5</td>
</tr>
<tr>
<td>Secure</td>
<td>9,941</td>
<td>0.597</td>
<td>0.491</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Senior</td>
<td>9,941</td>
<td>0.098</td>
<td>0.043</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Dividend rest</td>
<td>9,941</td>
<td>0.609</td>
<td>0.488</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Corporate purposes</td>
<td>9,941</td>
<td>0.295</td>
<td>0.456</td>
<td>0</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Debt repay</td>
<td>9,941</td>
<td>0.204</td>
<td>0.403</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Working capital</td>
<td>9,941</td>
<td>0.218</td>
<td>0.413</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Term loan</td>
<td>9,941</td>
<td>0.257</td>
<td>0.437</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bridge loan</td>
<td>9,941</td>
<td>0.012</td>
<td>0.107</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Credit line</td>
<td>9,941</td>
<td>0.653</td>
<td>0.476</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Log number of lenders</td>
<td>9,935</td>
<td>1.321</td>
<td>0.906</td>
<td>0.693</td>
<td>1.386</td>
<td>1.946</td>
</tr>
<tr>
<td><strong>Macro Controls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIBOR (%)</td>
<td>9,941</td>
<td>3.791</td>
<td>2.247</td>
<td>1.559</td>
<td>4.765</td>
<td>5.623</td>
</tr>
</tbody>
</table>
Table 2 Correlation matrix
This table presents Pearson correlations among short-term debt variables ($ST$, $LT1AT$, and $STDEBT$), the leverage, and the logarithm of loan duration on new issuance loans.

<table>
<thead>
<tr>
<th></th>
<th>Spread</th>
<th>$ST$</th>
<th>$LT1AT$</th>
<th>$STDEBT$</th>
<th>Leverage</th>
<th>Log loan duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ST$</td>
<td>0.17</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$LT1AT$</td>
<td>0.17</td>
<td>0.67</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$STDEBT$</td>
<td>0.03</td>
<td>0.59</td>
<td>0.32</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leverage</td>
<td>0.26</td>
<td>0.31</td>
<td>0.30</td>
<td>-0.25</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Log loan duration</td>
<td>0.01</td>
<td>-0.11</td>
<td>-0.05</td>
<td>-0.14</td>
<td>0.05</td>
<td>1</td>
</tr>
</tbody>
</table>
This table presents spread (basis points) across quartiles of short-maturity debt proxies (i.e., $ST$, $LT1AT$, and $STDEBT$) and new issuance loan duration ($log\ loan\ duration$). For each year, firms are classified into one of four groups. The means are reported, with the medians in brackets, among firms classified to quartiles. Panel A presents results based on the full sample; Panels B and C presents results for low- and high-growth firms, respectively. The low-growth (high-growth) firms are identified when firms’ $MTB$ value is less than (greater than) the median of $MTB$ ratios among all firms for a given year. We test the difference in means and medians between high and low quartile groups based on the Wilcoxon one-way sample $t$-test. ***, **, and * denote significance of the $t$ tests at the 1%, 5%, and 10% level, respectively.

### Panel A: All firms

<table>
<thead>
<tr>
<th>Debt Maturity Variable Quantiles</th>
<th>$ST$</th>
<th>$LT1AT$</th>
<th>$STDEBT$</th>
<th>Log loan duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Low</td>
<td>183.74</td>
<td>177.92</td>
<td>197.84</td>
<td>210.54</td>
</tr>
<tr>
<td></td>
<td>(162.5)</td>
<td>(150)</td>
<td>(175)</td>
<td>(200)</td>
</tr>
<tr>
<td>2</td>
<td>192.61</td>
<td>193.54</td>
<td>206.11</td>
<td>196.18</td>
</tr>
<tr>
<td></td>
<td>(175)</td>
<td>(175)</td>
<td>(200)</td>
<td>(187.7)</td>
</tr>
<tr>
<td>3</td>
<td>204.93</td>
<td>207.64</td>
<td>200.73</td>
<td>179.99</td>
</tr>
<tr>
<td></td>
<td>(200)</td>
<td>(200)</td>
<td>(182.5)</td>
<td>(150)</td>
</tr>
<tr>
<td>4 = High</td>
<td>226.84</td>
<td>228.95</td>
<td>203.51</td>
<td>229.12</td>
</tr>
<tr>
<td></td>
<td>(225)</td>
<td>(225)</td>
<td>(185)</td>
<td>(225)</td>
</tr>
</tbody>
</table>

