Debt Maturity and Cost of Bank Loans

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Abstract

We examine the extent to which a firm's debt maturity structure affects borrowing costs from banks. We study syndicated loans from 1990 to 2014 in U.S. market, and show that a firm's short-maturity debt structure is an important determinant of loan spreads after accounting for many firm-specific, loan-specific variables, firm fixed effects, and year fixed effects. One standard-deviation increase of the ratio of short-term debts to total asset values leads to an increase by 5.66% of the mean loan spreads, about $0.643 million of total interest expenses per loan facility. The finding conforms to rollover risk mechanism through which credit risk amplified due to refinancing risk. We also show that high-growth firms pay much lower loan spreads than low-growth firms when firms' debt spectrum becomes shorter, consistent with the asset substitution theory that short-term debts help reduce loan spreads especially for firms with more incentives taking risky investments.

Keywords: Bank loan; All-in-drawn spread; Debt maturity; Rollover risk; Asset substitution
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1. Introduction

The simple debt-equity choice cannot fully picture a firm's capital structure. The debt maturity is one particular attribute of the debt structure that has been received much attention, ever since Myers (1977) suggests that debt maturity is important to be chosen to reduce underinvestment problems. Unlike previous works focusing on investments, we study debt financing costs, and specifically examine the extent to which a firm's debt maturity structure affects the perspective of banks on charging loan interest rates from borrowers.

The theory highlights the rollover risk mechanism through which short-term debts amplifies credit risk (see He and Xiong, 2012), and if creditors understand this rollover risk effect and price it, they would require higher risk premium for borrowers with more short-term debts. Our results strongly support this theoretical prediction. On the other hand, the asset substitution theory suggests that high-growth firms use short-term debts to mitigate the incentives of such firms in shifting investments toward risky assets (see e.g., Billett, King, and Mauer, 2007). Therefore, other things equal, two firms with similar debt maturity structures, the one with more growth opportunities pay less because of the mitigation effect of asset substitution, but the one with few growth opportunities pay more interests driven by the rollover risk hypothesis. We find strong evidence in supportive of these theoretical predictions.

We study the syndicated loans granted in the U.S. market from 1990 to 2014. Our large panel loan-level sample contains 9,941 loan facilities from 2,754 unique firms. The evidence conforms to our rollover risk hypothesis that short-maturity debt structure increases the cost of bank debt financing, and this impact is economically and statistically significant. A one-standard-deviation increases in short-debt-to-total asset ratio on average increases loan spreads[1] by 11.44 basis points, about 5.66% of

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[1] In line with the literature, we use the all-in-drawn spreads to capture the overall cost of loan.

the average loan spreads, even after we control for a large number of firm-specific variables, loan-specific characteristics, firm fixed effects, and year fixed effects.[2]

We next examine the asset substitution hypothesis that short-term debts helps lower the cost of bank loans for firms that likely to engage in risk-shifting (i.e., high-growth firms). We find strong evidence supporting this prediction. For a high-growth firm, a one-standard-deviation increase in the short-debt ratio leads to an increase in loan spreads of about 1.87% of the sample mean, whereas for a low-growth firm, the same rise in the same ratio indicates a much larger increase in loan spreads by 8.75%.

We alternatively use the short-maturity debt proxy measuring by the ratio of *long-term debt* maturing in next year to total assets; the results are still consistent with our central hypothesis Because the long-term debt payable during this year is decided in the past, and is mechanically less exposed to the endogenous concern that a firm's unobserved risk factors and short-term debts might be simultaneously determined (see the argument in Almeida *et al*., 2012). Our findings also continue to exist if we use the ratio of short-term debts to total debts to proxy for the short-maturity debt.

In addition, we investigate our central hypotheses by taking into account the influence of the level of a firm risk. He and Xiong's (2012) model predicts that riskier firms likely incur larger credit risk than less risky firms even when both firms have similar shorter debt structures. If our results indeed derive from our rollover risk hypotheses, then they should be more pronounced among risker borrowers. Furthermore, because riskier borrowers have even more incentives to take on higher risk by substituting less risky asset with more risky asset. The risky firms more

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[2] Our sample is drawn from the Loan Pricing Corporation's Dealscan database. Since this database focuses on large loans and large firms presumably suffer less rollover risk than smaller ones, use of this database should bias against finding evidence of such monopolistic loan pricing behavior.

likely pursue shorter debts in mitigating this risk-seeking behavior, and thus our substitution asset hypothesis should be more pronounced in the case of high risky firms compared with the case of low risky firms. Overall, our firm risk analysis concurs with these views and our central hypotheses are further supported.

Importantly, our findings are robust to a bunch of robustness tests. In our story, banks' ability to pass their costs onto borrowers (i.e., supply-side pressure) is the essential driving force, implying that the link predicted in our key hypotheses should be more pronounced among borrowers that depend on banks for funding. Furthermore, if the short-maturity debt structure plays a role in the price banks charge corporations for future increased credit risk, then this effect should be more pronounced among firms that borrow credit lines than other types of loans. We indeed find that the increase of loan spreads due to an increase of short-term debts, is larger among borrowers that are dependent on the banks, and borrowers that take credit lines.

We also find that shorter debts have an amplification effect not only on the price of credit to corporations (i.e., all-in-drawn spreads), but also on the price corporations pay to guarantee access to liquidity (i.e., all-in-undrawn fees). Our findings also continue to exist under a variety of alternative model specifications and estimation methods.[3] More robustness test is to deal with the concern that each observation in our baseline regression represents a single loan facility but a deal

[3] In our main analysis, we use panel data model with firm fixed effects and year fixed effects, and take clustered standard errors at firm level to adjust estimation bias. The literature suggests that this methodology is preferable to other methods, because it allows us to reduce endogenous problem. For robustness, we consider two different model specification: (1) the ordinary least squares regressions with standard errors adjusted for heteroskedasticity and within firm clustering; and (2) include industry fixed effect, and random fixed effect model, in which we include industry dummies, and clustered standard errors at firm level.

package can contain multiple loan facilities, and these loan facilities might simply reflect the deal level negotiation (i.e., they are not completely independent observations). Treating these loans as independent facilities could bias toward to inflate the statistical significant of our results. To address this possibility, we re-examine our main analysis on the sample that contains only the largest facility, on the consolidated sample (firm-year observation). The results clearly indicate that the deal-level bias does not affect our inferences.

In our study, the major concern related to endogeneity problem is that our benchmark debt maturity measure (the short-debt-to-total-asset ratio) may be simultaneously determined with bank loan costs. We have to emphasize that relative to other studies, this simultaneity issue is minimized in our tests, because loan spreads are set by the firms' creditors under competitive forces in the market. One of our used debt proxies that measures the proportion of long-term maturing within one year to total asset, has been adopted in rollover risk literature because this measure generate results less subject to endogenous concern. Nevertheless, we also use a system of simultaneous equation model to address the endogenous concern that short-maturity proportion, loan spreads, and leverage might be simultaneously determined. Our evidence on the simultaneous equation model suggests that short-maturity debt ratios are still positively associated with loan spreads, reinforcing our conclusion that banks perceive refinancing risk channel.

Our study makes several contributions to the literature. Our primary contribution is to provide new insights into the loan pricing literature by showing that a firm's short-term debt is an important determinant of bank loan contract terms on spreads. With this regard, we also complement to recent empirics that document the amplification mechanism of rollover risk on debt financing costs. The extant findings are restricted to public debt markets (Chen, Xu, and Yang, 2012; Gopalan *et al*., 2014; Valenzuela, 2015); to the best of knowledge, we are the first empirical work in supportive of this mechanism in the context of private credit agreements, and specifically in syndicated loan market.

Furthermore, unlike prior studies that examine the impact of short-term debts on mitigating the debt overhang problem for high growth firms (e.g., Johnson, 2003), we focus on bankers' evaluation of corporate debt maturity, and complements this research strand by showing that banks recognize firms of using short-term debt to mitigate asset substitution problems, and accordingly charge lower interest rates. All together, we argue that there is a trade-off effect for high growth firms to choose debt maturity structure.

Last but not least, we contribute to the literature that study the determination of the loan duration on spreads (see Dennis, Nandy, and Sharpe, 2000) by providing new evidence that a firm's overall debt maturity structure is more informative to predict loan spreads than duration of loan contracts. The result implies that absent contracting mechanisms, rational creditors anticipate conflicts between debtholder and shareholder in times of refinancing debts, and require a higher cost of bank financing.[4]

The remainder of the paper proceeds as follows. The next section presents theoretical arguments on how a firm's debt maturity structure could affect the cost of debt. Section 3 describes the data and variables. Section 4 provides and interprets our empirical results on the interplay between debt maturity and loan spreads. Section 5 presents robustness testing results and deals with endogenous problem. Section 6 concludes.

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[4] We depart from earlier studies by examining the maturity of all liabilities on a firm's balance sheet rather than the maturity of incremental debt issues. The weakness of the incremental approach is that it provides noisy tests of agency theories of maturity choice (which is the key theory in this study) that depend largely on slowly changing characteristics such as asset lives and the investment opportunity set.

2. Theoretical Background and Hypotheses

The purpose of this study is to examine whether and how a firm's debt maturity structure affects the perspective of banks on charging interests when a firm borrows from them. Theory establishes the linkage between the debt maturity structure and bank loan pricing on the channel of rolling over debts through which a firm's default risk changes in a way that is not reflected on observed credit risk indicators. On the other hand, the asset substitution theory suggests that short-maturity debt is beneficial to reduce firms' risk-seeking behaviors, and banks should charge lower interests on borrowers. We discuss these theories and propose our hypotheses in this section.

2.1 Rollover Risk Theory

He and Xiong (2012) argue that rollover risk could be a source of credit risk, because it sharpens conflicts of interest between shareholders and debtholders in which shareholders bear refinancing costs, making equity holders declare the firm insolvent even when the value of the assets of the firm is higher than it would be in the standard insolvency situation. Gopalan *et al*. (2014) provide empirical evidence that firms with greater exposure to rollover risk have been downgraded more than other firms with similar risk characteristics, and Chiu, Peña, and Wang (2015) find that the rollover risk exposure increases firms expected default probabilities.

One empirical implication in line with this theory is that, if creditors recognize the fact that rollover risk deteriorates the borrower's credit worthiness and they would require higher risk premium by more than justified on borrower default risk alone. Recent empirical studies provide supports on this presumption by looking at credit default swaps (Chen *et al*., 2012), and corporate bonds (Gopalan *et al*., 2014; Valenzuela, 2015).

Thus far, the related studies are restricted to *public debt* markets, and yet we argue that the rollover channel through which creditors require larger premium on lending to firms should also appear in *private debt* markets. Because private debts are usually settled at shorter maturity than public traded debts, the rollover risk effect is expected to be more significant in private debt markets. Furthermore, the majority of private debts belong to syndicated bank loan; it motivates us to focus on the impact of debt maturity on bank loan spreads.

A firm with shorter debt maturity profile has a higher likelihood of refinancing debts, making the firm more exposed to rollover risk, reinforcing the interdependence between rollover risk and credit risk, which eventually leads higher level of credit risk. If banks perceive this rollover risk channel, and recognize it in pricing loans, we would observe higher interest rates charged on firms with shorter debt structure than otherwise similar firms with longer debt structure. Our first hypothesis follows directly from the above theoretical prediction:

Hypothesis 1. Firms with shorter debt maturity structure pay greater premium when obtaining bank loans.

2.2 Asset Substitution Theory

Contracting to rollover risk theory, the asset substitution theory suggests that firms with more short-term debts could reduce costs of bank loans. Jensen and Meckling (1976) argue that shareholders may benefit owing to more investments on risky projects, because their payoffs become larger as a firm's volatility increases. On the contrary, debtholders may harm, because they require only a fixed income, while the company increases its chance of defaulting on debts. Therefore, shareholders have incentives to exploit bondholder wealth by replacing less risky investment with riskier investments, and this asset substitution behavior leads to more risk incurred by firms.

One solution of restricting firms' asset substitution behavior is to use short-term debts. The more short-term debts the more frequency of renegotiation between shareholders and debtholders; debtholders more often monitor investment projects (Jensen and Mechling, 1976). There is substantial evidence that banks demand higher loan spreads in anticipation of potential risks they face in debt contracting (Bharath, Sunder, and Sunder, 2008; Graham, Li, and Qiu, 2008; Hasan, Hoi, Wu, and Zhang, 2014). If bankers understand the channel of shorter debts restraining managerial risk-seeking incentives and rationally price loans based on this recognition, banks would charge lower interests on firms with more short-maturity debts.

However, finance theory also suggests that the latitude in shifting investments toward risky assets does not manifest systematically across all firms, but specifically on firms with more growth options (see Johnson, 2003; Billett *et al*., 2007; and Eisdorfer, 2008). Therefore, the mitigation effect of short-term debts on loan costs likely only exists for high-growth firms. Accordingly, we hypothesize that,

Hypothesis 2. High-growth firms pay lower interests on borrowing from banks than low-growth firms given a similar level of short-term debts.

3. Data and Variables

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

3.1 Sample Construction

We study the syndicated loan market in U.S. from 1990 to 2014. We collect bank loan information from Dealscan LPC database.[5] We perform a data selection filter as shown in the following. First, we exclude financial firms (standard industrial classification [SIC] codes 6000–6999), utilities (SIC codes 4900–4999), and quasi-public firms (SIC codes over 8999), whose capital structure decisions can be subject to regulation. We exclude privately held firms from our sample, because we need accounting and equity information to measure debt maturity and control variables. To construct our sample, we merge Dealscan LPC database with COMPUSTAT and CRSP databases by using the conversion table provided by Chava and Roberts (2008). This generates loan-day dataset.

Regarding to the costs of bank loans, we follow literature to use all-in-drawn spreads (*Spread*) as the overall cost of loan, which is obtained from Dealscan LPC database (e.g. Santos, 2011). We remove observations with missing value of *Spread*, and with missing value of short-term debt or long-term debts maturing within one year (because both variables are used to construct our short-maturity debt variables). We also remove observations with missing value of control firm-specific and loan-specific variables.

