Capital Age and Debt Maturity: Evidence from U.S. Public Firms on Asset Life and Financing Cycles

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Abstract

This paper examines how firms' capital age and asset life influence their financing decisions, specifically focusing on debt maturity and leverage cycles. Using a comprehensive dataset of U.S. public firms from 1995 to 2023, we document that capital age is negatively related to both leverage and debt maturity, while asset life is positively associated with debt maturity and the length of debt cycles. We develop a dynamic model in which firms issue debt to finance investment and subsequently deleverage as capital ages to create financial slack for future replacement investments. Our model predicts that firms issue debt with a maturity that matches the useful life of their assets and with a repayment schedule that reflects the need to free up debt capacity as capital ages. These dynamics generate financing cycles where leverage and debt maturity decrease as capital ages. Cross-sectional tests reveal that the length of debt cycles and average debt maturity increase with asset life. Our findings help reconcile conflicting evidence on the maturity matching principle and demonstrate that both capital age and asset life are critical determinants of corporate financing choices.

Keywords: Capital age, Asset life, Maturity matching, Debt cycles, Financing decisions
JEL Classification: G32, G30, E22, D92

1. Introduction

Capital aging is an inevitable process that ultimately necessitates replacement investment. This fundamental economic reality has substantial implications for corporate financing decisions that have received limited attention in existing literature. When firms plan for the replacement of aging capital, how does this affect their leverage choices and debt maturity structure? This paper addresses this question by examining the relationships between capital age, asset life, leverage, and debt maturity.

Our study is motivated by several empirical patterns that have not been fully explained by existing theories. First, firms experience clear debt cycles where leverage spikes around major investments and subsequently decreases until the next investment spike (DeAngelo, DeAngelo, and Whited, 2023; Denis and McKeon, 2022). Second, despite the widespread belief in a “maturity matching principle” among practitioners (Graham, 2022), empirical evidence on the relationship between asset maturity and debt maturity is mixed. Notably, Stohs and Mauer (1996) document a positive cross-sectional relationship between asset maturity and debt maturity, while Custódio, Ferreira, and Laureano (2013) find no significant relationship in panel regressions with firm fixed effects.

To explain these patterns, we propose a dynamic model in which capital aging is strongly associated with financing decisions. In our model, firms borrow to finance investment and then optimally deleverage as capital ages to create financial slack for future replacement investments. To minimize issuance costs, firms issue debt with a maturity that approximately matches the useful life of new assets and with a repayment schedule that progressively frees up debt capacity. This behavior generates cycles in which both leverage and debt maturity decrease as capital ages.

Our model generates two key testable predictions: (1) leverage and debt maturity should be negatively related to capital age in the time series, and (2) average debt maturity and the duration of debt cycles should be positively related to asset life in the cross-section. We test these predictions using a comprehensive panel of U.S. public firms from 1995 to 2023.

Consistent with our model's predictions, we find strong evidence that capital age is negatively related to both leverage and debt maturity, even after controlling for standard determinants of leverage and maturity. Capital age is associated with a 3.8 percentage point decrease in net book leverage and a 0.421-year decrease in debt maturity. These effects are economically significant and robust to various specifications and alternative measures of capital age.

We also find strong support for our cross-sectional predictions. Firms with longer-lived assets tend to have longer debt cycles and longer average debt maturity. A one standard deviation increase in asset life is associated with a 0.96-year increase in average debt maturity and a 1.24-year increase in the length of debt cycles. These findings help reconcile the conflicting evidence on the maturity matching principle: asset life primarily explains cross-sectional variation in debt maturity, while capital age shapes time-series variation.

While prior studies have examined either cross-sectional determinants of debt maturity (Stohs and Mauer, 1996; Barclay and Smith, 1995) or time-series dynamics of leverage (DeAngelo, DeAngelo, and Whited, 2023), none has jointly modeled the dual role of capital age and asset life as distinct drivers of financing decisions. The key insight of our reconciliation is methodological: studies using cross-sectional or pooled regressions capture the asset life effect and find maturity matching, while studies using firm fixed effects absorb the cross-sectional variation and find only the time-series capital age effect — which can appear as a lack of maturity matching. Our framework unifies both results within a single dynamic model. We demonstrate this reconciliation empirically in Section 5.3.2, where we show that the coefficient on asset life becomes insignificant once firm fixed effects absorb the cross-sectional variation.

Our paper makes several contributions to the literature. First, we advance the understanding of dynamic capital structure choices by highlighting the role of capital age and asset life in determining both leverage and debt maturity. Previous research has focused primarily on either leverage (DeAngelo, DeAngelo, and Whited, 2023; Denis and

McKeon, 2022) or debt maturity (Choi, Hackbarth, and Zechner, 2021; Parise, Colla, and Filippo, 2023), but has not fully explored the interconnection between these dimensions.

Second, we provide a theoretical foundation for the widely observed debt cycles in corporate financing. Our model shows that these cycles arise naturally from firms' optimal response to the need for planned replacement investments. This complements existing explanations based on market timing (Baker and Wurgler, 2002), adjustment costs (Leary and Roberts, 2005), or financial flexibility (Denis and McKeon, 2022).

Third, we reconcile conflicting empirical evidence on the maturity matching principle. By distinguishing between the roles of capital age and asset life, we explain why some studies find support for maturity matching while others do not. This resolution has implications for how researchers should approach the study of debt maturity choices.

Finally, our paper contributes to the growing literature on the economic implications of capital age. Recent studies have explored the effects of capital age on asset pricing (Lin, Palazzo, and Yang, 2020), investment decisions (Livdan and Nezlobin, 2022), and firm value (Belo, Gala, Salomao, and Vitorino, 2022). Our paper extends this line of research by documenting the significant role of capital age on financing decisions.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 presents our theoretical model and derives testable predictions. Section 4 describes our data and methodology. Section 5 presents our empirical results. Section 6 discusses the implications of our findings, and Section 7 concludes.

2. Literature Review

Our paper builds on several strands of the literature on corporate financing decisions. The first strand focuses on dynamic capital structure choices. Beginning with Fischer, Heinkel, and Zechner (1989) and continued by Leary and Roberts (2005), Lemmon, Roberts, and Zender (2008), and DeAngelo, DeAngelo, and Whited (2023), this literature examines how firms adjust their capital structures over time in response to various factors. A key finding from this literature is that firms tend to follow target leverage ratios but deviate temporarily due to adjustment costs or financing needs.

DeAngelo, DeAngelo, and Whited (2023) develop a dynamic model in which firms use transitory debt to finance investment and subsequently pay it down to maintain financial flexibility. Denis and McKeon (2022) provide empirical evidence that firms make large leverage increases primarily to fund investment and then actively reduce leverage over time. Our paper extends this literature by explicitly modeling the role of capital age and asset life in these dynamic financing decisions.

The second strand of literature examines debt maturity choices. Building on the seminal work of Myers (1977) and Diamond (1991), recent studies by Choi, Hackbarth, and Zechner (2021) and Parise, Colla, and Filippo (2023) have examined how firms determine the maturity structure of their debt. A central concept in this literature is the "maturity matching principle," which suggests that firms should match the maturity of their assets and liabilities to reduce refinancing risk.

