Mind the Gap: The Market Price of Financial (In)Flexibility*

Filippo Ippolito† Roberto Steri‡ Claudio Tebaldi§ Alessandro T. Villa¶

April 2025

Abstract

The empirical connection between financial leverage and equity risk premia is surprisingly weak. We propose a quantitative model linking limited financial flexibility to levered risk premia, where firms make dynamic investment, financing, and default decisions. The model highlights two key variables, *leverage gaps* and *leverage targets*, as drivers of risk premia. Firms partially close the gap toward their target, remaining optimally over- or under-levered. Equityholders of overlevered firms face higher debt costs, as their capital structure becomes more exposed to bankruptcy risk. As a result, leverage gaps amplify asset returns. The "lost" leverage risk premium reappears after controlling for targets.

Keywords: firm dynamics, financial flexibility, financial frictions, heterogeneous firms, capital misallocation, cross section of returns, dynamic capital structure, risk premia.

JEL Classification Numbers: G12, G32.

*We thank Luca Benzoni, Joel David, François Gourio, Leonardo Melosi, and Lukas Schmid for valuable comments, and seminar participants at the University of Manchester. The views expressed in this paper do not represent the views of the Chicago Fed or the Federal Reserve System. We declare that we have no relevant or material financial interests that relate to the research described in the paper.

†Barcelona Graduate School of Economics and CEPR, Universitat Pompeu Fabra. E-mail: filippo.ippolito@upf.edu.

‡Department of Finance at the University of Luxembourg. E-mail: roberto.steri@uni.lu.

§Department of Finance at Bocconi University. E-mail: claudio.tebaldi@unibocconi.it.

¶Federal Reserve Bank of Chicago. E-mail: alessandro.villa@chi.frb.org.

1 Introduction

Financial flexibility, or the ability of a business to efficiently adjust its funding, is a key driver of firm dynamics. Scholars and industry experts concur that restrictions on such flexibility shape firm investment and financing choices. As highlighted in Graham (2022)'s survey, chief financial officers (CFOs) in the U.S. view financial flexibility as the primary aspect shaping a firm's debt policy, with roughly 80% of them indicating it as a key driver. While Gamba and Triantis (2008) estimate that financial flexibility holds significant value for companies, its impact on stock market valuations for levered firms remains underexplored.

The main takeaway of this paper is that accounting for limited financial flexibility resurrects the expected strong connection between financial leverage and equity risk premia, which is crucial for understanding firms' financing costs and thus influences investment and capital allocation decisions.[1] Accordingly, financial flexibility offers a simple explanation for the surprisingly weak relationship previously documented in the empirical literature.

We present a quantitative model of firm dynamics, in the spirit of Gomes and Schmid (2010), to study the equilibrium relationship between limited financial flexibility and expected returns. We calibrate our model using U.S. data, and we simulate artificial panels of firms. In the model, firms face both idiosyncratic and aggregate risk and make dynamic investment, financing, and default decisions. They balance the traditional trade-off between the tax benefits of debt and bankruptcy costs. A key feature is the presence of debt adjustment costs, which determine the degree of financial flexibility in the economy. To build intuition, we first develop a two-period version of the model, where the optimal capital structure can be characterized relative to a leverage target and linked analytically to equity returns through an expression similar to Proposition 2 of Modigliani and Miller (1958).

First, when financial flexibility is limited, firms generally face excessive costs to attain their leverage target, and optimally choose to only partially close the gap between their current and target

[1] From a practical standpoint, a conventional approach to making capital budgeting decisions involves using the net present value (NPV) method, where the firm's cash flows are discounted using the weighted-average cost of capital (WACC). The calculation of the WACC is rooted in Proposition 2 of Modigliani and Miller (1958). Additionally, according to estimates by David, Schmid, and Zeke (2022), around 25% of the dispersion in the marginal product of capital among U.S. firms is accounted for by risk premium dispersion across firms.

leverage. The latter is the optimal leverage that firms would pursue with full financial flexibility. As a result, firms may be either optimally underlevered — when their leverage is lower than the target, or overlevered — when their leverage exceeds the target. Intuitively, the rate at which firms close their leverage gaps increases with financial flexibility. Second, in equilibrium, every dollar of debt incurs a higher cost for equity holders of overlevered firms than for those of underlevered firms. Thus, optimal leverage is no longer a sufficient statistic for the net cost of debt, as two firms holding the same dollar amount of debt may incur different costs of carrying it, depending on their leverage gaps. This aspect has implications for the conventional mechanism amplifying asset returns via leverage, with large leverage gaps triggering further amplification. The higher cost of holding debt for equity holders of overlevered firms arises because, at their optimal leverage point, the average bankruptcy costs they bear exceed the average tax benefits. When financial flexibility is perfect, firms reach their leverage targets, making gaps irrelevant for equity returns.[2] Instead of leverage gaps, leverage targets offer an equivalent characterization of the relationship between leverage and returns. Under mild conditions, the "lost" leverage risk premium re-emerges when controlling for targets, with high targets leading to lower risk premia. Firms with high targets are less likely to become overlevered due to productivity shocks, thereby hedging over-leverage risks.

Guided by the model's predictions, we document two new empirical facts. Since leverage targets and leverage gaps are unobservable, we build two main empirical measures. First, following the empirical corporate finance literature, we use a reduced-form measure based on the approach of Flannery and Rangan (2006). Because the mapping between leverage in the model and this measure is unclear, we also implement a measure linked directly to the calibrated model's policy functions. In the model, leverage targets are observable. We project them non-linearly onto a set of variables available in both the model and the data. In the simulated economy under the baseline calibration, this measure correlates with the model-based target at approximately 95%. In the data, we estimate a multinomial logit model of leverage adjustments towards targets using the same functional form. The results are overall consistent across both empirical measures. First, we find that estimated leverage gaps have a strong positive association with stock returns. Second, upon breaking down leverage gaps into leverage targets and observed leverage, we find that stocks from high-leverage

[2]Since investment is endogenous in our model, the leverage amplification mechanism remains active regardless of asset return differences between mature and young firms, which is the focus of Gomes and Schmid (2010).

firms command a premium. Leverage targets, instead, exhibit a negative relationship with returns. These empirical patterns are robust across various specifications.[3]

We perform our quantitative analysis through the lens of a discrete-time, infinite-horizon neoclassical investment model where firms make investment, financing, and default decisions to maximize their value in arbitrage-free markets. The model incorporates cross-sectional firm heterogeneity through idiosyncratic productivity shocks. It also factors in aggregate shocks, which concurrently impact firm profitability and discount rates, or the stochastic discount factor (SDF) of the economy. Firms face financial constraints due to issuance costs of external equity and the potential for endogenous default on debt when borrowing from competitive lenders. The model structure is similar to Gomes and Schmid (2010), to which we add costs associated with adjusting the firm's debt stock, whose magnitude determines the degree of financial flexibility in the economy. These costs, which can pertain to both issuances and reductions of corporate debt, can stem from various sources, including underwriting and management fees (Fischer, Heinkel, and Zechner, 1989; Strebulaev, 2007), seniority issues that make significant changes in the capital structure expensive (Acharya, Bharath, and Srinivasan, 2007), and liquidation and agency costs associated with debt usage (Myers, 1977; Diamond, 1991). To preserve tractability without committing to a specific mechanism, we adopt a reduced-form flexible specification for the financial flexibility costs. Although including debt adjustment costs in endogenous default models to account for limited financial flexibility is conceptually straightforward, it triggers technical challenges because of the problem's dimensionality.

While informative, reduced-form proxies of leverage targets and gaps are prone to measurement error and may not precisely match the model's predictions. In the model, we define leverage targets based on the "gap approach" to costly adjustments of production factors, commonly used in the macroeconomic literature.[4] To extend this approach to economies with multiple frictions affecting dynamic choices, we follow the literature in industrial organization and, more recently, sovereign default studies (e.g., Chatterjee and Eyigungor, 2012; Dvorkin, Sánchez, Sapriza, and Yurdagul, 2021; Chatterjee, Corbae, Dempsey, and Ríos-Rull, 2023). In line with these studies, our

[3]They are robust to both book and market value measures of leverage and to the inclusion of additional controls such as investment and profitability. We also verify that the results are not driven by firms' investment, disinvestment, or cash accumulation policies.

[4]See, for example, Sargent (1978), Caballero and Engel (1993), Cooper and Willis (2004), King and Thomas (2006), and Bayer (2009).

model includes logistically distributed shocks to shareholders' outside options. This setup nests the standard framework where shareholders default when equity value turns negative and allows us to derive the firm's investment and debt policy optimality conditions analytically. A natural definition of the adjustment gap emerges, as the optimality conditions defining leverage targets and gaps retain the same structure and economic interpretation as in the two-period case. The dynamic leverage target evolves with the model's state variables, incorporating forward-looking funding needs. We use the calibrated model, where leverage targets are observed, as a laboratory to cleanly assess how financial flexibility affects risk premia. In addition, in the simulated economy, we implement versions of the two empirical measures used in the data. The results are consistent with those based on the model-implied definitions and with our empirical findings.

Quantitatively, the model provides a good fit to the data, as it succeeds in reasonably matching not only the targeted moments used in its calibration but also various untargeted ones. These encompass firm dynamics, such as investment, financing, and profits, as well as aggregate stock market valuations. Through the lens of the calibrated model, we study capital structure dynamics and levered risk premia. We find that firms adjust their capital structure toward their dynamic targets. When leverage gaps are positive, indicating overlevered firms, firms tend to decrease their leverage. Conversely, firms with negative gaps tend to increase their leverage. Financial flexibility has a pronounced quantitative effect. On average, firms close their gaps at a rate of 32%,[5] consistent with previous studies documenting hysteresis in capital structure (e.g., Hennessy and Whited, 2005; Lemmon, Roberts, and Zender, 2008).

Crucially, the calibrated model replicates the empirical patterns in levered risk premia, as documented using reduced-form proxies. Leverage gaps are strongly positively related to equity returns. The traditional positive leverage premium reemerges when we control for leverage targets, which load negatively on returns. The estimated coefficient of leverage, both in isolation and after controlling for size and book-to-market equity, is still positive, but quantitatively small. Specifically, its magnitude is roughly three times smaller than when the specification includes leverage targets.

Our quantitative analysis provides an array of supplementary results. We simulate a series of counterfactual economies, each exhibiting varying degrees of financial flexibility. Perhaps not

[5]Explicitly, shifts in targets and gaps are accompanied by simultaneous adjustments in firms' capital structures, filling 32% of the gap. As targets and gaps are generally subject to fluctuations in each time period (e.g., monthly, annually), this figure remains invariant across different frequencies of observations in large samples.

surprisingly, an inverse relationship emerges between the degree of inflexibility in the economy and the rate at which firms close their leverage gaps. This relationship is distinctly nonlinear. In the scenario of full flexibility, firms close 100% of their leverage gaps. However, slight increments in inflexibility from the full-flexibility benchmark trigger swift declines in adjustment speeds. At high levels of inflexibility, adjustment speeds hover around 23%, a figure relatively close to the 32% under our baseline calibration. The stock market's price of financial flexibility mirrors these patterns, with the relationship between returns and gaps being more pronounced in economies with low flexibility. Since existing studies, such as Chaderina, Weiss, and Zechner (2022) for debt maturity, document risk premia arising from the covariance of costly debt reductions with a countercyclical price of risk, we also consider counterfactual economies with different degrees of asymmetry in debt adjustment costs. As debt reductions become more costly, overlevered firms close a smaller portion of their leverage gaps. Leverage gaps remain relevant for returns and are sensitive to asymmetries, but no clear monotonic relationship emerges. This is consistent with return premia in our model arising even when the stochastic discount factor features a constant price of risk.

Finally, we study how the relevance of leverage gaps for stock returns varies with the persistence of stochastic profitability shocks, using both the data and the model. The impact of financial inflexibility on capital structure dynamics and the return-gap relationship depends on the degree of shock persistence. In the model, under the baseline calibration, a comparative statics exercise shows that lower persistence leads firms to close smaller fractions of their leverage gaps, which in turn matter more for equity returns. Empirically, validating this effect is challenging because isolating changes in persistence without affecting other properties of shock dynamics or unobservable factors is difficult. Event-based methods are unsuitable since cross-sectional return tests require long time spans, and narrowing the sample by industry or period does not resolve this problem. Given these caveats, we explore the issue with a matching approach. Each year, we estimate profitability persistence for each firm and match firms in the top tercile of persistence with firms from the lower two terciles, minimizing differences in profitability dynamics (i.e., averages and volatilities). The empirical results support the model's comparative statics findings.

Related Literature. Our work primarily contributes to the following three research areas.

Firm-Level Equity Risk Premia, Corporate Capital Structure, and Anomalies. Our paper builds on studies that calibrate dynamic models to link equity risk premia with aspects of capital and debt structure. Some studies examine the relationship between leverage and returns. We align most closely with Gomes and Schmid (2010), who also study the weak leverage-return relation. They develop a dynamic model with endogenous investment and financing decisions and predict a quantitatively weak relationship. We extend their framework, which suggests that mature and safer firms have higher leverage. Our results suggest that the differences in asset returns between mature and young firms are not enough to mask the positive leverage-return relationship. While the argument put forth by Gomes and Schmid (2010) holds merit, our findings suggest that the conventional leverage amplification mechanism continues to be important. This effect is captured by considering leverage gaps and leverage targets.

