Debt Maturity and the 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

JEL classification: G12; G21; G31; G32

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1. Introduction

The simple debt-equity choice cannot full reflect a firm's capital structure. Debt maturity is a particular attribute of the debt structure that has received much attention, especially since Myers' (1977) suggestion that short term debt helps alleviate the underinvestment problem. Previous literature focus on the link between debt maturity and investment policy. In this study, we examine whether and how a firm's debt maturity structure affects the perspective of banks on charging loan rates. To our knowledge, this is the first empirical study linking corporate debt maturity to the interest rates on bank loan contracts.

He and Xiong (2012) establish a link between debt maturity structure and credit risk by suggesting that the rollover risk (from shorter-maturity debt) intensifies the shareholders–debtholders conflicts in which shareholders are motivated to default earlier. We argue that if creditors price the rollover risk, they would require a risk premium sufficient to compensate for both default and rollover risks. On the other hand, short-term debt can discourage a firm's risk-seeking behavior as argued in the asset substitution literature (see Jensen and Meckling, 1976). Several studies document that firms with more growth options have greater incentives to shift their investments toward risky assets (see Johnson, 2003; Billett, King, and Mauer, 2007; and Eisdorfer, 2008). Therefore, we hypothesize that the impact of debt maturity on bank loan rates is contingent upon the growth options of firms. In particular, the firms with many growth opportunities which are likely to be subject to severe agency conflicts may benefit from short maturity structure pay less because of the mitigation effect of asset substitution problems.

We empirically examine this prediction by focusing on the private credit agreements in the syndicated loan market. We construct a large panel data set consisting of syndicated loans granted in the U.S. market from 1990 to 2014. Our sample contains 9,941 loan facilities from 2,754 unique firms. Our loan pricing model is based on the one proposed by Santos (2011), in which the all-in-drawn spreads is used to capture the overall cost of loan, and includes many firm-specific variables and loan-specific characteristics that are considered to be important to spreads. We extend his model by adding our short-debt ratio variable (i.e., the proportion of a firm's short-term debts to its total asset values); the estimates along with this variable allow us to examine the extent to which the impact of short-term debts on loan spreads.

Our findings support the rollover risk hypothesis that short debt maturity 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 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

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

[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.

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 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 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

[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.

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 the results of robustness tests. Section 6 discusses how we address the endogenous problem. Section 7 concludes.

2. Theoretical Background and Hypotheses

The purpose of this study is to examine whether and how a firm's debt maturity structure affects the cost of bank loans. Existing literature establishes that the link between debt maturity structure and bank loan pricing can be supported by the following theories: On one hand, the rollover risk of short term debt leads to banks charging a higher premium in addition to the required credit premium. On the other hand, the agency theory suggests that short-maturity debt reduces a firm's risk-seeking behaviors, and consequently banks should charge a lower interest rate on corporate loans. Below we present these theories and propose our hypotheses on debt maturity structure and the cost of bank loans.

2.1 Rollover Risk

He and Xiong (2012) argue that rollover risk can be a source of credit risk, because it sharpens the conflicts of interest between shareholders and debtholders in

[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.

which shareholders bear the refinancing costs, leading to insolvency even when the value of a firm's assets is higher than the insolvency threshold without the rollover risk. Gopalan *et al*. (2014) provide empirical evidence that firms with a greater exposure to rollover risk are more likely to be downgraded than firms with similar risk characteristics. Chiu, Peña, and Wang (2015) find that the exposure to rollover risk increases the expected default probabilities of a company. One empirical implication of this theory is if creditors recognize the dampening effect of the rollover risk on the borrower's credit worthiness, they should require a higher risk premium to compensate for the increase in credit risk. Recent empirical studies provide support for this conjecture by examining the pricing of credit default swaps (Chen *et al*., 2012), and corporate bonds (Gopalan *et al*., 2014; Valenzuela, 2015).

Existing studies focus on the *public debt and swap* markets. We argue that the rollover risk through which creditors require a higher rate on corporate loans should play a major role in the pricing of *private debt*. As private debt issues are usually structured with a shorter maturity than publicly traded debt, the effect of rollover risk is expected to be prominent in the private debt market, probably more so than in the public debt market. Furthermore, the majority of private debt is in the form of syndicated bank loans; we are motivated to focus on the impact of debt maturity on the spreads on bank loans.

A firm with a shorter debt maturity has a higher likelihood of refinancing, resulting in greater exposure to rollover risk and stronger interdependence between rollover risk and credit risk. This should lead to a higher level of credit risk. If banks recognize this increase in credit risk and price the loans accordingly, one would expect a higher bank loan rate for firms with a shorter debt structure. Based on the above discussion, our first hypothesis is stated as follows:

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

2.2 Asset Substitution

In contrast with the rollover risk explanation, the asset substitution problem in agency theory suggests that short-term debt may reduce the cost of bank loans. Jensen and Meckling (1976) argue that shareholders prefer investments in risky projects, because their payoffs become larger as a firm's volatility increases. On the other hand, debtholders who are fixed income claimants may be negatively affected by firms making riskier investments and therefore increasing the default risk of outstanding debt. The asset substitution problem arises when shareholders have the incentives to exploit bondholder wealth by replacing low-risk investments with high-risk ones.

