Impacts of Firm Life Cycle on Bond Ratings and Yields

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Abstract

We examine how firm life cycle impacts ratings and costs of debt for public offers during 1991-2020. We find ratings for issuers in the introduction and decline stages are lower than those for growth and mature issuers. A similar U-shaped relation between life stage and yield spread, after controlling for credit rating, indicates that life stage impacts cost of debt through multiple channels. Costs of debt are lower for growth and mature issuers than for issuers in the introduction and decline stages. Analyses of high yield bonds and term to maturity suggest that the adverse effect on costs of debt for introduction and decline firms is associated with their elevated riskiness and greater information asymmetry.

JEL Classification: G30; G32; L22

Keywords: Corporate debt, Yield spread, Credit rating, Life cycle stage

I. INTRODUCTION

We examine the impact of a firm's life cycle stage on the initial credit rating and cost of debt of its newly issued public bonds. Credit rating agencies (CRAs) analyze information about the issuer in assessing the likelihood of default on the debt issue. Their assessments determine the initial credit rating assigned to the debt issue, which is a primary determinant of yield spread on the issue. Growing literature, however, suggests that both analysts and investors may consider other factors that are not fully captured in financial information in their assessments. For instance, Bhojraj and Sengupta (2003) provide evidence linking corporate governance mechanisms to higher bond ratings and lower bond yields. John et al. (2010) find that the market systematically prices differently bonds of identical ratings but different seniority.

Using Dickinson's (2011) life cycle measure, which classifies a firm's life cycle into five stages – introduction, growth, mature, shakeout, and decline, Hasan and Hossain (2017) find that idiosyncratic equity risk of firms in the introduction and decline stages is greater than that of growth and mature firms. Their findings echo Dickinson's (2011) findings that asset betas of firms in the introduction and decline stages are much higher than those of mature firms. Besides, Habib and Hasan (2017) report that firms in the introduction and decline stages display greater risk-taking behaviors that are associated with greater cash flow and information uncertainties. Focusing on the valuation impact, Hasan et al. (2015) document that the cost of equity capital is higher for firms in the introduction and decline stages, but lower for growth and mature firms, suggesting a U-shaped relation between life stage and the cost of equity capital across a firm's life cycle. In these studies, the life stage of a firm plays a significant role in explaining the riskiness of a firm after controlling for known determinants that are based on financial information. These findings suggest

possible influence of a firm's life stage in the level of default risk and hence the related credit assessment and valuation by bond market participants.

Despite the voluminous market for corporate debt and its role in a firm's capital structure, there is limited research on the role of life stage information in the analysis of corporate bonds. We fill the void in the literature by examining the influence of a firm's life stage in the assignment of initial credit rating and cost of debt when it seeks external financing. With a sample of 11,115 corporate bond offers over the period of 1991 to 2020, we find that on average, bonds issued by firms in the introduction and decline stages received lower ratings than their peers in the growth and mature stages. Initial credit rating for bonds issued by firms in the introduction (decline) stage is, on average, 7.8% (10%) lower than the sample mean while that of the growth (mature) issuers is 4% (8%) higher.

We next examine whether life stage impacts the costs of debt of new issues. We document a U-shaped relation between life stages and costs of debt, after controlling issue-, issuer- and market characteristics. On average, the yield spread is higher for bonds issued by firms in the introduction and decline stages than those issued by growth and mature firms. Given their average issue size of $271M ($374M), growth (mature) firms save an average of $740K ($140M) annual interest costs in their bond offers. In contrast, the average issue size of $291M ($296M) indicates issuing firms in the introduction (decline) stage incurs additional annual interest costs of $156M ($243M) for their bond offers.

Previous literature documents that credit rating is a primary determinant of the cost of debt (Hand et al. 1992). To further examine whether there is a direct impact of the issuer's life stage on the cost of debt instead of the indirect impact through initial credit rating, we include the initial credit rating as a control variable in our further analysis of the relation between life stage and yield

spread. The results suggest a direct impact of the issuer's life stage on its cost of debt as the U-shaped relation persists with the inclusion of initial rating in the regression. The results suggests that the issuer's life stage impacts its cost of debt through multiple channels. The significant coefficient estimates for life stage variables, though with smaller magnitudes, suggest that life cycle has a direct impact on the cost of debt. Besides, the significant positive coefficient for *Rating* suggests life stage of the issuer impacts the cost of debt indirectly through initial credit rating.

Further analysis indicates that the U-shaped relation between the issuer's life stage and both the initial credit rating and its cost of debt is mostly driven by issuers with lower credit quality, i.e., high yield (HY) issues. The increased level of risk and uncertainties associated with the introduction and decline stages heightens the conservatism of CRAs in their assessments of default risk and add to the risk aversion of bond investors in their valuation of new issues, when the issuers have a struggling track record to begin with. Besides, our finding of a shortening effect of life cycle on the maturity of new issues echoes concerns of bond investors with additional information risk associated with firms in the introduction and decline stages. Short term bonds require issuers in the introduction and decline stages to provide frequent information disclosure and update on the status of their financial performance and investment success (Barclay and Smith 1995).

The robustness tests using DeAngelo et al. (2006) life cycle measures show that issuers that have higher retained earnings ratios, i.e., mature firms, are assigned better initial credit ratings and lower yield spreads on their new debt issues than those with lower ratios, i.e., younger firms. This confirms our primary findings that bonds issued by mature firms generally have better credit ratings and lower costs of debt than new debt issues of firms in the introduction stage.

To mitigate potential concerns of endogeneity, we lag firm-level independent variables in all specifications. We conduct a two-stage least squares regression analysis with various

instrumental variables to address the endogeneity concern in our findings regarding the role of the issuer's life stage on the initial credit rating and its cost of debt. The results from the second-stage regression confirm our primary findings of a statistically significant U-shaped relation between the issuer's life stage and both initial credit rating and yield spread of new debt issue. After controlling for credit rating along with issue-, issue-, and market-characteristics, new debt issued by firms in their introduction and decline stages carry higher costs of debt than the issues of growth and mature firms.

Overall, our findings show that bond market participants incorporate life stage attributes in their assessment of default risk and valuation of new debt issues. Greater risk-taking activities, cash flow and information uncertainties of issuers in the introduction and decline stages heighten conservatism displayed by CRAs and risk aversion of bond investors. This leads to lower initial bond ratings and higher yield spreads for their new debt issues. The concerns of bond market participants intensify among new issues from firms that display financial distress.

Our study extends the literature on information and factors considered by credit rating agencies (CRAs) in their rating process. Faff et al. (2016) document a similar inverse U-shaped relation between the level of debt issuance and life stage of the issuer. Blomkvist et al. (2021) explores firms' access to bond markets over the corporate life cycle and find that a firm's likelihood to obtain a rating initially increases over firm life cycle and decreases during the shakeout and decline phases. To the best of our knowledge, our paper is the first to investigate whether life stage of the issuer affects the initial credit rating assigned to its new debt offer. Our results indicate that CRAs consider life stage attributes in their assessment of default risk and hence their assignment of initial credit rating. Our study contributes to the growing literature on the role of information beyond what is captured in financial statements in explaining default risk

assessment (Bonsall et al. 2017).

Our findings also contribute to the literature examining how firm life cycle impacts the cost of debt. Prior work documents that firm life cycle impacts the cost of equity (Blomkvist et al., 2021) and lending spreads in the bank loan market (Amin et al., 2021). Our work focuses on the public debt market. It is different from the bank loan market in that banks have an informational advantage over corporate bond investors. Using financial reports and private disclosures, banks have the expertise to estimate the issuer's operating and default risk. Hence, credit rating provided by CRAs is not essential in the bank loan market. In their study of the impact of life cycle on lending spreads, Amin et al. (2021) do not include credit rating in their analysis. In contrast, corporate bond investors obtain limited public information about the issuing firm. Hence, the initial credit rating provided by CRAs plays a major role in the determination of the yield spread. In this study, we find that the issuer's life stage impacts the cost of debt not only indirectly through initial credit rating but also directly on the yield spread. Though with a smaller magnitude, the statistically significant positive (negative) coefficients for new debt issues by firms in the introduction and decline stages (growth and mature stages) on yield spread, i.e., the cost of debt, persist with the inclusion of initial credit rating in the regressions.

Besides, our study contributes to the growing body of literature on the role of nonfinancial information in explaining corporate decisions and performance, as well as assessment and valuation by capital market participants. In conjunction with findings from prior research that focus on the equity market (Habib and Hasan 2017; Hasan et al. 2021), our findings suggest that life stage of a firm impacts both debt and equity market participants in a similar manner despite the differences in seniority in claims on cash flows and assets of the two groups of stakeholders. Greater risk-taking activities in investments with severe information asymmetry that are

associated with firms in the introduction and decline stages intensify the concern of information risk among risk averse capital providers.

II. RELATED LITERATURE AND HYPOTHESES DEVELOPMENT

The dynamic resource-based view of a firm's life cycle (Helfat and Peteraf 2003) suggests that with its time varying coordination of organizational resources and capabilities, a firm's competitive advantage, reputation, and performance may swing across different stages in its life cycle. The life cycle literature documents a nonlinear relation between life stage of a firm and its performance in profitability and riskiness (e.g., Dickinson 2011; Koh et al. 2015; Coad et al. 2016; Habib and Hasan 2017; Hasan and Hossain 2017), dividends and financing policies (e.g., DeAngelo et al. 2006 & 2010; Liang et al. 2013; Faff et al. 2016; Bhattacharya et al. 2020), earnings management (Krishnan et al. 2020; Jaggi et al. 2022), and market accessibility and valuation of its securities (e.g., Hasan et al. 2015; Chuang 2020; Blomkvist et al. 2021; Hasan et al. 2021). As default risk is the main concern for bond analysts and investors, the issuer's life stage could impact risk assessment and valuation of its new debt issue to the extent that financial information does not fully capture the characteristics of issuing firms in different life stages.

In the introduction stage, firms have high growth potential that takes the form of risky innovative investments as they pursue opportunities in new markets and venues (Coad et al. 2016). Consequently, firms in this life stage tend to be risky with uncertain profitability and cash flows, and face severe information asymmetry (Dickinson 2011; Hasan and Habib 2017). The intensified riskiness and severe information asymmetry, which are accompanied with lagging profitability and cash flows, result in limited access to external financing and higher costs of capital (Blomkvist et al. 2021; Hasan et al. 2015).

As firms transit into the growth stage, they start establishing themselves in the markets that

offer them access to resources for their fast growth. Growth firms experience improved profitability and enhanced cash flow positions, and achieve greater success in their investments and operations as they become more efficient and experienced. These favorable changes lower the level of riskiness and the degree of information asymmetry for growth firms that lead to better access to external capital and lower costs of capital (Dickinson 2011; Hasan et al. 2015).