**Two sample differences tests**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>10</th>
<th>5</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>High – Low (Mean)</td>
<td>43.11***</td>
<td>51.02***</td>
<td>5.66*</td>
<td>18.58***</td>
<td></td>
</tr>
<tr>
<td>High – Low (Median)</td>
<td>62.5***</td>
<td>75***</td>
<td>10***</td>
<td>25***</td>
<td></td>
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</table>

### Panel B: Low-growth firms

<table>
<thead>
<tr>
<th>Debt Maturity Variable Quantiles</th>
<th>$ST$</th>
<th>$LT1AT$</th>
<th>$STDEBT$</th>
<th>Log loan duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Low</td>
<td>206.34</td>
<td>202.62</td>
<td>215.16</td>
<td>232.5</td>
</tr>
<tr>
<td></td>
<td>(187.5)</td>
<td>(187.5)</td>
<td>(200)</td>
<td>(225)</td>
</tr>
<tr>
<td>2</td>
<td>209.31</td>
<td>215.03</td>
<td>221.39</td>
<td>212.52</td>
</tr>
<tr>
<td></td>
<td>(200)</td>
<td>(200)</td>
<td>(225)</td>
<td>(200)</td>
</tr>
<tr>
<td>3</td>
<td>226.25</td>
<td>225.29</td>
<td>220.61</td>
<td>207.89</td>
</tr>
<tr>
<td></td>
<td>(225)</td>
<td>(225)</td>
<td>(200)</td>
<td>(200)</td>
</tr>
<tr>
<td>4 = High</td>
<td>247.49</td>
<td>246.4</td>
<td>232.2</td>
<td>242.54</td>
</tr>
<tr>
<td></td>
<td>(250)</td>
<td>(250)</td>
<td>(225)</td>
<td>(225)</td>
</tr>
</tbody>
</table>

**Two sample differences tests**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>10</th>
<th>5</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>High – Low (Mean)</td>
<td>41.15***</td>
<td>43.78***</td>
<td>17.04***</td>
<td>10.03***</td>
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</tr>
<tr>
<td>High – Low (Median)</td>
<td>62.5***</td>
<td>62.5***</td>
<td>25***</td>
<td>0***</td>
<td></td>
</tr>
</tbody>
</table>

### Panel C: High-growth firms

<table>
<thead>
<tr>
<th>Debt Maturity Variable Quantiles</th>
<th>$ST$</th>
<th>$LT1AT$</th>
<th>$STDEBT$</th>
<th>Log loan duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Low</td>
<td>164.96</td>
<td>160.44</td>
<td>180.45</td>
<td>186.34</td>
</tr>
<tr>
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**Two sample differences tests**

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<td>High – Low (Median)</td>
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**Table 4 Short-term debts and loan spreads**

This table presents the results of regressing loan spreads on short-debt ratios ($ST$, $LTIAT$, and $STDEBT$). The sample contains syndicated loans in the U.S. market from 1990 to 2014. We estimate models with or without control variables, and all models include firm and year fixed effects. In terms of $ST$, Model 1 is estimated without including any firm- and loan-level control; Model 2 includes only loan-level controls; Model 3 includes only firm-level controls; Model 4 includes both loan- and firm-level controls and is our benchmark model. We replace $ST$ in Model 4 with $LTIAT$ and $STDEBT$ and report estimation results in Models 5 and 6, respectively. The $p$ values are reported in parenthesis and obtained after considering clustered standard errors at firm level. Indicator variables for year and firm fixed effects are not reported.

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<td>8,888</td>
<td>8,882</td>
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<td>0.36</td>
<td>0.46</td>
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Table 5 The effect of short-maturity debts on loan spreads by growth opportunities

This table presents the regression results for the effect of short-maturity debt variables on loan spreads conditional on growth opportunities. The High_MTB is the dummy variable, identifying firms as high-growth-opportunity firms when firms’ MTB values are greater than the median value of the variable for all firms in a given year. Results of the tests of the differences between coefficients on the interaction terms in Columns 1–3 are presented in the row titled ΔCoef. Control variables on firm- and loan-specific variables, firm and year fixed effects, and LIBOR in the month of the loan are included in all regressions but coefficients are not reported. Estimations consider clustered standard errors at firm level, which are reported in parenthesis.

