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Working Paper 2018:33

Department of Economics
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November 2018

LUND UNIVERSITY

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November 13, 2017

Abstract

This paper explores whether refinancing risk is an important determinant of maturity decisions by investigating how firms with refinancing risk choose the maturity of new loans they obtain during the 2007–2009 financial crisis. The firms' refinancing risk is measured by the maturing portion of outstanding long-term debt. The result shows that firms with a high refinancing risk choose longer maturities. This effect is stronger for speculative-grade and low-cash-flow firms. There is also evidence that firms with refinancing risk obtain longer maturities from their relationship lenders.

JEL codes: *G01, G32, G39*
Keywords—*Refinancing risk; Debt maturity; Financial crisis*

1. Introduction

The notion that refinancing risk is an important factor to consider in the determination of debt maturity has received much attention in recent years (see, e.g., Brunnermeier, 2009; González, 2015; Paligorova and Santos, 2016).[1] According to this notion, when refinancing risk is present, firms choose longer maturities (Diamond, 1991). The argument is that longer maturities enable firms to avoid concentrating maturity expiration dates (Cheng and Milbradt, 2012; He and Xiong, 2012a) and that they allow firms to lengthen their overall debt-maturity structure (He and Milbradt, 2016). These aspects are valued by firms because, in contrast to that of shorter maturities (see, e.g., Jun and Jen, 2003), they lower the rate at which firms seek to refinance their debt coming due. This aspect can help mitigate exposure to refinancing risk. While theoretical work relates refinancing risk to debt-maturity choice and firms have

*I am thankful to Erik von Schedvin, one of the discussants during the author's 'final seminar', for offering valuable comments and suggestions. I would like to thank Mariassunta Giannetti for comments and suggestions on the earlier version of this paper. I would also like to thank participants at finance seminar at the department of Economics, Lund University.

[1] Refinancing risk is the risk of being unable to roll maturing debt or that it will have to be refinanced at significantly high interest rates (Froot et al., 1993; Hu, 2010; Valenzuela, 2015).

expressed concerns about refinancing risk during the recent financial crisis, much less is known about the empirical link.

This study's research objective is to empirically explore refinancing-risk considerations as an important determinant of debt-maturity choice by examining the relationship between firms' potential for exposure to refinancing risk and the maturity of new loans obtained during the 2007–2009 financial crisis. Since this crisis resulted in a secular decline in credit supply (see, e.g., Ivashina and Scharfstein, 2010), it provides a useful empirical laboratory for studying such relationships. This study thus helps to understand how well the theory squares with how firms have responded to the financial crisis—do firms with refinancing risk display debt-maturity choice behavior consistent with the theoretical prediction? The answer is far from obvious.

There is a compelling economic reason to expect firms for whom refinancing risk is a real concern to actively engage in lengthening their debt maturity to alleviate exposure to refinancing risk. These firms would stand to absorb an economically significant cost if they are unable to roll over their maturing debt. This includes an inefficient liquidation by creditors (Diamond, 1991; He and Xiong, 2012a), the sale of assets at fire-sale prices (Brunnermeier and Yogo, 2009; Shleifer and Vishny, 2011; Choi et al., 2013) and missed profitable investments (Duchin et al., 2010; Almeida et al., 2012). Considering such significant costs, one would expect firms with refinancing risk concerns to exhibit maturity-choice behavior in line with the theory's prediction.

On the other hand, while the theoretical basis for expecting a maturity effect from refinancing-risk considerations is strong, it is less clear if firms with refinancing risk are able to raise debt with longer maturities in a tight credit market. Creditors may adopt more restrictive lending policies during these times. In fact, studies examining the effects of the recent financial crisis document several pieces of evidence consistent with this argument. For example, Chui et al. (2010) and Ivashina and Scharfstein (2010) find that the financial crisis led to a contraction in the supply of bank loans. Campello et al. (2011) and Puri et al. (2011) note that financial institutions tightened their lending standards. González (2015) and Paligorova and Santos (2016) document further evidence that creditors shortened the maturity of loans to reduce the maturity mismatch on their balance sheets—i.e., the mismatch between the maturity of the loanable funds they raise and the loans they offer. Given these manifestations of the financial crisis, some firms obviously find it difficult to raise funds. This makes the research question pursued in this paper particularly interesting, precisely because theory suggests a systematic pattern of maturity management behavior that reflects the refinancing-risk concern to be displayed in those times when obtaining financing is challenging.

Establishing a causal relationship between firms' potential for exposure to refinancing risk and the maturity of new loans issued is, however, challenging. A major challenge confronting the empirical attempt relates to the applied measure of refinancing risk. While the corporate finance literature widely blames excessive reliance on shorter maturities for firms' exposure to refinancing risk (see, e.g., Brunnermeier, 2009), empirical frameworks in which short-term debt on the balance sheets is used to measure a firm's exposure to refinancing risk suffer from endogeneity bias. That is, since maturity choice is an endogenous decision, the preference for outstanding short-term debt might also be influenced by the same factors that affect the maturity of a newly issued debt. To overcome this problem, the recently emerging literature on refinancing risk has used long-term debt coming due in one year to identify the variation in firms' exposure to refinancing risk (see, e.g., Hu, 2010; Almeida et al., 2012; Harford et al., 2014; Gopalan et al., 2014). Yet, even using this measure as an identification tool in this article is likely to raise some concerns.

One potential concern stems from classifying a wide spectrum of financial obligations coming due in one or more years as long-term debt. This classification indicates that it is not unlikely for long-term debt maturing within a year to be partly explained by the firm's current risk characteristics, suggesting that measures of this type are endogenous. An issue of another concern is that, since the financial crisis spans over the period 2007–2009, for instance, long-term debt outstanding in 2007 and that comes due in 2008 is obviously affected by the crisis. This long-term debt becomes endogenous with regard to its impact on the maturity of new loans issued in 2008. Also, it is not unlikely for firms to anticipate and prepare for the crisis by refinancing a portion of long-term debt expected to come due during the crisis. In fact, there is evidence supporting this argument (see, e.g., Mian and Santos, 2011; Xu, 2016). These concerns suggest that statistical tests are likely to be confounded; thus, it is difficult to make causal claims with empirical tests in which long-term debt maturing in one year is used as an identification tool.

The current study addresses these concerns by predetermining firms' exposure to refinancing risk during the 2007–2009 financial crisis. More precisely, the relationship between refinancing risk and the maturity of new loans is tested by exploiting the maturity profile of long-term debt many years back before the scheduled due date during the financial crisis to identify the variation in firms' potential for exposure to refinancing risk. Since this variable is unaffected by the firm's behavior during the crisis, it can serve as an exogenous measure and help to isolate the causal effect of refinancing risk on the maturity of loans issued during the crisis period. The estimation is based on loan-level data for U.S. firms from the DealScan database.

The analysis provides strong evidence that firms with refinancing risk choose longer maturities during the financial crisis. The maturity effect of refinancing risk is statistically significant and economically nonnegligible. As the estimated coefficients suggest, a one-standard-deviation increase in the maturing portion of outstanding long-term debt out of total long-term debt measured at the end of year 2004 leads to about a 3% increase in the maturity of new loans relative to the sample mean. This positive empirical relationship is consistent with the theoretical prediction that firms with different exposures to refinancing risk choose their maturities differently. In particular, this relationship can be interpreted as firms choosing longer maturities to mitigate their exposure to refinancing risk. Such a relationship is unlikely to be explained by the alternative interpretation that the observed association is part of a general pattern whereby firms replace maturing long-term debt with new loans of longer maturity. The estimated precrisis negative relationship does not support this alternative hypothesis.

Building on this baseline result, this study next investigates whether the maturity effect of refinancing risk varies between different groups of firms. If alleviating exposure to refinancing risk is the driving factor behind the observed relationship, one would expect the effect to be stronger for firms that are more concerned about refinancing risk. In line with this expectation, the analysis provides evidence that the effect is more pronounced for firms with speculative-grade ratings than unrated and investment-grade firms. This result can be understood in light of the evidence that firms with limited access to public debt markets are the most affected by the recent crisis (see, e.g., Campello et al., 2010). Hence, they are expected to display strong refinancing-risk concerns. While both unrated and speculative-grade firms are widely believed to have restricted access to public debt finance, a potential explanation for the differential impact between them may be that financial institutions restrict unrated firms from participating at the very long end of the maturity spectrum.

The analysis provides further evidence that the effect also varies between firms classified according to internally generated liquidity. More precisely, the effect is stronger for firms with low cash flows. Such differential impact can be understood in light of the theoretical suggestion (see, e.g., Chen et al., 2012) and empirical evidence (see, e.g., Choi et al., 2013) that firms with low cash flows favor longer debt maturity because their debt is more risky, and they will face greater refinancing risk. In keeping with the recent relationship literature's argument that establishing lending relationships with creditors is particularly valuable in times of crisis (see, e.g., Hainz and Wiegand, 2013; Gobbi and Sette, 2014; Bolton et al., 2016), the analysis shows that firms with refinancing risk obtain longer maturities from their established relationship lenders.

The baseline result is strongly robust to alternative estimation techniques and model specifications. For example, the matching method shows that, except for the maturing long-term debt, otherwise similar firms that need to roll over a large amount of debt issue new loans that are of longer maturity. This result can alleviate a potential concern related to sample-selection bias that may arise from the possibility that firms obtaining credit during the financial crisis may be a nonrandom sample. One might suspect that firms that normally issue shorter maturities may be excluded from the loan market. If so, such selection may put an upward pressure on the refinancing-risk effect. The main result also remains statistically significant in the alternative specifications that control for bank fixed effects and clustering the standard errors at the bank level.

This study contributes to the literature on determinants of corporate debt maturity choice. Existing research has made significant progress in explaining the determinants of debt maturity. For example, some studies (see, e.g., Barclay and Smith, 1995; Guedes and Opler, 1996; Johnson, 2003; Billett et al., 2007) show that firms who want to reduce agency costs of debt, such as asset substitution and underinvestment, choose shorter maturities. Others (see, e.g., Mitchell, 1993; Barclay and Smith, 1995; Berger et al., 2005) show that firms with a higher level of information asymmetry choose shorter maturities. Others argue that firms time the credit markets to determine the maturity that reduces the financing costs (see, e.g., Butler et al., 2006). The current article extends this line of research by identifying refinancing risk as an important factor influencing corporate debt-maturity choices during uncertain funding conditions.

In providing a new perspective on the maturity effects of refinancing risk, this paper is closely related to the recent empirical studies by Mian and Santos (2011) and Xu (2016). That literature focuses on early refinancing—i.e., refinancing before loans reach their maturity date. They argue that firms manage the maturity of their debt by issuing longer maturities during good credit times to minimize their exposure to liquidity risk during tight credit conditions. The current article distinguishes itself from these studies in two ways. First, this analysis focuses on refinancing risk associated with the roll over of maturing debt. Second, the analysis examines maturity decisions during bad credit market conditions. In doing so, this study adds to the above literature by showing that firms with refinancing risk display maturity-lengthening behavior even during crisis times.

The remaining sections of this article are structured as follows. Section 2 briefly reviews the theoretical underpinnings behind the refinancing risk in credit markets. Developing an empirically testable refinancing-risk–maturity prediction is also the topic of this section. Section 3 describes the data used for the analysis and constructs the refinancing-risk measures. The empirical results demonstrating the effects of refinancing risk on loan-maturity decisions are presented in Section 4. While Sections 5 and 6 present the analysis that investigates whether the effect of refinancing risk varies across different firms and loans, Section 7 undertakes additional robustness checks. The article closes with a conclusion in Section 8.

2. Theory and Testable Hypotheses

The idea that refinancing-risk considerations can influence corporate debt-maturity choice was originally presented by Diamond (1991). Yet, this topic has not until recently occupied a central position in the corporate debt-maturity-choice literature. The increased attention this notion has received in recent years was inspired by the 2007–2009 financial crisis. Following this crisis, a growing number of finance studies have investigated not only the extent to which the choice of shorter versus longer maturities can expose firms to refinancing risk (see, e.g., Brunnermeier, 2009; He and Xiong, 2012a,b; Morris and Shin, 2016; Seta et al., 2016), but also to what extent firms choose shorter versus longer maturities in anticipation of refinancing risk (see, e.g., Cheng and Milbradt, 2012; Szkup, 2013; He and Milbradt, 2016). This literature suggests that firms may be unable to roll over shorter-maturing debt at times when refinancing coincides with tight credit-market conditions or weaker firm fundamentals.

A large body of recent literature provides the mechanism that links tight credit-market conditions and refinancing risk. For example, Brunnermeier (2009), Gorton (2009), Acharya et al. (2011) and Schroth et al. (2014) point out that the 2007–2009 financial crisis generated refinancing risk for firms through its impact on money markets such as the commercial paper markets, overnight sale and repurchase (repo) markets, and interbank lending markets. They document different episodes that show the freeze in money markets, which led to the wholesale funding liquidity dry-up as investors shied away to avoid losses. The liquidity dry-up in these funding markets made it difficult for the financial institutions to raise loanable funds and, thereby, translated into considerable credit-supply shrinkage (see, e.g., Ivashina and Scharfstein, 2010). The disruption of the supply of credit generally led to an increase in firms' refinancing risk.