Mature firms tend to be larger with established track records of success in the markets and communities that offer them competitive advantage in attaining resources (Helfat and Peteraf 2003). Mature firms are profitable with stable cash flows and less aggressive investments, and are subject to less information asymmetry. These attributes mitigate the concerns of analysts and investors in their assessment of riskiness of mature firms that enhance their access to external financing with lower cost of capital.

Firms in the decline stage face stagnant growth resulted from shrinking investment opportunities and resource bases, and are in financial distress due to declining sales, profits and cash flows. These firms are associated with increasing information uncertainty as they struggle to regain their competitiveness and profitability by pursuing riskier projects that are associated with greater cash flow uncertainty (Hasan et al. 2015). Similar to firms in the introduction stage, decline firms also face great challenges in seeking external capital and pay higher costs of capital.

Through credit ratings that they assign to bond issues, which reflect their professional assessment of the issuer's credit risk and likelihood of default, credit rating agencies (CRAs) help reduce information asymmetry between issuers and investors. For firms that face a greater level of information asymmetry, it is more challenging for CRAs to assess the creditworthiness of the debt issue that may lead to a conservative rating. Previous literature suggests that credit ratings are lower for issuers with greater information asymmetry. For example, Atilgan et. al. (2015) argue

that cross-listed bonds have higher information asymmetry than U.S. bonds and thus cross-listed bonds are associated with lower credit ratings. Bonsall and Miller (2017) find that bonds issued by firms with less readable financial disclosure receive less favorable ratings because less readable financial disclosures are associated with greater information problems. Firms in the introduction and decline stages face severe information asymmetry as they pursue aggressive investment opportunities in areas that they do not have established reputation when compared to growth and mature firms. The less favorable information environment of firms in the information and decline stages may lead to conservative ratings on their bond issues. We therefore offer

H1: The credit ratings for bonds issued by firms in the introduction and decline stages are lower than those issued by firms in the growth and mature stages.

We next analyze whether the issuer's life stage impacts its cost of debt. The literature on the cost of debt suggests that information asymmetry between creditors and borrowers increases the credit premium required by investors (e.g., La Porta et al. 1997; Miller and Puthenpurackal 2002; Qian and Strahan 2007; Miller and Reisel 2012; Zhu and Cai 2014; Derrien et al. 2016). The life cycle literature indicates that firms in the introduction and decline stage are associated with severe information asymmetry and are more likely to practice earnings management to decorate their lackluster performance. On the other hand, growth and mature firms tend to be profitable with established track records and associated with less information asymmetry. Vorst and Yohn (2018) find that stock investors take into account of life stage attributes that improve the accuracy of earnings forecasts in their valuation.

We postulate that bond investors take into account of life stage attributes in their valuation of new debt issues that determine yield spreads and hence costs of debt to the issuers. Specifically, we argue that bond investors demand higher yield spreads to compensate for additional

information risk associated with bonds issued by firms in the introduction and decline stages, compared to those issued by growth and mature firms. While credit rating is a primary factor in the valuation of bond issues, it may not fully address the concerns of risk averse bond investors regarding the information risk associated with new debt issues. Hence, life stage attributes could impact the cost of debt both indirectly through their impacts on credit rating and directly on yield spread of the new bond issue. We therefore offer

H2: The costs of debt for bonds issued by firms in the introduction and decline stages are higher than those issued by firms in the mature and growth stages.

III. DATA AND METHODOLOGY

Sample selection

We use SDC Global New Issues Databases to identify the initial sample of corporate bonds issued in the U.S. over the period of 1991 – 2020, and obtain detailed information on issue characteristics such as issue date, issue amount, seniority, and maturity date. We use Moody's credit rating as a measure of the issue's credit rating at the time of the offer. We exclude bonds issued by financial firms (SIC=6XXX) and utility firms (SIC=49XX) from the sample. We merge the sample with the issuer's first listing date from the Center for Research in Security Prices (CRSP) to compute firm age. Firm characteristic information such as firm size, leverage ratio, and market to book ratio is obtained from the Compustat Database. CBOE S&P 500 Volatility Index (*VIX*) is obtained from Wharton Research Data Services (WRDS). From the Federal Reserve Bank's website, we obtain ten-year and one-year benchmark Treasury yields and bond yields on AAA index and BBB index. Our final sample has 11,115 public debt offers.

Measure of the cost of debt

We use yield spreads to measure the cost of debt. Yield spread (*YieldSpread*) is computed as the bond's offer yield minus the Treasury yield of comparable maturity. The data on Treasury yields are obtained from the Federal Reserve Economic Data (FRED) database. They represent daily averages of the constant-maturity yield. If the maturity period of a corporate bond issue does not have exact match with that of Treasury bonds, we use the yield of the Treasury bond with the closest maturity to calculate the yield spread of the issue.

Measure of firm life cycle

We use Dickinson's (2011) life cycle proxy to capture the dynamics of a firm's attributes that vary across its life cycle stages. Firms may move from one life stage to another in a dynamic pattern as their financial resources, managerial capabilities, competitive environment, and hence organizational structure, strategy, and competitive advantage may vary considerably over time.

Dickinson's (2011) cashflow based life cycle proxy, which is constructed according to the predicted combinations of operating (OANCF), investing (IVNCF), and financing (FINCF) cash flows, classifies firms into five life stages, namely, introduction, growth, maturity, shakeout, and decline. She shows that different cash flow patterns are driven by a firm's profitability, growth, risk performance, and allocation of resources, as predicted in economic theories. For instance, firms in the introduction stage likely invest more than they divest, spend more resources than they generate, and raise more capital than they repay, resulting in negative OANCF and IVNCF, but a positive FINCF. The five stages of a firm's life cycle are classified according to the following combinations of operating, investing and financing cash flows:

Introduction (1): OANCF < 0, IVNCF < 0, and FINCF > 0.

Growth (2): OANCF > 0, IVNCF < 0, and FINCF > 0.

Mature (3): OANCF > 0, IVNCF < 0, and FINCF < 0.

Shake-out (4): all three cash flows, i.e., OANPCF, IVNCF, and FINCF, are ≤ or ≥ 0.

Decline (5): OANCF < 0, IVNCF > 0 and FINCF ≤ or ≥ 0.

Empirical methodology

To examine the impact of a firm's life cycle on bond ratings and the cost of debt, we specify our regression model as follows:

$$Rating/YieldSpread = \alpha_1 Intro + \alpha_2 Growth + \alpha_3 Mature + \alpha_4 Decline + \beta X + \gamma FEs + \varepsilon$$

where the bond's credit rating (*Rating*) is obtained by converting Moody's 20 rating classifications into numerical values. A lower numerical value represents a better credit rating. For example, AAA rating corresponds to a rating number of 1, AA+, AA and AA- ratings correspond to a rating number of 2, 3, and 4, respectively. *YieldSpread* is our measure of the cost of debt, which is computed as the bond's offer yield minus the Treasury yield of comparable maturity. *Intro*, *Growth*, *Mature*, and *Decline* are four indicator variables that equal to one for the issuing firm that is classified into one of the four stages of firm life cycle and zero otherwise, respectively.[1] X is a set of control variables and FEs are year and industry fixed effects.

In all regressions, we control for issue-, issuer-, and market specific variables commonly used in the debt financing literature (e.g., Zhu and Cai 2014; Atilgan et. al. 2015). Specifically, *IssueSize* is the natural logarithm of the dollar amount (in millions) of the bond offer. *TTM* is time to maturity that is defined as the issue's maturity in years. *Senior* equals to one if the bond is a

[1] We use shakeout stage as the benchmark in our main tests. Our inferences, however, remain quantitatively unchanged when an alternative stage such as the mature stage is considered as the benchmark.

senior bond, and zero otherwise. *HighTech* equals to one if the issuing firm operates in the high technology sector, and zero otherwise. *Simoffer* equals to one if the bond is offered in the same marketplace, and zero otherwise. *Rule144a* equals to one if the bond is offered as a Rule 144A issue, and zero otherwise. *TAsset* is the issuing firm's total assets in billions of dollars. *MB* is the market-to-book ratio, which is defined as closing price at the fiscal year end times common shares outstanding divided by the book value of equity. *LEV* is the issuing firm's leverage, which is defined as debt in current liabilities plus total long-term debt scaled by total assets. *RD* is the issuing firm's research and development expenses scaled by total assets. *TANG* is the issuing firm's property, plant, and equipment scaled by total assets. *CAPX* is the issuing firm's capital expenditure scaled by total assets. *Age* is firm age, which is calculated as the time span between the issue date and the first date the firm price was available in the CRSP database. *FinDistress* classifies the issuing firm into one of the three categories according to its Altman's Z-score. *FinDistress* takes the value of 1 that denotes the issuing firm is under financial distress with a Z-Score < 1.8; 2 denotes normal that carries a Z-score between 1.8 and 3.0; and 3 represents a financially healthy firm with a Z-Score > 3.0. *FirmEfficiency*, which is developed in Demerjian et al. (2012), measures the efficiency of the issue firm (relative to its industry peers) to generate sales from its resources with values ranging from zero to one. *VIX* is CBOE S&P 500 Volatility Index that measures the level of volatility in the equity market. The higher the VIX, the greater the level of market uncertainty. We use *DefaultSpread*, which is the difference in yields between BBB bonds and AAA bonds of comparable maturity to measure investors' sentiment. We use *TermSpread*, which is the difference between the Federal Reserve Bank's ten-year and one-year benchmark Treasury yields to measure bond market conditions. The appendix presents the variable definitions and data sources.

In all regressions, we also include industry and year fixed effects to control for omitted heterogeneity across industries and in a given year. All continuous control variables are winsorized at the 1% and 99% levels. The estimated standard errors are correct for heteroscedasticity and are clustered at the firm level.

IV. EMPIRICAL RESULTS

Descriptive statistics

Figure I plots bond credit ratings and yield spreads against firm life cycle. It shows that bonds issued by firms in their growth and mature stages have better credit ratings and lower yield spreads than those issued by firms in their introduction and decline stages. Our preliminary findings suggest that both bond credit ratings and yield spreads (i.e., the costs of debt) exhibit a U-shape pattern across firm life cycle.

Table 1 reports the sample distribution by year. The average initial credit rating is 9.28, which represents a rating between Baa2 and Baa3, whereas the average yield spread is 2.33%. The distributions of bonds issued by firms across the five life cycle stages are 3.1%, 31.5%, 58.7%, 5.7%, and 0.9% for introduction, growth, mature, shakeout, and decline stages, respectively.