In addition, we exclude firms with ratings in our main analysis, because rated firms are able to access public debt markets, less dependent on bank borrowing, and thus their costs of taking bank loans should be less affected by rollover risk channel. However, there is also a possibility that rated firms finance mainly from banks. We carefully check the degree of bank debt dependence (by looking at ratio of bank debts to total asset) on rated firms and re-examine our central hypotheses on rated firms in the robustness section (detailed analysis refereed to Section 5.1.2).

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[5] 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.

To minimize the effects of outliers on the results, *Spread* and all variables are winsorized at the 1st and 99th percentiles (e.g., values exceeding the 99th percentile are set equal to the 99th percentile). Our final sample contains 9,941 loan facilities and 2,754 unique firms. Figure 1 plots *Spread* (solid line scaled in the left y-axis) as well as total number of loans (dotted line scaled in the right y-axis). The *Spread* exhibited a significant increase during 2007–09 financial crisis. The number of loans increased since 1992, but there was a big reduction during 2007–09 financial crisis. Both facts are consistent with the expectation.

[Insert Figure 1]

3.2 Variables

This section describes the main short-maturity debt variables and the control variables both at firm-level and loan-level.

3.2.1 Short-maturity debt variables

The purpose of this study is to investigate whether a firm's debt maturity structure is associated with borrowing costs from banks. Our hypotheses highlight the important role of short-term debts. As a result, we use the proportion of a firm's short-term debts to its total asset values (*ST*) to be our benchmark debt maturity measure.[6] The major concern of using *ST* is that the amount of short-term debts is likely simultaneously determined with bank loan costs, or may be unobserved risks, both could causing endogeneity problem.

With this drawback in minds, we also consider the ratio of long-term debt matured in one year to total asset (*LT1AT*) as the second benchmark short-maturity debt proxy. *LT1AT* is considered to especially suitable for testing the rollover risk

[6] Short-term debt comprises all current liabilities, i.e. loans, trade credits and other current liabilities, with maturities less than one year.

theory as suggested in recent papers (e.g., Almeida *et al*., 2012; Gopalan *et al*., 2014), because unlike short-term debts, long-term debt payable during this year is decided in the past, and thus less correlated with the firm's current risk characteristics.

Finally, instead of using "total asset value" as the denominator, we take the ratio of short-term debts to "total debts" as the third debt maturity proxy (*STDEBT*).

3.2.2 Control variables

We control for many firm- and the loan-specific variables identified by loan contracting literature to be important determinants of loan spreads (see e.g., Santos and Winton, 2008; Santos, 2011).

As for firm-specific control variables, we include *age* (Log age) and *size* (Log sales); both of them are expected to be negatively associated with loan spreads, because older firms are typically better established and larger firms are usually better diversified, and, therefore, less risky.

A set of variables serve as proxies for the risk of the firm's debt is also considered. The *leverage* is included because the higher level of debts indicates a greater chance of default, and it should have a positive effect on spreads. The *profit margin* indicates a firm's profitability, and more profitable firms have a greater cushion for servicing debt and thus should pay lower interests. The *interest coverage* indicates a firm's capability to pay interests, and thus a higher interest coverage ratio should make the firm's debt less risky, and then has negative impact on spreads.

The amount that debtholders would loss in the event of default has been regarded as important element on credit risk. To capture that risk, we control for the size and quality of the asset that debt holders can draw on in defaults. The *market-to-book* ratio acted as a proxy for the value that the firm gains from future grow is expected to be negatively related to spreads. The *tangibility* is expected to have a negative effect on spreads, because tangible assets lose less of their value in default than do intangible assets. On the contrary, the *R&D* and the *advertising* proxy for a firm's brand equity belonging to intangible assets, and is expected to be positively related to loan spreads. Furthermore, we include the *net working capital* to measure the liquid asset that is less likely to lose value in default, and so we expect it to have a negative effect on spreads.

In addition to accounting-based risk indicators, we further control for two market-based risk indicators. We include the *excess stock return* and the *stock volatility*. The former is expected to have negative impact on spreads because it is the indicator that a firm outperforms the market's required return, and should have more cushions against default, and thus, a lower spread. In contrast, the latter indicates higher volatility, which leads to a greater risk of default, so that we expect this variable to have a positive impact on spreads.

Finally, we include a forward-looking default risk indicator, the *distance-to-default* measured based on KMV approach.[7] The variable is widely used in literature as a proxy for the likelihood of a borrower's future default, and the higher value of this variable indicates that a firm is farer away from its default point, and we expect that this variable would be negatively related to the borrower's loan spread.

We control for many loan characteristics. It includes the *log loan size* and the *log loan duration*. The impacts of the two variables on the spreads are ambiguous. Larger loans may represent more credit risk, but they may also allow for economies of scale in processing and monitoring. Similarly, loan with longer maturities may face greater credits, but they are more likely to be granted to firms that are thought

[7] The detailed description of the KMV-Merton methodology is provided in Vassalou and Xing (2004).

to be creditworthy. We also include a set of dummy variables equal to one if the loan has restrictions on paying dividends, is senior, or is secured. Since the purpose of the loan may also affect its spreads, we include dummy variables to distinguish among loans that are corporate purposes, loans to repay existing debt, and working capital loans. In addition, we count for the type of the loan contract and distinguish between term loans, bridge loans, and lines of credit.[8]

Finally, in addition to variables suggested in Santos (2011), we further include the *logarithm number of lenders*. This variable is considered to be important in the literature (Santos and Winton, 2008) that is related to hold-up effect, and is expected to have negative impacts on spreads. The detailed descriptions of building our variables are provided in Appendix A.

3.3 Descriptive Statistics

We present the descriptive statistics in Table 1. The mean value of *ST* is 0.051, pointing to the fact that for an average unrated firm, the amount of short-term debt is 5.1% of its total assets. As can be expected, *LT1AT* is lower than *ST* with the mean value of 0.027, indicating that about a half of debts maturing in one year is due to long-term debts matured. Also, the mean value of *STDEBT* is about 0.25, indicating that on average a quarter of debt will mature in one year for an unrated firm.

[Insert Table 1 here]

Table 1 also reports summary statistics on loan characteristics. The average loan size is about $140.67 million, the average loan spread is 202 basis points over LIBOR, and the average loan duration is about 4 years. About 25.7% of the credit facilities in the sample are term loans, whereas the remainders are revolving and

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[8] Chava, Livdan, and Purnanandam (2008) suggest that the pricing of term loans can be very different from that of revolving loans, and thus we include dummy variables for each loan type.

other loans.

3.4 Correlation Matrix

Table 2 presents correlations among short-term debt variables, leverage, and the duration of new issuance loan. The positive correlations between short-term debt variables and loan spreads suggest that our rollover risk hypothesis is validated. Furthermore, we find much stronger correlations between *Spread* and our three short-maturity debt variables, ranging from 0.03 to 0.17, whereas the correlation between *Spread* with the logarithm loan duration is only 0.01. These preliminary results provide insights that balance-sheet debt maturity structure is a stronger determinant to bank borrowing costs compared with the incremental debt maturity. Although the impact of loan duration on loan spreads has been widely studied in the literature, based on the above stylized fact, it is worthwhile studying the impact balance-sheet debt maturity structure on borrowing costs from banks, other than incremental loan duration. Finally, the correlations between leverage and short-term debt variables are not high, suggesting that a firm's capital structure cannot entirely explain a firm's debt maturity structure, and we should dig deeper to understand to the extent to which the a firm's debt maturity structure affects its borrowing costs from banks.

[Insert Table 2]

4. Empirical Results

We present the results in four sections, focusing on (1) the univariate analysis of the relation between short-term debt ratios and loan spreads; (2) the results of testing the effect of rollover risk on loan spreads; (3) the test of the hypothesis that the short maturity structure is beneficial for high-growth firms to have lower borrowing costs from banks; (4) the extended tests related firms' risk conditions.

4.1 Univariate Analysis of Loan Spreads

Before presenting multivariate regression results, we provide preliminary results to examine the impact of short-maturity debts on the cost of bank loans by comparing the *Spread* across quartiles of short-maturity debt proxies (i.e., *ST, LT1AT,* and *STDEBT*). For every year, firms are classified into one of four groups, and we report the mean as well as the median value of *Spread* on each group in Table 3.

Based on the full sample, the *Spread* monotonically increases as *ST* increases from the lowest to the highest category. Simple mean (median) comparison between these two categories indicates 43 basis points (62 basis points) difference in spreads, which is about 19% (27%) of the sample average spread for firms in the highest *ST* category (see Column 1 of Panel A). We also find similar patterns in the case of using *LT1AT* and *STDBET* as short-maturity proxies (see Column 2 and 3 of Panel A).[9] These preliminary findings support our *Hypothesis 1* that banks charge larger interests for firms with more short-maturity debts.

As for the duration of new issuance loan, it is clear to observe a U-shape feature, in which firms pay lower interest rates when borrowing loans with intermediate

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[9] The debt maturity literature considers relatively longer debts ratios as 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 total debt) (see e.g., Datta, Iskandar-Datta, and Raman, 2005; Billett *et al*., 2007; Brockman, Xiumin, and Unlu, 2010). However, we should emphasize that short-term debts maturing within one year are more appropriate proxies in our study because we focus on "unrated firms", whereas three year (or longer) debt proxies are probably more suitable for "rated firms". The reason is that unrated firms use loans as the main financing sources, and the duration of loans are usually much shorter than corporate bonds. Nevertheless, we acknowledge that there is no perfect debt maturity proxy. Therefore, we also use *ST3*, *ST5*, and *MAT* (book-value weighted numerical estimate of debt maturity, and the detailed definition can be seen in Appendix) as complementary measures to our benchmark measures. We return to the analysis of Table 3 by using these alternative proxies. The results are generally consistent with our benchmark debt maturity proxies, but are weaker. It implies that our short-maturity proxies dominate these relatively longer so-called short-term debt proxies in our case. The results are not presented here, but can be found in our Online Appendix.

duration, whereas pay higher interests when borrowing loans with relatively short and long duration. This U-shape feature reflects the fact that the literatures suggest an ambiguous effect of loan duration on loan spreads as we mentioned in Section 3. [10] Importantly, these preliminary results clearly indicate that a firm's balance-sheet debt maturity structure and new issuance loan duration differently affect the costs of bank loans.

To gain insights on our *Hypothesis 2*, we perform similar analysis on low-growth firms (see Panel B) and high-growth firms (Panel C) separately. For low-growth firms, we continuously find a remarkable positive relationship between short-term debt ratios and loan spreads across all debt proxies. In contrast, for high-growth firms, this positive relation no longer exists in terms of *STDEBT*, and becomes weaker in terms of *ST*, judged by the differences of spreads (on means and medians) between the highest and lowest quartiles. This result indicates that short-term debts indeed help mitigate loan spreads for high-growth firms, but not for low-growth firms, consistent with the prediction of *Hypothesis 2*.

Overall, the univariate results on the relation between short-term debts and loan spreads strongly support our central hypotheses that firms with more short-term debts pay larger interests to banks, but short-term debts also reduce spreads because of the mitigation of asset substitution problems for high-growth firms.

[Insert Table 3]

4.2 Multivariate Analysis of Loan Spreads

Although univariate analysis is informative and offers supports to our hypotheses, many other factors could also affect the views that how much banks

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[10] This is also consistent with Diamond's (1991) argument that short-term debt exposes the firm to a liquidity risk if lenders will not allow refinancing and the firm is liquidated. Because of this liquidity risk, he argues that only the highest quality and lowest quality firms use short-term debt.

charge borrowers. For this reason, we provide multivariate analysis, in which we regress loan spreads on short-maturity debt proxies and control for many firm- and loan-specific variables that have been documented as important determinants of spreads in the literature.

4.2.1 Empirical methodology

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

$$\begin{aligned} Spread_{i,j,t,d} &= c + \beta \times ST_{i,t-1} + \mathbf{X}_{i,t-1} + \mathbf{Y}_{i,j,t,d} + LIBOR_d \\ &\quad + Firm\ Fixed\ Fffects + Time\ Fixed\ Effects + \varepsilon_{i,j,t,d} \end{aligned} \tag{1}$$

where *i*,*j*,*t*, and *d* denote the i^{th} firm and j^{th} loan for year *t* and day *d*. The *Spread* is the amount of loan interest payment in basis points over LIBOR (i.e., the all-in-drawn spread) for a loan facility *j* of firm *i* taken out at date *d* in year *t*, and *ST* is our main interested variable (the ratio of short-term debts to total asset value). The *ST* can be replaced by other two alternative short-term debt variables of *LT1AT* (the ratio of long-term debts maturing within one year) and *STDEBT* (the ratio of short-term debts to total debt). Consistent with *Hypothesis 1*, a firm with a shorter debt structure should be charged larger spreads, we expect $\beta>0$.

The **X** represents a vector of firm-level control variables and the **Y** represents a vector of contemporaneous loan-level control variables that are expected to affect the loan's spreads (as we have described in Section 3). All firm-level variables enter our models are determined at the fiscal-year-end before the firm arranges the loan contract. This scheme can make sure that the debt maturity structure and control variables are set up by a firm before loan take out. We follow Santos (2011) to include firm fixed effects, because loan spreads can vary across firms not captured by our controls. The loan spread is also likely to be affected by time fixed effects, in which some unobserved factors influence loan spreads systematically across many firms for a given time point. To further reduce this concern, all our models include year dummies. Coupled with the fact that the dependent variable is a spread over a floating rate, adding LIBOR variable is necessary to capture the effects of any intertemporal economic shocks (see Acharya *et al*., 2013).[11] Finally we estimate all models with clustered standard errors at firm level as suggested in Petersen (2009).

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

Table 4 presents the estimated coefficients. Since our main interested variable of *short-term debts*, firm-specific controls, and loan-specific controls can be determined jointly with loan spreads, we estimate models with or without control variables, but all models include firm fixed effects and year fixed effects. 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-level and firm-level, and this full model is our benchmark model in this paper.

We find that the estimates on our main interested variable of *ST* are positive and highly significant at 1% level across all models, with and/or without firm-level and loan-level control variables. These results indicate that firms with higher levels of short-maturity debts incur significantly larger bank loan costs after controlling for many loan pricing determinants, and thus provide strong evidence to support our *Hypothesis 1*.

[Insert Table 4]

[11] The data on LIBOR refer to the level of LIBOR in the month in which a firm initiates the loans.