Other papers studying asset pricing implications of dynamic leverage models focus on mechanisms that emphasize asymmetries — particularly the higher cost of downward adjustments — which generate risk by covarying with the countercyclical price of risk in the stochastic discount factor. Yamarthy (2020), Chaderina, Weiss, and Zechner (2022), and Friewald, Nagler, and Wagner (2022) examine the risk premia arising from debt maturity choices, building on insights from Admati, DeMarzo, Hellwig, and Pfleiderer (2018), Dangl and Zechner (2021), and DeMarzo and He (2021). Chen (2010), Bhamra, Kuehn, and Strebulaev (2010), and Gomes and Schmid (2021) propose credit risk models to interpret the joint time-series patterns of debt and equity prices over the business cycle.[6] Unlike these studies, the mechanism in our model does not necessarily depend on asymmetries in debt adjustments or on the cyclical behavior of the price of risk in the stochastic discount factor. Our stochastic discount factor, following Clementi and Palazzo (2019), implies a constant market price of risk. We show that limited financial flexibility modifies the standard leverage amplification mechanism from Modigliani and Miller (1958), where financial leverage amplifies gains and losses on the asset side. Leverage gaps and targets play a central role in explaining levered returns through this channel, and our empirical and quantitative analysis confirms their relevance. Analytical results from our two-period example highlight that, similar to the second proposition in Modigliani and Miller (1958), the relationship between equity returns, leverage, and leverage gaps holds not only for expected returns but also for realized returns, and under any stochastic discount factor.

[6]Other studies focus on pricing firms' credit instruments, such as Bhamra, Fisher, and Kuehn (2011), Kuehn and Schmid (2014), Palazzo and Yamarthy (2022), and Danis and Gamba (2023). In contrast, we examine cross-sectional equity risk premia rather than aggregate risk premia on credit instruments.

Other recent studies, such as Ozdagli (2012), Choi (2013), Obreja (2013), and Doshi, Jacobs, Kumar, and Rabinovitch (2019), jointly study risk premia related to corporate leverage and book-to-market equity. Although the value premium is not the main focus of our analysis, our results suggest that leverage gaps interact with the value premium. The sensitivity of returns to book-to-market decreases — both economically and statistically — when leverage gaps are included in cross-sectional return regressions.

Finally, other studies have developed models that connect default probabilities with equity risk premia and credit spreads, building upon the "distress puzzle" that was empirically documented by Campbell, Hilscher, and Szilagyi (2008). Recent contributions in this area include Friewald, Wagner, and Zechner (2014), and Chen, Hackbarth, and Strebulaev (2022), among others. The "distress premium puzzle" is not the focus of this study. Instead, we examine the leverage amplification mechanism, which, as Gomes and Schmid (2010) emphasize, is generally not associated with financial distress.

Firm Dynamics and Financial Flexibility. Numerous studies calibrate or estimate dynamic models to explore firm dynamics in the face of frictions in adjusting their capital structure. The closest study to ours is Gamba and Triantis (2008). Their study emphasizes the value losses from financial inflexibility, especially for small firms. Differently from them, we use asset pricing data and focus on the puzzling evidence on levered risk premia. Among these studies, our work primarily relates to those that introduce leverage targets in dynamic economies. Hennessy and Whited (2005) underscore the challenges in defining leverage targets in a dynamic investment and financing model, where there is no target leverage, defined as a single optimal capital structure independent of the current state of the world. DeAngelo, DeAngelo, and Whited (2011) recognize that a meaningful leverage target exists in a similar model. They consider a long-term target, from which firms occasionally move away with debt adjustments that they interpret as transitory. Leverage targets are also routinely used to characterize (S, s)-type refinancing policies in continuous-time models.[7] Our findings complement these studies by characterizing leverage policies by means of a dynamic leverage target, defined using the "gap approach." Most importantly, our focus is on the weak relationship between leverage and risk premia. Our focus is on the weak relationship between leverage

[7] A non-exhaustive list of contributions includes Fischer, Heinkel, and Zechner (1989), Goldstein, Ju, and Leland (2001), Strebulaev (2007), Morellec and Zhdanov (2008), Hugonnier, Malamud, and Morellec (2015), Bolton, Wang, and Yang (2021), and Benzoni, Garlappi, Goldstein, and Ying (2022).

and risk premia, and on the role of financial flexibility in affecting it. Consistent with this goal, we adopt a parsimonious approach to financial inflexibility by modeling reduced-form debt adjustment costs as a catch-all for a broad set of frictions affecting financial flexibility, without microfounding their sources.

Discrete-Time Models with Endogenous Default. From a methodological perspective, we conduct our quantitative analysis using a discrete-time model with endogenous investment, financing, and default, for which we employ a global numerical solution. As discussed, for example, in Chen and Frank (2022), the solution of these models presents computational complexity. This complexity arises because the default condition of the firm depends on the equity value, which, in turn, is influenced by debt prices. These debt prices are internalized by each firm's decision-making process. Some successful quantitative analyses have been conducted using models of this nature, such as Hennessy and Whited (2005), Gomes and Schmid (2010), Obreja (2013), Kuehn and Schmid (2014), Gomes and Schmid (2021), and Danis and Gamba (2018). However, incorporating financial inflexibility prevents the redefinition of the state space, a commonly used technique in the literature to reduce dimensionality (see Section 3.4). To tackle this challenge, we employ projection methods and rely on a non-parametric structure for interpolation.

2 Empirical Patterns in Levered Returns

This section presents three empirical facts that motivate our quantitative analysis. First, we replicate the well-known puzzle that leverage and equity returns are weakly related after controlling for standard return predictors, namely size and book-to-market. Second, we show that empirical proxies of leverage gaps are strongly positively related to stock returns. Third, when we decompose leverage gaps into target leverage and actual leverage, the expected positive relation between leverage and returns reappears, while the coefficient on target leverage turns negative.

2.1 Data and Sample

Accounting variables are from the CRSP/COMPUSTAT merged annual database over the period 1965-2020. Our sample includes all companies listed on AMEX, NYSE, and NASDAQ. We exclude financial firms (SIC codes 6000-6999), utility companies (SIC codes 4900-4999), and firms that are not incorporated in the United States. All variables used in the analysis are defined in Appendix A.

We match accounting variables to monthly stock prices and returns from the Center of Research in Security Prices (CRSP). We drop observations for which the trading status is halted or suspended and we include delisting returns in the time series of returns. To avoid look-ahead biases, we follow Fama and French (1992) and conservatively require a minimum gap of six months between fiscal year-ends and realized returns. To do so, for each firm, we match data from the latest fiscal year ending in calendar year $t-1$ to returns on common shares from July of calendar year t to June of calendar year $t+1$.

2.2 Empirical Proxies of Leverage Targets and Gaps

Our analysis involves reduced-form measures of leverage targets and gaps, which need to be estimated. We construct two such measures: one based on the empirical corporate finance literature, and another derived from the quantitative analysis in Section 4. First, we follow on the empirical model of Flannery and Rangan (2006), which is widely used in the corporate finance literature to produce proxies of leverage targets.[8] We implement rolling estimates of leverage targets $LT_{i,t}$ for firm i in year t to avoid look-ahead biases when including them in our asset pricing tests. Years from 1965 to 1979 are used as a "burn-in" period to obtain sensible initial estimates. We then continue on a rolling basis using accounting information available until year t. To be included in the analysis, firms are required to have at least five consecutive years of observations.

In Flannery and Rangan (2006)'s model, firms partially adjust their leverage $L_{i,t}$ over time toward the target level $LT_{i,t}$ with a "speed of adjustment" λ, i.e.,

$$L_{i,t} - L_{i,t-1} = \lambda(LT_{i,t} - L_{i,t-1}) + \epsilon_{i,t},$$

where leverage targets $LT_{i,t} = \beta X_{i,t-1}$ are linear functions of firm-level characteristics $X_{i,t-1}$, and vary both over time and across firms. Using this linear approximation, one obtains the following

[8] The validation of alternative reduced-form proxies of leverage targets is outside the scope of our model-based analysis. In a review article, Flannery and Hankins (2013) assess different estimation procedures for leverage targets in dynamic panels. The evidence on their performance is mixed, but we choose Flannery and Rangan (2006)'s approach primarily for its computational efficiency in large datasets.

estimable regression equation:

$$L_{i,t} = (\lambda\beta)X_{i,t-1} + (1-\lambda)L_{i,t-1} + \epsilon_{i,t}. \tag{1}$$

The control variables that Flannery and Rangan (2006) include in $X_{i,t-1}$ are profitability, the market-to-book value of assets, depreciation, total assets, a measure of tangibility, R&D expenses, an indicator variable for missing values of R&D expenses, industry-median leverage, and a firm fixed effect. We first estimate (1) to obtain the coefficients $\lambda\beta$ on $X_{i,t-1}$ and $(1-\lambda)$ on $L_{i,t-1}$. We then recover λ and β and estimate $LT_{i,t}$. Finally, we compute leverage gaps as the difference between observed and leverage targets, i.e., as $L_{i,t-1} - LT_{i,t}$.

Second, we estimate a multinomial logit model for leverage adjustments. Leverage targets are approximated using a functional form obtained by projecting the policy functions from the calibrated dynamic model onto a set of observable variables. For brevity, we refer to this proxy as the "projection target." As detailed in Section 4.3, we choose a functional form that closely approximates the model-implied leverage targets, achieving a correlation of approximately 95%.[9]

To capture non-linearities in adjustment behavior without imposing strong functional assumptions, we define a discrete variable $Adj_{i,t}$: it takes the value 1 if a firm increases its leverage $L_{i,t}$ relative to the previous year's one ($L_{i,t-1}$), -1 if it decreases it, and 0 if it remains stable, all within a $\pm 1\%$ band. Based on the analysis in Section 4.3, we model leverage targets as:

$$LT_{i,t} = \frac{1}{1 + e^{-\gamma Z_{i,t}}},$$

where γ is a vector of coefficients to be estimated, and $Z_{i,t}$ includes a second-order polynomial in the logs of total assets, median leverage, and market-to-book ratio, and profitability (i.e., these variables along with their interaction terms and squared terms), and a firm fixed effect.

We model the probabilities of leverage adjustments using a multinomial logit function of the

[9] A related approach — often referred to as empirical policy functions — has been used in Bazdresch, Kahn, and Whited (2018) and Nikolov, Schmid, and Steri (2021).

leverage gap $Gap^{L}_{i,t} \equiv L_{i,t-1} - LT_{i,t}$:

$$\mathbb{P}(\text{Adj}_{i,t} = 0) = \frac{1}{1 + e^{\beta_{\text{inc}}\text{Gap}^{L}_{i,t}} + e^{\beta_{\text{dec}}\text{Gap}^{L}_{i,t}}},$$
$$\mathbb{P}(\text{Adj}_{i,t} = 1) = \frac{e^{\beta_{\text{inc}}\text{Gap}^{L}_{i,t}}}{1 + e^{\beta_{\text{inc}}\text{Gap}^{L}_{i,t}} + e^{\beta_{\text{dec}}\text{Gap}^{L}_{i,t}}},$$
$$\mathbb{P}(\text{Adj}_{i,t} = -1) = \frac{e^{\beta_{\text{dec}}\text{Gap}^{L}_{i,t}}}{1 + e^{\beta_{\text{inc}}\text{Gap}^{L}_{i,t}} + e^{\beta_{\text{dec}}\text{Gap}^{L}_{i,t}}},$$

where β_{inc} and β_{dec}, to be estimated, capture how sensitive adjustment behavior is to the leverage gap. Each firm-year observation contributes to the total log-likelihood $\log(\mathcal{L})$ as:

$$\log \mathcal{L}_{i,t} \equiv \begin{cases} \log \mathbb{P}(\text{Adj}_{i,t} = 0) & \text{if } Adj_{i,t} = 0, \\ \log \mathbb{P}(\text{Adj}_{i,t} = 1) & \text{if } Adj_{i,t} = 1, \\ \log \mathbb{P}(\text{Adj}_{i,t} = -1) & \text{if } Adj_{i,t} = -1, \end{cases}$$

where $\log(\mathcal{L}) = \sum_{i,t} \log \mathcal{L}_{i,t}$. We estimate the parameters $\{\gamma, \beta_{\text{inc}}, \beta_{\text{dec}}\}$, and leverage targets and gaps, by maximizing this likelihood. As before, we use a rolling estimation procedure to avoid look-ahead bias. Appendix A provides further details.

As is standard in the literature on dynamic models linking corporate policies to asset returns (see Gomes and Schmid, 2010; Bolton, Chen, and Wang, 2011; Kuehn and Schmid, 2014; Gomes, Jermann, and Schmid, 2016, among others), firms differ only through ex-post realizations of productivity shocks. That is, the model does not explicitly include firm fixed effects in parameterizations. To map model-based policies to the data, the quantitative literature typically removes firm fixed effects from the data. In some cases, studies add noise to simulations or explicitly model ex-ante firm heterogeneity. These approaches appear in, for example, Cooper and Ejarque (2003), Hennessy and Whited (2005), Hennessy and Whited (2007), and Gamba and Saretto (2020). In our empirical analysis, both measures of leverage targets include firm fixed effects to account for this heterogeneity and to improve comparability with the simulated model economies.

2.3 Empirical Facts

Table 1 summarizes our key empirical facts. Table 1 reports estimates from cross-sectional regressions of stock returns on leverage variables, size, and book-to-market. Reported coefficients are time-series averages of the estimates from monthly cross-sectional regressions. Newey-West standard errors with lag-length of 4 are in parentheses. In Appendix E, we report a series of robustness checks and sensitivity analyses, which we summarize in Subsection 2.4. The empirical analysis of levered returns involves several variables, such as controls for dispersion in asset returns, size and book-to-market equity, and multiple leverage variables. Cross-sectional regressions, as an empirical procedure, facilitate the simultaneous inclusion of multiple predictors and control variables in the analysis. In contrast, portfolio sorts become impractical when handling more than a few characteristics concurrently. This is due to the limited number of stocks available to populate a sufficient number of diversified portfolios each month.

Fact #1: Leverage is Weakly Related to Average Returns. The leftmost column shows that leverage has a positive coefficient, which is statistically insignificant at the conventional levels after controlling for size and book-to-market equity. This results illustrates the well-known "leverage puzzle" that emerges in the empirical literature and that Gomes and Schmid (2010) highlight. In fact, several studies have explored the relationship between leverage and equity returns. Contributions in this area include Bhandari (1988), Fama and French (1992), Penman, Richardson, and Tuna (1992), George and Hwang (2010), Caskey, Hughes, and Liu (2012), and Doshi, Jacobs, Kumar, and Rabinovitch (2019). In particular, Caskey, Hughes, and Liu (2012), like our study, refer to overlevered and underlevered firms based solely on variations in marginal tax benefits, as measured by the "kink" proxy of Graham (2000).