[Insert Table 1 about here]

Table 2 presents the summary statistics of our key variables for the full sample. The issue size is about $336 million and the time to maturity is about 11 years. Over 19% of issues in our sample are senior bonds whereas over 28% of issues are Rule 144A issues. Additionally, 36% of issuing firms are in the high technology sector whereas 47% of bonds are offered in the same marketplace. The average firm size is approximately $31 billion with an average market-to-book ratio of 3.73. The ratios of leverage, R&D, property, plant, and equipment expenses, and capital

expenditure to total assets are 0.34, 0.02, 0.36. and 0.07, respectively. Firms on average are listed on the exchange for 32 years. The average value for financial distress is 1.42, suggesting that our sample firms lie in between the financial distress and normal categories. The average value of 0.51 for financial efficiency indicates that our sample firms, as a whole, display at par performance with their industry peers in converting resources into revenues. The equity market volatility is about 20, indicating a normal level of market uncertainty.

[Insert Table 2 about here]

Consistent with Figure I, the cost of debt decreases from the introduction stage (4.19%) through growth stage (2.72%) to mature stage (2.01%), and then increases from the shakeout stage (2.62%) to the decline stage (4.27%). Credit ratings show the same pattern that the rank of credit ratings improves from the introduction stage (B1) through growth (Baa3/Ba1) to mature stage (Baa1), and then worsens from the shakeout stage (Baa3) to the decline stage (Ba3/B1). The evidence is consistent with the predictions of hypotheses 1 and 2 that both the credit ratings and costs of debt of new bond issues exhibit a U-shape pattern across the issuers' life stages.

[Insert Figure 1 about here]

Bond ratings and firm life cycle

We start our analysis by examining whether credit rating agencies (CRAs) consider a firm's life stage when rating new bond issues with the following regression model.

$$Rating = \alpha_1 Intro + \alpha_2 Growth + \alpha_3 Mature + \alpha_4 Decline + \beta X + \gamma FEs + \varepsilon \quad (1)$$

where a lower numerical value for *Rating* represents a better credit rating. Table 3 presents the results for all bond offers. In Column 1, the positive coefficient estimates of 0.724 and 0.927, respectively, on *Intro* and *Decline* are significant at the 1% level. The negative coefficient estimates of -0.372 and -0.741, respectively, on *Growth* and *Mature* are significant at the 1% level.

The signs of the statistically significant coefficients for the life stage variables are consistent with our hypothesis H1 that credit rating analysts assigned less favorable ratings to new debt issues by firms in the introduction and decline stages that are associated with greater information asymmetry, when compared to debt issues from growth and mature firms. The results are also economically significant. Given that the sample mean of credit ratings is 9.28, the 72.4 notches increase for issuers in the introduction stage implies a drop of 7.8% (=0.724/9.28) relative to the sample mean, and the 92.7 notches increase for issuers in the decline stage is translated into a 10% drop in comparison. On the other hand, the 37.2 notches reduction for growth firms represents a 4% (=0.372/9.28) improvement in the initial credit rating on their new bond issues relative to the sample mean, and the 74.1 notches reduction for mature firms implies an 8% rise in the rating on their new bond issues in comparison.

[Insert Table 3 about here]

Atilgan et. al. (2015) show that compared to non-investment grade bonds, investment grade bonds are associated with less information asymmetry problems and carry lower default risk. To the extent that the impact of life stage attributes on credit ratings of new bond issues is driven by the information environment of issuers, we postulate that the observed relation between life stages and credit ratings reported in Column 1 of Table 3 is mainly driven by non-investment grade issues. Next, we examine whether the impact of firm life cycle on credit ratings is the same for investment grade (IG) bonds and high yield (HY) bonds. We define high yield bonds as bonds with initial credit ratings of Ba1 or worse whereas investment grade bonds are bonds with ratings of Baa3 or better. In comparison of the results reported in Columns 2 and 3, we find that the impact of the issuer's life stage on credit rating is less prominent for IG bonds. While the coefficients on *Intro* and *Decline* are still positive and significant for HY bonds, the corresponding coefficients are

insignificant for IG bonds. The results are consistent with Atilgan et. al. (2015) that CRAs display conservatism only when rating HY bonds issued by firms in the introduction and decline stages.

Yield spreads and firm life cycle

We examine whether the cost of debt is affected by firm's life stage with the following regression.

$$YieldSpread = \alpha_1 Intro + \alpha_2 Growth + \alpha_3 Mature + \alpha_4 Decline + \beta X + \gamma FEs + \varepsilon \quad (2)$$

where *YieldSpread* is the cost of debt that is computed as the bond's offer yield minus the Treasury yield of comparable maturity. We first study the direct impact of an issuing firm's life stage on its cost of debt (*YieldSpread*) without controlling for the initial credit rating (*Rating)* in Column 1 of Table 4. The positive coefficient estimates of 0.714 and 0.822, respectively, on *Intro* and *Decline*, and the negative coefficient estimates of -0.273 and -0.375, respectively, on *Growth* and *Mature*, are all significant at the 1% level. The baseline results are consistent with our hypothesis H2 that yield spreads are higher for bonds issued by firms in the introduction and decline stages, but are lower for growth and mature issuers. The results are also economically significant. Given the average amount of bonds issued by firms in the introduction (decline) stage of $219M ($296M), our regression analysis without controlling for *Rating* implies that the bond issued by introduction (decline) firms, on average, incur $156M ($243M) more in interest costs per year. In contrast, the average amount of bonds issued by growth (mature) firms of $271M ($374M) suggests that on average growth (mature) firms save $740K ($140M) in annual interest costs.

[Insert Table 4 about here]

Given the finding of a U-shaped relation between the issuer's life stage and the issue's initial credit rating reported in the preceding section, we conduct further analysis on the relation between life stages and yield spreads by controlling for the bond's initial rating. If all information

about default risk is fully captured in the bond's initial credit rating, then the yield spread should not be affected by firm life cycle after controlling for the bond's credit rating. Otherwise, the issuer's life stage may directly impact the bond's yield spread, though probably with a smaller magnitude. The results reported in Column 2 of Table 4 show that the inclusion of *Rating* significantly lessens the impact of an issuing firm's life stage on its cost of debt, however, the corresponding coefficients are still statistically significant. Specifically, the coefficient estimates of 0.468 and 0.507, on *Intro* and *Decline* are significant at the 1% and 5% level, respectively. The coefficient estimates of -0.146 and -0.123, respectively, on *Growth* and *Mature* are significant at the 5% level. Economically, from our regression analysis that controls for initial credit rating, the average amount of bonds issued by firms in the growth (mature) stage of $271M ($374M) implies that growth (mature) issuers on average save approximately $396K ($460K) in annual interest costs. In contrast, given that an average amount of the bond issue in the introduction (decline) stage is $219M ($296M), it implies that on average the bond issued by introduction (decline) firms can incur $102M ($150M) more in interest costs per year. The results suggest that firm life cycle directly affects the cost of debt that is incremental to the indirect effect through its impact on the initial credit ratings. Together, the findings suggest that issuing firms tend to experience relatively lower (higher) costs of debt during their growth and mature (introduction and decline) life stages, consistent with our hypothesis H2.

We next examine whether the impact of firm life cycle on the cost of debt is the same for investment grade (IG) bonds and high yield (HY) bonds. Comparing the results reported in Columns 3 and 4 to those reported in Columns 5 and 6, we find that the impact of firm life cycle on the cost of debt is more prominent for HY bonds. For HY bonds, the coefficients on *Intro* and *Decline* are positive and significant whereas the coefficients on *Growth* and *Mature* are negative

and significant. However, the U-shape relation between the cost of debt and firm life cycle is no longer hold for IG bonds. The results imply that the U-shape relation between firm life cycle and the cost of debt is more pronounced for HY bonds that are more likely to be associated with increased level of default risk and greater information asymmetry.

Table 4 shows that the signs for the coefficients of other key control variables are consistent with the literature. For example, the coefficient estimate on the credit rating variable (*Rating*) is positive and statistically significantly associated with the cost of debt (*YieldSpread*), which indicates that a bad credit rating leads to a higher cost of debt. The significant negative coefficients of the *FirmEfficiency* variable indicate that issuers demonstrate higher operating efficiency help mitigate concerns about information asymmetry. This leads to lower costs of debt on their issues. The coefficients for the Rule 144a dummy are significantly positive. The Rule 144a bonds allow issuing firms to raise U.S. dollar-dominated bonds in the U.S. corporate bond market to qualified institutional buyers (QIBs) with lesser disclosure requirements and filing regulations. As a result, Rule 144a issues provide issuing firms speedy access to the U.S. corporate bond market. However, Rule 144a issues face higher information problems compared to public offerings. Thus, these issues may receive a lower credit rating and are associated with higher costs of debt. The significant positive coefficients for both measures of investor sentiment, i.e., *VIX* and *DefaultSpread*, echo the findings in the literature that the sensitivity of investors to market volatilities add to the cost of capital incurred by issuing firms.

Overall, we show that there exists a U-shape pattern of bond credit rating and the cost of debt across stages of the issuing firm's life cycle. Our findings are consistent with the notion that when the debt issues are perceived to carry more default risk with greater information asymmetry, CRAs tend to assign more conservative ratings and investors tend to require a larger compensation

for bearing greater default and information risks that lead to higher bond yield. Specifically, firms in the introduction stage tend to pursue riskier innovative investment opportunities in emerging venues while they have a limited track record of success. In addition, they are likely to be new to the public debt market. These lead to severe information asymmetry faced by bond issuers in the introduction stage. Firms in the decline stage are subject to higher cash-flow risk, information risk, and financial distress as they struggle to regain their competitive positions (Hasan et al. 2015). Thus, new debt issued by firms in the introduction and decline stages are associated with lower initial credit rating and higher cost of debt. On the other hand, firms in the growth stage experience reduced cash-flow uncertainties and less information asymmetry (Dickinson 2011; Hasan et al. 2015). Firms in the mature stage generate greater operating cash flows and profit, and are subject to less cash-flow risk and information uncertainty (Dickinson 2011; Habib and Hasan 2019). As a result, firms in the growth stage and mature stage are associated with better initial credit ratings and lower costs of debt on their new issues.

Robustness tests: Alternative life cycle measures

As a robust test, we use the retained earnings (RE) based life cycle measure developed in DeAngelo et al. (2006). The two RE-based measures are defined as the ratio of retained earnings to total equity (RE/TE) and to total assets (RE/TA), respectively, where total equity (TE) is the sum of retained and contributed equity. DeAngelo et al. (2006) argue that these two ratios increase as firms mature because they become more profitable while they have shrinking growth opportunities. Both factors lead to more earnings retained for financing their growth internally.

The underlying premise is that young and decline firms have low RE/TE (RE/TA) ratios because young firms have little or no retained equity and rely on contributed (external) equity, and decline firms tend to deplete RE to support lowering profitability while trying to maintain dividend

payout. In contrast, mature firms with positive net cash inflows generated from operations coupled with a diminishing investment opportunity set have greater access to internal funds (retained equity) and less need for contributed equity. Hence, mature firms are expected to have higher RE/TE (RE/TA) ratios.