Empirical evidence on maturity matching is mixed. Stohs and Mauer (1996) and Graham and Harvey (2001) find support for the principle, while Custódio, Ferreira, and Laureano (2013) find that debt maturity has declined over time despite relatively stable asset maturity. Our paper helps reconcile these findings by distinguishing between cross-sectional and time-series effects.

The third relevant strand of literature examines the economic implications of capital age. This relatively new line of research includes Lin, Palazzo, and Yang (2020), who study the asset pricing implications of capital age, and Livdan and Nezlobin (2022), who examine the relationship between capital age, investment, and firm value. Our paper contributes to this literature by exploring how capital age affects financing decisions.

Finally, our paper relates to the literature on cash flow-based borrowing constraints. Lian and Ma (2021) document that the majority of corporate debt in the U.S. is based on cash flow rather than asset-based constraints. Block, Jang, Kaplan, and Schulze (2023) find similar patterns in private debt markets. Our model incorporates cash flow-based constraints, which are crucial for understanding the relationship between capital age and leverage dynamics.

Our paper also speaks to an emerging international literature on debt maturity and capital structure. Billett, King, and Mauer (2007) show that growth opportunities interact with maturity matching, documenting how firms adjust debt maturity in response to asset characteristics. Antoniou, Guney, and Paudyal (2006) examine capital structure determinants in France, Germany, and the UK, finding that institutional differences shape leverage choices. Fan, Titman, and Twite (2012), using data from 39 countries published in the Journal of Financial and Quantitative Analysis, show that a country's legal and tax environment significantly affects debt maturity decisions. Demirguc-Kunt and Maksimovic (1999) provide evidence from developing economies that financial market development shapes debt maturity choices. These international findings suggest that while our model is estimated on U.S. data, the underlying mechanism — capital aging shaping financing cycles — is likely to operate across institutional settings, a promising avenue for future research.

3. Theoretical Framework

3.1. Model Setup

We develop a discrete-time dynamic model of investment and financing in which capital ages and must eventually be replaced. Time is indexed by $t \in \{0, 1, 2, \ldots\}$. We consider a representative firm owned by risk-neutral shareholders who discount cash flows at rate $r > 0$.

The firm operates a production technology that uses capital to produce output. Capital has a finite useful life of n periods, after which it must be replaced. During its useful life, capital generates a constant cash flow of $\pi > 0$ per period. The price of new capital is K, and investment is irreversible.

The firm can finance investment using internal funds (retained earnings) or external financing (debt). Following Lian and Ma (2021), we assume that the firm faces a cash flow-based borrowing constraint:

$$D_t \leq \varphi \times \pi \tag{1}$$

where D_t is total debt at time t and $\varphi \in [\varphi, \bar{\varphi})$ is a constant multiple. This constraint reflects the common practice in corporate lending where debt capacity is tied to cash flow measures such as EBITDA.

Issuing debt incurs proportional transaction costs $\varepsilon > 0$, reflecting various frictions in debt markets (Altınkılıç and Hansen, 2000; Yasuda, 2005). The firm can issue debt with various maturities, and interest is paid each period. We assume that creditors discount cash flows at rate $\rho_D < r$, which generates an incentive for the firm to issue debt due to tax advantages or other benefits.

3.2. Optimal Investment and Financing Policies

Given this setup, we solve for the firm's optimal investment and financing policies. We first establish that the firm always replaces capital when it reaches the end of its useful life and never before, as formalized in the following proposition:

Proposition 1: The firm never defaults on its debt and replaces existing capital when it reaches the end of its useful life and never before.

This result follows from the positive NPV nature of investment and the fact that early replacement would incur unnecessary costs. Given this investment policy, we can characterize the firm's optimal financing strategy.

Let $a \in \{0, 1, \ldots, n-1\}$ denote the age of the firm's current capital. We show that the firm's optimal debt policy involves cycles that are synchronized with capital age:

Theorem 1: As capital ages, the firm frees up debt capacity to finance replacement investments, such that:

$$ND_{a+1} \leq ND_a \tag{2}$$

where ND_a is the firm's net debt when capital has age a.

This result indicates that the firm optimally reduces its leverage as capital ages to create financial slack for future replacement investment. When capital is new ($a = 0$), the firm maximizes its borrowing by setting $ND_0 = \varphi\pi$. As capital ages, the firm progressively pays down debt to ensure that it has sufficient debt capacity to finance the replacement of capital when it reaches the end of its useful life.

3.3. Debt Maturity and Capital Age

Given the presence of debt issuance costs, the firm minimizes these costs by issuing long-term debt when it invests in new capital:

Theorem 2: With debt issuance costs, the firm only issues debt when buying new capital and optimally issues debt with a maturity that matches the useful life of new assets and with a repayment schedule that reflects the need to free up debt capacity as capital ages.

This result establishes the optimality of maturity matching and explains why firms issue long-term debt rather than repeatedly rolling over short-term debt. By matching the maturity of debt to the useful life of assets, firms minimize issuance costs while ensuring that debt repayments are synchronized with the need to create financial slack for replacement investments.

The optimal debt maturity structure leads to a negative relationship between capital age and average debt maturity:

Proposition 2: Average debt maturity is decreasing in capital age:

$$M_{a+1} \leq M_a \qquad (3)$$

where M_a is the average maturity of outstanding debt when capital has age a.

This result arises because as capital ages, the remaining maturity of outstanding debt declines. Firms do not issue new debt until they invest in new capital, so there is no countervailing force to offset this natural decline in average maturity.

3.4. Cross-Sectional Implications of Asset Life

Our model also generates cross-sectional predictions related to the useful life of assets (n):

Theorem 3: Increasing the useful life of assets increases average debt maturity:

$$\Delta M_a / \Delta n \geq 0 \qquad (4)$$

Firms with longer-lived assets optimally issue debt with longer maturities to match the longer life of their assets. This leads to a positive cross-sectional relationship between asset life and debt maturity.

Similarly, our model predicts that the length of debt cycles increases with asset life. Firms with longer-lived assets experience longer periods between investments and therefore longer debt cycles.

3.5. Testable Predictions

Our theoretical model generates several testable predictions:

Prediction 1: Capital age and leverage are negatively related in the time series.

Prediction 2: Capital age and debt maturity are negatively related in the time series.

Prediction 3: The effects of capital age on leverage and debt maturity are stronger in firms with more lumpy investment and lower return on investment.

Prediction 4: Asset life and average debt maturity are positively related in the cross-section.

Prediction 5: Asset life and the duration of debt cycles are positively related in the cross-section.

We test these predictions empirically in the following sections.

We note that while our theoretical model generates clear causal predictions, the empirical tests below are associational in nature. Capital age is determined by past investment decisions, which are themselves endogenous to financing conditions. Although we control for standard determinants of leverage and debt maturity and exploit within-firm time-series variation through firm fixed effects, we cannot fully rule out reverse causality or omitted variable bias. We therefore interpret our empirical findings as consistent with the model's predictions rather than as causal estimates. Section 4.3 discusses our approach to mitigating endogeneity concerns.