Fact #2: Leverage Gaps are Positively Related to Average Returns. Columns (2) and (4) of Table 1 relate returns to leverage gaps, using the Flannery-Rangan and projection targets, respectively. In both columns, the coefficients are positive and significant at the 1 percent level. Introducing leverage gaps reduces the coefficient on book-to-market equity, though the change is not statistically significant relative to column (1). This result may not be particularly surprising, and it is intuitive to include growth options — proxied by book-to-market — in leverage targets. However, the resulting effect is not straightforward, as book-to-market enters both the linear target specification and the non-linear projection model alongside other variables, through different functional forms and estimation methods. When observed leverage and the leverage gap are included in columns (3) and (5), the gap coefficient remains positive and significant at the 1 percent level. The coefficient on leverage also remains positive, but is less than one standard error from zero and thus not statistically significant at conventional levels.

Fact #3: Controlling for Leverage Targets, Leverage is Positively Related to Average Returns. Columns (1) and (2) of Appendix Table A2 include both observed leverage and leverage targets in the same regression. These specifications are equivalent to those in columns (3) and (5) of Table 1, since the leverage gap is defined as the difference between observed leverage and the target. As a result, the coefficients on the targets have the same magnitude but the opposite sign of the leverage gap coefficients in columns (3) and (5) of Table 1. The coefficient on observed leverage corresponds to the sum of the coefficients on leverage and the gap. Despite these mechanical relationships, Appendix Table A2 provides an alternative view of the results. When both leverage variables are included, the positive relation between observed leverage and returns reappears, while leverage targets are negatively related to returns. Both coefficients are statistically significant at the 1 percent level across all specifications.

2.4 Robustness and Sensitivity Analyses

In Appendix E, we implement a series of robustness checks and sensitivity analyses. Table A1 shows that the results in Table 1 continue to hold qualitatively when leverage is measured using book values or net of cash, as these alternatives occasionally affect results in the literature.[10] Table A3 includes investment and profitability factors as additional controls for heterogeneous asset returns, as suggested by the q-factor model of Hou, Xue, and Zhang (2015) and the five-factor model of Fama and French (2016). Although some coefficients are smaller in magnitude, they retain the same signs as in Table 1 and remain statistically significant.

Table A4 examines whether changes in leverage driven by asset sales (disinvestments) or, more broadly, by changes in assets, influence the gap-return relationship. The baseline results remain

[10] See, for example, George and Hwang (2010) and Ozdagli (2012). The analysis of market versus book measures of leverage for the mapping between data and structural models is beyond the scope of this paper. For a detailed discussion, see Bretscher, Feldhütter, Kane, and Schmid (2020).

robust when controlling for leverage changes driven by asset variation in the denominator, holding debt constant, and for a negative investment indicator. Both variables are positively associated with returns and statistically significant at the one percent level. However, after controlling for profitability and investment (columns 3, 4, 7, and 8), the leverage change due to asset variation loses both statistical and economic significance. The disinvestment indicator remains significant at the ten percent level, though with a smaller economic effect. Table A5 benchmarks our results against firms with zero leverage and negative net leverage, which have received attention in the literature (e.g., Bates, Kahle, and Stulz, 2009; Strebulaev and Yang, 2013). The results are consistent with the baseline, although returns in this subsample show greater sensitivity to leverage and leverage gaps.

Finally, we note that since book-to-market and size are used as controls in the cross-sectional return regressions — and analogous variables (e.g., book-to-market of assets) also enter the construction of leverage targets — this overlap could drive the results. However, the relationship is not straightforward. In the Flannery-Rangan target, book-to-market enters through a linear combination of several variables, while in the projection target, it is included in a more flexible, non-linear specification. In our sample, the correlation between the leverage target and book-to-market is 0.12 for the Flannery-Rangan target and –0.07 for the projection target. For size, the corresponding values are –0.09 and 0.30, respectively.

3 The Model

In this section, we lay out a dynamic model, which serves as a basis for the quantitative analysis in Section 4. In the model, as is standard in the literature (e.g., Gomes, 2001; Gamba and Triantis, 2008; Gomes and Schmid, 2010), firms are ex-post heterogeneous due to idiosyncratic productivity shocks. Unlike ex-ante heterogeneity in parameters, this feature endogenously propagates and amplifies shocks through the model's structure, helping to discipline the analysis. We also introduce aggregate shocks, which affect firms' profitability and discount rates, to better study the role of differences in leverage targets across firms. Every period, firms make endogenous financing and investment decisions. Moreover, firms are financially constrained as external equity is costly and firms can endogenously default on their debt. Finally, firms have limited financial flexibility as

Table 1
Empirical Facts on Leverage and Returns

The table reports coefficient estimates of Fama-MacBeth cross-sectional regression of monthly stock returns on leverage variables and controls. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2020 and covered by the Center of Research in Security Prices (CRSP). Leverage targets and leverage gaps are the results of the rolling estimation procedure described in Section 2. Columns (2) and (3) report results based on leverage gaps estimated using the Flannery–Rangan approach ("Flannery-Rangan Target"). Columns (4) and (5) use leverage targets derived from a dynamic model, where model-based targets are projected onto a set of variables observed in the data ("Projection Target"). The resulting functional form is then used to estimate a multinomial logit model, as discussed in Section 4.3. Years from 1965 to 1979 are used as a "burn in" period. Annual accounting variables are matched to monthly returns from July 1980 to December 2020 following the standard procedure of Fama and French (1992). Newey-West standard errors with lag-length of 4 are in parentheses. R^2 and N. Obs denote the cross-sectional R-squared and the number of observations respectively. All variables are described in Appendix A.

Dependent Variable: Monthly Stock Return					
		Flannery-Rangan Target		Projection Target	
	(1)	(2)	(3)	(4)	(5)
Leverage	0.24		0.18		0.17
	(0.35)		(0.33)		(0.32)
Lev. Gap		0.96	0.79	0.50	0.47
		(0.33)	(0.29)	(0.17)	(0.16)
Size	-0.21	-0.18	-0.18	-0.19	-0.20
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)
Be/Me	0.16	0.11	0.10	0.14	0.12
	(0.07)	(0.07)	(0.06)	(0.07)	(0.06)
R^2	0.02	0.02	0.02	0.02	0.02
N. Obs	1221746	880452	880452	761294	761294

they bear costs of adjusting their capital structure. Section 3.1 describes the infinite-horizon setup. Section 3.2 illustrates the economic mechanism at work in a two-period version of the model and suggests an interpretation of the empirical patterns in Section 2 through the lens of the model. Section 3.3 discusses the definition of a dynamic leverage target. Section 3.4 specifies the functional forms used in the quantitative analysis and describes the numerical solution method.

3.1 Setup

Technology and Investment. Time is discrete. We consider the problem of a value-maximizing firm i in a perfectly competitive environment. In each period t, the after-tax operating profits $\Pi_{i,t}$ are given by

$$\Pi_{i,t} = (1-\tau) f(A_t, Z_{i,t}, K_{i,t}), \tag{2}$$

where $\tau \in (0,1)$ is the corporate tax rate, $K_{i,t}$ is firm i's capital stock, $f(A_t, Z_{i,t}, K_{i,t})$ is a production function, A_t is an exogenous aggregate shock, and $Z_{i,t}$ is a firm-specific shock. The variables A_t and $Z_{i,t}$ can be interpreted as shocks to demand, input prices, or productivity. We assume that $f(\cdot)$ is strictly increasing, strictly concave, and differentiable in capital $K_{i,t}$. A_t and $Z_{i,t}$ have bounded support $\mathcal{A} = [\underline{A}, \overline{A}]$ and $\mathcal{Z} = [\underline{Z}, \overline{Z}]$, respectively. The law of motion of A_t is described by a Markovian transition function $Q_A(A_t, A_{t+1})$. Similarly, $Z_{i,t}$ is Markovian with transition function $Q_Z(Z_{i,t}, Z_{i,t+1})$.

At the beginning of each period, firms can scale operations by choosing investment $I_{i,t}$ in physical capital. Next period's capital stock $K_{i,t+1}$ satisfies the standard law of motion for capital accumulation

$$K_{i,t+1} = (1-\delta) K_{i,t} + I_{i,t}, \tag{3}$$

where $\delta \in (0,1)$ is the depreciation rate of capital.

Financing. Investment and distributions to shareholders can be financed with either the internal funds generated by operating profits or new issues. The latter can take the form of new debt (net of repayments) or external equity.

We denote the firm's debt stock as $B_{i,t}$. Outstanding one-period debt pays a coupon $c_{i,t}$ per unit of time. As we detail below, the coupon is set in competitive credit markets to compensate expected bankruptcy costs in case of default, in which lenders recover a liquidation value $L_{i,t}$. Firms are allowed to refinance their debt stock by issuing a net amount $\Delta B_{i,t} \equiv B_{i,t+1} - B_{i,t}$.

Similar to Croce, Kung, Nguyen, and Schmid (2012) and Belo, Lin, and Yang (2014), firms incur costs $\Lambda^B(\Delta B_{i,t}) \geq 0$ of adjusting their debt stock. In our quantitative analysis, we choose a flexible parameterization for $\Lambda^B(\Delta B_{i,t})$ to allow for asymmetries and possibly large marginal costs for small adjustments. Having a flexible reduced-form functional form allows us to keep the model tractable without committing to a specific microfoundation. In fact, debt adjustment costs can arise from several quantitatively relevant sources, including underwriting and management spreads (e.g., Fischer, Heinkel, and Zechner, 1989; Strebulaev, 2007), seniority issues that prevent firms from making large changes in the capital structure (e.g., Acharya, Bharath, and Srinivasan, 2007), costs associated with the liquidation of short-term debt (Diamond, 1991), and agency costs associated with long-term debt (e.g., debt overhang and underinvestment as in Myers, 1977).

Firms can also raise external finance through seasoned equity offerings (SEOs). Let $E_{i,t}$ denote the equity issuances. Following the extensive existing literature, we consider equity issuance costs $\Lambda^E(E_{i,t}) \geq 0$. We interpret negative values for $E_{i,t}$ as equity payouts.

Investment financing decisions must satisfy the firm's budget constraint, which takes the form of the following accounting identity between uses and sources of funds:

$$\Pi_{i,t} + \Delta B_{i,t} + E_{i,t} + \tau\delta K_{i,t} + \tau c_{i,t} B_{i,t} = I_{i,t} + c_{i,t} B_{i,t} + \Lambda^B(\Delta B_{i,t}), \tag{4}$$

where the terms $\tau\delta K_{i,t}$ and $\tau c_{i,t} B_{i,t}$ reflect the tax deductibility of depreciation and interest expenses, respectively. Net distributions to shareholders, $D_{i,t}$, are then defined as equity payout net of issuance costs, i.e.,

$$D_{i,t} = -E_{i,t} - \Lambda^E(E_{i,t}). \tag{5}$$

Valuation. We assume the absence of arbitrage opportunities in financial markets, which implies the existence of a stochastic discount factor $M_t > 0$ (e.g., Harrison and Kreps, 1979). Defining $V_{i,t}$ as the firm's equity value, we assume that shareholders strategically default on their debt obligations if $V_{i,t} < \xi_{i,t}$, where $\xi_{i,t}$ is a random variable capturing uncertainty in shareholders' outside options. We further assume that $\xi_{i,t}$ follows a logistic distribution with mean zero and scale parameter $s \geq 0$ and is independent of other shocks in the model. This specification generalizes the standard assumption in the literature that the outside option is deterministic and equal to zero. Specifically, for small values of s, the outside option converges to the mean of $\xi_{i,t}$.

From a technical perspective, introducing shocks to outside options $\xi_{i,t}$ allows for the analytical derivation of optimality conditions, which prove useful in Subsection 3.3 when defining a dynamic leverage target based on the gap literature (e.g., Bayer, 2009). In our framework, this approach helps address the challenge of characterizing optimal dynamic capital structure choices when various frictions – such as equity issuance and bankruptcy costs – affect firms' decisions, whereas models in the gap literature typically consider only convex adjustment costs. This technique has long been used in economics to formulate differentiable dynamic discrete choice problems that yield smooth decision rules (e.g., McFadden, 1977), including applications in industrial organization and, more recently, sovereign default studies. Recent relevant contributions include Chatterjee and Eyigungor (2012), Dvorkin, Sánchez, Sapriza, and Yurdagul (2021), and Chatterjee, Corbae, Dempsey, and Ríos-Rull (2023), among others.

Accordingly, interest payments $c_{i,t}$ are determined endogenously as follows:

$$B_{i,t+1} = \mathbb{E}_t \left[M_{t+1} \left((1 + c_{i,t+1}) B_{i,t+1} \chi_{\{V_{i,t+1} > \xi_{i,t+1}\}} + L_{i,t+1} \chi_{\{V_{i,t+1} \leq \xi_{i,t+1}\}} \right) \right], \tag{6}$$

where $\chi_{\{\cdot\}}$ is an indicator function that takes: value 1 when the event $\{\cdot\}$ happens; value 0 when the event $\{\cdot\}$ does not happen.