In Table 5, Columns 1-3 report the results using the *RE/TA* measure of firm life cycle whereas Columns 4-6 report the results using the *RE/TE* measure of firm life cycle. The results in Columns 1 and 4 show that there is a negative relationship between alternative measures of firm life cycle (*RE/TA* or *RE/TE*) and initial credit rating. Consistent with DeAngelo et al. (2006), the negative relationship between firm life cycle (*RE/TA or RE/TE*) and initial credit rating implies that as firms grow and become mature, they start to exhibit positive net cash inflows from operations, and reputable customer satisfactions, which leads to better credit ratings.

[Insert Table 5 about here]

The results in Columns 2-3 and Columns 5-6 show that there is a negative relationship between alternative measures of firm life cycle (*RE/TA* or *RE/TE*) and the cost of debt. Consistent with DeAngelo et al. (2006), the negative relationship between life cycle (*RE/TA or RE/TE*) and the cost of debt suggests that as firms mature, they become more profitable, which leads to more earnings retained for financing their growth internally. The improving profitability and cash flow positions reduces their needs for external financing and help them to access external financing at a lower cost of capital. Besides, echoing the findings using Dickinson's (2011) life cycle measure, the negative coefficients for the *LifeStage* variable reported in Columns 3 and 6 indicate a direct impact of life cycle on the cost of debt. Though the coefficients are of smaller magnitude when compared to those reported in Columns 2 and 5, they continue to be statistically significant with the inclusion of the credit rating variable in the analysis.

Robustness tests: Non-crisis period

To alleviate the concern that financial crises during our sample period may interfere our results, we rerun all the regression tests using bonds issued in the non-crisis period only. Specially, we define the non-crisis period as the sample years excluding 1997, 2008, and 2009. Estimates in Column 1 of Table 6 show that bonds issued by firms in the introduction and decline stages tend to have lower initial ratings and those issued by firms in the growth and mature stages tend to have better initial ratings in the non-crisis period. Results in Columns 2 and 3 show that issuing firms in the introduction and decline (growth and mature) stages tend to experience higher (lower) borrowing costs in the non-crisis period. The results are consistent with those reported in Tables 3 and 4 and support prior findings that there exists a U-shape pattern of the initial credit rating and cost of debt across the issuer's life stages. Initial rating (cost of debt) is lower (higher) for bonds issued by firms in the introduction and decline stages whereas initial rating (cost of debt) is higher (lower) for bonds issued by growth and mature firms.

[Insert Table 6 about here]

Role of non-price contract terms

Our baseline results indicate that life stage of a firm impacts both the initial rating and yield spread of its new debt issue. Further analysis suggests that bond investors concern with information asymmetry of issuers in the introduction and decline stages, especially those face financial distress. Flannery (1986) and Diamond (1991) suggest that the level of risk and asymmetric information have significant impact in determining the debt maturity. Besides, Barclay and Smith (1995) show that short term bonds require issuers to provide frequent information disclosure through their repeated needs for external financing. Next we examine whether the issuer's life stage also impacts non-price terms such as maturity in the design of the

bond contract that helps address the concern of investors.

Table 7 presents the results for the non-price contract variable, i.e., maturity (*TTM*), being the dependent variable. The coefficients on *Intro* and *Decline* in Columns 1 and 2 are statistically significant at the 5% and 1% level, respectively, suggesting that bond investors prefer shorter term debt from issuing firms that are in the introduction and decline stages. Consistent with Flannery (1986) and Diamond (1991), risky firms with long-term projects might borrow on a short-term basis in the presence of asymmetric information. Since firms in the introduction and decline stages are subject to higher cash-flow risk and asymmetric information, the time to maturity for bonds issued by these firms are shorter. The shortening effect on the maturity of new debt issues also echo the concerns of bond investors with additional information risk associated with firms in the introduction and decline stages. Shorter term bonds require these issuers to provide frequent information disclosure and update on the status of their financial performance and investment success that help mitigate the information asymmetry problem.

[Insert Table 7 about here]

V. ENDOGENEITY

Our main findings suggest a U-shape pattern of yield spreads across firm life cycle, where the cost of debt increases (decrease) during the introduction and decline (growth and mature) stages. However, our results could suffer from potential endogeneity arising from an omitted variable bias, which could result in the error term being correlated with our life cycle measure in the regressions. In this section, we use an instrumental variables (IVs) approach that controls for potential endogeneity to correct for possible biases associated with unobserved omitted variables. Specifically, we select two-years-lagged life cycle measures (*LagIntro*, *LagGrowth*, *LagMature*,

LagDecline) as our instrumental variables. Another instrumental variable we select is a transition IV, *Ch21Decline*, measured as one if an issuing firm is transiting from the mature stage two-years-ago to the shakeout stage one-year-ago or from the shakeout stage two-years-ago to the decline stage one-year-ago, and zero otherwise. We also choose a constant IV, *Con10Decline*, that takes the value of one if an issuing firm stays in the decline stage during both current year and preceding year, and zero otherwise.

To be considered valid instruments, the selected IVs must meet two criteria: (i) the relevant condition, where the selected IVs must be correlated with measures of firm life cycle but uncorrelated with the error term; and (ii) the exclusion restriction, where the selected IVs are correlated with an issuing firm's cost of debt only through its correlation with measures of firm life cycle. Specifically, the two-years-lagged life cycle measures are generated from firms' cash flow reported previous two years and are thus highly correlated with firms' cash flow reported one year ago which is used to compute the measures of firms' one-year-lagged life cycle stages. With a two-year lag, our two-years-lagged life cycle measures are unlikely to be correlated with the contemporaneous error term. Hence, the two-years-lagged life cycle measures satisfy the relevance condition. Additionally, investors evaluate an issuing firm's future uncertainty when assessing the firm's financing costs. The two-years-lagged life cycle measures are likely to be correlated with historical level of default risk and are thus unlikely to be directly related to an issuing firm's cost of debt, which meets the exclusion condition. Both the transition IV (transiting from $Mature_{t-2}$ to $Shakeout_{t-1}$ or from $Shakeout_{t-2}$ to $Decline_{t-1}$) and the constant IV (remaining in the decline stage both one year ago and during the issuing year) are highly correlated with measures of one-year-lagged life stages. Furthermore, both the transition and constant IVs are approximately exogenous. It is less likely that an issuing firm's life stage transition from two years to one year ago will be

correlated with a firm's cost of debt. It is also unlikely that issuing firm's life stage remaining in the decline stage both in the preceding year and during the issuing year will be correlated with a firm's cost of debt. Thus, our selected IVs (i.e., two-year-lagged life cycle measures, transition IV, and constant IV) fairly meet both the relevance condition and the exclusion restriction.

Table 8 presents the results from the two stage least squares (2SLS) regressions. In the first-stage regressions, we regress each life stages on the IVs and controls of the issue-, issuer-, and market-specific variables. The dependent variables are *Intro*, *Growth*, *Mature*, and *Decline* in Columns 1 through 4, respectively. Panel A shows that the coefficients on two-year-lagged instrumental variables are statistically significant, implying that the two-year-lagged life stages are related to firm life stages. The transition IV (transiting from $Mature_{t-2}$ to $Shakeout_{t-1}$ or from $Shakeout_{t-2}$ to $Decline_{t-1}$) is positively associated with the introduction and growth firms but is negatively associated with the mature and decline firms. In addition, the constant IV (remaining in the decline stage both in the preceding year and during the issuing year) is positively associated with the decline stage but is negatively associated with the introduction stage.

To validate our instrumental variables, we conduct tests of endogeneity, weak instruments, under- and over-identification. In panel B, the test results show that cluster-robust C statistics is 17.592 and is statistically significant at the 1% level, suggesting that the endogeneity test rejects the null hypothesis that the life cycle measures are exogenous. The Kleibergen-Paap rk Wald F statistic is 12.472 with the critical value of 9.01,[2] indicating that our IVs are highly correlated with

[2] Stock and Yogo (2005) critical values are only for up to three endogenous regressors. However, our estimation has four endogenous regressors (as a proxy for four life cycle stages). The cluster-

the life cycle measures, alleviating the concern of weak instruments. Using the Kleibergen-Paap rk LM statistic of underidentification (92.402), we reject the null hypothesis that the excluded instruments are correlated with the endogenous regressors, implying that the instruments are relevant. We also use the Hansen test to examine the overidentifying restrictions. The Hansen J statistic (3.102, p-value=0.5409) suggests that we fail to reject the null hypothesis that our IVs are uncorrelated with the error term. This implies that our IVs are exogenous with respect to the yield spread. Collectively, these post-IV tests suggest that our IVs are valid.

Panel C presents the second stage regression results, where we regress the cost of debt (*YieldSpread*) on the predicted values of the life cycle measures from the first stage (*PredIntro*, *PredGrowth*, *PredMature*, and *PredDecline*) and on controls of issue-, issuer-, and market-specific variables. The findings show that the cost of debt is positively associated with predicted introduction and decline stages but is negatively associated with predicted growth and mature stages. They are consistent with our main findings of a dynamic U-shape between an issuing firm's life stage and the cost of debt on its new debt issue. Thus, our instrumental variables analysis in Table 8 suggests that the introduction and decline (growth and mature) firms causally increase (decrease) the cost of debt.

[Insert Table 8 about here]

VI. CONCLUSION

robust Kleibergen-Paap rk Wald F statistic is a corrected version of the first-stage F statistics, which is appropriate for our setting of four endogenous regressors.

We examine the impact of firm life cycle on the initial credit rating and cost of debt in the public debt market. We first find a U-shaped relation between the issuer's life stage and initial credit rating of its new bond issue. Our findings show that credit rating agencies rated conservatively for bonds issued by firms in their introduction and decline stages and assign better ratings for bonds issued by growth and mature firms. The U-shaped relation is also found among high yield issues that display signs of financial distress, but is less prominent for better quality issues.

We find a similar U-shaped relation between the issuer's life stage and the yield spread of their debt issue. The costs of debt are higher for bonds issued by firms in their introduction and decline stages than those issued by growth and mature firms. We note that the issuer's life stage impacts yield spread through multiple channels. Life stage impacts the cost of debt indirectly through its impact on the initial rating, given that bond rating is a primary determinant of bond yield. After controlling for credit rating in the analysis, the statistically significant U-shaped relation between life stage and yield spread persists. This suggests a direct impact of life stage on cost of debt. Besides, our findings of a shortening effect on the maturity of debt issued by firms in the introduction and decline stages are consistent with the role of short term debt in mitigating the concern of information asymmetry associated with issuers in the introduction and decline stages.

Our findings provide additional evidence for the interactions between firm life cycle and the cost of capital. Our results support previous studies in the life cycle literature that firms in the introduction and decline stages carry elevated risk and greater information asymmetry, which are associated with lower credit rating and higher cost of debt.