Another theoretical literature offers a different mechanism that connects weaker firm fundamentals and refinancing risk. For example, Cheng and Milbradt (2012), He and Xiong (2012a,b), and Morris and Shin (2016) note that deterioration in a firm's future fundamentals creates interdependence among the creditors of the firm in terms of their willingness to refinance. Using debt-rollover models, they show that the current creditors, who face uncertainty about future creditors' rollover decisions, refuse to roll over the currently maturing debt to avoid absorbing costs in the event of liquidation by future creditors. In the presence of the well-established coordination problems among multiple creditors, uncertainty about future valuation of the underlying asset could undermine current creditors' confidence. Thus, they may not allow refinancing to take place.

Irrespective of the sources of refinancing risk discussed above, firms are exposed to refinancing risk through the maturity structure of their debt. The corporate finance literature has long recognized the importance of adjusting debt's maturity structure in the presence of uncertain financing conditions. For example, Diamond (1991, p. 718) vividly states that "if liquidity risk is absent, then short-term debt is preferred. If liquidity risk is present, then long-term debt can be preferred".[2] Longer maturities can help hedge against refinancing risk mainly because they permit firms to spread out the expiration period across an extended time (Cheng and Milbradt, 2012; He and Xiong, 2012a). This means that, with longer maturities, refinancing needs increase at a much slower rate, reducing the frequency with which the firm needs to tap the credit markets.

One may argue that firms can still issue shorter maturities and continually roll them over, as in the spirit of the model by Leland (1998) and He and Xiong (2012a). While such debt-maturity policies could be adopted by some firms, those with refinancing risk may not afford the strategy of repeatedly rolling over maturing short-term debt without exacerbating their refinancing risk. The reason is that shorter maturities increase the speed at which firms need the next refinance (Jun and Jen, 2003); that high rollover frequency ultimately diminishes collateral value and debt capacity (Acharya et al., 2011).

[2] In the above-cited article, liquidity risk is defined similarly to refinancing risk.

Due to the feedback effect, adding additional shorter maturities ultimately exposes firms with refinancing risk to tight credit-market conditions—i.e., unable to refinance or forced roll over debt at prohibitively high interest rates.

While longer maturities can help to alleviate exposure to refinancing risk, it is important to note that they may also introduce agency and incentive-related problems. A well-established literature argues that shorter maturities can alleviate maturity-induced conflicts such as asset substitution (Jensen and Meckling, 1976; Barnea et al., 1980) and debt overhang (Myers, 1977), align shareholder–manager interests (Grossman and Hart, 1982), reduce costs of capital (Taggart, 1977; Jun and Jen, 2003), and decrease the misvaluation of debt due to information asymmetry (Flannery, 1986). This shows that, when determining debt's maturity, firms generally face a trade-off between minimizing refinancing risk and maintaining low agency and incentive-related friction. Hence, firms' maturity choices depend on which problem dominates. With drastic credit-supply shrinkage and increased lending standards during the recent financial crisis, if refinancing risk concerns outweigh those of agency-related frictions, firms with refinancing risk are expected to choose longer maturities. This empirical prediction is expressed in Hypothesis 1.

Hypothesis 1 (Refinancing-Risk–Maturity Hypothesis)**:** *Firms with refinancing risk choose longer maturing loans during the 2007–2009 financial crisis.*

Many extensions of the refinancing-risk–maturity prediction are also examined. For example, whether refinancing risk's maturity effect varies between firms classified on the basis of their position in accessing external debt financing. The extensive empirical literature assessing the effects of the 2007–2009 financial crisis has documented that firms with limited access to public debt markets are most exposed to negative credit-supply shocks (see, e.g., Chava and Purnanandam, 2011; Hale and Santos, 2013; Chiu et al., 2014). There is also strong evidence that these firms experienced credit rationing in capital markets (see, e.g., Campello et al., 2010). Consequently, one may expect firms' maturity choices to respond differently to refinancing-risk concerns depending on the their relative access to external debt financing.

Another strand of recent literature emphasizes the importance of internal financial constraints for firms' exposure to refinancing risk. For example, Chen et al. (2012) build a dynamic debt-maturity–choice model in which firms generating low cash flows favor longer debt maturities because they would otherwise incur higher rollover costs. A theoretical perspective behind this argument is that low cash flows (i.e., weaker firm fundamentals) tend to drive down the market value of debt, mainly because the debt becomes riskier. When this happens, as noted by Seta et al. (2016), firms incur refinancing losses from issuing new debt to replace maturing debt. He and Xiong (2012a) demonstrate that an increase in rollover losses endogenously drives up firm defaults. An increase in defaults, as He and Xiong (2012b) shows by deriving a rollover threshold equilibrium, exacerbates debt runs. That is, it encourages creditors not to roll over their debt contracts with the firm to avoid absorbing costs in the event of a liquidation. One may, thus, expect refinancing-risk concerns to encourage firms with limited internally generated funds to lengthen their debt maturity.

Several recent studies in the relationship literature show a connection between building lending relationships with creditors and being exposed to credit-supply disruptions. For example, the Bolton et al. (2016) model predicts that firms that borrow from relationship-based lending are better able to limit the impact of shocks during crisis times. They find evidence that firms secure better continuation financing from their relationship lenders. Gobbi and Sette (2014) also offer evidence that firms who concentrate borrowing from fewer banks manage to reduce a contraction in the availability of bank credit while those borrowing from more banks suffer a larger contraction. Further evidence is provided by Hainz and Wiegand (2013), who show that relationship lending helps firms avoid a deterioration in nonprice contract terms, such as collateral and maturity. According to these studies, firms with refinancing risk can obtain longer maturities from their relationship lenders.

3. The Data Set

3.1 Data Source and Sample Construction

To conduct empirical tests of Hypothesis 1, this paper uses data from two sources. Loan-specific information is extracted from Thomson-Reuters LPC's DealScan database. This data source provides detailed information on loan facilities made to U.S. firms by U.S. and foreign financial intermediaries. Loan facilities reported by the DealScan database are syndicated and unsyndicated loans. This article uses both types to investigate how refinancing-risk considerations may influence maturity choices at the time of loan origination. To this end, information on the maturity and amount of the loan, facility start date and loan type and purpose is collected for all loan facilities.

Quarterly information from the firms' balance sheet is extracted from the Compustat database because DealScan does not provide sufficient information on firm-specific characteristics, though it does report the firm's identity. The two data sources, however, do not have a common identifying code between them. This study, thus, uses the *DealScan–Compustat* link table constructed by Michael Roberts and Wharton Research Data Services to merge the loan-facility information to the borrowing firm's financial information.[3] This link table combines the corresponding information in the two data sources on the basis of the borrowing company name. Loan facilities that cannot be merged to the corresponding firm's financial information using this link table are excluded from the analysis.

The analysis is based on the sample drawn from the DealScan–Compustat merged database. The sample construction begins by focusing on U.S. firms as borrowers. In keeping with previous empirical studies, the sample is restricted to nonfinancial borrowers by excluding firms in the financial sectors

[3] For a detailed description of how the DealScan–Compustat link table was constructed, refer to Chava and Roberts (2008).

(those with primary Standard Industrial Classification (SIC) codes between 6000 and 6999). Firm–year observations with negative values for total assets are also removed from the sample.

This paper measures a firm's potential for exposure to refinancing risk using the maturing portion of outstanding long-term debt, discussed in detail in a subsequent subsection. It is therefore crucial to clean inconsistencies in the long-term-debt entries. For this purpose, the following filtering strategies are applied as in Hu (2010), Almeida et al. (2012) and Li (2013). Firm–year observations with negative values of long-term debt maturing in one, two, three, four or five years are removed from the sample. Also, firm–year observations for which long-term debt maturing in one, two, three, four or five year is greater than total long-term debt are dropped from the sample.

The sample is further restricted to facilities originated between August 2007 and June 2009 because the paper investigates the relationship between refinancing risk and loan maturity during the recent financial crisis. The origin of this crisis goes back to the collapse of the U.S. subprime loan market during the summer of 2007. Accordingly, studies widely attribute August 2007 as the beginning period of the financial crisis (see, e.g., Duchin et al., 2010; Ivashina and Scharfstein, 2010). This study considers June 2009 as the end of the sample period because the National Bureau of Economic Research notes that the financial crisis ended at the end of the second quarter of 2009.

3.2 Measuring Dependent and Control Variables

Since the aim of this article is to examine how refinancing-risk considerations may affect debt-maturity decisions, the maturity (*Maturity*) of new loans obtained during the recent financial crisis is used as the dependent variable. The maturity of incremental debt issues is more relevant for the purpose of this study than the maturity of all financial obligations on the firm's balance sheet. DealScan measures the maturity of loans by the number of months from the loan start date to the end date.

In keeping with the prediction of the broad categories of the theoretical literature and prior empirical studies of the debt-maturity decision, a large number of loan-level and firm-specific characteristics are used as control variables. Loan size (*Loan Size*) is measured by the natural logarithm of loan facility amount in U.S. dollars. This paper constructs four dummy variables to indicate whether the type of the loan facility is a revolver (*Revolver*), term loan (*Term Loan*), 360-day facility (*364-Day Facility*) or another loan type (*Other Type*). Additionally, five other variables are also constructed to identify whether the purpose of the loan facility is for a corporate purpose (*Corporate Purpose*), working capital (*Working Capital*), debt repayment (*Debt Repay*), takeover (*Takeover*) or another loan purpose (*Other Purpose*) .

Firm size (*Firm Size*) is measured by the natural logarithm of the book value of total assets. Earnings before interest, taxes, depreciation and amortization scaled by total assets is used to measure firm profitability (*Profitability*). Market-to-Book (*Market-to-Book*) is measured as the ratio of the book value of total assets minus the book value of equity plus the market value of equity to total assets. Firm leverage (*Leverage*) is measured by the ratio of total debt (i.e., the sum of debt in current liability and long-term debt) to total assets. The firm's tax payment (*Taxes*) is measured by the ratio of total tax payment scaled by total assets. Cash flow (*Cash Flow*) is measured by operating income before depreciation (Compustat item OIBDPQ) over total assets.

Following Gopalan et al. (2014), an ordinal credit rating variable (*Rating*) is constructed based on a firm's Standard & Poor's (S&P) long-term domestic-issuer credit rating as a measure of its credit quality. Following Benmelech et al. (2015), asset maturity (*Asset Maturity*) is measured by net property, plant, and equipment divided by depreciation expenses. Following Bharath et al. (2007, 2011), relationship lending (*Relationship*) is measured by the ratio of the number of previous interactions between the firm and the lender of a loan in the last five years, scaled by the total number of loans the firm has borrowed over the same time period. All variables used in this study are formally defined in the appendix.

3.3 Measuring Refinancing Risk Exposure

To construct a measure of a firm's exposure to refinancing risk, this study uses information on long-term debt payable in the first (Compustat item dd1), second (Compustat item dd2), third (Compustat item dd3), fourth (Compustat item dd4) and fifth (Compustat item dd5) year, as provided by the Compustat database. Accordingly, the refinancing risk exposure ratio is computed as

$$Maturing/LT_{f,t} = \frac{dd_{2004,f,t}}{(dd1 + dltt)_{2004,f}}, \tag{1}$$

where $Maturing/LT_{f,t}$ is defined as the proportion of the amount of firm f's long-term debt outstanding at year-end 2004 with the repayment due date in year t ($dd_{2004,f,t}$) out of the firm's total long-term debt outstanding at year-end 2004 ($(dd1 + dltt)_{2004,f}$). As an alternative measure, the proportion of long-term debt outstanding at the end of year 2004 and that comes due in year t scaled by total assets at the end of year 2004 ($Maturing/AT_{f,t}$) is also constructed. A higher value of $Maturing/LT_{f,t}$ and $Maturing/AT_{f,t}$ means that a large amount of long-term debt is coming due in year t. Evidently, a higher level of maturing debt increases firms' refinancing risk, because firms with a higher volumes of debt maturing soon are more likely to repeatedly tap credit markets. Hence, these variables can serve as a proxy measure of firms' potential for exposure to refinancing risk. Since they are constructed in such a way that they predetermine firms' exposure to refinancing risk, these measures alleviate concerns associated with the use of short-term debt and long-term debt maturing in one year discussed in the introduction.

3.4 Descriptive Statistics

The summary statistics of the DealScan–Compustat dataset on which the debt-maturity effect of refinancing risk are analyzed is presented in Table 1. Panel

A of this table reports summary statistics of the maturing portion of outstanding long-term debt constructed based on the data in year 2004. These summary statistics are calculated at the firm–year level, as some borrowers appear in the sample more than once. Panel B displays the descriptive statistics of new loans, which are calculated at a loan-facility level. Summary statistics of the borrowing firms' financial information, which are calculated at the firm–quarter level, are presented in Panel C.

Table 1. Summary Statistics

This table presents summary statistics of the data. Panel A reports summary statistics of the maturing portion of outstanding long-term debt constructed based year-2004 data. These summary statistics are calculated at the firm–year level. Panel B presents summary statistics of new loans, which are calculated at a loan-facility level. Panel C displays statistics on the borrowing firms' financial information, which are calculated at the firm–quarter level. Summary statistics of cash flows scaled by total assets measured in 2006 (average of quarter 1 to quarter 4) are calculated firm level. Summary statistics of S&P credit ratings measured, as of the end of June 30, 2007, are also calculated at the firm level. All variables are defined in the appendix.