3.6. Discussion of Model Assumptions

Our model assumes that the useful life of capital n is fixed, homogeneous within the firm, and known with certainty at the time of investment. In practice, however, asset lives exhibit considerable heterogeneity — both across firms and industries (e.g., utilities vs. technology firms) and within firms across different asset classes (e.g., buildings vs. equipment). In our sample, the interquartile range of useful life spans from approximately 9.5 to 17.5 years, reflecting substantial cross-sectional dispersion. Moreover, firms face genuine uncertainty about when assets will need replacement, due to technological obsolescence, demand shifts, or maintenance decisions. This heterogeneity has two implications for our predictions. First, cross-sectional variation in asset life — which we measure empirically using depreciation rates — should amplify the positive relationship between asset life and debt maturity (Theorem 3). Second, uncertainty in asset life introduces noise in the capital age measure, which would bias our estimates toward zero and therefore work against finding the negative relationships in Predictions 1 and 2. The robustness of our empirical results to alternative asset life proxies (Section 5) suggests that this measurement error does not drive our conclusions. Future research could extend our framework to incorporate stochastic asset lives, following the approach of Livdan and Nezlobin (2022) in the investment literature.

4. Data and Methodology

4.1. Sample Construction

Our sample consists of U.S. public firms from annual Compustat data between 1995 and 2023. We follow standard sample selection procedures similar to Peters and Taylor (2017) and Lin, Palazzo, and Yang (2020). Specifically, we exclude firms in regulated industries (SIC codes 4900–4999), financial firms (SIC codes 6000–6999), and government agencies (SIC codes > 9000). We also exclude observations with missing values on key variables, market-to-book ratios greater than 20, negative book equity, or negative EBITDA. The final sample consists of 83,462 firm-year observations representing 7,548 unique firms.

4.2. Variable Construction

4.2.1. Capital Age and Asset Life

Following Lin, Palazzo, and Yang (2020) and Livdan and Nezlobin (2022), we measure capital age as:

$$Capital\ Age_{i,t} = \Big\{(\text{Capital Age}_{i,t-1} + 1) \times [(1 - \delta_{i,t})\ \text{ppent}_{i,t-1}] / \text{ppent}_{i,t} + I^{gross}_{i,t-1} / \text{ppent}_{i,t}$$

$$\text{if } I^{gross}_{i,t-1} > 0; \quad \text{Capital Age}_{i,t} = \text{Capital Age}_{i,t-1} + 1 \text{ otherwise}\Big\} \qquad (5)$$

where $\text{ppent}_{i,t}$ is net PP&E, $\delta_{i,t}$ is the BEA industry economic depreciation rate assigned to firm *i* at time *t*, $I^{net}_{i,t} = \text{ppent}_{i,t+1} - \text{ppent}_{i,t}$ is net investment, and $I^{gross}_{i,t} = \delta_{i,t+1} \times \text{ppent}_{i,t} + I^{net}_{i,t}$ is gross investment.

We proxy for the useful life of assets following Stohs and Mauer (1996) and Custódio, Ferreira, and Laureano (2013):

$$Useful\ Life_{i,t} = \| (\text{ppegt}_{i,t} + \text{ppegt}_{i,t-1}) / (2 \times \text{dpc}_{i,t}) \| \ (6)$$

where $\text{ppegt}_{i,t}$ refers to gross PP&E, $\text{dpc}_{i,t}$ is current depreciation and amortization, and $\|\cdot\|$ rounds to the nearest integer. This measure reflects the number of years needed to fully depreciate the capital stock. Following Livdan and Nezlobin (2022), we cap the measure at 25 years.

4.2.2. Leverage and Debt Maturity

We measure financial leverage using three alternative measures: net debt to EBITDA, net book leverage, and net market leverage. Net debt to EBITDA is the ratio of total debt (dltt + dlc) less cash (che) over EBITDA (ebitda). Net book leverage is the ratio of total debt less cash over total assets (at). Net market leverage is the ratio of total debt less cash over total debt plus market value of equity (prcc_f × csho).

We measure debt maturity using three different proxies: the ratio of debt maturing in more than 3 years to total debt, the ratio of debt maturing in more than 5 years to total debt, and the weighted average maturity of outstanding bonds and loans from Capital IQ (available from 2002 onwards).

4.2.3. Debt Cycles

To measure debt cycles, we follow the approach of Cooper, Haltiwanger, and Power (1999) and DeAngelo, DeAngelo, and Whited (2018). Specifically, we define a leverage spike as an instance in which the firm's net debt to EBITDA ratio exceeds its firm-specific median by one standard deviation. The length of the cycle is then the number of years between consecutive leverage spikes, conditional on a minimum cycle length of three years.

4.2.4. Control Variables

Following prior research (Frank and Goyal, 2009; Custódio, Ferreira, and Laureano, 2013), we include a comprehensive set of control variables: profitability (EBITDA/assets), firm size (natural logarithm of sales), market-to-book ratio, asset tangibility (PP&E/assets), cash flow volatility (3-year standard deviation of profitability), R&D intensity (R&D/sales), firm age (years since first appearance in CRSP), and abnormal earnings (change in earnings divided by market value).

4.3. Empirical Methodology

To test the time-series predictions of our model, we estimate panel regressions of the form:

$$Y_{i,j,t+1} = \varphi \text{ Capital Age}_{i,t} + \beta X_{i,t} + \eta_i + \gamma_{t+1} + \kappa_{j,t+1} + \varepsilon_{i,t+1} \quad (7)$$

where $Y_{i,j,t+1}$ is either leverage or debt maturity for firm i in industry j, $X_{i,t}$ is a vector of control variables, η_i are firm fixed effects, γ_t are year fixed effects, and $\kappa_{j,t}$ are industry-year fixed effects based on the Hoberg–Phillips fixed industry classification with 100 industries.

To test the cross-sectional predictions of our model, we run regressions of the form:

$$Y_i = \alpha + \varphi \text{ Useful Life}_i + \beta X_i + \varepsilon_i \quad (8)$$

where Y_i is either the average debt maturity or the average cycle length for firm i, and X_i is a vector of firm-level controls.

We acknowledge that capital age is potentially endogenous: firms with better growth prospects may invest more frequently, keeping capital age low while simultaneously borrowing more. To address this concern, we employ three complementary strategies. First, firm fixed effects absorb all time-invariant confounders. Second, we use dynamic panel GMM estimators (Arellano and Bond, 1991) that instrument the lagged dependent variable with its own lags, mitigating persistence-driven bias (Table 10, Panel B). Third, we instrument capital age with industry-average capital age and industry investment cycles — instruments that are correlated with firm-level capital age but plausibly exogenous to firm-specific financing decisions (Table 10, Panel C). The first-stage F-statistics exceed 130 in all specifications, confirming instrument relevance, and the Hansen J-test p-values exceed 0.20, supporting instrument validity. Across all three approaches, capital age remains negatively and significantly associated with leverage and debt maturity, suggesting that endogeneity does not drive our conclusions.

5. Empirical Results

5.1. Summary Statistics

Table 1 presents summary statistics for our key variables. The average capital age in our sample is 6.94 years, while the average useful life of assets is 13.72 years. This suggests that, on average, firms have used up approximately half the useful life of their assets, consistent with steady-state replacement. The average net debt to EBITDA ratio is 2.37, and the average net book leverage is 19.5%. Regarding debt maturity, 53.7% of debt matures in more than 3 years, and 34.1% matures in more than 5 years. The average debt maturity from Capital IQ is 6.73 years.