REFERENCES

Amin, A., Bowler, B., Hasan, M., Lobo, G., and J. Tresl, 2021, Firm life cycle and cost of debt, Working paper. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3688557.

Atilgan, Y., Ghosh, A., Yan, M., and J. Zhang, 2015, Cross-listed bonds, information asymmetry and conservatism in credit ratings, Journal of Money, Credit and Banking 47, 897–929.

Barclay, M., and C. Smith Jr., 1995, The Maturity Structure of Corporate Debt, Journal of Finance, 50, 609-631.

Beatty, A., Weber, J., and J. Yu, 2008, Conservatism and debt, Journal of Accounting and Economics 45, 154–174.

Bhattacharya, D., Chang, C., and W. Li, 2020, Stages of firm life cycle, transition, and dividend policy, Finance Research Letters 33, 1-12.

Bhojraj, S. and P. Sengupta, 2003, The effect of corporate governance mechanisms on bond ratings and yields, Journal of Business 76, 455-475.

Blomkvist, M., Loflund, A., and H. Vyas, 2021, Credit ratings and firm life-cycle, Finance Research Letters 39, 1-5.

Bonsall, S., Holzman, E., and B. Miller, 2017, Managerial ability and credit risk assessment, Management Science 63, 1425-1449.

Bonsall, S., and B. Miller, 2017, The impact of narrative disclosure readability on bond ratings and the cost of debt, Review of Accounting Studies 22, 608–643.

Chuang, K., 2020, Private placements, market discounts and firm performance: The perspective of corporate life cycle analysis, Review of Quantitative Finance and Accounting 54, 541-564.

Coad, A., Segarra, A., and M. Teruel, 2016, Innovation and firm growth: Does firm age play a role? Research Policy 45, 387-400.

DeAngelo, H., DeAngelo, L., and R. Stulz, 2006, Dividend policy and the earned/contributed capital mix: A test of the life-cycle theory, Journal of Financial Economics 81, 227-254.

DeAngela, H., DeAngelo, L., and R. Stulz, 2010, Seasoned equity offerings, market timing, and the corporate lifecycle, Journal of Financial Economics 95, 275-295.

Demerjian, P., Lev, B., and S. McVay, 2012, Quantifying managerial ability: A new measure and validity tests, Management Science 58, 1229-1248.

Derrien, F., Hilary, G., Kecskes, A., and S. Mansi, 2016, Information asymmetry, credit Events and the cost of debt, Journal of Corporate Finance 39, 295-311.

Diamond, D., 1991, Debt maturity structure and liquidity risk, Quarterly Journal of Economics 106, 709-738.

Dickinson, V., 2011, Cash flow patterns as a proxy for firm life cycle, The Accounting Review 86, 1969-1994.

Faff, R., Kwok, W., and E. Podolski, 2016, Do corporate policies follow a life-cycle? Journal of Banking and Finance 69, 95-107.

Flannery, M., 1986, Asymmetric information and risky debt maturity choice, Journal of Finance 41, 19-37.

Habib, A., and M. Hasan, 2017, Firm life cycle, corporate risk taking and investor sentiment, Accounting & Finance 57, 465-497.

Hand, J., Holthausen, R., and R. Leftwich, 1992, The effect of bond rating agency announcements on bond and stock prices, Journal of Finance 47, 733–752.

Hasan, M., Cheung, A., Tunas, L., and H. Kot, 2021, Firm life cycle and trade credit, Financial Review 56, 744-771.

Hasan, M., Hossain, M., Cheung A., and A. Habib, 2015, Corporate life cycle and cost of equity capital, Journal of Contemporary Accounting & Economics 11, 46-60.

Hasan, M., and M. Hossain, 2017, Firm life cycle and idiosyncratic volatility, International Review of Financial Analysis 50, 164-175.

Helfat, C., and M. Peteraf, 2003, The dynamic resource-based view: Capability life cycles, Strategic Management Journal 24, 997-1010.

Jaggi, B., Allini, A., Casciello, R., and F. Meucci, 2022, Firm life cycle stages and earnings management, Review of Quantitative Finance and Accounting 89, 1019-1049.

John, K., Ravid A., and N. Reisel, 2010, The notching rule for subordinated debt and the information content of debt rating, Financial Management 39, 489–513.

Koh, S., Durand, R., Dai, L., and M. Chang, 2015, Financial distress: lifecycle and corporate restructuring, Journal of Corporate Finance 33, 19-33.

Krishnan G., Myllymaki, E., and N. Nagar, 2021, Does financial reporting quality vary across firm life cycle? Journal of Business Finance and Accounting 48, 954-987.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A.., and R. Vishny, 1997, Legal determinants of external finance, Journal of Finance 52, 1131–1150.

Liang W., Chan K., Lai W., and Y. Wang, 2013, Motivation for repurchases: a life cycle explanation, Journal of Financial Services Research 43, 221–242

Miller, D., and J. Puthenpurackal, 2002, The costs, wealth effects, and determinants of international capital raising: Evidence from public Yankee bonds, Journal of Financial Intermediation 11, 455–485.

Miller, D., and N. Reisel, 2012, Do country-level investor protections affect security-level contract design? Evidence from foreign bond covenants, Review of Financial Studies 25, 408–438.

Qian, J., and P. Strahan, 2007, How laws and institutions shape financial contracts: The case of bank loans, Journal of Finance 62, 2803–2834.

Stock, J., and M. Yogo, 2005, Testing for Weak Instruments in Linear IV Regression. In D.W.K. Andrews & J.H. Stock (eds.) Identification and Inference for Econometric Models Essays in Honor of Thomas Rothenberg. Cambridge: Cambridge University Press, 80-108.

Vorst, P., and T. Yohn, 2018, Life cycle models and forecasting growth and profitability, The Accounting Review 93, 357-381.

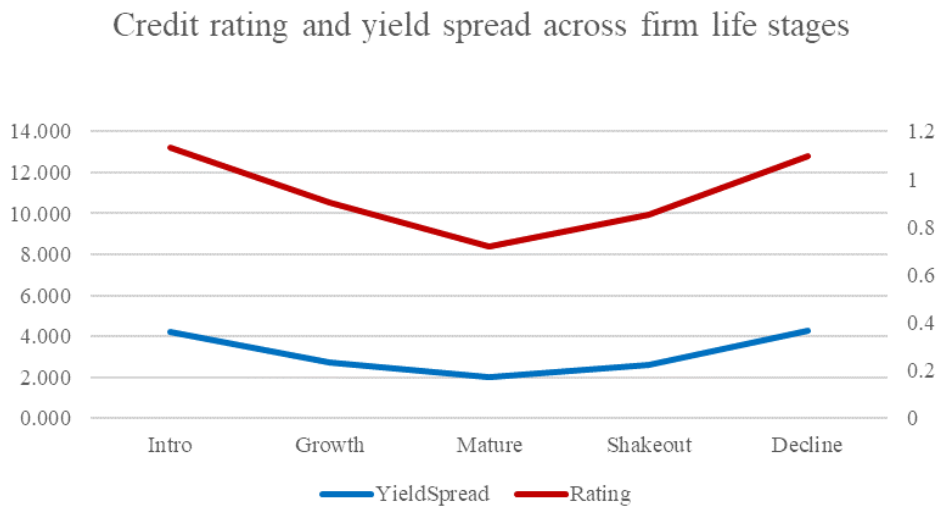
Zhu, H., and K. Cai, 2014, Culture distance and bond pricing: evidence in the Yankee and Rule 144A bond markets, Journal of Financial Research 37, 357-384.

APPENDIX: VARIABLE DEFINITIONS AND DATA SOURCES

Variable	Definition	Data source
Panel A: Dependent and independent variables		
YieldSpread	Yield spread is computed as the bond's offer yield over the Treasury rate of comparable maturity.	Federal Reserve Economic Data (FRED) and authors' calculation
Rating	An issuing firm's rating number, transferred from Moody's 20 rating classifications with a lower number indicating a better credit rating.	Securities Data Corporation, Inc. (SDC)
Intro	Introduction stage equals to one if OANCF < 0, IVNCF < 0, and FINCF > 0, and zero otherwise.	Dickinson's (2011) cashflow based life cycle measure is constructed according to the predicted combinations of operating (OANCF), investing (IVNCF) and financing (FINCF) cash flows. It classifies firms into five life stages: introduction, growth, maturity, shake-out and decline.
Growth	Growth stage equals to one if OANCF > 0, IVNCF < 0, and FINCF > 0, and zero otherwise.	
Mature	Mature stage equals to one if OANCF > 0, IVNCF < 0, and FINCF < 0, and zero otherwise.	
Shakeout	Shakeout stage equals to one if all three cash flows, i.e., OANPCF, IVNCF, and FINCF, are ≤ or ≥ 0, and zero otherwise.	
Decline	Decline stage equals to one if OANCF < 0, IVNCF > 0 and FINCF ≤ or ≥ 0, and zero otherwise.	
RE/TA	An issuing firm's retained Earnings scaled by total assets.	Compustat and Authors' calculation
RE/TE	An issuing firm's retained Earnings scaled by book value of equity.	Compustat and Authors' calculation
Panel B: Bond-specific control variables		
IssueSize	Issue size. It is the natural logarithm of the dollar size of the bond's offer amount in millions of dollars.	SDC
TTM	Time to maturity. It is the issue's maturity in years.	SDC
Senior	The indicator variable equals to one if the bond is senior bond, and zero otherwise.	SDC
HighTech	High technology dummy variable. It equals to one if the firm belongs to high tech industry and zero otherwise.	SDC
Simoffer	The indicator variable equals to one if the bond is offered in the same marketplace and zero otherwise.	SDC
Rule144a	The Rule 144A issuance equals to one if the firm issues in the Rule 144A market and zero otherwise.	SDC
Panel C: Issuing firm specific control variables		
TAsset	An issuing firm's total booking assets in millions of dollars.	Compustat and Authors' calculation
MB	Market-to-book ratio is defined as closing price at the fiscal year end times common shares outstanding divided by book value of equity.	Compustat and Authors' calculation

LEV	An issuing firm's leverage is defined as debt in current liabilities plus total long-term debt scaled by total assets.	Compustat and Authors' calculation
RD	An issuing firm's research and development expenses scaled by total assets.	Compustat and Authors' calculation
TANG	An issuing firm's property, plant, and equipment scaled by total assets.	Compustat and Authors' calculation
CAPX	An issuing firm's capital expenditure scaled by total assets.	Compustat and Authors' calculation
Age	Firm age is defined as a firm's issuing date subtracted by the first date the firm price was available in the CRSP database.	CRSP, SDC, and Authors' calculation
Panel D: Market specific control variables		
FinDistress	An issuing firm is classified into one of the three categories according to its likelihood of bankruptcy measured with the Altman's Z-score. An issuing firm that is under financial distress is assigned the value of "1" when its Z-score < 1.8; "2" (normal) when its Z-score lies in the range of 1.8 and 3.0; and "3" (healthy) when its Z-score > 3.0.	Compustat and Authors' calculation
FirmEfficiency	The Firm Efficiency score calculated in Demerjian et. al. (2012), with values ranging from zero to one.	Peter Demerjian website https://peterdemerjian.weebly.com/managerialability.html
VIX	CBOE S&P 500 Volatility Index is the equity market volatility index	Wharton Research Data Services
DefaultSpread	Defined as the difference in yields between BBB bonds and AAA bonds.	SDC and Authors' calculation
TermSpread	Term spread is the difference between the Federal Reserve Bank's ten-year and one-year benchmark Treasury Yields	FRED and authors' calculation

FIGURE I: Bond credit rating and yield spread over firm life cycle



Note: The figure shows credit rating and yield spread over firm life cycle. The x-axis is life stages of introduction, growth, mature, shakeout, and decline defined in Table A1 of the Appendix. The y-axis is credit rating, and the z-axis is the corresponding yield spreads.