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<td>46.19 * (0.09)</td>
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<td>$ST \times (1-\text{High}_\text{MTB})$</td>
<td>203.18 *** (0.00)</td>
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<tr>
<td>$LT1AT \times \text{High}_\text{MTB}$</td>
<td>4.72 (0.89)</td>
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<tr>
<td>$LT1AT \times (1-\text{High}_\text{MTB})$</td>
<td>228.73 *** (0.00)</td>
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<tr>
<td>$\text{STDEBT} \times \text{High}_\text{MTB}$</td>
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<td>10.32 (0.11)</td>
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<tr>
<td>$\text{STDEBT} \times (1-\text{High}_\text{MTB})$</td>
<td></td>
<td>29.95 *** (0.00)</td>
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<td>ΔCoef.</td>
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<td>-224.01 *** (0.00)</td>
<td>-19.63 * (0.05)</td>
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Table 6 The effect of short-maturity debts on loan spreads by firm risk
This table presents the results of regressing loan spreads on short-debt ratios (ST, LT1AT, and STDEBT) conditional on firm risk level. The main interested variables are ST \times Risk\_dummy and ST \times (1 - Risk\_dummy), in which Risk\_dummy is a dummy variable, and the value of one represents high-risk firms. We consider four risk indicators: STOCKVOL-A50, ZSCORE-B50, DTD-B50, and INTCOVERAGE-B50. Results of the tests of the differences between coefficients on the interaction terms are presented in the row titled ΔCoef. We estimate models with firm- and loan-specific variables, firm and year fixed effects, and LIBOR. For saving places, we only report the results of our main explanatory variables. The p values are reported in parenthesis and obtained after considering clustered standard errors at firm level.

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<th>Risk dummy</th>
<th>STOCKVOL-A50</th>
<th>ZSCORE-B50</th>
<th>DTD-B50</th>
<th>INTCOVERAGE-B50</th>
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<td>ST \times Risk_dummy</td>
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<td>148.39 ***</td>
<td>168.71 ***</td>
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<tr>
<td>ST \times (1 - Risk_dummy)</td>
<td>81.09 ***</td>
<td>18.82</td>
<td>70.94 **</td>
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<td></td>
<td></td>
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<tr>
<td>ΔCoef.</td>
<td>90.83 **</td>
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<td>194.64 ***</td>
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<tr>
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</table>

| CONSTANT | Yes | Yes | Yes | Yes |
| Firm variables | Yes | Yes | Yes | Yes |
| Loan variables | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes |
| Firm fixed effects | Yes | Yes | Yes | Yes |
| #of observations | 8,882 | 8,882 | 8,882 | 8,882 |
| R-squared | 0.46 | 0.46 | 0.46 | 0.46 |

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<th>STOCKVOL-A50</th>
<th>ZSCORE-B50</th>
<th>DTD-B50</th>
<th>INTCOVERAGE-B50</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT1AT \times Risk_dummy</td>
<td>163.1 ***</td>
<td>153.55 ***</td>
<td>139.31 ***</td>
<td>160.24 ***</td>
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<tr>
<td>LT1AT \times (1 - Risk_dummy)</td>
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<td>56.95</td>
<td>114.97 ***</td>
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<tr>
<td>ΔCoef.</td>
<td>67.48</td>
<td>96.6 *</td>
<td>24.34</td>
<td>152.93 **</td>
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| CONSTANT | Yes | Yes | Yes | Yes |
| Firm variables | Yes | Yes | Yes | Yes |
| Loan variables | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes |
| Firm fixed effects | Yes | Yes | Yes | Yes |
| #of observations | 8,882 | 8,882 | 8,882 | 8,882 |
| R-squared | 0.46 | 0.46 | 0.46 | 0.46 |

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<th>DTD-B50</th>
<th>INTCOVERAGE-B50</th>
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<td>27.51 ***</td>
<td>48.64 ***</td>
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<tr>
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<td>ΔCoef.</td>
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<td>15.72 *</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
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</tr>
<tr>
<td>Loan variables</td>
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<td>Yes</td>
<td>Yes</td>
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<td>Year fixed effects</td>
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**Table 7. The effect of short-maturity debt on loan spreads, dependent on growth opportunity for high- and low-risk firms**