Based on the estimate of our benchmark model of Model 4 and given that the average loan spread in our sample is 202 basis points, a one-standard-deviation increase in *ST* in the data leads to an additional increase of loan spreads by about 11.44 basis points, which is about 5.66% of the average *Spread*.[12] The loan size and the time to maturity in the sample, on average, are \$140.67 million and around 4 years as shown in Table 1, implying that a one-standard-deviation in *ST* increases total interest expenses per loan facility by \$0.643 million (0.528=140.67 × 0.001144 × 4). Therefore, the effect of *ST* on bank loan cost is economically meaningful.

As for other two short-term debt proxies, *LT1AT* and *STDEBT*, the estimated coefficients are both systematically positive and highly statistically significant (see Model 5–6). The impact of *LT1AT* and *STDEBT* on *Spreads* is also economically significant. A one-standard-deviation increase in *LT1AT* (*STDEBT*) in the data leads to an additional increase of loan spreads by about 6.32 (4.41) basis points.[13] Taken together, our results strongly suggest that unrated firms with higher level of short debts pay much higher spreads on borrowing from banks.

When we compare the economic impacts from our results with extant literature, our estimates of *ST* with 11.44 basis points is much better than results presented in prior studies. For example, Bharath, Sunder, and Sunder (2008), Francis, Hasan,

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[12] The detailed calculation is as follows. Given that the standard deviation of *ST* with 0.086 (see the summary statistics in Table 1) and the estimated coefficient of *ST* in the Model 4 of Table 4 with 133, a one-standard-deviation increase in *ST* leads to an increase of *Spread* by 0.086 × 133 =11.44 basis points. Since the mean value of *Spread* is 202 basis points (see Table 1), the percentage increase is 11.44/202 = 5.66%.

[13] We also re-examine 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* show very significant and predicted signs. The detailed results are presented in Table OA2 in Online Appendix.

Koetter, and Wu (2012), and Hasan *et al*. (2014, 2016) find that a one-standard-deviation increase in accounting quality, board independence, cash effective tax rate, social capital in their respective samples reduces bank loan spread by 6.65, 5.50, and 4.87 basis points, and 4.33 basis points, respectively. In terms of *LT1AT* (6.32 basis points) and *STDEBT* (4.41 basis points) are consistent with those reported in prior works.

With regard to firm controls, market-based and forward-looking variables (i.e., the stock volatility, the excess stock return, and the distance-to-default) we use attract expected coefficients and highly significant. That is, firms with higher volatility on stock returns essentially have greater risk of defaults, and pay greater spreads; in contrast, firms that perform better than markets and their asset values are larger than default barriers pay lower spreads. For many of other borrower-specific controls, results resemble those as shown in Santos (2011). For example, firms those are larger, less levered, more profitable and have more growth opportunities pay significantly lower spreads. With some surprises, firms' age and net working capital ratios are positively related to spreads in some models. We check Pearson correlations on these variables with *Spread*, the correlations present consistent signs as we expect to see.[14] This seemingly bizarre result should not cause any major concern. The *LIBOR* is negatively associated with spreads, which is consistent with Acharya *et al*. (2013).

The coefficients on loan characteristics (e.g., loan amount, loan type, purpose dummies, and number of leaders) are largely significant. We discuss the estimation results on the loan duration variable in more detailed here, for two reasons. First, the duration of new loans, in nature, contributes to a firm's debt maturity profile. Second,

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[14] In the study of Santos (2011), his results on *log age* variable also present a positive sign in the full model.

the loan contracting literature widely accepts that loan duration as an important determinant on loan spreads, but its impact is ambiguous.[15] We review several key works on the determinant of loan duration on loan spreads with a summarized table provided in Appendix B. We find that the estimated coefficient of *log loan duration* is not significant in any model, suggesting that a firm's overall debt maturity is more informative than incremental debt maturity (i.e., loan duration), in terms of explaining loan spreads.

Overall, we find strong evidence in supportive of *Hypothesis 1* that the rollover risk channel through which banks charge larger interest rates on firms whose debt maturity profile is shorter.

4.2.3 The effect of short-term debts on loan spreads conditional on growth opportunities

To shed light on the importance of asset substitution theory in shaping the relation between a shorter debt structure and loan spreads, we return regression analysis to examine whether the effect of rollover risk on spreads varies systematically with different growth opportunity levels. We hypothesize that if the mitigation effect of asset substitution is valid, the net effect of short-term debts on spreads should *not* play an important role in the decisions of banks charge on loan contracts for *high-growth* firms. On the contrary, the amplification effect of short-term debts on spreads should be more pronounced for *low-growth* firms than for high-growth firms.

To test this prediction, we use market-to-book ratio (*MTB*) to be the proxy of a

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[15] On the one hand, loans with longer durations may face greater credit risk, and banks charge higher spreads. On the other hand, banks may grant loans to firms that are thought to be creditworthy, or high-risk borrowers are just crowed out of the long debt market, which leads to a negative relationship (e.g., Santos, 2011; Goss and Roberts, 2011).

firm's growth options conforming to the literature. We create a dummy variable, *High_MTB*, identifying firms that belong to high growth opportunity firms when firms' *MTB* values are above the median value of *MTB* among all firms in a given year. We modify our baseline model in Equation (1) to test *Hypothesis 2*, in which we replace $ST_{i,t\text{-}1}$ with $ST_{i,t\text{-}1} \times High\_MTB$ and $ST_{i,t\text{-}1} \times (1 - High\_MTB)$. These interactions make the effect of short-term debts on loan spreads conditional on a firm's growth opportunities. The model is presented in the following,

$$\begin{aligned} Spread_{i,j,t,d} = {} & c + \beta_1 \times (ST_{i,t-1} \times High\_MTB) + \beta_2 \times (ST_{i,t-1} \times (1 - High\_MTB)) \\ & + \mathbf{X}_{i,t-1} + \mathbf{Y}_{i,j,t,d} + LIBOR_d \\ & + Firm\ Fixed\ Fffects + Time\ Fixed\ Effects + \varepsilon_{i,j,t,d} \end{aligned} \tag{2}$$

To be consistent with *Hypothesis 2*, the β_1 is expected to be nonsignificant, because for *high-growth* firms, the net effect of short-maturity debts on loan spreads will be determined empirically by the perception of banks on the amplification effect through which rollover risk increases spreads and the reduction effect through which the mitigation of asset substitution problems decreases spreads. Conversely, the β_2 is expected to be significantly positive as predicted in *Hypothesis 1*, mainly affected through rollover risk channel, because *low-growth* firms have no incentives in using short-term debts to mitigate asset substitution problems.

We present the regression results in Table 5. In terms of *ST* (see Model 1), we find that the coefficient of $ST_{i,t\text{-}1} \times High\_MTB$ is positive but weakly significant, whereas the coefficient of $ST_{i,t\text{-}1} \times (1 - High\_MTB)$ is positive and highly significant at 1% level. The statistical test on the difference between the two coefficients (see the row titled *ΔCoef.*) is significantly away from 0, indicating the two coefficients are significantly different from each other, although they are both positive.

When we re-examine *Hypothesis 2* by replacing *ST* with *LT1AT* and *STDEBT*, the results are largely consistent with those as in *ST* (see Model 2 and 3).

[Insert Table 5]

The economic impact of *ST* on *Spread* is quite substantial for *low-growth* firms. According to the estimate in Model 1, a one-standard-deviation rise in *ST* leads to an increase in loan spreads about 19.44 (0.0957 × 203.18) basis points, which is about 8.75% (19.44/222) of the average sample *Spread*.[16] On the other hand, for a *high-growth* firm, the same rise in *ST* indicates an equivalent increase in *Spread* by only 3.4 (0.0738 × 46.19) basis points, which is about 1.87% (3.4/182) of the average sample *Spread*. The dollar impact is also very different. For low-growth firms, a one-standard-deviation in *ST* increases total interest expenses per loan facility by $0.94 million (0.94=120.8 × 0.001944 × 4); In contrast, for high-growth firms, a one-standard-deviation in *ST* increases total interest expenses per loan facility by only $0.22 million (0.22=160.3 × 0.00034 × 4).

These results clearly offer supports to *Hypothesis 2*. That is, high-growth firms experience the two contradicting effects of short-maturity debts—reducing asset substitution problems and increasing credit risk due to refinancing risk, we find a net insignificant effect of short-term debts on loan spreads. On the other hand, for low-growth firms, the relatively large liquidity risk effect outweighs the attenuation of asset substitution problems effect, so that the net effect of shorter maturity on spread is significantly positive.

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[16] In computing economic impacts in Equation (2), instead of using the summary statistics on the full sample (as shown in Table 1), we use summary statistics on low-growth firms and high-growth firms separately. We provide key information here. The standard deviation of *ST* on low-growth (high-growth) firms is 0.0957 (0.0738), and the average *Spread* on low-growth (high-growth) firms is about 222 basis points (182 basis points). The loan size in the sample, on average, are $120.8 million for low-growth firms and $160.3 million for high-growth firms, respectively, and the time to maturity of a loan are 4 years for both types of firms.

4.3 Further Test on Firm Risk

In this section, we investigate our central hypotheses by additionally taking into account the influence of the level of a firm risk.

4.3.1 The effect of short-term debts on loan spreads on short-term debts conditional on firm risk

He and Xiong's (2012) model highlights that when a firm is more likely to face negative shocks and at the same time has more short-term debt outstanding; it leads to a drop in liquid reserves and causes the firm to suffer refinancing losses even more when rolling over its short term debts. Through this amplification mechanism, a riskier firm likely incurs larger credit risk than a less risky firm even when both firms have similar shorter debt structures. Additionally, stockholder-debtholder conflicts become more severe when debt is risky, and since the liquidity risk of short-term debt is more important for lower quality firms, we expect that our results are stronger for high risky firms. Furthermore, Gopalan *et al*. (2014) empirically document that the bondholders require larger spreads on firms with more debts maturing in the next year for firms more likely exposure to financial distress. Different from prior studies, we examine this theoretical prediction in the context of syndicated loan markets.

We replace *ST* in the baseline regression (Equation 1) with two interaction terms: *ST* × *Risk Indicator* and *ST* × (1− *Risk Indicator*), where *Risk Indicator* is a dummy variable that equals to 1 if the firm is identified as high risky firm otherwise 0. Consistent with this prediction, we expect to see the coefficient of *ST* × *Risk Indicator* is positive and more significant than the coefficient *ST* × (1− *Risk Indicator*).

We consider four different risk indicators. The first one is defined as *STOCKVOL-A50*, equivalent to one if a firm's equity volatility is above the median value among firms in a given year, otherwise zero. Thus, by construction, the value one of *STOCKVOL-A50* stands for high risky firms. Following similar logit, we create other three risk indicators by using Altman's Z-score, the distance-to-default, and the interest coverage, defined as *ZSCORE-B50*, *DTD-B50*, and *INTCOVERAGE-B50*. Unlike the stock volatility, these variables are inversely related to the level of risk.[17] Therefore, the three dummy variables assumes a value of 1 for firms with the variable *below* the median value of the variable among firms for a given year (higher-risky firms) and 0 otherwise.

Table 6 reports estimation results on *ST*, *LT1AT*, and *STDEBT* in Panel A, B, and C, respectively. We find the coefficients along with high risk interaction are significantly larger than the ones with low risk interaction in almost all the model specifications. The statistically test (see titled Δ*Coef.*) also shows that the coefficients on the two interaction terms are significantly different from each other at 5% level.

Overall, the results lend more support to the rollover risk hypothesis that given a similar increase of short-maturity debt, higher risky firms are charged greater spreads than less-risky firms.

[Insert Table 6]

4.3.2 Growth opportunity and firm risk

The asset substitution problem theory predicts that the attenuation effect of short-maturity debts on loan spread should be more pronounced for firms with higher risk than those with lower risk. The rationale is that *riskier borrowers* have even stronger incentives to take on higher risk by engaging in risky asset

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[17] The interest coverage ratio indicates a firm's capability to pay interests, and thus a lower value of this ratio should make the firm's debt more risky.

substitution (Campbell and Kracaw, 1990),[18] and thus using short-term debts in reducing the risk-taking behaviors should be more effective, and thus banks would charge lower interest rates. We have provided evidence that high-growth firms are charged lower interests; based on the above theoretical prediction. We expect an even stronger attenuation effect of short-term debts on loan spreads for the risker firms than less risky firms.

To test this prediction, we divide our sample into high risk subsample and low risk subsample on the basis of firm risk indicators we used in previous section, namely *STOCKVOL-A50*, *ZSCORE-B50*, *DTD-B50*, and *INTCOVERAGE-B50*. We re-run regressions performed in Table 5 separately on high and low risk subsamples. The results are presented in Table 7. Across four risk indicators, only for high risk category, we find the coefficient of the interaction between short-term debt and (1–*High_MTB*) (i.e., the effect of short-term debts on loan spreads for low-growth firms) is systematically significant, whereas the coefficient of the interaction between short-term debt and *High_MTB* (i.e., the effect of short-term debts on loan spreads for high-growth firms) is largely not significant. Additionally, the difference of the coefficients between the two main interaction variables (i.e., *ΔCoef.*) is only evident for high risk firms, but not for low risk firms.

Overall, there results further support for *Hypothesis 2*, in the sense that for high risk firms, rollover risk effect dominates asset substitution effect that low-growth firms pay much more interests than high-growth firms do when there is an increase in short-term debts.

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[18] 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 sufficiently positively correlated, 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.

[Insert Table 7]

5. Robustness and Endogeneity

We provide a battery of robustness checks and deal with endogenous problems in this section. These results are largely consistent with our main analysis, and thus lend strong support to our central hypotheses.

5.1 Robustness Checks

5.1.1 Bank dependence

The spirit of *Hypothesis 1* is that banks perceive borrowers' debt maturity structure and decide how much interest rates they would charge, which is mainly driven by *supply-side* effects. Therefore, if we find the amplification effect of short-term debts on the loan spreads to be more pronounced for firms with more dependence on bank debt financing, our *Hypothesis 1* is further supported.