TABLE 1: Sample distribution

Year	N	*YieldSpread*	*Rating*	*Intro*	*Growth*	*Mature*	*Shakeout*	*Decline*	*RE/TA*	*RE/TE*
1991	28	1.349	7.036	0.000	0.857	0.143	0.000	0.000	0.257	0.777
1992	219	1.649	8.434	0.014	0.411	0.489	0.082	0.005	0.143	0.942
1993	266	1.713	8.752	0.041	0.391	0.489	0.064	0.015	0.196	0.638
1994	155	1.704	8.974	0.039	0.348	0.568	0.032	0.013	0.156	0.725
1995	249	1.384	8.241	0.024	0.426	0.478	0.052	0.020	0.202	0.666
1996	290	1.657	9.048	0.045	0.552	0.352	0.038	0.014	0.191	-0.793
1997	415	1.694	9.537	0.051	0.494	0.417	0.039	0.000	0.191	-3.608
1998	584	1.752	8.902	0.062	0.420	0.479	0.036	0.003	0.180	0.987
1999	341	2.322	9.123	0.067	0.402	0.469	0.059	0.003	0.168	0.762
2000	170	2.455	8.265	0.088	0.388	0.465	0.059	0.000	0.224	0.909
2001	406	2.503	7.990	0.034	0.313	0.601	0.052	0.000	0.247	1.142
2002	372	2.174	8.215	0.035	0.266	0.624	0.067	0.008	0.271	0.880
2003	338	2.928	10.743	0.050	0.219	0.639	0.071	0.021	0.120	0.981
2004	276	2.145	10.826	0.062	0.228	0.630	0.069	0.011	0.100	1.241
2005	214	2.130	10.407	0.093	0.313	0.523	0.065	0.005	0.124	1.027
2006	211	1.934	10.052	0.024	0.341	0.573	0.052	0.009	0.194	0.453
2007	257	1.976	9.288	0.004	0.257	0.661	0.062	0.016	0.264	0.908
2008	225	3.009	7.742	0.000	0.231	0.720	0.044	0.004	0.331	0.917
2009	431	4.054	9.241	0.019	0.244	0.643	0.058	0.037	0.190	-1.119
2010	416	3.047	10.332	0.017	0.226	0.709	0.043	0.005	0.127	0.208
2011	414	2.631	9.430	0.010	0.184	0.744	0.063	0.000	0.228	5.205
2012	523	2.960	9.983	0.015	0.262	0.658	0.046	0.019	0.208	1.092
2013	540	2.461	9.880	0.022	0.231	0.681	0.050	0.015	0.204	3.917
2014	533	2.090	9.696	0.026	0.285	0.629	0.043	0.017	0.243	0.586
2015	555	2.223	8.993	0.009	0.198	0.755	0.032	0.005	0.262	0.544
2016	468	2.190	8.799	0.019	0.218	0.694	0.064	0.004	0.275	0.935
2017	559	1.986	9.485	0.020	0.202	0.723	0.047	0.009	0.188	0.238
2018	388	1.872	9.567	0.013	0.196	0.691	0.093	0.008	0.290	2.405
2019	437	2.018	9.297	0.011	0.185	0.645	0.146	0.011	0.294	5.313
2020	875	2.946	9.024	0.018	0.165	0.715	0.095	0.007	0.266	0.372
Total/Avg	11155	2.329	9.278	0.031	0.315	0.587	0.057	0.009	0.216	1.007

Note: This table presents the sample of 11,155 bonds issued in the U.S. corporate bond market during the period of 1991-2020. It shows sample distribution of yield spread, credit rating, and various measures of firm life cycle over time. Table A1 in the Appendix provides the definitions and data sources for the variables.

TABLE 2: Descriptive statistics

Variables	Mean	Intro	Growth	Mature	Shakeout	Decline
N	11155	325	3126	6924	671	109
YieldSpread	2.329	4.193	2.715	2.010	2.616	4.270
Rating	9.278	13.215	10.544	8.401	9.955	12.817
RE/TA	0.216	-0.035	0.137	0.272	0.157	-0.058
RE/TE	1.007	-5.189	1.041	1.595	0.002	-12.244
IssueSize	5.817	5.389	5.601	5.923	5.963	5.692
TTM	11.217	8.436	10.883	11.580	10.813	8.571
Senior	0.192	0.425	0.235	0.161	0.191	0.266
HighTech	0.362	0.305	0.297	0.384	0.478	0.303
Simoffer	0.470	0.178	0.341	0.544	0.481	0.248
Rule144a	0.283	0.597	0.384	0.216	0.320	0.523
TAsset	30.598	9.663	19.147	37.255	28.314	12.610
MB	3.731	2.269	2.643	4.340	3.524	1.875
LEV	0.338	0.418	0.379	0.314	0.338	0.398
RD	0.016	0.010	0.010	0.019	0.024	0.017
TANG	0.359	0.204	0.431	0.348	0.243	0.185
CAPX	0.064	0.051	0.094	0.055	0.036	0.024
Age	31.846	18.034	24.687	35.685	32.672	29.349
FinDistress	1.419	-1.822	1.015	1.833	1.057	-1.422
FirmEfficiency	0.507	0.406	0.443	0.543	0.492	0.480
VIX	19.929	19.323	19.348	20.209	20.199	18.945
DefaultSpread	0.972	0.874	0.913	1.001	0.988	1.029
TermSpread	1.445	1.324	1.379	1.488	1.329	1.719

Note: This table presents the descriptive statistics for variables used in the main regression analysis of the impact of firm life cycle on the cost of debt. The sample period is 1991–2020. Table A1 in the Appendix provides the definitions and data sources for the variables.

TABLE 3: The impact of firm life cycle on credit ratings

	(1)	(2)	(3)
	Full Sample	Investment Grade Bonds	High Yield Bonds
VARIABLES	*Rating*	*Rating*	*Rating*
Intro	0.724***	0.408	0.311*
	(3.15)	(0.94)	(1.67)
Growth	-0.372***	-0.054	-0.211*
	(-2.66)	(-0.32)	(-1.74)
Mature	-0.741***	-0.294**	-0.399***
	(-5.92)	(-1.97)	(-3.49)
Decline	0.927***	0.442	0.412*
	(3.91)	(0.86)	(1.93)
IssueSize	0.092	0.229*	-0.278***
	(0.77)	(1.78)	(-5.27)
TTM	-0.018***	-0.002	-0.073***
	(-5.37)	(-0.56)	(-7.69)
Senior	0.550***	0.269**	-0.301***
	(6.52)	(2.43)	(-4.34)
HighTech	-0.405*	-0.310	-0.018
	(-1.86)	(-1.11)	(-0.14)
SimOffer	-0.765***	-0.067	-0.436***
	(-8.84)	(-0.86)	(-4.14)
Rule144a	2.126***	0.389***	0.933***
	(18.84)	(2.88)	(9.36)
TAsset	-1.401***	-0.014***	-0.008**
	(-5.56)	(-5.81)	(-2.43)
MB	-0.019***	-0.016**	-0.012*
	(-2.68)	(-2.32)	(-1.75)
LEV	4.645***	2.548***	2.043***
	(14.08)	(4.80)	(10.10)
RD	-6.614**	-3.473	-0.987
	(-2.22)	(-0.99)	(-0.42)
TANG	-0.856*	-0.257	-0.625***
	(-1.93)	(-0.36)	(-2.59)
CAPX	0.093	-3.113	1.884***
	(0.09)	(-1.62)	(3.05)
Age	-0.023***	-0.013***	-0.011***
	(-6.45)	(-3.50)	(-4.01)
FinDistress	-0.077***	-0.096***	-0.023*
	(-3.54)	(-4.06)	(-1.88)
FirmEfficiency	-3.141***	-2.319***	-1.188***
	(-7.79)	(-5.10)	(-4.02)
VIX	-0.021***	-0.011**	-0.010
	(-3.64)	(-2.10)	(-1.21)

DefaultSpread	0.192	0.112	-0.175
	(1.27)	(0.79)	(-1.00)
TermSpread	0.334***	0.110	0.187**
	(4.01)	(1.31)	(2.33)
Constant	9.281***	8.261***	14.263***
	(8.75)	(8.35)	(18.80)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
N	11,155	7,680	3,475
R^2	0.710	0.485	0.353

Note: This table presents the estimation results obtained by regressing credit rating (*Rating*) on life cycle stages (*Intro*, *Growth*, *Mature*, *Decline*) and on controls of issue- and issuer-specific characteristics, as well as market conditions. Column 1 is for the full sample. Columns 2 and 3 are for the subsample of investment grade bonds and high yield bonds, respectively. Investment grade bonds are the one with credit ratings of Baa3 or better and high yield bonds are the one with credit ratings of Ba1 or worse. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry and year fixed effects. The industry controls are based on the 48 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels. t-statistics based on robust standard errors with clustering at the firm level are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