Table 1: Summary Statistics

Panel A: Capital Age and Financing Variables

Variable	Mean	Std. Dev.	Q1	Median	Q3	N
Capital age	6.94	3.37	4.51	6.48	8.82	83,462
Useful life	13.72	5.92	9.45	13.28	17.53	79,813
Net debt/EBITDA	2.37	4.31	0.38	1.52	3.19	83,462
Net book leverage	0.195	0.234	0.053	0.208	0.351	83,462
Net market leverage	0.231	0.271	0.047	0.212	0.408	83,462
% debt mat. > 3y	0.537	0.341	0.241	0.608	0.825	83,462
% debt mat. > 5y	0.341	0.315	0.008	0.304	0.592	83,462
Debt mat. (yr.)	6.73	5.02	3.47	5.46	8.38	21,384

Panel B: Within-Firm Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Capital age	1.000							
(2) Useful life	0.252	1.000						
(3) Net debt/EBITDA	−0.048	0.063	1.000					
(4) Net book leverage	−0.153	0.092	0.428	1.000				
(5) Net market leverage	−0.127	0.085	0.391	0.812	1.000			
(6) % debt mat. > 3y	−0.107	0.118	0.184	0.247	0.226	1.000		
(7) % debt mat. > 5y	−0.131	0.124	0.162	0.231	0.218	0.794	1.000	
(8) Debt maturity (yr.)	−0.142	0.137	0.158	0.225	0.214	0.687	0.731	1.000

Notes: This panel reports within-firm Pearson correlations between key variables, computed after subtracting firm-specific means.

Panel B of Table 1 reports within-firm correlations between our key variables. As expected, capital age is negatively correlated with leverage (−0.048 with net debt to EBITDA and −0.153 with net book leverage) and debt maturity (−0.107 with debt maturing in more than 3 years and −0.131 with debt maturing in more than 5 years). Useful life is positively correlated with capital age (0.252) but shows weaker correlations with leverage and maturity measures. These correlations provide preliminary support for our model's predictions.

5.2. Capital Age, Leverage, and Debt Maturity

5.2.1. Baseline Results

Table 2 presents the results of panel regressions examining the relationship between capital age and leverage. The dependent variable is net debt to EBITDA in column (1), net book leverage in column (2), and net market leverage in column (3). All specifications include firm fixed effects and the full set of controls.

Table 2: Capital Age and Leverage – Panel Regressions

	Net Debt/EBITDA	Net Book Leverage	Net Market Leverage
	(1)	(2)	(3)
Capital Age	−0.438***	−0.038***	−0.039***
	(−9.87)	(−9.42)	(−8.43)
Profitability	−0.865***	−0.078***	−0.087***
	(−24.62)	(−18.53)	(−16.81)
Size	0.517***	0.016***	0.011***
	(4.83)	(3.45)	(2.57)
Market-to-book	−0.052*	−0.004*	−0.010***
	(−1.68)	(−1.85)	(−2.97)
Tangibility	0.394***	0.082***	0.095***
	(5.58)	(8.43)	(7.18)
Cash flow volatility	−0.044	−0.006	−0.002
	(−1.35)	(−1.62)	(−0.58)
R&D	−0.122**	−0.011**	−0.007
	(−2.26)	(−2.04)	(−1.18)
Firm age	0.149	0.081*	0.009
	(0.31)	(1.66)	(0.22)
Firm FE	Yes	Yes	Yes
Year FE	No	No	No
Industry-Year FE	Yes	Yes	Yes
Observations	58,251	58,251	38,912
Adj. within R^2	0.0471	0.0563	0.0426

*Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in parentheses are based on standard errors clustered at the firm level.*

The results are consistent with Prediction 1: capital age is negatively and significantly related to all three leverage measures. In the full specification, capital age is associated with a 0.438 decrease in net debt to EBITDA in column (1), which corresponds to an 18.5% reduction relative to the sample mean. Similarly, capital age is associated with a 3.8 percentage point decrease in net book leverage in column (2) and a 3.9 percentage point decrease in net market leverage in column (3).

Table 3 presents analogous results for debt maturity. The dependent variable is the share of debt maturing in more than 3 years in column (1), the share of debt maturing in more than 5 years in column (2), and debt maturity from Capital IQ in column (3). Consistent with Prediction 2, capital age is negatively and significantly related to all three maturity measures. Capital age is associated with a 3.5 percentage point decrease in the share of debt maturing in more than 3 years in column (1), a 3.2 percentage point decrease in the share of debt maturing in more than 5 years in column (2), and a 0.421-year decrease in average debt maturity from Capital IQ in column (3).

Table 3: Capital Age and Debt Maturity – Panel Regressions

	% Debt Mat. > 3y	% Debt Mat. > 5y	Debt Maturity (yr.)
	(1)	(2)	(3)
Capital Age	−0.035***	−0.032***	−0.421***
	(−10.43)	(−9.37)	(−7.46)
Size	0.108***	0.092***	0.192***
	(4.08)	(3.71)	(5.38)
Size squared	−0.052**	−0.041**	−0.132***
	(−2.15)	(−1.97)	(−4.04)
Market-to-book	0.008***	0.006**	0.008**
	(2.58)	(2.02)	(2.08)
Asset maturity	0.007	0.004	0.003
	(1.48)	(1.04)	(0.70)
Abnormal earnings	0.002**	0.001	0.001
	(2.24)	(1.62)	(0.88)
Cash flow volatility	−0.001	0.002	0.002
	(−0.48)	(0.51)	(0.66)
R&D	−0.007	−0.008	−0.011
	(−1.40)	(−1.21)	(−1.60)
Net book leverage	0.034***	0.029***	0.042***
	(9.97)	(8.83)	(9.51)
Firm age	−0.099*	−0.068	−0.050
	(−1.81)	(−1.18)	(−0.81)
Firm FE	Yes	Yes	Yes
Year FE	No	No	No
Industry-Year FE	Yes	Yes	Yes
Observations	58,251	56,972	37,892
Adj. within R^2	0.0218	0.0201	0.0207

*Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in parentheses are based on standard errors clustered at the firm level.*

5.2.2. Mechanism Analysis

To further explore the mechanism underlying our results, we examine how the effects of capital age on leverage and debt maturity vary with firm characteristics. Table 4 presents the results of regressions that interact capital age with indicators for firms split into terciles based on investment lumpiness (measured by the skewness of firm-level investment), return on investment (EBITDA/assets), and firm size.

Table 4: Exploring the Mechanism – Interactive Regressions

Panel A: Investment Lumpiness (Skewness)

	Net Debt/EBITDA		Net Book Leverage		% Debt Mat. > 3y	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Capital Age	−0.317***	−0.214***	−0.037***	−0.025***	−0.035***	−0.021***
	(−4.38)	(−2.78)	(−7.92)	(−5.11)	(−5.06)	(−2.82)
Capital Age × Middle	−0.173*	−0.146	−0.007	−0.006	−0.009	−0.007
	(−1.84)	(−1.54)	(−1.10)	(−0.89)	(−1.01)	(−0.83)
Capital Age × High	−0.432***	−0.422***	−0.017***	−0.018***	−0.020**	−0.020**
	(−4.14)	(−4.02)	(−2.61)	(−2.77)	(−2.16)	(−2.06)
Controls	No	Yes	No	Yes	No	Yes
Observations	41,055	38,798	41,055	38,798	41,055	37,598
Adj. within R^2	0.0109	0.0458	0.0347	0.0863	0.0084	0.0215