This table presents the results of regressing loan spreads on short-debt ratios (ST, LT1AT, and STDEBT) conditional on growth opportunity and firm risk levels. The main interested variables are \( ST \times \text{High}_{\text{MTB}} \) and \( ST \times (1 - \text{High}_{\text{MTB}}) \). The \text{High}_{\text{MTB}} is the dummy variable, identifying firms as high-growth-opportunity firms when firms’ MTB values are greater than the median value of the variable for all firms in a given year. We consider four risk indicators: STOCKVOL-A50, ZSCORE-B50, DTD-B50, and INTCOVERAGE-B50. Results of the tests of the differences between coefficients on the interaction terms are presented in the row titled ΔCoef. We estimate models with firm- and loan-specific variables, firm and year fixed effects, and LIBOR. For saving places, we only report the results of our main explanatory variables. The \( p \) values are reported in parenthesis and obtained after considering clustered standard errors at firm level.

**Panel A: ST**

<table>
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<tr>
<th></th>
<th>STOCKVOL-A50</th>
<th>ZSCORE-B50</th>
<th>DTD-B50</th>
<th>INTCOVERAGE-B50</th>
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</thead>
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<tr>
<td></td>
<td>High Risk</td>
<td>Low Risk</td>
<td>High Risk</td>
<td>Low Risk</td>
</tr>
<tr>
<td>( ST \times \text{High}_{\text{MTB}} )</td>
<td>41.37</td>
<td>12.19</td>
<td>107.34 ***</td>
<td>38.79</td>
</tr>
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<td></td>
<td>(0.46)</td>
<td>(0.74)</td>
<td>(0.00)</td>
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<td>( ST \times (1 - \text{High}_{\text{MTB}}) )</td>
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<td>−6.98</td>
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<td>64.06</td>
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<td>(0.19)</td>
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<td>−124.28 **</td>
<td>−25.27</td>
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<td>(0.62)</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Loan variables</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Year fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
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<td>4,436</td>
<td>4,487</td>
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<td>0.39</td>
<td>0.44</td>
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**Panel B: LT1AT**

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<td></td>
<td>High Risk</td>
<td>Low Risk</td>
<td>High Risk</td>
<td>Low Risk</td>
</tr>
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<td>( LT1AT \times \text{High}_{\text{MTB}} )</td>
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<td>48.14</td>
<td>47.92</td>
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<td>(0.32)</td>
<td>(0.17)</td>
<td>(0.08)</td>
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<tr>
<td>$LT1AT \times (1-High_{MTB})$</td>
<td>257.80</td>
<td>55.39</td>
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<td></td>
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<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Loan variables</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Year fixed effects</td>
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<td>Firm fixed effects</td>
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<td>0.44</td>
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## Panel C: STDEBT

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<th>DTD-B50</th>
<th></th>
<th>INTOVERAGE-B50</th>
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<td>Low Risk</td>
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<td>STDEBT × High_MTB</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
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<tr>
<td></td>
<td>12.71</td>
<td>10.15</td>
<td>53.98</td>
<td>2.31</td>
<td>2.88</td>
<td>8.93</td>
<td>9.17</td>
<td>7.34</td>
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<td>(0.19)</td>
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<td>(0.71)</td>
<td>(0.85)</td>
<td>(0.15)</td>
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<td>STDEBT × (1–High_MTB)</td>
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<td>(0.01)</td>
<td>(0.34)</td>
<td>(0.01)</td>
<td>(0.81)</td>
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<td>0.19</td>
<td>−39.34 **</td>
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<td>−36.33 *</td>
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<td>(0.02)</td>
<td>(0.99)</td>
<td>(0.06)</td>
<td>(0.35)</td>
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|                      |              |          |            |          |         |          |                |          |
| CONSTANT             | Yes          | Yes      | Yes        | Yes      | Yes     | Yes      | Yes            | Yes      |
| Firm variables       | Yes          | Yes      | Yes        | Yes      | Yes     | Yes      | Yes            | Yes      |
| Loan variables       | Yes          | Yes      | Yes        | Yes      | Yes     | Yes      | Yes            | Yes      |
| Year fixed effects   | Yes          | Yes      | Yes        | Yes      | Yes     | Yes      | Yes            | Yes      |
| Firm fixed effects   | Yes          | Yes      | Yes        | Yes      | Yes     | Yes      | Yes            | Yes      |
| # of observations    | 4,399        | 4,483    | 4,303      | 4,579    | 4,446   | 4,436    | 4,395          | 4,487    |
| R-squared            | 0.37         | 0.47     | 0.4        | 0.44     | 0.34    | 0.47     | 0.42           | 0.43     |
Table 8 Bank dependence
This table presents regression results of the Capital IQ-based sample. The sample period is from 2002 to 2014 and the sample size is 3,557 for unrated firms and 3,669 for speculative-grade firms at loan level. We create a dummy variable of Bank_Dep that equals to 1 if the firm's ratio of bank debt to total asset exceeds the median value of the ratio, otherwise it equals to 0. This dummy variable is annually updated. We examine unrated firms in Columns 1–3 and speculative-grade firms in Columns 4–6. Results of the tests of the differences between coefficients on the interaction terms are presented in the row titled ΔCoef.