TABLE 4: The impact of firm life cycle on the cost of debt

	(1)	(2)	(3)	(4)	(5)	(6)
	Full sample		Investment Grade Bonds		High Yield Bonds	
VARIABLES	*YieldSpread*	*YieldSpread*	*YieldSpread*	*YieldSpread*	*YieldSpread*	*YieldSpread*
Intro	0.714***	0.468***	0.428*	0.364*	0.557***	0.414***
	(4.75)	(4.19)	(1.80)	(1.85)	(3.55)	(3.24)
Growth	-0.273***	-0.146**	-0.009	-0.001	-0.287**	-0.190*
	(-3.44)	(-2.21)	(-0.15)	(-0.02)	(-2.52)	(-1.93)
Mature	-0.375***	-0.123**	-0.066	-0.020	-0.348***	-0.164*
	(-4.97)	(-2.02)	(-1.15)	(-0.38)	(-3.22)	(-1.75)
Decline	0.822***	0.507**	0.301	0.233	0.544**	0.354*
	(3.49)	(2.53)	(0.91)	(0.85)	(2.47)	(1.77)
Rating		0.340***		0.156***		0.461***
		(26.48)		(14.91)		(26.71)
IssueSize	-0.054**	-0.085***	0.081***	0.045***	-0.318***	-0.190***
	(-1.96)	(-3.26)	(3.35)	(3.19)	(-6.01)	(-4.23)
TTM	0.001	0.007***	0.013***	0.014***	-0.103***	-0.069***
	(0.39)	(4.46)	(10.01)	(10.77)	(-6.03)	(-4.12)
Senior	0.168***	-0.019	0.052	0.010	-0.194***	-0.055
	(3.53)	(-0.52)	(1.41)	(0.28)	(-3.37)	(-1.13)
HighTech	-0.154**	-0.017	-0.111*	-0.063	0.028	0.036
	(-2.10)	(-0.28)	(-1.65)	(-1.17)	(0.22)	(0.32)
SimOffer	-0.468***	-0.208***	-0.119***	-0.108***	-0.165**	0.035
	(-10.87)	(-6.42)	(-4.09)	(-4.02)	(-1.98)	(0.49)
Rule144a	1.302***	0.580***	0.255***	0.195***	0.734***	0.304***
	(20.67)	(10.83)	(4.34)	(3.44)	(9.73)	(4.52)
TAsset	-0.001***	0.003***	-0.002***	0.000	0.009**	0.012***
	(-2.67)	(4.27)	(-5.07)	(1.06)	(2.51)	(4.68)
MB	-0.011***	-0.004**	-0.005**	-0.002	-0.016***	-0.010***
	(-3.03)	(-2.01)	(-2.31)	(-1.42)	(-3.53)	(-2.75)
LEV	1.813***	0.235*	0.235	-0.162	0.845***	-0.096
	(10.98)	(1.86)	(1.63)	(-1.40)	(4.67)	(-0.61)
RD	-0.983	1.263	-0.797	-0.255	-0.139	0.315
	(-1.02)	(1.23)	(-1.15)	(-0.37)	(-0.07)	(0.20)
TANG	0.178	0.469***	0.003	0.043	0.409**	0.696***
	(1.15)	(3.19)	(0.02)	(0.34)	(2.02)	(3.82)
CAPX	0.374	0.342	0.059	0.545	0.741	-0.127
	(0.71)	(0.76)	(0.11)	(1.16)	(1.23)	(-0.25)
Age	-0.007***	0.001	-0.003***	-0.001	-0.001	0.004**
	(-5.62)	(0.84)	(-3.19)	(-1.07)	(-0.44)	(2.07)
FinDistress	-0.024**	0.003	-0.024***	-0.009	-0.008	0.003
	(-2.21)	(0.40)	(-3.45)	(-1.55)	(-0.72)	(0.25)
FirmEfficiency	-1.339***	-0.272**	-0.656***	-0.294***	-1.645***	-1.098***
	(-10.09)	(-2.32)	(-6.29)	(-3.27)	(-8.10)	(-6.38)

VIX	0.024***	0.031***	0.026***	0.028***	0.074***	0.079***
	(7.80)	(12.17)	(10.32)	(11.74)	(9.51)	(10.82)
DefaultSpread	1.002***	0.937***	1.084***	1.067***	0.608***	0.689***
	(10.37)	(11.60)	(12.34)	(12.80)	(3.76)	(4.43)
TermSpread	0.120***	0.006	0.047	0.030	-0.159**	-0.245***
	(2.84)	(0.18)	(1.34)	(0.96)	(-2.16)	(-3.77)
Constant	1.123***	-2.029***	0.317	-0.971***	4.195***	-2.374***
	(3.70)	(-6.62)	(1.52)	(-4.48)	(7.60)	(-4.59)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	11,155	11,155	7,680	7,680	3,475	3,475
R^2	0.575	0.713	0.466	0.526	0.467	0.604

Note: This table presents the estimation results obtained by regressing the cost of debt (*YieldSpread*) on life cycle stages (*Intro*, *Growth*, *Mature*, *Decline*) and on controls of issue- and issuer-specific characteristics, as well as market conditions. Columns 1 and 2 are for the full sample. Columns 3 and 4 are for the subsample of investment grade bonds whereas Columns 5 and 6 are for the subsample of high yield bonds. Investment grade bonds are the one with credit ratings of Baa3 or better and high yield bonds are the one with credit ratings of Ba1 or worse. Columns 1, 3, and 5 exclude rating as a control variable (*Rating*) whereas Columns 2, 4, and 6 control for *Rating*. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry and year fixed effects. The industry controls are based on the 48 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels. t-statistics based on robust standard errors with clustering at the firm level are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

TABLE 5: Robustness tests: Alternative measures of firm life cycle

	(1)	(2)	(3)	(4)	(5)	(6)
	RE/TA			RE/TE		
VARIABLES	*Rating*	*YieldSpread*	*YieldSpread*	*Rating*	*YieldSpread*	*YieldSpread*
LifeStage	-2.753***	-1.201***	-0.299***	-0.360***	-0.192***	-0.077***
	(-12.72)	(-11.94)	(-3.59)	(-8.69)	(-8.72)	(-4.55)
Rating			0.328***			0.318***
			(24.53)			(24.75)
IssueSize	0.132	-0.034	-0.077***	0.103	-0.041	-0.074***
	(1.17)	(-1.33)	(-3.01)	(0.84)	(-1.48)	(-3.00)
TTM	-0.015***	0.002	0.007***	-0.015***	0.002	0.007***
	(-4.74)	(0.91)	(4.32)	(-4.60)	(1.13)	(4.49)
Senior	0.525***	0.162***	-0.010	0.595***	0.209***	0.020
	(6.53)	(3.39)	(-0.25)	(6.73)	(4.17)	(0.51)
HighTech	-0.473**	-0.177**	-0.022	-0.501**	-0.212***	-0.053
	(-2.22)	(-2.43)	(-0.36)	(-2.15)	(-2.80)	(-0.86)
SimOffer	-0.629***	-0.404***	-0.198***	-0.659***	-0.413***	-0.204***
	(-7.81)	(-9.49)	(-5.90)	(-7.74)	(-9.55)	(-6.05)
Rule144a	1.946***	1.232***	0.595***	2.062***	1.250***	0.594***
	(16.92)	(18.28)	(10.38)	(17.14)	(18.19)	(10.20)
TAsset	-1.478***	-0.163***	0.321***	-1.458***	-0.160***	0.304***
	(-6.08)	(-2.77)	(3.97)	(-5.74)	(-2.99)	(3.92)
MB	-0.015**	-0.008***	-0.003*	-0.022*	-0.009	-0.001
	(-2.48)	(-3.02)	(-1.77)	(-1.80)	(-1.51)	(-0.53)
LEV	3.117***	1.170***	0.149	5.007***	1.783***	0.191
	(9.19)	(6.86)	(1.13)	(12.12)	(9.14)	(1.22)
RD	-6.225**	-0.586	1.453	-4.852	-0.102	1.441
	(-2.09)	(-0.57)	(1.38)	(-1.64)	(-0.11)	(1.37)
TANG	-0.753*	0.203	0.449***	-1.005**	0.100	0.420***
	(-1.69)	(1.30)	(2.85)	(-2.08)	(0.64)	(2.64)
CAPX	0.314	0.360	0.257	0.854	0.439	0.168
	(0.31)	(0.71)	(0.54)	(0.77)	(0.86)	(0.35)
Age	-0.017***	-0.004***	0.001	-0.021***	-0.006***	0.001
	(-4.92)	(-3.41)	(1.08)	(-6.15)	(-5.28)	(0.84)
FinDistress	-0.069***	-0.023*	-0.000	-0.067**	-0.023*	-0.002
	(-2.97)	(-1.94)	(-0.03)	(-2.53)	(-1.76)	(-0.20)
FirmEfficiency	-3.128***	-1.346***	-0.322***	-3.087***	-1.277***	-0.295**
	(-7.73)	(-9.89)	(-2.75)	(-7.63)	(-9.59)	(-2.52)
VIX	-0.020***	0.025***	0.032***	-0.021***	0.024***	0.031***
	(-3.46)	(8.03)	(12.18)	(-3.46)	(7.62)	(11.53)
DefaultSpread	0.204	0.954***	0.887***	0.164	0.951***	0.899***
	(1.40)	(9.61)	(10.60)	(1.09)	(9.87)	(10.62)
TermSpread	0.313***	0.118***	0.015	0.261***	0.103**	0.020
	(3.91)	(2.82)	(0.43)	(3.11)	(2.48)	(0.56)

Constant	11.526***	3.127***	-0.648	9.311***	1.529*	-1.433**
	(9.47)	(4.18)	(-0.92)	(6.84)	(1.88)	(-1.96)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
N	10,723	10,723	10,723	10,202	10,202	10,202
R^2	0.736	0.592	0.709	0.713	0.581	0.704

Note: This table presents the estimation results obtained by regressing credit rating (*Rating*) and the cost of debt (*YieldSpread*) on alternative retained earnings based life cycle measures and on controls of issue- and issuer-specific characteristics, as well as market conditions. The dependent variable in Column 1 is *Rating* whereas the dependent variable in Columns 2 and 3 is *Yield Spread*. The independent variables in Columns 1-3 are the ratio of retained earnings to total assets (*RE/TA*) whereas the independent variables in Columns 4-6 are the ratio of retained earnings to total equity (*RE/TE*), respectively. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry and year fixed effects. The industry controls are based on the 48 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels. t-statistics based on robust standard errors with clustering at the firm level are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

TABLE 6: Subsample analyses: Non-crisis period

VARIABLES	(1) *Rating*	(2) *YieldSpread*	(3) *YieldSpread*
Intro	0.678***	0.677***	0.446***
	(2.77)	(4.38)	(3.97)
Growth	-0.335**	-0.283***	-0.169**
	(-2.27)	(-3.42)	(-2.45)
Mature	-0.709***	-0.350***	-0.109*
	(-5.47)	(-4.48)	(-1.70)
Decline	0.983***	0.842***	0.507***
	(4.12)	(4.27)	(2.93)
Rating			0.341***
			(25.53)
IssueSize	0.093	-0.056*	-0.088***
	(0.71)	(-1.90)	(-3.18)
TTM	-0.017***	0.004**	0.010***
	(-5.07)	(2.09)	(6.78)
Senior	0.590***	0.218***	0.017
	(6.64)	(4.39)	(0.43)
HighTech	-0.431*	-0.142*	0.005
	(-1.94)	(-1.85)	(0.08)
SimOffer	-0.755***	-0.441***	-0.183***
	(-8.44)	(-10.16)	(-5.88)
Rule144a	2.127***	1.312***	0.587***
	(18.55)	(20.57)	(10.70)
TAsset	-0.014***	-0.001**	0.004***
	(-5.72)	(-2.18)	(4.93)
MB	-0.019***	-0.011***	-0.005**
	(-2.80)	(-3.56)	(-2.50)
LEV	4.818***	1.897***	0.255**
	(14.32)	(11.53)	(2.00)
RD	-7.010**	-1.010	1.379
	(-2.24)	(-1.09)	(1.27)
TANG	-1.052**	0.083	0.441***
	(-2.30)	(0.52)	(2.97)
CAPX	0.146	0.772	0.723
	(0.13)	(1.42)	(1.55)
Age	-0.023***	-0.007***	0.000
	(-6.19)	(-6.04)	(0.28)
FinDistress	-0.087***	-0.025**	0.005
	(-3.87)	(-2.17)	(0.73)
FirmEfficiency	-3.005***	-1.354***	-0.330***
	(-7.11)	(-9.87)	(-2.76)
VIX	-0.022***	0.024***	0.032***
	(-3.52)	(7.28)	(11.49)

DefaultSpread	0.038	0.965***	0.952***
	(0.16)	(7.04)	(8.61)
TermSpread	0.275***	0.105**	0.011
	(3.26)	(2.41)	(0.30)
Constant	11.478***	3.249***	-0.663
	(8.57)	(3.34)	(-0.67)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
N	10,084	10,084	10,084
R^2	0.715	0.579	0.727

Note: This table presents the subsample test results obtained by regressing credit ratings (*Rating*) and the yield spread (*YieldSpread*) on life cycle stages (*Intro*, *Growth*, *Mature*, *Decline*) and on controls of issue- and issuer-specific characteristics, as well as market conditions. Columns 1-3 cover non-financial crisis period only, excluding the financial crisis period of years 1997, 2008, and 2009. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry and year fixed effects. The industry controls are based on the 48 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels. t-statistics based on robust standard errors with clustering at the firm level are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

TABLE 7: The impact of firm life cycle on non-price terms: Time to maturity

VARIABLES	(1) *TTM*	(2) *TTM*
Intro	-0.875**	-0.697**
	(-2.53)	(-2.01)
Growth	0.112	0.021
	(0.38)	(0.07)
Mature	0.103	-0.076
	(0.37)	(-0.28)
Decline	-1.480***	-1.250***
	(-3.17)	(-2.77)
Rating		-0.242***
		(-5.60)
IssueSize	0.900***	0.918***
	(7.73)	(8.05)
Senior	-0.750***	-0.614***
	(-4.11)	(-3.36)
HighTech	-0.188	-0.285
	(-0.62)	(-0.90)
SimOffer	0.911***	0.722***
	(3.86)	(3.02)
Rule144a	-1.997***	-1.475***
	(-9.14)	(-6.62)
TAsset	-0.144	-0.482
	(-0.44)	(-1.38)
MB	0.014	0.009
	(1.25)	(0.79)
LEV	-1.402***	-0.274
	(-2.68)	(-0.49)
RD	0.840	-0.761
	(0.19)	(-0.18)
TANG	2.268***	2.052***
	(2.89)	(2.59)
CAPX	-4.739***	-4.697***
	(-2.78)	(-2.75)
Age	0.003	-0.003
	(0.47)	(-0.49)
FinDistress	0.048	0.029
	(1.20)	(0.74)
FirmEfficiency	1.270**	0.506
	(1.99)	(0.74)
VIX	0.013	0.008
	(0.91)	(0.55)

DefaultSpread	-1.496***	-1.444***
	(-3.96)	(-3.81)
TermSpread	-0.480***	-0.397**
	(-2.60)	(-2.13)
Constant	4.592***	6.814***
	(3.41)	(4.65)
Year FE	Yes	Yes
Industry FE	Yes	Yes
N	11,155	11,155
R^2	0.091	0.095

Note: This table presents the estimation results obtained by regressing nonprice contract terms – bond maturity (*TTM*) – on life cycle stages (*Intro*, *Growth*, *Mature*, *Decline*) and on controls of issue- and issuer-specific characteristics, as well as market conditions. Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry and year fixed effects. The industry controls are based on the 48 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels. t-statistics based on robust standard errors with clustering at the firm level are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.

TABLE 8: Instrumental variables regressions

	(1)	(2)	(3)	(4)	(5)
	Panel A: First-stage results				Panel B: Second-stage results
VARIABLES	*Intro*	*Growth*	*Mature*	*Decline*	*YieldSpread*
LagIntro/PredIntro	0.222***	-0.125***	-0.103***	0.013	1.565***
	(6.25)	(-2.98)	(-3.14)	(1.04)	(4.16)
LagGrowth/PredGrowth	-0.022**	0.125***	-0.074***	0.004	-0.282***
	(-2.23)	(5.61)	(-3.09)	(0.72)	(-2.83)
LagMature/PredMature	-0.024***	0.011	0.063***	0.007	-0.162**
	(-2.74)	(0.59)	(2.81)	(1.07)	(-2.23)
LagDecline/PredDecline	0.029	0.078	-0.189***	0.129***	0.731**
	(0.81)	(1.41)	(-3.71)	(2.76)	(2.09)
Chg21Decline	0.042***	0.040*	-0.427***	-0.082***	
	(3.86)	(1.92)	(-11.79)	(-3.16)	
Con10Deacline	-0.180***	-0.023	-0.083	0.832***	
	(-2.94)	(-0.59)	(-1.34)	(26.68)	
SICLeader	-0.068***	-0.403***	0.505***	-0.005***	
	(-10.84)	(-36.66)	(51.62)	(-3.81)	
SICLaggard	0.076***	0.429***	-0.466***	-0.007***	
	(11.23)	(38.33)	(-50.34)	(-4.57)	
Rating	0.004***	0.005*	-0.010***	0.001**	0.332***
	(3.72)	(1.67)	(-3.89)	(2.51)	(25.95)
IssueSize	0.001	0.020**	-0.020**	0.000	-0.084***
	(0.44)	(2.19)	(-2.44)	(0.19)	(-3.33)
TTM	-0.000*	0.001**	-0.001	-0.000*	0.007***
	(-1.82)	(1.97)	(-1.47)	(-1.78)	(4.64)
Senior	0.009	-0.006	-0.004	-0.002	-0.031
	(1.55)	(-0.50)	(-0.38)	(-0.78)	(-0.82)
HighTech	0.003	-0.013	0.011	-0.001	-0.023
	(0.35)	(-0.77)	(0.64)	(-0.23)	(-0.38)
SimOffer	0.002	-0.010	0.012	-0.000	-0.213***
	(0.60)	(-0.86)	(1.00)	(-0.23)	(-6.48)
Rule144a	-0.004	0.009	-0.003	0.004	0.575***
	(-0.57)	(0.61)	(-0.24)	(1.36)	(10.69)
TAsset	0.012**	-0.003	-0.012	0.001	0.321***
	(2.18)	(-0.28)	(-0.90)	(0.40)	(4.18)
MB	0.000	-0.001	0.001	-0.000	-0.004*
	(0.20)	(-1.11)	(1.31)	(-0.88)	(-1.92)
LEV	0.005	0.193***	-0.190***	0.005	0.247*
	(0.39)	(5.28)	(-5.15)	(0.62)	(1.93)
RD	0.176*	-0.382	0.238	0.094	0.897
	(1.81)	(-1.62)	(0.95)	(1.11)	(0.89)
TANG	-0.069***	-0.147***	0.234***	-0.009	0.565***
	(-4.37)	(-3.26)	(5.61)	(-1.43)	(3.83)

CAPX	0.052	1.287***	-1.292***	-0.019	0.399
	(1.11)	(9.57)	(-10.39)	(-0.68)	(0.87)
Age	0.000	-0.000	0.000	0.000	0.001
	(0.74)	(-0.91)	(0.87)	(0.01)	(0.78)
FinDistress	-0.000	-0.008***	0.007***	0.001**	0.002
	(-0.21)	(-2.79)	(2.72)	(2.10)	(0.33)
FirmEfficiency	-0.018	-0.119***	0.120***	0.007	-0.261**
	(-1.39)	(-3.47)	(3.47)	(1.19)	(-2.18)
VIX	0.000	0.001	-0.001	0.000	0.031***
	(0.16)	(0.92)	(-1.38)	(0.68)	(12.31)
DefaultSpread	0.005	-0.014	0.016	-0.008	0.934***
	(0.52)	(-0.64)	(0.70)	(-1.00)	(11.63)
TermSpread	-0.001	-0.029**	0.040***	-0.000	0.004
	(-0.27)	(-2.26)	(3.05)	(-0.10)	(0.11)
Constant	0.049	0.041	0.943***	-0.035***	-2.291***
	(0.87)	(0.34)	(8.52)	(-2.72)	(-7.26)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
N	11,155	11,155	11,155	11,155	11,155
R^2	0.265	0.437	0.562	0.349	0.704
Panel C: Test of endogeneity, weak instruments, under- and overidentification					
Cluster-robust C statistics	17.592 (p = 0.0015)				
Cluster-robust Kleibergen-Paap rk Wald F statistic	12.472 (critical value* = 9.01)				
Kleibergen-Paap rk LM statistic	92.402 (p = 0.0000)				
Hansen J statistic	3.102 (p = 0.5409)				

Note: This table presents the estimation results from two-stage least squares (2SLS) regressions. Panel A reports the first-stage results and Panel C reports the second-stage results. In the first stage, we regress the presence of life stages (*Intro*, *Growth*, *Mature*, *Decline*) on the instrumental variables (*LagIntro*, *LagGrowth*, *LagMature*, *LagDecline*, *Ch21Decline*, *Con10Decline*) and on controls of issue- and issuer-specific characteristics, as well as market conditions, respectively. *LagIntro*, *LagGrowth*, *LagMature*, *LagDecline* are two-year lagged life cycle measures. *Ch21Decline* is an indicator variable set to one if an issuing firm is transiting from the mature stage two-years-ago to the shake-out stage one-year-ago or from the shake-out stage two-years-ago to the decline stage one-year-ago, and zero otherwise. *Con10Decline* is an indicator variable set to one if an issuing firm's life stage keeps constant at the decline stage during both current year and one-year-ago, and zero otherwise. In the second stage, we regress the yield spread (*YieldSpread*) on the predicted values from the first stage regressions and on controls of issue- and issuer-specific characteristics, as well as market conditions. Panel B presents the tests of endogeneity, weak instruments, under- and over-identification, where # denotes Stock and Yogo (2005) 10% maximal IV relative bias (critical value). Table A1 in the Appendix provides the definitions and data sources for the regression variables. All regressions include industry and year fixed effects. The industry controls are based on the 48 Fama-French industry classification codes. All continuous control variables are winsorized at the 1% and 99% levels. t-statistics based on robust standard errors with clustering at the firm level are reported in parentheses.

*** Significant at the 1% level.

** Significant at the 5% level.

* Significant at the 10% level.