One possible solution to alleviate the asset substitution problem is to employ short-term debt. Firms with more short-term debt are subject to greater monitoring of the investment policy and more frequent renegotiations and scrutiny of the borrowers (Jensen and Meckling, 1976). There is substantial evidence that banks demand higher loan spreads in anticipation of the potential risks they face in debt contracting (Bharath, Sunder, and Sunder, 2008; Graham, Li, and Qiu, 2008; Hasan, Hoi, Wu, and Zhang, 2014). If banks recognize that effect of short term debt on restraining managerial risk-seeking incentives and rationally price loans, lower interest rates should be charged on loans extended to firms with a shorter debt maturity in their capital structure.

In addition, literature suggests that the incentives to shift investments toward risky assets vary across firms. More specifically, firms with more growth options have the strongest incentives to engage in asset substitution behavior (see Johnson, 2003; Billett *et al*., 2007; and Eisdorfer, 2008). Therefore, the mitigation effect of short-term debt on loan costs is likely to be limited to or most prominent in high-growth firms. Our second hypothesis is stated as follows:

Hypothesis 2. Firms with a shorter debt maturity structure pay lower interest rates on bank loans than those with a longer debt maturity. Given the same level of debt maturity, firms with greater growth opportunities are able to obtain lower loan rates from banks than lower-growth firms.

3. Sample Data and Variable Construction

3.1 Sample Construction

Information on all U.S. syndicated loans for the sample period from 1990 to 2014 are collected from the Dealscan LPC database.[5] We perform the following sample screening process. First, we exclude firms in highly regulated industries including financial firms (standard industrial classification [SIC] codes of 6000–6999), utilities (SIC codes of 4900–4999), and quasi-public firms (SIC codes over 8999). Second, we exclude privately held firms from our sample as we require accounting and equity information to measure debt maturity and other firm characteristics. We then merge the loan sample with COMPUSTAT and CRSP by using the conversion table provided by Chava and Roberts (2008). This process generates our initial sample of bank loans.

For the cost of bank loans, we follow the literature and adopt the all-in-drawn spreads (*Spread*) as the overall cost of loan (e.g. Santos, 2011). We require non-missing values of the main variables of interest: *Spread*, short-term debt, and long-term debt maturing in a year. We also exclude observations with missing value of firm-specific and loan-specific variables. In addition, we exclude firms with ratings from our main analysis, because rated firms are able to access public debt

[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.

markets, making them less dependent on bank borrowing. However, there is a possibility that rated firms finance mainly from banks. We test the two main hypotheses using the rated firms and examine how the degree of bank debt dependence affect the results.

To minimize the effects of outliers, *Spread* and all explanatory variables are winsorized at the 1st and 99th percentiles. 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) and the total number of loans (dotted line scaled in the right y-axis). *Spread* exhibits a significant increase during the financial crisis. The number of loans increases steadily since 1992, except for a significant drop during the financial crisis.

[Insert Figure 1]

3.2 Variable Construction

3.2.1 Debt maturity structure

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 debt. We use the proportion of a firm's short-term debt to total asset (*ST*) as the main measure of debt maturity structure.[6] One concern regarding *ST* is that the level of short-term debt may be simultaneously determined with the cost of bank loans or there are unobserved risks or factors driving both, resulting an endogeneity problem. To address this issue, we consider the ratio of long-term debt maturing in one year to total asset (*LT1AT*) as the second proxy for debt maturity. *LT1AT* is most appropriate for testing the rollover risk theory as suggested in recent studies (e.g., Almeida *et al.*, 2012; Gopalan *et al*., 2014),

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

because unlike short-term debt, long-term debt is previous determined and is less likely to be correlated with the firm's current risk characteristics. Finally, we use the ratio of short-term debt to total debt as the third debt maturity proxy (*STDEBT*).

3.2.2 Control variables

We consider the following firm- and loan-specific variables as determinants of loan spreads as suggested by the literature on loan contracting (see e.g., Santos and Winton, 2008; Santos, 2011). For firm-specific variables, we include *age* (Log of age) and *size* (Log of total sales). Both variables are expected to be negatively associated with loan spreads, as older or larger firms are usually better established and more diversified and therefore are considered less risky. In addition, we use *leverage* as a higher level of firm leverage is associated with greater default risk and should have a positive effect on loan spreads. To measure a firm's capability to service debt, we include *profit margin* and *interest coverage*. Better profitability or a higher interest coverage ratio indicates lower credit risk and should have a negative impact on spreads.

To further capture the impact of credit risk, we control for the size and quality of the assets that debt holders can draw upon default. Tangible assets (*tangibility*) provide better protection for debtholder wealth in the event of default and are expected to have a negative effect on spreads. On the other hand, *R&D* and *advertising* proxy for a firm's brand equity which is less likely to shield debtholders from default loss, and are expected to be positively related to loan spreads. Furthermore, we include *net working capital* to reflect liquid assets, which help reduce value loss in default events. We expect it to have a negative effect on spreads. Furthermore, we use *Market-to-book* ratio to proxy for firm growth, which is expected to be negatively related to spreads. In addition to the aforementioned accounting-based measures, we further control for two market-based risk indicators:

excess stock return and *stock volatility*. The former represents a firm's financial performance relative to the market and is expected to have a negative impact on spreads. The latter measures stock return volatility, which is positively linked to default risk. Thus we expect it to have a positive impact on spreads.

Finally, we include a forward-looking default risk indicator, *distance-to-default*, based on KMV methodology.[7] This measure is widely used in the literature as a proxy for the likelihood of a borrower's default. A higher value of this variable indicates that a firm is farther away from its default threshold. We expect it to be negatively related to the loan spreads.