<table>
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<th>Unrated firms</th>
<th>Unrated firms</th>
<th>Unrated firms</th>
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<th>Speculative-grade firms</th>
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<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>ST × Bank_Dep</td>
<td>293.31 ***</td>
<td>125.97 *</td>
<td>117.42</td>
<td>239.76 ***</td>
<td>249.20 **</td>
<td>78.82 **</td>
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<tr>
<td></td>
<td>(0.00)</td>
<td>(0.05)</td>
<td>(0.41)</td>
<td>(0.01)</td>
<td>(0.05)</td>
<td>(0.03)</td>
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<tr>
<td>ST × (1–Bank_Dep)</td>
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<td>213.40</td>
<td>239.76 ***</td>
<td>249.20 **</td>
<td>78.82 **</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.09)</td>
<td>(0.14)</td>
<td>(0.01)</td>
<td>(0.05)</td>
<td>(0.03)</td>
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<tr>
<td>LTIAT × Bank_Dep</td>
<td>300.06 ***</td>
<td>53.98 ***</td>
<td>49.78 ***</td>
<td>239.76 ***</td>
<td>249.20 **</td>
<td>78.82 **</td>
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<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.05)</td>
<td>(0.03)</td>
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<tr>
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<td>–21.35</td>
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<tr>
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<td>53.98 ***</td>
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<td>239.76 ***</td>
<td>249.20 **</td>
<td>78.82 **</td>
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<td>(0.01)</td>
<td>(0.05)</td>
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<td>239.76 ***</td>
<td>249.20 **</td>
<td>78.82 **</td>
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<td>(0.01)</td>
<td>(0.01)</td>
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<td>Yes</td>
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<td>Yes</td>
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<td>0.44</td>
<td>0.45</td>
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Table 9 All-in-undrawn spreads and credit lines

This table presents the benchmark regression results using all-in-undrawn spreads as the dependent variable, instead of all-in-drawn spreads, which is used in the main analysis (Panel A). The all-in-undrawn spreads refers to the undrawn fees and includes both commitment and annual fees that the borrower must pay to the bank for funds committed for the credit line but not taken down. This table also presents regression results that examine whether the effect of short-maturity debt variables on loan spreads is more pronounced on credit lines (Panel B). The \textit{CREDITLINE} is a dummy variable, which is 1 when the loan type belongs to credit line, and otherwise is 0. Results of the tests of the differences between coefficients on the interaction terms are presented in the row titled \textit{ΔCoef}.

Panel A: All-in-undrawn spreads

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<td>(0.01)</td>
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<td></td>
</tr>
<tr>
<td>\textit{STDEBT}</td>
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<td></td>
<td></td>
</tr>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm variables</td>
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<td>Yes</td>
</tr>
<tr>
<td>Loan variables</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Year fixed effects</td>
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<td>Yes</td>
<td>Yes</td>
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Panel B: Credit lines

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<td>\textit{ST} × \textit{CREDITLINE}</td>
<td>153.76 ***</td>
<td>180.62 ***</td>
<td>21.34 ***</td>
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<td></td>
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<td>(0.00)</td>
<td>(0.00)</td>
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<td>\textit{ST} × (1−\textit{CREDITLINE})</td>
<td>99.85 **</td>
<td>54.2</td>
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<td>\textit{LT1AT} × (1−\textit{CREDITLINE})</td>
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<td>\textit{STDEBT} × \textit{CREDITLINE}</td>
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<td>\textit{STDEBT} × (1−\textit{CREDITLINE})</td>
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Table 10. SEM model: Consolidated sample (firm-year sample)
This table presents the results of the SEM which includes the loan spread, debt maturity, and leverage equations (Eqs. 3, 4, and 5, respectively). The two-equation SEM includes the loan spread and short-maturity debt equations. The three-equation SEM includes all three equations. The model is applied on the consolidated sample (firm-year sample). We estimate the SEM by the GMM, using the exogenous variables as instruments in the moment conditions. The GMM estimation method ensures that the standard errors of the estimates are heteroskedasticity and autocorrelation consistent. Panels A, B, and C present results in terms of using ST, LTIAT, and STDEBT respectively.