				Distribution				
	N	Mean	SD	Min	25^{th}	50^{th}	75^{th}	Max
Panel A: Maturing Long-Term Debt								
Maturing/LT	1,068	0.11	0.19	0.00	0.00	0.04	0.14	1.00
Maturing/AT	1,068	0.04	0.08	0.00	0.00	0.01	0.03	0.76
Panel B: Loan Characteristics								
Maturity	1,629	45.21	26.26	1.00	24.00	48.00	60.00	300.00
Amount (million)	1,687	590.82	1,476.00	0.00	60.30	200.00	500.00	22,500.00
Term Loan	1,687	0.29	0.45	0.00	0.00	0.00	1.00	1.00
Revolver	1,687	0.53	0.50	0.00	0.00	1.00	1.00	1.00
364-Day Facility	1,687	0.07	0.26	0.00	0.00	0.00	0.00	1.00
Corporate Purpose	1,687	0.40	0.49	0.00	0.00	0.00	1.00	1.00
Working Capital	1,687	0.20	0.40	0.00	0.00	0.00	0.00	1.00
Takeover	1,687	0.12	0.32	0.00	0.00	0.00	0.00	1.00
Debt Repay	1,687	0.03	0.17	0.00	0.00	0.00	0.00	1.00
Relationship	1,549	0.63	0.48	0.00	0.00	1.00	1.00	1.00
Panel C: Borrower Characteristics								
Total AssetB	1,070	10.75	41.70	0.01	0.56	1.88	6.43	797.77
Market-to-Book	975	1.52	0.79	0.31	1.00	1.31	1.76	4.70
Profitability	1,044	0.03	0.03	−0.21	0.02	0.03	0.05	0.16
Leverage	1,048	0.30	0.21	0.00	0.15	0.28	0.40	1.03
Taxes	1,068	0.00	0.01	−0.11	0.00	0.00	0.01	0.14
Utility Industry	1,143	0.15	0.36	0.00	0.00	0.00	0.00	1.00
Asset Maturity	1,038	34.40	27.32	0.42	15.01	25.11	44.42	128.13
Cash Flow	798	0.03	0.03	−0.22	0.02	0.03	0.05	0.17
No Rating	887	0.46	0.50	0.00	0.00	0.00	1.00	1.00
SG Rating	887	0.27	0.44	0.00	0.00	0.00	1.00	1.00
IG Rating	887	0.27	0.44	0.00	0.00	0.00	1.00	1.00

With regard to the maturing portion of long-term debt outstanding, the results depicted in Panel A show considerable variation among firms. For instance, the values that the variable *Maturing/LT* takes vary between 0.00 and 1.00, with the mean of 0.11. The distribution of this variable indicates that, on average, 11% of long-term debt outstanding as of the year-end 2004 matures during the financial crisis. The maximum value of this variable indicates that some firms have 100% of their outstanding long-term debt coming due at some point during the recent financial crisis. On the other hand, the minimum value indicates that some firms have none of their long-term debt coming due during the crisis. Given this wide cross-firm variation in the amount of long-term debt scheduled to mature during the recent financial crisis, it is not unreasonable to expect significant differences in the firms' exposure to refinancing risk. This difference would provide a natural motivation to investigate whether these variations also translate into a significant variation in loan-maturity choices.

In terms of loan characteristics, loan facilities have an average maturity of 45 months and the median maturity of 48 months, with maturity ranges from 1 to 300 months. The facility amount is US$ 590.8 million on average and varies between US$ 549,700 and US$ 22.5 billion. Most loan facilities (53% of the loans in the sample) are in the form of a revolver. The next largest loan type is a term loan, which accounts for 29% of the facilities in the sample. Firms issue a significant fraction of loan facilities for corporate purposes, 40% of the loans in the sample. The other main purposes for which firms issue loan facilities are working capital (20%) and takeover (12%). Most loan facilities (63%) are obtained from relationship lenders.

With respect to firm characteristics, a borrower has US$ 10.75 billion total assets on average each quarter, varying between US$ 12 million and US$ 797.77 billion. The average firm has 3% profitability per quarter. Firm leverage and asset maturity are Winsorized at the 99$^{\text{th}}$ percentile to eliminate extreme outliers from influencing the results. After Winsorization, the average firm is leveraged at 30% each quarter, and the average asset maturity is 34.4 months. The mean cash-flow-to-asset ratio measured in year 2006 (average of quarter 1 to quarter 1) is 0.12. In terms of long-term issuers' credit ratings measured at the end of June 30, 2007, 46% of the firms in the sample have no S&P credit ratings while 27% have a speculative-grade credit rating.

4. Refinancing Risk and Loan Maturity: Empirical Evidence

4.1 Model Specification

To investigate the impact of refinancing risk on loan-maturity choice, this article estimates a loan-maturity regression model of the form

$$Maturity_{l,f,t} = \alpha + \beta Refinancing\ Risk_{f,t} + \gamma X_{f,t-1} + \eta X_{l,t} + FE_{\text{industry}} + FE_{\text{time}} + \epsilon_{l,f,t}, \quad (2)$$

where $Maturity_{l,f,t}$ is the term to maturity of loan facility l obtained by firm f at time t. From the point of view of Hypothesis 1 developed in Section 2, the key independent variable of interest is $Refinancing\ Risk_{f,t}$. The proportion of long-term debt that comes due during the 2007–2009 financial crisis, measured based on data as of the year-end 2004, is used to proxy for this variable. According to the refinancing-risk–maturity prediction, firms with refinancing risk should display a strong tendency to issue longer maturities. Thus, the main coefficient of interest, β, should be positive. This model also controls for firm-specific ($X_{f,t-1}$) and loan-level ($X_{l,t}$) characteristics, which are presented as firm and loan controls for clarity.

Firm Controls. Agency-based theories of debt-maturity choice argue that short-term debt alleviates the problems of underinvestment (Myers, 1977) and asset-substitution (Barnea et al., 1980). Since small firms are more likely to face greater agency problems (Smith and Warner, 1979), they are expected to have more short-term debt. Thus, *Firm Size* is used as a control variable. Firms with growth opportunities are also more likely to face greater agency conflicts between shareholders and debt holders. For investment opportunities that involve growth options, Myers (1977) argues that choosing debt that matures before growth options are exercised mitigates underinvestment problems. Since firms with higher market-to-book ratios are expected to have greater growth options, they are expected to use short-term debt. Hence, this paper controls for growth options using *Market-to-Book*.

Theoretical work by Morris (1992) and Leland and Toft (1996) shows that firms who choose greater leverage also prefer to choose longer maturity. Since higher leverage involves greater bankruptcy risk, issuing long-term debt allows firms to minimize exposure to such risk. According to these studies, there is a positive relationship between leverage and debt maturity. However, Dennis et al. (2000) argue that higher leverage increases agency costs by encouraging managerial opportunism. They argue that creditors use short-term debt for firms with higher leverage to discourage such opportunism, suggesting a negative relationship. Accordingly, this paper controls for such possibilities using *Leverage*.

Brick and Ravid (1985) and Kane et al. (1985) develop theoretical models of optimal debt-maturity structures that incorporate taxes. They argue that managers can increase firm value by choosing long-term debt when the tax advantage of debt decreases. Thus, this paper controls for this possibility using *Taxes*. Flannery (1986) argues that short-term debt allows firms suffering from informational problems to mitigate the mispricing of debt associated with information asymmetries. Shorter maturities reduce the misvaluation of debt by allowing costs of financing to depend on the arrival of favorable information. Diamond (1991) argues that low- and high-quality firms issue short-term debt, while medium-quality firms use long-term debt. This paper controls for information asymmetries and credit qualities using *Rating*.

Barclay and Smith (1995) argue that utility industries suffer less from agency-related problems because authorities regulate them. A reduction in the agency problem may thus allow firms in the utility industry to borrow longer-maturing debt. This paper thus controls for regulated industries using the dummy variable *Utility Industry*. Following Xu (2016), this paper also controls for firm profitability (*Profitability*).

According to the matching principle, firms should match the maturity of the debt they issue with the maturity of their assets. The reason is that if debt matures before assets produce cash, firms many not be able to honor their debt-repayment schedule. Further, Myers (1977) argues that matching the maturity of debt with the maturity of assets mitigates agency conflicts. The matching principle thus suggests that longer asset maturity supports long-term debt. This paper controls for this notion using *Asset Maturity*. Goswami (2000) argues that information asymmetries regarding firms' cash flow may induce a nonlinear relationship between the maturity of debt and asset maturity. This study controls for such a possibility using the square of asset maturity (*Asset Maturity*^{2}).

Loan Controls. The model controls for loan amounts using *Loan Size*. In all model specifications, *Revolver*, *Term Loan* and *364-Day Facility* dummies are used to control for the loan type. *Corporate Purpose*, *Working Capital*, *Debt Repay* and *Takeover* dummies are used to control for loan purpose.

Fixed-effect dummies and clustering. Since debt-maturity policies can differ between industries, the loan-maturity model controls for industry-level fixed effects with industry dummies using a one-digit SIC code (*Industry Dummy*). Further, debt-maturity choices can also vary with time. The regression model accounts for this possibility by allowing for year-specific effects with time dummies (*Time Dummy*). Because there are few observations for each firm, this paper cannot include firm-level fixed-effect dummies in the model. Standard errors are clustered at a firm level and allowed to be heteroskedastically robust.

4.2 Loan Maturity Regression Analysis: Testing Hypothesis 1

If maturity lengthening can help firms reduce their exposure to refinancing risk, one would expect to observe firms actively involved in lengthening their debt's maturity structure. Such maturity-management practices are expected more among firms with a large amount of debt coming due soon, because a large volume of maturing debt would put firms at greater refinancing risk in times of financial crisis. This positive relationship is the prediction of Hypothesis 1 developed in Section 2, and is tested using the maturity regression model given in Equation (2). Table 2 reports baseline results from the empirical analysis of how the maturing portion of outstanding long-term debt is related to the maturity of loans obtained during the 2007–2009 financing crisis.

The results show that firms with a large portion of their debt maturing during the crisis experience an increase in the maturity of newly issued loans. As can be seen from the results presented in Column (1), the regression coefficient for the relationship between the maturing portion of outstanding long-term debt and the maturity of new loans is positive and significant at the 5% level. In addition to being statistically distinct from zero, this baseline result is also economically nonnegligible. The estimated coefficient on *Maturing/LT* suggests that a one-standard-deviation increase in the maturing portion of outstanding long-term debt is associated with an increase of around two months in the maturity of newly obtained loans. Given that the average loan maturity is 48 months, this increase corresponds to about 3% relative to the sample mean. This baseline result is robust to a different measure of refinancing risk. As can be noted from the coefficients reported in Column (2), *Maturing/AT* has a positive and highly significantly (at the 1% level) estimated coefficient.

Table 2. Loan-Maturity Regression Analysis: Testing Hypothesis 1

This table presents coefficient estimates from regressions relating the maturing portion of outstanding debt to the maturity of new loans obtained during the 2007–2009 financial crisis. The dependent variable, *Maturity*, is the maturity of loans. Columns (1) and (2) report the estimated coefficients for the sample period from August 2007 to June 2009. Columns (3) and (4) display the coefficient estimates for the sample period from August 2007 to December 2008. The independent variables of interest, *Maturing/LT* and *Maturing/AT*, are the proportion of maturing outstanding long-term debt scaled by total long-term debt and total assets, respectively. Definitions of the remaining variables are provided in the appendix. In all columns, standard errors are clustered at the firm level and are heteroskedastically robust. The *t*-test of significance is *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level.

	Maturity			
	As of year-end 2004 August 2007–June 2009		As of year-end 2003 August 2007–December 2008	
	(1)	(2)	(3)	(4)
Maturing/LT	8.339**		7.633*	
	(3.28)		(4.10)	
Maturing/AT		36.077***		28.200**
		(11.33)		(12.49)
Loan Size	2.771***	2.685***	2.818***	2.793***
	(0.73)	(0.72)	(0.91)	(0.90)
Firm Size	−1.792**	−1.720*	−1.632	−1.586
	(0.88)	(0.88)	(1.02)	(1.02)
Market-to-Book	−1.699**	−1.676**	−1.433	−1.377
	(0.85)	(0.85)	(1.02)	(1.01)
Profitability	83.159***	79.881***	122.871***	118.941***
	(28.63)	(28.50)	(43.72)	(43.72)
Leverage	−1.628	−3.962	−3.005	−4.164
	(5.20)	(5.20)	(5.12)	(5.11)
Taxes	−54.726	−53.695	−128.732*	−125.354*
	(50.43)	(49.34)	(71.94)	(70.84)
Rating	0.044	0.051	0.116	0.133
	(0.18)	(0.18)	(0.21)	(0.21)
Utility Industry	−11.644	−11.942	−6.651	−6.317
	(8.43)	(8.41)	(5.52)	(5.55)
Asset Maturity	0.046	0.027	0.019	0.035
	(0.12)	(0.12)	(0.13)	(0.13)
[*Asset Maturity*]^2	−0.001	−0.001	−0.001	−0.001
	(0.00)	(0.00)	(0.00)	(0.00)
Loan Type Dummy	YES	YES	YES	YES
Loan Purpose Dummy	YES	YES	YES	YES
Industry Dummy	YES	YES	YES	YES
Time Dummy	YES	YES	YES	YES
R^2	0.332	0.336	0.314	0.316
N	1,272	1,272	954	954

This baseline result can be viewed as providing empirical support to the notion that refinancing-risk considerations matter for corporate debt-maturity choices in crisis times. As such, firms with refinancing risk design a maturity-choice strategy by considering the implication of the existing maturity structure for their exposure to refinancing risk. Firms whose maturing outstanding long-term debt is large are expected to be more concerned about refinancing risk. For these firms, issuing additional shorter maturities could cause a growing exposure to refinancing risk. Thus, the maturity-lengthening behavior displayed by these firms, despite the finding of previous studies (see, e.g., Hu, 2010; Gopalan et al., 2014) that they also experience a higher credit spread, suggests that refinancing risks became a first-order concern for them. In response, consistent with the theoretical prediction, these firms roll over debt maturing soon into new loans of longer maturities to minimize refinancing-risk exposure.

The identification strategy behind this baseline result relies on the variation of the maturity structure of outstanding long-term debt based on data as of year-end 2004. One might wonder, however, whether this measure is sufficiently predetermined in the sense that it is unlikely for firms to anticipate the financial crisis and restructure their outstanding long-term-debt maturity profile. If firms did that, the observed relationship would be heavily influenced by an unobserved expectation confounder: As such, the result would not entirely reflect the impact of refinancing risk. To address this concern, the same analysis is repeated using a maturity profile measured at the end of 2003, the farthest one can go back with Compustat information about the maturity structure of long-term debt. Using this alternative measure, the refinancing-risk–maturity relationship is reestimated for the sample period between August 2007 and year-end 2008.

Interestingly, the estimation produces results comparable with those of the first two columns. For example, the estimated coefficient reported in Column (3) shows a positive and statistically significant (at the 10% level) relationship between *Maturing/LT* and the maturity of the newly issued loans. Column (4) repeats the same analysis using the alternative measure, *Maturing/AT*, and reports that the relationship continues to be positive and significant at the 5% level. These results do not suggest that the refinancing-risk measure constructed based on 2004 data suffers from the problems mentioned above. The slight reduction in the size and statistical significance of the estimated coefficients on the refinancing-risk proxy measures computed based on the year 2003 information is not unexpected. As one goes further back in time, the association between these variables would become weaker, because some debt may retire before the scheduled due date.

Regarding firm and loan characteristics, the results reported in Table 2 show that most of the control variables assume the expected sign. Loan size is positive and statistically significantly associated with loan maturity, which is consistent with agency considerations. Among firm-level factors, maturity significantly decreases with firm size. Firms' growth options are negatively associated with maturity, which supports the agency-conflict argument. Firm profitability is positively related to loan maturity. There is some evidence that the relationship between taxes and loan maturity is negative, which is counterintuitive. As expected, asset maturity has a nonmonotonic relationship, though it is statistically insignificant.

4.3 Multinomial Logistic Regression Analysis

The previous regression provides evidence consistent with the view that firms with refinancing risk lengthen the maturity of their loans. There is more to be learned by investigating whether the maturities that these firms choose are in a particular maturity class along the loan maturity spectrum. For example, do

Table 3. Multinomial Logistic Regression Analysis

This table reports results from multinomial logistic regression with the dependent variable *Maturity* taking a maturity class: 0–12 months, 13–36 months, 37–60 months, and more than 60 months. $\ln(P_{13\text{–}36}/P_{0\text{–}12})$ is the natural log of the odds of choosing a maturity class of 13–36 months relative to the odds of choosing a maturity class of 0–12 months; $\ln(P_{37\text{–}60}/P_{0\text{–}12})$ is the natural log of the odds of choosing a maturity class of 37–60 months relative to the odds of choosing a maturity class of 0–12 months; $\ln(P_{>60}/P_{0\text{–}12})$ is the natural log of the odds of choosing a maturity class more than 60 months relative to the odds of choosing a maturity class of 0–12 months. Coeff. stands for coefficient while Margin. stands for marginal effect. The main independent variable is *Maturing/LT*, denoting the proportion of maturing outstanding long-term debt scaled by total long-term debt measured based on 2004 data. Definitions of the remaining variables are provided in the appendix. In all columns, standard errors are clustered at the firm level and heteroskedastically robust. The t-test of significance is *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level.

	Maturity					
	$\ln(P_{13\text{–}36}/P_{0\text{–}12})$		$\ln(P_{37\text{–}60}/P_{0\text{–}12})$		$\ln(P_{>60}/P_{0\text{–}12})$	
	Coeff. [1]	Margin. [2]	Coeff. [3]	Margin. [4]	Coeff. [5]	Margin. [6]
Maturing/LT	1.485*	.007	1.678**	.028	2.736***	.107***
	(0.82)		(0.80)		(0.89)	
Loan Size	0.001	−.026***	0.243***	.023**	0.388***	.018**
	(0.09)		(0.09)		(0.11)	
Firm Size	−0.275**	.003	−0.383***	−.026**	−0.345***	−.004
	(0.11)		(0.10)		(0.13)	
Market-to-Book	−0.513***	−.029*	−0.348**	.008	−0.486**	−.013
	(0.17)		(0.16)		(0.22)	
Profitability	14.128***	−.224	20.277***	1.305**	20.050***	.348
	(4.19)		(4.33)		(6.18)	
Leverage	−0.545	−.059	−0.382	−.094	1.544**	.144***
	(0.64)		(0.61)		(0.72)	
Taxes	−5.663	.163	−7.238	.155	−18.826	−1.006
	(9.06)		(8.88)		(12.27)	
Rating	0.008	.001	−0.003	−.002	0.009	.001
	(0.03)		(0.02)		(0.03)	
Utility Industry	0.722*	.126	−0.271	−.076	−0.687	−.049
	(0.76)		(0.65)		(0.68)	
Asset Maturity	−0.010	−.002	0.008	.002	−0.010	−.001
	(0.02)		(0.02)		(0.02)	
[*Asset Maturity*]^2	0.000	.000	−0.000	−.000	−0.000	.000
	(0.00)		(0.00)		(0.00)	
Loan Type Dummy	YES	YES	YES	YES	YES	YES
Loan Purpose Dummy	YES	YES	YES	YES	YES	YES
Industry Dummy	YES	YES	YES	YES	YES	YES
Time Dummy	YES	YES	YES	YES	YES	YES
N	1,272					
LR $\chi^2(99)$	1,176.45					
Pseudo R^2	0.36					

they prefer one specific maturity bucket toward the long end? Or are firms, once they get maturity extension for the duration of the financial crisis, indifferent between different maturity classes. These issues are investigated using a multinomial logistic regression analysis. To this end, the loan maturities in the sample are categorized into different maturity buckets: 0–12 months, 13–36 months, 37–60 months, and more than 60 months. The multinomial-logistic-regression approach assigns one of these dependent-variable classes to be the baseline against which all other maturity classes are compared. More formally, the estimated model takes the form

$$ln\left(Pr(Maturity = k)/Pr(Maturity = k_B)\right) = \alpha + \beta Refinancing\ Risk_{f,t} + \gamma X_{f,t-1} + \eta X_{l,t} + FE_{\text{industry}} + FE_{\text{time}} + \epsilon_{l,f,t}. \quad (3)$$

In this regression model, maturity class k_B serves as the baseline group against which maturity class k is compared. The maturity categories that the dependent variable takes are k = 0–12 months, 13–36 months, 37–60 months, or more than 60 months. The multinomial logistic regression given in Equation (3) therefore estimates the natural log of the odds of choosing a certain maturity class k ($Pr(Maturity = k)$) relative to the odds of choosing the reference maturity class k_B ($Pr(Maturity = k_B)$). Table 3 reports the estimated coefficients and marginal effects of choosing a particular maturity class relative to the baseline group (i.e., a maturity class of 0–12 months).

The reported results suggest that a greater maturing portion of outstanding long-term debt engenders greater odds of the firm choosing longer maturities than the baseline group. For example, Column (2) shows that the relative probability of choosing a maturity class of 13–36 months instead of choosing a maturity class of 0–12 months increases by 0.7% for a percentage-point increase in maturing outstanding long-term debt. Column (4) shows that a percentage-point increase in maturing outstanding long-term debt increases the probability of choosing a maturity class of 37–60 months relative to a maturity class of 0–12 months by 2.8%. However, the maturing portion of long-term debt (*Maturing/LT*) is statistically insignificant in determining the relative probabilities presented in the first and fourth columns. In contrast, Column (6) shows that firms with refinancing risk are 10.6% more likely to choose a maturity class of more than 60 months relative to a maturity class of 0–12 months for every percentage-point increase in maturing outstanding long-term debt. The highly significant marginal effects along the maturity spectrum suggest that firms with refinancing risk are more likely to choose the longest possible maturity, as exposure to refinancing risk decreases along the loan-maturity spectrum.

4.4 Alternative Explanation: Evidence from Precrisis Periods

One concern with the observed positive relationship may be that such pattern might not be specific to the impact of refinancing risk; but might also result from a routine maturity-choice pattern in which firms replace maturing long-term debt with new loans of longer maturity. If this alternative hypothesis is correct, then one should observe a positive relationship between the two variables irrespective of the sample periods used for the analysis—i.e., such association should be a key attribute of the data. Extending the analysis to precrisis periods could therefore be useful to better understand the primary mechanism driving the relationship. A finding of a negative relationship during a precrisis period would not support the alternative explanation. Table 4 reports the regression results from the analysis aimed at checking the validity of this alternative hypothesis using the precrisis periods 2005—July 31, 2007.

Table 4. Alternative Explanation: Evidence from Precrisis Periods

This table reports coefficient estimates from regressions relating the maturing portion of outstanding debt to the maturity of new loans obtained during the precrisis periods. The dependent variable, *Maturity*, is the maturity of loans. Columns (1) and (2) present coefficient estimates for the sample period from 2005 to July 2007. Columns (3) and (4) report the estimated coefficients for the sample period from 2004 to July 2007. The independent variables of interest, *Maturing/LT* and *Maturing/AT*, are the proportion of maturing outstanding long-term debt scaled by total long-term debt and total assets, respectively. Definitions of the remaining variables are provided in the appendix. In all columns, standard errors (in parentheses) are clustered at the firm level and heteroskedastically robust. The *t*-test of significance is *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level.

	Maturity			
	As of year-end 2004 January 2005 — July 2007		As of year-end 2003 January 2004 — July 2007	
	[1]	[2]	[3]	[4]
Maturing/LT	−6.671***		−4.518***	
	(1.96)		(1.48)	
Maturing/AT		−11.248*		−11.431**
		(6.41)		(5.27)
Loan Size	2.417***	2.458***	2.986***	2.999***
	(0.45)	(0.45)	(0.38)	(0.38)
Firm Size	−0.908	−0.910	−1.169***	−1.160**
	(0.56)	(0.56)	(0.45)	(0.45)
Market-to-Book	−0.705	−0.686	−1.032*	−1.051*
	(0.67)	(0.68)	(0.56)	(0.56)
Profitability	48.899***	42.685**	73.091***	73.105***
	(14.69)	(16.94)	(14.46)	(14.41)
Leverage	3.357*	4.902**	2.244	3.287*
	(1.90)	(1.93)	(1.82)	(1.85)
Taxes	−17.267	−12.209	−53.539***	−53.991***
	(25.78)	(25.79)	(17.82)	(17.76)
Rating	−0.096	−0.112	−0.174**	−0.178**
	(0.11)	(0.11)	(0.09)	(0.09)
Utility Industry	−4.605	−4.732	−1.116	−1.314
	(3.58)	(3.59)	(2.94)	(2.94)
Asset Maturity	0.075	0.084	0.001	0.007
	(0.06)	(0.06)	(0.05)	(0.05)
$[\textit{Asset Maturity}]^2$	−0.001	−0.001	−0.000	−0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Loan Type Dummy	YES	YES	YES	YES
Loan Purpose Dummy	YES	YES	YES	YES
Industry Dummy	YES	YES	YES	YES
Time Dummy	YES	YES	YES	YES
R^2	0.272	0.270	0.319	0.319
N	3,607	3,607	4,923	4,923

The results suggest that firms whose outstanding long-term debt maturing soon seek new loans of shorter maturities. As can be seen from the results presented in Column (1), the regression coefficient for the relationship between *Maturing/LT* and the maturity of new loans is negative ($\beta = -6.67$, $S.E. = 1.96$) and statistically significant at the 1% level. This negative relationship continues to hold, though with marginal significance, when the maturing portion of long-term debt is scaled by total assets (*Maturing/AT*), as shown in Column (2). The last two columns of Table 3 repeat the above experiment using the maturing long-term debt constructed based on 2003 data and the sample period 2004—July 31, 2007. The reported results show that the maturing portion of outstanding long-term debt is negatively and significantly associated with the maturity of new loans.

Such a negative association does not support the alternative explanation. Rather, the negative relationship could potentially be explained by the fact that firms are generally less constrained in raising external debt capital in non-crisis times. Indeed there is strong evidence that supports this argument. For example, Keys et al. (2010), Purnanandam (2011) and Bord and Santos (2012) note that the increasing use of the *originate and distribute* model in which financial institutions repackage and offload loans to investors with different appetites for risk led to a considerable expansion of the supply of cheap credit in the years leading to the 2007–2009 financial crisis. This suggests that refinancing risk is less of a concern during this time. One can thus argue that firms replace maturing debt with new shorter maturities to secure rollover gains. In line with this argument, the Seta et al. (2016) model suggests that short-term financing increases the proceeds from debt rollover in good credit-market conditions.

In sum, the relationship's switch to positive during the crisis period likely reflects the change in credit-market conditions. The precrisis and postcrisis periods capture two different aspects of credit-market situations. As discussed in the introduction, the credit-market disruption during the financial crisis markedly increased concerns about the risk of limited refinancing, which undoubtedly encouraged firms to seek longer maturities.

5. Does Firm Type Matter? Cross-Sectional Analysis

The preceding section established a strong positive association between the maturing portion of outstanding long-term debt and the maturity of new loans obtained during the recent financial crisis, suggesting that refinancing-risk considerations are the key factor driving such associations. A natural assumption is that factors influencing the likelihood of being exposed to refinancing risk may also influence such relationships. As discussed in Section 2, firm attributes such as access to public credit markets and the availability of internally generated liquidity would create different refinancing risk effects across firms. The purpose of this section is, therefore, to investigate whether the established baseline result varies between firms classified into different groups according to these attributes. The relationship between refinancing risk and loan maturity across groups of firms is estimated using a model of the form

$$\begin{aligned} Maturity_{l,f,t} = \alpha + \beta_g \sum_{g=1}^{k} \Big(\textit{Refinancing Risk}_{f,t} \times Group(g) \Big) \\ + \gamma X_{f,t-1} + \eta X_{l,t} + FE_{\text{industry}} + FE_{\text{time}} + \epsilon_{l,f,t}, \quad (4) \end{aligned}$$

where $Group(g)$ is an indicator variable equal 1 if a firm belongs to group g according to firm classifications based on the degree to which they access public debt markets and the level of internally generated funds. $Maturity_{l,f,t}$, *Refinancing Risk*$_{f,t}$, $X_{f,t-1}$ and $X_{l,t}$ are defined as for Equation (2). The regression includes an industry dummy (based on one digit SIC code) and a time dummy to control for industry and year effects. Standard errors are clustered at the firm level and heteroskedastically robust. The analysis are presented in the following subsections.

5.1 Firm's Access to Public Debt Financing

The extent to which a firm is exposed to refinancing risk may vary inversely with the firm's relative position in accessing public debt markets. As has been observed during the recent financial crisis (see, e.g., Campello et al., 2010; Chava and Purnanandam, 2011; Hale and Santos, 2013; Chiu et al., 2014), problems of refinancing risk appear to be particularly severe for firms with limited access to public debt financing. These firms may therefore be more concerned about refinancing risk. Consequently, they are expected to exhibit strong maturity-lengthening behavior to reduce their refinancing-risk exposure. The aim of this section is, therefore, to examine the question of whether refinancing-risk considerations have a differential impact on loan maturity across firms classified on the basis of the degree to which they access public debt markets.

To this end, the firms in the sample are classified on the basis of their pre-crisis S&P credit ratings measured at the end of June 30, 2007. The credit rating is a common measure of firms' public debt market access (see, e.g., Gilchrista and Himmelberg, 1995; Almeida et al., 2004; Sufi, 2009; Campello et al., 2010; Duchin et al., 2010; Subrahmanyam et al., 2014). Following the standard practice, this study splits firms into three groups: *No Rating* is equal to 1 if firm f has no S&P credit rating; *SG Rating* is equal to 1 if firm f has an S&P rating of BB^{+} or less; and *IG Rating* is equal to 1 if firm f has an S&P rating of BBB^{-} or more. These dummies are allowed to interact with the maturing portion of outstanding long-term debt to construct three interaction terms: *Maturing/LT* × *No Rating*, *Maturing/LT* × *SG Rating* and *Maturing/LT* × *IG Rating*. The estimation technique then involves running the maturity regression model given in Equation (4) by replacing *Refinancing Risk*$_{ft} \times$ *Group*(g) with the three interaction terms constructed above. Table 5 reports the coefficient estimates from this regression.

The results show a notable difference between the three groups with respect to the impact of refinancing risk on loan maturity. As can be noted from the results reported in Column (1), the coefficient on the interaction term *Maturing/LT* × *No Rating* is statistically insignificant. This implies that an increase in the amount of outstanding long-term debt coming due soon has no effect on the maturity of new loans for firms without a credit rating. Given that refinancing-risk concerns encourage firms without credit ratings to lengthen the maturity of their loans, the finding of insignificant association may suggest that these firms are unable to do so. A plausible explanation is that they are excluded from participating in the long-term credit markets, as argued by Diamond (1991).

Table 5. Refinancing risk: Firm's Access to Public Debt Finance

This table reports coefficient estimates from the regression relating the maturing portion of outstanding long-term debt to the maturity of newly issued loans during the financial crisis of 2007–2009. The dependent variable *Maturity* is the maturity of new loans in months. The main independent variable *Maturing/LT* is the maturing outstanding long-term debt scaled by total long-term debt constructed based on 2004 data. *No Rating* identifies firms without S&P credit ratings. *SG Rating* identifies firms with speculative-grade credit ratings (i.e., S&P rating BB^{+} or less). *IG Rating* identifies firms with investment-grade credit ratings (i.e., S&P rating BBB^{-} or more). For Columns (1) and (2), S&P ratings are measured at the end of June 30, 2007. For Columns (3) and (4), it is measured at the end of December 31, 2006. Definitions of the remaining variables are provided in the appendix. In both columns, standard errors are clustered at the firm level and heteroskedastically robust. The *t*-test of significance is *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level.

	Maturity			
	S&P measured at the end of June 30, 2007		S&P measured at the end of December 31, 2006	
	Coeff. [1]	S.E. [2]	Coeff. [3]	S.E. [4]
Maturing/LT × *No Rating*	2.852	(3.41)	3.418	(3.29)
Maturing/LT × *SG Rating*	23.608***	(6.69)	21.343***	(6.73)
Maturing/LT × *IG Rating*	−1.645	(8.97)	5.717	(10.65)
Loan Size	2.604***	(0.72)	2.655***	(0.72)
Firm Size	−1.662*	(0.88)	−1.706*	(0.88)
Market-to-Book	−1.587*	(0.86)	−1.622*	(0.87)
Profitability	83.855***	(28.80)	83.847***	(28.74)
Leverage	−3.360	(5.17)	−3.047	(5.15)
Taxes	−56.493	(50.54)	−58.794	(50.50)
Rating	0.084	(0.20)	0.102	(0.20)
Utility Industry	−12.224	(8.43)	−11.854	(8.46)
Asset Maturity	0.030	(0.12)	0.035	(0.12)
$[\textit{Asset Maturity}]^2$	−0.001	(0.00)	−0.001	(0.00)
Loan Type Dummy	YES		YES	
Loan Purpose Dummy	YES		YES	
Industry Dummy	YES		YES	
Time Dummy	YES		YES	
R^2	0.338		0.336	
N	1,272		1,272	
H0: The impact of *Maturing/LT* on *Maturity* is the same for *No Rating* and *SG Rating* firms.	0.004		0.013	
H0: The impact of *Maturing/LT* on *Maturity* is the same for *No Rating* and *IG Rating* firms.	0.636		0.836	
H0: The impact of *Maturing/LT* on *Maturity* is the same for SG *Rating* and *IG Rating* firms.	0.020		0.198	

The estimated coefficient on *Maturing/LT* × *SG Rating* is positive and significant at the 1% level. In keeping with the ex ante expectation that firms whose access to public debt markets is relatively restricted face more refinancing risk, this result shows that speculative-grade firms choose longer maturities. The negative but insignificant coefficient of the interaction term *Maturing/LT* × *IG Rating* suggests that refinancing risk has no effect on loan maturity for investment-grade firms. This finding confirms the view that refinancing risk is not a major problem for high-credit-quality firms, as they have alternative financing sources available. Indeed, Cortina-Lorente et al. (2016) provides results consistent with this argument that the debt issuance of investment-grade firms shifted away from bank loans toward public bonds during the recent financial crisis.

To determine whether the refinancing-risk effects are different across these groups, the equality of the coefficients on the interaction terms is tested. The bottom of Table 5 reports p-values associated with the chi-square ($\mathcal{X}^2$) test statistic of the equality of the interaction coefficients. As can be noted from this result, the test rejects the null hypothesis of the equality of the coefficient on *Maturing/LT* $\times$ *No Rating* and *Maturing/LT* $\times$ *SG Rating* with a p-value of 0.004. The null hypothesis is also rejected when the coefficient on *Maturing/LT* $\times$ *SG Rating* is compared with that of *Maturing/LT* $\times$ *IG Rating* with a p-value of 0.02. On the other hand, the test cannot reject the null hypothesis of the equality of the coefficient on *Maturing/LT* $\times$ *No Rating* and *Maturing/LT* $\times$ *IG Rating* with a p-value of 0.636. On the basis of these tests, one can conclude that the maturity effect of refinancing risk is more pronounced for firms with speculative-grade credit ratings. The effect is not significantly different between firms without credit ratings and those with investment-grade credit ratings.

There might be some concern with using S&P credit ratings measured at the end of June 30, 2007, as an identification strategy. A potential concern with such a proxy measure may be that firms anticipate the financial crisis and change their financing, investment and risk-management policies. For example, Bolton et al. (2013) develop a theoretical model that predicts that firms that anticipate the threat of a future financial crisis postpone investments and payout decisions. Thus, one might argue that these policy adjustments may affect the firms' future maturity choices and their immediate credit ratings. If that is the case, the estimated results could be biased because of confounding factors. In that case, one would expect to observe results that are different from the results presented above when credit ratings are measured earlier in time. To address this concern, and also to gauge the performance of the S&P measure based on June 30, 2007, data as an identification tool, this study replicates the analysis in Column (1) using S&P credit ratings measured at the end of December 31, 2006.

The regression results reported in Column (3) of Table 5 somewhat reaffirm the significant difference in the maturity effect of refinancing risk across rating groups observed in the preceding column. For example, the coefficient of the interaction term *Maturing/LT* $\times$ *SG Rating* continues to be highly significant. On the other hand, the coefficient on *Maturing/LT* $\times$ *IG Rating* is still statistically indistinguishable from zero, though it changes its sign to positive. The estimated coefficient on *Maturing/LT* $\times$ *No Rating* is now marginally significant. However, according to the comparability tests of the interaction coefficients reported at the bottom of Table 5, one can continue to reject the null hypothesis of the equality of the coefficients on *Maturing/LT* $\times$ *No Rating* and *Maturing/LT* $\times$ *SG Rating*. Whereas one now fails to reject the equality of the coefficients on *Maturing/LT* $\times$ *SG Rating* and *Maturing/LT* $\times$ *IG Rating*.

5.2 Firm's Internal Financial Constraints

Recently emerging literature strongly suggests that firms that face higher internal financial constraints—i.e., limited level of internal funds—are more likely to be exposed to refinancing risk. Given the baseline result that firms with refinancing risk choose longer maturities, one would expect such preference for longer maturities to occur more among firms that face greater internal financial constraints. Therefore, the empirical analysis in this section is aimed at investigating how the maturity effect of refinancing risk varies across different groups of firms categorized according to the internal financial constrains they face.

In line with the discussion in Section 2, and also as in Cleary et al. (2007) and Guariglia (2008), this study uses cash flows as a measure of internal financial constrains. Accordingly, the firms in the sample are sorted into three groups based on average quarterly cash flows scaled by total assets measured in 2006 (Quarter 1 to Quarter 4). Three dummy variables are constructed: *Low Cash Flow* identifies those firms whose cash flows fall in the lower tercile of the cash-flow distribution of all firms. *Medium Cash Flow* identifies firms with cash flows that fall in the middle tercile of the cash-flow distribution of all firms. *High Cash Flow* identifies firms whose cash flows fall in the upper tercile of the cash flow distribution. These dummy variables interacted with the maturing portion of outstanding long-term debt scaled by total long-term debt. The regression model given in Equation (4) is then estimated by replacing $\textit{Refinancing Risk}_{f,t} \times \textit{Group}(g)$ with the three interaction terms. Table 6 displays the results obtained.

The result shows that the maturity effect of refinancing risk varies in the cross-section of firms sorted based on cash flows. As the results reported in Column (1) shows, the coefficient estimate on the interaction term *Maturing/LT* $\times$ *Low Cash Flow* is positive and statistically significant at the 1% level. This suggests that maturing long-term debt is associated with an increase in the maturity of newly issued loans for firms with low cash flows. This result is consistent with the finding of Choi et al. (2013) that low-cash-flow firms disperse the maturity structure of their debt. A number of scenarios could explain this result. One plausible explanation is that the negative or near-zero cash flows these firms maintain leaves them with insufficient funds for debt service. In this situation, choosing shorter maturities would mean, as debt retires at a higher frequency, magnifying the refinancing costs and risk that they already face. This can explain why they choose longer maturities.

Another possible explanation can be derived from the finding of Cleary et al. (2007). These authors argue that firms with negative cash flows need to raise large funds not only to close a financing gap, but also to make a large investment that generates sufficient cash flows to cove debt service for the creditors to be willing to offer funds in the first place. Higher debt ratios lower the firms' debt capacity, which in turn, exacerbates their refinancing risk even further. The finding of a positive association is therefore consistent with the argument forwarded by Sun (2014) that firms borrow with longer maturities to preserve their debt capacity.

Table 6. Refinancing Risk: Firm's Internal Financial Constraints

This table presents the results of regressions aimed at understanding whether the impact of refinancing risk on the maturity of new loans varies across firms classified by the internal financial constraints they face. The dependent variable, *Maturity*, is the maturity of new loans measured in months. The main independent variable of interest, *Maturing/LT*, is the proportion of maturing outstanding long-term debt scaled by total long-term debt computed based on 2004 data. *Low Cash Flow* identifies firms with cash flows in the lower tercile of the cash-flow distribution of all firms. *Medium Cash Flow* identifies firms whose cash flows fall in the middle tercile of the cash-flow distribution of all firms. *High Cash Flow* identifies firms with cash flows in the upper tercile of the cash-flow distribution. Cash flows are average cash flows scaled by total assets. For Column (1), cash flows are measured in 2006 (average of Quarter 1 to Quarter 4). For Column (3), cash flows are measured in 2005 (average of Quarter 1 to Quarter 4). Definitions of the remaining variables are provided in the appendix. In both columns, standard errors are clustered at the firm level and heteroskedastically robust. The t-test of significance is *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level.

	Maturity			
	Cash flows measured in 2006 (average of Q1 to Q4)		Cash flows measured in 2005 (average of Q1 to Q4)	
	Coeff. [1]	S.E. [2]	Coeff. [3]	S.E. [4]
Maturing/LT × *Low Cash Flow*	25.288***	(9.176)	29.558***	(10.131)
Maturing/LT × *Medium Cash Flow*	8.518*	(4.647)	7.026	(5.340)
Maturing/LT × *High Cash Flow*	5.869	(3.992)	3.557	(3.912)
Loan Size	2.784***	(0.757)	2.793***	(0.788)
Firm Size	−1.830*	(0.934)	−2.090**	(0.983)
Market-to-Book	−1.349	(0.864)	−1.276	(0.887)
Profitability	72.734**	(30.130)	101.123***	(34.126)
Leverage	−0.649	(5.367)	−3.608	(5.338)
Taxes	−47.093	(52.163)	−117.231	(73.639)
Rating	0.047	(0.195)	0.015	(0.200)
Utility Industry	−13.258	(8.434)	−14.302*	(8.627)
Asset Maturity	0.026	(0.120)	0.042	(0.126)
$[Asset\ Maturity]^2$	−0.001	(0.001)	−0.001	(0.001)
Loan Type Dummy	YES		YES	
Loan Purpose Dummy	YES		YES	
Industry Dummy	YES		YES	
Time Dummy	YES		YES	
R^2	0.338		0.338	
N	1,205		1,180	
H0: The impact of *Maturing/LT* on *Maturity* is the same for *Low Cash Flow* and *Medium Cash Flow* firms.	0.092		0.042	
H0: The impact of *Maturing/LT* on *Maturity* is the same for *Low Cash Flow* and *High Cash Flow* firms.	0.043		0.014	
H0: The impact of *Maturing/LT* on *Maturity* is the same for *Medium Cash Flow* and *High Cash Flow* firms.	0.648		0.576	

One may, however, appeal to the finding of previous studies that low-cash-flow firms maintain cash reserves as a liquidity buffer (Bates et al., 1958), and that firms use cash holdings to absorb rollover losses (Harford et al., 2014), and argue that firms with low cash flows can still borrow at shorter maturities. While these firms might make such maturity decisions, it is, however, important to note that they cannot do so without ultimately exposing themselves to refinancing risk. The main reason is that, in the presence of maturing outstanding debt, additional shorter maturities will drain internal savings for those firms with negative or close to zero cash flows.

Another result presented in Column (1) is that, while the estimated coefficient of the interaction term *Maturing/LT* × *Medium Cash Flow* is marginally significant, the estimated coefficient of the interaction term *Maturing/LT* × *High Cash Flow* is not statistically distinguishable from zero. This result suggests that maturing outstanding long-term debt has no effect on the maturity of new loans issued by firms with high cash flows. This is perhaps because the high cash flows that firms maintain allows them to absorb any rollover losses. Consequently, they may not seek longer-maturity debt.

To investigate whether the refinancing-risk effects differ among these firms, the analysis in this section next compares the estimated coefficients of the three interaction terms. The bottom of Table 6 reports p-values associated with $\mathcal{X}^2$ test statistic. As one can note from the reported results, the test rejects the null hypothesis of the equality of the coefficients on the interaction terms *Maturing/LT* × *Low Cash Flow* and *Maturing/LT* × *Medium Cash Flow* with a p-value of 0.09. The test also rejects the equality of the coefficients on *Maturing/LT* × *Low Cash Flow* and *Maturing/LT* × *High Cash Flow* with a p-value of 0.04. In contrast, the test cannot reject the null hypothesis of the equality of the estimated coefficients on the interaction terms *Maturing/LT* × *Medium Cash Flow* and *Maturing/LT* × *High Cash Flow* with a p-value of 0.65. On the basis of the comparability tests of the interaction-term coefficients, one would conclude that the effect is more pronounced for low-cash-flow firms while the maturity effect of refinancing risk is very similar for firms with medium and high cash flows.

To gauge the performance of the cash flows measured based on 2006 data as an identification tool, Column (3) repeats the analysis by splitting the firms in the sample based on average quarterly cash flows scaled by total assets measured in 2005 (Quarter 1 to Quarter 4). As can be seen from the reported results, the estimated coefficient on *Maturing/LT* × *Low Cash Flow* continues to be highly significant, whereas the coefficient on *Maturing/LT* × *High Cash Flow* remains insignificant. The only change is that the interaction term *Maturing/LT* × *Medium Cash Flow* has now a statistically insignificant coefficient. The p-values associated with the test of the equality of the coefficients reported at the bottom of Table 6 also show that the test continues to reject the null hypothesis that the coefficient on *Maturing/LT* × *Low Cash Flow* is comparable with that on *Maturing/LT* × *Medium Cash Flow*. Again, the test fails to reject the hypothesis of the equality of the coefficients on *Maturing/LT* × *Medium Cash Flow* and *Maturing/LT* × *High Cash Flow*.

6. Refinancing Risk: Lending Relationship with Creditors

An emerging body of literature on relationship lending emphasizes the importance of bank–firm relationships as an important credit-constraint alleviating factor, especially during crises. Therefore, this section investigates whether building lending relationships with creditors benefits firms with refinancing risk by offering longer maturities during periods of financial crises. Such analysis requires distinguishing among loan facilities based on the existence of a firm's lending relationship with creditors. In the literature on relationship lending, firms' repeated interactions with their previous lenders are commonly used as a sorting device (see, e.g., Dahiya et al., 2003; Bharath et al., 2007, 2011; Gopalan et al., 2011). Following this literature, the current analysis uses previous firm–lender interactions to split the loan facilities in the sample into relationship and nonrelationship loans. The analysis is then performed by running split-sample regression—i.e., regressing a loan maturity equation for each group separately. Table 7 reports the regression results.

From the results reported in Column (1), the regression coefficient for the relationship between *Maturing/LT* and the maturity of new loans is statistically significant (at the 1% level) within the sample of relationship loans. This significant relationship continues to hold when alternative measure *Maturing/AT* is used, as shown in Column (2). The last two columns of Table 7 repeat the same exercise using the sample of nonrelationship loan facilities. In contrast to the results reported in the first three columns, Columns (4) and (5) show that the estimated coefficients on *Maturing/LT* and *Maturing/AT* are not statistically distinct from zero. The result that an increase in refinancing risk is associated with an increase in the maturity of the loans obtained from relationship lenders is consistent with the view that relationship lenders help their borrowers in crisis times.

To examine whether the effect is significantly greater in the sample of relationship loans, the analysis next compares the estimated coefficients of *Maturing/LT* and *Maturing/AT* within relationship and nonrelationship loans. The bottom of Table 7 reports p-values corresponding to the z test statistic for the difference between the two regression coefficients. While refinancing risk has a significant effect on loan maturity within the sample of relationship loans, the test however cannot reject the null hypothesis of the equality of the coefficients on refinancing risk within the samples of relationship and nonrelationship loans. Thus, one could not conclude that the refinancing-risk effect is significant.

A standard result in the relationship-lending literature is that firms who use one bank tend to have stronger relationships than do firms relying on multiple banks (see, e.g., Detragiache et al., 2000; Farinha and Santos, 2002). Accordingly, a further analysis is performed to investigate whether the maturity effect of refinancing risk varies between firms with different degrees of lending relationships with creditors. To this end, three dummy variables are constructed based on the number of repeated firm–lender interactions: *Weak Relation* identifies loan facilities for which the borrowers' lending relationships with creditors fall in the lower tercile of the distribution of all firm's lending interactions. *Medium Relation* identifies facilities obtained from lenders with whom the borrowers have lending relationships that fall in the middle tercile. *Strong Relationship* identifies loan facilities that firms have received from lenders with whom they have lending relationships that fall in the upper tercile of the distribution of lending interactions for all firms. These dummies are allowed to interact with the maturing portion of outstanding long-term

Table 7. Refinancing Risk: Lending Relationship with Creditors

Maturity is the dependent variable. The independent variables are *Maturing/LT* and *Maturing/AT*. *Weak Relation*, *Medium Relation* and *Strong Relationship* identify facilities obtained from lenders with whom the borrowers have lending relationships that fall in the lower, middle and upper terciles of the distribution of lending interactions of all firms, respectively. Columns (1)–(3) present results obtained from the sample of relationship loans. Columns (4) and (5) report results from nonrelationship loans. In addition to the reported variables, the regressions also control for taxes, rating, utility industry, asset maturity and square of asset maturity. Definitions of the remaining variables are provided in the appendix. In all columns, standard errors (in parentheses) are clustered at the firm level and are heteroskedastically robust. The *t*-test of significance is *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level.

	Maturity				
	Relationship loan			Nonrelationship loan	
	[1]	[2]	[3]	[4]	[5]
Maturing/LT	9.411***			5.492	
	(3.40)			(6.23)	
Maturing/AT		34.909***			36.396
		(9.28)			(27.02)
Maturing/LT × *Weak Relation*			16.354***		
			(5.62)		
Maturing/LT × *Medium Relation*			9.012		
			(5.91)		
Maturing/LT × *Strong Relationship*			4.849		
			(4.66)		
Loan Size	3.060***	2.898***	3.041***	1.946	1.901
	(0.83)	(0.82)	(0.83)	(1.26)	(1.25)
Firm Size	−2.083**	−1.928**	−2.091**	−1.887	−1.841
	(0.95)	(0.93)	(0.95)	(1.80)	(1.80)
Market-to-Book	−2.907**	−2.663**	−2.830**	−2.745	−2.755
	(1.18)	(1.16)	(1.18)	(2.23)	(2.22)
Profitability	150.667***	140.576***	151.466***	88.595*	86.712
	(51.24)	(50.77)	(51.48)	(52.41)	(52.69)
Leverage	−0.768	−2.959	−1.390	−6.067	−8.576
	(5.67)	(5.57)	(5.62)	(9.33)	(9.39)
Loan Type Dummy	YES	YES	YES	YES	YES
Loan Purpose Dummy	YES	YES	YES	YES	YES
Industry Dummy	YES	YES	YES	YES	YES
Time Dummy	YES	YES	YES	YES	YES
R^2	0.485	0.490	0.486	0.279	0.282
N	656	656	656	432	432
H0: The impact of *Maturing/LT* on *Maturity* is the same in Columns (1) and (4).	0.547				
H0: The impact of *Maturing/AT* on *Maturity* is the same in Columns (2) and (5).		0.954			
H0: The impact of *Maturing/LT* on *Maturity* is the same for *Weak Relation* and *Medium Relation*.			0.372		
H0: The impact of *Maturing/LT* on *Maturity* is the same for *Weak* and *Strong Relationship*.			0.101		
H0: The impact of *Maturing/LT* on *Maturity* is the same for *Medium* and *Strong Relationship*.			0.542		

debt to create three interaction terms, which are used to replace $\textit{Refinancing Risk}_{f,t} \times \textit{Group}(g)$ in Equation (4).

The results from running such a regression model are displayed in Column (3) of Table 7. As can be seen from the reported results, while the estimated coefficients on the interaction term *Maturing/LT* × *Weak Relation* is statistically significant, the interaction term *Maturing/LT* × *Medium Relation* and

Maturing/LT $\times$ *Strong Relationship* are insignificantly estimated. This result is unexpected. The test reported at the bottom of Table 7 however cannot reject the null hypothesis of equal coefficients on the three interaction terms. Thus, one cannot conclude that the effect is significantly more pronounced in loan facilities in which the firms have weak relationships with the creditors.

7. Additional Robustness Check

So far, this analysis has conducted robustness checks of the baseline results to an alternative measure of refinancing risk and an alternative interpretation. Nevertheless, there may still exist some potential concerns related to sample selection and estimation specification. To address these concerns, this section reports two additional robustness checks.