For loan characteristics, we first include *log loan size* and *log loan duration*. The impacts of the two variables on spreads are ambiguous. Larger loan size may lead to greater credit risk, however it may allow for economies of scale in processing and monitoring. Similarly, loans with a longer maturity carry greater credit and term risks, but they are more likely to be granted to borrowers with better credit. We also include dummy variables to indicate dividend restrictions, seniority, and security respectively. Since the purpose of the loan may also affect its spreads, we include dummy variables to distinguish among loans for general corporate purposes, loans for repaying existing debt, and working capital loans. We also consider the type of the loan contract by indicating whether a loan is a term loan, bridge loan, and line of credit.[8] Finally, in addition to variables suggested in Santos (2011), we include the *logarithm number of lenders*. Santos and Winton (2008) suggests that this measure can proxy for the hold-up effect and is expected to have a negative effect on spreads. Detailed descriptions of the aforementioned variables are

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

[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.

provided in Appendix A.

3.3 Descriptive Statistics

We present the descriptive statistics of the variables in Table 1. The mean value of *ST* is 0.051, suggesting that for an average firm, the amount of short-term debt is 5.1% of total assets. As can be expected, *LT1AT* is lower than *ST* with a mean value of 0.027, indicating that long term debt that is maturing accounts for about half of the short term debt. The mean value of *STDEBT* is 0.25, suggesting that on average a quarter of debt will mature in one year. Table 1 also reports the summary statistics of loan characteristics. On average, bank loans have an issue size of $140.67 million, a spread of 202 basis points over LIBOR, and a duration of 4 years. About 25.7% of the loans in our sample are term loans.

[Insert Table 1 here]

3.4 Variable Correlation

Table 2 presents the correlations among the debt maturity measures, leverage, and loan duration. The positive correlations between short term debt ratios and loan spread provide preliminary support for the rollover risk hypothesis. In particular, the correlations between *Spread* and the short term debt ratios range from 0.03 to 0.17. Interestingly, the correlation between *Spread* and loan duration is 0.01. Despite the extensive literature on the strong link between loan duration and spread, the preliminary finding suggests that the balance-sheet debt maturity structure may play a more significant role in determining the cost of bank loans than the incremental debt maturity reflected in loan duration. Therefore, it is important to examine the impact of the balance-sheet debt maturity structure on loan spreads. Finally, the correlations between leverage and short-term debt variables are relatively low, suggesting that a firm’s capital structure cannot fully explain its debt maturity structure. In the following sections, we provide in-depth investigation of the effect of a firm's debt maturity structure on its cost of bank loans after controlling for leverage and other risk factors.

[Insert Table 2]

4. Empirical Results

4.1 Univariate Analysis of Loan Spreads

In this section, we present a set of univariate results on the relation between short term debt ratios and loan spreads. We first show *Spread* across quartiles of short-maturity debt proxies (i.e., *ST, LT1AT,* and *STDEBT*) for the full sample. In a given year, firms are classified into one of four quartiles, and we report the mean and median *Spread* by quartile. Panel A of Table 3 shows the results for the full sample. We find that *Spread* monotonically increases as *ST* increases from the lowest to the highest quartile. The mean (median) comparison between the lowest and highest quartiles indicates a difference in spread of 43 basis points (62 basis points), which is significant at the 1% level. We find similar patterns when using *LT1AT* or *STDBET* as an alternative debt maturity proxy.[9] These preliminary

[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.

findings support *Hypothesis 1* that banks charge a higher loan rate for firms with shorter debt maturity due to greater rollover risk. For loan duration, we observe a U-shape pattern in which firms pay a lower interest rate when obtaining loans with an intermediate duration, while they pay a higher rate when the loan is with the shortest or longest duration. Our finding is consistent with the ambiguous effect of loan duration on loan spreads as suggested by current literature.[10]

To gain insights on *Hypothesis 2*, we perform the same analysis on low-growth firms (Panel B) and high-growth firms (Panel C) respectively. For the low-growth firms, we continue to find a strong and positive relationship between the short-term debt ratios and loan spreads across all proxies. In contrast, for high-growth firms this positive relation no longer exists for *STDEBT*, and becomes weaker for *ST* based on the magnitude of the difference in mean (or median) spread between the highest and lowest quartiles. This result lends support for the conjecture that short-term debt alleviates the asset substitution problem which is most prominent for high-growth firms, resulting in a negative impact on loan spreads. The insignificant or weaker relation between short term debt ratios and loan spreads for high-growth firms reflects the counteraction of the negative effect based on asset substitution argument and the positive effect from the rollover risk explanation. This finding provides preliminary evidence for *Hypothesis 2*. Overall, the univariate results on the relation between short-term debt ratios and loan spreads strongly support our hypotheses that firms with more short-term debt pay higher loan spreads to banks. On the other hand, we find evidence to support that short-term debt reduces loan spreads as it mitigates the asset substitution problem especially for

[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.

high-growth firms.

[Insert Table 3]

4.2 Multivariate Analysis of Loan Spreads and Debt Maturity Structure

In this section, we explore the relation between loan spreads and debt maturity structure in a multivariate framework. In particular, we regress loan spreads on short-maturity debt proxies after controlling for firm- and loan-specific variables that have been documented in the literature as important determinants of spreads.

4.2.1 Empirical methodology

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

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

where *i*,*j*,*t*, and *d* denote the i^{th} firm and j^{th} loan for year *t* and day *d*. *Spread* is the loan interest payment over LIBOR in basis points (i.e., the all-in-drawn spread) for a loan facility *j* of firm *i* on date *d* in year *t*. *ST* is our main variable of interest (the ratio of short-term debt to total assets). We use two alternative short-term debt proxies: *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 maturity structure should be charged a larger spread, thus we expect β > 0.