Panel A: ST

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<td>-0.8583 ***</td>
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<td>-0.1485 ***</td>
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<td>(0.11)</td>
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<td>0.0347 **</td>
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<td>(0.77)</td>
<td>-0.0001</td>
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<td>FIXED_ASSET</td>
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<td>(0.00)</td>
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<tr>
<td>Industry fixed effects</td>
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<td>Yes</td>
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## Panel B: \( LT1AT \)

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<td>Spread</td>
<td>( LT1AT )</td>
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</tr>
<tr>
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<td>0.0005 ***</td>
<td>(0.00)</td>
<td>0.0009 ***</td>
<td>(0.00)</td>
<td>0.0058 ***</td>
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<td>( LT1AT )</td>
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<td>(0.00)</td>
<td>256.7646 ***</td>
<td>(0.00)</td>
<td>-1.2920 ***</td>
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<td>(0.00) –(0.05)</td>
<td>141.5287 *** –0.1039 ***</td>
<td>(0.00) –(0.00)</td>
<td>(0.00)</td>
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<td>(0.23)</td>
<td>0.0002</td>
<td>(0.12)</td>
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</tr>
<tr>
<td>Log age</td>
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<td>–1.8894 ***</td>
<td>(0.00)</td>
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</tr>
<tr>
<td>Log sales</td>
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<td>(0.00) (0.13)</td>
<td>–22.3523 *** 0.0370 ***</td>
<td>(0.00) (0.00)</td>
<td>0.1341 ***</td>
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<td>(0.87)</td>
<td>–0.0015 *</td>
<td>(0.07)</td>
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</tr>
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<td>FIXED_ASSET</td>
<td>0.0870 ***</td>
<td>(0.00)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTB</td>
<td>–9.8741 *** 0.0043 ***</td>
<td>(0.00) (0.00)</td>
<td>–11.0333 *** 0.0101 ***</td>
<td>(0.00) (0.00)</td>
<td>0.0644</td>
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<td>Profit margin</td>
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<td>(0.04)</td>
<td>–15.8295 ***</td>
<td>(0.00)</td>
<td>0.0887 ***</td>
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<td>Interest coverage</td>
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<td>(0.00)</td>
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<tr>
<td>R&amp;D</td>
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<td>–3.8266 *</td>
<td>(0.08)</td>
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<td>18.9746 ***</td>
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<td>(0.00) (0.00)</td>
<td>–0.7365 ***</td>
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<td>(0.00) (0.00)</td>
<td>–13.8846 *** 0.0158 ***</td>
<td>(0.00) (0.00)</td>
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<td>–1.0346 *** 0.0128</td>
<td>(0.00) (0.10)</td>
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<td>Yes</td>
<td>Yes</td>
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<td></td>
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<tr>
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<td>---------------------</td>
<td>-----------------------</td>
<td>----------</td>
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<td>0.0068 ***</td>
<td>0.0050 ***</td>
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<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
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<tr>
<td><strong>STDEBT</strong></td>
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<td>65.0958 ***</td>
<td>-0.3804 ***</td>
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<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.00)</td>
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<td>162.2282 ***</td>
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<td>0.0010 ** (0.04)</td>
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<td><strong>MTB</strong></td>
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<td>-12.3470 ***</td>
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<td><strong>Profit margin</strong></td>
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<td>-10.1204 *** 0.0783 ***</td>
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<td></td>
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<td>(0.00)</td>
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<tr>
<td><strong>Industry fixed effects</strong></td>
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<td>Yes</td>
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</table>
Table 11 Alternative model specification

This table presents regression results for the baseline model with alternative model specification. Columns 1–3 present results of Pool-OLS regressions with standard errors adjusted for heteroskedasticity and within firm clustering, and include industry fixed effects. Columns 4–6 present the results of the random fixed effect model, in which we include industry dummies and clustered standard errors at firm level. The industry fixed effects are captured using single-digit SIC industry dummies.