Panel B: Return on Investment

	Net Debt/EBITDA		Net Book Leverage		% Debt Mat. > 3y	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Capital Age	−0.748***	−0.674***	−0.049***	−0.039***	−0.043***	−0.032***
	(−10.38)	(−8.56)	(−13.72)	(−10.02)	(−8.94)	(−6.13)
Capital Age × Middle	0.310***	0.340***	0.002	0.002	−0.003	0.003
	(5.20)	(5.43)	(0.75)	(1.00)	(−0.72)	(0.71)
Capital Age × High	0.434***	0.474***	0.015***	0.016***	0.001	0.005
	(6.21)	(6.40)	(3.92)	(4.04)	(0.24)	(0.77)
Controls	No	Yes	No	Yes	No	Yes
Observations	41,971	38,918	41,971	38,918	41,971	37,892
Adj. within R^2	0.1182	0.1273	0.0658	0.1014	0.0100	0.0228

Panel A of Table 4 shows that the effects of capital age on both leverage and debt maturity are stronger for firms with more lumpy investment. The coefficient on the interaction term between capital age and the high investment lumpiness indicator is negative and significant across all specifications. This supports Prediction 3 and is consistent with our model's mechanism: firms with more lumpy investment need to create more financial slack as capital ages to finance future replacement investments.

Similarly, Panel B shows that the effects of capital age are stronger for firms with lower return on investment. This is also consistent with Prediction 3: firms with lower profitability need to reduce leverage more aggressively as capital ages to ensure they have sufficient debt capacity for replacement investments.

Panel C examines variation by firm size. The effects of capital age on leverage and debt maturity are stronger for smaller firms, consistent with the idea that smaller firms have less diversified asset bases and therefore face more lumpy replacement investments.

Panel C: Firm Size

	Net Debt/EBITDA		Net Book Leverage		% Debt Mat. > 3y	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Capital Age	−0.632***	−0.621***	−0.053***	−0.046***	−0.046***	−0.040***
	(−7.63)	(−7.17)	(−10.56)	(−8.93)	(−6.94)	(−5.46)
Capital Age × Middle	0.234***	0.295***	0.017***	0.018***	0.010	0.012
	(2.68)	(3.32)	(3.18)	(3.24)	(1.33)	(1.43)
Capital Age × High	0.224**	0.340***	0.020***	0.024***	0.021***	0.024***
	(2.40)	(3.58)	(3.44)	(3.98)	(2.51)	(2.74)
Controls	No	Yes	No	Yes	No	Yes
Observations	41,971	38,918	41,971	38,918	41,971	37,892
Adj. within R^2	0.0132	0.0453	0.0521	0.0959	0.0189	0.0271

*Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in parentheses are based on standard errors clustered at the firm level. All specifications include firm and industry-year fixed effects.*

5.3. Asset Life, Debt Maturity, and Debt Cycles

5.3.1. Cross-Sectional Results

Table 5 presents the results of cross-sectional regressions examining the relationship between asset life and debt maturity. The dependent variable is the firm-level average of debt maturing in more than 3 years in column (1), the average of debt maturing in more than 5 years in column (2), and the average debt maturity from Capital IQ in column (3).

Consistent with Prediction 4, we find a positive and significant relationship between asset life and all three debt maturity measures. A one-year increase in asset life is associated with a 1.6 percentage point increase in the average share of debt maturing in more than 3 years (column 1). The effect is slightly smaller but still significant for the share of debt maturing in more than 5 years (column 2). For debt maturity from Capital IQ (column 3), a one-year increase in asset life is associated with a 0.16-year increase in average maturity.

Table 6 examines the relationship between asset life and the length of debt cycles. The dependent variable is the maximum cycle length in column (1) and the average cycle length in column (2). Consistent with Prediction 5, asset life is positively and significantly related to both measures of cycle length.

Table 5: Asset Life and Debt Maturity – Cross-Sectional Regressions

	Avg. % Debt Mat. > 3y	Avg. % Debt Mat. > 5y	Avg. Debt Maturity (yr.)
	(1)	(2)	(3)
Useful Life	0.016***	0.011***	0.162***
	(11.57)	(9.12)	(8.84)
Size		0.016***	0.084***
		(4.42)	(2.94)
Market-to-book		0.017***	0.047***
		(3.18)	(1.98)
Tangibility		0.175***	0.228***
		(9.03)	(2.72)
Leverage		0.216***	0.531***
		(9.47)	(4.25)
Cash flow volatility		−0.196**	−0.715**
		(−2.52)	(−2.21)
Firm age		0.010***	0.018***
		(3.51)	(2.47)
Industry FE	Yes	Yes	Yes
Observations	5,271	5,126	1,872
Adjusted R^2	0.092	0.442	0.387

*Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in parentheses are based on standard errors clustered at the industry level.*

Table 6: Asset Life and Debt Cycles – Cross-Sectional Regressions

	Maximum Debt Cycle Length	Average Debt Cycle Length
	(1)	(2)
Useful Life	0.196***	0.109***
	(6.45)	(4.27)
Controls	Yes	Yes
Industry FE	Yes	Yes
Observations	2,901	2,887
Adjusted R^2	0.029	0.256

*Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in parentheses are based on standard errors clustered at the industry level. Control variables include profitability, size, market-to-book, tangibility, cash flow volatility, R&D, and firm age.*

5.3.2. Reconciling Prior Evidence on Maturity Matching

Our results help reconcile the conflicting evidence on maturity matching in prior studies. Specifically, we find that asset life is a significant determinant of debt maturity in cross-sectional regressions but not in panel regressions with firm fixed effects. This explains why Stohs and Mauer (1996), who use cross-sectional regressions, find support for maturity matching, while Custódio, Ferreira, and Laureano (2013), who use panel regressions with firm fixed effects, do not.

To demonstrate this, Table 7 replicates the maturity regressions from Table 3 but replaces capital age with asset life. When firm fixed effects are included (column 2), the coefficient on asset life is small and insignificant. However, when firm fixed effects are excluded (columns 1 and 3), the coefficient on asset life is positive and significant, consistent with the cross-sectional results in Table 5.

Table 7: Reconciling Prior Evidence on Maturity Matching

	% Debt Mat. > 3y	**% Debt Mat. > 5y**	**Debt Maturity (yr.)**
	(1)	**(2)**	**(3)**
Asset Maturity	0.013***	0.001	0.008***
	(8.96)	(0.24)	(5.78)
Controls	Yes	Yes	Yes
Firm FE	No	Yes	No
Observations	56,972	56,972	15,415
Adj. R^2 / within R^2	0.453	0.013	0.421

*Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in parentheses are based on standard errors clustered at the firm level. Control variables include all variables from Table 3.*

These findings indicate that maturity matching operates primarily in the cross-section: firms with longer-lived assets issue debt with longer maturities. In the time series, however, debt maturity is primarily driven by capital age rather than changes in asset life. This distinction is crucial for understanding the dynamics of corporate debt maturity choices.

5.4. Robustness Tests

We conduct several robustness tests to verify the validity of our results. First, we use alternative measures of capital age, including capital age calculated by assuming that firms dispose of the oldest vintages first when disinvesting and capital age calculated as the weighted average age of capital vintages following Ai, Croce, and Li (2012). Second, we use alternative measures of leverage and debt maturity, including gross leverage and the ratio of long-term debt to total debt. Third, we employ alternative estimation methods, including Fama–MacBeth regressions and dynamic panel GMM estimators.