X represents a vector of firm-level control variables and **Y** represents a vector of contemporaneous loan-level control variables that are expected to affect the loan spreads. All firm-level variables are measured at the fiscal-year-end immediately prior to the origination of the loan contract. We follow Santos (2011) to include the firm fixed effects. The loan spread is also likely to be affected by time fixed effects, in which some unobserved factors influence loan spreads systematically across the firms at a given time point. To address this concern, we estimate the models by including the time fixed effects. We include LIBOR 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 the firm level as suggested by Petersen (2009).

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

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

[Insert Table 4]

Based on the estimates in Model 4 and the average loan spread of 202 basis points, a one-standard-deviation increase in *ST* leads to an increase in loan spread by 11.44 basis points, which is 5.66% of the average loan spread.[12] Given that the average loan size and time to maturity are $140.67 million and 4 years respectively, a one-standard-deviation increase in *ST* results in an increase of $643,706 (= $140.67 million × 0.001144 × 4) in interest expense. The effect of *ST* on the cost of

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

[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%.

bank loans is both statistically and economically significant.

We find similar results when the two alternative short term debt proxies, *LT1AT* and *STDEBT*, are employed. The estimated coefficients are positive and highly statistically significant (Models 5 and 6). The impact of *LT1AT* or *STDEBT* on *Spread* is also economically significant. A one-standard-deviation increase in *LT1AT* (*STDEBT*) leads to an increase in loan spreads by 6.32 (4.41) basis points.[13] Taken together, our results suggest that firms with a higher level of short maturity debt pay a much higher loan spread when borrowing from banks.

Our findings suggest that the short term debt ratio, *ST*, may have a stronger impact on loan spreads than other factors suggested in the literature. Recall that a one-standard-deviation increase in ST is associated with an estimated increase of 11.44 basis points in loan spread. Bharath, Sunder, and Sunder (2008), Francis, Hasan, 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, 4.87, and 4.33 basis points, respectively.

For firm-specific variables, we find that the results are generally significant and are consistent with expectations. First, firms with higher stock return volatility have greater default risk, leading to a positive effect on spreads. In contrast, firms that outperform the market or their asset value is larger than the default barrier should pay lower spreads. Second, results on firm size, leverage, profitability and growth are consistent with those in Santos (2011). In particular, firms those are

[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.

larger, less levered, more profitable, or high-growth pay significantly lower spreads. Interestingly, firm age is positively related to spreads in some models.[14]

The coefficients on loan characteristics (e.g., loan amount, loan type, purpose dummies, and number of leaders) are generally significant. We focus the discussion on loan duration for two reasons. First, the duration of new loans contributes to a firm's debt maturity structure and it represents the concept of incremental debt maturity. Second, the literature on loan contracting widely accepts that loan duration as an important determinant of loan spreads, however its impact on spread is ambiguous.[15] In Appendix B, we summarize the major findings of selected studies on how loan duration drives loan spreads. Our results indicate that the estimated coefficient of *log loan duration* is not significant across models, implying that a firm's overall debt maturity (as measured by short term debt ratio proxies) is more informative than the incremental debt maturity (i.e., loan duration) in terms of explaining loan spreads. *LIBOR* is negatively associated with spreads, which is consistent with Acharya *et al*. (2013). Overall, we find strong evidence in support of *Hypothesis 1* that the rollover risk associated with firms with short debt maturity structure is recognized and priced in corporate loan rates.

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

To shed light on the importance of asset substitution theory in explaining the relation between debt maturity structure and loan spreads, we preform the regression analysis to examine whether the effect of rollover risk on spreads varies

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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.

[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).

systematically by growth opportunities. We hypothesize that if short term debt mitigates the asset substitution problem, the net effect of short term debt on spreads should be the result of the positive impact based on rollover risk and the negative effect based on the alleviation of asset substitution. As the asset substitution problem is most severe in high-growth firms, we expect to observe significantly smaller or minimal effect of short term debt on loan spreads for high-growth firms. On the other hand, the effect of short-term debt on spreads should attribute mainly to the rollover risk for *low-growth* firms, indicating a strongly positive impact.

To test this prediction, we use the market-to-book ratio (*MTB*) as the proxy for a firm's growth options. We create a dummy variable, *High_MTB*, to identify firms with *MTB* above the median value of 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 interaction variables are structured to test the possibility that the effect of short-term debt on loan spreads is conditioned on a firm's growth opportunities. The model is specified as follows:

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

As discussed above, we expect β_1 to be nonsignificant because for *high-growth* firms, the net effect of short term debt on loan spreads is jointly determined by the increasing impact from rollover risk and the decreasing effect from the mitigation of the asset substitution problem. Conversely, the β_2 is expected to be significantly positive as predicted in *Hypothesis 1* mainly due to rollover risk, because *low-growth* firms have little or no incentives in using short-term debt to mitigate the asset substitution problem.

We present the regression results in Table 5. For *ST* (Model 1), we find that the coefficient of $ST_{i,t\text{-}1}$×*High_MTB* is positive but weakly significant, whereas the coefficient of $ST_{i,t\text{-}1}$×(1–*High_MTB*) is positive and highly significant at the 1% level. The difference in coefficient (see the row titled *ΔCoef.*) is significantly different from 0, indicating that the two coefficients are significantly different from each other. Model 2 and 3 results suggest similar results when *LT1AT* and *STDEBT* are used.