To identify bank-dependent firms, we collect information from Capital IQ database, which provides detailed information on the debts. For each firm, we compute the ratio of bank debt to total assets, and we classify a firm as a bank dependent firm if it has this ratio above the median value of the ratio among firms in a given year. We create a dummy variable, named, *Bank_Dep_dummy*, which equals to one if a firm is an identified bank-dependent firm, otherwise 0. The Capital IQ database only provides reliable information after 2002; thus, the analysis in this subsection is based on the sample spanning from 2002 to 2014 (called "CIQ-based sample" henceforth). Accordingly, the sample size drops to 3,557 from 9,941.

With the CIQ-based sample, we return to our baseline model specifications, and then examine the rollover risk effect conditional on bank financing dependence. Table 8 reports results. There are several important findings.

[Insert Table 8]

Firstly, we confirm that the results remain consistent with our main analysis. Remarkably, the amplification effect of short-term debts on loan spreads becomes even stronger than results in the main analysis across three short-term debt proxies. For example, the coefficient of *ST* is 252 in the CIQ-based sample (Column 1 of Table 8), compared with 133 in the main result.[19] These results indicate that the amplification effect of a short-maturity structure on costs of bank loans is more significant in a recent decade.[20]

The effect of short-term debt structure reducing costs is also more significant for high-growth firms. The difference between the coefficient of *ST* × *High_MTB* and the coefficient of *ST* ×(1–*High_MTB*) (row titled, *ΔCoef.*) is -207 in the CIQ-based sample (Column 2 of Table 8) versus -156 in the main sample. For *LT1AT*, it is -329 in the CIQ-based sample (Column 5 of Table 8) versus -224 in the main sample, and for *STDEBT* it is -32 (Column 8 of Table 8) versus -19 in the main sample.

Importantly, we find the coefficients of *Debt Variable* × *Bank_Dep_dummy* are highly significant at 1% level, whereas the coefficients of *Debt Variable* × (1–*Bank_Dep_dummy*) are not significant. The results clearly indicate that rollover risk effect is more pronounced for bank-dependent firms.

Overall, our results shows that given a similar increase of short-term debts, bank-dependent borrower pay much larger interests to banks than less bank-dependent firms, it lends more support to *Hypothesis 1*.

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[19] The coefficient of *LT1AT* is 223 in the CIQ-based sample (Column 4 of Table 8) versus 134 in the main result, and the coefficient of *STDEBT* is 24 in the CIQ-based sample (Column 7 of Table 8) compared with 19 in the main result.

[20] The economic impact is also more sizable compared with the results in the main analysis. A one-standard-deviation increase of short-term debt proxy leads to the increased spreads by 21, 12, and 8 basis points when we use *ST*, *LT1AT*, and *STDEBT* respectively, whereas in the main analysis, the a similar situation only increases spreads by 11, 6, and 4 basis points on these debt proxies, respectively.

5.1.2 Speculative grade firms

Although we do not include rated firms in our main analysis, we acknowledge that even rated firms (i.e., likely have a wider range of financing sources) may depend on bank financing, which means it is probably we could also find rollover risk effect on loan spreads in the case of rated firms.

We compute bank-debt-to-asset ratios[21] for the unrated sample, the speculative grade sample (i.e., firms with ratings below BBB-), and investment grade sample. We also plot the distributions on these three subsamples and present in Figure 2.[22] As expected, unrated firms have largest ratio of bank debts to total asset. The same ratio exhibit similar pattern on the speculative grade subsample, indicating some speculative grade firms may also depend on bank financing. Investment grade firms clearly have very low level of bank-debt-to-asset ratios, and therefore, we exclude investment-grade firms, which borrowing costs should be less affected by banks' perspectives.

[Insert Figure 2]

We repeat our bank dependence analysis on the speculative grade subsample here, and we report results in Table 9. We find the coefficient of *ST* × *Bank_Dep_dummy* (representing bank-dependent firms) is positively significant while the coefficient of *ST* × (1–*Bank_Dep_dummy*) is negatively significant (see Column 1). In addition, the difference between the two interaction variables (row

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[21] As we mentioned before, the data on the amount of bank debts for a firm are obtained from the Capital IQ database.

[22] Since the data used here is obtained from the Capital IQ database, the period for these subsamples is from 2002 to 2014. There are 3,949 loan level observations for unrated firms, 4,183 loan level observations for speculative grade firms, and 2,330 loan level observations for investment grade firms.

titled, *ΔCoef.*) are highly significant at better than 5% level. Replacing *ST* with *LT1AT* or *STDEBT*, we find similar results (see Column 2-3).

Overall, we show that speculative grade firms with bank financing dependence pay significant larger interests when they have shorter debt structure, and thus our *Hypothesis 1* is further supported.

[Insert Table 9]

5.1.3 Credit lines

The all-in-drawn spread on credit lines compensates the bank for the credit risk it incurs when the borrower draws down on its credit line in the future. The essential mechanism of rollover risk hypothesis is the conflict between shareholder and debtholder would increase the likelihood of defaults *in the future*, but not necessary at the current time. If we can find all-in-drawn spreads are significantly larger for credit lines than for other types of loans, given a similar increase of short-term debts, it would further support *Hypothesis 1*. We examine this prediction by adding two interaction terms which we interact debt maturity proxy with *CREDITLINE* dummy variable and (1-*CREDITLINE*). The results are presented in Table 10, and they confirm our prediction.

[Insert Table 10]

5.1.4 All-in-undrawn spreads

Different from all-in-drawn spreads, the undrawn fee includes both the commitment fee and the annual fee that the borrower must pay its bank for funds committed under the credit line but not taken down. The undrawn fee, therefore, compensates the bank for the liquidity risk it incurs by guaranteeing the firm access to funding at its discretion over the life of the credit line and up to the total commitment amount. Therefore, we should also expect that rollover risk hypothesis holds when we focus on undrawn fees. We return to our *Hypothesis 1* tests, and replace all-in-drawn spreads with undrawn fee (i.e., All-in-Undrawn spread in the DealScan database). The results are presented in Table 11, and we find that the estimated coefficients on *ST*, *LT1AT*, and *STDEBT* are all positive and highly significant, implying that the shorter debts have an amplification effect not only on the price of credit to corporations, but also on the price corporations pay to guarantee access to liquidity.

[Insert Table 11]

5.1.5 Alternative model specification

Our baseline regressions are estimated using Panel data model with firm fixed effects. For robustness, we consider other model specifications in this section. First, we estimate the baseline model using ordinary least squares (Pool-OLS) regressions with standard errors adjusted for heteroskedasticity and within firm clustering, and include industry fixed effect. Second, instead of using panel fixed effect model, we perform random fixed effect model, in which we include industry dummies, and clustered standard errors at firm level. Table 12 presents the results. Overall, our results are robust to alternative model specifications because the estimated coefficients are systematically significant across all debt maturity proxies.

[Insert Table 12]

5.1.6 Natural logarithm loan spreads and newly listed firms

Some prior studies suggest that the natural logarithm of loan spread is able to mitigate the effect of skewness of the data (e.g., Campello *et al*., 2011). For robustness, we rerun baseline regressions by replacing the raw spreads with the natural logarithm of spreads. Furthermore, Custódio, Ferreira, and Laureano (2013) document that firms in the most recent listing use more short-term debt. Since newly listed firms are less transparent, our findings may be subject to the selection bias toward to favour our rollover risk hypothesis. For robustness, we exclude firms with age up to four years and re-do our baseline regressions. Panel A of Table 13 reports the results for logarithm loan spreads and Panel B of Table 7 the results for the exclusion of newly listed firms. The results are largely qualitative similar to our main analysis.

[Insert Table 13]

5.1.7 Largest facility and consolidated sample

In our main analysis, each observation in our baseline regression represents a single loan facility but a deal package can contain multiple loan facilities, and these loan facilities might simply reflect the deal level negotiation (i.e., they are not completely independent observations). Treating these loans as independent facilities could bias toward to inflate the statistical significant of our results. To address this possibility, we consider two approaches.

First, we test the robustness of our results by using only the *largest* facility a firm received in a specific year, as suggested in Hertzel and Officer (2012) and Houston *et al*. (2014). When we restrict ourselves to using only the largest facility, the number of observations shrinks from 9,941 to 5,940. The estimated results are reported in Table 14. For this sample of loans, the *ST* (see Panel A) is shown to reduce loan prices by 4.98% (or 10.01 basis points). This coefficient is statistically significant at the 1% level and is similar to the 5.66% (or 11.44 basis points) coefficient reported in our baseline analysis presented in Model 4 of Table 4. We also rerun all the analysis we have done in the above by using the largest facility sample; the results are systematically consistent with the above results. The results based on *LT1AT* and *STDEBT* (see Panel B and C of Table 14) are consistent too.

[Insert Table 14]

Second, we follow Graham *et al*. (2008) by aggregating loans into “deals” using loan-size weighted averages of the relevant loan terms. This consolidated sample (firm-year type) contains 5,946 firm-year observations. The estimated results are presented in Table 15. We find that short-maturity debt proxies are positive and highly significant everywhere in Column 1-3, and low-growth firms experiences greater loan spreads than high-growth firms as the a firm short-term debts increases (see Column 4).

Overall, the results based on both largest facility subsample and on the consolidated sample indicate that the deal-level bias does not affect our inferences, and continue to support our central hypotheses.

[Insert Table 15]

5.2. Endogenous Issues

The empirical results so far show that there is a strong and consistent association between short-term debt and loan pricing. However, like any other empirical works, our study is also subject to endogenous problems. For example, firms with larger borrowing costs are likely to be risker firms, and are restricted to be granted longer funds, indicating a reverse causality problem. There is also possibility that loan spreads and short-term debts are determined simultaneously in the same direction because of unobserved risk factors. These endogenous problems may drive our results, and thus bias our findings.

Firstly, we should 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., observed outcomes are not firm-choice variables). Furthermore, in our main analysis, we have included firm fixed effects and time fixed effects in our regressions to control for time-invariant and time-varying factors that may affect both debt maturity structure and loan spreads.

We acknowledge it is extremely difficult to completely eliminate the endogeneity bias. In this section, we attempt to further address the endogenous problem by using a system simultaneous equations (SEM) approach. Eventually, we show that a shorter debt structure continues to significantly increase borrowing costs from banks after accounting for the potential issue of endogeneity.

5.2.1 Simultaneous equation model

We perform SEM model by using the consolidated sample (i.e., firm-year observation), because short-maturity debt variables and leverage are all measured at firm-level. We expand the spread single equation model by including the debt maturity equation and the leverage equation, presented as follows.

$$\begin{aligned} Spread_{i,t} &= \alpha_{10} + \alpha_{11} \times ST_{i,t} + \mathbf{X}_{i,t-1} + LIBOR_t \\ &\quad + Industry\ Fixed\ Fffects + Time\ Fixed\ Effects + \varepsilon_{i,t} \end{aligned} \tag{3}$$

$$\begin{aligned} ST_{i,t} &= \alpha_{20} + \alpha_{21} \times Spread_{i,t} + \alpha_{22} \times leverage_{i,t} + \alpha_{23} \times ASSET\_MAT_{i,t} \\ &\quad + \alpha_{24} \times (stock\ volatility)_{i,t} + \alpha_{25} \times (log\ sales)_{i,t} + \alpha_{26} \times LSALES\_squared_{i,t} \\ &\quad + \alpha_{27} \times MTB_{i,t} + \alpha_{28} \times (excess\ stock\ return)_{i,t} + LIBOR_t \\ &\quad + Industry\ Fixed\ Fffects + Time\ Fixed\ Effects + \varepsilon_{i,t} \end{aligned} \tag{4}$$

$$\begin{aligned} Leverage_{i,t} &= \alpha_{30} + \alpha_{31} \times Spread_{i,t} + \alpha_{32} \times ST_{i,t} + \alpha_{33} \times (Profit\ margin)_{i,t} \\ &\quad + \alpha_{34} \times (stock\ volatility)_{i,t} + \alpha_{35} \times (log\ sales)_{i,t} + \alpha_{36} \times MTB_{i,t} \\ &\quad + \alpha_{37} \times (excess\ stock\ return)_{i,t} + \alpha_{38} \times FIXED\_ASSET_{i,t} \\ &\quad + Industry\ Fixed\ Fffects + Time\ Fixed\ Effects + \varepsilon_{i,t} \end{aligned} \tag{5}$$

where $Spread_{i,t}$ is the weighted average all-in-drawn spreads weighted based on loan size among loans for a given year and for a given firm. The **X** represents a vector of firm-level control variables, as described in Equation (1). *ASSET_MAT* is the asset maturity variable, *LSALES_squared* is the squared of *log sales*, *FIXED_ASSET* represents a firm's fixed asset, and other variables are defined in Appendix A. The industry fixed effects are captured by using one-digit SIC industry dummies in line with Acharya *et al*. (2013). The SEM analysis to reduce endogenous concern on the reverse causality between loan spreads and debt maturity, and simultaneously determined among loan spreads, debt maturity, and leverage.

We follow Johnson (2003) and the subsequent debt maturity literature (e.g., Datta, Iskandar-Datta, and Raman, 2005; Billett *et al*., 2007) to estimate leverage and maturity jointly. We estimate the SEM by 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.[23]

5.2.2 SEM results

We first use two equations SEM, which includes only the loan spread equation and the short-maturity debt equation. The results are reported in Table 16. We find significant bi-directional relationship between short-maturity debt ratios and spreads. The results indicate that the amplification effect of short-term debts on the costs of bank loans consistently exists after accounting for the endogenous issue.

We then perform the three equations SEM by additionally including the leverage equation. We continuously find a positive and significant bi-directional relationship between short-maturity ratios and spreads. Also, notice in the leverage equation that the coefficients on short-term debt variables are negative and significantly different from zero, which is consistent with the liquidity risk effects reported by Johnson (2003), and the single-equation findings in Barclay and Smith

[23] Note that we do not report the R^2s for our estimated equations, since as Goldberger (1991) observes, there is no guarantee that the R^2s reported in system estimation techniques lie between zero and one. Unfortunately, there is no widely accepted goodness of fit measure for nonlinear system estimation. Also note that other instrumental variables techniques, such as two-stage least squares (2SLS), are special cases of GMM. For example, in comparison with 2SLS, Greene (2002) and Kennedy (2003) observe that GMM estimates are more efficient than 2SLS estimates when regression errors are heteroskedastic and/or autocorrelated, and that GMM estimates coincide with 2SLS estimates otherwise.