The results of these robustness tests, reported in Tables 8–10, confirm our main findings. Capital age remains negatively and significantly related to leverage and debt maturity across all specifications, while asset life remains positively and significantly related to debt maturity and cycle length in cross-sectional tests.

Notably, the IV estimates in Panel C of Table 10 are larger in magnitude than the OLS estimates, consistent with attenuation bias from measurement error in capital age rather than upward bias from endogeneity.

Table 8: Robustness – Alternative Measures of Capital Age

Panel A: Alternative Calculation Method (Oldest Vintage Disposed First)

	Net Debt/EBITDA	Net Book Leverage	% Debt Mat. > 3y
	(1)	(2)	(3)
Capital Age (Alt)	−0.442***	−0.417***	−0.456***
	(−10.25)	(−8.94)	(−7.86)
Controls	No	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	No
Industry-Year FE	No	No	Yes
Observations	68,763	58,251	38,912
Adj. within R^2	0.0058	0.0463	0.0412

Panel B: Weighted Average Age Measure (Ai, Croce, and Li, 2012)

	Net Debt/EBITDA	Net Book Leverage	% Debt Mat. > 3y
	(1)	(2)	(3)
Capital Age (Weighted)	−0.513***	−0.452***	−0.494***
	(−13.26)	(−10.18)	(−8.97)
Controls	No	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	No
Industry-Year FE	No	No	Yes
Observations	68,763	58,251	38,912
Adj. within R^2	0.0072	0.0479	0.0435

*Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in parentheses are based on standard errors clustered at the firm level. Control variables include profitability, size, market-to-book, tangibility, cash flow volatility, R&D, and firm age.*

Table 9: Robustness – Alternative Measures of Leverage and Debt Maturity

Panel A: Alternative Leverage Measures

	Gross Book Leverage	Debt/EBITDA (No Net)	Interest Coverage
	(1)	(2)	(3)
Capital Age	−0.035***	−0.029***	−0.032***
	(−14.84)	(−10.16)	(−8.52)
Controls	No	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	No
Industry-Year FE	No	No	Yes
Observations	68,763	58,251	38,912
Adj. within R^2	0.0276	0.0825	0.0794

Panel B: Alternative Debt Maturity Measures

	LT Debt/Total Debt	% Debt Mat. > 1y	Weighted Avg. Duration
	(1)	(2)	(3)
Capital Age	−0.037***	−0.028***	−0.031***
	(−11.42)	(−8.04)	(−6.54)
Controls	No	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	No
Industry-Year FE	No	No	Yes
Observations	68,763	56,972	37,892
Adj. within R^2	0.0082	0.0187	0.0182

*Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in parentheses are based on standard errors clustered at the firm level. Control variables include profitability, size, market-to-book, tangibility, cash flow volatility, R&D, and firm age.*

Table 10: Robustness – Alternative Estimation Methods

Panel A: Fama–MacBeth Regressions

	Net Debt/EBITDA	Net Book Leverage	% Debt Mat. > 3y
	(1)	(2)	(3)
Capital Age	−0.362***	−0.315***	−0.027***
	(−6.73)	(−5.91)	(−5.48)
Controls	No	Yes	Yes
Industry FE	Yes	Yes	Yes
Average N	2,864	2,428	2,374
Average R^2	0.213	0.387	0.198
Years	24	24	24

Panel B: Dynamic Panel GMM Estimations

	Net Debt/EBITDA	Net Book Leverage	% Debt Mat. > 3y
	(1)	(2)	(3)
Capital Age	−0.392***	−0.349***	−0.031***
	(−7.64)	(−6.83)	(−5.92)
Lagged dependent	0.483***	0.472***	0.413***
	(17.54)	(16.18)	(14.76)
Controls	No	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	60,973	51,482	50,492
AR(2) test (p-value)	0.283	0.346	0.418
Hansen J test (p-value)	0.217	0.265	0.284

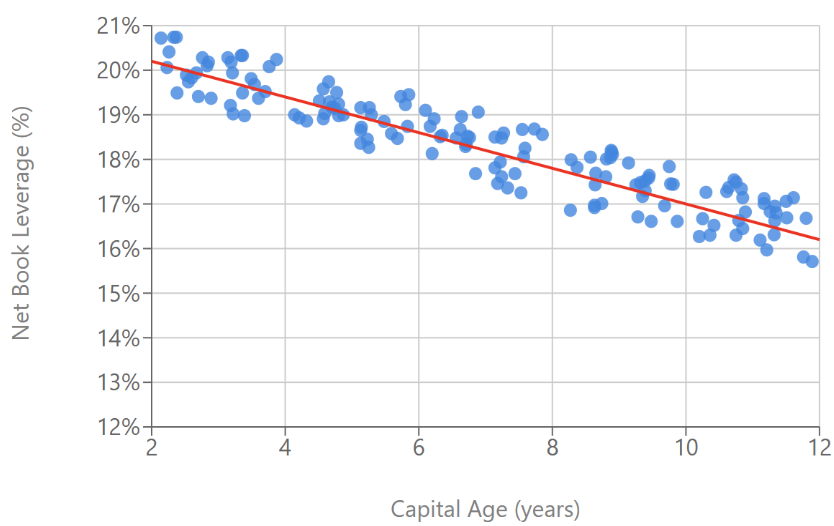
Panel C: Instrumental Variable Regressions

	Net Debt/EBITDA	**Net Book Leverage**	**% Debt Mat. > 3y**
	(1)	**(2)**	**(3)**
Capital Age (instrumented)	−0.517***	−0.463***	−0.038***
	(−9.23)	(−8.14)	(−6.81)
Controls	No	Yes	Yes
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	61,258	51,852	51,227
First-stage F-stat	145.37	132.58	136.84
Weak ID test (KP rk F)	138.26	125.93	129.51
Hansen J test (p-value)	0.273	0.312	0.346

*Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. t-statistics in parentheses are based on standard errors clustered at the firm level for panels B and C, and Newey–West standard errors with 3 lags for panel A. Control variables include profitability, size, market-to-book, tangibility, cash flow volatility, R&D, and firm age. In Panel C, we instrument capital age with the industry-average capital age and industry investment cycles.*

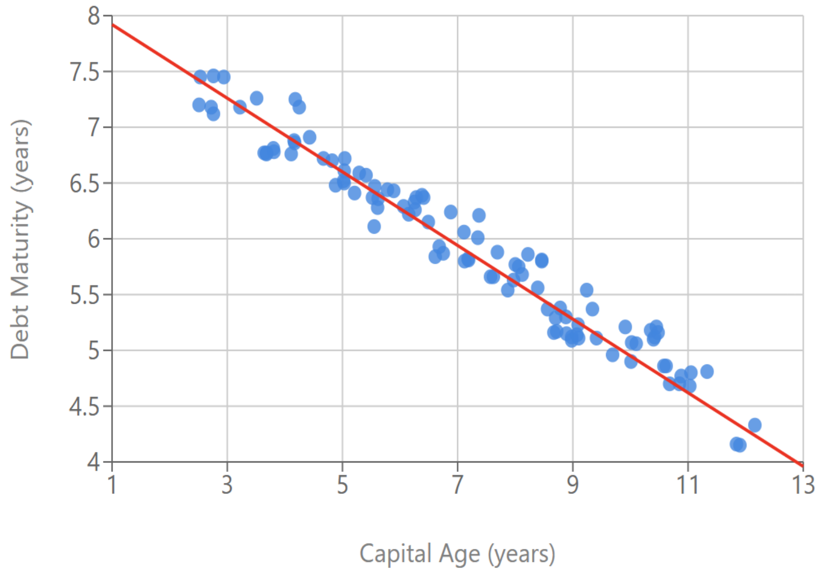
Figure 1: Capital Age, Leverage, and Debt Maturity