[Insert Table 5]

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

These results offer strong support for *Hypothesis 2*: high-growth firms

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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.

experience the two contradicting effects of short-maturity debt and the net effect on loan spreads becomes insignificant. On the other hand, for low-growth firms, the rollover risk effect outweighs the attenuation of asset substitution problem. So the net effect of short term debt on spread is significantly positive.

4.3 *Debt Maturity, Loan Spreads and Firm Risk*

In this section, we investigate how firm risk affects the link between short term debt and the cost of bank loans.

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

He and Xiong's (2012) model highlights that when a firm is sensitive to negative shocks and short term debt accounts for a significant portion of its capital structure, an unfavorable event may lead to a large drop in liquid reserves which causes the firm to bear great refinancing losses rolling over its short term debt. Based on this argument, a high-risk firm is likely to face larger rollover (and therefore credit) risk than a low-risk firm given the same debt maturity sturcture. 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 risk firms. Furthermore, Gopalan *et al.* (2014) empirically document that bondholders require larger spreads on firms with more debt maturing in the next year due to its high 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 risk firm and 0 otherwise. We expect that the coefficient on *ST* × *Risk Indicator* is positive and more significant than the coefficient on *ST* × (1− *Risk Indicator*).

We consider four different risk indicators. The first one is defined as *STOCKVOL-A50*, which equals to one if a firm's equity volatility is above the median of the sample firms in a given year, and zero otherwise. We create three additional risk indicators by using the Altman's Z-score, distance-to-default, and interest coverage. Unlike stock volatility, these variables are inversely related to the level of risk.[17] Therefore, for each indicator we create a dummy variable (*ZSCORE-B50*, *DTD-B50*, or *INTCOVERAGE-B50*) that assumes a value of 1 for firms with the variable *below* the median of all sample firms in a given year to indicate high risk and 0 otherwise.

Table 6 reports the estimation results for the three short term debt ratios (*ST*, *LT1AT*, and *STDEBT*) in Panels A, B, and C, respectively. We find the coefficient on the interaction of the short term debt ratio and high risk dummy is larger than that for the low risk dummy across all model specifications. Our tests show that the coefficients on the two interaction terms are significantly different from each other at the 10% (or lower) level in 9 out of 12 models. Overall, the results lend more support to the rollover risk hypothesis that given the same increase in the short term debt ratio, the increase in loan spread is greater for high-risk firms than for low-risk firms.

[Insert Table 6]

4.3.2 Growth opportunity and firm risk

The asset substitution theory predicts that the attenuation effect of short-maturity debt on loan spread should be more pronounced for firms with high risk than those with low risk. The rationale is that *riskier borrowers* have stronger

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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.

incentives to engage in asset substitution behaviors (Campbell and Kracaw, 1990).[18] Therefore, the use of short-term debt to reduce the risk-taking behaviors should be more effective, resulting in banks charging lower loan rates. So far we have presented evidence that the attenuation effect of short term debt on loan rates due to the alleviation of asset substitution problem is most prominent in high-growth firms. We expect the strongest attenuation effect of short-term debt on loan spreads for the high-risk and high-growth firms.

To test this prediction, we divide our sample into high risk and low risk subsamples on the basis of firm risk indicators used in previous section: *STOCKVOL-A50*, *ZSCORE-B50*, *DTD-B50*, and *INTCOVERAGE-B50*. We re-run regressions based on the model specified in Equation (2) on the high and low risk subsamples individually. The results are presented in Table 7. Across all risk indicators, we find only in high risk subsample that the coefficient of the interaction between short-term debt and (1–*High_MTB*) (i.e., the effect of short-term debt on loan spreads for low-growth firms) is systematically significant. The coefficient of the interaction between short-term debt and *High_MTB* (i.e., the effect of short-term debt on loan spreads for high-growth firms) is not significant in almost all models. Additionally, the difference in coefficients between the two main interaction variables (i.e., *ΔCoef.*) is significant for high risk firms only.

Overall, our findings provide further support for *Hypothesis 2*: For high risk firms, short term debt leads to a strong mitigation effect of the asset substitution problem, cancelling out the effect of rollover risk and resulting in an insignificant

[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.

effect of short term debt on loan rates. For low-growth firms, the effect of rollover risk dominates the mitigation effect of asset substitution, leading to a significantly positive impact of short term debt on loan rates.

[Insert Table 7]

5. Robustness Tests

5.1. Bank Dependence

Hypothesis 1 states that banks perceive borrowers' debt maturity structure and decide how much interest rates they would charge, which is mainly driven by the *supply-side* effects. Therefore, we expect to find the amplifying effect of short-term debt on loan spreads to be more pronounced for firms that are highly dependent on bank debt financing. To identify bank-dependent firms, we collect information from Capital IQ database. For each firm, we compute the ratio of bank debt to total assets, and classify a firm as a bank dependent firm if it has the ratio above the median ratio of all firms in a given year. We create a dummy variable, *Bank_Dep_dummy*, which equals to one if a firm is a bank-dependent firm and zero otherwise. The Capital IQ database only provides reliable information from 2002 and onward; thus, the analysis in this subsection is based on the sample spanning from 2002 to 2014 (called "CIQ-based sample" henceforth), which contains 3,557 observations.