In our baseline infinite-horizon economy, the firm's maximization problem can be formulated recursively using the beginning-of-period value function, before outside option shocks $\xi_{i,t}$ are realized. Equity holders choose (i) investment $I_{i,t}$, (ii) debt issuance $\Delta B_{i,t}$, and (iii) default decisions $DEF_{i,t} \in \{0, 1\}$, where 1 indicates default and 0 solvency. Let $S_{i,t} \equiv \{K_{i,t}, B_{i,t}, c_{i,t}, Z_{i,t}, A_t\}$ denote the state vector of firm i at time t. The continuation value function $V^C(S_{i,t})$, conditional on the firm not defaulting in the current period, is defined as

$$V^C(S_{i,t}) \equiv \max_{\Delta B_{i,t}, I_{i,t}} D_{i,t} + \mathbb{E}[M_{t+1} V(S_{i,t+1}) | S_{i,t}]. \tag{7}$$

Equity holders decide whether to default before time-t outside option shocks by choosing

$$DEF_{i,t} = \begin{cases} 1 & \text{if } \xi_{i,t} > V^C(S_{i,t}) \\ 0 & \text{if } \xi_{i,t} \leq V^C(S_{i,t}). \end{cases}$$

Under this intra-period timing, the beginning-of-period value function $V(S_{i,t})$ relates to the continuation value as

$$\begin{aligned} V(S_{i,t}) &= \mathbb{E}^{\zeta}[\max\{\xi_{i,t}, V^C(S_{i,t})\}] \\ &= \mathbb{E}^{\zeta}\left[\max_{DEF_{i,t}\in\{0,1\}} (1 - DEF_{i,t})V^C(S_{i,t}) + DEF_{i,t}\xi_{i,t}\right], \end{aligned} \tag{8}$$

where the second line follows from the definition of $DEF_{i,t}$, and the expectation operator $\mathbb{E}^{\zeta}[\cdot]$ is taken with respect to $\xi_{i,t}$, formally defined as

$$\mathbb{E}^{\zeta}[g(\xi)] \equiv \int_{-\infty}^{\infty} g(x)dF^{\zeta}(x),$$

for any integrable function $g(\xi)$ and cumulative distribution function $F^{\zeta}(\zeta)$. Substituting $V^C(S_{i,t})$ from (7) into (8), we obtain the recursive formulation:

$$V(S_{i,t}) = \mathbb{E}^{\zeta}[\max\{\xi_{i,t}, \max_{\Delta B_{i,t}, I_{i,t}} D_{i,t} + \mathbb{E}[M_{t+1}V(S_{i,t+1})|S_{i,t}]\}], \tag{9}$$

subject to: (i) the law of motion for capital (3), (ii) the firm's budget constraints (4) and (5), and (iii) the debt pricing equation (6). Note that leverage, leverage gaps, and leverage targets are ultimately determined by the model's state variables $S_{i,t}$. However, when we analyze our quantitative results and compare them to the data, we avoid depending on this direct mapping to derive a more insightful characterization and empirical predictions. As elaborated on in Section 3.3, this approach aligns well with established practices in the literature on levered risk premia, and it is also commonly seen in other contexts, like when corporate investment is linked to Tobin's Q (e.g., Hayashi, 1982).

3.2 Economic Mechanism in a Two-Period Version of the Model

This section presents the underlying economic mechanism in a two-period version of the model, with dates denoted as $t = 1, 2$. This simplified setting provides analytical solutions that effectively characterize leverage dynamics and levered returns. The main results take a form similar to the first and second propositions of Modigliani and Miller (1958), within a tradeoff economy with limited financial flexibility. In this setup, definitions of targets and gaps in capital structure arise naturally, consistent with the macroeconomic literature on adjustment gaps. In Section 3.3, we use the differentiability properties of the firm's problem in (9) to extend these definitions to the baseline infinite-horizon economy. To serve our purpose of illustration, we make the following assumptions.

Assumptions. First, each firm i defaults at $t = 2$ with exogenous probability $1 - \rho_i$, where $\rho_i \in (0, 1)$ is a constant solvency probability, independent of other shocks in the model and of the stochastic discount factor. Second, the recovery value L_2 (in case of default at $t = 2$) increases at a constant rate $\xi_K > 0$ with residual capital at $t = 2$ and decreases at a linear rate $\xi_B > 0$ with debt; i.e., $\frac{\partial L_2}{\partial K_2} = \xi_K$ and $\frac{\partial L_2}{\partial B_2} = -\xi_B B_2$. Thus, bankruptcy costs increase more than proportionally with the firms' stock of debt. These two assumptions, which our full model relaxes, enable us to sidestep the analytical computation of the default region while keeping intact the dependency of expected default costs on debt. Third, the cost of equity issuance $E_{i,t}$ is equal to zero. Thus, we focus on a pure tradeoff economy, in which firms are not financially constrained for their investment expenses, but issue debt to trade off their tax benefits and bankruptcy costs. Finally, the firm's costs of adjusting its debt stock are quadratic; i.e., $\Lambda^B(B_2 - B_1) \equiv \frac{\lambda_B}{2}(B_2 - B_1)^2$. Accordingly, large debt adjustments are disproportionately more costly than small adjustments. Relaxing the assumption of cost symmetry still allows for closed-form solutions, though these offer limited additional insights.

Notation. For explanation purposes, it is convenient to adapt the notation as follows. From now on, we refer to firm i more simply as "the firm", and drop the subscript i. We define bankruptcy costs BC_2, tax shields TS_2, and debt repayments (principal plus interest) DR_2 at $t = 2$ as

$$BC_2 \equiv \begin{cases} 0, & DEF_2 = 0 \\ R_2^A K_2 - L_2, & DEF_2 = 1 \end{cases}, \; TS_2 \equiv \begin{cases} \tau c_2 B_2, & DEF_2 = 0 \\ 0, & DEF_2 = 1 \end{cases}, \; DR_2 \equiv \begin{cases} (1+c_2)B_2, & DEF_2 = 0 \\ L_2, & DEF_2 = 1 \end{cases}, \tag{10}$$

where DEF_2 is an indicator variable for solvency ($DEF_2 = 0$) or default ($DEF_2 = 1$) at $t = 2$, and $R_2^A \equiv 1 + (1-\tau)\left(f(A_2, Z_2, K_2)/K_2 - \delta\right)$. Given these definitions, the firm pays the following dividend at $t = 2$

$$D_2 = R_2^A K_2 - R_2^D B_2, \tag{11}$$

where $R_2^D \equiv \frac{DR_2 - TS_2 + BC_2}{B_2}$ is the effective ex-post gross return on debt the firm needs to pay in each state.[11] Note that these definitions render the shareholders' recovery value, which is the realization random variable D_2 in the case of default, equal to zero. Moreover, define the rate of payment to debt holders r_2^D as a random variable such that: (i) $r_2^D = c_2$ in the case of solvency and (ii) $r_2^D = L_2/B_2 - 1$ in the case of default. Under this definition, the debt pricing equation (6) can be conveniently rewritten as

$$\mathbb{E}[M_2(1 + r_2^D)|\, S_1] = 1, \tag{12}$$

given initial conditions $S_1 = \{K_1, B_1, c_1, Z_1, A_1\}$. We also define the riskfree rate $r_F \equiv \mathbb{E}[M_2|\, S_1]^{-1} - 1$. The dividend at $t = 1$ is instead given by (4) and is equal to

$$D_1 = R_1^A K_1 - I_1 + B_2 - (1 + (1-\tau))c_1 B_1 - \frac{\lambda_B}{2}(B_2 - B_1)^2,$$

where $R_1^A \equiv 1 + (1-\tau)\left(\frac{\Pi(K_1, A_1, Z_1)}{K_1} - \delta\right)$.

Therefore, the firm chooses capital K_2 and debt B_2 to maximize the equity value V_1, that is:

$$V_1 = \max_{K_2, B_2} D_1 + \mathbb{E}[M_2 \cdot D_2|\, S_1].$$

[11] Observe that the final dividend D_2 at $t = 2$ from (11) coincides with the one in (4) and (5) when investment and capital structure adjustments are set to zero, consistent with $t = 2$ being the terminal period.

Optimality Conditions. The first-order condition with respect to K_2 can be written as

$$1 = \rho\mathbb{E}\left[M_2 \left(1 + (1-\tau)(f_k(A_2, Z_2, K_2) - \delta) + (1-\tau)\frac{1-\rho}{\rho}\frac{\partial L_2}{\partial K_2} \right) \middle| S_1 \right]. \tag{13}$$

This condition has an intuitive interpretation. The firm finds the optimal investment at the point where the marginal cost of giving up one unit of capital at time 1 equates to the marginal benefit from the future after-tax marginal productivity of capital net of depreciation, and from a lower future coupon. The term $(1-\tau)\frac{1-\rho}{\rho}\frac{\partial L_2}{\partial K_2}$ accounts for the lower promised interest payments the firm attains through a higher lender recovery value in default. The constant term $\frac{1-\rho}{\rho}$ captures the idea that, under fair debt pricing, higher recovery values effectively transfer resources from default states (which occur with probability $1-\rho$) to solvency states (which occur with probability ρ).

The first-order condition with respect to B_2 is

$$1 - \frac{\partial \Lambda^B(\Delta B_1)}{\partial B_2} = \rho\mathbb{E}\left[M_2 \left(1 + (1-\tau)\left(c_2 + \frac{(1-\rho)}{\rho}\left(\frac{L_2}{B_2} - \frac{\partial L_2}{\partial B_2} \right) \right) \right) \middle| S_1 \right]. \tag{14}$$

The optimal debt level equalizes its net marginal benefit at time 1 (on the left-hand side) and its expected discounted net marginal cost at time 2 (on the right-hand side). The marginal benefit at $t = 1$ is one additional dollar of debt, net of the adjustment cost that arises from the change in debt. The expected discounted marginal cost at $t = 2$ can be decomposed in two parts. First, the promised repayment $1 + (1-\tau)c_2$, i.e., the principal plus the coupon, net of tax shields. Second, the term multiplying $\frac{1-\rho}{\rho}$ captures the higher coupon that the firm obtains by marginally increasing its debt stock relative to the recovery value ($\frac{L_2}{B_2}$). This term also takes into account the reduction in the recovery value itself, since $\frac{\partial L_2}{\partial B_2} \leq 0$.

The following proposition characterizes the optimal financing policy in terms of leverage gaps.

Proposition 1 ***(Optimal Financing Policy).*** *Given initial conditions S_1, the firm optimally: a) sets its debt stock B_2 to close a fraction λ_1 of the gap between their initial debt stock B_1 and their target debt stock B_2^*, that is*

$$B_2 - B_1 = \lambda_1(B_2^* - B_1), \tag{15}$$

where

$$\lambda_1 = \frac{(1-\tau)(1-\rho)\xi_B}{\lambda_B(1+r_F) + (1-\tau)(1-\rho)\xi_B}, \tag{16}$$

and

$$B_2^* = \frac{\tau(r_F + 1 - \rho)}{(1-\tau)(1-\rho)\xi_B}. \tag{17}$$

b) sets its leverage ratio $\frac{B_2}{K_2}$ *according to*

$$\frac{B_2}{K_2} - \frac{B_1}{K_1} = \lambda_1 \left(\frac{B_2^*}{K_2^*} - \frac{B_1}{K_1} \right) + (1-\lambda_1) \left(\frac{B_1}{K_2} - \frac{B_1}{K_1} \right), \tag{18}$$

with $K_2^* = K_2$.

Proof. See Appendix.

Part a) of Proposition 1 shows that the optimal debt adjustment policy can be understood as a partial adjustment rule. We define the debt gap, $Gap_1^B \equiv B_1 - B_2^*$, as the difference between actual and target debt. Because $\lambda_1 \in [0, 1]$, firms always close a fraction of their gap toward the target. When firms have excess debt compared to their target, they decrease their debt stock, and vice versa, as

$$B_2 - B_1 = -\lambda_1 Gap_1^B.$$

Expression (17) shows that firms target higher debt stock the higher the marginal tax shield in case of solvency. The term that multiplies the tax rate τ in the numerator captures tax-deductible interest expenses, which include the riskfree rate r_F and the credit spread to compensate for default with probability $1 - \rho$. The term $(1 - \tau)(1 - \rho)\xi_B$ is the marginal bankruptcy cost. Higher values of ξ_B reduce the debt recovery rate in the case of default per dollar of debt, since $\frac{\partial L_2}{\partial B_2} = -\xi_B B_2$. The factor $1 - \tau$ accounts for the indirect tax benefit of bankruptcy costs, which increases the tax deductible interests in solvency states.

Part b) of Proposition 1 turns to leverage dynamics by looking at adjustments in the firms' debt-to-asset ratios. As for debt stocks, firms close a fraction λ_1 of the gap Gap_1^L between observed and target leverage, defined as

$$Gap_1^L \equiv \frac{B_1}{K_1} - \frac{B_2^*}{K_2^*}.$$

Firms with positive gaps are *overlevered*, i.e., their observed leverage is above the target, while firms with negative gaps are *underlevered*. Hence, equation (18) can be rewritten as:

$$\frac{B_2}{K_2} - \frac{B_1}{K_1} = -\lambda_1 Gap_1^L + (1-\lambda_1)\left(\frac{B_1}{K_2} - \frac{B_1}{K_1}\right).$$

The term $(1-\lambda_1)\left(\frac{B_1}{K_2} - \frac{B_1}{K_1}\right)$ accounts for the indirect effect of investment on debt-to-asset ratios. Firms that increase their scale (i.e., $K_2 > K_1$) effectively reduce their leverage even without actively issuing (or withdrawing) debt with respect to their initial stock B_1. If the firm starts at the efficient level of capital at $t = 1$ (i.e., $K_1 = K_2$), then the overlevered firms always reduce their leverage, and the underlevered firms always increase it, similar to the debt policy in (15). Occasionally, the firm can move away from the target by disinvesting enough to increase its debt-to-asset ratio if overlevered, or by expanding enough to reduce it if underlevered.[12] Similarly, the firm can "overshoot" and choose a leverage ratio even higher then the target leverage when overlevered, or even lower than its target leverage when underlevered.[13] In an environment with full financial flexibility, i.e., $\lambda_B = 0$, it follows that $B_2 = B_2^*$, and $\lambda_1 = 1$. λ_1 decreases with λ_B, as financial flexibility is helpful in closing gaps.[14]

Financial Flexibility and Equity Returns. We now investigate the impact of limited financial flexibility on the firm's stock return. Since $V_1 = D_1 + \mathbb{E}\left[M_2 D_2 |\, S_1\right]$ is the cum-dividend equity value of the firm, $P_1 = V_1 - D_1$ is the (ex-dividend) stock prices at time $t = 1$, P_2 at $t = 2$ is zero because there are no more cash flows after that time, and the realized firm's stock return R^E is defined as

$$R_2^E = \frac{D_2}{\mathbb{E}[M_2 D_2 |\, S_1]}. \tag{19}$$

Proposition 2 ***(Financial Flexibility and Equity Returns).*** *Given initial conditions S_1: a) realized equity returns of the firm between $t = 1$ and $t = 2$ are related to leverage targets and*

[12]Formally, this occurs when the "passive" change in leverage due to the indirect effect of the denominator is large enough in absolute value, i.e., $\frac{B_1}{K_2} - \frac{B_1}{K_1} > -\frac{\lambda_1}{1-\lambda_1} Gap_1^L$ for overlevered firms, and $\frac{B_1}{K_2} - \frac{B_1}{K_1} < -\frac{\lambda_1}{1-\lambda_1} Gap_1^L$ for underlevered firms.