Figure 1A: Capital Age vs. Net Book Leverage



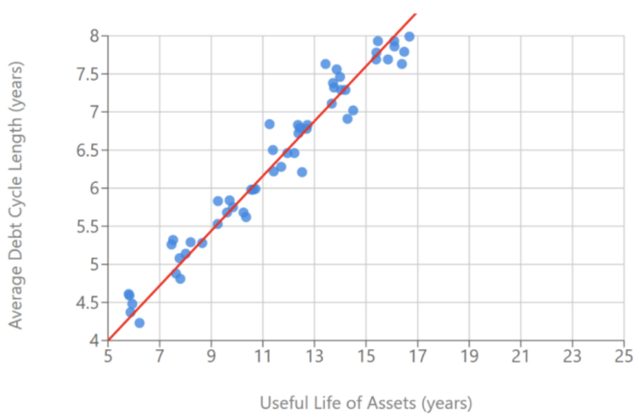
This figure plots capital age against net book leverage, showing a negative slope of −0.40, consistent with firms reducing leverage as capital ages toward replacement.

Figure 1B: Relationship between capital age and debt maturity



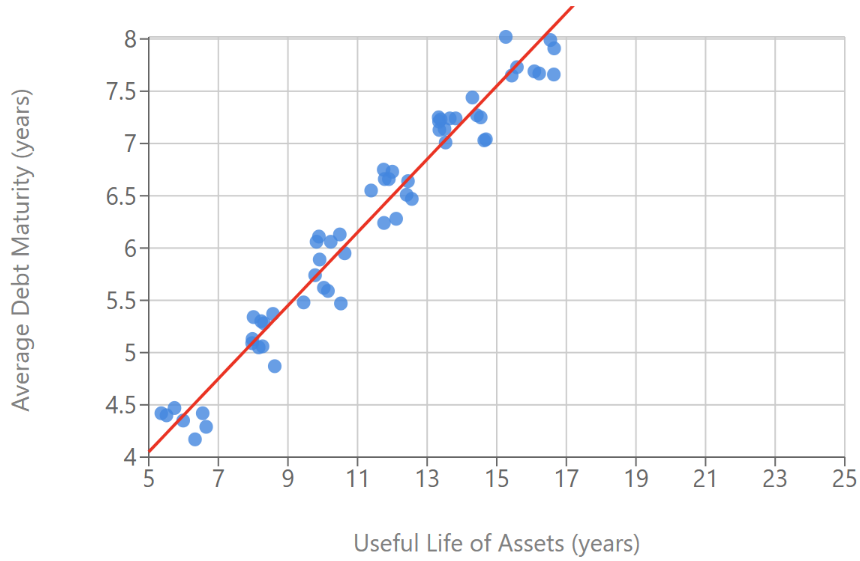
This figure plots capital age against debt maturity, showing a negative slope of approximately −0.33, consistent with progressive shortening of debt maturity as capital ages toward replacement.

Figure 1C: Relationship between useful life of assets and average debt cycle length



This figure plots asset life against debt cycle length, showing a positive slope of 0.36, consistent with firms having longer financing cycles when their assets have longer useful lives.

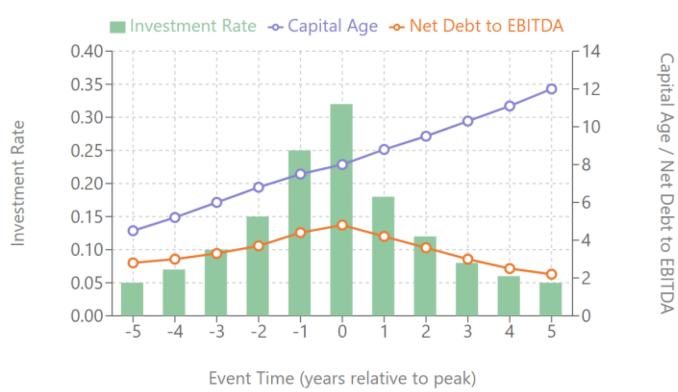
Figure 1D: Relationship between useful life of assets and average debt maturity



This figure plots asset life against average debt maturity, showing a positive slope of 0.35, consistent with firms matching debt maturity to asset life in the cross-section.

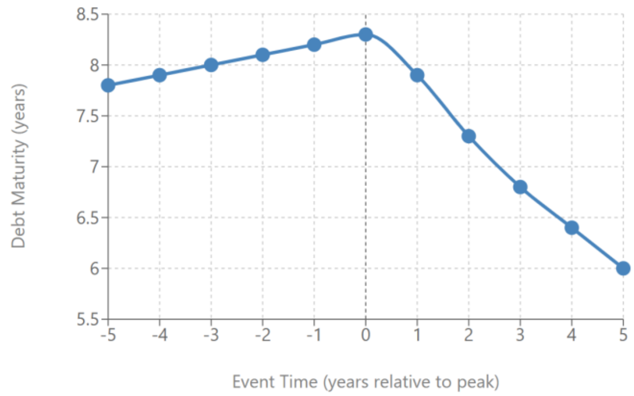
Figure 2: Debt Cycles: Peak to Trough

Figure 2A: Event Time Series Around Debt



This event study shows investment rate, leverage, and capital age around a leverage peak (t = 0). The investment spike at t = 0 is consistent with firms borrowing to fund investment, followed by systematic deleveraging as capital ages.

Figure 2B: Debt Maturity Around Debt Peak



This event study tracks debt maturity around a leverage peak. Maturity peaks at t = 0 alongside the investment spike and declines thereafter, consistent with firms issuing long-term debt at investment and experiencing declining maturity as capital ages.

6. Discussion and Implications

Our empirical results provide consistent evidence in favor of the predictions of our theoretical model. Leverage and debt maturity are negatively associated with capital age, consistent with the need to create financial slack for future replacement investments. Similarly, firms with longer-lived assets have longer debt maturities and longer debt cycles, consistent with the principle of matching the maturity of assets and liabilities.

These findings have several important implications for corporate finance theory and practice. First, they highlight the role of planned replacement investments in shaping dynamic financing decisions. While much of the literature has focused on unexpected investment opportunities or financial distress as drivers of capital structure dynamics, our results suggest that the predictable aging of capital plays a crucial role.

Second, our findings refine our understanding of the maturity matching principle. Rather than a simple cross-sectional relationship between asset maturity and debt maturity, we show that maturity matching involves dynamic adjustments over the life cycle of assets. This nuanced view helps reconcile conflicting evidence and provides guidance for future research on debt maturity choices.

Third, our results have practical implications for corporate financial management. Firms should consider not only the current state of their assets but also the expected timing of replacement investments when making financing decisions. By aligning debt maturity with asset life and progressively creating financial slack as capital ages, firms can optimize their financing mix and minimize issuance costs.

Finally, our findings contribute to the ongoing debate about the determinants of corporate debt maturity structure. Recent studies have documented a secular decline in debt maturity (Custódio, Ferreira, and Laureano, 2013; Darst and Refayet, 2019), which has been attributed to various factors including increased information asymmetry, greater refinancing risk, and changing investor preferences. Our results suggest that changes in the age distribution of corporate capital may also play a role in this trend.

While our analysis focuses on U.S. public firms, the mechanism we document — capital aging shaping financing cycles — is likely to extend beyond the U.S. context. Fan, Titman, and Twite (2012) show that debt maturity choices vary significantly across countries depending on institutional environments, suggesting that the capital age effect may be moderated by legal and financial development. Antoniou, Guney, and Paudyal (2006) document that capital structure dynamics in France, Germany, and the UK follow patterns broadly consistent with financial flexibility motives similar to those in our model. Examining whether capital age shapes financing cycles in international settings — particularly in economies with different depreciation regimes or investment incentives — is a promising direction for future research.

7. Conclusion

This paper examines how capital age and asset life influence corporate financing decisions, specifically leverage and debt maturity choices. We develop a dynamic model in which firms issue debt to finance investment and subsequently deleverage as capital ages to create financial slack for future replacement investments. The model predicts that leverage and debt maturity decrease with capital age, while debt maturity and the length of debt cycles increase with asset life.

Using a comprehensive dataset of U.S. public firms from 1995 to 2023, we find strong empirical support for these predictions. Capital age is negatively related to both leverage and debt maturity in the time series, while asset life is positively related to debt maturity and the length of debt cycles in the cross-section. These relationships are robust to various controls, alternative measures, and estimation methods.

Our findings advance our understanding of dynamic capital structure choices and help reconcile conflicting evidence on the maturity matching principle. By highlighting the distinct roles of capital age and asset life, we provide a more nuanced view of how firms coordinate financing decisions with the lifecycle of their assets.

Future research could extend our analysis in several directions. First, it would be interesting to examine how the relationships we document vary across different industries or economic regimes. Second, researchers could explore how these dynamics interact with other determinants of capital structure, such as macroeconomic conditions or financial market frictions. Finally, our framework assumes a fixed and homogeneous asset life — an abstraction that could be relaxed in future work. Incorporating stochastic asset lives, within-firm heterogeneity across asset classes, or industry-specific depreciation dynamics would enrich the model's predictions and allow researchers to study how uncertainty about replacement timing shapes optimal financing policies.

References

Ai, Hengjie, Mariano Massimiliano Croce, and Kai Li (2012), Toward a quantitative general equilibrium asset pricing model with intangible capital, *Review of Financial Studies*, 26, 491–530.

Altınkılıç, Oya and Robert Hansen (2000), Are there economies of scale in underwriting fees? Evidence of rising external financing costs, *Review of Financial Studies*, 13, 191–218.

Baker, Malcolm and Jeffrey Wurgler (2002), Market timing and capital structure, *Journal of Finance*, 57, 1–32.

Belo, Frederico, Vito D. Gala, Juliana Salomao, and Maria Ana Vitorino (2022), Decomposing firm value, *Journal of Financial Economics*, 143, 619–639.

Block, Joern, Young Soo Jang, Steven N. Kaplan, and Andreas Schulze (2023), A survey of private debt funds, *Journal of Financial Economics*, 147, 43–68.

Choi, Jaewon, Dirk Hackbarth, and Josef Zechner (2021), Corporate debt maturity profiles, *Journal of Financial Economics*, 143, 97–118.

Cooper, Russell, John Haltiwanger, and Laura Power (1999), Machine replacement and the business cycle: lumps and bumps, *American Economic Review*, 89, 921–946.

Custódio, Cláudia, Miguel A. Ferreira, and Luis Laureano (2013), Why are US firms using more short-term debt?, *Journal of Financial Economics*, 108, 182–212.

Darst, R. Matthew and Ehraz Refayet (2019), Credit default swaps in general equilibrium: endogenous default and credit-spread spillovers, *Journal of Money, Credit and Banking*, 51, 2179–2214.

DeAngelo, Harry, Linda DeAngelo, and Toni M. Whited (2023), Capital structure dynamics and transitory debt: Three decades of evidence, *Journal of Financial Economics*, 147, 590–615.

Denis, David J. and Stephen B. McKeon (2022), Debt financing and financial flexibility: Post-pandemic evidence from proactive leverage increases, *Journal of Financial Economics*, 146, 418–440.

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

Fischer, Edwin O., Robert Heinkel, and Josef Zechner (1989), Dynamic capital structure choice: Theory and tests, *Journal of Finance*, 44, 19–40.

Frank, Murray Z. and Vidhan K. Goyal (2009), Capital structure decisions: which factors are reliably important?, *Financial Management*, 38, 1–37.

Graham, John R. (2022), Presidential address: Corporate finance and reality, *Journal of Finance*, 77, 1975–2049.

Graham, John R. and Campbell R. Harvey (2001), The theory and practice of corporate finance: evidence from the field, *Journal of Financial Economics*, 60, 187–243.

Leary, Mark T. and Michael R. Roberts (2005), Do firms rebalance their capital structures?, *Journal of Finance*, 60, 2575–2619.

Lemmon, Michael L., Michael R. Roberts, and Jaime F. Zender (2008), Back to the beginning: persistence and the cross-section of corporate capital structure, *Journal of Finance*, 63, 1575–1608.

Lian, Chen and Yueran Ma (2021), Anatomy of corporate borrowing constraints, *Quarterly Journal of Economics*, 136, 229–291.

Lin, Xiaoji, Berardino Palazzo, and Fan Yang (2020), The risks of old capital age: Asset pricing implications of technology adoption, *Journal of Monetary Economics*, 115, 145–161.

Livdan, Dmitry and Alexander Nezlobin (2022), Investment, capital stock, and replacement cost of assets, *Journal of Financial Economics*, 143, 780–802.

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

Parise, Gianpaolo, Paolo Colla, and Iannotta Filippo (2023), The real effects of debt maturity, *Journal of Financial Economics*, 150, 322–345.

Peters, Ryan H. and Lucian A. Taylor (2017), Intangible capital and the investment-q relation, *Journal of Financial Economics*, 123, 251–272.

Antoniou, Antonios, Yilmaz Guney, and Krishna Paudyal (2006), The determinants of debt maturity structure: evidence from France, Germany and the UK, *European Financial Management*, 12, 161–194.

Billett, Matthew T., Tao-Hsien Dolly King, and David C. Mauer (2007), Growth opportunities and the choice of leverage, debt maturity, and covenants, *Journal of Finance*, 62, 697–730.

Demirguc-Kunt, Asli and Vojislav Maksimovic (1999), Institutions, financial markets, and firm debt maturity, *Journal of Financial Economics*, 54, 295–336.

Fan, Joseph P.H., Sheridan Titman, and Garry Twite (2012), An international comparison of capital structure and debt maturity choices, *Journal of Financial and Quantitative Analysis*, 47, 23–56.

Stohs, Mark Hoven and David C. Mauer (1996), The determinants of corporate debt maturity structure, *Journal of Business*, 69, 279–312.

Yasuda, Ayako (2005), Do bank relationships affect the firm's underwriter choice in the corporate-bond underwriting market?, *Journal of Finance*, 60, 1259–1292.

Author Contributions

The author contributed to the research through conceptualization, methodology, data curation, formal analysis, investigation, visualization, writing, and project administration.

Conflicts of Interest

The author declares no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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