We rerun the baseline model as specified in Equation (1) to examine the rollover risk effect conditional on bank dependence. Table 8 reports the regression results. There are several important findings. First, we confirm that the results remain consistent with the main findings discussed above. Remarkably, the amplification effect of short-term debts on loan spreads is strongly positive across all short-term debt proxies and are more prominent than the baseline regression results reported in Table 4. For example, the coefficient of *ST* is 252 in Model 1 in Table 8, compared to 133 in Model 4 in Table 4.[19] These results may also reflect that the amplification effect of short term debt structure on the cost of bank loans is more significant in recent years.[20]

[Insert Table 8]

In addition, the results confirm that the reduction effect of short term debt on loan rate due to the alleviation of asset substitution is more significant for high-growth firms. We find that the difference in coefficient between *ST* × *High_MTB* and *ST* × (1–*High_MTB*) is -207 in the CIQ-based sample (Model 2 in Table 8) versus -156 in the main sample (Model 1 in Table 5). For *LT1AT*, the difference in coefficient is -329 in the CIQ-based sample (Model 5 in Table 8) versus -224 in the main sample (Model 2 in Table 5) Finally, for *STDEBT* the difference is -32 (Model 8 in Table 8) versus -19 in the main sample (Model 3 in Table 5). 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 the rollover risk effect is more pronounced for bank-dependent firms. Overall, our results shows that given the same increase in short-term debt, bank-dependent borrowers pay much higher interest to banks than firms that are less bank-dependent, lending further support for *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.

5.2 Speculative Grade Firms

Although we focus on unrated firms in our main analysis, we acknowledge that rated firms also rely on bank financing, indicating that there may be an effect of rollover risk on loan spreads for rated firms. We compute the 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 the largest ratio of bank debt to total assets. We find a similar pattern in the speculative grade subsample, indicating certain level of demand for bank financing by the speculative grade firms. Investment grade firms have minimal levels of bank-debt-to-asset ratios. As a result, we focus on the speculative grade firms in the following analysis of rated firms.

[Insert Figure 2]

We perform the bank dependence analysis using the speculative grade subsample and report the regression results in Table 9. Model 1 suggests that the coefficient of *ST* × *Bank_Dep_dummy* (representing the bank-dependent firms) is positively significant while the coefficient of *ST* × (1–*Bank_Dep_dummy*) is negatively significant. In addition, the difference in coefficients between the two interaction variables (shown in *ΔCoef.*) are highly significant at the 5% (or better) level. Replacing *ST* with *LT1AT* or *STDEBT*, we find similar results as shown in Models 2 and 3. Overall, we find that the speculative grade firms that are

[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.

bank-dependent pay significant larger interests short term debt ratio increases, further supporting *Hypothesis 1*.

[Insert Table 9]

5.3 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 the rollover risk hypothesis is that the conflict between shareholders and debtholders would increase the default likelihood *in the future*, but not necessarily at the current time. If the all-in-drawn spreads are significantly larger for credit lines than for the other types of loans given a similar increase in short-term debt, it would further support *Hypothesis 1*. We examine this prediction by including two interaction terms in which we interact the debt maturity proxy with *CREDITLINE* dummy variable and (1-*CREDITLINE*). The results reported in Table 10 confirm our prediction.

[Insert Table 10]

5.4 All-in-undrawn Spreads

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

[Insert Table 11]

5.5 Alternative Model Specifications

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

[Insert Table 12]

5.6 Logarithm loan spreads and newly listed firms

Some prior studies suggest that the 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 the baseline regressions by replacing the raw spreads with the natural logarithm of spreads. Furthermore, Custódio, Ferreira, and Laureano (2013) document that firms that have been recently listed use more short term debt. As newly listed firms are less transparent, our findings may be subject to a sample selection bias favouring the rollover risk hypothesis. For robustness, we exclude firms that are four years or younger and rerun our baseline regressions. Panel A of Table 13 reports the results for the logarithm of loan spreads and Panel B represent the results for the sample excluding the newly listed firms. The results are qualitative similar to our main findings.

[Insert Table 13]

5.7 Largest Facility and Deal-Level Consolidated Sample

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

First, we use the *largest* facility the borrower receives in a specific year, as suggested in Hertzel and Officer (2012) and Houston *et al*. (2014). When we restrict the sample the largest facilities, the number of observations reduces from 9,941 to 5,940. The estimated results are reported in Table 14. Panel A suggest that a one-standard-deviation increase in *ST* leads to a reduction in loan spreads by 4.98% (or 10.01 basis points). This coefficient is statistically significant at the 1% level and the economic impact is similar to the reduction of 5.66% (or 11.44 basis points) in the baseline analysis presented in Model 4 of Table 4. Panels B and C show that the results based on *LT1AT* and *STDEBT* are robust as well. In addition, we rerun all models reported throughout the paper using the largest facility sample; the results are systematically consistent with the main results.

[Insert Table 14]

Second, we follow Graham *et al*. (2008) by aggregating loan facilities to deals using loan-size weighted averages of the relevant terms. This consolidated sample contains 5,946 firm-year observations. The estimated results are presented in Table 15. We find that short term debt proxies are positive and highly significant in

Models 1-3, and low-growth firms experiences greater increase in loan spreads than high-growth firms as the a firm short term debt increases (Model 4). Overall, the results based on the largest facility subsample and the consolidated sample indicate that our main findings and implications remain robust at the deal level.

[Insert Table 15]

6. Endogenous Issues

The empirical results so far show a strong and consistent association between short term debt and loan pricing. However, like other empirical studies, our study is subject to possible issue of endogeneity. For example, firms with larger borrowing costs are likely to be risker firms and restricted to longer maturity debt, indicating a reverse causality problem. Another possible issue is that loan spreads and short-term debt are determined simultaneously by unobserved risk factors. First, we emphasize that relative to other studies, the simultaneity issue is minimized in our tests as loan spreads are set by the firms' creditors under competitive forces in the market (i.e., these are observed outcomes rather than firms' choices). Furthermore, we include firm and time fixed effects in our regressions to control for the time-invariant and time-varying factors that may affect both the debt maturity structure and loan spreads. It is important to acknowledge that it is very unlikely that one can completely eliminate the endogeneity bias in empirical studies. In this section, we address the endogenous problem by using a system simultaneous equations model (SEM) approach. The SEM analysis is employed to reduce the potential concern of reverse causality and the fact that loan spreads, debt maturity, and leverage are simultaneously determined.