(1995) that firms with longer maturity debt have higher leverage. Additionally, note in the short-maturity debt equation that the proportion of short-term debts is positively related to the market-to-book ratio, which is consistent with the predicted positive relation documented in Barclay *et al*. (2003). Finally, we note that the coefficients on the other variables in the leverage and maturity equations are generally consistent with those reported in Johnson (2003) and Barclay et al. (2003).[24]

Taken together, we use the simultaneous equations framework to examine whether short-term debt ratios are positively associated with the costs of bank loans. This framework controls for unobservable effects in estimating the effect of short-maturity debts on loan spreads, and reverse causality bias between short-term debts and loan spreads. Our evidence suggests that short-maturity debt ratios are positively associated with spreads, reinforcing our conclusion that a firm's short-maturity debt structure are significant in banks' decision of charging interests from borrowers..

[Insert Table 16]

6. Conclusion

Do banks penalize debt rollover risk on charging larger interest spreads? We answer this question by studying syndicated loans from 1990 to 2014 in U.S. market and provide strong empirical evidence to show that short-debt ratio is indeed an important determinant of loan spreads after accounting for many firm-specific, loan-specific variables, firm-fixed effects, and year-fixed effects.

We also examine another opposite theoretical implication that short-term debts

[24] We also re-examine our *Hypothesis 2* based on SEM approach. The results continuously support the hypothesis that the short-term debt plays an important role 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 OA3 in Online Appendix.

are beneficial to reduce bank loan spreads for firms with more incentives to seek risky investments by replacing lower risky ones. We find that high growth firms (with high risk-shifting incentives) pay significantly lower spreads than low growth firms given a similar increase on short-maturity debts.

Our additional tests suggest for firms that are riskier, bank-dependent, commit to credit lines, extending their debt maturity structure is especially important to reduce borrowing costs. These results further validate our central hypotheses. Our findings are strongly supported on alternative debt maturity proxies, from a bunch of robustness tests, and after taking into account endogenous problems.

Altogether, our findings confirm that banks do value a firm's debt maturity structure to adjust the pricing of bank loans, in addition to extant known pricing factors. Whether other attributes on the debt maturity (e.g., debt concentration) also affect costs of bank loans is worthwhile to explore in the future.

Appendices

Appendix A. Variable description

Variable	Definition	Source
Dependent Variables		
Spread	Loan spread over LIBOR plus fees in the issue date in basis points (DealScan item all-in-drawn spread).	DealScan
Debt maturity variables		
ST	Proportion of short-term debts to the total assets	Compustat
LT1AT	Proportion of long-term debts maturing in 1 year to the total assets	Compustat
STDEBT	Proportion of short-term debts to the total debts	Compustat
ST3	Proportion of total debt that matures within 3 years	Compustat
ST4	Proportion of total debt that matures within 4 years	Compustat
ST5	Proportion of total debt that matures within than 5 years	Compustat
MAT	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.	Compustat
Firm Variables		
Log age	Logarithm of age	Compustat
Log sales	Logarithm of sales	Compustat
Leverage	Ratio of total debts to total assets	Compustat
MTB (market-to-book)	Ratio of market value to book value	Compustat
Profit margin	Ratio of net income to sales	Compustat
Interest coverage	Logarithm of 1 plus *EBITDA* divided by interest expense truncated at 0	Compustat
Tangibility	Ratio of inventories plus plant, property, and equipment to total assets	Compustat
Net working capital	Ratio of networking capital (current assets less current liabilities) to total debt	Compustat
R&D	Firm's research and development expense divided by sales	Compustat
Advertising	Firm's advertising expense divided by sales	Compustat
Excess stock return	Excess stock return (relative to the market) over the past 12 months	Compustat / CRSP
Stock volatility	Standard deviation of a firm's excess stock return over the past 12 months	Compustat / CRSP
Distance-to-default	KMV distance-to-default based on Vassalou and Xing (2004)	Compustat / CRSP
ASSET_MAT	The weighted average of the maturity of long-term assets and current assets. The maturity of long-term assets is	Compustat

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

Appendix B. Summarizing literature on the determinant of loan duration on loan spreads

Literature	Expected sign	Methodology	Data / Data period	Empirical Result
(1) Campello, Lin, Ma, Zou (2011, *The Journal of Finance*)	+	Single equation	All loans / 1996–2002	Positive (not significant)
(2) Houston, Jiang, Lin, and Ma (2014, *Journal of Accounting Research*)	+	Single equation	All loans on S&P 500 companies / 2003–2008	Positive (significant)
(3) Dennis, Nandy, and Sharpe (2000, *Journal of Financial and Quantitative Analysis*)	(+/–)	1. System of equations; 2. Single equation	Bank revolving credit, no term loans / 1987 - 1995	Negative (significant)
(4) Santos (2011, *Review of Financial Studies*)	(+/–)	Single equation	All loans / 2002 - 2008	Negative (significant)
(5) Brockman, Martin, and Unlu (2010, *The Journal of Finance*)	+	1. Single equation; 2. System of equations model	Corporate bond / 1994 - 2005	Positive (significant)
(6) Goss and Roberts (2011, *Journal of Banking & Finance*)	–	Single equation	All loans / 1991–2006	Negative (not significant)
(7) Santos and Winton (2008, *The Journal of Finance*)	(+/–)	Single equation	All loans / 1987–2002	Negative (significant)

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Table 1. Summary statistics

This table presents the summary statistics on the variables used in this paper. The variables are characterized as short-term debt variables, firm- and loan-level control variables. The short-term debt variables are: (1) *ST*, measures the ratio of short-term debts to total asset values; (2) *LT1AT*, the ratio of long-term debts matured within one 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 the overall borrowing costs from banks beyond LIBOR. The detailed construction of other variables is provided in Appendix A.

	Obs.	Mean	Std. Dev.	p25	Median	p75
Short-Term Debt Variables						
ST	9,941	0.051	0.086	0.003	0.02	0.058
LT1AT	9,941	0.027	0.053	0.001	0.009	0.031
STDEBT	9,941	0.253	0.311	0.023	0.116	0.361
Firm Characteristics						
Log age	9,941	2.516	0.773	1.946	2.485	3.091
Log sales	9,941	5.866	1.286	4.999	5.884	6.733
Leverage	9,941	0.268	0.206	0.111	0.237	0.377
MTB (market-to-book)	9,941	1.743	1.002	1.123	1.451	2.001
Profit margin	9,941	0.009	0.223	0.005	0.035	0.07
Interest coverage	9,941	23.854	57.083	3.524	7.221	17.481
Tangibility	9,941	0.296	0.226	0.12	0.233	0.417
Net working capital	9,941	11.911	55.99	0.22	0.834	2.147
R&D	9,941	0.019	0.052	0	0	0.013
Advertising	9,941	0.009	0.024	0	0	0.005
Excess stock return	9,941	0.083	0.625	-0.264	0.058	0.389
Stock volatility	9,941	0.476	0.259	0.304	0.414	0.575
Distance-to-default	8,888	6.401	5.009	2.934	5.33	8.556
Loan Characteristics						
Spread (all-in-drawn spread)	9,941	202.045	120.322	115	175	275
Log loan spread (all-in-drawn spread)	9,941	5.123	0.645	4.745	5.165	5.617
All-in-undrawn spread	6,347	33.035	16.7	22.5	30	47.5
Log loan size	9,941	18.022	1.282	17.217	18.133	18.859
Loan size ($million)	9,941	140.672	235.847	30	75	155
Log loan duration (months)	9,941	3.735	0.596	3.584	3.97	4.094
Loan duration (years)	9,941	3.998	1.735	3	4.417	5
Secure	9,941	0.597	0.491	0	1	1
Senior	9,941	0.998	0.043	1	1	1
Dividend rest	9,941	0.609	0.488	0	1	1
Corporate purposes	9,941	0.295	0.456	0	0	1
Debt repay	9,941	0.204	0.403	0	0	0
Working capital	9,941	0.218	0.413	0	0	0
Term loan	9,941	0.257	0.437	0	0	1
Bridge loan	9,941	0.012	0.107	0	0	0
Credit line	9,941	0.653	0.476	0	1	1
Log number of lenders	9,935	1.321	0.906	0.693	1.386	1.946
Macro Controls						
LIBOR (%)	9,941	3.791	2.247	1.559	4.765	5.623

Table 2. Correlation matrix.

This table presents Pearson correlations among the three short-term debt variables (*ST*, *LT1AT*, and *STDEBT*), the leverage, and the logarithm of loan duration on new issuance loans.

	Spread	*ST*	*LT1AT*	*STDEBT*	Leverage	Log loan duration
ST	0.17	1	0.67	0.59	0.31	-0.11
LT1AT	0.17	0.67	1	0.32	0.30	-0.05
STDEBT	0.03	0.59	0.32	1	-0.25	-0.14
Leverage	0.26	0.31	0.30	-0.25	1	0.05
Log loan duration	0.01	-0.11	-0.05	-0.14	0.05	1

Table 3. Mean (median) loan spreads, categorized by short-term debt proxies.

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, and Panel B and C presents results for low-growth firms and high-growth firms, respectively. The low-growth (high-growth) firms are identified when firms' market-to-book value is below (above) the median value of market-to-book ratios among all firms for a given year. We test the difference on means and medians between high quartile and low quartile group based on the Wilcoxon one-way sample t-test. ***, **, and * denote statistical significance of the *t*-tests at the 1%, 5%, and 10% level, respectively.

Panel A: All firms

Debt Maturity Variable Quantiles	*ST*	*LT1AT*	*STDEBT*	*Log loan duration*
1 = Low	183.74	177.92	197.84	210.54
	(162.5)	(150)	(175)	(200)
2	192.61	193.54	206.11	196.18
	(175)	(175)	(200)	(187.5)
3	204.93	207.64	200.73	179.99
	(200)	(200)	(182.5)	(150)
4 = High	226.84	228.95	203.51	229.12
	(225)	(225)	(185)	(225)
Two sample differences tests				
High – Low (Mean)	43.11 ***	51.02 ***	5.66 *	18.58 ***
High – Low (Median)	62.5 ***	75 ***	10 ***	25 ***

Panel B: Low-growth firms

Debt Maturity Variable Quantiles	*ST*	*LT1AT*	*STDEBT*	*Log loan duration*
1 = Low	206.34	202.62	215.16	232.5
	(187.5)	(187.5)	(200)	(225)
2	209.31	215.03	221.39	212.52
	(200)	(200)	(225)	(200)
3	226.25	225.29	220.61	207.89
	(225)	(225)	(200)	(200)
4 = High	247.49	246.4	232.2	242.54
	(250)	(250)	(225)	(225)
Two sample differences tests				
High – Low (Mean)	41.15 ***	43.78 ***	17.04 ***	10.03 ***
High – Low (Median)	62.5 ***	62.5 ***	25 ***	0 ***

Panel C: High-growth firms

Debt Maturity Variable Quantiles	*ST*	*LT1AT*	*STDEBT*	*Log loan duration*
1 = Low	164.96	160.44	180.45	186.34
	(150)	(125)	(150)	(175)
2	182.12	171.11	191.7	181.52
	(150)	(150)	(175)	(175)
3	183.49	189.59	180.36	157.52
	(152.5)	(175)	(165.63)	(137.5)
4 = High	197.27	206.75	175.49	227.8
	(175)	(192.08)	(150)	(200)
Two sample differences tests				
High – Low (Mean)	32.31 ***	46.31 ***	-4.97	41.46 ***
High – Low (Median)	25 ***	67.08 ***	0	25 ***

Table 4. Short-term debts and loan spreads

This table presents the results of regressing loan spreads on short-debt ratios (*ST*, *LT1AT*, and *STDEBT*). The sample contains syndicated loans in U.S. market from 1990 to 2014. We estimate models with or without control variables, but all models include firm fixed effects 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-level and firm-level, which is our benchmark model. We replace *ST* in the Model 4 with *LT1AT* and *STDEBT* and report estimation results in Model 5 and 6 respectively. *P*-values are reported in parenthesis, and obtained after taking clustered standard errors at firm level. Indicator variables for year, firm fixed effect are not reported.