7.1 Sample-Selection Bias

One of the potential concerns with the analysis in this article is related to the problem of sample-selection bias. The problem is that information on loan facilities is observed only for those firms that obtain loans during the crisis; it is not observed for firms that obtain loans during precrisis periods and not during the financial crisis. Some firms that obtain loans during precrisis periods may be credit rationed (even if they would like to borrow) and are excluded from participating in the credit markets during the financial crisis. This type of selection might bias the conclusion if those firms that would normally take short-term loans—perhaps because they are informationally opaque and, hence, need to be closely monitored—are the ones that are credit rationed. More precisely, such selection may put an upward pressure on the effect of refinancing on the maturity of loans.

To address this concern, this article follows Almeida et al. (2012) and uses matching-estimation approaches developed in the literature to mitigate this type of selection bias due to observables. To this end, firms' potential for exposure to refinancing risk based on the maturing portion of outstanding long-term debt is used to sort firms into *treated* and *untreated* groups. Matching then involves identifying control firms (i.e., firms that do not have a large fraction of maturing long-term debt and, hence, do not need to roll over maturing debt) from the untreated groups that best match the treated firm (i.e., firms that have a large fraction of maturing long-term debt and, hence, have more potential for refinancing risk). This method allows comparison of firms that are identical in all aspects except for the portion of maturing outstanding long-term debt. Thus, any difference in the maturity of new loans between the two most-closely matched groups can be attributed to the effect of refinancing risk.

To identify control firms, this study employs the Mahalanobis matching technique described by Cochran and Rubin (1973) and Rubin (1980). In this covariate-based matching method, control firms are selected on the basis of their Mahalanobis-distance metric from the treated firms. A number of loan and firm characteristics are used to match firms in the two groups. These in-

Table 8. Robustness Check of Sample-Selection Bias: Evidence from Mahalanobis Matching

This table reports results from the Mahalanobis-matching technique. The dependent variable is *Maturity*, measured in months. Panel A sorts firms into the treated group whose maturing outstanding long-term debt out of total long-term debt, measured in 2004, is greater than 10%. In Panel B, the treated firms are defined as those for which the maturing portion of outstanding long-term debt, measured in 2004, is greater than 20%. The *nearest neighbor* estimator calculates the difference in loan maturity between each treated loan and n untreated loans that have the closest Mahalanobis distance. *ATT* denotes the average treatment on the treated. The t-test of significance is *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level.

	Treated obs.	Untreated obs.	*ATT*	
			Coeff.	S.E.
	[1]	[2]	[3]	
Panel A: Treated if *Maturing/LT* > 10%				
One to one	425	847	6.33***	(1.66)
Nearest neighbors ($n = 10$)	425	847	6.33***	(1.66)
Nearest neighbors ($n = 50$)	425	847	6.33***	(1.77)
Panel B: Treated if *Maturing/LT* > 20%				
One-to-one	206	1,066	6.55***	(1.89)
Nearest neighbors ($n = 10$)	206	1,066	6.55***	(2.32)
Nearest neighbors ($n = 50$)	206	1,066	6.55***	(2.43)

clude loan size, firm size, profitability, market to book, leverage, credit rating, taxes and asset maturity. The study uses the *nearest neighbor* matching estimator to implement the matching techniques. This estimator calculates the difference in the maturity of new loans between the two groups for which the Mahalanobis-distance matrix is minimal. The matching results are displayed in Table 8.

In Panel A, the treated firms are defined as those for which the maturing portion of outstanding long-term debt is greater than 10% while firms whose maturing long-term debt is less than 10% are considered as untreated. As can be seen from Column (3), the one-to-one estimator produces the average treatment effect on the treated (*ATT*) of 6.3. Increasing the number of firms used as the control group (n) does not affect the result. For example, for $n = 10$ and $n = 50$, the nearest-neighbor estimator reports the *ATT* of 6.3. Panel B repeats the same analysis by focusing on firms whose maturing outstanding long-term debt out of total long-term debt is greater than 20%. As can be seen from the table, the *ATT* for the one-to-one estimator is 6.6. For the nearest-neighbor estimator, the *ATT* is also 6.6 whether $n = 10$ or $n = 50$. This matching analysis demonstrates that those firms that have a large proportion of maturing long-term debt during the financial crisis obtain longer maturities than otherwise-similar firms, except for the amount of long-term debt coming due. One can thus conclude from this analysis that the baseline result survives even after correcting for a sample-selection bias.

7.2 Bank Fixed Effect

Another potential concern is associated with the creditor-level heterogeneity in terms of the maturity of loans. Agency-based theories of corporate maturity choice suggest that creditors can use debt maturity to control agency-related problems. The more the agency conflicts between creditors and firms, the more creditors want to use shorter maturities to control firms. Conversely, creditors having less agency friction with firms may less urgently need shorter maturities as a disciplining device. It is possible that such heterogeneity across lenders may affect the maturity of the loans they offer. To check the robustness of the baseline regression results to this variation, this section reestimates the maturity regression model while controlling for lender fixed effects through the use of lender dummies. Table 9 reports the results from this regression specification.

Inclusion of the lender-level fixed-effect dummy does not affect the estimated coefficients much when compared to the results reported in Table 2.[4] As Column (1) displays, the estimated coefficient on *Maturing/LT* is still statis-

[4] Note that there are fewer observations in Table 9 than in Table 2 because of missing information on the identity of some lenders. Hence, one cannot directly compare the results reported in the two tables.

Table 9. Robustness Check: Bank Fixed Effect

This table presents coefficient estimates from regressions relating the maturing portion of outstanding debt and the maturity of new loans obtained during the 2007–2009 financial crisis. The dependent variable, *Maturity*, is the maturity of loans in months. The independent variable of interest, *Maturing/LT*, is the proportion of maturing outstanding long-term debt scaled by total long-term debt measured in year 2004. Column (1) reports the coefficient estimates obtained from a regression that includes the lender-fixed-effect dummy and clusters the standard errors at the firm level. Column (2) presents results obtained from a regression that clusters standard errors at the firm and lender level. Column (3) reports results obtained from a regression that includes the lender-fixed-effect dummy and clusters the standard errors at the firm and lender level. Definitions of the remaining variables are provided in the appendix. In all columns, standard errors are heteroskedastically robust. The *t*-test of significance is *** significant at the 1% level, ** significant at the 5% level and * significant at the 10% level.

	Maturity					
	Lender FE		Clust. by lender and firm		Lender FE, clust. by firm and lender	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
	[1]		[2]		[3]	
Maturing/LT	8.623**	(3.58)	8.324**	(3.41)	8.623**	(3.49)
Loan Size	3.324***	(0.68)	2.769***	(0.72)	3.324***	(0.63)
Firm Size	−2.194**	(0.93)	−1.775*	(0.98)	−2.194*	(1.13)
Market-to-Book	−1.265	(0.88)	−1.684*	(0.99)	−1.265	(1.11)
Profitability	108.299***	(33.39)	83.253***	(28.00)	108.299***	(28.16)
Leverage	−3.347	(4.73)	−1.706	(5.18)	−3.347	(4.52)
Taxes	−32.638	(70.45)	−54.439	(48.24)	−32.638	(62.48)
Rating	0.091	(0.18)	0.048	(0.18)	0.091	(0.15)
Utility Industry	0.942	(3.97)	−11.550	(9.29)	0.942	(3.84)
Asset Maturity	0.023	(0.12)	0.039	(0.12)	0.023	(0.11)
[*Asset Maturity*]^2	−0.001	(0.00)	−0.001	(0.00)	−0.001	(0.00)
Loan Type Dummy	YES		YES		YES	
Loan Purpose Dummy	YES		YES		YES	
Industry Dummy	YES		YES		YES	
Time Dummy	YES		YES		YES	
Lender Fixed Effect	YES		No		YES	
R^2	0.604		0.331		0.604	
N	1,269		1,269		1,269	

tically significant (at the 5% level). Column (2) presents results from a regression specification that clusters standard errors at the firm and lender levels. As the result shows, such clustering does not make the coefficient estimate of *Maturing/LT* statistically less significant. Column (3) estimates a regression that includes the lender-level fixed-effect dummy and clusters the standard errors by firm and lender, and obtains similar results. Evidently, the baseline regression result is robust to this alternative specification.

8. Concluding Remarks

This study explores whether refinancing risk is an important determinant of debt-maturity choice. To do so, the analysis in this paper investigates how firms with a potential for exposure to refinancing risk choose the maturity of new loans they obtain during the 2007–2009 financial crisis. To address concerns related to endogeneity, firms' exposure to refinancing risk is predetermined using the maturity profile of long-term debt outstanding in year 2004 and that comes due during the financial crisis. The evidence shows that an increase in the amount of maturing outstanding long-term debt is associated with new loans of longer maturities. This result is consistent with theories that promote the view that, in the presence of refinancing risk, firms choose longer maturities because longer maturities help to mitigate refinancing-risk exposure.

The maturity effect of refinancing risk is stronger for firms with speculative-grade credit ratings. This result can be understood in the context of recent evidence that firms with limited access to public debt markets are more exposed to negative credit-supply shocks. Expectedly, this encourages speculative-grade firms to extend the maturity of their debt. Consistent with the view that firms with limited internally generated funds are more likely to be exposed to more refinancing losses because their debt is more risky, the effect is more pronounced for firms that maintain low cash flows. Furthermore, there is also evidence that firms with refinancing risk obtain longer maturities from their relationship lenders.

While the result is robust to an alternative measure of refinancing risk, an estimation technique that accounts for sample-selection bias and alternative specifications, one caveat of this study is that firms' equity issues are omitted from the analysis. Thus, one direction of future research is to investigate the sensitivity of the baseline result to equity choices. Reestimating the analysis in this paper using public debt, which has larger maturity than bank loans used in this study, also appears promising.

REFERENCES

Acharya, V. V., Gale, D. and Yorulmazer, T. (2011), 'Rollover risk and market freezes', *Journal of Finance* **66**, 1177–1209.

Almeida, H., Campello, M., Laranjeira, B. and Weisbenner, S. (2012), 'Corporate debt maturity and the real effects of the 2007 credit crisis', *Critical Fi-*

nance Review **1**, 3–58.

Almeida, H., Campello, M. and Weisbach, M. (2004), 'The cash flow sensitivity of cash', *Journal of Finance* **59**, 1777–1804.

Barclay, M. J. and Smith, C. W. (1995), 'The maturity structure of corporate debt', *Journal of Finance* **50**, 609–631.

Barnea, A., Haugen, R. A. and Senbet, L. W. (1980), 'A rationale for debt maturity structure and call provisions in the agency theoretic framework', *Journal of Finance* **35**, 1223–1234.

Bates, T., Kahle, K. and Stulz, R. (1958), 'Why do u.s. firms hold so much more cash than they used to?', *Journal of Finance* **64**, 1985–2021.

Benmelech, E., Bergman, N. and Seru, A. (2015), 'Financing labor', *NBER Working Paper No. 17144* .

Berger, A. N., Espinosa-Vega, M. A., Frame, W. S. and Miller, N. H. (2005), 'Debt maturity, risk, and asymmetric information', *Journal of Finance* **60**, 2895–2923.

Bharath, S., Dahiya, S., Saunders, A. and Srinivasan, A. (2007), 'So what do i get? the bank's view of lending relationships', *Journal of Financial Economics* **85**, 368–419.

Bharath, S., Dahiya, S., Saunders, A. and Srinivasan, A. (2011), 'Lending relationships and loan contract terms', *Review of Economic Studies* **24**, 1141–1203.

Billett, M. T., King, T.-H. D. and Mauer, D. C. (2007), 'Growth opportunities and the choice of leverage, debt maturity, and covenants', *Journal of Finance* **62**, 697–730.

Bolton, P., Chen, H. and Wang, N. (2013), 'Market timing, investment, and risk management', *Journal of Financial Economics* **109**, 40–62.

Bolton, P., Freixas, X., Gambacorta, L. and Mistrulli, P. E. (2016), 'Relationship and transaction lending in a crisis', *Review of Financial Studies* **29**, 2643–2676.

Bord, V. and Santos, J. A. (2012), 'The rise of the originate-to-distribute model and the role of banks in financial intermediation', *Economic Policy Review* **18**, 21–34.

Brick, I. E. and Ravid, S. A. (1985), 'On the relevance of debt maturity structure', *Journal of Finance* **40**, 1423–1437.

Brunnermeier, M. K. (2009), 'Deciphering the liquidity and credit crunch 2007-2008', *Journal of Economic Perspectives* **33**, 77–100.

Brunnermeier, M. K. and Yogo, M. (2009), 'A note on liquidity risk management', *American Economic Review* **99**, 578–83.

Butler, A. W., Grullon, G. and Weston, J. (2006), 'Can managers successfully time the maturity structure of their debt issues?', *Journal of Finance* **61**, 1731–1758.

Campello, M., Giambona, E., Graham, J. R. and Harvey, C. R. (2011), 'Liquidity management and corporate investment during a financial crisis', *The Review of Financial Studies* **24**, 1944–1979.

Campello, M., Graham, J. R. and Harvey, C. R. (2010), 'The real effects of financial constraints: Evidence from a financial crisis', *Journal of Financial Economics* **97**, 470–487.

Chava, S. and Purnanandam, A. (2011), 'The effect of banking crisis on bank-dependent borrowers', *Journal of Financial Economics* **99**, 116–135.

Chava, S. and Roberts, M. R. (2008), 'How does financing impact investment? the role of debt covenants', *Journal of Finance* **63**, 2085 – 2121.

Chen, H., Xu, Y. and Jun, Y. (2012), 'Systematic risk, debt maturity, and the term structure of credit spreads', *NBER Working Paper 18367* .

Cheng, I.-H. and Milbradt, K. (2012), 'The hazards of debt: Rollover freezes, incentives, and bailouts', *Review of Financial Studies* **25**, 1070–1110.

Chiu, W.-C., Peña, J. I. and Wang, C.-W. (2014), 'Financial crises, financing sources, and default risks', *Available at SSRN: http://ssrn.com/abstract=2513756 or http://dx.doi.org/10.2139/ssrn.2513756* .

Choi, J., Hackbarth, D. and Zechner, J. (2013), 'Granularity of corporate debt', *CFS Working Paper, No. 2013/26* .

Chui, M., Domanski, D., Kugler, P. and Shek, J. (2010), 'The collapse of international bank finance during the crisis: evidence from syndicated loan markets', *BIS Quarterly Review* **September**, 39–49.

Cleary, S., Povel, P. and Raith, M. (2007), 'The u-shaped investment curve: Theory and evidence', *Journal of Financial & Quantitative Analysis* **42**, 1–39.

Cochran, W. G. and Rubin, D. B. (1973), 'Controlling bias in observational studies: A review', *Sankhyā: The Indian Journal of Statistics, Series A* **35**, 417–446.

Cortina-Lorente, J. J., Didier, T. and Schmukle, S. L. (2016), 'How long is the maturity of corporate borrowing? evidence from bond and loan issuances across markets', *WB, Policy Research Working Papers 7815* .

Dahiya, S., Saunders, A. and Srinivasan, A. (2003), 'Financial distress and bank lending relationships', *Journal of Finance* **58**, 375–399.

Dennis, S., Nandy, D. and Sharpe, I. G. (2000), 'The determinants of contract terms in bank revolving credit agreements', *Journal of Financial and Quantitative Analysis* **35**, 87–110.

Detragiache, E., Garella, P. and Guiso, L. (2000), 'Multiple versus single banking relationships: Theory and evidence', *Journal of Finance* **55**, 1133–1161.

Diamond, D. W. (1991), 'Debt maturity structure and liquidity risk', *Quarterly Journal of Economics* **106**, 709–737.

Duchin, R., Ozbas, O. and Sensoy, B. A. (2010), 'Costly external ïňĄnance, corporate investment, and the subprime mortgage credit crisis', *Journal of Financial Economics* **97**, 418–435.

Farinha, L. A. and Santos, J. A. (2002), 'Switching from single to multiple bank lending relationships: Determinants and implications', *Journal of Financial Intermediation* **11**, 124–151.

Flannery, M. J. (1986), 'Asymmetric information and risky debt maturity choice', *Journal of Finance* **41**, 19–37.

Froot, K. A., Scharfstein, D. S. and Stein, J. C. (1993), 'Risk management: Coordinating corporate investment and financing policies', *Journal of Finance* **48**, 1629–1658.

Gilchrista, S. and Himmelberg, C. P. (1995), 'Evidence on the role of cash flow for investment', *Journal of Monetary Economics* **36**, 541–572.

Gobbi, G. and Sette, E. (2014), 'Do firms benefit from concentrating their borrowing? evidence from the great recession', *Review of Finance* **18**, 527–560.

González, V. M. (2015), 'The financial crisis and corporate debt maturity: The role of banking structure', *Journal of Corporate Finance* **35**, 310–328.

Gopalan, R., Song, F. and Yerramilli, V. (2014), 'Debt maturity structure and credit quality', *Journal of Financial and Quantitative Analysis* **49**, 817–842.

Gopalan, R., Udell, G. F. and Yerramilli, V. (2011), 'Why do firms form new banking relationships?', *Journal of Financial and Quantitative Analysis* **46**, 1335–1365.

Gorton, G. B. (2009), 'Slapped in the face by the invisible hand: Banking and the panic of 2007', *Prepared for the Federal Reserve Bank of Atlanta's 2009 Financial Markets Conference: Financial Innovation and Crisis, May 11-13* .

Goswami, G. (2000), 'Asset maturity, debt covenants, and debt maturity choice', *The Financial Review* **35**, 51–68.

Grossman, S. J. and Hart, O. D. (1982), 'Corporate financial structure and managerial incentives', *The Economics of Information and Uncertainty, edited by John McCall. Chicago: University of Chicago Press* .

Guariglia, A. (2008), 'Internal financial constraints, external financial constraints, and investment choice: Evidence from a panel of uk firms', *Journal of Banking & Finance* **32**, 1795–1809.

Guedes, J. and Opler, T. (1996), 'The determinants of the maturity of corporate debt issues', *Journal of Finance* **51**, 1809–1833.

Hainz, C. and Wiegand, M. (2013), 'How does relationship banking influence credit financing? evidence from the financial crisis', *Ifo Working Paper, No. 157* .

Hale, G. and Santos, J. a. A. C. (2013), 'Do banks propagate debt market shocks?'.

Harford, J., Klasa, S. and Maxwell, W. F. (2014), 'Refinancing risk and cash holdings', *Journal of Finance* **69**, 975–1012.

He, Z. and Milbradt, K. (2016), 'Dynamic debt maturity', *Review of Financial Studies* **29**, 2677–2736.

He, Z. and Xiong, W. (2012a), 'Rollover risk and credit risk', *Journal of Finance* **67**, 391–429.

He, Z. and Xiong, W. (2012b), 'Dynamic debt runs', *Review of Financial Studies* **25**, 1799–1843.

Hu, X. (2010), 'Rollover risk and credit spreads in the financial crisis of 2008'.

Ivashina, V. and Scharfstein, D. S. (2010), 'Bank lending during the financial crisis of 2008', *Journal of Financial Economics* **97**, 319–338.

Jensen, M. C. and Meckling, W. H. (1976), 'Theory of the firm: Managerial behavior, agency costs and ownership structure', *Journal of Financial Economics* **3**, 305–360.

Johnson, S. A. (2003), 'Debt maturity and the effects of growth opportunities and liquidity risk on leverage', *Review of Financial Studies* **16**, 209–236.

Jun, S.-G. and Jen, F. C. (2003), 'Trade-off model of debt maturity structure', *Review of Quantitative Finance and Accounting* **20**, 5–34.

Kane, A., Marcus, A. J. and McDonald, R. L. (1985), 'Debt policy and the rate of return premium to leverage', *Journal of Financial and Quantitative Analysis* **20**, 479–499.

Keys, B. J., Mukherjee, T., Seru, A. and Vig, V. (2010), 'Did securitization lead to lax screening? evidence from subprime loans', *Quarterly Journal of Economics* **125**, 307–362.

Leland, H. E. (1998), 'Agency costs, risk management, and capital structure', *Journal of Finance* **53**, 1213–1243.

Leland, H. E. and Toft, K. B. (1996), 'Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads', *Journal of Finance* **51**, 987–1019.

Li, B. (2013), 'Refinancing risk, managerial risk shifting, and debt covenants: An empirical analysis', *Queen's University* .

Mian, A. R. and Santos, J. a. A. C. (2011), 'Liquidity risk, and maturity management over the credit cycle', *University of California, Berkeley, Working Paper* .

Mitchell, K. (1993), 'The debt maturity choice: An empirical investigation', *Journal of Financial Research* **16**, 309–320.

Morris, J. (1992), 'Factors affecting the maturity structure of corporate debt', *Working paper, University of Colorado at Denver* .

Morris, S. and Shin, H. S. (2016), 'Illiquidity component of credit risk—the 2015 lawrence r. klein lecture', *International Economic Review* **57**, 1135–1148.

Myers, S. C. (1977), 'Determinants of corporate borrowing', *Journal of Financial Economics* **5**, 147–175.

Paligorova, T. and Santos, J. a. A. C. (2016), 'Banks' exposure to rollover risk and the maturity of corporate loans', *Review of Finance* **doi: 10.1093/rof/rfw039**, 1–27.

Puri, M., Rocholl, J. and Steffen, S. (2011), 'Global retail lending in the aftermath of the us financial crisis: Distinguishing between supply and demand effects', *Journal of Financial Economics* **100**, 556–578.

Purnanandam, A. (2011), 'Originate-to-distribute model and the subprime mortgage crisis', *Review of Financial Studies* **24**, 1881–1915.

Rubin, D. B. (1980), 'Bias reduction using mahalanobis-metric matching', *Biometrics* **36**, 293–298.

Schroth, E., Suarez, G. A. and Taylor, L. A. (2014), 'Dynamic debt runs and financial fragility: Evidence from the 2007 abcp crisis', *Journal of Financial Economics* **112**, 164–189.

Seta, M. D., Morellec, E. and Zucchi, F. (2016), 'Rollover traps', *Swiss Finance Institute Research Paper No. 16–19* .

Shleifer, A. and Vishny, R. W. (2011), 'Fire sales in finance and macroeconomics', *Journal of Economic Perspectives* **25**, 29–48.

Smith, C. W. J. and Warner, J. B. (1979), 'On financial contracting: An analysis of bond covenants', *Journal of Financial Economics* **7**, 117–161.

Subrahmanyam, M. G., Tang, D. Y. and Wang, S. Q. (2014), 'Credit default swaps and corporate cash holdings', *CFS Working Paper, No. 462* .

Sufi, A. (2009), 'The real effects of debt certification: Evidence from the introduction of bank loan ratings', *Review of Financial Studies* **22**, 1659–1691.

Sun, Q. (2014), 'Cash holdings and risky access to future credit', *mimeo, University of Southern California* .

Szkup, M. (2013), 'Optimal debt maturity structure, rollover risk and strategic uncertainty', *mimeo, New York University* .

Taggart, R. A. J. (1977), 'A model of corporate financing decisions', *Journal of Finance* **32**, 1467–1484.

Valenzuela, P. (2015), 'Rollover risk and credit spreads: Evidence from international corporate bonds', *Review of Finance* **20**, 631–661.

Xu, Q. (2016), 'Early refinancing and maturity management in the corporate bond market', *Available at SSRN: https://ssrn.com/abstract=2787968* .

Table 10. Variable Definitions

This table presents the definition of the variables used in this study.

Maturing/LT	The ratio of long-term debt that becomes due in one, two, three, four and five year scaled by total long-term debt based on data in 2003.
Maturing/AT	The ratio of long-term debt that becomes due in one, two, three, four and five year scaled by total assets based on data in 2003.
Maturity	The number of months from facility start date to facility end date
Loan Size	The natural logarithm of loan facility amount in million
Term Loan	A dummy variable taking the value one if the loan type is term loan
Revolver	A dummy variable taking the value one if the loan type is revolver
364-Day Facility	A dummy variable taking the value one if the loan type is 364-day facility
Other Type	A dummy variable taking the value one if the loan type is other
Corporate Purpose	A dummy variable taking the value one if the loan purpose is corporate purpose
Working Capital	A dummy variable taking the value one if the loan purpose is working capital
Takeover	A dummy variable taking the value one if the if loan purpose is for takeover
Debt Repay	A dummy variable taking the value one if the loan purpose is for debt repayment
Other Purpose	A dummy variable taking the value one if the loan purpose is for others
Relationship	A dummy taking the value one if the loan is issued by relationship lender
Weak Relation	A dummy taking the value one facilities for which the borrowers lending relationships with creditors fall in the lower tercile of the distribution of all firm's lending interactions
Medium Relation	A dummy taking the value one facilities for which the borrowers lending relationships with creditors fall in the middle tercile of the distribution of all firm's lending interactions
Strong Relationship	A dummy taking the value one facilities for which the borrowers lending relationships with creditors fall in the upper tercile of the distribution of all firm's lending interactions
Firm Size	The natural logarithm of the book value of total assets
Profitability	The ratio of earnings before interest, taxes, depreciation and amortization to the book value of total assets
Leverage	The ratio of total debt (which is the sum of debt in current liability and long-term debt) to the book value of total assets
Market-to-Book	The ratio of book value of total asset minus book value of equity plus market value of equity to book value of total asset
Rating	A dummy variable taking the value one if the firm has standard and poor's long-term issuer rating
IG Rating	A dummy variable taking the value one if the firm's S&P credit rating is "BBB-" or above
SG Rating	A dummy variable taking the value one if the firm's S&P credit rating is "BB+" or below
Utility Industry	A dummy variable taking the value one if the firm is in the utility industry
Asset Maturity	The ratio of net property, plant, and equipment to depreciation expenses
Cash Flow	The ratio of quarterly cash flows to the book value of total assets
Low Cash Flow	A dummy variable taking the value one for firms whose cash flows fall in the lower tercile of the cash flow distribution of all firms
Medium Cash Flow	A dummy variable taking the value one for firms whose cash flows fall in the middle tercile of the cash flow distribution of all firms
High Cash Flow	A dummy variable taking the value one for firms whose cash flows fall in the upper tercile of the cash flow distribution
Taxes	The ratio of total tax payment scaled by total assets