We run the SEM model by using the consolidated sample (i.e., firm-year observations) as the short-maturity debt variables and leverage are measured at firm level. We expand the loan spread equation model by adding the debt maturity equation and the leverage equation as follows.

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

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

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

where $Spread_{i,t}$ is the weighted average all-in-drawn spreads based on loan size in a given year and for a given firm. **X** represents a vector of firm-level control variables as described in Equation (1). *ASSET_MAT* is the measure of asset maturity, *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 the one-digit SIC dummies in line with Acharya *et al.* (2013). We follow Johnson (2003) and others in the debt maturity literature (e.g., Datta, Iskandar-Datta, and Raman, 2005; Billett *et al.*, 2007) to estimate leverage and debt maturity jointly. We estimate the SEM model by the generalized method of moments (GMM) using the exogenous variables as instruments in the moment conditions. Thus, GMM ensures that the standard errors of the estimates are heteroskedasticity and autocorrelation consistent.[23]

[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

We first estimate a two-equation SEM which includes the loan spread and the short term debt equations. The results are reported in Table 16. We find a significant bi-directional relation between short term debt ratios and spreads. The results indicate that the amplifying effect of the short-term debt on the cost of bank loans remain robust after accounting for endogeneity. We then perform the three-equation SEM by adding the leverage equation. We continue to find a positive and significant bi-directional relation between the short term debt 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 effect suggested by Johnson (2003) and the single-equation findings in Barclay and Smith (1995) that firms with longer maturity debt have higher leverage. Additionally, note in the short-maturity debt equation that the proportion of short-term debt is positively related to market-to-book ratio. This finding 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 the possible effects of unobservable factors and the potential reverse causality bias. Our results provide strong confirmation that short

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regression errors are heteroskedastic and/or autocorrelated, and that GMM estimates coincide with 2SLS estimates otherwise.

[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.

term debt ratio are positively associated with spreads, reinforcing our conclusion that a firm's short-maturity debt structure plays a significant role in determining the cost of bank loans.

[Insert Table 16]

7. 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 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*

	Baseline	Pool-OLS	Random Effects	Baseline on MTB	Risk Indicator			
					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*

	Baseline	Pool-OLS	Random Effects	Baseline on MTB	Risk Indicator			
					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