Model	(1)	(2)	(3)	(4)	(5)	(6)
Short-term debt variables						
ST	235.85 ***	211.24 ***	149.26 ***	133.10 ***		
	(0.00)	(0.00)	(0.00)	(0.00)		
LT1AT					134.12 ***	
					(0.00)	
STDEBT						19.25 ***
						(0.00)
Firm-Level Characteristics						
Log age			5.46	4.43	4.66	4.39
			(0.50)	(0.55)	(0.53)	(0.55)
Log sales			-30.18 ***	-19.39 ***	-20.13 ***	-20.15 ***
			(0.00)	(0.00)	(0.00)	(0.00)
Leverage			55.03 ***	62.64 ***	71.53 ***	88.66 ***
			(0.00)	(0.00)	(0.00)	(0.00)
MTB			-11.98 ***	-9.92 ***	-9.77 ***	-9.88 ***
			(0.00)	(0.00)	(0.00)	(0.00)
Profit margin			-36.19 **	-36.77 **	-37.87 **	-37.71 **
			(0.04)	(0.02)	(0.02)	(0.02)
Interest coverage			0.01	-0.01	-0.01	-0.02
			(0.70)	(0.68)	(0.77)	(0.57)
Net working capital			0.07 **	0.06 **	0.06 **	0.04
			(0.02)	(0.03)	(0.05)	(0.14)
Tangibility			22.30	23.51	18.46	18.01
			(0.36)	(0.29)	(0.40)	(0.41)
R&D			-77.91	-33.49	-39.36	-32.42
			(0.45)	(0.73)	(0.69)	(0.74)
Advertising			63.55	39.82	28.21	44.13
			(0.72)	(0.82)	(0.87)	(0.80)
Stock volatility			48.35 ***	50.09 ***	51.77 ***	50.58 ***
			(0.00)	(0.00)	(0.00)	(0.00)
Excess stock return			-1.31	-3.72	-4.29	-4.11
			(0.69)	(0.23)	(0.16)	(0.18)
Distance-to-default			-3.23 ***	-2.38 ***	-2.38 ***	-2.40 ***
			(0.00)	(0.00)	(0.00)	(0.00)
Loan-Level Characteristics						

Log loan size		-9.81 ***		-6.80 ***	-6.78 ***	-6.82 ***
		(0.00)		(0.00)	(0.00)	(0.00)
Log loan duration		-1.95		-1.28	-1.41	-1.30
		(0.48)		(0.62)	(0.59)	(0.62)
Secure		34.60 ***		28.35 ***	28.48 ***	28.54 ***
		(0.00)		(0.00)	(0.00)	(0.00)
Senior		-180.91 ***		-152.15 ***	-153.56 ***	-156.33 ***
		(0.00)		(0.01)	(0.01)	(0.01)
Dividend rest		-9.42 ***		-6.03 *	-6.09 *	-6.14 ***
		(0.01)		(0.08)	(0.08)	(0.08)
Corporate purposes		-32.05 ***		-27.14 ***	-27.65 ***	-27.50 ***
		(0.00)		(0.00)	(0.00)	(0.00)
Debt repay		-14.71 ***		-16.69 ***	-16.88 ***	-16.74 ***
		(0.00)		(0.00)	(0.00)	(0.00)
Working capital		-31.30 ***		-26.20 ***	-26.88 ***	-26.53 ***
		(0.00)		(0.00)	(0.00)	(0.00)
Term loan		45.03 ***		39.23 ***	38.95 ***	39.28 ***
		(0.00)		(0.00)	(0.00)	(0.00)
Bridge loan		93.71 ***		82.52 ***	82.85 ***	82.06 ***
		(0.00)		(0.00)	(0.00)	(0.00)
Credit line		5.92		3.76	3.58	3.88
		(0.16)		(0.37)	(0.39)	(0.36)
Log number of lenders		-9.18 ***		-8.10 ***	-8.00 ***	-8.25 ***
		(0.00)		(0.00)	(0.00)	(0.00)
LIBOR		-5.53 *		-8.18 ***	-7.95 ***	-7.82 ***
		(0.07)		(0.00)	(0.00)	(0.00)
CONSTANT	132.31 ***	534.48 ***	264.82 ***	546.67 ***	553.24 ***	547.56 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,941	9,935	8,888	8,882	8,882	8,882
R-squared	0.13	0.34	0.36	0.46	0.46	0.46

Table 5. The effect of short-maturity debts on loan spreads conditional on growth opportunity.

This table presents the regression results examining the effect of short-maturity debt variables on loan spreads conditional on growth opportunities. The *High_MTB* is the dummy variable, identifying firms that belong to high growth opportunity firms when firms' market-to-book values are above the median value of the variable among 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 Δ*Coef*. Control variables on firm and loan-specific variables, firm fixed effects, year fixed effects, and LIBOR at the month of the loan are included in all regressions but coefficients are not reported. Estimations are done with clustered standard errors at firm level, which are reported in parenthesis.

Model	(1)	(2)	(3)
ST × *High_MTB*	46.19 *		
	(0.09)		
ST × (1–*High_MTB*)	203.18 ***		
	(0.00)		
LT1AT × *High_MTB*		4.72	
		(0.89)	
LT1AT × (1–*High_MTB*)		228.73 ***	
		(0.00)	
STDEBT × *High_MTB*			10.32
			(0.11)
STDEBT × (1–*High_MTB*)			29.95 ***
			(0.00)
ΔCoef.	-156.99 ***	-224.01 ***	-19.63 *
	(0.00)	(0.00)	(0.05)
CONSTANT	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes
Loan variables	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
# of observations	8,882	8,882	8,882
R-squared	0.46	0.46	0.46

Table 6. The effect of short-maturity debts on loan spreads dependent on firm risk.

This table presents the results of regressing loan spreads on short-debt ratios (*ST*, *LT1AT*, and *STDEBT*) conditional on firm-level risk. The main interested variables are *ST* × *Risk Indicator* and *ST* × (1− *Risk Indicator*), in which *Risk Indicator* is a dummy variable, and value of one stands for high risky 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 Δ*Coef*. We estimate models with firm- and loan-specific variables, firm fixed effects, year fixed effect, and LIBOR. For saving places, we only report the results on our main explanatory variables. *P*-values are reported in parenthesis, and obtained after taking clustered standard errors at firm level.

	Risk Indicator			
	STOCKVOL-A50	***ZSCORE-B50***	***DTD-B50***	***INTCOVERAGE-B50***
Panel A: *ST*				
ST × *Risk Indicator*	171.92 ***	161.79 ***	148.39 ***	168.71 ***
	(0.00)	(0.00)	(0.00)	(0.00)
ST × (1–*Risk Indicator*)	81.09 ***	18.82	70.94 **	-25.93
	(0.00)	(0.61)	(0.04)	(0.48)
ΔCoef.	90.83 **	142.97 ***	77.45 **	194.64 ***
	(0.03)	(0.00)	(0.04)	(0.00)
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	0.47
Panel B: *LT1AT*				
LT1AT × *Risk Indicator*	163.10 ***	153.55 ***	139.31 ***	160.24 ***
	(0.01)	(0.00)	(0.00)	(0.00)
LT1AT × (1–*Risk Indicator*)	95.62 ***	56.95	114.97 ***	7.31
	(0.01)	(0.22)	(0.01)	(0.90)
ΔCoef.	67.48	96.60 *	24.34	152.93 **
	(0.28)	(0.10)	(0.64)	(0.02)
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
Panel C: *STDEBT*				
STDEBT × *Risk Indicator*	24.73 ***	44.35 ***	27.51 ***	48.64 ***
	(0.01)	(0.00)	(0.00)	(0.00)
STDEBT × (1–*Risk Indicator*)	14.79 **	0.96	11.79 *	-2.70
	(0.02)	(0.88)	(0.06)	(0.66)
ΔCoef.	9.94	43.39 ***	15.72 *	51.34 ***

	(0.30)	(0.00)	(0.09)	(0.00)
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	0.47	0.46	0.47

Table 7. The effect of short-maturity debt on loan spreads dependent on growth opportunity for high risk 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-level risk. The main interested variables are *ST* × *High_MTB* and *ST* × (1− *High_MTB*), in which The *High_MTB* is the dummy variable, identifying firms that belong to high growth opportunity firms when firms' market-to-book values are above the median value of the variable among all firms in a given year. *Risk Indicator* is a dummy variable, and value of one stands for high risky 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 Δ*Coef*. We estimate models with firm- and loan-specific variables, firm fixed effects, year fixed effect, and LIBOR. For saving places, we only report the results on our main explanatory variables. *P*-values are reported in parenthesis, and obtained after taking clustered standard errors at firm level.

	Risk Indicator							
	STOCKVOL-A50		*ZSCORE-B50*		*DTD-B50*		*INTCOVERAGE-B50*	
	High Risk	Low Risk	High Risk	Low Risk	High Risk	Low Risk	High Risk	Low Risk
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: *ST*								
ST × *High_MTB*	41.37	12.19	107.34 ***	38.79	30.53	37.20	37.29	30.69
	(0.46)	(0.74)	(0.00)	(0.36)	(0.37)	(0.38)	(0.22)	(0.51)
ST × (1–*High_MTB*)	283.96 ***	-6.98	231.63 ***	64.06	223.28 ***	60.11	188.61 ***	-24.50
	(0.00)	(0.86)	(0.00)	(0.19)	(0.00)	(0.22)	(0.00)	(0.72)
ΔCoef.	-242.59 ***	19.16	-124.28 **	-25.27	-192.75 ***	-22.91	-151.33 ***	55.19
	(0.00)	(0.67)	(0.03)	(0.62)	(0.00)	(0.71)	(0.01)	(0.43)
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	0.39	0.44	0.33	0.46	0.41	0.43
Panel B: *LT1AT*								
LT1AT × *High_MTB*	-98.52	48.14	47.92	104.83 *	-59.10	126.17 **	29.10	47.43
	(0.13)	(0.32)	(0.17)	(0.08)	(0.18)	(0.02)	(0.51)	(0.44)
LT1AT × (1–*High_MTB*)	257.80 ***	55.39	190.11 **	244.53 ***	215.45 ***	202.30 ***	188.56 ***	113.22

	(0.01)	(0.37)	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.24)
ΔCoef.	-356.32 ***	-7.25	-142.19 *	-139.70	-274.55 ***	-76.12	-159.46 **	-65.80
	(0.00)	(0.92)	(0.06)	(0.14)	(0.00)	(0.39)	(0.04)	(0.55)
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	0.38	0.47	0.40	0.44	0.34	0.46	0.42	0.43
Panel C: *STDEBT*								
STDEBT × *High_MTB*	12.71	10.15	53.98 ***	2.31	2.88	8.93	9.17	7.34
	(0.33)	(0.19)	(0.00)	(0.71)	(0.85)	(0.15)	(0.55)	(0.27)
STDEBT × (1–*High_MTB*)	48.31 ***	-6.33	51.29 ***	2.12	42.22 **	8.80	45.50 ***	-2.22
	(0.01)	(0.45)	(0.00)	(0.80)	(0.01)	(0.34)	(0.01)	(0.81)
ΔCoef.	-35.60 **	16.48	2.69	0.19	-39.34 **	0.13	-36.33 *	9.56
	(0.05)	(0.10)	(0.89)	(0.98)	(0.02)	(0.99)	(0.06)	(0.35)
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	0.40	0.44	0.34	0.47	0.42	0.43

Table 8. Bank debt dependence

This table presents regression results on Capital-IQ based sample. The sample period is from 2002 to 2014, and the sample size is 3,557 at loan-level. We create a dummy variable of *Bank_Dep_dummy* that equals to 1 if the firm's ratio of bank debt to total asset is above the median value of the ratio, otherwise 0. This dummy variable is updated every year. We consider three short-maturity debt proxies, and report results for *ST* in Model 1-3, for *LT1AT* in Model 4-6, and for *STDEBT* in Model 7-8. Results of the tests of the differences between coefficients on the interaction terms are presented in the row titled Δ*Coef*.

	Debt Maturity Variable								
	ST			***LT1AT***			***STDEBT***		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Debt Variable	252.61 ***			223.38 ***			23.77 **		
	(0.00)			(0.00)			(0.03)		
Debt Variable × *High_MTB*		107.65			7.40			9.29	
		(0.13)			(0.93)			(0.35)	
Debt Variable × (1–*High_MTB*)		315.44 ***			336.64 ***			41.34 **	
		(0.00)			(0.00)			(0.02)	
Debt Variable × *Bank_Dep_dummy*			293.31 ***			300.06 ***			53.98 ***
			(0.00)			(0.00)			(0.00)
Debt Variable × (1–*Bank_Dep_dummy*)			175.89			86.66			4.20
			(0.18)			(0.45)			(0.73)
ΔCoef.		-207.78 **	117.42		-329.24 ***	213.40		-32.05 *	49.78 ***
		(0.02)	(0.41)		(0.00)	(0.14)		(0.08)	(0.01)
CONSTANT	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of observations	3,557	3,557	3,557	3,557	3,557	3,557	3,557	3,557	3,557
R-squared	0.41	0.42	0.41	0.42	0.46	0.42	0.42	0.43	0.42

Table 9. Speculative grade firms dependent on bank financing

This table presents regression results on speculative grade firms with no missing values of bank debts in the Capital IQ database. The sample period is from 2002 to 2014, and the sample size is 3,669 at loan-level. We create a dummy variable of *Bank_Dep_dummy* that equals to 1 if the firm's ratio of bank debt to total asset is above the median value of the ratio, otherwise 0. This dummy variable is updated every year. We consider three short-maturity debt proxies, and report results for *ST* in Column 1, for *LT1AT* in Column 2, and for *STDEBT* in Column 3. Results of the tests of the differences between coefficients on the interaction terms are presented in the row titled Δ*Coef*.

	(1)	(2)	(3)
ST × *Bank_Dep_dummy*	125.97 *		
	(0.05)		
ST × (1–*Bank_Dep_dummy*)	-113.79 *		
	(0.09)		
LT1AT × *Bank_Dep_dummy*		155.10 *	
		(0.09)	
LT1AT × (1–*Bank_Dep_dummy*)		-94.10	
		(0.30)	
STDEBT × *Bank_Dep_dummy*			57.47 ***
			(0.01)
STDEBT × (1–*Bank_Dep_dummy*)			-21.35
			(0.44)
ΔCoef.	239.76 ***	249.20 **	78.82 **
	(0.01)	(0.05)	(0.03)
CONSTANT	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes
Loan variables	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
# of observations	3,669	3,669	3,669
R-squared	0.44	0.44	0.45

Table 10. Loan Spread on Credit lines

This table presents regression results examining whether the effect of short-maturity debt variables on loan spreads is more pronounced on credit lines. The *CREDITLINE* is dummy variable, with value one when the loan type belongs to credit line, otherwise 0. We consider three short-maturity debt proxies, and report results for *ST* in Column 1, for *LT1AT* in Column 2, and for *STDEBT* in Column 3. Results of the tests of the differences between coefficients on the interaction terms are presented in the row titled Δ*Coef*.

	(1)	(2)	(3)
ST × *CREDITLINE*	153.76 ***		
	(0.00)		
ST × (1–*CREDITLINE*)	99.85 **		
	(0.02)		
LT1AT × *CREDITLINE*		180.62 ***	
		(0.00)	
LT1AT × (1–*CREDITLINE*)		54.20	
		(0.29)	
STDEBT × *CREDITLINE*			21.34 ***
			(0.00)
STDEBT × (1–*CREDITLINE*)			13.90
			(0.11)
ΔCoef.	53.91 **	126.42 ***	7.44
	(0.03)	(0.00)	(0.27)
CONSTANT	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes
Loan variables (except "Credit line")	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
# of observations	8,882	8,882	8,882
R-squared	0.46	0.46	0.46

Table 11. All-in-Undrawn spreads

This table present benchmark regression results by dependent variable with all-in-undrawn spreads, instead of all-in-drawn spreads, as used in the main analysis. The all-in-undrawn spreads refers to the undrawn fee includes both the commitment fee and the annual fee that the borrower must pay its bank for funds committed under the credit line but not taken down.