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<td>Loan variables</td>
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<td>Yes</td>
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<tr>
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<tr>
<td>R-squared</td>
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<td>0.5</td>
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</table>


Table 12 Largest loan facility and consolidated samples

This table presents the regression results for the subsample comprising only the largest facility on a given loan deal with the sample size of 6,603 (Columns 1–2). This table also presents the firm-level regression results for the consolidated sample, which is constructed by taking the weighted average of loan spreads for a given year in a given firm, thereby rendering the sample as firm-year observations. The consolidated sample comprises 5,946 firm-year observations. The results are reported in Columns 3–4. The industry fixed effects are captured using single-digit SIC industry dummies.

Panel A: ST

<table>
<thead>
<tr>
<th></th>
<th>Largest facility</th>
<th>Largest facility</th>
<th>Consolidated sample</th>
<th>Consolidated sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>ST</td>
<td>117.33 ***</td>
<td>140.12 ***</td>
<td>0.00</td>
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</tr>
<tr>
<td>ST × High_MTB</td>
<td>28.12</td>
<td>56.26 *</td>
<td>(0.38)</td>
<td>(0.09)</td>
</tr>
<tr>
<td>ST × (1–High_MTB)</td>
<td>180.55 ***</td>
<td>197.83 ***</td>
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</tr>
<tr>
<td>ΔCoef.</td>
<td>‒152.43 ***</td>
<td>‒141.57 ***</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm variables</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Loan variables</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Year fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Firm fixed effects</td>
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<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>#of observations</td>
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<td>5,940</td>
<td>5,946</td>
<td>5,946</td>
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<tr>
<td>R-squared</td>
<td>0.48</td>
<td>0.48</td>
<td>0.39</td>
<td>0.39</td>
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Panel B: LT1AT

<table>
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<th>Consolidated sample</th>
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<td>(3)</td>
<td>(4)</td>
</tr>
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<td>LT1AT</td>
<td>119.26 ***</td>
<td>148.74 ***</td>
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<tr>
<td>LT1AT × High_MTB</td>
<td>‒22.98</td>
<td>‒1.84</td>
<td>(0.52)</td>
<td>(0.96)</td>
</tr>
<tr>
<td>LT1AT × (1–High_MTB)</td>
<td>212.20 ***</td>
<td>241.48 ***</td>
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</tr>
<tr>
<td>ΔCoef.</td>
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<td>‒243.32 ***</td>
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<tr>
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<tr>
<td>Loan variables</td>
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<tr>
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<tr>
<td>Firm fixed effects</td>
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<td>Yes</td>
<td>No</td>
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<tr>
<td>#of observations</td>
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<td>5,940</td>
<td>5,946</td>
<td>5,946</td>
</tr>
<tr>
<td>R-squared</td>
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<td>0.48</td>
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### Panel C: STDEBT

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</thead>
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<td>STDEBT</td>
<td>14.19 ***</td>
<td>20.53 ***</td>
<td>10.52</td>
<td>32.02 ***</td>
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<td>(0.11)</td>
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<td>10.52</td>
<td>27.29 ***</td>
<td>32.02 ***</td>
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<td>(0.11)</td>
<td>(0.64)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>STDEBT × (1‒High_MTB)</td>
<td>27.29 ***</td>
<td>32.02 ***</td>
<td>0.00</td>
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</tr>
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<td>(0.00)</td>
<td>0.00</td>
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<td>ΔCoef.</td>
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<td>R-squared</td>
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<td>0.49</td>
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</table>
Fig. 1. Syndicated loans in the U.S. market during 1990–2014
The all-in-drawn spreads, indicated by the solid line scaled toward the left on the Y axis, and the total number of loans, indicated by the dotted line scaled toward the right on the Y axis, for the U.S. syndicated loan market from 1990 to 2014.

Fig. 2. Distribution of bank debt to total assets ratio
This figure presents the distribution of the ratio of bank debt to asset based on the Capital IQ dataset. The sample period is from 2002 to 2014. The sample contains 3,949, 4,183, and 2,330 loan-level observations for unrated, speculative-grade, and investment grade firms, respectively. The black line represents the distribution for the unrated subsample; the gray line represents the distribution for the speculative-grade subsample; and the dotted line represents the distribution for the investment-grade subsample.