[13]This requires that firms, despite being underlevered, have excess debt, i.e., $B_1 > B_2^*$. Symmetrically, overlevered firms "overshoot" when $B_1 < B_2^*$.

[14]Observe that the dynamics for debt and leverage in Proposition 1 can be alternatively characterized using the gap with respect to the current debt/leverage (in other words, the "residual gap" after adjustment), that is, $Gap_2^B \equiv B_2 - B_2^*$ and $Gap_2^L \equiv \frac{B_2}{K_2} - \frac{B_2^*}{K_2^*}$. In this case, one obtains $B_2 - B_1 = -\frac{\lambda_1}{1-\lambda_1} Gap_2^B$, and $\frac{B_2}{K_2} - \frac{B_1}{K_2} = -\frac{\lambda_1}{1-\lambda_1} Gap_2^L$.

gaps through the following relationship:

$$R_2^E = \frac{R_2^A}{\gamma_A(K_2)} + \frac{B_2\gamma_D(B_2)}{K_2\gamma_A(K_2) - B_2\gamma_D(B_2)}\left(\frac{R_2^A}{\gamma_A(K_2)} - \frac{R_2^D}{\gamma_D(B_2)}\right), \tag{20}$$

where $\gamma_A(K_2) \equiv \mathbb{E}[\,M_2R_2^A\big|\,S_1]$, *and* $\gamma_D(B_2) \equiv 1 + \frac{\mathbb{E}[\,M_2BC_2|S_1]-\mathbb{E}[\,M_2TS_2|S_1]}{B_2}$.
Expected equity returns are given by:

$$\mathbb{E}[\,R_2^E\big|\,S_1] = \frac{\mathbb{E}[\,R_2^A\big|\,S_1]}{\gamma_A(K_2)} + \frac{B_2\gamma_D(B_2)}{K_2\gamma_A(K_2) - B_2\gamma_D(B_2)}\left(\frac{\mathbb{E}[\,R_2^A\big|\,S_1]}{\gamma_A(K_2)} - \frac{\mathbb{E}[\,R_2^D\big|\,S_1]}{\gamma_D(B_2)}\right); \tag{21}$$

b) the shareholders' expected cost of debt financing $\gamma_D(B_2)$ *is linked to leverage gaps as follows:*

$$\gamma_D(B_2) = 1 + \kappa_1 K_2 Gap_2^L + (1-\rho)\mathbb{E}\left[\,M_2\frac{R_2^A}{\frac{B_2}{K_2}}\right|\left.DEF_2 = 1, S_1\right], \tag{22}$$

where $Gap_2^L = \frac{B_2}{K_2} - \frac{B_2^*}{K_2^*}$, $\kappa_1 \equiv \frac{(1-\tau)(1-\rho)\xi_B}{1+r_F}$, *and the notation* $\mathbb{E}[\cdot|DEF_2 = 1, S_1]$ *indicates the conditional expectation in case of default.*

Proof. See Appendix.

Part a) of Proposition 2 resembles the second proposition of Modigliani and Miller (1958), which relates to the special case of (21) with $\gamma_D(B_2) = 1$ and $\gamma_A(K_2) = 1$.[15] As in the case of Modigliani and Miller (1958), the relationship between equity returns and capital structure also holds ex post for realized returns, as shown in (20). Part b) instead establishes a link between the equity premia of the left-hand side of (21) and financial flexibility through leverage gaps.

The expression for the expected cost of debt, $\gamma_D(B_2)$, from the shareholders' perspective in part (a) highlights how the textbook positive relationship between leverage and expected returns breaks down in our setup. Due to the existence of bankruptcy costs and tax shields, the cost of each dollar of debt for the company R_2^D is not equal to the market return on debt for debt holders $1 + r_2^D$. The net cost to leverage (e.g., Korteweg, 2010), which is the difference between the average bankruptcy costs and tax shields, is denoted by the term $\frac{\mathbb{E}[\,M_2BC_2|S_1]-\mathbb{E}[\,M_2TS_2|S_1]}{B_2}$ in $\gamma_D(B_2)$.

[15] As in the original second proposition of Modigliani and Miller, leverage would appear as the debt-to-equity ratio $\frac{B_2}{K_2-B_2}$ in this limiting case. As the debt-to-equity ratio is a monotone increasing function of the debt-to-asset ratio, this definition does not alter the qualitative leverage-returns relationship.

Since $\gamma_D(B_2)$ multiplies B_2 in (21), an amplification effect is created if $\gamma_D(B_2) > 1$ and average bankruptcy costs exceed average tax shields in correspondence of optimal leverage choices. Vice versa, a dampening effect arises if $\gamma_D(B_2) < 1$ and average tax shields are larger than average bankruptcy costs. As in Modigliani and Miller (1958), capital structure propagates both good and bad cash flow outcomes (asset risk) to equity payouts. In contrast, the relation between leverage and returns is influenced not only by the amount of debt B_2, but also by the net cost that equity holders bear per dollar of debt.[16]

The conditions for $\gamma_D(B_2) = \gamma_A(K_2) = 1$ are intuitive. For $\gamma_D(B_2)$, tax shields and bankruptcy costs must be absent. Specifically, $\gamma_D(B_2)$ equals one when the average present value (per dollar of debt) of tax shields matches the present value of bankruptcy costs. Because tax shields are linear in debt and bankruptcy costs are convex, equal marginal values — i.e., in the absence of debt adjustment costs — still generate surplus on inframarginal units. This surplus affects firm value and expected returns. As in the Modigliani-Miller framework, capital structure becomes irrelevant. For $\gamma_A(K_2) = 1$, two conditions must hold: (i) the effect of capital on bankruptcy costs must be eliminated, which follows from the conditions that yield $\gamma_D(B_2) = 1$; and (ii) the production function must be homogeneous of degree one in capital, i.e., $f(A_2, Z_2, K_2) = f_k(A_2, Z_2, K_2)K_2$. Under these assumptions, equation (13) simplifies to $\mathbb{E}\left[M_2 R_2^A \middle| S_1\right] = 1$, implying $\gamma_A(K_2) = 1$.[17]

Part b) of Proposition 2 characterizes the relationship between capital structure and expected returns under limited financial flexibility. It links the expected cost of debt, $\gamma_D(B_2)$, to inflexibility through leverage gaps. This result helps interpret the findings in Section 2 and Section 4, which support the empirical and quantitative relevance of the characterization. Intuitively, the optimality condition (14) shows that optimal capital structure choices balance the marginal costs of capital structure rebalancing with the wedge between marginal tax shields and bankruptcy costs. Thus, changes in leverage impact the expected cost of debt, as financial flexibility, as captured by $\Lambda^B(\Delta B_1)$, depends on debt adjustments ΔB_1. As Proposition 1 establishes, optimal leverage dynamics entail partially closing leverage gaps. As a consequence, leverage gaps enter the expected cost of debt $\gamma_D(B_2)$ in (22).

[16]As the present values of tax shields and bankruptcy costs in $\gamma_D(B_2)$ are computed using the pricing kernel M_2, their risks are priced as they cannot be diversified away.

[17]This parallels the neoclassical q theory result: with constant returns to scale and no capital adjustment costs, average q equals marginal q, and the firm earns no surplus on inframarginal units.

Expression (22) theoretically predicts that equity returns are positively linked to leverage gaps, along the lines of the empirical evidence in Table 1. Residual leverage gaps Gap_2^L load on $\gamma_D(B_2)$ with a positive sign.[18] All else being equal, shareholders of overlevered firms (positive gaps) bear larger costs per dollar of debt than underlevered firms (negative gaps), controlling for observed leverage. Given the optimal policy investment and financing policy B_2 and K_2, the ratio $\frac{B_2\gamma_D(B_2)}{K_2\gamma_A(K_2)-B_2\gamma_D(B_2)}$ increases in leverage gaps, and so does the spread $\mathbb{E}\left[\frac{R_2^A}{\gamma_A(K_2)} - \frac{R_2^D}{\gamma_D(B_2)}\middle| S_1\right]$.

The relationship between observed leverage and returns remains ambiguous, even when controlling for leverage gaps. Controlling for Gap_2^L, a higher leverage $\frac{B_2}{K_2}$ is not necessarily associated with higher expected equity returns. This results from two confounding effects. First, the term $(1-\rho)\mathbb{E}\left[M_2\frac{R_2^A}{\frac{B_2}{K_2}}\middle| DEF_2 = 1, S_1\right]$ in (22) shows that, for each dollar of debt B_2, debt recovery values $R_2^A K_2$ lower interest payments. The expression for $\mathbb{E}\left[R_2^E\middle| S_1\right]$ in (21) then shows that the adjusted financial leverage ratio $\frac{B_2\gamma_D(B_2)}{K_2\gamma_A(K_2)-B_2\gamma_D(B_2)} = \frac{\frac{B_2}{K_2}\gamma_D(B_2)}{\gamma_A(K_2)-\frac{B_2}{K_2}\gamma_D(B_2)}$ can either increase or decrease with leverage, due to the joint effect of $\frac{B_2}{K_2}$ and $\gamma_D(B_2)$. This interaction dampens the textbook leverage amplification effect. Second, the effect of leverage $\frac{B_2}{K_2}$ on the expected cost of debt to the firm, $\mathbb{E}[R_2^D\middle| S_1]$, may depend on the chosen parameterizations, which determine the average tax shield and bankruptcy costs associated with the firm's optimal choice of B_2.

Naturally, the heterogeneity in asset returns R_2^A can also confound the relationship between leverage and gaps and expected equity returns.[19] As standard in the literature, the reduced-form evidence in Table 1 includes variables that capture differences in the riskiness of firms' assets in place and growth options, namely size and book-to-market equity (e.g., Gomes and Schmid, 2010).[20]

Which effects are empirically more relevant is a quantitative question, on which our analysis in Section 4 offers insights. The reduced-form evidence in Table 1 suggests that the ambiguity in the returns-leverage relationship resolves when target leverage is included as a predictor. Since the

[18] Note that Gap_2^L is well defined only if $\lambda_2 < 1$, that is, if $\lambda_B > 0$. Empirically, using Gap_1^L in place of Gap_2^L has negligible effects on the results.

[19] In Appendix B, we show that $\gamma_A(K_2)$ is constant in K_2 for a production function which is homogeneous of degree α in K_2, such as the Cobb-Douglas with decreasing returns to scale we use in the following quantitative analysis. Notice that, in our economy, $\mathbb{E}[M_2R_2^A\middle| S_1]$ is not equal to one because of decreasing returns to scale. This is the case only when $\alpha = 1$, which however is incompatible with an interior solution for K_2.

[20] Hou, Xue, and Zhang (2015) interpret these variables in a neoclassical production economy with endogenous investment. Table A3 shows the results in Table 1 are robust to the inclusion of investment and profitability.

leverage gap Gap_2^L is the difference between observed leverage and target leverage, the expected cost of debt in (22) can be equivalently expressed as

$$\gamma_D(B_2) = 1 + \kappa_1 K_2 \left(\frac{B_2}{K_2} - \frac{B_2^*}{K_2^*} \right) + (1-\rho)\mathbb{E}\left[M_2 \frac{R_2^A}{\frac{B_2}{K_2}} \middle| DEF_2 = 1, S_1 \right]. \tag{23}$$

A comparison of the expressions for $\gamma_D(B_2)$ in (22) and (23) suggests that, controlling for leverage targets instead of leverage gaps, helps revive the classic leverage amplification effect on equity returns. Although the relationship between leverage and returns is still formally ambiguous, the term $\left(\frac{B_2}{K_2} - \frac{B_2^*}{K_2^*}\right)$, in lieu of Gap_2^L, adds an additional dimension through which leverage loads positively on the expected cost of debt. In this specification, target leverage is negatively related to returns, as it loads negatively on $\gamma_D(B_2)$. Intuitively, leverage is less risky for firms with high leverage targets, as their capital structure yields high tax shields compared to bankruptcy costs, as Proposition 1 shows.

3.3 Defining a Dynamic Target

The Gap Approach. In the simplified setup from the previous section, the definitions of targets and gaps in capital structure naturally characterize firms' optimal policies. These definitions align with the "gap approach", which is widely used to describe costly adjustments in production factors such as capital and labor (e.g., Sargent, 1978; Caballero and Engel, 1993; Cooper and Willis, 2004; King and Thomas, 2006; Bayer, 2009). These studies approximate firm dynamics by modeling how firms adjust production factors toward a dynamic target, known as the frictionless target. This target represents the level a production factor would reach in the absence of changes in stochastic variables. More formally, it is defined as the policy function obtained when adjustment costs are removed for a single period.

Unlike, for example, Bayer (2009), which considers only convex adjustment costs in labor decisions, our dynamic model incorporates additional frictions, such as equity issuance costs and default risk. In this section, we exploit the differentiability of the firm's problem in (9) to extend the definitions from the two-period example – motivated by the gap approach – to our dynamic economy.