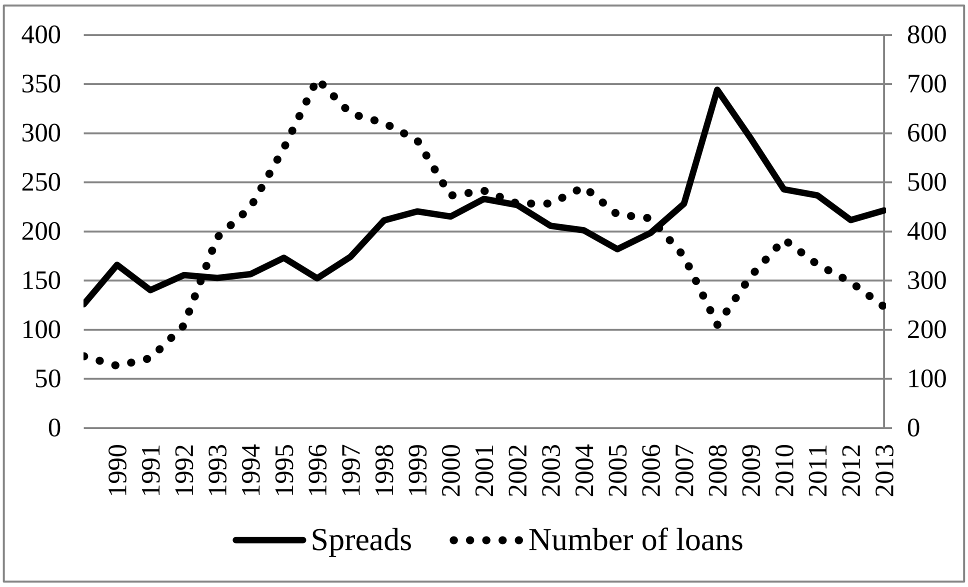
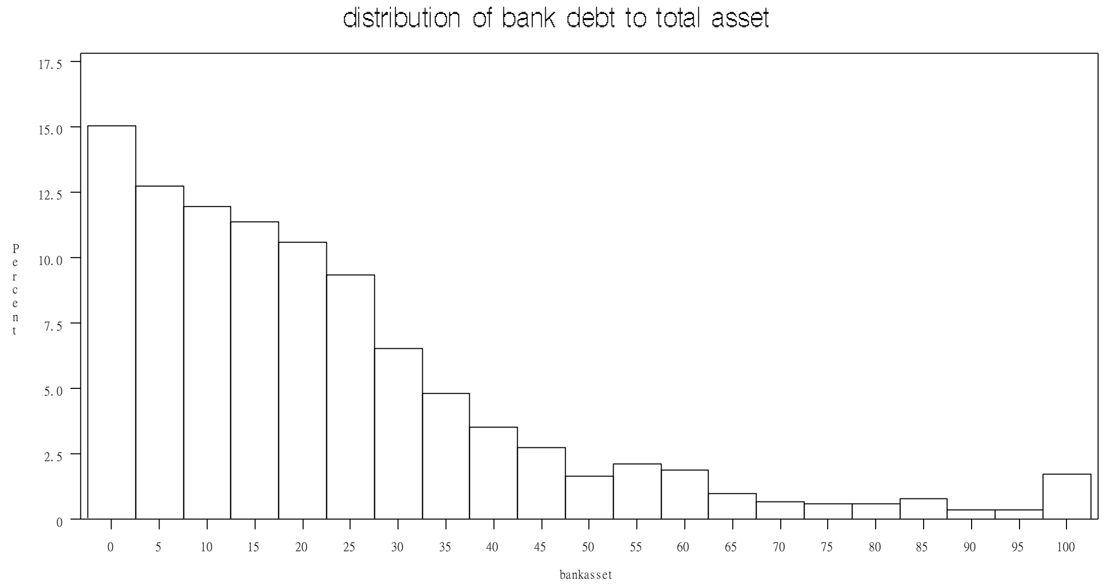
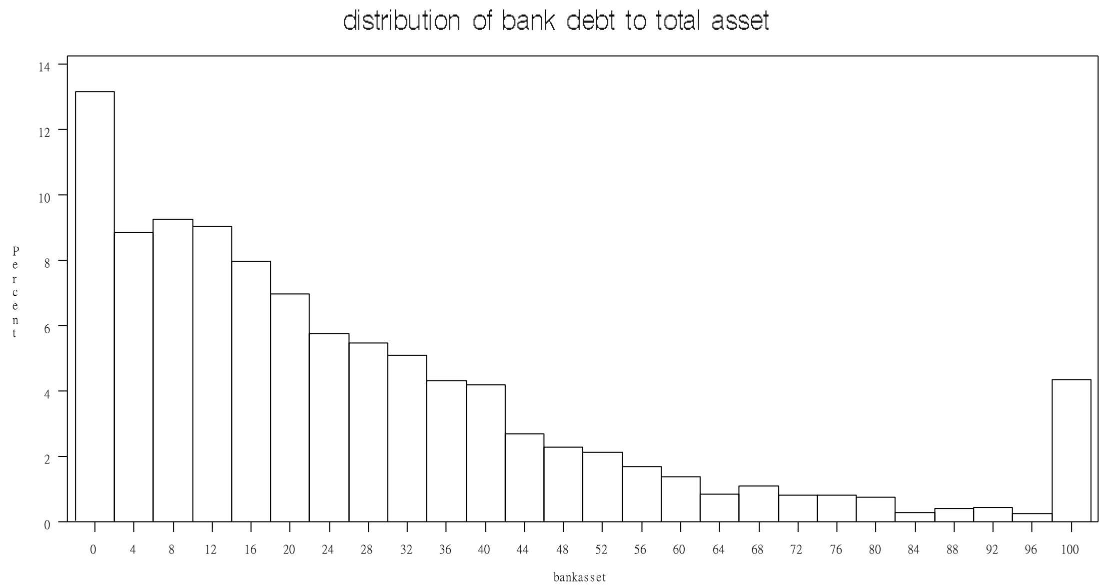


Figure 1. Syndicated loans in U.S. market during 1990–2014.

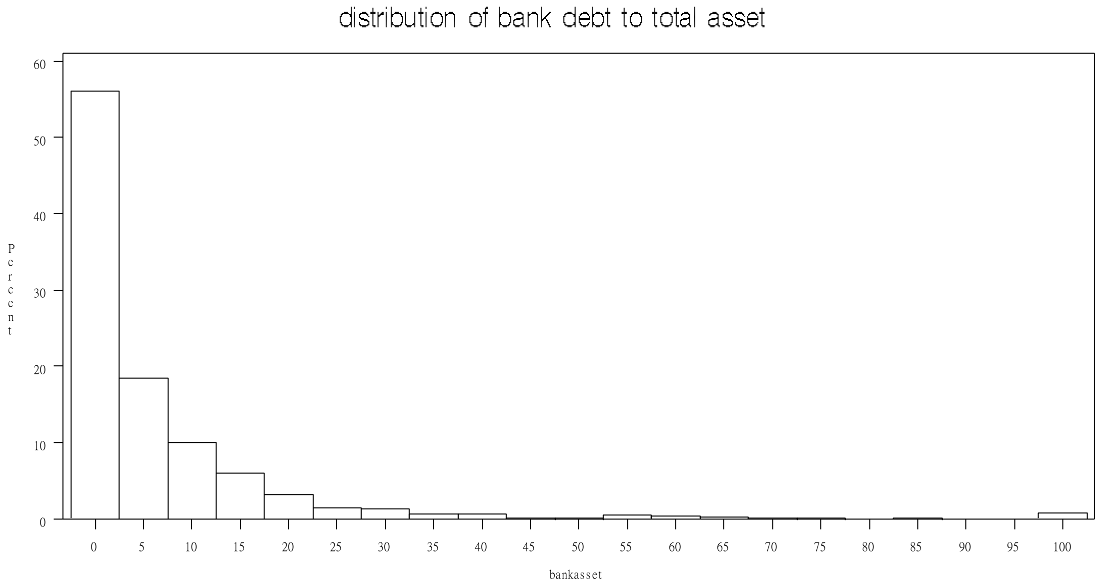
This figure presents all-in-drawn spreads (AIDS) with the solid line scaled in the left y-axis and total number of loans with the dotted line scaled in the right y-axis in the U.S. syndicated loan market from 1990 to 2014.



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