Firm life cycle and loan contract terms

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Abstract

Using a sample of 13,065 firm-quarter observations of U.S. publicly traded firms from 1994 to 2015, we show that loan spreads follow a U shape over the life cycle of a firm. In particular, the cost of corporate borrowing decreases from the introduction to the growth stage and reaches the bottom in the mature phase. Loan spreads increase in the shake-out phase and peak in the decline phase. This result is mimicked when analysing the probability of covenant violations. Non-pricing terms of loan contracts, such as debt maturity and loan securitization follow the inverse U shape and U shape pattern, respectively, as well. The results are not specific to any benchmark stages. They are also not driven by unobserved firm level heterogeneity or by the use of specific firm life cycle measures. Overall, the results suggest that private credit markets take into account the distinct stages of firm development when setting loan pricing and loan characteristics.

Keywords: Frim life cycle; Bank loans; Cost of debt
JEL Classification: G21, G32

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* We would like to thank Philip Brown, Demian Berchtold, Robert Durand, Adrian Cheung, Jan Hanousek, Anastasiya Shamshur, and Felix Chan for encouragement, helpful comments and suggestions. We also thank the workshop participants at University of Western Australia, Central Michigan University, and Curtin University for comments and suggestions. The research is supported by GAČR grant No.16-20451S. The usual disclaimer applies.

1. Introduction

Life cycle theory emphasizes that firms develop in distinct phases (Kimberly and Miles, 1980; Miller and Friesen,1980,1984; Quinn and Cameron, 1983). In each phase firms make different operating decisions given their available resources, which lead to systematic differences in profitability, riskiness and their persistence (Dickinson, 2011). Naturally, as firms progress, they require external financing. Studies show that access to external financing depends on firms' competitiveness, riskiness, creditworthiness and business environment (Campello and Gao, 2017; Valta, 2012). In this study, we examine whether loan contract terms in the private debt market vary depending on the life cycle stages of the firm.

Private debt is a primary source of external financing (Chava, Livdan, and Purnanandam, 2009; Graham, Li, and Qiu, 2008; Li, Qiu, and Wan, 2011) and banks as quasi-insiders have better abilities to process financial information than equity markets (see e.g. Bharat, Sunder, and Sunder, 2008). Houston and James (1996) show that bank debt represents 64% of total debt in the USA. Similarly, Bradley and Roberts (2015) note that the amount of private debt issuance substantially swamps the amount of public debt issuance. Given the dominance and importance of the private debt market as a means of external financing, it is important to understand whether firm life cycle stages have any influence on loan contract terms within it. Therefore, in this paper, we aim to fill a gap in the literature by asking whether and how private credit markets take into account the stages of firm development when setting loan pricing and loan characteristics.

There are several reasons why private lenders might consider life cycle stages when assessing loan requests. The obvious reasons are risk, uncertainty, and asymmetric information. Seminal works, such as that of Agarwal and Gort (2002), show that firm survival rates are crucially dependent on the firm life cycle. Pastor and Veronesi (2003) argue that young firms are much riskier than older firms because of uncertainty about future profitability, which results in higher idiosyncratic return volatility. As firms grow and develop, product mix and innovation helps them to reduce exposure to idiosyncratic risk. The information content of accounting numbers may also vary over a firms' life cycle. Hribar and Yehuda (2015), argue that "cash flows and accruals convey different information at different stages of the firm's development" (page 1053). Lastly, asymmetric information may also vary over the life cycle. Growth firms attract greater analyst coverage, which reduces mispricing and information asymmetry (Barth et al., 2001; Brennan and Subrahmanyam, 1995) and information contained in analyst forecasts reduces bond yields (Mansi,

Maxwell, and Miller, 2011). Senguta (1998) further shows that high disclosure quality ratings from financial analysts lowers the effective interest cost of issuing debt, and Easley and O'Hara (2004) put it in more general terms by suggesting that "it seems reasonable that a firm with a long operating history will be better known by investors" (page 1574). This may be applicable to all market participants including the banks.

Another reason might be the firm's competitive abilities, which evolve over its life. This theory is formulated in the 'capabilities lifecycle' of Helfat and Peteraf (2003), who propose that competitiveness, as a function of a firm's resources and capabilities, evolves in accordance with a firm's life cycle.[1] In addition to these competitive abilities, private lenders might also consider the recsourse-based view of the firm; as firms become more competitive they have more resources at hand, which allows for higher liquidation values. This would be the case in the growth and mature stages rather than in the introduction or decline stages. Liquidation values are of central importance for the pricing of debt contracts (Aghion and Bolton, 1992; Hart and Moore, 1994; Bolton and Scharfstein, 1996).

Since the inherent riskiness of a firm, its uncertainty about future profitability, its competitiveness and resource-base, analyst coverage, and the information content of accounting numbers fundamentally vary over the firm's life cycle, we posit that private credit markets may purposefully evaluate firms in distinct stages, and modify loan terms accordingly. This may be reflected in loan spreads (e.g. Graham, Li, and Qui, 2008; Bharath, Dahiya, Saunders, and Srinivasan, 2011), and non-price loan terms, such as short maturity (e.g. Barclay and Smith, 1995; Wittenberg-Moerman, 2008), or collateral requirements (Berger and Udell, 1990; Bharath et al., 2011). Loan terms may also be modified in order to limit the exposure to borrowers' risks and agency costs (Jensen 1986; Myers 1977; Smith and Warner, 1979). Additionally, if firms' risk and uncertainty profiles change fundamentally, we should observe a distinct behaviour of the probability of covenant violation. (Demerjian and Owens, 2016; Demerjian, 2017).

To conduct our analysis, we create a comprehensive sample of 13,065 firm-quarter observations of publicly traded U.S. firms from 1994 to 2015. We collect information on bank loan terms using the Loan Pricing Corporation's (LPC) Dealscan database, on financial data using

[1] Competitive heterogeneity, i.e. advantages and disadvantages, arise from differences in a firm's resources and capabilities (Peteraf, 1993; Priem and Butler, 2000; Hoopes, Madsen, and Walker, 2003).

Compustat, and on stock price data using the CRSP. We follow Dickinson (2011) in defining firms' life cycle stages as those of 'introduction', 'growth', 'mature', 'shake-out', and 'decline'.

Our results show that loan spreads follow a U shape over the life of a firm. The introduction stage has higher loan pricings, which decline slowly in the growth phase and bottom out in the firm's mature phase. As firms leave the mature phase, the loan spreads widen in the shake-out phase and peak in the decline phase. In terms of economic significance, loan spreads in the introduction and decline phases are 7.7% and 12.3% higher than in the shake out phase, while in the growth and mature stages they are 7.0% and 17.2% lower. From a different standpoint, the incremental annual outlay on interest payments is about 19 and 29 million dollars in the introduction and decline phases for the sample's average debt face value of 245 million and 238 million, respectively. On the other hand, firms in the growth and mature stages pay, respectively, about 33 and 82 million less in annual interest payment for the sample average debt face value of 472 million and 479 million. These results show that the cost of borrowing is related to the distinct phases of the firm's life cycle and they are consistent with Agarwal and Gort (2002,) who show that survival rates depend on the life cycle. Firms with a higher default risk tend to pay higher rates (Valta, 2012).

We also examine these results from the perspective of covenant violation. We use Demerjian and Owens' (2016) probability of covenants violation measure, which measures the probability that a borrower will violate financial covenants in private debt contracts. Our results mimic the findings for loan spreads, as the probability of debt covenant violations also varies over the firm's life cycle in a U shape form. In particular, the probability of covenant violation is higher in the introduction stage, slowly decreases over the growth stage and, once again, bottoms out in the mature phase. If firms are unable to remain in the mature stage, the probability of violations is higher in the shake-out stage and highest in the decline stage. However, since the probability of covenant violation serves as a proxy for borrower riskiness (Demerjian and Owens, 2016), and this covenant violation varies over the life cycle stages, it is likely that a lender takes the probability of violation along with firm life cycle stages into account when setting the pricing aspect of a loan contract. Thus, the firm life cycle may affect loan spreads directly and indirectly (through its effect on probability of covenant violation) which is the so-called mediation effect. We use a simultaneous equation model to define and estimate such effects. Our results confirm that firm life cycle affects loan spread both directly and indirectly. Importantly, the total effect (sum of direct

and indirect effects) of introduction and decline stages on loan spreads is positive and significant, while that for growth and mature stages is negative and significant. This emphasizes the importance of incorporating mediating effects of probability of covenant violation when evaluating the effects of firm life cycle stages on loan spreads.

In addition to the impact of firm life cycle stages on loan spreads, lenders may use stricter non-price loan terms, such as loan securitization and shorter debt maturities, to overcome asymmetric information and agency cost problems in each of the life cycle stages.

We find that firms in the growth and mature stages have longer maturity loans, whilst loans to firms in the decline stage have shorter maturities. The maturities between firms in the introduction phase and shake-out phase are similar. In terms of economic significance, our estimates suggest that, compared to firms in the shake-out stage, growth (mature) firms are associated with a 4.6% (3.0%) longer loan maturity. Similarly, compared to shake-out stage, firms in the decline stage are associated with a 7.3% lower loan maturity. Overall, the results suggest that life cycle is associated with the loan maturity of firms, which is both statistically and economically significant. These results are also consistent with prior studies which show that longer maturities are consistent with lower risk characteristics of the borrower (Wittenberg-Moerman, 2008).

We further examine the requirement of collateral security over the firm's life cycle. Collateral mitigates the adverse selection problem, reduces lending risk and better aligns the interests of the bank and the firm in a debt contract (Berger and Udell, 1990; Bharath et al., 2011; Ertugrul, et al., 2017; Stiglitz and Weiss, 1981). We estimate a logit model to assess whether the likelihood of loan security requirements varies with firm life cycle stages. Our results show that when compared to the shake-out firms, firms in the introduction and decline stage are more likely to have secured loans, while those in the growth and mature stages are less likely to have secured loans. Thus, we find that the firm life cycle has a significant bearing on the likelihood of pledging collateral, which varies with the inherent riskiness of each stage.

In the robustness section, instead of using the shake-out stage as the benchmark, we present our results with respect to alternative benchmark stages, in order to show that our results are not specific to any benchmark stage. We also provide alternative multivariate specifications and show that our results are not driven by unobserved firm level heterogeneity. More importantly, we re-run all the regressions using the alternative life cycle measure of DeAngelo et al. (2006). Again,

we show that the use of an alternative life cycle measure yields results which are consistent with that reported in the main analysis.

Our paper contributes to the literature in several dimensions. First, this study augments the recent literature, which examines the relation of business environment and competitiveness to private debt. Valta (2012) and Campello and Gao (2017) show how competitive environments and business relations affect debt financing. We extend this literature by showing how the firm life cycle relates to the characteristics of loan contracts.

Second, this paper also contributes to the incomplete contract theory as proposed by Christensen, Nikolaev, and Moerman (2016). The authors argue that accounting measures provide signals for state-contingent allocation of control rights. Our paper supports the argument that accounting measures provide signals about a change in a firm's state, and that this signal is considered by private markets when loan characteristics are negotiated. Our analysis also shows that the probability of covenant violations varies with the firm's life cycle. These stages thus represent a change in the probability of a state-contingent allocation of control rights.

Third, this paper adds to the very limited understanding of capital structure decisions over the firms' life cycle. La Rocca, La Rocca, Cariola (2011) examines the financing choices of small and medium-sized firms. They argue that firms experience different degrees of information opacity and needs at specific stages of their life cycles which are reflected in capital structure decisions.

Lastly, we contribute to the existing literature which examines corporate finance decisions over the firm's life cycle. Life cycles distinctively impact investment policies, debt and equity issuances, and cash holdings (Faff et al., 2016), as well as secondary equity offerings (DeAngelo et al., 2010), takeover activity (Owen and Yawson, 2010; Arikan and Stulz, 2016), firms' financial structure (Bender and Ward, 1993; Berger and Udell, 1998), restructuring strategies (Koh et al., 2015), firm-level risk (Hasan and Habib, 2017), corporate tax avoidance (Hasan et al., 2017), and dividend policy (DeAngelo et al., 2006). This paper complements Hasan et al. (2015) who examine the relation between cost of equity and the firm's life cycle in a sample of Australian firms.

This paper is structured as follows. Section two reviews the literature and develops the hypothesis. Section three presents the research design. Section four contains the summary statistics and univariate tests. Section five presents the multivariate results. Section six addresses robustness, and section seven concludes.

2. Literature Review and Hypothesis Development

2.1. Firm-life cycle

Although corporate life cycle theory originated in the organizational science literature, it has been widely adopted by financial economists over recent decades. The idea behind the corporate life cycle model is that firms experience several stages of development, from birth to decline. At each stage of their life cycle, firms' strategies, structures and activities correspond to their stages of development (Gray and Ariss, 1985; Miller and Friesen, 1984, 1980; Quinn and Cameron, 1983). Early research in this field identified several determinants that might impede a firm's growth, such as managerial limitations (Penrose, 1959), and competitive advantage (Wernerfelt, 1984). More recently, Helfat and Peteraf (2003), argued that the link between a firm's competitive advantages or disadvantages in its stages of development shifts over time, and therefore proposed a 'dynamic resource-based theory'. Following this theory, we argue that as firms evolve from several states of development, it is plausible that their competitive landscapes change, which in turn affects their ability to negotiate a loan agreement. Agarwal and Gort (2002), complement this theory by showing that firm survival rates are crucially dependent on the firm life cycle.

We follow the identification strategy of Dickinson (2011) and divide firms into five categories to study the association between corporate life cycle and loan agreement.

A firm in the introduction stage is often characterized by a simple, closely-held organization, where entrepreneurs are mainly focusing on innovation (Miller and Friesen, 1984, Audretsch and Feldman, 1996), marketing activities to gain visibility (Caves, 1972), and establishing a market niche for a product (Gupta and Chin, 1991; Ramaswamy et al., 2007). These firms tend to pursue a more long-run growth oriented investment strategy (Richardson, 2006) conventionally supported by either private equity (Garbowski and Mueller, 1975) or debt markets (Berger and Udell, 1998; Dickinson, 2011). The survival of these firms in the future is highly unpredictable, which may be reflected in a higher book to market ratio and higher firm specific risk, as documented in Pastor and Veronesi (2003).

The growth stage of a firm's life cycle is characterized by a sizeable increase in sales and in the number of products, which leads to a growing market share, profitability and positive cash flow (Dickinson, 2011; Spence, 1981). These firms have already overcome the 'liability of

newness' and initial exit probabilities. The operational strategies of a growing firm include continuing innovation by investing in research and development (Selling and Stickney, 1989), increasing visibility by advertising (Dickinson, 2011), and establishing initial competitive competencies (Miller and Friesen, 1984). To support the rapid expansion (Scherer, 1970), these firms are also expected to seek more internal and external financing (Jovanovic, 1982). Due to tax advantages, firms tend to prefer debt over equity financing (Barclay and Smith, 2005). Dickinson (2011) shows that growth firms face fewer capital constraints, and leverage is maximized in this stage. On the supply side, the lender may favourably consider higher growth opportunities and positive revenue, which, with lower uncertainty about future operating cash flows, might benefit these firms in raising funds.

Firms in the mature stage experience steady sales because of immense market competition (Kallunki and Silvola, 2008; Miller and Friesen, 1984) In this stage, firms rely on production efficiency (Spence, 1981; Wernerfelt, 1985) to generate profitability (Selling and Stickney, 1989), and operating cash flow (Dickinson, 2011). At this stage, improvements in governance structures (Barclay and Smith, 2005; Bonn and Pettigrew, 2009) and distribution of higher sustained dividend payouts (DeAngelo et al., 2006) are clearly evident. Further, mature firms tend either to invest less or invest merely to maintain assets-in-place (Richardson, 2006), delay investment in new innovation (Hitt et al., 1996), issue less equity and debt (i.e. rely more on the public market), hold more cash (Dickinson, 2011, Faff et al., 2016), and enjoy a low cost of capital due to reduced uncertainty (Mueller, 1992). Overall, mature firms are more stable, predictable and visible and have less uncertainty than those in the growth stage.

Because of intense competition, lack of innovation or inefficiency, firms in the shake-out stage can experience a significant loss in market share, reduction in profitability (Lester et al., 2008), a possibly negative operating cash flow, and a negative growth rate. Management often makes a desperate attempt to revive and reinvent the firm, for example by improving operational efficiency (Akhtar, 2012; Edwards et al. 2016; Lester et al., 2008). As firms enter the decline stage, some may initiate asset liquidation and/or disinvestment (Kimberly and Miles, 1980; Miller and Friesen, 1984; Quinn and Cameron, 1983), pay down debt, or focus on factors which help to maintain a going concern. However, opportunistic managers in other types of declining firms may initiate a risk shifting strategy (Jensen and Meckling, 1976; Richardson et al., 2015) by taking on more leverage in order to invest in risky projects. In an analogous study, Akhtar (2012) shows that

relative to the peak or boom phases of the business cycle, firms seek or rely more on external debt in the contraction or trough phases. Overall, a firm in the decline stage is more likely to report greater cash flow risk, negative profitability and operating cash flows, and higher demand for debt capital to maintain a going concern, which might result in an increased cost of capital.

2.2 Firm life cycle and loan contracts

Prior studies have identified key determinants of pricing (the cost of debt) and non-pricing (e.g., covenant violation, loan maturity, loan collateral) aspects of loan contracts. These studies include for example, loan covenants (Smith and Warner, 1979), creditor rights (Bae and Goyel, 2009), corporate transparency (Ertugrul et al., 2017; Andrade et al., 2014), management risk (Pan et al., 2015), corporate governance (Chava et al., 2009), lending relationships (Bharat et al., 2011), analyst forecast characteristics (Mansi et al., 2011) and corporate misreporting (Graham et al., 2008). A common conclusion from these papers is that default risk, corporate governance, and information risk affect both the pricing and non-pricing aspect of loan contracting. We posit that these will also be likely to correspond to firm life cycle stages, which in turn affect loan contracting.

Firms in the introduction and decline stages have uncertainties about their future cash flows that can exacerbate the probability of default. Introduction- and decline-phase firms have a limited, concentrated and outdated resource-base (Helfat and Peteraf, 2003), which exposes the lender to more risk of loss should the borrower default. Moreover, firms in the introduction and decline stages are less closely followed by analysts and investors (Easley and O'Hara, 2004). Because of a limited resource base and higher default risk and agency problems, we would expect to see a higher cost of debt for introduction- and decline-stage firms

Firms in the growth and mature stages have more stable revenues and cash flows, so their overall uncertainties are less than firms at the shake-out stage. Furthermore, these firms have a diverse and rich resource base and capabilities, which reduces the loss in case of default. Prior studies (Easley and O'Hara, 2004) indicate that these firms have a relatively long operating history and they are better known by investors and analysts. We would expect to see a lower cost of debt for firms in the growth and mature stages. Thus, our first prediction regarding the cost of debt and the firm life cycle is as follows:

Alternative hypothesis one (H1): The cost of debt is higher for firms in the introduction and the decline stages, whereas firms in the growth and mature stages have a lower cost of debt.

Demerjian (2017) presents a simple model to explain the interplay between contracting with incomplete information and covenant intensities. He predicts and finds that intensities of financial covenants increase as uncertainties about future economic events increase. Covenants in loan contracts are benchmarked to accounting performances and change in accordance with the credit worthiness of the firm. When the performance of the firm is below the thresholds stated in the covenants, the firm could be in technical default and the control rights passed onto the lender. Lenders often renegotiate the loan contract with these firms, based on their financial condition following the technical default. As outlined in the previous section, the financial condition of the firm changes significantly across different stages of the life cycle. In the introduction and decline stages, greater uncertainties about future economic events will create more pressure and it is likely to see more stringent convents from the lender. In addition, the likelihood of covenant violation is also going to be high. Studies also show that firms with good corporate governance and less asymmetric information are less likely to face covenant violation (Robin et al., 2016; Kim et al., 2011). Thus, firms in the introduction and decline stages are exposed to higher economic uncertainties and are therefore likely to face debt covenant violation. In contrast, firms in the growth and mature stages operate in a more predictable environment. Hence, our second hypothesis is stated as follows:

Alternative hypothesis two (H2):

The probability of covenant violation is higher for firms in the introduction and decline stages but lower for firms in the growth and mature stages.

Capital structure research indicates that potential conflicts of interest between shareholders and bondholders, including risk shifting and claim dilution, reduces the debt maturity structure (Smith and Warner, 1979; Myers, 1977). Studies also indicate that short-maturity debt reduces agency costs by subjecting managers to more frequent monitoring by lenders, as short-term debt comes up for frequent renewal (Barclay and Smith, 1995; Stulz, 2000). Since firms in the introduction and decline stages are more exposed to agency problems relating to risk shifting and

claim dilution, (and thus have a higher failure rate), a lender might attempt to control its risk by extending shorter maturity loans to them. On the other hand, growth- and mature-stage firms have a lower asymmetric information and agency problem (Easley and O'Hara, 2004; Yi, 2005), higher tangible assets relative to future investment opportunities and a lower risk of failure (Dickinson, 2011). Therefore, lenders might be willing to provide a loan with greater maturity to these firms. The logic also extends to the collateral requirements of loans (Berger and Udell, 1990; Bharath et al., 2011).

Alternative hypothesis 3A (H3A):

The Loan maturities tend to be shorter in the introduction and decline stages but longer in the growth and mature stages.

Alternative hypothesis 3B (H3B):

Loan securitizations are likely to be higher in the introduction and decline stages but lower in the growth and mature stages.

3. Research design

3.1 Sample and data

We use several databases to collect data in order to examine the association between firm life cycle and bank loan contracting. In particular, we collect (i) bond characteristics and pricing information from the Loan Pricing Corporation's (LPC) Dealscan database, (ii) financial data from COMPUSTAT, and (iii) stock price data from the Center for Research in Security Prices (CRSP), and we merge these datasets to generate a sample for the study.

Our analysis thus includes publicly traded U.S. firms from 1994 to 2015, covered by these databases. We begin with 1994, since bond characteristics and pricing information are mostly unavailable before then. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date. We also exclude observations with missing values in the measurement of key dependent, independent and control variables. To mitigate the effect of outliers, we winsorize the variables at their first and ninety-ninth percentiles.

Our final sample consists of 13,065 firm-quarter observations. However, sample size varies depending on model-specific data requirements. Variable definitions are presented in the Appendix.

3.2 Empirical model

We employ the following model to test the relation between the firm life cycle and cost of borrowing (H1):

$$\begin{aligned}\log(Loan\ Spreads) = \beta_0 + \sum_{i=1}^{4}\beta_i LCS + \beta_5 SIZE + \beta_6 MTB + \beta_7 LEV + \\ \beta_8 TANGIBILITY + \beta_9 STD\ CF + \beta_{10} Z - SCORE + \\ \beta_{11} PROFITABILITY + \beta_{12} LOAN\ MATURITY + \\ \beta_{13} LOAN\ SIZE + \beta_{14} CREDIT\ SPREAD + \\ \beta_{15} TERM\ SPREAD + LOANTYPE\ FE + IND\ FE + \\ PERIOD\ FE + \varepsilon \end{aligned} \quad (1)$$

where the dependent variable log of loan spreads is used to proxy for the cost of debt (see Section 3.3.1) and *LCS* is corporate life cycle stages following Dickinson (2011) (see Section 3.4). We also include a set of control variables that are known to affect loan spreads in the literature (Ertugrul et al., 2017; Kabir et al., 2013; Mansi et al., 2016; Valta, 2012). These include size, market-to-book ratio, leverage, tangibility, cash flow risk, Z-score, profitability, loan maturity, loan size, credit spread and term spread. The constant term, β_0, captures the influence of the shake-out stage on loan spreads, while the incremental effect of other life-cycle stage firms (relative to this base case) is captured by associate $\beta_1 - \beta_4$ term. In other words, the full impact of other life-cycle stages (x) on loan spread is captured by $\beta_0+\beta x$. We also include dummy variables to control for loan-type, industry and period effects. A comprehensive list of variable definitions is provided in the Appendix.

Furthermore, we specify the following empirical model to test the relation between the firm life cycle and the probability of covenant violation (test of H2):

$$\begin{aligned}PVIOL = \gamma_0 + \sum_{j=1}^{4}\gamma_j LCS + \gamma_5 SIZE + \gamma_6 MTB + \gamma_7 LEV + \gamma_8 TANGIBILITY + \\ \gamma_9 STD\ CF + \gamma_{10} Z - SCORE + \gamma_{11} PROFITABILITY + \\ \gamma_{12} LOAN\ MATURITY + \gamma_{13} LOAN\ SIZE + \gamma_{14} R\&D + \\ \gamma_{15} SECURE + \gamma_{16} REVOLVING + IND\ FE + PERIOD\ FE + \varepsilon \end{aligned} \quad (2)$$

where the dependent variable *PVIOL* is the probability of covenant violation (see Section 3.3.2). Following prior studies (Christensen and Nikolaev, 2012; Demerjian, 2017; Robin et al., 2017) we control for size, market-to-book ratio, leverage, tangibility, cash flow risk, Z-score, profitability,

loan maturity, loan size, research and development expenditure, loan security, revolving loans, industry and period effects.

Finally, we specify the following empirical model to disentangle the direct and indirect effect (through probability of covenant violation) of corporate life cycle on the cost of debt:

$$Log(Loan\ Spreads) = \beta_0 + \sum_{i=1}^{4} \beta_i LCS + \beta_5 PVIOL + \sum_{j=6}^{m} \beta_j Controls + LOAN\ TYPE\ FE + IND\ FE + YEAR\ FE + \varepsilon \quad (3)$$

$$PVIOL = \alpha_0 + \sum_{k=1}^{4} \alpha_k LCS + \sum_{l=6}^{n} \alpha_l Controls + IND\ FE + YEAR\ FE + \omega \quad (4)$$

The model consists of two equations. Equation (3) shows how the probability of covenant violation (PVIOL) channel influences loan spreads. The presence of *LCS* in Equation (3) allows for the possibility that corporate life cycle stages may have a direct relation with the loan spreads. Equation (4) shows how firm life cycle stages (*LCS*) are associated with loan spreads through the *PVIOL* channel (indirect effect). The controls for Equation (3) and (4) are explained earlier under Equation (1) and (2), respectively.[2]

3.3 Dependent variables

3.3.1 Loan spreads

Our main variable of interest in the pricing aspect of corporate borrowing analysis is the loan spreads. Extant research frequently uses loan spreads over the London Interbank Offered Rate (LIBOR) at the time of the loan origination as a measure of the cost of borrowing (e.g., Chakravarty and Rutherford, 2017; Ertugrul et al., 2017; Freudenberg et al., 2017; Graham et al., 2008; Bharath, Dahiya, Saunders, and Srinivasan, 2011; Valta, 2012). DealScan's "all-in-drawn" variable provides the amount the borrowers pay in basis points over the LIBOR for each dollar drawn down. This measure also adds any annual (or facility) fees paid to the bank group to the loan spread. In our correlation and regression analysis, we use the natural logarithm of the "all-in-drawn" variable as a measure of the cost of borrowing *log(loan spreads)*.

[2] Following prior studies (Cheung et al., 2016; Shan et al., 2017) we use different set of controls for equation (3) and (4). In particular, equation (3) includes controls that prior studies show to affect *loan spreads* (Ertugrul et al., 2017; Kabir et al., 2013; Mansi et al., 2016; Valta, 2012). Moreover, since equation (4) shows how firm life cycle affects the *loan spreads* though the *probability of covenant violation* channel, we include controls that prior studies suggest effect *probability of covenant violation* (Christensen and Nikolaev, 2012; Demerjian, 2017; Robin et al., 2017). Note that our results (untabulated) remain qualitatively similar even if we include a similar set of controls for both equations; the only difference is that the indirect effect of the *INTRO* stage on *loan spreads* turns to be statistically insignificant.

3.3.2 Probability of covenant violation

In hypothesis 2, our main dependent variable is the aggregate probability of covenant violation (*PVIOL*) developed by Demerjian and Owens (2016). This measure captures the probability that a borrower will violate financial covenants in private debt contracts across all covenants included on a given loan package from the total set of fifteen covenant categories. The authors provide empirical evidence that this aggregate probability measure is superior to alternatives used in prior literature.[3]

3.4 Independent variable: Corporate life cycle

Our main independent variable is firm life cycle stages. We follow the methodologies of Dickinson (2011) and DeAngelo et al. (2006) to develop proxies for the firms' stage in the life cycle. Using cash flow from operating (CFO), investing (CFI) and financing (CFF) data from the cash flow statement, Dickinson (2011) classifies firms into five life cycle stages: 'introduction', 'growth', 'mature', 'shake-out' and 'decline'.[4] The methodology is: introduction: if CFO ≤ 0, CFI ≤ 0 and CFF > 0; growth: if CFO > 0, CFI ≤ 0 and CFF > 0; mature: if CFO > 0, CFI ≤ 0 and CFF ≤ 0; decline: if CFO ≤ 0, CFI > 0 and CFF $\leq$ or ≥ 0; and the remaining firm years will be classified under the shake-out stage. In the main analysis we include introduction, growth, mature and decline stages in the regression. We omit the shake-out stage in the regressions to mitigate the multicollinearity problem. Dickinson (2011) suggests that literature on the firm life cycle clearly spells out the role of different stages of the firm life cycle, except for the shake-out stage. Therefore, following Hasan and Cheung (2018) we use the shake-out stage as a benchmark for our analysis.[5]

We also follow DeAngelo et al. (2006, 2010), and use retained earnings as a proportion of total assets (RE/TA) and total equity (RE/TE) as proxies for the corporate life cycle. These proxies measure the extent to which a firm is self-financing, or reliant on external capital. A firm with high RE/TA and RE/TE is more mature or old with declining investment, while a firm with a low RE/TA and RE/TE tends to be young and growing (DeAngelo et al., 2006).

[3] See Demerjian and Owens (2016) for detailed discussion.

[4] For detailed justification used to classify firms into different life cycle stages based on cash flow statement data, refer to Dickinson (2011).

[5] In the sensitivity analysis, we use each of the life cycle stages as a benchmark of analysis.

Recent life cycle studies in finance and accounting have used these measures extensively to proxy for the firm life cycle (Faff et al., 2016; Hasan et al., 2017; Hasan and Cheung, 2018; Koh et al., 2015; Owen and Yawson, 2010).

4. Descriptive statistics and univariate analysis

Table 1 Panel A presents the summary statistics for loan contract terms and Panel B for firm and macro environment characteristics. Panel A shows that the mean (median) of loan spreads is 214.27 (181.00) basis points over LIBOR. The average loan maturity is 47.81 months, the average loan size is 412.40 million and average probability of covenant violation is 0.390. Moreover, in the sample, 66% of the loans are secured and 83% are revolving in nature. Furthermore, descriptive statistics for firm characteristics in Panel B show that the average firm has a size of 6.42, leverage of 25.4%, a market-to-book ratio of 2.72, profitability of 1%, a standard deviation of cash flows of 4%, a z-score of 2.44, and R&D expenses 1% of assets.

In Table 1 we also present the life-cycle wise summary statistics to shed light on how loan contract terms and firm characteristics evolve. The tabulated results show that on average, *loan spreads*, the probability of covenant violation (*PVIOL)* and the use of *secured loans* are higher in the introduction, shake-out and decline stages when compared to the growth and mature stages. On the other hand, *loan maturity* and *loan size* are lower in the introduction, shake-out and decline stages compared to in the growth and mature stages. The mean value of *SIZE*, market-to-book *(MTB)*, *PROFITABILITY* and the cash flow volatility *(STD CF)* across the life cycle stages are also largely consistent with those of prior studies (Dickinson, 2011; Hasan et al., 2017). Further analysis reveals that *SIZE*, scaled retained earnings *(RE/TA, RE/TE)*, *PROFITABILITY* and *Z-SCORE* progressively increase as firms move from the introduction to the mature stage and that these estimates then drop as firms move from the mature to the decline stage. Finally, the life-cycle-wise sample distribution shows that around 67.5% of the firms fall into the growth and mature stages.[6]

[6] The distribution of the sample across life cycle stages is consistent with prior studies (Dickinson, 2011; Hasan and Cheung, 2018). Note that in our sample, 10.54% and 4.13% of observations belong to the shake-out and decline stages, respectively (7.98% and 4.99% in Dickinson (2011)). Dickinson 2011 (p. 1980) shows that the proportion of firms that survive five subsequent years beyond life cycle identification at year t are 76.59% and 75.14% for the shake-out and decline stages, respectively; as opposed to 76.95% and 80.33% for the growth and mature stages, respectively. Thus, survivorship is not unique to any particular stage.

Figure 1 shows the mean and median loan spreads graphically. The lowest loan spreads for mature stage firms indicate that mature firms are, on average, amongst the least risky firms. Overall, loan spreads show a "U" shaped pattern across the life cycle.

Table 2 reports the pair-wise correlation between the variables included in the regression models. As expected, loan spreads are significantly ($p<0.01$) positively correlated with the introduction, shake-out and decline stages ($\rho = 0.15, 0.04, 0.09$, respectively), while significantly ($p<0.01$) negatively correlated with the growth and mature stages ($\rho = -0.04, -0.14$, respectively) of the firm life cycle. Similar evidence is documented for life cycle stages and probability of covenant violation (PVIOL). Correlation coefficients also show that loan maturity (and loan size) are positively correlated ($p<0.01$) with the growth and mature stages, while negatively correlated ($p<0.01$) with the introduction, shake-out and decline stages. Importantly, the correlation table also suggests that loan security is significantly positively correlated with the introduction, shake-out and decline stages ($p<0.01$), but significantly negatively correlated with the mature stage ($p<0.01$). Overall, the correlations between loan spreads, probability of covenant violations, the life cycle proxies, and the control variables are all in the expected direction, and thus provide support for the validity of our key measures and constructs.

Table 3 reports the pair-wise comparison of loan spreads and the probability of covenant violations (PVIOL) for different life cycle stages. We perform an ANOVA test, followed by Tukey's HSD (honest significant difference) and the Tukey–Kramer (TK) method, to determine whether the mean of loan spreads and PVIOL for the various pair-wise relationships differ from each other significantly. The results show that the mean level of loan spreads and PVIOL decreases significantly from the introduction to the growth stage, from the introduction to mature and shake-out stages, and from the growth to mature stages. However, the mean level of loan spreads and the probability of covenant violation *(PVIOL)* increases significantly from the growth to the shake-out and decline stages, the mature to the shake-out and decline stages, and from the shake-out to the decline stages. Interestingly, loan spreads and the probability of covenant violation *(PVIOL)* are indistinguishable between the introduction and the decline stages. Both Tukey's HSD and the TK test results provide reasonable evidence that loan spreads and the probability of covenant violation *(PVIOL)* are relatively higher in the introduction, shake-out and decline stages but lower in the growth and mature stages.

5. Multivariate Analysis

5.1 Firm life cycle and loan spreads

Table 4 Panel A presents the baseline regression results for equation (1) where the *loan spreads* variable is regressed on firm life cycle stages and a set of control variables with clustered standard errors at the firm level. We hypothesized that *loan spreads* is higher (lower) during the introduction and decline (growth and mature) stages according to our hypothesis 1 (H1).

In Column (1) we present the OLS regression results where *loan spreads* is regressed on firm life cycle stages, and on period and industry fixed effects. We find that coefficients for the introduction stage (*INTRO)* and decline stage (*DECLINE)* are positive and significant (β_1 =0.210; $p<0.01$ and β_4 =0.216; $p<0.01$), while those for the growth stage (*GROWTH)* and mature stage (*MATURE)* are negative and significant (β_2 = -0.117; $p<0.01$ and (β_3 = -0.248; $p<0.01$). This result suggests that compared to the shake-out stage, *loan spreads* are significantly higher in the introduction and decline stages but lower in the growth and mature stages. In Column (2) we include firm-level controls, loan characteristics and loan-type fixed effects in addition to industry and period fixed effects. We continue to find positive and significant (at $p<0.01$) coefficients for the *INTRO* (β_1 =0.077) and *DECLINE* (β_4 =0.123) stages, while negative and significant (at $p<0.01$) coefficients for the *GROWTH* (β_2 = -0.070) and *MATURE* (β_3 = -0.172) stages. In terms of economic significance, the estimates in Column (2) suggest that, ceteris paribus, on average, *INTRO (DECLINE)* firms are associated with 7.7% (12.3%) higher loan spreads, whereas *GROWTH (MATURE)* firms are associated with 7.0% (17.2%) lower loan spreads. To provide additional perspective, our results imply that incremental annual outlay in interest payments is 18.93 million (i.e., 245.83 million *0.077) and 29.23 million (i.e., 237.662 million *0.123) for the *INTRO* and *DECLINE* stages, for the sample average debt face value of 245.83 million and 237.662 million, respectively. On the other hand, *GROWTH* and *DECLINE* firms pay 33.05 million and 82.45 million less in annual interest payments for the sample average debt face value of 472.172 million and 479.348 million, respectively. Two additional observations are worth noting from this analysis: *first, loan spreads* is highest in the decline stage. *Second, loan spreads* is lowest in the mature stage of the firm life cycle. In Column (3) we include credit spread and

term spread as an additional variable (Valta, 2012) and the results show that the sign, significance and magnitude of the variables remain unaffected by the inclusion of these controls.

The regression results in Table 4 Panel A also show that the coefficients for most of the control variables have the predicted signs and statistical significance. For example, in accord with the empirical findings we find that larger firms, firms with a higher Z score, and higher profitability and tangibility ratios have lower loan spreads. As expected, firms with higher leverage ratios have higher loan spreads. Regarding loan level controls, loan spreads are higher for larger loans but lower for loans with longer maturities.

In our main regression analysis in Table 4 Panel A, we include a set of controls that prior studies have found to be associated with cost of borrowings. Despite this, it is possible that our analysis omits some other determinants of cost of borrowing that may cause omitted variable bias. One may argue that lenders incorporate the information in the firm's cash flow in pricing the loan and as such, our documented association between firm life cycle and loan spreads is driven by operating cash flow, rather than by firm life cycle stages. In addition, Mansi et al. (2016) argue that sales growth is negatively related to the cost of debt financing. Valta (2012) shows that firms operating in a competitive product market are associated with a higher cost of borrowing. Bradley et al. (2016) contend that older firms have lower yield spreads. To mitigate potential problems arising from correlated omitted variables, we re-estimate the regression incorporating operating cash flow scaled by sales (CF/SALE), sales growth (%ΔSALES), product market competition (C4-Index) and firm age (AGE_LN). Results reported in Panel B of Table 4 show that the relation between firm life cycle and cost of borrowing remain qualitatively similar in terms of sign, significance, and magnitude. These results suggest that our results are unlikely to be driven by omitted correlated time-invariant variables. We collapse the display of coefficients on the other controls which are similar to those in Panel A. Of course they are available upon requests.

5.2 Firm life cycle and probability of debt covenant violation (PVIOL)

Table 5 presents regression results for the hypothesis that the probability of debt covenant violation varies depending on the firm life cycle stages (H2).

As expected, regression results reported in Column (1) show a positive and significant ($p<0.01$) coefficient for the *INTRO* and *DECLINE* stages, while exhibiting a negative and significant ($p<0.01$) coefficient for the *GROWTH* and *MATURE* stages. The coefficients remain robust after the inclusion of firm and loan characteristics in our analyses, as shown in column (2).

In particular, coefficients for *INTRO* and *DECLINE* are 0.026 and 0.039 (significant at p<0.10), while those for *GROWTH* and *MATURE* are -0.064 and -0.066 (significant at p<0.01), respectively. These results suggest that compared to the shake-out stage of the life cycle, the probability of debt covenant violation is higher for the introduction and decline stages, whereas it is lower for the growth and mature stages. In relative terms, the probability of debt covenant violation is highest (lowest) for the decline (mature) stage. These results highlight the importance of firm life cycle stages in affecting their probability of covenant violation.

5.3 Firm life cycle, debt covenant violation and cost of debt: Mediation test

Table 4 suggests that firm life cycle affects are associated with loan spreads, even after explicitly controlling for known firm-specific and loan-specific variables, industry and period fixed effects. Results in Table 5 show that *PVIOL* also varies over the life cycle stages. Since PVIOL indicates the riskiness of the borrower, it is likely that a lender takes *PVIOL* into account when setting the pricing aspect of the loan contract. Thus, *PVIOL* has the potential to affect loan spreads. Given these documented relationships and argument, a related issue is the extent to which the firm life cycle affects loan spreads directly (without mediation by any other variable in the model) and indirectly (through its effect on PVIOL): the so-called mediation effect. We use a simultaneous equation model for defining and estimating such effects. In our settings, *direct effects* are effects from the firm life cycle to loan spreads (firm life cycle→ loan spreads) that are not mediated by any other variable in the model. *Indirect effects* are paths from the firm life cycle to loan spreads that travel through *PVIOL*. The sum of direct and indirect effects represents total effects.

Results reported in Column (2) of Table 6 (Panel A) show that the life cycle has a significant effect on PVIOL. In particular, the coefficients for *INTRO* and *DECLINE* are positive and significant (p<0.10), while those for *GROWTH* and *MATURE* are negative and significant (p<0.01), suggesting a statistically significant effect of life cycle stages on the channel variable (PVIOL). Results in Column (1) indicate that the effect of *INTRO* and *DECLINE* (*GROWTH* and *MATURE*) on loan spreads is positive (negative) and significant, while the effect of *PVIOL* on loan spreads is positive and significant (p<0.01). These results imply that firm life cycle stages and the channel can directly (i.e., independently - without the inclusion of the mediator) affect loan spreads.

Panel B shows the direct (independent), indirect (through the *IVIOL* channel), and total effect of firm life cycle stages on loan spreads. As mentioned earlier, the direct effect of the introduction and decline stages on loan spreads is positive and significant (coefficient of 0.040 and 0.093; $p<0.10$ and $p<0.01$, respectively), while those for the growth and mature stages are negative and significant (coefficient of -0.051 and -0.149; $p<0.05$ and $p<0.01$, respectively). The indirect effect of the introduction and decline (growth and mature) stages, (through the PVIOL channel), on loan spreads is also positive (negative) and significant at the conventional level, implying that life cycle stages affect PVIOL, which in turn affects loan spreads. The total effect of the introduction and decline stages (sum of direct and indirect effects) on loan spreads is positive (coefficients of 0.051 for *INTRO* and 0.109 for *DECLINE*) and significant ($p<0.05$ and $p<0.01$). Moreover, the total effect of the growth and mature stages (sum of direct and indirect effects) on loan spreads is negative (coefficients of -0.076 and -0.176 for *GROWTH* and *MATURE*, respectively) and significant at $p<0.01$. This indicates the importance of incorporating the mediating effects (*PVIOL* in our case) in evaluating the effects of firm life cycle stages on loan spreads.

5.4 Loan maturity and securitization

In addition to the loan spreads, depending on the firm life cycle stages, lenders may use differential non-price loan terms to limit their exposure to borrowers' risks and agency costs. Studies (Graham et al., 2008; Smith and Warner, 1979) suggest that strict non-price terms, such as short maturity or collateral requirements, impose considerable indirect costs on the borrowing firms. In this section we examine whether firm life cycle stages are associated with two leading non-price loan terms: loan maturity and security requirement.

Firm life cycle and loan maturity. Capital structure research indicates that potential conflicts of interest between shareholders and bondholders, including risk shifting and claim dilution, reduce the debt maturity structure (Smith and Warner, 1979; Myers, 1977). Studies also indicate that short-maturity debt reduces agency costs by subjecting managers to more frequent monitoring by lenders, as short-term debt comes up for frequent renewal (Barclay and Smith, 1995; Stulz 2000). Since the introduction- and decline-stage firms are more exposed to agency problems relating to risk shifting and claim dilution, and have a higher failure rate, the lender might attempt to control its risk by extending shorter maturity loans to these firms. On the other hand, firms in the growth and mature stages have lower asymmetric information and agency problems (Yi, 2005),

higher tangible assets relative to future investment opportunities and lower risk of failure. Therefore, lenders might be willing to provide loans with greater maturity to these firms.

To study the association between firm life cycle and loan maturity, following Ertugrul, et al. (2017) we regress the natural logarithm of debt maturity (in monthly units) on firm life cycle stages and various firm and loan characteristics, and report the results in Table 7. Column 1 shows that coefficients for *GROWTH* and *MATURE* are positive and significant (coefficients of 0.046 and 0.030; $p<0.01$ and $p<0.05$, respectively), implying that firms in the growth and mature stages have longer maturity loans. However, the coefficient for *DECLINE* is negative ($\beta_4 = -0.073$ and significant at $p<0.01$), indicating that firms in the decline stage have shorter maturity loans. The association between *INTRO* and loan maturity, however, is not significant at conventional levels. In terms of economic significance, the estimates in Column (1) suggest that compared to firms in the shake-out stage, growth (mature) firms are associated with a 4.6% (3.0%) higher loan maturity, which is translated to an increase in loan maturity of 2.20 (1.43) months on the loan maturity of average firms.[7] In a similar vein, compared to shake-out firms, those in the decline stage are associated with 7.3% lower loan maturity, which can be interpreted as a decrease in loan maturity of 3.49 months from that of average firms. Overall, the tabulated results suggest that life cycle has an association with the loan maturity of firms which is both statistically and economically significant.

Firm life cycle and use of secured loan. We now examine whether firm life cycle stages affect another key non-price loan term: the requirement of collateral security. Collateral mitigates the adverse selection problem, reduces lending risk and better aligns the interests of the bank and the firm in the debt contract (Ertugrul, et al., 2017; Stiglitz and Weiss, 1981). The seminal study of Berger and Udell (1990) also shows a positive relationship between credit risk and collateral, implying that lenders are more likely to ask for collateral from the borrower with higher credit risk. In the preceding section, we explained that firms in the introduction and decline (growth and mature) stages are more (less) exposed to credit risk. Therefore, we argue that banks are more (less) likely to require introduction and decline (growth and mature) firms to pledge collateral.

We estimate a logit model to assess whether the likelihood of security requirements varies with firm life cycle stages and present the results in Column (2) of Table 7. The dependent variable,

[7] Economic significance for *INTRO* is calculated as: coefficient * loan maturity of average firms in months (i.e., 0.046*47.809 months = 2.20 months). A similar procedure is followed for other life cycle stages.

SECURE, is a dummy variable that takes a value of 1 if a loan is secured and 0 otherwise. We also control for various firm and loan characteristics (Ertugrul, et al., 2017). The findings from logistic regression results support our conjecture that compared to shake-out firms, introduction and decline firms are more likely to be associated with a *SECURE* loan, while growth and mature firms are less likely to be associated with a *SECURE* loan. Thus, firm life cycle has a significant bearing on the likelihood of pledging collateral.

6. Robustness

Alternative life cycle stages as benchmark. In our main regression analyses we used the shake-out stage as a benchmark. However, one may contend that the shake-out stage is of a transitory nature, and the pricing and non-pricing features of the loan contract could be ambiguous. To ensure that our results are not specific to any benchmark stage, we repeat the estimations using other firm life cycle stages as a benchmark. Table 8, Panel A shows that compared to introduction firms - growth, mature and shake-out firms are associated with significantly lower *loan spreads* and *PVIOL*. Moreover, when the mature stage is used as a benchmark, regression results suggest that *loan spreads* and *PVIOL* are significantly higher in the introduction, growth, shake-out, and decline stages. Furthermore, compared to the growth stage, *loan spreads* and *PVIOL* are higher in the introduction, shake-out and decline stages but *loan spreads* are higher in the mature stage. Finally, compared to the decline stage, *loan spreads* and *PVIOL* are lower in the growth, mature and shake-out stages.

Panel B of Table 8 reports results for loan maturity and loan security when alternative life cycle stages are used as a benchmark for regression analysis. The results show that compared to the introduction stage, loan maturity is significantly ($p<0.01$) higher (lower) in the growth (decline) stage. Moreover, compared to firms in the growth stage, firms in other life cycle stages are associated with significantly lower ($p<0.01$) loan maturity. Furthermore, compared to the mature stage, loan maturity is higher ($p<0.05$) in the growth stage but lower in the shake-out and decline stages ($p<0.01$). Finally, when compared with the decline stage, loan maturity is significantly higher ($p<.01$) in all other stages. The sensitivity analysis for loan security over the life cycle shows that compared to the mature stage, the likelihood of the use of a secured loan is higher ($p<0.01$) in

all the other stages. Moreover, compared to all other benchmark life cycle stages, the likelihood of the use of a secured loan is higher in the decline stage.

Overall, regression results corroborate the results reported earlier in our main analysis, indicating that our inferences from analysis are not sensitive to the specific benchmark life cycle stages.

Alternative regression specification: Firm fixed effect. In our main analysis, we report results using an OLS regression model that controls for firm characteristics, loan features and industry and period effects. However, one may argue that firm fixed effects estimates are critical in order to control for unobserved time-invariant firm heterogeneity. Therefore, in Table 9, we present results obtained from firm fixed effect (FFE) regression models. Column (1) shows that firms in the growth and mature (decline) stages are associated with significantly lower (higher) loan spreads when compared with the shake-out stage. However, firm fixed effect results suggest that the association of the introduction and shake-out stages with loan spreads is indistinguishable.

Results reported in Column (2) suggest that growth- and mature-stage firms are less likely to violate covenants. However, the coefficients for the introduction and decline stages are insignificant, suggesting that the association of introduction and decline stages with loan spreads is indistinguishable from that of the shake-out stage. The coefficients for Column (2) together with those for Column (3) suggests that life cycle stages affect *PVIOL,* which in turn affects the loan spreads, implying a mediation effect of *PVIOL* in affecting loan spreads.

Column (4) suggests that loan maturity is significantly higher (lower) for the growth and mature (decline) stages when compared with the shake-out stage.[8]

Overall, our firm fixed effect regression results are qualitatively similar to the OLS results, confirming that our results are not driven by firm level unobserved heterogeneity. Thus, these results suggest that firm life cycle has a profound impact on debt contracting.

Alternative life cycle proxy. In our main analysis, we use Dickinson's (2011) cash-flow-based life cycle measure. In the sensitivity analysis, we re-run all the regressions using DeAngelo et al.'s (2006) alternative life cycle measure. They argue that firms with high Retained Earnings to Total Assets (*RE/TA*) and Retained Earnings to Total Equity (*RE/TE*) ratios are typically more mature,

[8] Note that we do not use the firm fixed effect logit model for testing *H3B.* This is because, prior studies suggest that fixed effects estimators of nonlinear panel data models can be severely biased owing to the incidental parameter problem (Neyman and Scott, 1948).

or old with declining investment, while firms with low *RE/TA* and *RE/TE* ratios tend to be young and growing. Table 10 reports results using this alternative life cycle measure.

Columns (1) and (2) report results for the association between firm life cycle and loan spreads (H1). The coefficients for *RE/TA* and *RE/TE* are -0.130 ($p<0.01$) and -0.012 ($p<.05$), respectively. These results indicate that compared to young and growing firms, loan spreads are significantly lower for mature firms. In columns (3) and (4), we report results for the association between firm life cycle and *PVIOL* (H2). We find that the coefficients for *RE/TA* and *RE/TE* are -0.066 and -0.010, respectively (both significat at $p<0.01$). These results suggest that compared to young and growing firms, *PVIOL* is significantly lower for mature firms. Furthermore, Columns (5) and (6) in conjunction with Columns (3) and (4) indicate that firm maturity can directly and indirectly (through reduced *PVIOL)* reduce loan spreads.

The results reported in Columns (7) and (8) indicate that firms in the mature life cycle stage are associated with longer loan maturity, while Columns (9) and (10) indicate that mature firms are less likely to use a secured loan.

Overall, results from the use of the alternative life cycle measure are consistent with those reported in the main analysis. This sensitivity analysis suggests that our results are not driven by the use of any specific firm-life-cycle measure.

7. Conclusion

This study analyzes the relationship between a firm's life cycle and loan characteristics. The life cycle theory suggests that firms pass though different life cycle stages. Each stage is characterized by fundamentally different decisions as the firms have varying competitive abilities, resources, and they also face different challenges internally and externally (Dickinson, 2011). Raising capital is a necessary process as firms evolve throughout each stage and private debt remains the dominant form of external capital (Chava, Livdan, and Purnananda, 2009; Graham, Li, and Qiu, 2008; Li, Qiu, and Wan, 2011).

In a sample of 13,065 firm-quarter observations of publicly traded U.S firms from 1994 to 2015, we show that private debt lenders take into account the distinct characteristics of each of the life cycle stages when determining loan characteristics. Specifically, we find that loan spreads follow a U shape form. The cost of corporate borrowing decreases from the introduction to the growth stage and bottoms out when a firm reaches mature stage. Loan spreads increase in the

shake-out phase and peak in the decline phase. We obtain similar results when analysing the probability of covenant violations. Further, of the non-pricing terms of loan contracts, debt maturity follows an inverted U-shape pattern and loan securitization follows the U shape format. These results are robust to a battery of robustness test. This study strengthens the existing literature which focuses on explaining corporate behaviour from an evolutionary point of view.

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Appendix

Variables	Definition and measurement
Dependent variable	
LOAN SPREAD	Loan spread is measured as all-in-spread drawn in the Dealscan database. This variable provides the amount the borrowers pay in basis points over the LIBOR for each dollar drawn down. We use the natural logarithm of the "all-in-drawn" variable as a measure of the cost of borrowing.
PVIOL	The aggregate probability of covenant violation developed by Demerjian and Owens (2016). This measure captures the probability that a borrower will violate financial covenants in private debt contracts across all covenants included on a given loan package from the total set of fifteen covenant categories.
LOAN MATURITY	Loan maturity measured in months. In the correlation and regression, we use the natural logarithm of debt maturity (in monthly units).
Firm life cycle proxies	
LCS	A vector of dummy variables that capture firms' different stages in the life cycle (Dickinson, 2011)
RE/TA	Retained earnings (*REQ*) as a proportion of total assets (*ATQ*).
RE/TE	Retained earnings (*REQ*) as a proportion of total equity (*CEQQ*).
Control Variables	
SIZE	Natural logarithm of total assets (*ATQ*).
MTB	Market-to-book ratio, measured as market value of equity (*PRCC_Q * CSHOQ*) scaled by book value of equity (*CEQQ*).
LEV	Leverage, measured as total long-term debt (*DLTTQ*) scaled by total asset (*ATQ*).
TANGIBILITY	Net property, plant, and equipment (*PPENTQ*) divided by total assets (*ATQ*).
STD CF	The standard deviation of the cash flow from operation (*OANCFQ*) scaled by total assets (*ATQ*) over the past eight quarters.
Z-SCORE	Bankruptcy risk estimated by Altman's Z-score model.
PROFITABILITY	Return on equity, measured as income before extraordinary and special items (*IBQ – XIQ*) scaled by total equity (*CEQQ*).
LOAN SIZE	Natural logarithm of the amount of a loan in millions of dollars.
CREDIT SPREAD	The difference between AAA corporate bond yield and BAA corporate bond yield.
TERM SPREAD	The difference between the 10-year Treasury yield and the T-bill yield.
R&D	Research and development expenses (*XRDQ*) scaled by total assets (*ATQ*). We replace missing research and development by 0.
SECURE	The dummy variable indicating the collateral requirement.
REVOLVING	Dummy variable indicating whether a loan is revolving in nature.
%ΔSALES	Sales growth, measures as $(SALEQ_t – SALEQ_{t-1})/SALEQ_{t-1}$
C4-INDEX	The sum of the market shares of the four largest firms in an industry
AGE_LN	Age is measured as the number of years since the firm was first covered by the Center for Research in Securities Prices (CRSP) (*DATADATE – BEGDAT*). For regression analysis, we measure *AGE* as natural log of (1+ age of the firm).
Loan Type	Dummy variables to control for loan type fixed effect.
Period	Dummy variables to control for fiscal year-quarter effect.
Industry	Dummy variables to control for industry effect.

Figure 1
Loan spreads and firms' life cycle stages
This figure shows the evolution of loan spreads over the firms' life cycle stages. We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'.Our sample includes publicly traded U.S. firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. Variable definitions are presented in the Appendix.

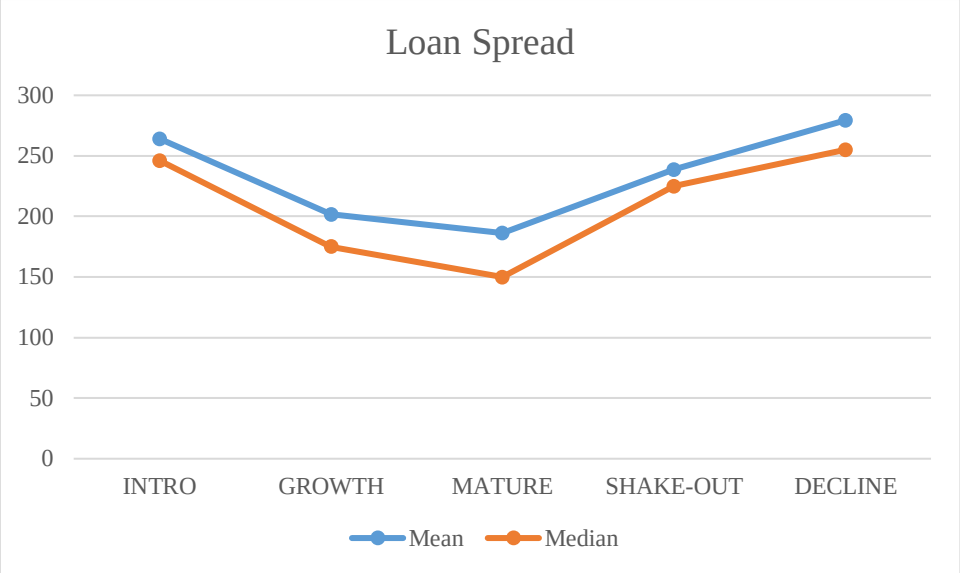

Table 1

Summary Statistics

This table shows the summary statistics of the sample, which includes U.S. publicly traded firms from 1994 to 2015. Panel A shows the loan characteristics and Panel B shows the firm and macro environment characteristics. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, financial data from COMPUSTAT, and stock price data from the CRSP. We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date.Variable definitions are presented in the Appendix.

Panel A: Loan Characteristics

			Life-cycle Stage				
Variable	Stat.	Sample	*INTRO*	*GROWTH*	*MATURE*	*SHAKE-OUT*	*DECLINE*
LOAN SPREAD	Mean	214.27	264.20	201.77	186.27	238.62	279.32
(BPS)	Median	181.00	246.10	175.00	150.00	225.00	255.00
	Std. Dev.	154.81	169.72	146.53	139.12	168.22	165.05
LOAN MATURITY	Mean	47.81	45.74	50.95	48.18	44.57	38.38
(MONTHS)	Median	48.00	39.00	54.67	53.15	41.00	36.00
	Std. Dev.	24.00	25.49	24.73	22.18	24.19	22.80
LOAN SIZE	Mean	412.40	245.83	472.17	479.35	354.62	237.66
(MILLION)	Median	150.00	85.00	200.00	220.00	105.00	53.73
	Std. Dev.	691.00	484.92	760.12	723.16	649.50	540.26
PVIOL	Mean	0.39	0.52	0.36	0.33	0.45	0.56
	Median	0.15	0.49	0.12	0.09	0.26	0.73
	Std. Dev.	0.42	0.42	0.41	0.40	0.43	0.43
SECURE	Mean	0.66	0.80	0.65	0.56	0.71	0.84
	Median	1.00	1.00	1.00	1.00	1.00	1.00
	Std. Dev.	0.48	0.40	0.48	0.50	0.45	0.36
REVOLVING	Mean	0.83	0.88	0.82	0.82	0.83	0.82
	Median	1.00	1.00	1.00	1.00	1.00	1.00
	Std. Dev.	0.37	0.33	0.38	0.38	0.38	0.39
N		13,065	2,328	4,009	4,811	1,377	540

Panel B: Firm and Macro Environment Characteristics

			Life-cycle Stage				
Variable	Stat.	Sample	*INTRO*	*GROWTH*	*MATURE*	*SHAKE-OUT*	*DECLINE*
SIZE	Mean	6.42	5.63	6.58	6.79	6.25	5.68
	Median	6.44	5.61	6.57	6.84	6.24	5.69
	Std. Dev.	1.83	1.70	1.71	1.82	1.89	1.85
MTB	Mean	2.73	2.82	2.95	2.62	2.42	2.33
	Median	2.04	1.89	2.26	2.04	1.81	1.52
	Std. Dev.	6.60	7.46	5.78	6.94	5.99	6.66
LEV	Mean	0.25	0.26	0.28	0.24	0.22	0.21
	Median	0.23	0.23	0.27	0.21	0.18	0.15
	Std. Dev.	0.22	0.24	0.21	0.20	0.22	0.23
RE/TA	Mean	-0.00	-0.20	0.06	0.12	-0.09	-0.45
	Median	0.11	0.02	0.11	0.19	0.09	-0.04
	Std. Dev.	0.63	0.77	0.44	0.50	0.79	1.11
RE/TE	Mean	0.12	-0.27	0.21	0.36	-0.01	-0.68
	Median	0.35	0.02	0.30	0.51	0.32	0.04
	Std. Dev.	2.82	3.53	2.15	2.51	3.27	4.41
TANGIBILITY	Mean	0.30	0.24	0.36	0.30	0.27	0.24
	Median	0.23	0.19	0.27	0.24	0.19	0.17
	Std. Dev.	0.24	0.20	0.28	0.23	0.22	0.20
STD CF	Mean	0.04	0.05	0.03	0.05	0.03	0.05
	Median	0.030	0.03	0.02	0.03	0.02	0.03
	Std. Dev.	0.05	0.08	0.03	0.05	0.04	0.07
Z-SCORE	Mean	2.44	2.14	2.70	2.45	2.57	1.37
	Median	1.71	1.43	1.71	1.91	1.63	1.22
	Std. Dev.	4.34	5.22	4.21	2.86	6.27	5.49
PROFITABILITY	Mean	0.01	-0.02	0.02	0.03	0.00	-0.06
	Median	0.03	0.01	0.03	0.03	0.02	-0.01
	Std. Dev.	0.32	0.40	0.23	0.30	0.36	0.53
R&D	Mean	0.01	0.01	0.00	0.00	0.01	0.01
	Median	0.00	0.00	0.00	0.00	0.00	0.00
	Std. Dev.	0.02	0.02	0.02	0.01	0.02	0.03
CREDIT SPREAD	Mean	1.64	-	-	-	-	-
	Median	1.62					
	Std. Dev.	1.10					
TERM SPREAD	Mean	0.92	-	-	-	-	-
	Median	0.83					
	Std. Dev.	0.35					
N		13,065	2,328	4,009	4,811	1,377	540

Table 2

Correlations

This table presents the correlations between variables. Our sample includes U.S. publicly traded firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, financial data from COMPUSTAT, and stock price data from the CRSP. We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date.Variable definitions are presented in the Appendix. All ***bold and italics*** numbers are significant at $p<0.01$ and only **bold** numbers are significant at $p<0.05$.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LOAN SPREADS [1]	1																			
INTRO [2]	***0.15***	1																		
GROWTH [3]	***-0.04***	***-0.32***	1																	
MATURE [4]	***-0.14***	***-0.35***	***-0.50***	1																
SHAKE-OUT [5]	***0.04***	***-0.16***	***-0.23***	***-0.26***	1															
DECLINE [6]	***0.09***	***-0.10***	***-0.14***	***-0.16***	***-0.07***	1														
SIZE [7]	***-0.39***	***-0.18***	***0.06***	***0.14***	***-0.02***	***-0.07***	1													
MTB [8]	***-0.06***	0.01	**0.02**	-0.01	-0.02	-0.01	0.00	1												
LEV [9]	***0.20***	***0.02***	***0.09***	***-0.06***	***-0.05***	***-0.03***	***0.17***	***-0.05***	1											
TANGIBILITY [10]	-0.02	***-0.12***	***0.17***	0.00	***-0.06***	***-0.06***	***0.11***	***-0.03***	***0.21***	1										
STD_CF [11]	**0.02**	***0.04***	***-0.13***	***0.09***	***-0.04***	***0.06***	***-0.19***	***0.04***	***-0.13***	***-0.06***	1									
Z-SCORE [12]	***-0.15***	***-0.02***	***0.04***	-0.01	0.01	***-0.05***	***-0.10***	***0.16***	***-0.32***	***-0.11***	***0.05***	1								
PROFITABILITY [13]	***-0.05***	***-0.04***	0.00	***0.04***	0.00	***-0.03***	***0.05***	0.00	0.00	0.01	-0.01	***0.06***	1							
LOAN MATURITY [14]	0.01	***-0.05***	***0.07***	***0.03***	***-0.04***	***-0.08***	***0.22***	0.00	***0.27***	***0.07***	***-0.11***	***-0.08***	***0.04***	1						
LOAN SIZE [15]	***-0.34***	***-0.16***	***0.08***	***0.12***	***-0.05***	***-0.09***	***0.88***	0.02	***0.28***	***0.12***	***-0.15***	***-0.13***	***0.05***	***0.38***	1					
CREDIT SPREAD [16]	***0.16***	***-0.08***	***-0.08***	***0.11***	***0.04***	0.00	***0.13***	***-0.03***	-0.01	0.00	***-0.03***	***-0.06***	***0.02***	***-0.04***	***0.07***	1				
TERM SPREAD [17]	***0.16***	***-0.09***	***-0.04***	***0.10***	***0.03***	-0.01	***0.16***	***-0.04***	***-0.04***	0.00	**-0.02**	***-0.07***	-0.01	***-0.06***	***0.09***	***0.39***	1			
PVIOL [18]	***0.34***	***0.13***	***-0.04***	***-0.12***	***0.04***	***0.08***	***-0.23***	***-0.05***	***0.18***	***0.04***	0.00	***-0.17***	***-0.04***	***-0.04***	***-0.21***	0.01	**-0.02**	1		
SECURE [19]	***0.60***	***0.13***	-0.01	***-0.15***	***0.03***	***0.07***	***-0.39***	***-0.05***	***0.17***	0.00	***0.02***	***-0.11***	***-0.04***	***0.06***	***-0.29***	0.00	**0.02**	***0.30***	1	
REVOLVING [20]	***0.10***	***0.03***	**-0.02**	-0.02	0.01	-0.01	***-0.20***	0.00	-0.02	0.00	**0.02**	0.00	-0.01	***0.26***	***-0.08***	-0.01	***-0.05***	***0.07***	***0.17***	1

Table 3

Univariate Analysis

This table examines the mean differences of loan spreads and probabilities of covenant violations (*PVIOL)* between each of the life-cycle stages. Our sample includes U.S. publicly traded firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. The test of the mean differences is conducted using the Tukey HSD (honest significant difference) pairwise comparisons and Tukey-Kramer (TK) test. The studentized range critical value at 5% significance level is 3.858 for each tests. Variable definitions are in the Appendix.

	Group means				
Variables	(Stage 1)	(Stage 2)	Mean differences	HSD-test	TK-test
	INTRO	*GROWTH*			
LOAN SPREADS	264.20	201.77	-62.43	15.65*	22.37*
PVIOL	0.52	0.36	-0.16	12.98*	18.61*
	INTRO	*MATURE*			
LOAN SPREADS	264.20	186.27	-77.93	19.54*	28.81*
PVIOL	0.52	0.33	-0.19	15.85*	23.54*
	INTRO	*SHAKE–OUT*			
LOAN SPREADS	264.20	238.62	-25.58	6.41*	7.02*
PVIOL	0.52	0.45	-0.07	5.71*	6.21*
	INTRO	*DECLINE*			
LOAN SPREADS	264.20	279.32	15.12	3.79	2.96
PVIOL	0.52	0.56	0.04	3.05	2.38
	GROWTH	*MATURE*			
LOAN SPREADS	201.77	186.27	-15.50	3.89*	6.76*
PVIOL	0.36	0.33	-0.03	2.87	5.02*
	GROWTH	*SHAKE–OUT*			
LOAN SPREADS	201.77	238.62	36.85	9.24*	11.01*
PVIOL	0.36	0.44	0.08	7.27*	8.59*
	GROWTH	*DECLINE*			
LOAN SPREADS	201.77	279.32	77.55	19.45*	15.79*
PVIOL	0.36	0.56	0.20	16.03*	13.04*
	MATURE	*SHAKE–OUT*			
LOAN SPREADS	186.27	238.62	52.35	13.13*	15.99*
PVIOL	0.33	0.45	0.12	10.15*	12.27*
	MATURE	*DECLINE*			
LOAN SPREADS	186.27	279.32	93.05	23.33*	19.14*
PVIOL	0.33	0.56	0.23	18.90*	15.55*
	SHAKE–OUT	*DECLINE*			
LOAN SPREADS	238.62	279.32	40.70	10.21*	7.48*
PVIOL	0.45	0.56	0.11	8.75*	6.41*

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Table 4

Firm life cycle and loan spreads

This table shows the relationship between firms' lifecycle and loan spreads. Panel A shows the results for regression equation (1). Panel B shows the results when additional control variables are added (Mansi et al., 2016; Valta, 2012; Bradley et al., 2016). Our sample includes U.S. publicly traded firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, financial data from COMPUSTAT, and stock price data from the CRSP. We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date.Variable definitions are presented in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the firm level; t-Statistics are provided in parentheses.

Panel A: Firm life cycle and loan spreads

	Dependent Variable = *LOAN SPREADS*		
Independent Variables	(1)	(2)	(3)
INTRO	0.210***	0.077***	0.077***
	[8.18]	[3.51]	[3.51]
GROWTH	-0.117***	-0.070***	-0.070***
	[-4.80]	[-3.48]	[-3.48]
MATURE	-0.248***	-0.172***	-0.172***
	[-10.51]	[-8.81]	[-8.81]
DECLINE	0.216***	0.123***	0.123***
	[5.29]	[3.78]	[3.78]
SIZE		-0.167***	-0.167***
		[-17.68]	[-17.68]
MTB		-0.001	-0.001
		[-1.12]	[-1.12]
LEV		0.736***	0.736***
		[18.29]	[18.29]
TANGIBILITY		-0.176***	-0.176***
		[-3.77]	[-3.77]
STD CF		-0.248**	-0.248**
		[-2.05]	[-2.05]
Z-SCORE		-0.018***	-0.018***
		[-7.44]	[-7.44]
PROFITABILITY		-0.061***	-0.061***
		[-2.96]	[-2.96]
LOAN MATURITY		0.110***	0.110***
		[6.34]	[6.34]
LOAN SIZE		-0.066***	-0.066***
		[-6.84]	[-6.84]
CREDIT SPREAD			0.299***
			[16.86]
TERM SPREAD			0.163***
			[4.26]
Constant	4.744***	5.480***	5.804***
	[21.44]	[25.94]	[26.56]
Loan Type FE	No	Yes	Yes
Industry FE	Yes	Yes	Yes
Period FE	Yes	Yes	Yes
N	15,383	13,064	13,064
Adj. R-squared	0.15	0.47	0.47

Panel B: Firm life cycle and loan spreads with additional controls

	Dependent Variable = *LOAN SPREADS*				
Independent Variables	(1)	(2)	(3)	(4)	(5)
INTRO	0.045**	0.070***	0.078***	0.061***	0.038*
	[2.17]	[3.21]	[3.57]	[2.98]	[1.80]
GROWTH	-0.056**	-0.073***	-0.070***	-0.073***	-0.065***
	[-2.91]	[-3.61]	[-3.50]	[-3.79]	[-3.31]
MATURE	-0.155***	-0.169***	-0.171***	-0.154***	-0.139***
	[-8.14]	[-8.63]	[-8.73]	[-8.25]	[-7.26]
DECLINE	0.088***	0.123***	0.123***	0.114***	0.086***
	[2.81]	[3.75]	[3.78]	[3.69]	[2.72]
CF_SALE	-0.127***				-0.110***
	[2.81]				[3.30]
%ΔSALES		0.066***			0.050***
		[4.14]			[3.21]
C4-INDEX			-0.291***		-0.205***
			[-4.23]		[-3.31]
AGE_LN				-0.087***	-0.085***
				[-10.52]	[-10.23]
Constant	6.110***	5.759***	6.179***	6.340***	6.505***
	[28.90]	[26.19]	[26.24]	[29.94]	[28.85]
Other controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Loan Type FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes
N	13,064	13,018	13,064	12,398	12,354
Adj. R-squared	0.48	0.47	0.47	0.48	0.49

Table 5

Firm life cycle and probability of debt covenant violation

This table shows the relationship between firms' life cycle and the probability of debt covenant violation *(PVOIL)*, using regression equation (2. Our sample includes U.S. publicly traded firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, financial data from COMPUSTAT, and stock price data from the CRSP. We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date.Variable definitions are presented in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. The standard errors are clustered at the firm level**;** t-Statistics are provided in parentheses.

	Dependent Variable= *PVIOL*	
Independent Variables	(1)	(2)
INTRO	0.055***	0.026*
	[3.52]	[1.66]
GROWTH	-0.089***	-0.064***
	[-6.18]	[-4.46]
MATURE	-0.115***	-0.066***
	[-8.25]	[-4.73]
DECLINE	0.083***	0.039*
	[3.64]	[1.68]
SIZE		-0.013**
		[-2.07]
MTB		-0.001
		[-0.80]
TANGIBILITY		-0.030
		[-0.92]
STD CF		-0.268**
		[-2.54]
Z-SCORE		-0.015***
		[-8.29]
PROFITABILITY		-0.014
		[-1.01]
LOAN MATURITY		0.013
		[1.56]
LOAN SIZE		-0.024***
		[-3.64]
R&D		-1.000***
		[-3.46]
SECURE		0.187***
		[17.10]
REVOLVING		0.018
		[1.53]
Constant	0.871***	1.109***
	[4.64]	[4.69]
Period FE	Yes	Yes
Industry FE	Yes	Yes
N	11,851	10,305
Adj. R-squared	0.08	0.19

Table 6

Mediation Test: Firm life cycle, loan spread and probability of debt covenant violation

This table shows the mediation test between firms' lifecycle, loan spreads, the probability of debt covenant violation (*PVIOL*), using the simultaneous equation model (equation (3) and (4)) in Panel A. Panel B shows the direct, indirect and total effects. Our sample includes U.S. publicly traded firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, financial data from COMPUSTAT, and stock price data from the CRSP. We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date. Variable definitions are presented in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the firm level**;** t-Statistics are provided in parentheses.

Panel A: Simultaneous equation model

Independent Variables	Dependent Variables	
	LOAN SPREADS	*PVIOL*
	(1)	(2)
INTRO	0.040*	0.026*
	[1.82]	[1.73]
GROWTH	-0.051**	-0.059***
	[-2.53]	[-4.23]
MATURE	-0.149***	-0.065***
	[-7.68]	[-4.81]
DECLINE	0.093***	0.039*
	[2.91]	[1.78]
PVIOL	0.423***	
	[29.34]	
SIZE	-0.166***	-0.009*
	[-23.42]	[-1.83]
MTB	-0.002**	-0.001
	[-2.33]	[-0.94]
LEV	0.602***	
	[19.94]	
TANGIBILITY	-0.125***	-0.027
	[-3.50]	[-1.10]
STD CF	-0.176	-0.281***
	[-1.53]	[-3.46]
Z-SCORE	-0.012***	-0.015***
	[-7.86]	[-15.03]
PROFITABILITY	-0.048***	-0.012
	[-2.87]	[-1.04]
LOAN MATURITY	0.027**	0.010
	[2.04]	[1.29]
LOAN SIZE	-0.037***	-0.024***
	[-4.65]	[-4.49]
CREDIT SPREAD	0.246*	
	[1.78]	
TERM SPREAD	0.739	
	[0.32]	
R&D		-0.942***
		[-3.69]
SECURE		0.215***
		[23.51]
REVOLVING		0.016
		[1.41]
Constant	5.477**	0.918***
	[2.57]	[3.25]
Loan Type FE	Yes	No
Period FE	Yes	Yes
Industry FE	Yes	Yes
N	10,263	10,263
Adj. R-squared	0.52	0.20

Panel B: Separation of the direct and indirect effects

Direct effect	
INTRO	0.040*
	[1.82]
GROWTH	-0.051**
	[-2.53]
MATURE	-0.149***
	[-7.68]
DECLINE	0.093***
	[2.91]
Indirect effect	
INTRO	0.011*
	[1.72]
GROWTH	-0.025***
	[4.19]
MATURE	-0.028***
	[4.74]
DECLINE	0.017*
	[1.77]
Total effect	
INTRO	0.051**
	[2.28]
GROWTH	-0.076***
	[-3.71]
MATURE	-0.176***
	[8.93]
DECLINE	0.109***
	[3.37]

Table 7
Loan maturity and security over the life cycle

This table shows the loan maturity and security over the life cycle. Our sample includes U.S. publicly traded firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, financial data from COMPUSTAT, and stock price data from the CRSP. We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date. Variable definitions are presented in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the firm level**;** t-Statistics are provided in parentheses.

Independent Variables	Dependent Variable	
	LOAN_MAT_LN	*SECURE*
	(1)	(2)
INTRO	0.013	0.168*
	[0.89]	[1.65]
GROWTH	0.046***	-0.348***
	[3.47]	[-3.98]
MATURE	0.030**	-0.607***
	[2.46]	[-7.22]
DECLINE	-0.073***	0.601***
	[-3.16]	[3.69]
SIZE	-0.074***	-0.919***
	[-12.58]	[-21.81]
MTB	-0.001	-0.007
	[-0.99]	[-1.37]
LEV	0.235***	3.066***
	[8.88]	[14.91]
TANGIBILITY	0.024	-0.576**
	[0.86]	[-2.56]
Z-SCORE	0.001	-0.192**
	[0.79]	[-2.30]
PROFITABILITY	0.027*	-0.042***
	[1.92]	[-5.36]
LOAN SIZE	0.183***	0.186***
	[28.62]	[4.54]
SECURE	0.029***	
	[3.06]	
LOAN_MAT_LN		0.117*
		[1.79]
Constant	0.459***	1.855**
	[3.72]	[2.50]
Loan Type FE	Yes	Yes
Period FE	Yes	Yes
Industry FE	Yes	Yes
N	12,842	12,760
Adj. R-squared/ Pseudo R^2	0.56	0.29

Table 8
Sensitivity analysis and robustness checks

This table shows the association of loan spread and probability of covenant violation (PVIOL) with firm life cycle stages when alternative benchmarks are used. Previous analysis used the shake-out stage as the benchmark stage. Panel A shows the results when the dependent variables are loan spreads and the probability of covenant violations *(PVIOL).* Panel B shows the results when the dependent variables are loan maturity and loan security. Our sample includes U.S. publicly traded firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, financial data from COMPUSTAT, and stock price data from the CRSP. We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date; t-statistics are in brackets. Controls and industry and period fixed effects are included but not reported. Variable definitions are presented in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the firm level**;** t-Statistics are provided in parentheses.

Panel A: Loan Spread and probability of covenant violation (PVIOL)

Life Cycle Stage / Benchmark stage	Dependent Variable = *LOAN SPREADS*				Dependent Variable = *PVIOL*			
	INTRO	*GROWTH*	*MATURE*	*DECLINE*	*INTRO*	*GROWTH*	*MATURE*	*DECLINE*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INTRO		0.146***	0.249***	-0.046		0.090***	0.093***	-0.012
		[8.35]	[14.45]	[-1.49]		[7.23]	[7.64]	[-0.52]
GROWTH	-0.146***		0.103***	-0.193***	-0.090***		0.002	-0.102***
	[-8.35]		[7.50]	[-6.36]	[-7.23]		[0.24]	[-4.68]
MATURE	-0.249***	-0.103***		-0.295***	-0.093***	-0.002		-0.104***
	[-14.45]	[7.50]		[-9.82]	[-7.64]	[-0.24]		[-4.87]
SHAKE-OUT	-0.077***	0.070***	0.172***	-0.123***	-0.027*	0.064***	0.066***	-0.038
	[-3.51]	[3.48]	[8.81]	[-3.78]	[-1.69]	[4.47]	[4.73]	[-1.63]
DECLINE	0.046	0.193***	0.295***		0.012	0.102***	0.104***	
	[1.49]	[6.36]	[9.82]		[0.52]	[4.68]	[4.87]	

Panel B: Loan Maturity and Use of Loan Security

Life Cycle Stage / Benchmark stage	Dependent Variable = *LOAN_MAT_LN*				Dependent Variable = *SECURE*			
	INTRO	*GROWTH*	*MATURE*	*DECLINE*	*INTRO*	*GROWTH*	*MATURE*	*DECLINE*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INTRO		-0.034***	-0.016	0.088***		0.516***	0.774***	-0.435***
		[-2.77]	[-1.37]	[3.83]		[6.30]	[9.52]	[-2.75]
GROWTH	0.034***		0.018**	0.122***	-0.516***		0.258***	-0.950***
	[2.77]		[1.96]	[5.41]	[-6.30]		[4.37]	[6.29]
MATURE	0.016	-0.018**		0.104***	-0.774***	-0.258***		-1.209***
	[1.37]	[-1.96]		[4.70]	[-9.52]	[-4.37]		[8.00]
SHAKE-OUT	-0.013	-0.046***	-0.030**	0.073***	-0.168*	0.355***	0.607***	-0.601***
	[-0.89]	[-3.47]	[-2.46]	[3.16]	[-1.65]	[3.95]	[7.22]	[-3.69]
DECLINE	-0.088***	-0.122***	-0.104***		0.435***	0.950***	1.209***	
	[-3.83]	[-5.41]	[-4.70]		[2.75]	[6.29]	[8.00]	

Table 9

Alternative regression specification: Firm fixed effect

This table shows the results for an alternative regression specification which includes firm fixed effects. Our sample includes U.S. publicly traded firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, financial data from COMPUSTAT, and stock price data from the CRSP. We follow Dickinson (2011) in defining firms' life cycle stages as 'introduction', 'growth', 'mature', 'shake-out', and 'decline'. We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date.Variable definitions are presented in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the firm level**;** t-Statistics are provided in parentheses.

Independent Variables	Dependent Variable			
	LOAN SPREADS	*PVIOL*	*LOAN SPREADS*	*LOAN_MAT_LN*
	(1)	(2)	(3)	(4)
INTRO	0.007	-0.024	-0.005	0.012
	[0.33]	[-1.34]	[-0.30]	[0.71]
GROWTH	-0.060***	-0.093***	-0.050***	0.034**
	[-3.11]	[-5.83]	[-3.04]	[2.20]
MATURE	-0.111***	-0.068***	-0.096***	0.025*
	[-5.87]	[-4.40]	[-6.08]	[1.78]
DECLINE	0.064*	0.026	0.047*	-0.050*
	[1.82]	[0.96]	[1.80]	[-1.83]
PVIOL			0.197***	
			[14.88]	
Constant	6.239**	1.112***	4.673***	0.960***
	[2.48]	[5.70]	[3.09]	[6.27]
Other controls	Yes	Yes	Yes	Yes
Loan Type FE	Yes	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes
N	13,064	10,305	10,263	12,842
Adj. R-squared	0.66	0.40	0.80	0.62

Table 10

Alternative measure of firm life cycle

This table shows the results when alternative definitions of the life cycle are employed. Our sample includes U.S. publicly traded firms from 1994 to 2015. Bond characteristics data comes from the Loan Pricing Corporation's (LPC) Dealscan database, financial data from COMPUSTAT, and stock price data from the CRSP. We use DeAngelo et al.'s (2006) alternative life cycle measures: Retained Earnings to Total Assets (RE/TA) and Retained Earnings to Total Equity (RE/TE). We exclude financial (SIC 6000 - 6999) and utility (SIC 4900 - 4949) firms from the sample. We measure all financial information available on Compustat as of the quarter immediately preceding the debt contract agreement date.Variable definitions are presented in the Appendix. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The standard errors are clustered at the firm level**;** t-Statistics are provided in parentheses.

	Dependent Variable									
	LOAN SPREADS		*PVIOL*		*LOAN SPREADS*		LOAN_MAT_LN		SECURE	
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RE/TA	-0.130***		-0.066***		-0.163***		0.078***		-2.259***	-0.406***
	[-5.32]		[-6.74]		[-15.68]		[9.06]		[-10.95]	[-6.49]
RE/TE		-0.012**		-0.010***		-0.209***		0.006***		
		[-2.46]		[-3.68]		[-17.55]		[2.80]		
PVIOL					0.425***	0.399***				
					[30.47]	[28.46]				
Constant	6.077**	6.113**	1.064***	1.214***	5.684***	5.899***	0.544***	-0.413**	0.325	0.799
	[2.42]	[2.37]	[4.26]	[4.76]	[2.68]	[36.69]	[4.50]	[-2.14]	[0.41]	[1.03]
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	13,064	12,354	10,305	10,305	10,263	9,703	12,842	12,158	12,800	12,118
Adj. R-squared	0.36	0.37	0.19	0.18	0.52	0.54	0.56	0.56	0.33	0.31