The Firm's Problem. The expression in (8) can be rewritten as

$$\begin{aligned} V(S_{i,t}) &= \mathbb{E}^{\zeta}[\max\{\xi_{i,t}, V^C(S_{i,t})\}] \\ &= \int_{-\infty}^{V^C(S_{i,t})} V^C(S_{i,t}) dF^{\xi}(\xi_{i,t}) + \int_{V^C(S_{i,t})}^{\infty} \xi_{i,t} dF^{\xi}(\xi_{i,t}) \\ &= P^S_{i,t} V^C(S_{i,t}) + (1 - P^S_{i,t}) \mathbb{E}[\xi_{i,t} | DEF_{i,t} = 1, S_{i,t}]. \end{aligned} \tag{24}$$

The solvency probability $P^S_{i,t}$ is

$$P^S_{i,t} \equiv \Pr[V^C(S_{i,t}) \geq \xi_{i,t} | S_{i,t}] = F^{\xi}(V^C(S_{i,t})) = \frac{1}{1 + e^{-\frac{V^C(S_{i,t})}{s}}}, \tag{25}$$

which, by the properties of the logistic distribution, is differentiable in $V^C(S_{i,t})$. Likewise, the expected value of the outside option in case of default, $(1 - P^S_{i,t}) \mathbb{E}[\xi_{i,t} | DEF_{i,t} = 1, S_{i,t}]$, is also differentiable in $V^C(S_{i,t})$. Proposition 3 establishes this result by showing that (24) leads to (26).

Proposition 3 ***(Firm's Problem with Logistic Outside Option Shocks).***

a) The equity valuation equation (8) and the debt valuation equation (6) can be rewritten as

$$V(S_{i,t}) = V^C(S_{i,t}) + s \cdot \ln\left(1 + e^{-\frac{V^C(S_{i,t})}{s}}\right), \tag{26}$$

and

$$B_{i,t+1} = \mathbb{E}\left[M_{t+1}\left((1 + c_{i,t+1}) B_{i,t+1} P^S_{i,t+1} + L_{i,t+1}(1 - P^S_{i,t+1})\right) \middle| S_{i,t}\right]. \tag{27}$$

b) As $s \to 0^+$, the firm's problem in (26), subject to (27), (3), (4), and (5), converges to

$$V(S_{i,t}) = \max\left\{0, \max_{\Delta B_{i,t}, I_{i,t}} D_{i,t} + \mathbb{E}[M_{t+1} V(S_{i,t+1}) | S_{i,t}]\right\}, \tag{28}$$

subject to

$$B_{i,t+1} = \mathbb{E}\left[M_{t+1}\left((1 + c_{i,t+1}) B_{i,t+1} \chi_{\{V_{i,t+1} > 0\}} + L_{i,t+1} \chi_{\{V_{i,t+1} \leq 0\}}\right) \middle| S_{i,t}\right], \tag{29}$$

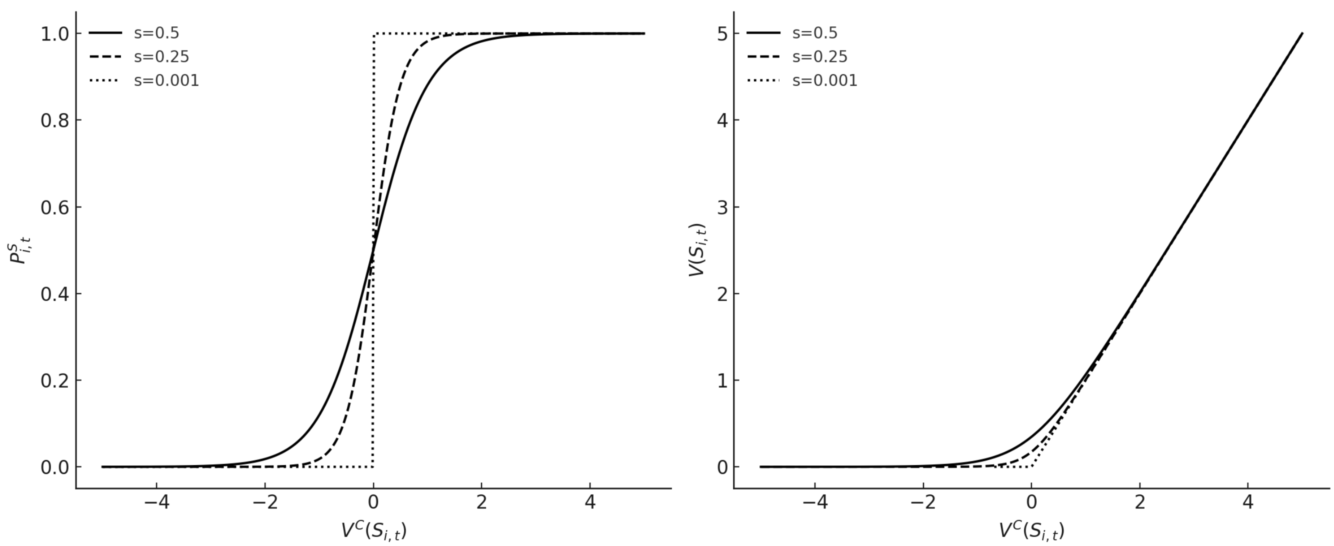
along with (3), (4), and (5).

Proof. See Appendix.

Figure 1 illustrates the intuition behind part b) of Proposition 3, showing that this differentiable problem nests the textbook case where shareholders' outside option is deterministically zero and converges to it as the scale parameter s approaches zero. Panel A of Figure 1 plots the solvency probability $P_{i,t}^S$ as a function of the continuation value $V^C(S_{i,t})$ for different values of s, while Panel B depicts the equity value $V(S_{i,t})$ from (26) against $V^C(S_{i,t})$. The solid, dashed, and dotted lines correspond to progressively smaller values of s. While maintaining differentiability due to its "softmax" property, the dashed line shows that for small s, the problem collapses to the textbook case with a zero outside option.

Figure 1
The Firm's Problem with Shocks to Outside Options

The figure shows the solvency probability $P_{i,t}^S$ (Panel A) and the equity value $V(S_{i,t})$ as a function of the continuation value $V^C(S_{i,t})$ for different values of the scale parameter s in the logistic distribution of outside option shocks $\xi_{i,t}$. The solid line corresponds to $s = 0.5$, the dashed line to $s = 0.25$, and the dotted line to $s = 0.001$.



In particular, the solvency probability in Panel A (dotted line) shows that for small s, firms default deterministically when the continuation value is negative and continue operating otherwise. Formally, this follows from

$$\lim_{s \to 0^+} P_{i,t}^S = \begin{cases} 1, & \text{if } V^C(S_{i,t}) > 0 \\ 0, & \text{if } V^C(S_{i,t}) < 0. \end{cases}$$

Similarly, the dotted line in Panel B shows that the equity value collapses to $\max\{0, V^C(S_{i,t})\}$, since

$$\lim_{s\to 0^+} V(S_{i,t}) = \begin{cases} V^C(S_{i,t}), & \text{if } V^C(S_{i,t}) \geq 0 \\ 0, & \text{if } V^C(S_{i,t}) < 0. \end{cases}$$

Optimality Conditions. By taking first-order conditions and applying the Benveniste-Scheinkman conditions, we derive the following optimality conditions for debt:

$$1 - \frac{\partial \Lambda^B(B_{i,t+1} - B_{i,t})}{\partial B_{i,t+1}} = \mathbb{E}\left[M_{t+1} \cdot P^S_{i,t+1} \cdot \left(\frac{1 + \frac{\partial \Lambda^E(E_{i,t+1})}{\partial E_{i,t+1}}}{1 + \frac{\partial \Lambda^E(E_{i,t})}{\partial E_{i,t}}} \right) \right.$$
$$\left. \cdot \left(1 + (1-\tau)\left(c_{i,t+1} + B_{i,t+1} \frac{\partial c_{i,t+1}}{\partial B_{i,t+1}} \right) - \frac{\partial \Lambda^B(B_{i,t+2} - B_{i,t+1})}{\partial B_{i,t+1}} \right) \middle| S_{i,t} \right], \tag{30}$$

and capital:

$$1 = \mathbb{E}\left[M_{t+1} \cdot P^S_{i,t+1} \cdot \left(\frac{1 + \frac{\partial \Lambda^E(E_{i,t+1})}{\partial E_{i,t+1}}}{1 + \frac{\partial \Lambda^E(E_{i,t})}{\partial E_{i,t}}} \right) \cdot \left(\frac{\partial \Pi_{i,t+1}}{\partial K_{i,t+1}} + 1 - \delta(1-\tau) - \frac{\partial c_{i,t+1}}{\partial K_{i,t+1}} B_{i,t+1}(1-\tau) \right) \middle| S_{i,t} \right]. \tag{31}$$

To define a dynamic target, it helps to compare these optimality conditions with those in the two-period example from Section 3.2, where the target definition naturally emerges. In the two-period case, the optimality conditions for debt (14) and capital (13) can be rewritten as:

$$1 - \frac{\partial \Lambda^B(B_2 - B_1)}{\partial B_2} = \mathbb{E}\left[M_2 \cdot P^S_2 \cdot \left(1 + (1-\tau)\left(c_2 + \frac{\partial c_2}{\partial B_2} B_2 \right) \right) \middle| S_1 \right], \tag{32}$$

and:

$$1 = \mathbb{E}\left[M_2 \cdot P^S_2 \cdot \left(\frac{\partial \Pi_2}{\partial K_2} + 1 - \delta(1-\tau) - \frac{\partial c_2}{\partial K_2}(1-\tau)B_2 \right) \middle| S_1 \right]. \tag{33}$$

Equations (32) and (33) share the same structure and economic interpretation as (31) and (30) when $t = 1$. However, the simplifying assumptions in Section 3.2 (e.g., exogenous default implies $P^S_2 = \rho$) yield closed-form solutions in Proposition 1 and Proposition 2, whereas the dynamic model does not have a closed-form solution. The terms $c_{i,t+1} + B_{i,t+1}\frac{\partial c_{i,t+1}}{\partial B_{i,t+1}}$ and $\frac{\partial c_{i,t+1}}{\partial K_{i,t+1}}$ capture how interest on debt responds to financing and investment decisions. The expression for $c_{i,t+1}$ follows from the debt pricing condition (6).

The differences between the two sets of optimality conditions are intuitive. First, the one-period-ahead adjustment cost term $\frac{\partial\Lambda^B(B_{i,t+2}-B_{i,t+1})}{\partial B_{i,t+1}}$ does not appear in the two-period model, aligning with the "gap approach," which removes current-period adjustment costs. In the two-period model, removing adjustment costs for one period or permanently is equivalent.[21] Second, the term $\frac{1+\frac{\partial\Lambda^E(E_{i,t+1})}{\partial E_{i,t+1}}}{1+\frac{\partial\Lambda^E(E_{i,t})}{\partial E_{i,t}}}$ is absent from the two-period case because, for analytical convenience, we assume no financing constraints. Later in this section, we discuss an extension of the two-period example to include costly equity issuance, further clarifying the parallel with the dynamic model.

Computing Dynamic Targets and Gaps. In our setup, the frictionless target debt stock $B^*_{i,t}$ satisfies the optimality condition for debt (30) without current-period debt adjustment costs:

$$1 = \mathbb{E}\left[M_{t+1}\cdot P^{S,*}_{i,t+1}\cdot\left(\frac{1+\frac{\partial\Lambda^E(E^*_{i,t+1})}{\partial E^*_{i,t+1}}}{1+\frac{\partial\Lambda^E(E^*_{i,t})}{\partial E^*_{i,t}}}\right)\right. \tag{34}$$

$$\left.\cdot\left(1+(1-\tau)\left(c^*_{i,t+1}+B^*_{i,t+1}\frac{\partial c^*_{i,t+1}}{\partial B^*_{i,t+1}}\right)-\frac{\partial\Lambda^B(B^*_{i,t+2}-B^*_{i,t+1})}{\partial B^*_{i,t+1}}\right)\;\middle|\; S_{i,t}\right]. \tag{35}$$

We use the superscript $*$ to indicate that all endogenous variables are computed without current-period adjustment costs. In the two-period example, the target defined in Proposition 1 analogously satisfies (32) when $\Lambda^B(B_{i,2}-B_{i,1})\equiv 0$.

As discussed in Section 3.4, our numerical solution method does not directly rely on optimality conditions. Instead, we compute the target debt stock as the solution to the Bellman equation:

$$V^*(S_{i,t}) = \mathbb{E}^{\zeta}[\max\{\xi_{i,t}, \max_{I^*_{i,t},\Delta B^*_{i,t}} D^*_{i,t}+\mathbb{E}[M_{t+1}V(S_{i,t+1})|S_{i,t}]\}], \tag{36}$$

[21] Adda and Cooper (2003) offer another interpretation of the frictionless target debt, which extends to linear-quadratic problems and applies to the simplified setup in Section 3.2. Specifically, the frictionless target is a fixed point of the debt policy function. It is immediate to verify that this is the case in (15), as $B^*_2{=}B_2$ only when adjustment costs of capital structure are zero and $\lambda_1 = 1$. The frictionless target generally differs from the static target, defined as the debt level that would arise if there were never any costs of adjustments (e.g., Cooper and Willis, 2004; Bayer, 2009), although they coincide in the two-period illustration of Section 3.2.

which yields $B^*_{i,t+1} = B_{i,t} + \Delta B^*_{i,t}$. The equity payout $D^*_{i,t}$ excludes current-period debt adjustment costs, i.e., $\Lambda(\Delta B_{i,t}) \equiv 0$. The continuation value $V(S_{i,t+1})$ is computed using the value function $V_{i,t}$ in (9), as adjustment costs are set to zero only for the current period.

We define the target leverage ratio as $\frac{B^*_{i,t}}{K^*_{i,t}}$, where $K^*_{i,t+1} = (1-\delta)K_{i,t} + I^*_{i,t}$. The leverage gap is then given by $Gap^L_{i,t} = \frac{B_{i,t}}{K_{i,t}} - \frac{B^*_{i,t}}{K^*_{i,t}}$. Notice that the dynamic model does not impose mechanical convergence to the target. Instead, the calibrated model serves as a lab to quantify the extent to which firms adjust their capital structure toward the target.

Defining Targets: Which Costs to Remove? The leverage target defined above removes only debt adjustment costs. One might ask whether alternative definitions could better capture capital structure dynamics. In particular, removing equity issuance costs for one period may seem appealing. However, this approach could also create an unrealistic benchmark for firm behavior. Without equity issuance costs, firms would not just gain flexibility in adjusting their capital structure – they would become entirely financially unconstrained.