	Dependent variable: All-in-Undrawn spreads		
	(1)	(2)	(3)
ST	13.74 ***		
	(0.00)		
LT1AT		15.22 **	
		(0.02)	
STDEBT			2.60 ***
			(0.01)
CONSTANT	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes
Loan variables	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
# of observations	5,787	5,787	5,787
R-squared	0.29	0.30	0.30

Table 12. Alternative model specification

This table presents regression results on the baseline model with alternative model specification. Column 1-3 shows results by using ordinary least squares (Pool-OLS) regressions with standard errors adjusted for heteroskedasticity and within firm clustering, and include industry fixed effect. Column 4-6 shows results by using random fixed effect model, in which we include industry dummies, and clustered standard errors at firm level. The industry fixed effects are captured by using one-digit SIC industry dummies.

	Pool-OLS	Random effect	Pool-OLS	Random effect	Pool-OLS	Random effect
	(1)	(2)	(3)	(4)	(5)	(6)
ST	45.02 **	86.62 ***				
	(0.05)	(0.00)				
LT1AT			58.97 *	102.09 ***		
			(0.09)	(0.00)		
STDEBT					11.57 **	15.38 ***
					(0.01)	(0.00)
CONSTANT	Yes	Yes	Yes	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes	Yes	Yes	Yes
Loan variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,882	8,882	8,882	8,882	8,882	8,882
R-squared	0.50	0.49	0.50	0.49	0.50	0.49

Table 13. Logarithm of spreads and newly listed firms

This table presents baseline regression results by replacing the raw spreads with the logarithm of loan spreads in Panel A, and by excluding firms with younger than 4 years in Panel B.

	Panel A: Dependent variable: Logarithm of all-in-drawn spreads			**Panel B: Subsample (firms with age > 4 years)**		
Model	(1)	(2)	(3)	(4)	(5)	(6)
ST	0.34 ***			140.14 ***		
	(0.00)			(0.00)		
LT1AT		0.43 ***			147.33 ***	
		(0.00)			(0.00)	
STDEBT			0.06 **			19.13 ***
			(0.04)			(0.00)
CONSTANT	Yes	Yes	Yes	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes	Yes	Yes	Yes
Loan variables	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
# of observations	8,882	8,882	8,882	8,393	8,393	8,393
R-squared	0.52	0.52	0.52	0.45	0.45	0.46

Table 14. Largest loan facility

This table presents the regression results based on the subsample covering only the largest facility on a given loan deal. The sample size is 6,603. The industry fixed effects are captured by using one-digit SIC industry dummies.

Panel A: *ST*

					Risk Indicator			
	Baseline	Pool-OLS	Random Effects	Baseline on MTB	STOCKVOL-A50	ZSCORE-B50	DTD-B50	LINTEREST_COV-B50
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ST	117.33 ***	52.78 ***	79.83 ***					
	(0.00)	(0.01)	(0.00)					
ST × *High_MTB*				28.12				
				(0.38)				
ST × (1–*High_MTB*)				180.55 ***				
				(0.00)				
ST × Risk Indicator					149.86 ***	149.01 ***	134.56 ***	160.58 ***
					(0.00)	(0.00)	(0.00)	(0.00)
ST × (1–Risk Indicator)					73.18 ***	0.21	56.50 *	-30.40
					(0.01)	(1.00)	(0.09)	(0.37)
ΔCoef.				-152.43 ***	76.69 **	148.80 ***	78.05 **	190.98 ***
				(0.00)	(0.02)	(0.00)	(0.02)	(0.00)
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	No	No	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	No	Yes	Yes	No	No	No	No	No
#of observations	5,940	5,940	5,940	5,940	5,940	5,940	5,940	5,940
R-squared	0.48	0.52	0.52	0.48	0.48	0.49	0.48	0.49

Panel B: *LT1AT*

					Risk Indicator			
	Baseline	Pool-OLS	Random Effects	Baseline on MTB	STOCKVOL-A50	ZSCORE-B50	DTD-B50	LINTEREST_COV-B50
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
LT1AT	119.26 ***	77.21 **	101.25 ***					
	(0.00)	(0.02)	(0.00)					
LT1AT × *High_MTB*				-22.98				
				(0.52)				
LT1AT × (1–*High_MTB*)				212.20 ***				
				(0.00)				
LT1AT × Risk Indicator					146.50 ***	150.46 ***	126.63 ***	150.53 ***
					(0.01)	(0.00)	(0.00)	(0.00)
LT1AT × (1–Risk Indicator)					83.70 ***	15.96	96.22 **	-4.14

					(0.01)	(0.75)	(0.02)	(0.94)
ΔCoef.				-235.18 ***	62.79	134.50 **	30.42	154.66 **
				(0.00)	(0.28)	(0.03)	(0.54)	(0.01)
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	No	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	No	No	Yes	No	No	No	No	No
#of observations	5,940	5,940	5,940	5,940	5,940	5,940	5,940	5,940
R-squared	0.48	0.52	0.52	0.48	0.48	0.48	0.48	0.49

Panel C: *STDEBT*

					Risk Indicator			
	Baseline	Pool-OLS	Random Effects	Baseline on MTB	STOCKVOL-A50	ZSCORE-B50	DTD-B50	LINTEREST_COV-B50
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
STDEBT	14.19 ***	8.82 **	11.82 ***					
	(0.01)	(0.03)	(0.00)					
STDEBT × *High_MTB*				2.90				
				(0.64)				
STDEBT × (1–*High_MTB*)				27.29 ***				
				(0.00)				
STDEBT × Risk Indicator					18.34 **	37.43 ***	22.80 ***	44.46 ***
					(0.02)	(0.00)	(0.00)	(0.00)
STDEBT × (1–Risk Indicator)					10.63 *	-2.72	6.47	-7.88
					(0.07)	(0.64)	(0.27)	(0.16)
ΔCoef.				-24.39 ***	7.71	40.16 ***	16.33 **	52.34 ***
				(0.01)	(0.34)	(0.00)	(0.04)	(0.00)
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	No	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	No	No	Yes	No	No	No	No	No
#of observations	5,940	5,940	5,940	5,940	5,940	5,940	5,940	5,940
R-squared	0.48	0.52	0.52	0.49	0.48	0.49	0.48	0.49

Table 15 Consolidated sample (firm-year sample)

This table presents the firm-level regression results based on the consolidated sample, which is constructed by taking the weighted average of loan spreads for a given year in a given firm. This makes the sample become firm-year observation. The consolidated sample contains 5,946 firm-year observations. The industry fixed effects are captured by using one-digit SIC industry dummies.

Panel A: *ST*

	Firm fixed effect	Pool-OLS	Random effect	Firm fixed effect
	(1)	(2)	(3)	(4)
ST	140.12 ***	58.12 ***	88.52 ***	
	(0.00)	(0.01)	(0.00)	
ST × *High_MTB*				56.26 *
				(0.09)
ST × (1–*High_MTB*)				197.83 ***
				(0.00)
ΔCoef.				-141.57 ***
				(0.00)
CONSTANT	Yes	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	No	No	Yes
Industry fixed effects	No	Yes	Yes	No
Observations	5,946	5,946	5,946	5,946
R-squared	0.39	0.44	0.44	0.39

Panel B: *LT1AT*

	Firm fixed effect	Pool-OLS	Random effect	Firm fixed effect
	(1)	(2)	(3)	(4)
LT1AT	148.74 ***	117.52 ***	133.00 ***	
	(0.00)	(0.00)	(0.00)	
LT1AT × *High_MTB*				-1.84
				(0.96)
LT1AT × (1–*High_MTB*)				241.48 ***
				(0.00)
ΔCoef.				-243.32 ***
				(0.00)
CONSTANT	Yes	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	No	No	Yes
Industry fixed effects	No	Yes	Yes	No
Observations	5,946	5,946	5,946	5,946
R-squared	0.39	0.44	0.44	0.39

Panel C: *STDEBT*

	Firm fixed effect	Pool-OLS	Random effect	Firm fixed effect
	(1)	(2)	(3)	(4)
STDEBT	20.53 ***	16.00 ***	18.13 ***	
	(0.00)	(0.00)	(0.00)	
STDEBT × *High_MTB*				10.52

				(0.11)
STDEBT × (1–*High_MTB*)				32.02 ***
				(0.00)
ΔCoef.				-21.49 **
				(0.02)
CONSTANT	Yes	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	No	No	Yes
Industry fixed effects	No	Yes	Yes	No
Observations	5,946	5,946	5,946	5,946
R-squared	0.40	0.44	0.44	0.40

Table 16. Simultaneous Equation Model: Consolidated sample (firm-year sample)

This table presents results on a system of simultaneous equations model, include the loan spread equation, the short-maturity debt equation, and the leverage equation. These equations are shown in Equation 3, 4, and 5 respectively, in the main context. The "Two-Equation System" only includes the loan spread equation and short-term debt equation. The "Three-Equation System" includes all three equations. The model is performed based on the consolidated sample (firm-year sample). We estimate the SEM by generalized method of moments (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. Panel A, B, and C present results in terms of using *ST*, *LT1AT*, and *STDEBT* respectively.

Panel A: *ST*

	Two-Equation System		Three-Equation System		
	Spread	*ST*	*Spread*	*ST*	Leverage
Spread		0.0007 ***		0.0015 ***	0.0059 ***
		(0.00)		(0.00)	(0.00)
ST	180.7599 ***		170.6869 ***		-0.8583 ***
	(0.00)		(0.00)		(0.00)
Leverage	75.4510 ***	-0.0265	132.2358 ***	-0.1485 ***	
	(0.00)	(0.11)	(0.00)	(0.00)	
ASSET_MAT		-0.0003		0.0001	
		(0.16)		(0.64)	
Log age	-5.1682 ***		-2.2058 ***		
	(0.00)		(0.00)		
Log sales	-22.3232 ***	-0.0023	-22.6560 ***	0.0347 **	0.1389 ***
	(0.00)	(0.77)	(0.00)	(0.02)	(0.00)
LSALES_squared		0.0015 **		-0.0001	
		(0.01)		(0.95)	
FIXED_ASSET					0.0881 ***
					(0.00)
MTB	-9.3990 ***	0.0041 **	-10.7546 ***	0.0138 ***	0.0634 ***
	(0.00)	(0.03)	(0.00)	(0.00)	(0.00)
Profit margin	-15.5945 **		-13.3022 ***		0.0743 **
	(0.04)		(0.01)		(0.02)
Interest coverage	-0.0482 ***		-0.0150 ***		
	(0.00)		(0.00)		
Net working capital	0.0269 *		0.0293 ***		
	(0.07)		(0.00)		
Tangibility	-10.9122 *		-8.9218 **		
	(0.07)		(0.01)		
R&D	-28.6297		-1.1955		
	(0.19)		(0.63)		
Advertising	135.2348 ***		29.9387 ***		
	(0.00)		(0.00)		
Stock volatility	84.6584 ***	-0.0578 ***	113.7636 ***	-0.1610 ***	-0.7471 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Excess stock return	-7.1017 ***	0.0078 ***	-13.0226 ***	0.0214 ***	0.0905 ***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Distance-to-default	-2.6777 ***		-0.9871 ***		
	(0.00)		(0.00)		
LIBOR	-4.0443	0.0062 *	-1.3534 ***	0.0121	
	(0.14)	(0.06)	(0.00)	(0.32)	
CONSTANT	261.6121 ***	-0.0803 *	188.5836 ***	-0.3431	-0.9156 ***
	(0.00)	(0.08)	(0.00)	(0.10)	(0.00)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes

Panel B: *LT1AT*

	Two-Equation System		Three-Equation System		
	Spread	*LT1AT*	*Spread*	*LT1AT*	Leverage
Spread		0.0005 ***		0.0009 ***	0.0058 ***
		(0.00)		(0.00)	(0.00)
LT1AT	274.3730 ***		256.7646 ***		-1.2920 ***
	(0.00)		(0.00)		(0.00)
Leverage	86.0844 ***	-0.0219 *	141.5287 ***	-0.1039 ***	
	(0.00)	(0.05)	(0.00)	(0.00)	
ASSET_MAT		-0.0002		0.0002	
		(0.23)		(0.12)	
Log age	-5.3560 ***		-1.8894 ***		
	(0.00)		(0.00)		
Log sales	-22.1614 ***	0.0081	-22.3523 ***	0.0370 ***	0.1341 ***
	(0.00)	(0.13)	(0.00)	(0.00)	(0.00)
LSALES_squared		0.0001		-0.0015 *	
		(0.87)		(0.07)	
FIXED_ASSET					0.0870 ***
					(0.00)
MTB	-9.8741 ***	0.0043 ***	-11.0333 ***	0.0101 ***	0.0644
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Profit margin	-14.5273 **		-15.8295 ***		0.0887 ***
	(0.04)		(0.00)		(0.00)
Interest coverage	-0.0372 **		-0.0107 ***		
	(0.01)		(0.00)		
Net working capital	0.0294 **		0.0178 ***		
	(0.03)		(0.00)		
Tangibility	-12.0207 **		-10.7209 ***		
	(0.04)		(0.00)		
R&D	-21.4583		-3.8266 *		
	(0.31)		(0.08)		
Advertising	59.4038		18.9746 ***		
	(0.13)		(0.00)		
Stock volatility	90.4599 ***	-0.0497 ***	116.0280 ***	-0.1063 ***	-0.7365 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Excess stock return	-8.9685 ***	0.0083 ***	-13.8846 ***	0.0158 ***	0.0918 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Distance-to-default	-2.3924 ***		-0.8657 ***		
	(0.00)		(0.00)		
LIBOR	-3.1362	-0.0003	-1.0346 ***	0.0128	
	(0.25)	(0.91)	(0.00)	(0.10)	
CONSTANT	242.6693 ***	-0.0515	175.9991 ***	-0.3565 ***	-0.8581 ***
	(0.00)	(0.10)	(0.00)	(0.01)	(0.00)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes

Panel C: *STDEBT*

	Two-Equation System		Three-Equation System		
	Spread	*STDEBT*	*Spread*	*STDEBT*	Leverage
Spread		0.0055 ***		0.0068 ***	0.0050 ***
		(0.00)		(0.00)	(0.00)
STDEBT	66.9721 ***		65.0958 ***		-0.3804 ***
	(0.00)		(0.00)		(0.00)
Leverage	142.8408 ***	-1.1306 ***	162.2282 ***	-1.4049 ***	
	(0.00)	(0.00)	(0.00)	(0.00)	
ASSET_MAT		0.0003		0.0010 **	
		(0.52)		(0.04)	
Log age	-5.6242 ***		-3.7109 ***		
	(0.00)		(0.00)		
Log sales	-22.7495 ***	0.1024 ***	-23.0057 ***	0.1472 ***	0.1217 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LSALES_squared		0.0020		0.0008	

		(0.15)		(0.51)	
FIXED_ASSET					0.0713 ***
					(0.00)
MTB	-12.0653 ***	0.0838 ***	-12.3470 ***	0.0993 ***	0.0663
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Profit margin	-13.9385 ***		-9.5717 ***		0.0334 ***
	(0.00)		(0.00)		(0.01)
Interest coverage	-0.0151		-0.0182 ***		
	(0.16)		(0.00)		
Net working capital	0.0410 ***		0.0369 ***		
	(0.00)		(0.00)		
Tangibility	-13.1061 ***		-11.9607 ***		
	(0.00)		(0.00)		
R&D	-8.1587		-4.7814		
	(0.46)		(0.19)		
Advertising	74.9612 ***		38.6651 ***		
	(0.00)		(0.00)		
Stock volatility	87.8219 ***	-0.5244 ***	100.3851 ***	-0.7070 ***	-0.5826 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Excess stock return	-7.5006 ***	0.0544 ***	-10.1204 ***	0.0783 ***	0.0671 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Distance-to-default	-2.3211 ***		-1.6041 ***		
	(0.00)		(0.00)		
LIBOR	-3.7717	0.0235	-1.5370 *	0.0131	
	(0.17)	(0.18)	(0.06)	(0.12)	
CONSTANT	225.4160 ***	-0.6594 ***	185.9958 ***	-0.8014 ***	-0.6993 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes

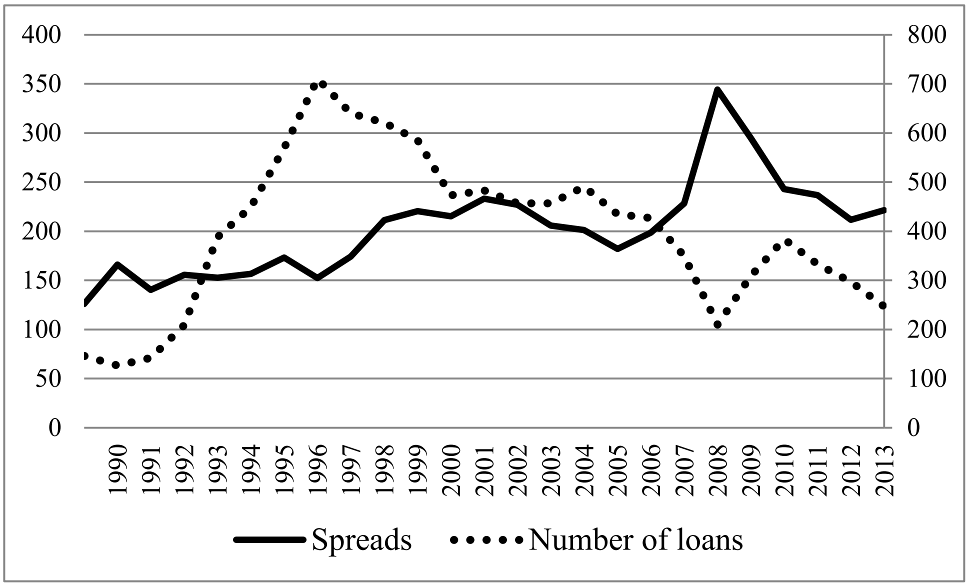
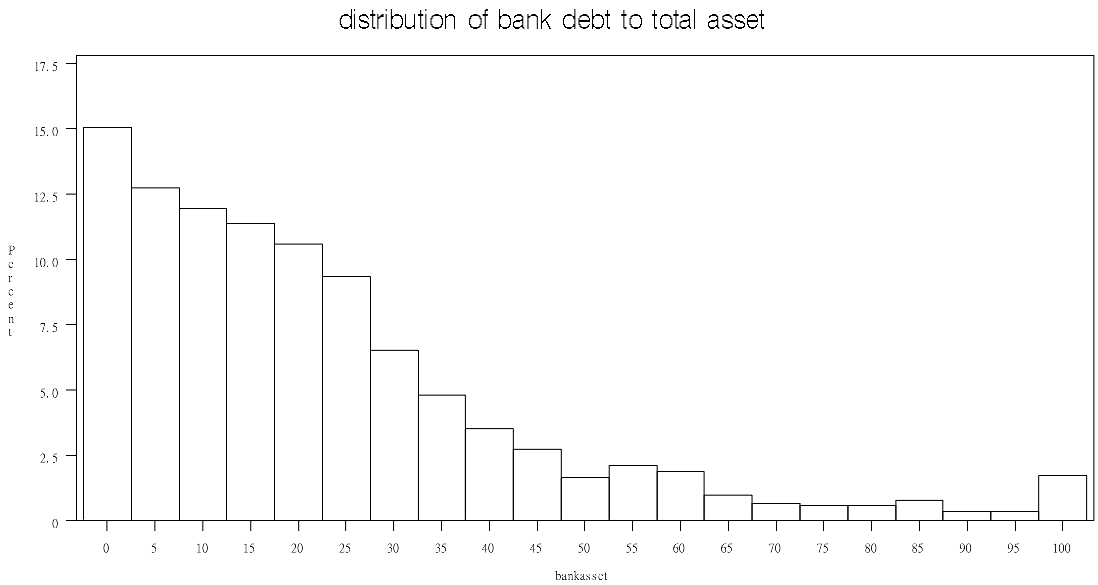
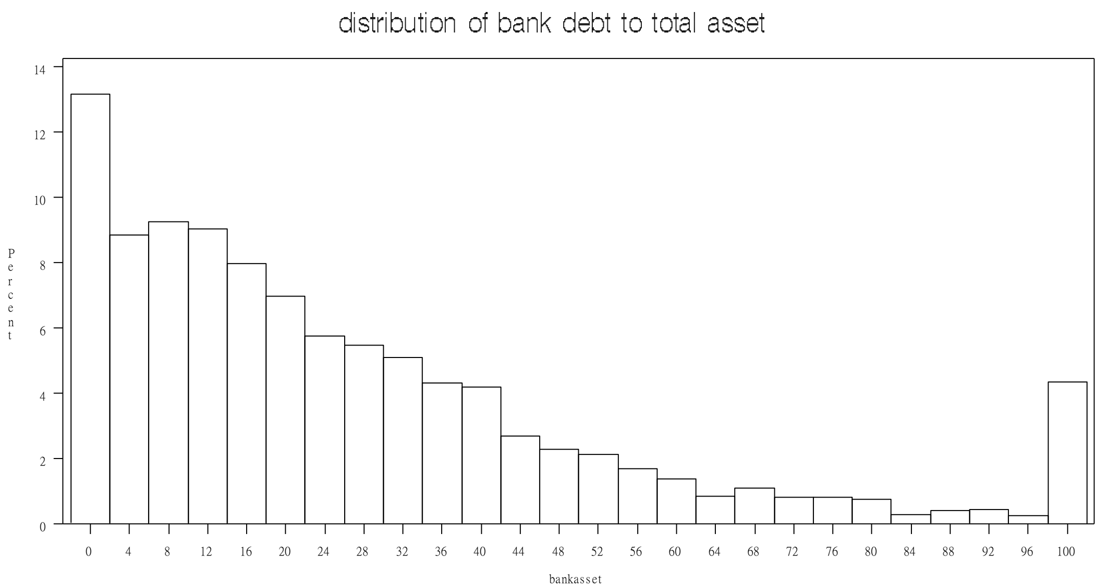


Figure 1. Syndicated loans in U.S. market during 1990–2014.

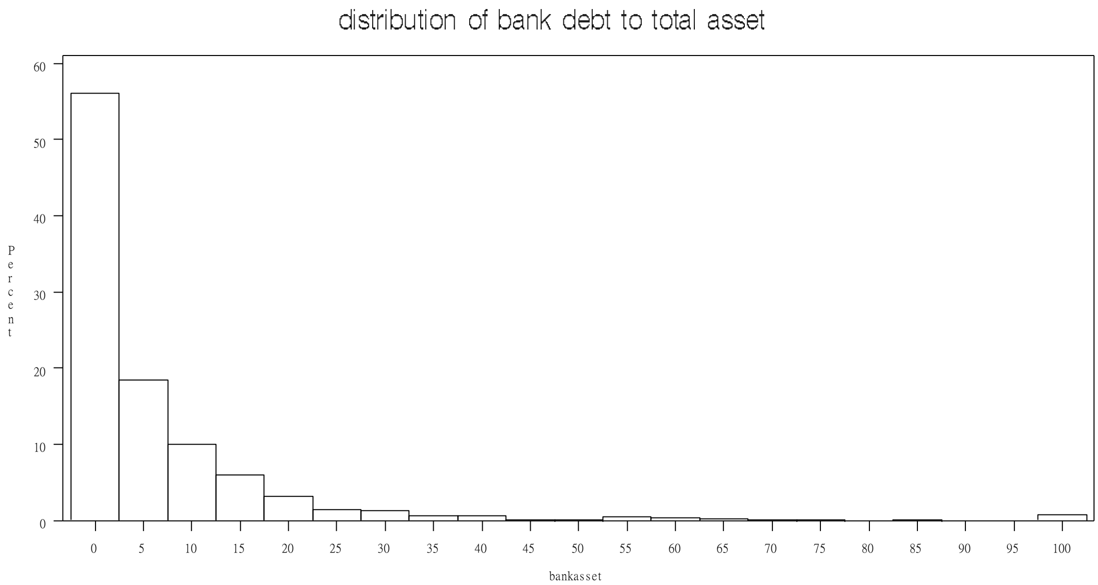
This figure presents all-in-drawn spreads (AIDS) with the solid line scaled in the left y-axis and total number of loans with the dotted line scaled in the right y-axis in the U.S. syndicated loan market from 1990 to 2014.



unrated firms



Speculative grade firms



Investment grade firms

Figure 2. The distribution of the ratio of bank debt to asset.

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 loan level observations for unrated firms, 4,183 loan level observations for speculative grade firms, and 2,330 loan level observations for investment grade firms.

Online Appendix

Debt Maturity and the Costs of Bank Loans

Table OA1. Mean (Median) Loan Spreads, Categorized by debt maturity proxies (ST3, ST5, and MAT) from the Fiscal Year End.

This table presents *Spread* (basis points) across quartiles of short-maturity debt proxies (i.e., *ST3, ST5, and MAT*) and new issuance loan duration. For each year, firms are classified into one of four groups. The means are reported below, with the medians in brackets among firms classified to quartiles. Panel A presents results based on the full sample, and Panel B and C presents results for low growth firms and high growth firms respectively. ***, **, and * denote statistical significance of the *t*-tests at the 1%, 5%, and 10% level, respectively.

Panel A: All firms			
Debt Maturity Variable Quantiles	*ST3*	*ST5*	*MAT*
1 = Low	201.97	196.39	204.72
	(175)	(175)	(190)
2	200.46	195.35	202.99
	(180)	(175)	(187.5)
3	197.73	207.76	200.78
	(175)	(200)	(175)
4 = High	207.61	208.51	199.68
	(200)	(200)	(175)
Two sample differences tests			
High – Low (Mean)	5.64 **	12.12 ***	-5.04 *
High – Low (Median)	25 ***	25 ***	-15 **
Panel B: Low-MTB firms			
Debt Maturity Variable Quantiles	*ST3*	*ST5*	*MAT*
1 = Low	218.98	213.75	235.05
	(200)	(200)	(225)
2	218.63	216.52	215.53
	(200)	(200)	(200)
3	219.69	232.00	223.12
	(200)	(225)	(225)
4 = High	231.82	225.30	215.20
	(225)	(215)	(200)
Two sample differences tests			
High – Low (Mean)	12.84 ***	11.55 ***	-19.84 ***
High – Low (Median)	25 ***	15 ***	-25 ***
Panel C: High-MTB firms			
Debt Maturity Variable Quantiles	*ST3*	*ST5*	*MAT*
1 = Low	184.75	180.88	180.89
	(150)	(150)	(150)
2	180.26	164.03	182.52
	(150)	(150)	(165)
3	171.16	189.99	180.93
	(150)	(175)	(150)
4 = High	190.14	192.18	183.81
	(175)	(163.75)	(150)
Two sample differences tests			
High – Low (Mean)	5.39	11.30 **	2.92
High – Low (Median)	25 *	13.75 *	0

Table OA2. Alternative Short-term debt proxy and Loan Spreads

This table presents the results of regressing loan spreads on short-debt ratios (*ST3, ST5, and MAT*). We return to our baseline regressions but with replacements of different debt maturity proxies. All estimations are done with clustered standard errors at firm level. P-values are reported in parenthesis. Indicator variables for year, firm fixed effect are not reported.

	(1)	(2)	(3)
ST3	6.27		
	(0.19)		
ST5		16.59 ***	
		(0.01)	
MAT			-1.96 **
			(0.01)
CONSTANT	Yes	Yes	Yes
Firm variables	Yes	Yes	Yes
Loan variables	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes
Observations	8,882	8,856	8,856
R-squared	0.46	0.46	0.46

Table OA3. Simultaneous Equation Model: Consolidated sample (firm-year sample) dependent on growth opportunity

	Two-Equation System			Three-Equation System		
	Spread			*Spread*		
ST × *High_MTB*	89.47 ***			80.01 ***		
	(0.00)			(0.00)		
ST × (1-*High_MTB*)	184.34 ***			225.98 ***		
	(0.00)			(0.00)		
LT1AT × *High_MTB*		90.32 ***			75.17 *	
		(0.00)			(0.05)	
LT1AT × (1-*High_MTB*)		295.98 ***			367.47 ***	
		(0.00)			(0.00)	
STDEBT × *High_MTB*			54.33 ***			51.77 ***
			(0.00)			(0.00)
STDEBT × (1-*High_MTB*)			71.18 ***			78.53 ***
			(0.00)			(0.00)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes