Journal of Banking and Finance 154 (2023) 106971

Contents lists available at ScienceDirect

Journal of Banking and Finance

journal homepage: www.elsevier.com/locate/jbf

Firm life cycle and cost of debt

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A R T I C L E I N F O

JEL Classification:
G32
M21

Keywords:
Firm life cycle
Cost of debt
Bank loans
Risk

A B S T R A C T

Theory provides several channels linking the corporate life cycle and lending risks. Using a sample of 20,307 firm-loan observations spanning 5,076 publicly traded U.S. firms, we find an economically significant relationship between firm life cycle stage and lending spreads. Based on the Owen and Yawson (2010) life cycle stage classification, young firms are expected to pay at least 15 bps more than mature firms, whereas mature firms pay at least 11 bps more than old firms. According to the Dickinson (2011) cash flow classification, firms in the introduction and decline phases pay lending spreads that are 6 and 12 percent greater than firms in the mature phase. We explore omitted variables bias and instrumental variable estimation in robustness testing to alleviate endogeneity concerns. A mechanism analysis shows that credit risk, systematic risk, and idiosyncratic risk follow the corporate life pattern in accordance with loan spreads, suggesting that banks charge a premium to compensate for risk. Our results support the theoretical prediction that structural changes occur as firms evolve across the corporate life cycle.

1. Introduction

Structural changes occur to firms as they evolve across life cycle stages, and these changes have broad effects on firms' behavior and risk profiles (Quinn and Cameron 1983; Miller and Friesen 1984). Given the "common wisdom" that a firm's life cycle stage is linked to external financing (Rajan and Zingales 1998), it is surprising that the nature of the relationship between a firm's life cycle stage and lending spreads is not well studied. This study examines whether firms' life cycles convey incremental information regarding lending spreads and, ultimately, whether that relationship is consistent with theoretical predictions.

On the one hand, life cycle measures may inform users regarding risks that are priced into lending spreads. Measures of credit risk, such as those used in predicting spreads, may not adequately capture the overall effects of firm life cycle in empirical models (Dickinson 2011). In addition to credit risk, lending spreads include compensation for systematic risk and non-diversifiable idiosyncratic risk (Amiram et al., 2017). Theory suggests that these risks vary with the corporate life cycle (Chowdhury and Chowdhury 2001; Gao 2019).

On the other hand, firm life cycle measures may not be incrementally informative to the pricing of lending spreads. After considering standard financial controls such as size, leverage, market-to-book ratio, and profitability, measures of the corporate life cycle may not provide significant information regarding lending spreads. Even if the corporate life cycle informs lending spreads beyond that of existing measures, other external measures such as credit ratings, may sufficiently capture such incremental information. Lastly, lending spreads are a product of markets. Prior research indicates that inefficiencies exist in equity markets with respect to life cycle phases (Dickinson 2011; Vorst and Yohn 2018). It is possible that spreads in the lending market fail to reflect variation in the corporate life cycle.

We conduct our analysis using a sample of 20,307 firm-loan observations. This sample includes 5076 unique publicly traded U.S. firms and spans the period from 1988 to 2018. We utilize three approaches in the literature to empirically measure and identify firms' life cycle stage. First, we utilize two continuous proxies for firm life cycle introduced by DeAngelo et al. (2006): the ratio of retained earnings to total assets (*RE/TA*) and the ratio of retained earnings to total equity (*RE/TE*).

Data availability: Data are available from the sources identified in the paper.

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https://doi.org/10.1016/j.jbankfin.2023.106971
Received 23 November 2022; Accepted 30 July 2023
Available online 1 August 2023

Second, following Owen and Yawson (2010) and Al-Hadi et al. (2016), we create life cycle indicator variables from the continuous *RE/TA* and *RE/TE* ratios denoted as *YOUNG, MATURE,* and *OLD* firms. Third, we follow the methodology of Dickinson (2011) in classifying firms into the introduction, growth, mature, shakeout, and decline life cycle phases according to their cash flows from operating, financing, and investing activities.

Descriptive statistics show that continuous measures of firm maturity (DeAngelo et al., 2006) have a negative and significant relationship with lending spreads. Fig. 1 plots mean and median lending spreads across the Owen and Yawson (2010) categorical measure of life cycle in Panel A and across Dickinson's (2011) categorical measures in Panel B. The results in Panel A indicate that firms pay lower spreads as they transition from the young stage to the mature and old stages. In Panel B, a U-shape pattern emerges where firms in the decline and introduction phases pay lending spreads that well exceed those of mature firms. In multivariate analyses, although traditional financial controls account for much of the initial variation that we observe, we find that the same patterns as in the univariate case persist. Fig. 2 plots the variation in lending spreads as predicted by the multivariate analyses. Panel A again indicates that older firms pay lower spreads and Panel B shows that the U-shape pattern persists across the Dickinson (2011) life cycle phases. These results are also economically significant. While continuous measures of firm maturity yield point elasticities with effects as large as 1.50 bps, categorical classification according to Owen and Yawson (2010) shows that young firms are expected to pay at least 15 bps more than mature firms, while mature firms pay at least 11 bps more than old firms. When examining the firms in Dickinson's (2011) introduction phase (decline phase), they may expect to pay lending spreads that are 6 percent (12 percent) higher than firms in the mature phase. As a reference for economic significance, we note that Campello and Gao (2017) find that a one standard deviation increase in customer concentration is associated with a 6 percent increase in loan spreads. Ertugrul et al. (2017) find that a one standard deviation increase in the natural log of 10-K file size is associated with a 9.73 percent increase in lending spreads.

Although a firm's life cycle station is arguably exogenous to the pricing of its debt, we recognize that the empirical design raises endogeneity concerns. To avoid simultaneity issues, we lag firm-level independent variables in all specifications. This more accurately depicts the firm characteristics observed by lenders when setting terms and prevents the lending decision *itself* from contaminating right-hand-side-variables.[1] We further address concerns of endogeneity and confounding variables in two ways. First, we calculate the impact threshold of a confounding variable (ITCV). This provides insight into how sensitive the results may be to omitted variables that we fail to consider. Second, we conduct an instrumental variable analysis using industry-level growth shocks and complement this analysis with an instrumental variable approach developed by Lewbel (2012), which constructs a set of instruments based on the heterogeneity in the error term of the first-stage regression model. The results of these analyses alleviate endogeneity concerns and are consistent with our initial findings.

To further exclude alternative explanations, we conduct several additional robustness tests. First, we include industry-period fixed effects, which account for unobserved time-variant industry heterogeneity. These results are primarily dependent upon *between-firm* variations of firm life cycle. Next, we include firm fixed effects, which account for time-invariant unobserved firm heterogeneity. These results are dependent upon *within-firm* variation of firm life cycle. Our results are largely consistent with the primary analysis. Combined, these analyses exclude several alternative explanations that depend upon either uncontrolled changes in the macro environment or uncontrolled differences between firms.

Next, we introduce additional empirical measures that could subsume the effects of firm life cycle. We introduce measures of loss given default, probability of covenant violation, and debt beta. Our results remain largely unchanged. We also examine lending terms other than pricing (i.e., the use of collateral and loan durations) as substitute measures for lending spreads. The results provide additional evidence supporting our findings regarding the corporate life cycle.

Lastly, we examine the mechanism through which life cycle proxies affect loan spreads. The interest rate spread on private loans includes premiums to compensate for expected loan loss, systematic risk, and non-diversifiable idiosyncratic risk (Amiram et al., 2017). We test these mechanisms with respect to the firms' life cycle stages. First, we explore the relation between categorical life cycle variables young, mature, and old (Owen and Yawson 2010) and default risk, systematic risk, and the volatility of cash from operations. Our results show a significant decrease in risk as firms go from young to old, i.e., Altman's Z-score increases, loss given default decreases, and the firm's beta decreases. We also see a decrease in cash flow volatility after firms exit the young stage. As for idiosyncratic risk, we find that it is the highest for young firms and that it subsequently declines for mature and old firms. Next, we examine these risk measures with respect to Dickinson's firm life cycle measures, which relate in a U-shape pattern to loan spreads. Our results for default risk and loss given default show that their proxies follow the familiar inverse U-shape pattern, suggesting higher risk in the introductory and decline stages and lower risk in the growth and mature stages. Systematic risk and cash flow volatility, on the other hand, follow the regular U-shaped patterns, meaning that they are lower for growth and mature firms. These results are consistent with theoretical literature (Agarwal and Gort 2002) regarding the risk profiles and firm life cycle stages. When examining the relationship between life cycle stages and idiosyncratic risk, we find that mature and growth firms experience significantly less idiosyncratic volatility than firms in the introduction, decline, or shakeout stages. These results are consistent with Amiram et al. (2017). In sum, the mechanism analysis shows that credit risk, systematic risk, and idiosyncratic risk follow the corporate life patterns in accordance with loan spreads, suggesting that banks charge premiums to compensate for risk.

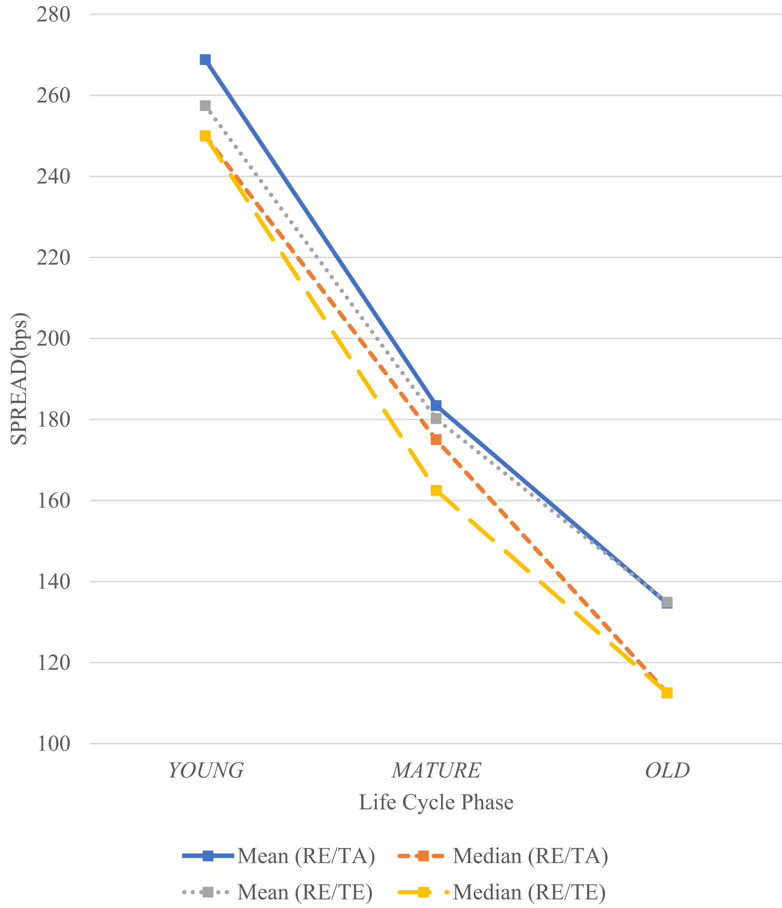
Our study contributes to several streams of research. It contributes to the literature on corporate life cycle and corporate finance (Habib and Hasan 2019). By using the private debt market, our setting allows for more heterogeneity across our sample (Francis et al., 2017) and it also complements prior literature that relates corporate life cycle to the debt market. For example, Faff et al. (2016) highlight how certain corporate policies (including debt issuances) follow the corporate life cycle. They show that the frequency of debt issuance increases in the introduction and growth stages and decreases in the mature, shake-out and decline stages. However, they do not identify a specific mechanism responsible for this result. Our study could be viewed as a potential mechanism for the findings of Faff et al. (2016), i.e., firms in decline may be less likely to issue debt because they generally pay higher spreads even after controlling for their financial position and credit risk.

Beyond the literature on firm life cycle, our findings make specific contributions to research on private debt markets. Empirical work shows that systematic risk plays an important role in determining interest rate spreads (Iannotta et al., 2019). Past literature also highlights that whereas expected loss (i.e., credit risk) and systematic risk explain a great deal of lending spreads, lenders also charge risk premiums for other factors (Amiram et al., 2017). Most notably, difficulties in fully diversifying certain idiosyncratic risks can lead banks to risk premiums that are distinct from premiums for expected loss. Theoretical works provide a basis for understanding why the ability to diversify certain idiosyncratic risk may vary with the corporate life cycle (Chowdhury and Chowdhury 2001; Gao 2019). Our results buttress these ideas and indicate that the corporate life cycle explains significant variation in spreads.

Lastly, our findings also speak to the broader literature linking

[1] The issuance of a loan has a mechanical relationship with assets, leverage, and cash from financing, and, therefore, empirical measures of firm life cycle.

Panel A: Categorical Life Cycle Stage Variables based on RE/TA and RE/TE



Panel B: Categorical Life Cycle Stage Variables using Cash Flow Information

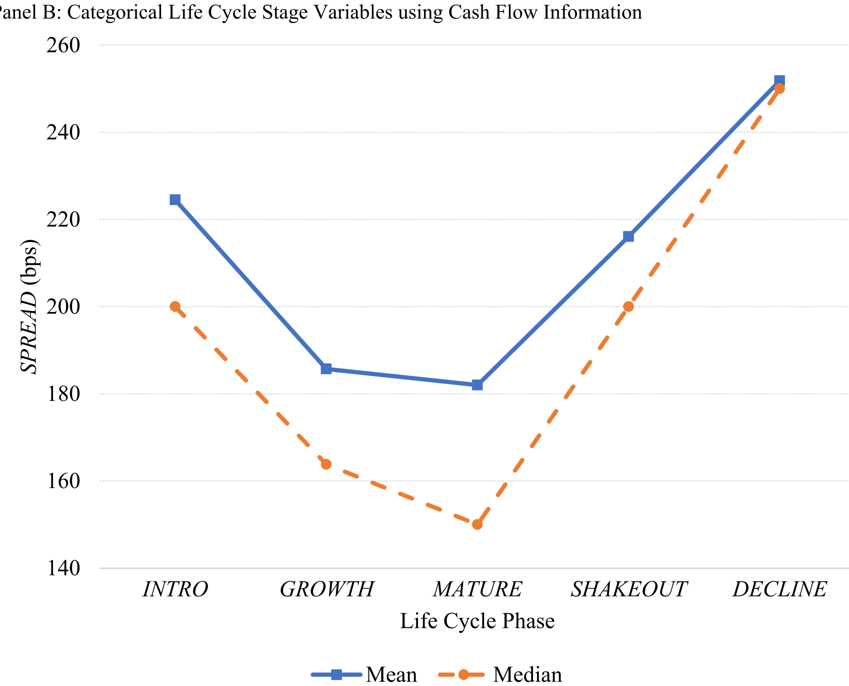
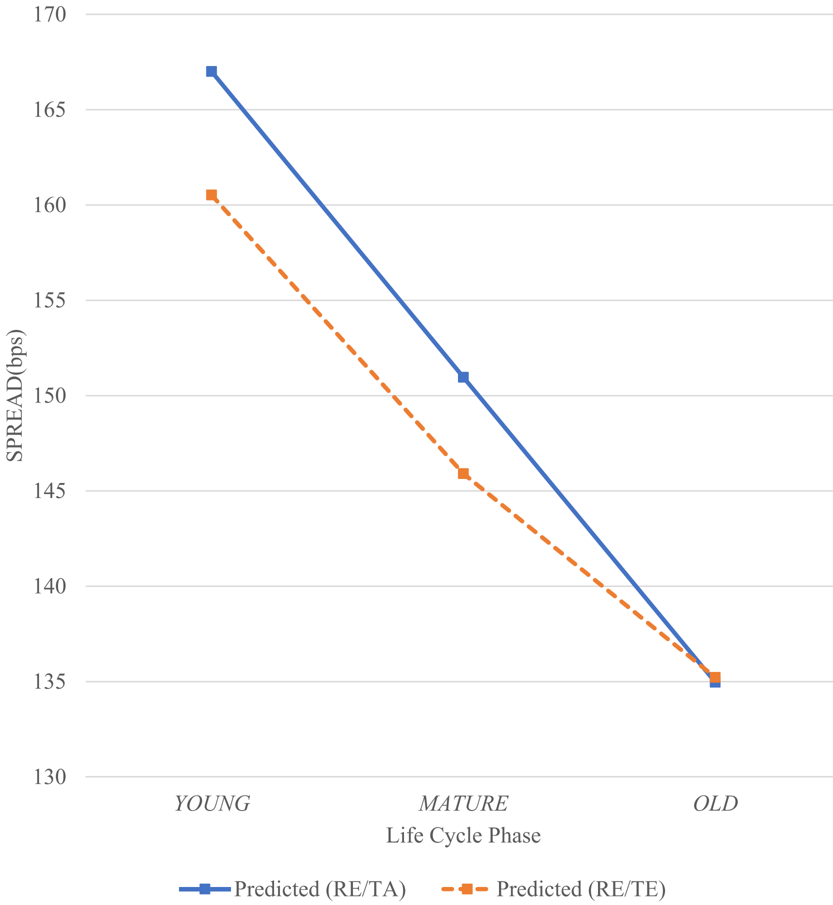


Fig. 1. Univariate Analysis: Loan Spread and Firms' Life Cycle Stages.
Panel A: Categorical Life Cycle Stage Variables based on RE/TA and RE/TE.
Panel B: Categorical Life Cycle Stage Variables using Cash Flow Information.
Notes: This figure shows the mean and median loan spreads (*SPREAD*) in basis points (bps) for each the life cycle stages Panel A shows the categorical life cycle stage variables based on *RE/TA* and *RE/TE*. Panel B shows the five life cycle phases, as defined by Dickinson (2011). See the Appendix for detailed variable definitions. The sample population includes 20,307 loans from fiscal years 1988 through 2018 that were made to 5076 distinct publicly traded U.S. firms. Loan data come from the Loan Pricing Corporation's (LPC) DealScan database. Financial (SIC 6000 – 6999) and utility (SIC 4900 – 4949) firms are excluded from the sample.

Panel A: Categorical Life Cycle Stage Variables based on RE/TA and RE/TE



Panel B: Categorical Life Cycle Stage Variables using Cash Flow Information

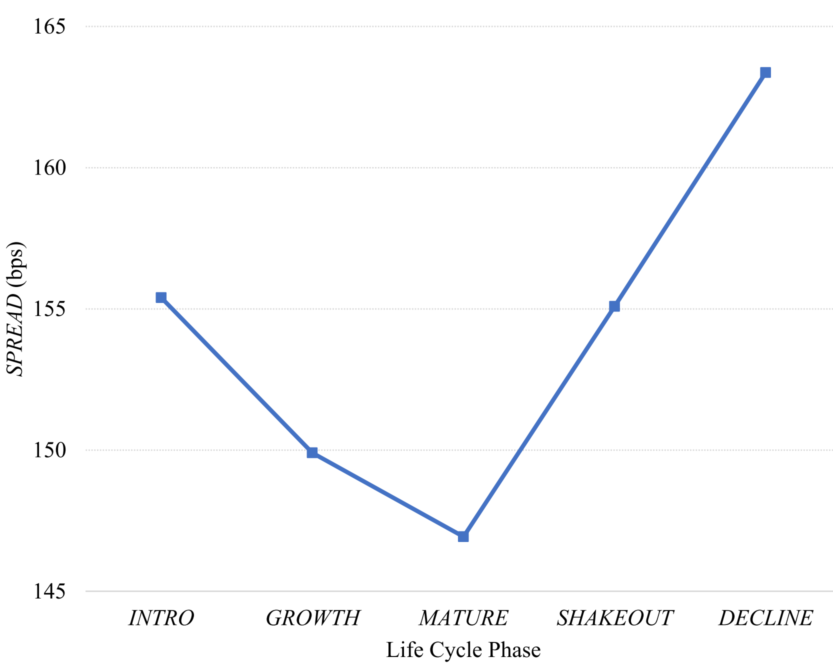


Fig. 2. Multivariate Analysis: Loan Spread and Firms' Life Cycle Stages.
Panel A: Categorical Life Cycle Stage Variables based on RE/TA and RE/TE.
Panel B: Categorical Life Cycle Stage Variables using Cash Flow Information.
Notes: This figure shows predicted loan spreads (*SPREAD*) in basis points (bps) for each the life cycle stages. Panel A shows the categorical life cycle stage variables based on *RE/TA* and *RE/TE*. Predictions are calculated using the parameters estimated in Table 3 Panel B, columns (2) and (4) at the sample mean. Panel B shows the five life cycle phases, as defined by Dickinson (2011). Predictions are calculated using the parameters estimated in Table 3 Panel B, column (5) at the sample mean. The sample population includes 20,307 loans from fiscal years 1988 through 2018 that were made to 5076 distinct publicly traded U.S. firms. Loan data come from the Loan Pricing Corporation's (LPC) DealScan database. Financial (SIC 6000 – 6999) and utility (SIC 4900 – 4949) firms are excluded from the sample.

accounting information to debt contracting (Ball et al., 2008; Christensen et al., 2016).

The remainder of this paper is organized as follows: Section 2 reviews the related literature and develops our hypothesis; Section 3 describes our research design and our sample; Section 4 presents our primary findings; Section 5 contains additional tests of robustness; Section 6 presents the mechanism analyses; and Section 7 concludes.

2. Literature review and hypothesis development

2.1. Literature review

Throughout their existence, firms traverse a corporate life cycle. DeAngelo et al. (2006) argue that firms with proportionately low (high) levels of retained earnings are less (more) mature and more dependent on (independent of) external financing. The authors reason that the ratio of retained earnings to total assets and the ratio of retained earnings to total equity are "logical prox(ies) for the life cycle stage at which a firm currently finds itself" (DeAngelo et al., 2006). Although the measures introduced by DeAngelo et al. (2006) provide a linear measure of firm maturity, firms' life cycles may alternatively be categorized into various phases. Owen and Yawson (2010) and Al-Hadi et al. (2016) define indicator variables from these ratios to separate firms into young, mature, and old stages whereas Gort and Klepper (1982) provide a finer classification into introduction, growth, mature, shake-out, and decline. Dickinson (2011) provides a parsimonious measure for identifying these latter phases according to the nature of the three components of the statement of cash flows.

Early work indicates that a firm's strategy, structure, and environment vary according to its life cycle station (Miller and Friesen 1984). Using survey data and field studies, Moores and Yuen (2001) show that a firm's life cycle stage has implications that extend to the configuration of its accounting systems. DeAngelo et al. (2010) show how the corporate life cycle can explain firms' interactions with equity markets. Not only is the linking of cash flows and external financing to the corporate life cycle intuitive, prior literature also shows that the disaggregation of cash flows into its operating, financing, and investing components provides incremental information (Livnat and Zarowin 1990). More recent work links the corporate life cycle to the sourcing of financing (Faff et al., 2016), but the variation in risk and the pricing of those risks in debt markets relative to the corporate life cycle remain unexplored.

Theory provides many empirically testable predictions regarding the consequence of a firm's life cycle station. Evidence indicates that firms' accounting information should be interpreted in light of their life cycle stages (Anthony and Ramesh 1992; Hribar and Yehuda 2015). Because a firm's life cycle phase is informative with respect to future profits, it is logical that a firm's life cycle also affects the pricing of its accruals (Cantrell and Dickinson 2020; Vorst and Yohn 2018; Dickinson 2011; Hribar and Yehuda 2015). Dickinson et al. (2018) show that investors rely more heavily on traditional accounting measures when firms are in the introduction or decline phases and that their attention shifts more to analyst forecasts when firms are growing or mature. Additional research indicates that companies adjust their disclosure practices and real business activities according to their life cycle stage (Chen et al., 2002; Cohen et al., 2010).

2.2. Hypothesis development

Our interest centers on the relationship between a firm's life cycle station and lending spreads. Agarwal and Gort (2002) develop a model showing that the probability of a firm's survival is inherently linked to its life cycle station. Empirical evidence also supports the predictive abilities of firm life cycle with respect to future firm performance (Dickinson 2011; Cantrell and Dickinson 2020; Vorst and Yohn 2018). In addition, theory recognizes that debt overhang and moral hazard problems are also intertwined with firms' life cycle station (Jensen and Meckling 1976; Diamond 1989; Chowdhury and Chowdhury 2001). Managerial risk taking appears to be consistent with these predictions (Habib and Hasan 2017). If a firm's survival and the probability of loan loss are functions of a firm's life cycle, then it follows that loan spreads should reflect such risks.

Liquidation values and moral hazard problems vary across firms' life cycle phases (Gort and Klepper 1982; Arikan and Stulz 2016). The debt overhang problem increases as firms face higher default risks and greater financial constraints (Cai and Zhang 2011). Asset substitution and information asymmetry problems result from uncertain and volatile cash flows.[2] Due to their more predictable earnings, these problems (and therefore lending spreads) are predicted to diminish for more mature firms (Lang 1991). Mature firms may also accumulate greater analyst following, which increases monitoring and further reduces information asymmetry (Barth et al., 2001).

A firm's relative position within its life cycle may be considered in three ways. The first follows DeAngelo et al. (2006) in essentially placing firms within a continuum of maturity. The second defines distinct stages within the continuum of maturity according to Owen and Yawson (2010). The third follows Gort and Klepper (1982) and Dickinson (2011) in categorizing firm's positions into five discreet phases. We consider all three proxy categories. Given prior findings, we expect lending spreads to decline as firms increase in maturity. In the context of Dickinson's (2011) life cycle phases, we expect spreads to be relatively high in the introduction phase, to moderate through the growth and mature phases, and to increase again in the shake-out and decline phases. Accordingly, we expect credit spreads to follow a U-shape pattern across these life cycle phases.

In addition to expected loan loss, the interest rate spreads on private loans include premiums to compensate for systematic risk and non-diversifiable idiosyncratic risk (Amiram et al., 2017). Less mature firms have higher uncertainty about future profitability and cash flow and thus experience higher idiosyncratic return volatility (Pástor and Veronesi 2003). Because moral hazard obstructs the diversification of idiosyncratic risks, this reinforces the U-shape hypothesis discussed above (Gao 2019). Furthermore, the statistics from Dickinson (2011) provide evidence that systematic risks also follow a U-shape across the firm life cycle.[3]

Despite the predicted negative relation (U-shape pattern) between firm maturity (life cycle phases) and lending spreads, it remains unclear whether such a relation would extend beyond that explained by common financial controls. Effective bankruptcy prediction models may be constructed using just a few financial measures (Beaver et al., 2005). Banks may be able to mitigate differences in moral hazard via monitoring. For example, evidence shows that bank monitoring can compensate, in part, for weaknesses in firms' information environment (Dhaliwal et al., 2011). Even if uncontrolled differences in risk exist across firms' life cycles, markets may not fully account for differences between life cycle phases (Dickinson 2011; Cantrell and Dickinson 2020; Vorst and Yohn 2018). Lenders are not always compensated for differences in systematic risk (Marques and Pinto 2020). For these reasons, we state our formal hypothesis in the null form as follows:

Hypothesis 1. *Lending spreads are not associated with firm life cycle stage.*

[2] See Jensen and Meckling (1976), Stiglitz and Weiss (1981), Myers and Majluf (1984), and Diamond (1989).

[3] See the descriptive statistics for Dickinson's (2011) "ASSET BETA" variable in Table 2 panel A .

3. Research design and sample construction

3.1. Research design

To explore the relation between a firm's cost of debt and its life cycle station, we follow prior literature in specifying the following model :[4]

$$SPREAD_{ilt} = f(LIFE\ CYCLE\ STAGE_{it-1}, FIRM\ CONTROLS_{it-1}, LOAN\ CONTROLS_{ilt}) \quad (1)$$

for all firms *i,* loans *l,* and quarters *t*. We lag measures of firms' life cycle stage as well as other firm controls by one quarter to control for conditions that are observable at the time loan spreads are set. We cluster standard errors at the firm level.

3.2. Measure of loan spread

Our primary dependent variable is the natural logarithm of loan spread ($SPREAD_{ilt}$). Following prior literature, we use loan spread over the London Interbank Offered Rate (LIBOR) at the time of loan origination as our primary measure of the cost of borrowing (Graham et al., 2008; Bharath et al., 2011; Ertugrul et al., 2017). DealScan's "all-in-drawn" spread provides the amount borrowers pay in basis points over the LIBOR for each dollar drawn down. The loan spread measure includes any annual (or facility) fees paid to the bank group. Where noted, we use the unlogged measure of loan spread in basis points (bps) for descriptive purposes.

3.3. Measures of corporate life cycle

We consider three approaches to measuring firms' life cycle stage. First, we utilize two continuous proxies for firm life cycle introduced by DeAngelo et al. (2006): the ratio of retained earnings to total assets (*RE/TA*) and the ratio of retained earnings to total equity (*RE/TE*). These measures capture the earned/contributed capital mix and proxy for the extent to which a firm is self-financing or reliant upon external capital. The ratios climb as firms mature with declining investment opportunities. Lower values are consistent with younger start-up firms and firms in decline. We calculate *RE/TA* and *RE/TE* using COMPUSTAT variables as described in the Appendix. If the value of total assets (total equity) is not greater than 0.00, then we consider *RE/TA* (*RE/TE*) to be undefined.

Second, following Owen and Yawson (2010) and Al-Hadi et al. (2016), we use the *RE/TA* and *RE/TE* ratios to categorize firms as being young, mature, or old. We code indicator variables *YOUNG, MATURE,* and *OLD* to be equal to one if the respective variable (*RE/TA* or *RE/TE*) is in the first, second, or third tercile.[5] This split maintains the original meaning of the variables.

Third, we follow the methodology of Dickinson (2011) in defining firms' life cycle phases. We create an indicator variable for each of the five life cycle phases (*INTRO, GROWTH, MATURE, SHAKEOUT*, and *DECLINE*).[6] We assign each observation to one of the phases according to the cash flow pattern observed across three components: cash flow from operations (CFO), cash flow from investing (CFI), and cash flow from financing (CFF).[7]

Firms in the introduction phase (*INTRO*$=1$) are figuring out their business plan and making investments (CFO ≤ 0 and CFI ≤ 0). These firms are dependent upon external financing (CFF > 0). Firms in the growth phase (*GROWTH*$=1$) have seemingly profitable business plans (CFO > 0), but still depend on external sources to finance their growth (CFI ≤ 0 and CFF > 0). Firms in the mature phase (*MATURE*$=1$) have seemingly profitable business plans (CFO > 0), and investments no longer depend on cash from external financing (CFI ≤ 0 and CFF ≤ 0). Firms in the decline phase (*DECLINE*$=1$) no longer seem to have profitable business plans (CFO ≤ 0). While in decline, firms predominantly divest from their current business lines (CFI > 0). Decline firms may return funds from these divestitures to their investors, or they may raise additional funds from investors in order to fill any shortages (CFF $\leq$ or $\geq$ 0). The remaining firms are defined as being in the shake-out phase (*SHAKEOUT*$=1$). These include firms that appear to be changing course by divesting from business plans that are currently profitable (CFO $>$ 0 and CFI > 0). The shake-out phase also includes firms that are reinventing themselves and would have been identified as introduction firms (CFO ≤ 0 and CFI ≤ 0), were they not well endowed financially from their past (CFF ≤ 0).

3.4. Firm controls

As with our measures of firm life cycle, we lag firm controls by one quarter to control for conditions that are observable at the time loan spreads are set. We use several controls frequently employed in the literature on loan spreads. These include firm size (*FIRM SIZE*); growth opportunities, as reflected by the market-to-book ratio (*MTB*); leverage (*LEV*); tangibility of assets (*TANGIBILITY*); operational cash flows[8] (*CFO*) as well as cash flow risk, as reflected by the standard deviation of cash flows from operations (*STD CF*); bankruptcy risk, as reflected by Altman's Z-Score (*Z-SCORE*); and firm profitability, as reflected by profit margin (*PROFITABILITY*). Because analysts may reduce monitoring costs, we also control for analyst following (*ANALYST*) (Barth et al., 2001). In addition, we control for sales growth (*SALES GROWTH*).

Valta (2012) shows that firms operating in a competitive product market are associated with a higher cost of borrowing. Therefore, we control for competition (*C4-INDEX*). We control for age (*AGE*) to better identify the effects specific to firms' life cycle (Bradley et al., 2016). Campello and Gao (2017) provide evidence that a concentrated set of large customers negatively affects private lending. Because customer concentration may also vary with firm life cycle, we control for customer concentration (*CUST CONCN*). We control for systematic risk (*BETA*). When available, we also control for credit ratings (credit rating fixed effects). Lastly, we include industry fixed effects (FFI48) to account for any systematic differences across industries. Broadly speaking, these controls account for the differences in risk lenders face between firms. Additional detail regarding the calculation of these variables is available in the Appendix.

3.5. Loan controls

We control for loan maturity (*LOAN TERM*), loan size (*LOAN SIZE*),

4 For examples, see Graham et al. (2008); Chava et al. (2009); Valta (2012); Fang et al. (2016); Ertugrul et al. (2017); Campello and Gao (2017); Amiram et al. (2017); and Robin et al. (2017).

5 When regressing on these phases, we omit *OLD* to avoid a dummy trap.

6 When regressing on the phases, we omit *SHAKEOUT* to avoid a dummy trap.

7 See Dickinson (2011) for a detailed discussion on the theoretical support for the construction of these variables.

8 Although the prior literature often opts not to control of operating cash flows (e.g., Ertugrul et al [2017], Campello and Gao [2017], and Qi et al [2010]), given the nature of our study we believe it is important to control for operating cash flows when considering the corporate life cycle.

and whether (or not) the loan is secured (*SECURE*). Our model includes fixed effects that control for the various types of loans issued. We include period fixed effects (calendar year-quarter) to control for temporal differences in the macroeconomic environment when loans are issued.

3.6. Sample construction

Our sample lies at the intersection of three databases. We obtain loan data from the Loan Pricing Corporation's (LPC) DealScan database,[9] construct financial measures using data from COMPUSTAT, and obtain stock price data from the Center for Research in Security Prices (CRSP) database. We limit our sample to U.S. firms over the years 1988 to 2018, inclusive.

We exclude financial (SIC 6000 – 6999) and utility (SIC 4900 – 4949) firms from our sample due to their regulated nature. We drop all firms without borrower ID and exclude observations missing any of our primary variables. Our final sample includes 20,307 firm-loan observations for 5076 publicly traded firms. To mitigate the effect of extreme values, we winsorize continuous variables at the 1st and the 99th percentiles.

3.7. Sample statistics

Table 1 Panel A presents summary statistics for our sample. The loans in our sample have a mean (median) spread (*SPREAD*) of 196 bps (175 bps) over LIBOR, a mean (median) loan maturity (*LOAN TERM*) of 46 months (49 months), and a mean (median) loan size (*LOAN SIZE*) of 506 million dollars (190 million dollars). These statistics are consistent with other studies investigating the cost of borrowing (e.g. Valta 2012; Ertugrul et al., 2017). More than 50 percent of the loans are secured.

The mean (median) ratio of retained earnings to total assets (*RE/TA*) is 0.05 (0.13). Because the calculation of *RE/TE* is more restrictive in that it requires total equity to be greater than zero, the population drops slightly when calculating this variable ($n = 19{,}342$). The distribution of our sample across the introduction *(INTRO)*, growth (*GROWTH*), mature *(MATURE)*, shake-out *(SHAKEOUT)*, and decline *(DECLINE)* life cycle phases is approximately 15 percent, 26 percent, 44 percent, 10 percent, and 4 percent, respectively. This distribution is generally consistent with that reported by Dickinson (2011).

Table 1 Panel B shows the distribution by year and Panel C shows the distribution by industry. The manufacturing industry represents about 46 percent of the sample.

In the Online Appendix, Table OA1 presents additional summary statistics partitioning the sample by the categorical life cycle variables. In Panel A, we split the sample into firms in the *YOUNG, MATURE*, and *OLD* categories based on the *RE/TA* variable. The mean (median) spread (SPREAD) for the young firms is 269 (250) bps and declines to 183 (175) bps for mature firms and to 135 (113) bps for old firms. The same pattern holds for firms classified into the same categorial life cycle variables but based on the *RE/TE* variable (see Panel B). Risk measures such as beta (*BETA*), the probability of covenant violation (*PVIOL*), debt beta (*DEBT BETA*), idiosyncratic volatility (*IDIOSYNC VOL*), and Altman's Z-Score (*Z-SCORE*) indicate a reduction in risk from the young to the old life cycle stage. In Panel C, we show the distribution by each of Dickinson's (2011) life cycle phases. As expected, both measures of scaled retained earnings (*RE/TA* and *RE/TE*) increase progressively when moving from *INTRO* to *GROWTH* to *MATURE*. They then decrease in the *SHAKEOUT* phase and drop to their lowest values in the *DECLINE* phase. The inverse U-shape trend that *RE/TA* and *RE/TE* follow across the life cycle phases is consistent with higher values signifying more mature firms. We note that an inverse relation between these measures and *SPREAD* would be consistent with a U-shape relation between life cycle phases and loan spreads. We observe this trend. Both the mean and the median loan spread are greater in the introduction, shake-out and decline phases than in the growth and mature phases. As for risk measures, beta (*BETA*), the probability of covenant violation (*PVIOL*), debt beta (*DEBT BETA*), idiosyncratic volatility (*IDIOSYNC VOL*), and Altman's Z-Score (*Z-SCORE*) indicate a reduction in risk from the young to mature firms and a subsequent increase in risk between firms in the mature and decline phase.[10] Table OA2 in the Online Appendix reports pair-wise correlations between the variables included in the regression models.

Table 2 reports univariate statistical comparisons of loan spreads for pairs of the categorical life cycle variables. Panel A (B) shows the relationship between young, mature, and old firms based on the *RE/TA(RE/TE)* variable. We calculate significance using both Tukey's honest significant difference (HSD) and the Tukey–Kramer (TK) method. The results indicate that the mean loan spread decreases significantly from young firms to old firms. In Panel C of Table 2, we show the relationship between the Dickinson (2011) life cycle phases. The results indicate that the mean loan spread decreases significantly from the introduction to the growth phase. Whereas the difference in *SPREAD* between the growth and mature phases is not statistically significant, there is a significant increase once firms enter the shake-out phase. Lastly, we find that firms in decline have spreads that are significantly higher than firms in all other phases. Both Tukey's HSD and the TK test results provide reasonable evidence that loan spreads are relatively higher in the introduction, shake-out, and decline phases and lower in the growth and mature phases. Fig. 1 Panel A provides a graphical representation of the univariate relationship between loan spreads and categorical life cycle variables according to Owen and Yawson (2010). Fig. 1 Panel B provides a graphical representation of the U-shape trend that spreads follow across the Dickinson's (2011) life cycle phases.

4. Empirical results

4.1. Main results

Table 3 presents the results for model (1). In Panel A, we present the OLS regression results for all life cycle variables while including only industry and period fixed effects. Columns (1) and (2) show the results for *RE/TA* and the categorical variables *YOUNG* and *MATURE*, which are based on *RE/TA*. The category *OLD* is the base category in the regression. Columns (4) and (5) show the corresponding results for *RE/TE* and its categorical versions *YOUNG* and *MATURE*. In all cases, we find a negative and significant relationship between firm maturity and lending spreads (all significant at the 0.01 level). The coefficients on *YOUNG* and *MATURE* are also statistically different from each other. In column (5), we use the life cycle phases of Dickinson (2011) as our independent variables of interest. If lending spreads follow a U-shape pattern over firms' life cycle, then loan spreads will be higher (lower) during the introduction and decline (growth and mature) phases. This is what we find. The coefficients for the introduction phase (*INTRO)* and the decline phase (*DECLINE)* are positive and statistically significant at

[9] LPC data are skewed against smaller firms and do not represent a random sample of bank loans (Valta 2012). Although this is an inherent limitation of our study, we believe that the suppressed variation in firm characteristics (e.g., size) would bias against us finding an association between life cycle stage and credit spreads. Furthermore, although imperfect, the private debt market does allow for more heterogeneity than other settings (Francis et al. 2017).

[10] Alternatively, loan maturity and loan size are generally greater in the growth and mature phases than in the introduction, shake-out and decline phases. Additionally, firms in the growth and mature phases are less likely to be collateralized (*SECURE*). The variation of firm size (SIZE), market-to-book (MTB), profitability (*PROFITABILITY*), and cash flow volatility (STD CF) across the life cycle stages is also consistent with those of prior studies (Dickinson 2011).

Table 1
Summary Statistics.

Panel A: Descriptive Statistics of Pooled Sample						
Variable	N	Mean	St.Dev	P25	P50	P75
SPREAD (bps)	20,307	195.617	129.229	100.000	175.000	273.125
LOAN TERM (mo)	20,307	46.308	21.797	31.826	49.263	60.000
LOAN SIZE (mil)	20,307	506.020	851.649	50.000	190.000	530.000
SECURE	20,307	0.525	0.499	0.000	1.000	1.000
RE/TA	20,307	0.052	0.507	−0.042	0.125	0.303
RE/TE	19,342	−0.010	2.238	−0.040	0.360	0.729
YOUNG (RE/TA)	20,307	0.333	0.471	0.000	0.000	1.000
MATURE (RE/TA)	20,307	0.333	0.471	0.000	0.000	1.000
OLD (RE/TA)	20,307	0.333	0.471	0.000	0.000	1.000
YOUNG (RE/TE)	19,342	0.333	0.471	0.000	0.000	1.000
MATURE (RE/TE)	19,342	0.333	0.471	0.000	0.000	1.000
OLD (RE/TE)	19,342	0.333	0.471	0.000	0.000	1.000
INTRO	20,307	0.151	0.358	0.000	0.000	0.000
GROWTH	20,307	0.263	0.440	0.000	0.000	1.000
MATURE	20,307	0.443	0.497	0.000	0.000	1.000
SHAKEOUT	20,307	0.104	0.305	0.000	0.000	0.000
DECLINE	20,307	0.038	0.191	0.000	0.000	0.000
FIRM SIZE (mil)	20,307	4980.113	11,835.420	245.758	933.909	3520.422
MTB	20,307	2.855	4.591	1.265	2.090	3.472
LEV	20,307	0.272	0.202	0.120	0.248	0.387
TANGIBILITY	20,307	0.314	0.242	0.119	0.244	0.453
CFO	20,307	0.019	0.045	0.002	0.021	0.039
STD CF	20,307	0.031	0.028	0.014	0.023	0.038
Z-SCORE	20,307	2.197	2.522	0.897	1.633	2.727
PROFITABILITY	20,307	0.140	0.215	0.067	0.131	0.213
ANALYST	20,307	7.437	7.143	2.000	5.000	11.000
SALES GROWTH	20,307	0.069	0.237	−0.037	0.032	0.125
C4-INDEX	20,307	0.414	0.154	0.299	0.386	0.479
AGE (yrs)	20,307	20.213	19.193	6.233	13.405	27.559
CUST CONCN	20,307	0.260	0.378	0.000	0.026	0.417
BETA	20,307	1.214	0.908	0.657	1.116	1.648
IDIOSYNC VOL	20,158	0.029	0.019	0.016	0.024	0.035

Panel B: Observations by Year			
YEAR	*N*	YEAR	*N*
1988	70	2004	921
1989	277	2005	864
1990	403	2006	824
1991	380	2007	801
1992	437	2008	584
1993	502	2009	346
1994	681	2010	475
1995	699	2011	708
1996	815	2012	616
1997	1065	2013	694
1998	953	2014	680
1999	752	2015	696
2000	815	2016	557
2001	862	2017	570
2002	900	2018	527
2003	833	Total	20,307

Panel C: Observations by Industry	
Industry	*N*
Agriculture, Forestry and Fishing	74
Mining	1841
Construction	221
Manufacturing	9344
Transportation, Communications, Electric, Gas and Sanitary service	1848
Wholesale Trade	1009
Retail Trade	1917
Services	3924
Non-classifiable	129
Total	20,307

Notes: This table provides summary statistics for our sample. The sample population includes 20,307 loans from fiscal years 1988 through 2018 that were made to 5076 distinct publicly traded U.S. firms. Financial (SIC 6000 – 6999) and utility (SIC 4900–4949) firms are excluded from the sample. Panel A provides descriptive statistics for the pooled sample. We provide detailed variable definitions in the Appendix. We present *SPREAD, LOAN TERM, LOAN SIZE, FIRM SIZE*, and *AGE* unlogged in terms of basis points (bps), months, millions of dollars, millions of dollars, and years, respectively, for descriptive purposes. Panel B and C, show the number of observations by year and industry.

Table 2
Univariate Analyses.

Panel A: Categorical Life Cycle Stage Variables based on *RE/TA*

	(1)*YOUNG*	(2)*MATURE*	(3)OLD	Difference-in-means	HSD-test	TK-test
Group means						
SPREAD (bps)	268.80	183.42	134.64			
Analyses of sequential pairs						
(1) vs. (2)	268.80	183.42		85.38	57.61***	57.61***
(1) vs. (3)	268.80		134.64	134.16	90.52***	90.52***
(2) vs. (3)		183.42	134.64	48.78	32.91***	32.91***

Panel B: Categorical Life Cycle Stage Variables based on *RE/TE*

	(1)*YOUNG*	(2)*MATURE*	(3)OLD	Difference-in-means	HSD-test	TK-test
Group means						
SPREAD (bps)	257.45	180.19	134.91			
Analyses of sequential pairs						
(1) vs. (2)	257.45	180.19		77.26	53.69***	53.69***
(1) vs. (3)	257.45		134.91	122.54	85.15***	85.16***
(2) vs. (3)		180.19	134.91	45.28	31.47***	31.47***

Panel C: Categorical Life Cycle Stage Variables based on Cash Flow Information

	(1)*INTRO*	(2)*GROWTH*	(3)*MATURE*	(4)*SHAKEOUT*	(5)*DECLINE*	Difference-in-means	HSD-test	TK-test
Group means								
SPREAD (bps)	224.51	185.70	182.01	216.07	251.82			
Analyses of sequential pairs								
(1) vs. (2)	224.51	185.70				38.80	13.90***	18.98***
(2) vs. (3)		185.70	182.01			3.69	1.32	2.37
(3) vs. (4)			182.01	216.07		−34.06	12.20***	15.61***
(4) vs. (5)				216.07	251.82	−35.74	12.80***	9.42***
Remaining analyses								
(1) vs. (3)	224.51		182.01			42.49	15.22***	22.52***
(1) vs. (4)	224.51			216.07		8.43	3.02	3.31
(1) vs. (5)	224.51				251.82	−27.31	9.78***	7.52***
(2) vs. (4)		185.70		216.07		−30.37	10.88***	13.10***
(2) vs. (5)		185.70			251.82	−66.11	23.68***	19.03***
(3) vs. (5)			182.01		251.82	−69.80	25.00***	20.63***

Notes: This table examines the differences in mean loan spreads (bps) between each of the life cycle stages. Panel A (B) shows the categorical life cycle stage variables based on *RE/TA* and *RE/TE*. Panel C shows the five life cycle phases, as defined by Dickinson (2011). Our sample includes U.S. publicly traded firms from 1988 to 2018. We exclude financial (SIC 6000 – 6999) and utility (SIC 4900 – 4949) firms from the sample. Tests of the difference-in-means are conducted using the Tukey honest significant difference test (HSD-test) and the Tukey-Kramer test (TK-test). See the Appendix to the paper for detailed variable definitions. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

the 1 percent level, while those for the growth phase (*GROWTH)* and the mature phase (*MATURE)* are negative and significant at the 1 percent level.[11] These results indicate that relative to the shake-out phase, loan spreads are significantly higher (lower) in the introduction and the decline phases (growth and mature phases).

In Panel B, we re-estimate model (1) after including loan and firm-level controls, and credit rating, loan type, industry, and quarter fixed effects. Although these controls explain much of the initial relation between firm maturity and lending spreads, we continue to find a negative and significant relationship between measures of firm maturity and lending spreads.

Even after controlling for variables such as *Z-SCORE* and credit ratings, we find that a 1 percent increase in *RE/TA* (*RE/TE*) lowers lending spreads by 1.50 bps (0.40 bps); see columns (1) and (3).[12] The statistical relationship is significant at the 1 percent level. We estimate lending spreads by life cycle phase using the parameters estimated in columns (2) and (4) at the sample means. Young, mature, and old firms based on the *RE/TA* (*RE/TE)* variable are predicted to pay lending spreads of 167 bps (161 bps), 151 bps (146 bps), and 135 bps (135 bps), respectively. The results, plotted in Fig. 2 Panel A, indicate that the decrease in spreads across the life cycle stages is significant, both statistically and economically. The coefficients for the control variables are in line with our expectations. For example, larger firms (*FIRM SIZE*), firms with more tangible assets (*TANGIBILITY*), and firms with greater outside monitoring (*ANALYST*) tend to pay smaller lending spreads, whereas firms with greater leverage (*LEV*) and more volatile cash flows (*STD CF*)

[11] We remind the reader that these coefficients are relative to the base case of our specification (*SHAKEOUT*= 1). At the bottom of Table 3, F-tests provide the significance of the difference in spreads between the introduction and growth phases, and the growth and mature phases. The significance of the difference between the mature (decline) and the shake-out phases is reflected by the significance of the *MATURE* (*DECLINE*) coefficient.

[12] The magnitudes for the coefficients of *RE/TA, YOUNG (RE/TA), MATURE (RE/TA)* and their *RE/TE* counterparts decline by more than 70 percent, respectively. Adjusted R-squared values increase by at least 2.2 times.

Table 3
Firm Life Cycle and Loan Spread.

Panel A: Model with Basic Fixed Effects and without Control Variables

	Dependent Variable= *SPREAD*				
Variable	(1)	(2)	(3)	(4)	(5)
RE/TA	−0.596***				
	(−30.87)				
YOUNG (RE/TA)		0.859***			
		(38.34)			
MATURE (RE/TA)		0.423***			
		(19.49)			
RE/TE			−0.097***		
			(−22.03)		
YOUNG (RE/TE)				0.833***	
				(34.48)	
MATURE (RE/TE)				0.423***	
				(18.30)	
INTRO					0.169***
					(6.74)
GROWTH					−0.129***
					(−5.76)
MATURE					−0.213***
					(−9.88)
DECLINE					0.278***
					(8.10)
Constant	5.658***	5.029***	5.689***	5.260***	5.614***
	(31.12)	(25.00)	(32.11)	(19.35)	(21.56)
Credit Rating FE	No	No	No	No	No
Loan Type FE	No	No	No	No	No
Industry FE (FFI48)	Yes	Yes	Yes	Yes	Yes
Period FE (calendar quarter)	Yes	Yes	Yes	Yes	Yes
Observations	20,307	20,307	19,342	19,342	20,307
Adj. R-squared	0.26	0.30	0.19	0.29	0.16
Test of Coefficients (F-Statistic)					
YOUNG=MATURE	595.56***		549.75***		
INTRO = GROWTH			212.68***		
GROWTH = MATURE			28.78***		

Panel B: Full Model

	Dependent Variable= *SPREAD*				
Variable	(1)	(2)	(3)	(4)	(5)
RE/TA	−0.093***				
	(−8.25)				
YOUNG (RE/TA)		0.214***			
		(15.81)			
MATURE (RE/TA)		0.113***			
		(9.66)			
RE/TE			−0.013***		
			(−5.70)		
YOUNG (RE/TE)				0.172***	
				(12.58)	
MATURE (RE/TE)				0.076***	
				(6.33)	
INTRO					0.002
					(0.10)
GROWTH					−0.034**
					(−2.58)
MATURE					−0.054***
					(−4.22)
DECLINE					0.051**
					(2.26)
FIRM SIZE	−0.026***	−0.033***	−0.035***	−0.035***	−0.033***
	(−3.15)	(−4.09)	(−4.13)	(−4.15)	(−3.99)
MTB	0.000	−0.000	−0.005***	−0.003***	0.001
	(0.34)	(−0.09)	(−3.83)	(−2.89)	(0.81)
LEV	0.204***	0.171***	0.348***	0.341***	0.234***
	(6.37)	(5.38)	(9.34)	(9.29)	(7.27)
TANGIBILITY	−0.119***	−0.101***	−0.134***	−0.117***	−0.120***
	(−4.18)	(−3.61)	(−4.60)	(−4.05)	(−4.20)
CFO	−0.332***	−0.341***	−0.304***	−0.291***	−0.075
	(−3.43)	(−3.63)	(−3.22)	(−3.13)	(−0.63)
STD CF	0.580***	0.641***	0.855***	0.925***	0.612***
	(3.00)	(3.37)	(4.38)	(4.77)	(3.21)
Z-SCORE	−0.026***	−0.024***	−0.026***	−0.024***	−0.033***
	(−11.27)	(−10.62)	(−10.66)	(−10.18)	(−14.68)

(*continued on next page*)

Table 3 (*continued*)

Panel B: Full Model

Variable	Dependent Variable= *SPREAD* (1)	(2)	(3)	(4)	(5)
PROFITABILITY	0.012	−0.002	−0.032	−0.031	−0.021
	(0.47)	(−0.09)	(−1.22)	(−1.21)	(−0.82)
ANALYST	−0.007***	−0.006***	−0.005***	−0.005***	−0.006***
	(−6.91)	(−6.21)	(−5.32)	(−5.33)	(−6.14)
SALES GROWTH	0.065***	0.061***	0.077***	0.071***	0.069***
	(4.13)	(3.95)	(4.85)	(4.51)	(4.35)
C4-INDEX	0.006	0.007	0.015	0.020	0.003
	(0.13)	(0.15)	(0.35)	(0.46)	(0.07)
AGE	−0.025***	−0.010*	−0.029***	−0.012**	−0.031***
	(−4.45)	(−1.73)	(−5.18)	(−2.00)	(−5.48)
CUST CONCN	0.019	0.019	0.016	0.017	0.021*
	(1.57)	(1.56)	(1.30)	(1.34)	(1.74)
BETA	0.018***	0.017***	0.020***	0.016***	0.024***
	(4.09)	(3.99)	(4.30)	(3.55)	(5.32)
LOAN TERM	−0.062***	−0.060***	−0.066***	−0.064***	−0.065***
	(−5.34)	(−5.24)	(−5.67)	(−5.53)	(−5.58)
LOAN SIZE	−0.117***	−0.115***	−0.121***	−0.118***	−0.119***
	(−14.91)	(−14.49)	(−14.81)	(−14.47)	(−15.28)
SECURE	0.325***	0.309***	0.328***	0.314***	0.330***
	(29.00)	(27.91)	(28.88)	(28.11)	(29.34)
Constant	7.008***	6.832***	7.076***	6.906***	7.106***
	(33.17)	(28.63)	(31.74)	(26.05)	(34.16)
Credit Rating FE	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes
Industry FE (FFI48)	Yes	Yes	Yes	Yes	Yes
Period FE (calendar quarter)	Yes	Yes	Yes	Yes	Yes
Observations	20,307	20,307	19,342	19,342	20,307
Adj. R-squared	0.67	0.67	0.67	0.67	0.66
Test of Coefficients (F-Statistic)					
YOUNG=MATURE		90.01***		79.72***	
INTRO = GROWTH					6.52**
GROWTH = MATURE				4.51**	

Notes: This table presents the results of the multivariate model, regressing loan spreads on life cycle measures. In Panel A we show results only for the life cycle measures and industry and time fixed effects. In Panel B, we show the results for model (1), regressing loan spreads on life cycle measures and control variables. The sample population includes 20,307 loans from fiscal years 1988 through 2018 that were made to 5076 distinct publicly traded U.S. firms. Financial (SIC 6000 – 6999) and utility (SIC 4900–4949) firms are excluded from the sample. Fixed effects for firm credit rating, loan type, industry (FFI48) and period are included as indicated. See the Appendix to the paper for detailed variable definitions. We cluster standard errors at the firm level. t-statistics are reported in parentheses. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

appear to pay larger lending spreads.[13] The coefficients for *LOAN TERM, LOAN SIZE*, and *SECURE* are also consistent with prior literature (e.g., Valta 2012; Robin et al., 2017; Ertugrul et al., 2017).

As for firms classified into different life cycle stages based on the cash flow information according to Dickinson (2011), we continue to find negative and statistically significant coefficients for the growth and mature phases (at the 0.01 and 0.05 level) and a positive and significant coefficient for the decline phase (at the 0.05 level). Although column (5) indicates that firms in the introduction phase do not have spreads that are significantly different from shake-out firms, an F-test indicates that they do have spreads that are significantly larger than firms in the growth phase. This is consistent with the U-shape pattern we have observed. The magnitudes of the coefficients when compared to Panel A column (5) decline after including all control variables. The adjusted R-squared value increases as well. This again suggests that our controls explain much of the variation in spreads observed across life cycle phases in the univariate analysis.[14] Even so, we still find that firm life cycle measures explain significant variation in lending spreads. For an economic perspective, firms in the introduction and decline phases are predicted to pay spreads that are respectively 6 percent and 12 percent greater than spreads paid by firms in the mature phase. We estimate lending spreads by life cycle phase using the parameters estimated in column (5) of Table 4 Panel B at the sample means. Firms in the introduction, growth, mature, shake-out, and decline phases are predicted to pay lending spreads of 156 bps, 150 bps, 147 bps, 155 bps, and 164 bps, respectively. The results, plotted in Fig. 2 Panel B, indicate that the U-shape pattern in spreads across the life cycle phases is again significant, both statistically and economically. We reject Hypothesis 1 and find evidence that the corporate life cycle stage does explain the variation in lending spreads.

[13] In column (5), *MTB* does not have a significant inverse relationship with lending spreads as predicted. This loss in significance is not unprecedented (Qi et al. 2010; Ni and Yin 2018; Arifin et al. 2020; Cai and Zhu 2020; Chen 2012). In Table OA3 of the Online Appendix, we find this loss in significance is driven by the inclusion of credit rating fixed effects rather than the inclusion of the Dickinson (2011) life cycle measures.

[14] While CFO does lose significance in column (5) this is not inconsistent with prior literature. In Pittman and Fortin (2004), the coefficient on cash from operations appears insignificant and in Kabir et al. (2013) the sign on the coefficient is opposite of the predicted direction. In Table OA4 of the Online Appendix, we conduct additional analyses regarding how Dickinson's life cycle stages interact with CFO. While Dickinson's life cycle measures are related to cash from operations, column (6) indicates that the life cycle measures capture effects that are distinct from the effects of the CFO control. Furthermore, many studies such as Ertugrul et al (2017), Campello and Gao (2017), and Qi et al (2010) refrain from controlling for operating cash flow altogether.

Table 4
Firm Life Cycle and Loan Spread: ITCV.

	RE/TA	*RE/TE*	Life Cycle Phases based on Cash Flow Information							
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Impact threshold of a confounding variable										
RE/TA	−0.045									
YOUNG(RE/TA)		0.098								
MATURE(RE/TA)			0.055							
RE/TE				−0.027						
YOUNG(RE/TE)					0.077					
MATURE(RE/TE)						0.032				
INTRO							−0.013			
GROWTH								−0.004		
MATURE									−0.016	
DECLINE										0.002
Partial impact of other life cycle measures										
YOUNG(RE/TA)			−0.093			−0.089				
MATURE(RE/TA)		0.017			0.014					
YOUNG(RE/TE)										
MATURE(RE/TE)										
INTRO								−0.008	−0.011	0.004
GROWTH							0.013		−0.005	0.010
MATURE							0.021	0.020		0.015
DECLINE							−0.009	−0.010	−0.011	
Partial impact of control variables										
FIRM SIZE	−0.007	0.000	−0.001	−0.003	0.002	0.002	0.001	0.000	0.001	0.000
MTB	−0.001	−0.001	−0.001	0.006	−0.002	0.004	0.000	0.000	0.000	0.000
LEV	−0.008	0.031	0.013	0.004	0.008	0.005	0.002	0.003	0.002	0.000
TANGIBILITY	−0.001	0.002	0.001	0.001	0.001	0.001	0.000	−0.002	−0.001	0.000
CFO	−0.003	0.001	0.001	−0.002	0.001	0.000	0.002	−0.001	−0.003	0.002
STD CF	−0.002	0.000	0.000	0.001	0.000	0.000	0.002	−0.001	−0.001	0.000
Z-SCORE	−0.049	0.037	0.021	−0.038	0.024	0.007	−0.001	−0.004	0.002	0.000
PROFITABILITY	−0.002	0.000	0.000	−0.002	0.000	0.000	0.000	0.000	0.000	0.001
ANALYST	0.006	0.000	0.000	0.002	−0.001	−0.001	0.000	0.000	0.000	0.000
SALES GROWTH	−0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.000	0.000
C4-INDEX	0.000	−0.001	0.000	0.000	−0.001	−0.001	0.000	0.000	0.000	0.000
AGE	−0.006	0.021	0.012	−0.004	0.025	0.011	0.001	0.002	0.001	0.000
CUST CONCN	0.000	0.002	−0.002	0.000	0.003	−0.001	0.000	0.000	0.000	0.000
BETA	−0.007	0.015	0.005	−0.004	0.015	0.006	0.000	0.000	−0.001	0.001
LOAN TERM	−0.003	−0.003	−0.002	−0.001	−0.001	−0.001	0.000	−0.001	−0.001	0.000
LOAN SIZE	−0.013	0.009	0.003	−0.011	0.008	0.001	−0.002	0.001	−0.002	0.002
SECURE	−0.020	0.068	0.036	−0.013	0.066	0.032	0.000	−0.006	−0.010	0.003

Notes: This table presents the impact threshold of a confounding variable (ITCV). Specifically, following Frank (2000) and Larcker and Rusticus (2010), the ITCV presents the correlation an omitted variable must have with our life cycle variables of interest in order to upend our primary findings. We present the partial impacts of the other life cycle measures and control variables as a benchmark for assessing the magnitude required in order to upend our primary findings. Columns (1) - (6) follow the specifications provided in column (1) - (4) of Table 3 Panel B. Columns (7) through (10) follow the specification provided in column (5) of Table 3 Panel B. See the Appendix to the paper for detailed variable definitions.

5. Robustness tests

5.1. Endogeneity concerns

5.1.1. Omitted variables: impact threshold of a confounding variable

There may be some concern that our results are sensitive to the omission of a confounding control variable. We assess this concern by following Frank (2000) and Larcker and Rusticus (2010) and calculate the impact threshold of a confounding variable (ITCV). The ITCV indicates how correlated an omitted variable must be with *SPREAD* and the various life cycle measures in order to overturn our results. We evaluate these thresholds relative to the partial impact of our control variables.

We evaluate the ITCV for *RE/TA* and *RE/TE* using columns (1) and (4) of Table 4, respectively. For the Dickinson (2011) life cycle phases, we use the specification provided in columns (7) to (10) of Table 4. The ITCV is −0.045 and −0.027 for *RE/TA* and *RE/TE*, implying that the minimum correlation between *RE/TA* and the unobserved confounding variable and between *SPREAD* and the confounding variable must be more than −0.21 and −0.16. The ITCV are −0.013 for the INTRO stage, −0.004 for the GROWTH stage, −0.016 for the MATURE stage, and 0.002 for the DECLINE stage. To put this in perspective, these ITCVs are greater in magnitude than the ITCV indices (partial impacts after the inclusion of all control variables) of our sixteen control variables with a few exceptions. For both *RE/TA* and *RE/TE*, the partial impact of *Z-SCORE* exceeds the ITCV. For *GROWTH* (*DECLINE*) the partial impact of *Z-SCORE* and SEC*URE* (*CFO, LOAN SIZE*, and SEC*URE*) are on par with the ITCV. It is perhaps not surprising that such measures of bankruptcy risk and loan characteristics vary with both firm life cycle and lending spreads. Given these findings, one might argue that a variable with a similar impact as bankruptcy risk and loan characteristics exists and could overturn our results. However, we emphasize that it is unlikely that such a variable exists because our regression model includes controls such as bankruptcy risk and loan characteristics in addition to the fixed effects for credit ratings and loan type. Although the inclusion of these controls reduces the magnitude of the coefficients on our variables of interest, we still find that corporate life cycle stage explains lending spreads in an economically and statistically significant way. We argue

Table 5
Firm Life Cycle and Loan Spread: Instrumental Variables Model.

	Dependent Variables			
	First-stage	Second-stage	First-stage	Second-stage
	RE/TA	*SPREAD*	*RE/TE*	*SPREAD*
Variables	(1)	(2)	(3)	(4)
IND-GRW-SHOCK_Res	−0.354***		−0.973**	
	(−3.12)		(−2.24)	
RE/TA (IV)		−1.653***		
		(−2.85)		
RE/TE (IV)				−0.602**
				(−2.15)
FIRM SIZE	0.074***	0.0890**	0.097***	0.0256
	(11.29)	(1.99)	(3.79)	(0.84)
MTB	−0.005***	−0.0078**	−0.142***	−0.0846**
	(−4.28)	(−2.15)	(−9.70)	(−2.11)
LEV	−0.290***	−0.2492	1.236***	0.9748***
	(−7.07)	(−1.34)	(6.73)	(2.73)
TANGIBILITY	0.058*	−0.0239	0.108	−0.0541
	(1.76)	(−0.35)	(0.92)	(−0.66)
CFO	0.754***	0.8536*	2.006***	0.8156
	(6.53)	(1.74)	(4.87)	(1.35)
STD CF	−0.867***	−0.8436	2.800***	2.2756***
	(−4.18)	(−1.27)	(3.33)	(2.71)
Z-SCORE	0.072***	0.0858**	0.202***	0.0881
	(20.44)	(2.04)	(16.24)	(1.57)
PROFITABILITY	0.395***	0.6273***	0.467***	0.2563*
	(12.96)	(2.65)	(4.15)	(1.79)
ANALYST	−0.009***	−0.0216***	−0.009**	−0.0115***
	(−8.68)	(−3.76)	(−2.16)	(−3.21)
SALES GROWTH	−0.048***	−0.0124	−0.065	0.0270
	(−3.18)	(−0.31)	(−1.23)	(0.72)
C4-INDEX	0.041	0.0674	0.044	0.0251
	(1.14)	(0.90)	(0.29)	(0.25)
AGE	0.057***	0.0658*	0.188***	0.0845
	(10.17)	(1.87)	(8.28)	(1.54)
CUST CONCN	−0.019	−0.0105	−0.043	−0.0056
	(−1.27)	(−0.37)	(−0.74)	(−0.14)
BETA	−0.068***	−0.0900**	−0.121***	−0.0501
	(−10.98)	(−2.16)	(−5.38)	(−1.38)
LOAN TERM	0.047***	0.0134	0.049	−0.0356
	(5.35)	(0.40)	(1.53)	(−1.34)
LOAN SIZE	0.031***	−0.0697***	0.089***	−0.0667**
	(7.19)	(−3.48)	(5.34)	(−2.35)
SECURE	−0.071***	0.2139***	−0.216***	0.2008***
	(−9.02)	(4.82)	(−7.48)	(3.18)
Credit Rating FE	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes
Observations	20,307	20,307	19,342	19,342
Kleibergen-Paap rk LM statistic	9.77		5.09	
Kleibergen-Paap (p-value)	0.00		0.02	
Kleibergen-Paap Wald F statistic	23.98		11.04	

Notes: This table presents results from estimating model (1) after instrumenting *RE/TA* and *RE/TE*. We use a 2SLS estimation for our IV approach. Columns (1) and (3) provide the first stage estimations of *RE/TA* and *RE/TE*, respectively. Columns (2) and (4) use the instrumented variables from the first stage estimations (*RE/TA (IV)* and *RE/TE (IV)*, respectively) and otherwise follow the specification provided in columns (1) and (3) of Table 3 Panel B, respectively. Our instrumental variable, *IND-GROW-SHOCK_Res*, is the residuals derived from estimating model (2). See the Appendix to the paper for detailed variable definitions. Standard errors are clustered by firm. t-statistics are reported in parentheses. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

that after considering our set of controls, it is unlikely that our findings are sensitive to the omission of a confounding variable.[15]

5.1.2. Two-stage least squares instrumental variable

In this section, we employ a two-stage least squares (2SLS) instrumental variable (IV) approach to mitigate endogeneity concerns. Prior studies emphasize that the growth and riskiness within an industry can have a profound effect on the transition of corporate life cycle stages. Maksimovic and Phillips (2008) suggest that firms' investment and organizational form should be sensitive to industry conditions. Lumpkin and Dess (2001) argue that the environment within an industry affects firms' entrepreneurial orientation with respect to proactiveness and competitive aggressiveness.

We consider the volatility of sales growth within an industry as our IV. Firms naturally reduce capital investments in uncertain environments (Gulen and Ion 2016). In addition, firms' payout policies are also a function of the uncertainty they face. Easing simultaneity concerns, Chay and Suh (2009) show that uncertainty is a determinant of dividends that is distinct from firms' life cycle. Arguably, the effect industry uncertainty has on lending spreads is limited by its implications for each individual firm. As an example, Gaspar and Massa (2006) show that the relation between marketplace competitiveness and idiosyncratic volatility is dependent upon how marketplace competitiveness affects individual firms. We argue that uncertainty in industry sales growth should only affect an individual firm's lending spreads to the extent such uncertainty affects the individual firm's environment. We construct our measure of industry growth uncertainty (*IND_GRW_SHOCK*) by first calculating the standard deviation of quarterly sales growth over the last eight quarters at the individual firm level. We then calculate the value of *IND_GRW_SHOCK* for firm *i* as the industry-mean of the standard deviations, calculated after excluding firm *i*'s standard deviation. Because the maturity of a firm is interlocked with its relative stability, we expect *IND_GRW_SHOCK* to be negatively related to maturity.[16]

Although *IND_GRW_SHOCK* meets the relevance condition, the exclusion restriction is a natural limitation of any IV design. Specifically, one may contend that *IND_GRW_SHOCK* is directly correlated with loan spreads (Amiram et al., 2017). To alleviate this potential concern, following prior studies (e.g., Francis et al., 2021; Hasan and Uddin 2022), we remove the industry loan spreads component from *IND_GRW_SHOCK*. In particular, we compute the industry (two-digit SIC)-year level loan spreads and then estimate the following time-series regression for each industry:

$$IND\_GRW\_SHOCK_{kt} = \alpha + SPREAD_{kt} + \varepsilon_{kt} \quad (2)$$

where, k represents industry and t represents time. The residuals resulting from the above regression (i.e., *IND_GRW_SHOCK_Res*) represent industry-level growth uncertainty unrelated to loan spreads. We use this variable as our instrument in the 2SLS regression.

Columns (1) and (3) of Table 5 present the first-stage regressions for *RE/TA* and *RE/TE*, respectively. As predicted, we find a negative and significant coefficient for our instrumental variable in both first-stage regressions. Columns (2) and (4) report the second-stage regression results for the relation between our instrumented measures of firm life cycle (*RE/TA (IV)* and *RE/TE (IV)*, respectively) and lending spreads. The Kleibergen-Paap rk LM and Kleibergen-Paap Wald F statistics support our identification and instrument selection for the *RE/TA* and *RE/TE*. Consistent with our main results, we find that the relation between our instrumented life cycle variables and lending spreads remains

[15] In the subsection, "Additional Control Variables," we include three additional controls that capture lending terms and risk: the probability of covenant violation (*PVIOL*), loss given default (*LGD*), and the beta of debt (*DEBT BETA*).

[16] Because the Owen and Yawson (2010) and Dickinson(2011) life cycle measures are discrete, they are not adequate for capturing the incremental effect of our instrumental variable.

Table 6
Alternative Regression Specifications: Firm and High Dimensional Fixed Effects.

Panel A: Full Model with Industry-Period Fixed Effects

	Dependent Variable= *SPREAD*				
Variable	(1)	(2)	(3)	(4)	(5)
RE/TA	−0.101***				
	(−8.45)				
YOUNG (RE/TA)		0.228***			
		(15.89)			
MATURE (RE/TA)		0.122***			
		(9.61)			
RE/TE			−0.014***		
			(−5.90)		
YOUNG (RE/TE)				0.185***	
				(12.69)	
MATURE (RE/TE)				0.084***	
				(6.40)	
INTRO					−0.005
					(−0.27)
GROWTH					−0.047***
					(−3.08)
MATURE					−0.069***
					(−4.80)
DECLINE					0.049*
					(1.93)
Controls	Yes	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes
Industry × Period FE	Yes	Yes	Yes	Yes	Yes
Observations	20,307	20,307	19,342	19,342	20,307
Adj. R-squared	0.67	0.68	0.67	0.68	0.67
Test of Coefficients (F-Statistic)					
YOUNG=MATURE		88.05***		73.30***	
INTRO = GROWTH					7.01***
GROWTH = MATURE					4.05**

Panel B: Full Model with Firm Fixed Effects

	Dependent Variable= *SPREAD*				
Variable	(1)	(2)	(3)	(4)	(5)
RE/TA	−0.044**				
	(−2.03)				
YOUNG (RE/TA)		0.149***			
		(7.39)			
MATURE (RE/TA)		0.061***			
		(4.06)			
RE/TE			−0.005		
			(−1.44)		
YOUNG (RE/TE)				0.118***	
				(5.84)	
MATURE (RE/TE)				0.037**	
				(2.40)	
INTRO					−0.024
					(−1.46)
GROWTH					−0.041***
					(−2.96)
MATURE					−0.036***
					(−2.78)
DECLINE					0.050**
					(1.97)
Controls	Yes	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Period FE	Yes	Yes	Yes	Yes	Yes
Observations	20,307	20,307	19,342	19,342	20,307
Adj. R-squared	0.73	0.73	0.73	0.73	0.73
Test of Coefficients (F-Statistic)					
YOUNG=MATURE		34.90***		30.03***	
INTRO = GROWTH					1.27
GROWTH = MATURE					0.26

Notes: This table presents the results of regressing loan spreads on life cycle measures and control variables. In Panel A we control for industry-period fixed effects. In Panel B we use firm fixed effects. The coefficients on the control variables are provided in the Online Appendix Table OA5. See the Appendix to the paper for detailed variable definitions. We cluster standard errors at the firm level. t-statistics are reported in parentheses. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

Table 7
Additional Control Variables.

Panel A: Full Model with Controls for Missing Variables

	Dependent Variable= *SPREAD*				
Variable	(1)	(2)	(3)	(4)	(5)
RE/TA	−0.091***				
	(−7.13)				
YOUNG (RE/TA)		0.248***			
		(16.63)			
MATURE (RE/TA)		0.167***			
		(13.18)			
RE/TE			−0.015***		
			(−5.78)		
YOUNG (RE/TE)				0.202***	
				(13.70)	
MATURE (RE/TE)				0.127***	
				(9.99)	
INTRO					0.001
					(0.06)
GROWTH					−0.034**
					(−2.43)
MATURE					−0.073***
					(−5.34)
DECLINE					0.054**
					(2.28)
DEBT BETA	0.963***	0.859***	1.020***	0.963***	0.952***
	(9.50)	(8.78)	(9.42)	(9.09)	(9.42)
MISSING DEBT BETA	0.065***	0.063***	0.059***	0.062***	0.060***
	(3.89)	(3.81)	(3.41)	(3.64)	(3.58)
PVIOL	0.175***	0.155***	0.172***	0.156***	0.175***
	(11.70)	(10.38)	(11.35)	(10.29)	(11.73)
MISSING PVIOL	0.061***	0.052***	0.060***	0.052***	0.063***
	(4.60)	(3.95)	(4.51)	(3.92)	(4.80)
LGD	0.102***	0.071***	0.135***	0.105***	0.123***
	(3.68)	(2.95)	(4.06)	(3.59)	(4.10)
MISSING LGD	0.177***	0.156***	0.228***	0.191***	0.225***
	(4.27)	(3.95)	(5.14)	(4.51)	(5.35)
Baseline Controls	Yes	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes
Industry FE (FFI48)	Yes	Yes	Yes	Yes	Yes
Period FE (calendar quarter)	Yes	Yes	Yes	Yes	Yes
Observations	20,307	20,307	19,342	19,342	20,307
Adj. R-squared	0.63	0.64	0.63	0.64	0.63
Test of Coefficients (F-Statistic)					
YOUNG=MATURE		47.59***		42.71***	
INTRO = GROWTH					5.82**
GROWTH = MATURE					16.09***

Panel B: Full Model without Controls for Missing Variables

	Dependent Variable= *SPREAD*				
Variable	(1)	(2)	(3)	(4)	(5)
RE/TA	−0.035				
	(−0.78)				
YOUNG (RE/TA)		0.163***			
		(4.51)			
MATURE (RE/TA)		0.099***			
		(3.78)			
RE/TE			−0.014***		
			(−2.84)		
YOUNG (RE/TE)				0.155***	
				(4.94)	
MATURE (RE/TE)				0.113***	
				(4.50)	
INTRO					−0.002
					(−0.05)
GROWTH					−0.085***
					(−3.11)
MATURE					−0.123***
					(−4.78)
DECLINE					0.067
					(1.21)
DEBT BETA	1.009***	0.900***	1.024***	0.994***	1.057***
	(4.55)	(4.08)	(4.52)	(4.40)	(4.85)
PVIOL	0.161***	0.151***	0.158***	0.151***	0.157***

(*continued on next page*)

Table 7 (*continued*)

Panel B: Full Model without Controls for Missing Variables

Variable	Dependent Variable= *SPREAD* (1)	(2)	(3)	(4)	(5)
	(6.63)	(6.26)	(6.31)	(6.08)	(6.51)
LGD	−0.020	−0.086	0.062	0.003	−0.020
	(−0.11)	(−0.46)	(0.35)	(0.02)	(−0.11)
Baseline Controls	Yes	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes
Industry FE (FFI48)	Yes	Yes	Yes	Yes	Yes
Period FE (calendar quarter)	Yes	Yes	Yes	Yes	Yes
Observations	3798	3798	3601	3601	3798
Adj. R-squared	0.71	0.72	0.72	0.72	0.72
Test of Coefficients (F-Statistic)					
YOUNG=MATURE	6.74***		2.88*		
INTRO = GROWTH			6.92***		
GROWTH = MATURE			3.69*		

Notes: This table presents the results of regressing loan spreads on life cycle measures and additional control variables. These are *DEBT BETA, PVIOL*, and *LGD*. In Panel A we replace undefined values of *DEBT BETA, PVIOL*, and *LGD* with zero and include indicator variables to account for such change (*MISSING DEBT BETA, MISSING PVIOL*, and *MISSING LGD*, respectively). In Panel B we exclude missing observations for these three variables. e cluster standard errors at the firm level. t-statistics are reported in parentheses. The coefficients on the control variables are provided in the Online Appendix Table OA6. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

negative and significant (p <0.01 for *RE/TA (IV)* and $p < 0.05$ for *RE/TE (IV)*).

The coefficients for our instrumented variables in Table 5 are greater in magnitude than those of the OLS coefficients reported in Table 3. One explanation is that the 2SLS regression identifies a local average treatment effect rather than the population effect. This may be due to the endogenous nature of our dependent variable. Because we only observe lending spreads when firms voluntarily take out loans, our sample is censored. This is a natural limitation of empirical work regarding lending spreads, as firms may postpone financing or find an alternative source of funds if they do not find lending spreads to be satisfactory. This limits variation in our dependent variable. As firms respond to uncertainty within their industry, their need for capital may become more urgent and our sample may become less censored.[17] The coefficients in Table 5 suggest that the importance of firm life cycle with respect to lending spreads may be even greater than that indicated by our primary OLS specification, but they are subject to criticism as in Jiang (2017).

5.1.3. *Two-stage least squares heteroskedasticity-based instruments*

To further alleviate endogeneity concerns, we employ the 2SLS regression estimation method developed by Lewbel (2012). This novel identification technique avoids reliance on external instruments by constructing a set of instruments based on the heterogeneity in the error term of the first-stage regression model.[18] This method is particularly useful when external instruments are weak or unavailable. Recent corporate finance studies use this technique to address endogeneity concerns (e.g., Hasan et al., 2022).

Columns (1) and (2) of Online Appendix Table OA5 present the 2SLS regression results using heteroskedasticity-based instruments. The relationship between our instrumented life cycle variables and lending spreads remains negative and significant (*RE/TA* = –0.064; $p < 0.01$ and *RE/TE* = –0.018; $p < 0.05$). Our analysis is also not prone to under-identification and over-identification concerns. Further, the two-step identification-robust confidence sets proposed by Andrews (2018) do not contain zeros, suggesting that our estimation is not subject to a weak-instrument problem.[19] Overall, the findings from this analysis suggest that our main results are robust and unlikely to be due to endogeneity problems.

5.2. *Fixed effects*

In our main analysis, our model controls for, among other things, industry, and period fixed effects. Although this is conventional practice in the literature (e.g., Valta 2012), there may be concern that our results are driven by time-variant industry effects or time-invariant cross-sectional differences between firms. In this section, we re-estimate our primary specification with industry-period fixed effects and, separately, with firm and period fixed effects.

Our abbreviated results are reported in Table 6.[20] In Panel A we estimate the model with industry-period fixed effects. Qualitatively, both the coefficients and the adjusted R-squared terms look very similar to those presented in Panel B of Table 3. These results show that the spreads decline as firms mature using the *RE/TA* and *RE/TE* continuous measures and their categorical classifications. They also show that the U-shape trend in lending spreads that we identify across firm life cycles using the Dickinson (2011) classification is not the consequence of variation in industry conditions over time. In addition, a comparison of adjusted R-squared terms suggests that time-variant industry conditions do not add significantly to explaining the variation in lending spreads beyond our existing suite of controls. This is consistent with our assumptions regarding the exclusion restriction in our IV analysis.

In Panel B of Table 6, we present results when substituting firm fixed effects for industry fixed effects in model (1). Such a fixed-effect structure is dependent upon *within firm* variation in firm life cycle. The magnitude and the significance of our results decline moderately for the *RE/TA* measure of firm life cycle, but significance remains at the 5 percent level (column 1). The negative coefficient for the *RE/TE* measure in column (3), however, lacks statistical significance.

The *YOUNG* and *MATURE* categories in columns (2) and (3) remain statistically significant at the 1 percent level. The results when using

[17] Supporting this notion, Table OA1 Panel C in the Online Appendix shows the standard deviation of lending spreads to be greatest for firms in the introduction and decline phases and lowest for firms in the growth and mature phases.

[18] This technique uses higher-order moments of the instrumental variables to construct a set of moment conditions that can be used to identify the causal effect of the endogenous variable on the outcome variable.

[19] Following Hasan et al. (2022) we use the weak instrument test of Andrews (2018). Notably, Andrews' (2018) method does not rely on the homoscedastic assumption and can effectively handle coverage distortion.

[20] Online Appendix Table OA6 shows the entire Table with coefficients of the control variables.

Table 8
Firm Life Cycle and Other Lending Terms.

Panel A: Firm Life Cycle and Securitization

	Dependent Variable= *SECURE*				
Variable	(1)	(2)	(3)	(4)	(5)
RE/TA	−0.077***				
	(−8.78)				
YOUNG (RE/TA)		0.175***			
		(14.50)			
MATURE (RE/TA)		0.109***			
		(10.73)			
RE/TE			−0.010***		
			(−5.92)		
YOUNG (RE/TE)				0.150***	
				(12.33)	
MATURE (RE/TE)				0.079***	
				(7.65)	
INTRO					0.002
					(0.14)
GROWTH					−0.033***
					(−3.00)
MATURE					−0.050***
					(−4.87)
DECLINE					0.029
					(1.61)
Controls	Yes	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes
Industry FE (FFI48)	Yes	Yes	Yes	Yes	Yes
Period FE (calendar quarter)	Yes	Yes	Yes	Yes	Yes
Observations	20,307	20,307	19,342	19,342	20,307
Adj. R-squared	0.37	0.37	0.36	0.37	0.36
Test of Coefficients (F-Statistic)					
YOUNG=MATURE		50.82***		56.68***	
INTRO = GROWTH					8.40***
GROWTH = MATURE					4.90**

Panel B: Firm Life Cycle and Loan Term

	Dependent Variable= *LOAN TERM*				
Variable	(1)	(2)	(3)	(4)	(5)
RE/TA	0.050***				
	(5.58)				
YOUNG (RE/TA)		−0.045***			
		(−4.40)			
MATURE (RE/TA)		−0.041***			
		(−4.86)			
RE/TE			0.004***		
			(2.64)		
YOUNG (RE/TE)				−0.031***	
				(−2.99)	
MATURE (RE/TE)				−0.024***	
				(−2.79)	
INTRO					−0.002
					(−0.15)
GROWTH					0.024**
					(2.18)
MATURE					0.036***
					(3.52)
DECLINE					−0.016
					(−0.81)
Controls	Yes	Yes	Yes	Yes	Yes
Credit Rating FE	Yes	Yes	Yes	Yes	Yes
Loan Type FE	Yes	Yes	Yes	Yes	Yes
Industry FE (FFI48)	Yes	Yes	Yes	Yes	Yes
Period FE (calendar quarter)	Yes	Yes	Yes	Yes	Yes
Observations	20,307	20,307	19,342	19,342	20,307
Adj. R-squared	0.64	0.64	0.64	0.64	0.64
Test of Coefficients (F-Statistic)					
YOUNG=MATURE	0.21		0.61		
INTRO = GROWTH			4.86**		
GROWTH = MATURE			2.40		

Notes: Panel A of this table shows the relationship between firm life cycle and securitization (*SECURITY*). Panel B shows the relationship between firm life cycle and loan term (*LOAN TERM*). The sample population includes 20,307 loans from fiscal years 1988 through 2018 that were made to 5076 distinct publicly traded U.S. firms. Financial (SIC 6000 – 6999) and utility (SIC 4900–4949) firms are excluded from the sample. Fixed effects for firm credit rating, loan type, industry (FFI48) and period are included as indicated. See the Appendix to the paper for detailed variable definitions. We cluster standard errors at the firm level. t-statistics are reported in parentheses. The coefficients on the control variables are provided in the Online Appendix Table OA7. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

Dickinson's life cycle measures remain qualitatively unchanged. In contrast to industry-period fixed effects, we do observe an increase in the adjusted R-squared values. This suggests that there is some heterogeneity amongst firms that explains the variation in lending spreads not captured by our primary specification.

5.3. Additional control variables

Next, we consider three additional control variables that further account for expected losses and the systematic risk associated with a firm's debt: the systematic risk of debt (*DEBT BETA*), the probability of loss given default (*LGD*), and the probability of covenant violation (*PVIOL*). We follow Amiram et al. (2017) in calculating *LGD*. If lenders find it more difficult to mitigate their losses when firms are in the introduction or decline phases, then such a measure could explain our findings. We measure *PVIOL* in accordance with Demerjian and Owens (2016).[21] In addition to credit risk, lending spreads compensate lenders for systematic risks. Arguably, the systematic risk of a firm's debt may also correlate with its life cycle. We calculate debt beta (*DEBT BETA*) following Schaefer and Strebulaev (2008) and Merton (1974). Detailed variable definitions are included in the Appendix.

We present the abbreviated results in Table 7.[22] In Panel A, we introduce three additional indicator variables to control for instances where *LGD, PVIOL*, or *DEBT BETA* are undefined (*MISSING LGD, MISSING PVIOL*, and *MISSING DEBT BETA*, respectively). Qualitatively, our results remain unchanged. In Panel B, we require all three new variables to be defined. Despite an over 80 percent drop in observations, we still observe a negative coefficient for *RE/TE* in column (3) and a declining effect as firms mature using the categorical *RE/TA* and *RE/TE* variables in columns (2) and (4), and all the coefficients are significant at the one percent level. The coefficient for *RE/TA* in column (1), however, loses statistical significance. Column (5) indicates that the U-shape trend in lending spreads across the Dickinson (2011) life cycle phases remains significant as well. Viewing the evidence collectively, Table 7 supports the notion that our primary findings are not an artifact of omitted variable bias.

5.4. Additional analysis: firm life cycle and non-pricing lending terms

Next, we consider the effects of firms' life cycle stage on other contractual lending terms. While lenders often manage their risk through loan pricing (i.e., spreads), they may also manage their risks through other non-price terms. We consider the use of collateral (*SECURITY*) and lending duration (*LOAN TERM*) as two measures of non-pricing lending terms. Given the high (low) levels of operating and informational riskiness in less mature (more mature) firms, we expect that the use of collateral will be greatest (lowest) when firms have lower (higher) retained earnings ratios (*RE/TA* and *RE/TE; MATURE(RE/TE [TA])* and *OLD(RE/TE[TA])* respectively) and when firms are in the *introduction* and *decline* (*growth* and *mature*) phases. Similarly, we also expect that less mature firms will have shorter loan durations.

We present our abbreviated results in Table 8.[23] In columns (1) and (4) of Panel A, an OLS probability model indicates that the probability of securitization declines as firms become more mature. We again emphasize that this finding is after controlling for financial performance and credit ratings. In column (5) of Panel A, we similarly find that loans to growth and mature firms are the least likely to be collateralized. These findings are unaffected when using a logit specification (untabulated). In Panel B of Table 8, we find that firms with greater retained earnings ratios and firms in the mature and growth phases obtain loans with longer terms. These findings are consistent with our predictions. The coefficients for young and mature are not statistically different from each other.

6. Mechanism

We explore several mechanisms by which life cycle stage may affect lending spreads. Structural changes occur to firms as they transit between life cycle stages, and these changes have broad effects on firms' behavior and risk profiles (Quinn and Cameron 1983; Miller and Friesen 1984). One of the interesting aspects of the corporate life cycle literature is that, although we have several empirical measures that proxy for firms' economic state and various dimensions of their risk, these measures do not adequately capture or model the differences we observe between firms in various life cycle stages (Dickinson 2011). Loan spreads compensate lenders for credit risk, systematic risk, and non-diversifiable idiosyncratic risk (Amiram et al., 2017). In Table 9, we examine how predicted loan loss, systematic risk, and idiosyncratic risk vary with the corporate life cycle.

In Panel A (B), we examine how risk measures vary according to the young and mature categories based on *RE/TA* (*RE/TE*). In columns (1), (2), and (3) of each Panel, we regress default risk (proxied by Altman's Z-score), loss given default (LGD; calculated per Amiram et al., 2017), and systematic risk on the categorical variables *YOUNG* and *MATURE*. Our results show a statistically significant decline in risk as firms go from the young to the old stage, with a statistical significance of at least 0.01. In column (4), we find that cash flow volatility (*STD CF*) is higher for young firms, but we find no evidence of differences between mature and old firms. In column (5), we show that idiosyncratic volatility is the highest for young firms and that it then declines for mature and old firms; the coefficients are statistically different from each other.

In columns (1) and (2) of Panel C, we regress default risk and loss given default on Dickinson's life cycle measures. When examining the Altman's Z-score, we find that firms in the introduction and decline stages have lower scores than firms in the growth and mature stages (column 1). In column 2, we find that the relationship between *LGD* and the life cycle stages follows a U-shaped pattern, where *LGD* is significantly lower for growth and mature firms. In columns (3) and (4), we find that systematic risk (proxied by beta) and cash flow volatility *(STD CF*) follow similar U-shape patterns. These results are consistent with theoretical literature (Agarwal and Gort 2002). Our mechanism analysis thus suggests that risk factors vary greatly across the corporate life cycle, which cause lending spread to vary across life cycle stages.

7. Conclusion

We examine the relation between firm life cycle stage and lending spreads in the private debt market. Univariate statistics indicate that lending spreads are negatively related to measures of maturity (DeAngelo et al., 2006; Owen and Yawson 2010) and follow a U-shape pattern across Dickinson's (2011) life cycle phases. Although traditional controls for financial performance and loan characteristics account for much of the univariate variation, an economically and statistically significant relationship persists. We conduct an ITCV analysis, an IV research approach, and a test for robustness with high-dimensional fixed effects and lesser-used control variables. We continue to find that firm life cycle explains unique variation in lending spreads.

Our findings have a number of implications for both research

[21] We thank the authors for making this measure available on their website: https://sites.google.com/site/edowensphd/research.

[22] Online Appendix Table OA7 shows the entire Table with coefficients of the control variables.

[23] Online Appendix Table OA8 shows the entire Table with coefficients of the control variables.

Table 9
Risk and Life Cycle Measures.

Panel A: Risk Measures and Categorical Life Cycle Stage Variables based on *RE/TA*

	Dependent Variable=				
VARIABLES	Z-SCORE (1)	LGD (2)	BETA (3)	STD CF (4)	IDIOSYNC VOL (5)
YOUNG(RE/TA)	−1.713***	0.103***	0.357***	0.001*	0.009***
	(−27.27)	(15.79)	(14.13)	(1.71)	(22.32)
MATURE(RE/TA)	−1.063***	0.036***	0.148***	0.001	0.003***
	(−21.23)	(7.09)	(7.56)	(0.94)	(9.59)
FIRM SIZE	−0.308***	0.032***	0.016*	−0.005***	−0.005***
	(−17.46)	(12.81)	(1.85)	(−18.06)	(−33.30)
MTB	0.089***	0.001**	−0.001	0.000***	−0.000***
	(13.13)	(2.18)	(−0.40)	(3.99)	(−3.11)
LEV	−4.205***	−0.138***	0.139**	−0.017***	−0.002**
	(−30.27)	(−8.86)	(2.19)	(−10.25)	(−2.48)
TANGIBILITY	−0.831***	−0.068***	0.196***	−0.015***	0.004***
	(−6.85)	(−5.18)	(3.21)	(−9.00)	(4.91)
STD CF	0.016	0.615***	0.942**		0.034***
	(0.02)	(6.08)	(2.45)		(5.01)
Z-SCORE		0.005***	0.025***	0.000	−0.001***
		(2.79)	(5.41)	(0.02)	(−13.45)
PROFITABILITY	1.833***	−0.073***	−0.457***	−0.014***	−0.009***
	(10.48)	(−7.60)	(−7.95)	(−8.62)	(−11.05)
ANALYST	0.076***	0.003***	0.002	0.000***	0.000***
	(14.71)	(4.47)	(1.16)	(2.72)	(6.95)
SALES GROWTH	0.196***	−0.032***	−0.030	0.007***	−0.000
	(2.58)	(−5.23)	(−0.96)	(4.92)	(−0.16)
C4-INDEX	0.023	−0.039*	−0.158*	0.003	0.001
	(0.15)	(−1.93)	(−1.80)	(0.91)	(0.57)
AGE	−0.325***	−0.007***	−0.056***	−0.000	−0.001***
	(−12.84)	(−3.08)	(−4.31)	(−1.15)	(−3.66)
CUST CONCN	0.052	0.004	−0.015	0.001	0.000
	(0.84)	(0.68)	(−0.51)	(1.10)	(0.76)
Constant	6.350***	0.500***	1.016***	0.071***	0.057***
	(38.11)	(24.23)	(12.41)	(28.89)	(49.39)
Industry FE (FFI48)	Yes	Yes	Yes	Yes	Yes
Period FE (cal quarter)	Yes	Yes	Yes	Yes	Yes
Observations	20,307	20,090	20,307	20,307	20,158
Adjusted R-squared	0.41	0.17	0.12	0.33	0.49
Test of Coefficients (F-Statistic)					
YOUNG=MATURE	192.17***	224.13***	79.48***	1.39	351.38***

Panel B: Risk Measures and Categorical Life Cycle Stage Variables based on *RE/TE*

	Dependent Variable=				
VARIABLES	Z-SCORE (1)	LGD (2)	BETA (3)	STD CF (4)	IDIOSYNC VOL (5)
YOUNG(RE/TE)	−1.283***	0.080***	0.347***	−0.001*	0.008***
	(−21.87)	(13.34)	(13.74)	(−1.74)	(19.88)
MATURE(RE/TE)	−0.446***	0.027***	0.153***	−0.001	0.002***
	(−9.28)	(5.87)	(7.82)	(−0.88)	(8.47)
FIRM SIZE	−0.311***	0.033***	0.019**	−0.004***	−0.005***
	(−16.88)	(12.63)	(2.17)	(−16.60)	(−33.99)
MTB	0.147***	0.005***	0.002	0.001***	−0.000**
	(16.12)	(10.47)	(0.76)	(11.06)	(−2.53)
LEV	−6.311***	−0.227***	0.120*	−0.028***	−0.001
	(−38.93)	(−12.70)	(1.70)	(−15.13)	(−0.87)
TANGIBILITY	−0.615***	−0.068***	0.194***	−0.014***	0.004***
	(−4.85)	(−4.88)	(3.22)	(−8.44)	(4.44)
STD CF	−2.938***	0.508***	1.058***		0.037***
	(−2.76)	(4.81)	(2.76)		(5.41)
Z-SCORE		0.000	0.022***	−0.000***	−0.001***
		(0.25)	(4.75)	(−2.80)	(−13.61)
PROFITABILITY	2.024***	−0.069***	−0.498***	−0.012***	−0.009***
	(11.16)	(−6.81)	(−8.14)	(−7.97)	(−11.21)
ANALYST	0.071***	0.003***	0.002	0.000	0.000***
	(13.65)	(3.76)	(1.21)	(0.63)	(8.33)
SALES GROWTH	0.210***	−0.028***	−0.027	0.008***	0.000
	(2.68)	(−4.60)	(−0.86)	(5.06)	(0.08)
C4-INDEX	0.041	−0.034	−0.153*	0.002	0.001
	(0.25)	(−1.64)	(−1.76)	(0.67)	(0.80)
AGE	−0.298***	−0.009***	−0.048***	−0.001***	−0.001***
	(−11.45)	(−4.16)	(−3.66)	(−2.69)	(−3.76)
CUST CONCN	0.054	0.006	−0.008	0.001	0.000
	(0.88)	(0.99)	(−0.29)	(1.33)	(0.70)

(*continued on next page*)

Table 9 (*continued*)

Panel B: Risk Measures and Categorical Life Cycle Stage Variables based on *RE/TE*

VARIABLES	Dependent Variable= Z-SCORE (1)	LGD (2)	BETA (3)	STD CF (4)	IDIOSYNC VOL (5)
Constant	6.306***	0.528***	0.964***	0.073***	0.057***
	(35.58)	(24.46)	(11.19)	(28.72)	(48.69)
Industry FE (FFI48)	Yes	Yes	Yes	Yes	Yes
Period FE (cal quarter)	Yes	Yes	Yes	Yes	Yes
Observations	19,342	19,130	19,342	19,342	19,342
Adjusted R-squared	0.40	0.17	0.12	0.34	0.50
Test of Coefficients (F-Statistic)					
YOUNG=MATURE	291***	126.79***	69.61***	1.71	292.32***

Panel C: Risk Measures and Categorical Life Cycle Stage Variables based on Cash Flow Information

VARIABLES	Dependent Variable= Z-SCORE (1)	LGD (2)	BETA (3)	STD CF (4)	IDIOSYNC VOL (5)
INTRO	−0.214***	−0.001	0.032	0.006***	0.000
	(−3.16)	(−0.22)	(1.12)	(5.96)	(0.37)
GROWTH	0.345***	−0.009*	−0.044*	−0.005***	−0.002***
	(5.61)	(−1.86)	(−1.73)	(−6.18)	(−5.33)
MATURE	0.115**	−0.020***	−0.140***	−0.003***	−0.003***
	(2.14)	(−3.96)	(−5.84)	(−4.87)	(−7.34)
DECLINE	−0.352***	0.018	0.126***	0.002	0.003***
	(−2.91)	(1.62)	(2.73)	(1.48)	(4.20)
FIRM SIZE	−0.294***	0.029***	0.007	−0.004***	−0.005***
	(−15.40)	(11.23)	(0.82)	(−17.52)	(−34.50)
MTB	0.090***	0.001***	0.001	0.000***	−0.000*
	(12.81)	(3.18)	(0.25)	(3.95)	(−1.81)
LEV	−5.335***	−0.095***	0.284***	−0.016***	0.002
	(−37.91)	(−5.80)	(4.43)	(−10.07)	(1.61)
TANGIBILITY	−0.753***	−0.078***	0.167***	−0.013***	0.004***
	(−5.64)	(−5.65)	(2.74)	(−8.31)	(4.11)
STD CF	0.500	0.606***	0.756*		0.030***
	(0.45)	(5.84)	(1.93)		(4.14)
Z-SCORE		−0.000	0.010**	0.000	−0.001***
		(−0.09)	(2.13)	(0.45)	(−17.42)
PROFITABILITY	2.085***	−0.085***	−0.457***	−0.011***	−0.009***
	(11.22)	(−8.62)	(−7.87)	(−6.76)	(−11.26)
ANALYST	0.086***	0.003***	0.002	0.000***	0.000***
	(15.92)	(4.27)	(0.93)	(2.77)	(6.36)
SALES GROWTH	0.102	−0.028***	−0.026	0.007***	0.000
	(1.28)	(−4.50)	(−0.82)	(4.74)	(0.37)
C4-INDEX	0.077	−0.042**	−0.161*	0.003	0.000
	(0.46)	(−2.03)	(−1.82)	(1.01)	(0.32)
AGE	−0.120***	−0.018***	−0.093***	−0.000	−0.002***
	(−4.69)	(−7.28)	(−7.42)	(−1.54)	(−9.49)
CUST CONCN	0.033	0.005	−0.011	0.001	0.000
	(0.51)	(0.83)	(−0.37)	(1.17)	(0.97)
Constant	4.857***	0.611***	1.412***	0.071***	0.068***
	(27.65)	(27.17)	(17.91)	(31.96)	(57.09)
Industry FE (FFI48)	Yes	Yes	Yes	Yes	Yes
Period FE (cal quarter)	Yes	Yes	Yes	Yes	Yes
Observations	20,307	20,090	20,307	20,307	20,158
Adjusted R-squared	0.36	0.14	0.11	0.34	0.47
Test of Coefficients (F-Statistic)					
INTRO = GROWTH	90.40***	1.76	8.88***	144.06***	21.34***
GROWTH = MATURE	31.81***	8.49***	37.64***	8.30***	8.10***

Notes: This table shows the results for the mechanism analysis. Panel A(B) shows the relationship between risk proxies and categorical life cycle stage variables based on *RE/TA(RE/TE)*. Panel C shows the relationship between risk proxies and categorical life cycle stage variables as defined by Dickinson (2011). The sample population includes 20,307 loans from fiscal years 1988 through 2018 that were made to 5076 distinct publicly traded U.S. firms. Financial (SIC 6000 – 6999) and utility (SIC 4900–4949) firms are excluded from the sample. See the Appendix to the paper for detailed variable definitions. We cluster standard errors at the firm level. t-statistics are reported in parentheses. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively (two-tailed).

regarding firm life cycle and research regarding lending spreads. Theory suggests that less mature firms carry greater systematic risk and non-diversifiable risk that typical controls are unable to capture. Our findings are consistent with these predictions. Researchers often look to lending spreads in an effort to understand how certain characteristics affect risk. Our results may also be interpreted with respect to the findings of Faff et al. (2016); the risk premiums that we observe being priced into lending spreads may explain reductions in the use of debt – particularly for firms in the shake-out and decline stages. Our mechanism analysis shows that credit risk, systematic risk, and idiosyncratic risk follow the corporate life cycle patterns in accordance with loan spreads, suggesting that banks charge premiums to compensate for risk.

Given the ubiquitous implications firm life cycle has on corporate structure, we expect many of these characteristics to also vary according to firms' life cycle. Researchers studying the relation between these other characteristics and lending spreads would be well served by controlling for firms' life cycle. Given the parsimonious nature of firm life cycle measures, such controls are widely implementable across a variety of research settings.

Although an advantage of studying the private debt market is that it allows for a more heterogeneous sample (Francis et al., 2017), a limitation of our study is that we do not consider the firm's choice of debt markets. Our study therefore presents results conditional on firms obtaining a loan. Denis and Mihov (2003) find that firms with medium credit quality usually borrow from banks while firms with high credit tend to utilize public debt markets. We leave it to future research to consider the impact of life cycle stages on the choice of debt markets.

Data availability

The authors do not have permission to share data.

Acknowledgements

We thank the Editor, an anonymous associate editor, and an anonymous reviewer for their valuable comments and suggestions on the earlier draft of this paper. We also thank Philip Brown, Demian Berchtold, Robert Durand, Adrian Cheung, Jan Hanousek, Tatyana Sokolyk, Anastasiya Shamshur, Ozde Oztekin, Raunaq Pangaliya, Felix Chan, Zhuoli Axelton and the workshop participants at University of Western Australia, Central Michigan University, Texas A&M International University, Curtin University, and participants of the 2018 New Zealand Finance Meeting and the 2021 Hawaii Accounting Research Conference for helpful comments and suggestions. The research is supported by GAČR grant No. 19–20771S. The usual disclaimer applies.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jbankfin.2023.106971.

Appendix

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Variables	Definition and Measurement
Life cycle variables of interest	
RE/TA	Retained earnings (REQ) divided by total assets (ATQ).
RE/TE	Retained earnings (REQ) divided by total equity (CEQQ).
YOUNG (RE/TA)	Indicator variable equal to 1 if the respective variable RE/TA is in the lower tercile.
MATURE (RE/TA)	Indicator variable equal to 1 if the respective variable RE/TA is in the middle tercile.
OLD (RE/TA)	Indicator variable equal to 1 if the respective variable RE/TA is in the upper tercile.
YOUNG (RE/TE)	Indicator variable equal to 1 if the respective variable RE/TE is in the lower tercile.
MATURE (RE/TE)	Indicator variable equal to 1 if the respective variable RE/TE is in the middle tercile.
OLD (RE/TE)	Indicator variable equal to 1 if the respective variable RE/TE is in the upper tercile.
INTRO	Indicator variable equal to one if 1) quarterly cash flows from operations (CFO) is less than or equal to zero; 2) quarterly cash flows from investing (CFI) is less than or equal to zero; and 3) quarterly cash flows from financing (CFF) is greater than zero, and zero otherwise. For observations where FQTR equals 1, we use the year-to-date (YTD) measures OANCFY, IVNCFY, and FINCFY to identify CFO, CFI, and CFF, respectively. When FQTR is greater than one, we identify quarterly cash flows by taking the YTD measure and subtracting the corresponding YTD measure from the prior quarter.
GROWTH	Indicator variable equal to one if 1) CFO is greater than zero; 2) CFI is less than or equal to zero; and 3) CFF is greater than zero, and zero otherwise.
MATURE	Indicator variable equal to one if 1) CFO is greater than zero; 2) CFI is less than or equal to zero; and 3) CFF is less than or equal to zero, and zero otherwise.
SHAKEOUT	Indicator variable equal to one if *INTRO, GROWTH, MATURE*, and *DECLINE* all equal zero, and zero otherwise.
DECLINE	Indicator variable equal to one if 1) CFO is less than or equal to zero; and 2) CFI is greater than zero, and zero otherwise.
Loan characteristics	
SPREAD	The natural logarithm of the "all-in-drawn" lending spread (bps) as reported in the DealScan database. Where specifically noted, we report this variable unlogged in terms of basis points (bps) for descriptive purposes. Source: DealScan.
LOAN TERM	The natural logarithm of loan maturity measured in months. Where specifically noted, we report this variable in terms of months for descriptive purposes. Source: DealScan.
LOAN SIZE	Natural logarithm of the amount of a loan in millions of dollars.
SECURE	Indicator variable equal to one if a loan is collateralized, and zero otherwise. Source: DealScan.
LOAN TYPE	The type of lending facility (LOANTYPE). Source: DealScan.
PVIOL	The predicted probability of covenant violation as defined and measured by Demerjian and Owens (2016). Source: https://sites.google.com/site/edowensphd/research.
MISSING PVIOL	Indicator variable equal to one if *PVIOL* is undefined, and zero otherwise.
Firm and other characteristics	
FIRM SIZE	The natural logarithm of total assets (ATQ). Where specifically noted, we report this variable in millions for descriptive purposes.
MTB	The market value of equity (PRCC_Q × CSHOQ) scaled by book value of equity (CEQQ).
LEV	Total long-term debt (DLTTQ) scaled by total assets (ATQ).
TANGIBILITY	Net property, plant, and equipment (PPENTQ) divided by total assets (ATQ).
CFO	Operating cash flow (OANCFQ) scaled by 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	Calculated as 1.2 × ((ACTQ-LCTQ)/ATQ) + 1.4 × (REQ/ATQ) + 3.3 × (PIQ/ATQ) + 0.6 × ((PRCCQ*CSHOQ)/LTQ) + 0.999 × (SALEQ/ATQ).
PROFITABILITY	The ratio of operating income before depreciation (OIBDPQ) scaled by sales (SALEQ) (Chava et al., 2009).

(*continued on next page*)

(*continued*)

Variables	Definition and Measurement
ANALYST	The number of unique analysts that issuing a forecast for the relevant period per the I\B\E\S database. Source: I\B\E\S.
SALES GROWTH	Sales growth, measures as ($SALEQ_t$ – $SALEQ_{t-1}$)/$SALEQ_{t-1}$
C4-INDEX	The aggregate market share, measured in sales (SALESQ), of the four largest firms in an industry (2 digit SIC). Calculated at the calendar quarter level.
AGE	The natural logarithm of one plus the number of years since the firm was first covered by the CRSP database ((DATADATE – BEGPRC)/365). Where specifically noted, we report this variable in terms of years for descriptive purposes. Source: Center for Research in Securities Prices (CRSP)
CUST CONCN	The aggregate percentage sales coming from the customers that represent at least 10% of total sales (see Campello and Gao (2017)).
BETA	Factor obtained from regressing monthly security returns on market returns (VWRETD) using a min (max) est. window of 36 (12) months. Source: Center for Research in Securities Prices (CRSP)
CREDIT RATING	The firm's S&P credit rating (SPLTICRM).
IND-GROW-SHOCK	The average standard deviation in sales across all firms within an industry (calculated while excluding firm *i* from the SIC2 industry average). Standard deviations are calculated using eight quarters of data.
LGD	Calculated per Amiram et al. (2017): 0.292 + 0.063 × *FIRM SIZE* + 0.018 × STTOLDEBT + 0.003 × (INTANQ/PPENTQ) − 0.005 × ((ATQ − LTQ)/CSHOQ) − 0.907 × (IBQ/ATQ)).
IDIOSYNC VOL	Idiosyncratic volatility estimated from the Fama–French (1993) three-factor model. Source: Beta Suite by WRDS
DEBT BETA	Equity beta adjusted by estimated hedge ratio (*BETA* × HEDGE RATIO). The value of HEDGE RATIO is obtained using the parameters estimated by Schaefer and Strebulaev (2008) in panel A of Table 8.
MISSING DEBT BETA	Indicator variable equal to one if *DEBT BETA* is undefined, and zero otherwise.
MISSING LGD	Indicator variable equal to one if *LGD* is undefined, and zero otherwise.

All data sourced from Compustat unless otherwise noted.

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