To explore this issue, it is helpful to rewrite the optimality conditions for debt (30) and capital (31) as follows:

$$\mathbb{E}\left[M^F_{i,t+1} R^b_{i,t+1} \middle| S_{i,t} \right] = 1 - \frac{\partial \Lambda^B(B_{i,t+1} - B_{i,t})}{\partial B_{i,t+1}}, \tag{37}$$

$$\mathbb{E}\left[M^F_{i,t+1} R^k_{i,t+1} \middle| S_{i,t} \right] = 1. \tag{38}$$

Following prior work (e.g., Love, 2003; Rampini and Viswanathan, 2013), we define

$$M^F_{i,t+1} \equiv M_{t+1} P^S_{i,t+1} \frac{1 + \frac{\partial \Lambda^E(E_{i,t+1})}{\partial E_{i,t+1}}}{1 + \frac{\partial \Lambda^E(E_{i,t})}{\partial E_{i,t}}}$$

as the firm's stochastic discount factor. This term incorporates expected marginal equity issuance costs, which influence the discount rate from the equityholders' perspective. The terms $R^b_{i,t+1}$ and $R^k_{i,t+1}$ represent the marginal cost of debt and the marginal product of capital, respectively, both from the shareholders' perspective:

$$R^b_{i,t+1} \equiv 1 + (1-\tau)\left(c_{i,t+1} + B_{i,t+1} \frac{\partial c_{i,t+1}}{\partial B_{i,t+1}} \right) - \frac{\Lambda^B(B_{i,t+2} - B_{i,t+1})}{\partial B_{i,t+1}}, \tag{39}$$

$$R^k_{i,t+1} \equiv \frac{\partial \Pi_{i,t+1}}{\partial K_{i,t+1}} + 1 - \delta(1-\tau) - \frac{\partial c_{i,t+1}}{\partial K_{i,t+1}} B_{i,t+1}(1-\tau). \tag{40}$$

Two remarks are in order. First, the optimality conditions reflect the shareholders' perspective. For this reason, the term $\frac{1+\frac{\partial \Lambda^E(E_{i,t+1})}{\partial E_{i,t+1}}}{1+\frac{\partial \Lambda^E(E_{i,t})}{\partial E_{i,t}}}$ appears symmetrically in the conditions for both debt and capital. As captured by the definition of $M^F_{i,t+1}$, equity issuance costs primarily affect the shareholders' discount rate. Combining (39) and (40) yields

$$\mathbb{E}\left[M^F_{i,t+1} R^e_{i,t+1} \middle| S_{i,t} \right] = \frac{\partial \Lambda^B(B_{i,t+1} - B_{i,t})}{\partial B_{i,t+1}}, \tag{41}$$

where the excess return $R^e_{i,t+1} \equiv R^k_{i,t+1} - R^b_{i,t+1}$ measures the difference between the marginal return on investment and the marginal cost of external financing sources from the shareholders' perspective (i.e., debt). The adjustment costs on the right-hand side of (41) prevent the returns on the use of funds and the cost of external financing from aligning, except at the target. Appendix B extends the two-period example in Section 3.2 to include equity issuance costs at $t = 1$. While the extension does not yield a closed-form solution, it provides modified versions of Propositions 1 and 2, where leverage targets are defined analogously.

Second, modeling debt adjustment costs in reduced form aligns with the quantitative focus of this paper. It enables the definition of a target without tying the analysis to a specific friction, such as debt maturity (e.g., Chaderina, Weiss, and Zechner, 2022), that may limit financial flexibility. In our setup, as is standard in the literature, equity issuance costs are also modeled in reduced form, and shareholders' and managers' incentives are aligned. The model also does not differentiate between current and future shareholders. Because firm dynamics are shaped by the shareholders' perspective, removing equity adjustment costs does not yield a benchmark for analyzing debt dynamics in this framework. More generally, since the appropriate definition of a target depends on its ability to capture firm behavior, other setups – for example, agency models with multiple shareholder groups – may call for different definitions. Quantitatively, and consistent with intuition, the model fit suggests that debt acts as the primary adjustment margin in response to shocks. This reflects the fact that equity adjustment costs still limit the firm's ability to fully reoptimize in most periods. Empirically, this is also consistent with the infrequent use of equity issuance by U.S. corporations, as documented in several studies (e.g., Hennessy and Whited, 2007).

Finally, although the baseline model does not include capital adjustment costs, it is natural to ask how their inclusion would affect the definition of the target. Appendix C examines an extension of the dynamic model that incorporates these costs. In this case, equation (41) becomes

$$\mathbb{E}\left[M^F_{i,t+1} R^e_{i,t+1} \middle| S_{i,t} \right] = \frac{\partial \Lambda^B(B_{i,t+1} - B_{i,t})}{\partial B_{i,t+1}} + \frac{\partial \Lambda^K(I_{i,t})}{\partial K_{i,t+1}},$$

where $\Lambda^K(I_{i,t})$ denotes the capital adjustment cost function, and $R^e_{i,t+1}$ is redefined in Appendix C to include one-period-ahead capital adjustment costs. In this setting, defining a meaningful target for capital structure dynamics requires removing both debt and capital adjustment costs. Appendix B extends the two-period example from Section 3.2 to include capital adjustment costs, further supporting this conclusion.

3.4 Functional Forms and Model Solution

Functional Forms. To carry out our quantitative analysis, we add structure to the model with the following functional forms. The production function is a Cobb-Douglas $f(A_t, Z_{i,t}, K_{i,t}) = A_t Z_{i,t} K^\alpha_{i,t} - F$, where $\alpha \in (0,1)$, A_t is an exogenous aggregate shock, $Z_{i,t}$ is a firm-specific shock, and $F > 0$ is a fixed production cost. We assume A_t and $Z_{i,t}$ follow AR(1) processes such that:

$$\log A_t = \mu_A(1 - \rho_A) + \rho_A \log A_{t-1} + \sigma_A \varepsilon^A_t,$$
$$\log Z_{i,t} = \rho_Z \log Z_{i,t-1} + \sigma_Z \varepsilon^Z_{i,t}.$$

As ε^A_t and $\varepsilon^Z_{i,t}$ are truncated standard normal variables, both A_t and $Z_{i,t}$ are lognormal, with mean $\mu_A \in (-\infty, \infty)$ and 0, persistence $\rho_A \in (0,1)$ and $\rho_Z \in (0,1)$, and volatility $\sigma_A \in (0,\infty)$ and $\sigma_Z \in (0,\infty)$, respectively.[22]

We choose a flexible linear-exponential (LINEX) functional form (e.g., Varian, 1975; Kim and Ruge-Murcia, 2009; Aruoba, Bocola, and Schorfheide, 2017) for the capital structure rebalancing costs, i.e.,

$$\Lambda^B(\Delta B_{i,t}) = \lambda_B(e^{\gamma_B \Delta B_{i,t}} - \gamma_B \Delta B_{i,t} - 1), \tag{42}$$

[22] As common in the literature, we set the mean of firm-specific shocks to zero (e.g., Hennessy and Whited, 2007; Gomes and Schmid, 2010).

with $\lambda_B \in (0, \infty)$ and $\gamma_B \in (-\infty, \infty)$. In our context, the LINEX adjustment cost function is attractive as it parsimoniously captures limited financial flexibility arising from different sources we do not explicitly model. Varying only two parameters, the "scale" λ_B and the "asymmetry" γ_B, $\Lambda(\Delta B_{i,t})$ spans a broad spectrum of functional forms.[23] As previous studies provide limited guidance on functional forms and economic magnitudes for the overall debt adjustment costs firms face, we exploit data restrictions to calibrate them to realistic values in the context of our model. Altınkılıç and Hansen (2000) provide empirical support for the convex nature of debt issuance costs in the context of straight bond underwriting fees. Their findings instead suggest that fixed costs constitute a minor portion, specifically 10.4% of underwriter spreads.[24]

Following Hennessy and Whited (2007) and Gomes and Schmid (2021), lenders recover a fraction $\xi \in (0, 1)$ of firm i's capital stock in bankruptcy, that is, $L_{i,t} = \xi K_{i,t}$. Different from the illustration model in Section 3.2 with exogenous default, we do not explicitly link ex-post realized bankruptcy costs to the stock of debt $B_{i,t}$. Since default in now endogenous, however, expected bankruptcy costs are increasing with debt.

Several studies, for example, Gomes (2001) and Falato, Kadyrzhanova, Sim, and Steri (2022), choose equity issuance costs $\Lambda(E_{i,t})$ with both a fixed and a proportional component, i.e.,

$$\Lambda^E(E_{i,t}) = (\lambda_0 + \lambda_1 E_{i,t})\chi_{\{E_{i,t}>0\}}, \tag{43}$$

with $\lambda_0 \in [0, \infty)$ and $\lambda_1 \in [0, \infty)$. Considering the extensive adoption of this simple functional form for the quantitative analysis of corporate equity issuance, we utilize it instead of pursuing a more flexible approach like the one for debt adjustment costs.

Following studies in cross-sectional production-based asset pricing (e.g., Berk, Green, and Naik, 1999; Zhang, 2005), we parameterize the stochastic discount factor without explicitly modeling the investor's problem, remaining agnostic about the specific sources of risk aversion. However, the qualitative results in 3.2 require only the existence of a stochastic discount factor and are consistent with arbitrage-free general equilibrium economies. As in Clementi and Palazzo (2019) and similarly

[23]The LINEX functional form nests the quadratic form as an approximation for $\gamma_B \to 0$.

[24]Other studies, such as Jungherr, Meier, Reinelt, Schott, et al. (2022), also assume convex functional forms.

to Zhang (2005) and Jones and Tuzel (2013), we assume the stochastic discount factor follows:

$$\log M_{t+1} = \log \beta + \gamma_0(A_t - \mu_A) + \gamma_1(A_{t+1} - \mu_A), \tag{44}$$

where $\beta \in (0,1)$, $\gamma_0 \in (0,\infty)$, and $\gamma_1 \in (-\infty, 0)$. The specification in Clementi and Palazzo (2019), similar to Gomes and Schmid (2010), results in a constant price of risk. This differentiates the economic mechanism in our model from studies where countercyclical risk premia play a central role, such as Zhang (2005) and Chaderina, Weiss, and Zechner (2022).

Model Solution. As the model admits no closed-form solution, we resort to numerical dynamic programming in our quantitative analysis. The model solution is computationally challenging for two main reasons. First, the problem features a large number of state variables and policy functions. Equity and debt values are mutually dependent since the default condition affects the debt pricing equation. In a similar context, Gomes and Schmid (2010) reduce the dimensionality of the state space using total debt commitments as a state variable. However, their approach is not viable in our case because of the presence of debt adjustment costs. Hence, we need to keep track of all five state variables $S_{i,t} \equiv \{K_{i,t}, B_{i,t}, c_{i,t}, z_{i,t}, A_t\}$ separately, for each firm i. Thus, we need to solve jointly for four policy functions: (i) default decisions $DEF_{i,t} = DEF_{i,t}(S_{i,t})$, (ii) new level of physical capital $K_{i,t+1} = K(S_{i,t})$ after investment, (iii) new debt issuance $B_{i,t+1} = B(S_{i,t})$, and (iv) interest rate schedule $c_{i,t+1} = c(S_{i,t})$. We reduce the dimensionality by projecting the value function $V(S_{i,t})$ on a non-parametric structure for interpolation. Second, problem (9) contains a forward-looking constraint, i.e., the debt's pricing equation (6), which pins down the interest rate schedule $c_{i,t+1} = c(S_{i,t})$. Hence, since $c_{i,t+1} = c(S_{i,t})$ enters the future default choices directly, its solution is significantly sensitive to the initial guess of the value function (especially in proximity of the default region). Appendix D details our numerical solution method.

4 Quantitative Analysis

The illustration in Section 3.2 provides intuition for our key results. However, it is too stylized to serve as a basis for a quantitative investigation of its predictions. In this section, we calibrate the quantitative model to U.S. data and present a host of quantitative results.

4.1 Calibration and Model Fit

Table 2 summarizes our baseline calibration. The calibration frequency is monthly. Details about the computation of the model-based and data variables are provided in Appendix A. The model features 17 parameters. The first 8 parameters in the table are on the technology side. We set the curvature of the profit function, α, to 0.4, to roughly match the capital share from the Bureau of Economic Analysis (BEA). This value is similar, for example, to the ones used by Kydland and Prescott (1982), Gomes (2001), and Gomes, Jermann, and Schmid (2016). The depreciation rate δ is set to be 0.01. This is a fairly common value in the literature, as it implies an annual rate of roughly 12%. This value is in line with the empirical estimates in Cooper and Haltiwanger (2006) and comparable to those used by previous studies. For example, Gomes (2001) uses a depreciation rate of 0.145, while Hennessy and Whited (2005) estimate a value of 0.10. We choose the persistence of the aggregate productivity process, ρ_A, and its volatility, σ_A, to be $0.95^{\frac{1}{3}}$ and 0.007/3, respectively. These monthly values correspond to 0.95 and 0.007 at the quarterly frequency, consistent with several studies, including Cooley and Prescott (2021), Zhang (2005), and Gomes, Jermann, and Schmid (2016). We normalize the average aggregate productivity, μ_A, to -2. μ_A is purely a scaling constant that determines the long-run average scale of the economy. As in Zhang (2005), we calibrate the persistence ρ_Z and volatility σ_Z of the idiosyncratic shock process to 0.97 and 0.1, respectively. The fixed cost of operation, F, is chosen to approximately match average profitability in our sample, which leads to a value of 0.18 (or 2.25% of the average capital stock).

The next three parameters describe the dynamics of the pricing kernels. We choose β, γ_0, and γ_1 to minimize mean square errors with respect to three aggregate data moments, namely the average Sharpe ratio, the average risk-free rate, and its volatility. This procedure yields $\beta = 0.9920$, $\gamma_0 = 52.68$, and $\gamma_1 = -53.00$.

The remaining six parameters are on the financing side. We pick the fixed and proportional equity flotation costs, λ_0 and λ_1, to be 0.5 and 0.025. Like, for example, Kuehn and Schmid (2014) and Bolton, Wang, and Yang (2021), we choose λ_0 to approximately match the frequency of equity issuance in the data. For the proportional component λ_1, we pick the same value as in Gomes and Schmid (2010), who also study levered returns. This is also close to Gomes (2001), who chooses 0.028, based on regressions of flotation costs on amount issued. We choose the recovery rate parameter ξ to be 0.125 of the firm's capital stock. This implies an average debt recovery rate of 53.9%, which is close to the 51% recovery rate for creditors when the firm defaults in Huang and Huang (2012).

We calibrate the debt adjustment cost parameters λ_B and γ_B to approximately target the average debt issuance and the frequency of default in our sample, respectively. The scale parameter λ_B affects the marginal cost of issuing debt and, in the model, discourages the use of external debt financing. Instead, positive values of γ_B imply that issuing debt is more costly than withdrawing debt. Thus, the lower γ_B (i.e., negative large values), the more likely firms default due to their inability of reducing leverage following negative shocks. These values imply an average cost of issuing debt, as a share of the total amount of debt issued, that is toward the lower end of the range used by Strebulaev (2007). The average costs of reducing debt as the total amount of debt withdrawn are roughly 30% larger than issuance costs. Overall, the magnitude of debt adjustment costs suggests that, as in Fischer, Heinkel, and Zechner (1989), Goldstein, Ju, and Leland (2001), and Strebulaev (2007), relatively small adjustment costs significantly affect leverage dynamics. Finally, following Nikolov and Whited (2014), we choose the tax rate τ to be 0.20. This is as an approximation of the statutory corporate tax rate relative to personal tax rates.

Table 3 summarizes the overall model fit under the parameterization reported in Table 2. The table compares model-implied moments, which are tabulated in the first column, with their empirical counterparts, which are tabulated in the second column. Overall, the model does a reasonable job at matching key variables describing the financing policies of U.S. firms. The model matches quite closely the Sharpe ratios, the annual risk-free rate, and the rate's volatility. The model produces a sizable equity premium, which we do not target in the calibration. Both in the model and in the data, this moment is around 7%. The second set of moments in the table refers to firms' real and financial policies. On the real side, the model matches fairly closely average profitability, the volatility and autocorrelation of profitability, and investment ratios. The model does a reasonable job of reproducing average leverage, an untargeted quantity. The model-implied leverage is 17%, a close to its data counterpart of 16%. Our parameterization also produces default rates and book-to-market ratios with comparable magnitudes to the data. The third set of moments in the table describe firms' capital structure rebalancing. Debt issuance is 17% in the model, and 22%

Table 2
PARAMETER VALUES

The table reports parameter choices for the calibrated model. The frequency of calibration is monthly.

Category	Description	Symbol	Value
Technology	Capital share	α	0.4
	Depreciation	δ	0.01
	Persistence of aggregate shock	ρ_A	$0.95^{\frac{1}{3}}$
	Standard deviation of aggregate shock	σ_A	0.007/3
	Mean of aggregate shock	μ_A	-2
	Persistence of idiosyncratic shock	ρ_z	0.97
	Standard deviation of idiosyncratic shock	σ_z	0.1
	Mean of idiosyncratic shock	μ_z	0
	Fixed cost of operations	F	0.18
Pricing Kernel	Time discount	β	0.9920
	"Risk aversion" parameters	γ_0	52.68
		γ_1	-53.00
Financing	Fixed equity flotation cost	λ_0	0.5
	Proportional equity flotation cost	λ_1	0.025
	Debt recovery in bankruptcy	ξ	0.125
	Debt adjustment cost ("scale")	λ_B	0.4
	Debt adjustment cost ("asymmetry")	γ_B	-0.2
	Corporate tax rate	τ	0.2

in the data. Although we target this moment in our calibration, we report model-implied and data moments that describe the relative frequency of positive and negative debt adjustments. The model-implied magnitudes of these additional non-targeted moments are also close to the data. Finally, the frequency of equity issuance in the model is 5%, fairly close to its data value of 4%. Overall, the model provides a reasonably good fit both for moments that serve as targets in the calibration, and for untargeted key statistics.

4.2 Capital Structure Dynamics

Table 4 describes capital structure dynamics around leverage targets under the baseline calibration of Table 2. Panel A breaks down the simulated data into quintiles of leverage gaps. All entries are in percentage points. The top row reports the average leverage gap for each quintile. As leverage gaps are defined as the difference between leverage and the frictionless target defined

Table 3
MOMENTS

The table reports model-implied and data moments for the baseline calibration of Table 2. The model-implied moments are calculated as averages of simulations of 5,000 firms and 5,000 time periods. The data source for the Sharpe Ratio and risk-free rate moments is Zhang (2005). The average annual equity return is computed using data from Kenneth French's data library. Default rates are taken from Covas and Den Haan (2011). The remaining data moments are computed from our sample of nonfinancial, unregulated firms from the annual Compustat dataset. All moments are annualized. Details on model and data variable definitions are provided in Appendix A.

	Model	Data
Average Sharpe Ratio	0.43	0.43
Average risk-free rate	0.02	0.02
Volatility of risk-free rate	0.03	0.03
Average equity premium	0.07	0.06
Average profitability	0.16	0.15
Volatility of profitability	0.08	0.09
Autocorrelation of profitability	0.65	0.75
Average investment	0.16	0.14
Average leverage	0.17	0.16
Frequency of default	0.01	0.02
Average book-to-market ratio	0.37	0.57
Average debt issuance	0.17	0.22
Frequency of positive debt adjustments	0.66	0.59
Frequency of negative debt adjustments	0.34	0.41
Frequency of equity issuance	0.05	0.04

as in (36), negative (positive) values refer to underlevered (overlevered) firms. The bottom row tabulates the corresponding one-period-ahead changes in leverage. Overlevered firms tend to lever down, while underlevered firms tend to lever up.

Panel B reports model-implied and data estimates of adjustment speeds, both in the model and in the data. Data estimates are from the estimation of the model of Flannery and Rangan (2006) in (1). As the target is observed within the model, we compute the average speed of adjustment as the average fraction of closed gaps, that is, $\frac{\Delta L_{i,t+1}}{-Gap^L_{i,t}}$, where $\Delta L_{i,t+1} = L_{i,t+1} - L_{i,t}$, and $L_{i,t} = B_{i,t}/K_{i,t}$. Notice that the negative sign in front of $Gap^L_{i,t}$ captures the fact that adjustments toward the target imply that positive values of $Gap^L_{i,t}$ are associated with negative values of $\Delta L_{i,t+1}$, and vice versa. This is because overlevered firms would tend to reduce their leverage (and vice versa), as the non-parametric evidence in Panel A indicates. The average adjustment speed is similar in the model and the data (0.32 vs. 0.33), with overlevered firms closing smaller fractions of their leverage gaps than underlevered firms.[25]

Taken together, the results in Table 4 suggest that firms adjust their capital structure toward a dynamic target leverage ratio, consistent with the intuition in Proposition 1.

Table 4

Adjustments toward Leverage Targets - Model

Panel A describes firms' capital structure adjustments toward leverage targets under the baseline calibration of Table 2. "Lev. Gap" denotes leverage gaps, (defined as the difference between leverage and target leverage defined as in (36), and "Adjustment" denotes the one-period-ahead change in leverage. Panel B reports model-implied and data estimates of adjustment speeds for the full sample of firms. "Up" and "Down" denote the adjustment speed conditional on firms being, respectively, underlevered and overlevered. Data figures are obtained with the measure of target leverage obtained from the estimation of the model of Flannery and Rangan (2006) in Equation (1). To compute "Up" and "Down" adjustment speeds in the data, we first run the empirical specification to identify overlevered and underlevered firms, and then estimate adjustment speeds separately for each group. Model-implied adjustment speeds are computed as the average fraction of closed gaps. All model-implied quantities are based on simulations of 5,000 firms and 5,000 time periods. Leverage gaps and adjustments are multiplied by 100. All variables are defined in Appendix A.

Panel A: Leverage Adjustments

	Group of Lev. Gap				
	Low	2	3	4	High
Lev. Gap	-4.10	-0.71	0.01	0.49	7.88
Adjustment	3.18	0.45	0.01	-0.11	-3.62

Panel B: Adjustment Speeds

	Model	Data
All Firms	0.32	0.33
Up	0.39	0.37
Down	0.22	0.32

[25]Some empirical studies, including Lemmon, Roberts, and Zender (2008), provide estimates of lower adjustment speeds (ranging from 0.2 to 0.25) in the data. These studies utilize the same reduced-form proxies but employ the Blundell-Bond generalized method of moments (GMM) as an estimator.

4.3 Revisiting Levered Returns

In Table 5, we present cross-sectional regression estimates of equity returns on various leverage variables, along with size and book-to-market ratios. These estimates are derived from simulated data using the baseline parameterization. Overall, the results suggest that our model is capable of reproducing the empirical patterns highlighted in Section 2.

To construct a model-based counterpart to Table 1, as leverage targets and gaps are not directly observable, we also estimate target leverage using reduced-form proxies in simulated data. While several studies, such as Flannery and Rangan (2006), rely on reduced-form proxies of leverage targets, it remains unclear how well these measures capture the dynamic targets defined in the model. We construct two proxies of leverage targets to assess the validity of the two reduced-form proxies developed in the empirical analysis in Section 2. We start by constructing a version of the reduced-form measure from Flannery and Rangan (2006), following equation (1). Because some variables used in the empirical analysis do not have counterparts in the model (e.g., R&D expenses, tangibility), $X_{i,t-1}$ includes total assets, profitability, median leverage, market-to-book of assets, and a firm fixed effect, as defined in Appendix A.

Second, we use the model's policy functions to build an empirical counterpart of leverage targets, which informs the functional form used to construct the projection targets in Section 2. Because leverage targets are observable in the model, we project them onto a set of state and control variables available in both the data and the model. Specifically, we regress the model-implied targets, computed as in (36), on a second-order polynomial in the logs of total assets, median leverage, and market-to-book assets, along with profitability, their interaction terms, and squared terms. Under the baseline calibration, the correlation between the model-based and projected targets is approximately 95%.

Table 5 presents the results. Columns (1) to (3) report estimates using model-based targets and gaps, as defined in Section 3.3. Columns (4) to (6) use proxies based on Flannery and Rangan (2006), while columns (7) to (9) show results for projection targets. All coefficients represent averages from 100 bootstrap simulations under the baseline calibration in Table 2, as explained in Appendix D. Bootstrapped standard errors appear in parentheses. Columns (1), (4), and (7) show a positive relationship between leverage and returns, controlling for firm size and book-to-market ratios. However, the leverage coefficients for the model-based and projection gaps fall within two standard errors of zero and are not statistically significant at the 5 percent level. Columns (2), (5), and (8) display the coefficients on leverage gaps. For the model-based and projection gaps, these coefficients are positive, statistically significant —exceeding two standard errors from zero — and larger than the corresponding leverage coefficients in the same samples (0.82 vs. 0.53 for model-based gaps, and 0.92 vs. 0.51 for projection gaps). This pattern holds across all three measures when both leverage ratios and gaps are included in the regressions, as shown in columns (3), (6), and (9). With Flannery-Rangan targets, the leverage coefficient is close to zero (0.04) and statistically insignificant, while the gap coefficient remains positive and significant at the one percent level. Overall, the estimates in columns (1) to (9) support Proposition 2 and align with the empirical findings in Table 5. Although the relationship between leverage and returns is relatively weak and lacks robustness, leverage gaps show a strong and positive association with equity returns.

In summary, the findings in Table 5 suggest that financial inflexibility is key to understanding the empirical patterns in levered returns. Costly capital structure rebalancing generates leverage gaps, which mediate the link between leverage and returns. The regression coefficients are not explicitly targeted in the model calibration, and the connection between reduced-form proxies (Section 2) and model targets is still imperfect. Nevertheless, the consistency in sign and relative magnitude of the leverage and gap coefficients is reassuring.

Table 5

Empirical Patterns on Leverage and Returns - Model

The table reports estimated coefficients from cross-sectional regressions of stock returns on leverage ("Leverage"), leverage gaps ("Lev. Gap"), leverage targets ("Lev. Target"), market capitalization ("Size"), and book-to-market equity ("Be/Me") across the entire simulated economy. In Columns (1) to (3), leverage targets and gaps are computed using the model-based approach described in Section 3.3. Columns (4) to (6) report results based on leverage targets and gaps estimated by mimicking the Flannery–Rangan approach on simulated data, as detailed in Section 4.3. Columns (7) to (9) use leverage targets obtained by projecting model-based targets onto a set of variables common to both the data and the model, also discussed in Section 4.3. All coefficients are averages from 100 simulations of 100 randomly drawn firms over 5,000 time periods under the baseline calibration of Table 2. Bootstrapped standard errors are reported in parentheses. Note that returns are monthly and expressed in percentage (multiplied by 100), and leverage gaps, leverage targets, and leverage are in levels (not in percentage). Size and Book-to-Market are expressed in log levels. All variables are defined in Appendix A.

	Dependent Variable: Monthly Stock Return								
	Model-Based Target			Flannery-Rangan Target			Projection Target		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Leverage	0.53		0.56	0.80		0.04	0.51		0.17
	(0.31)		(0.31)	(0.29)		(0.43)	(0.29)		(0.29)
Lev. Gap		0.82	0.85		0.62	0.61		0.92	0.87
		(0.35)	(0.35)		(0.14)	(0.21)		(0.25)	(0.25)
Size	-0.09	-0.19	-0.10	-0.19	-0.37	-0.36	-0.10	-0.18	-0.15
	(0.07)	(0.06)	(0.07)	(0.06)	(0.06)	(0.11)	(0.07)	(0.06)	(0.06)
Be/Me	0.20	0.08	0.21	0.29	0.22	0.23	0.19	0.06	0.10
	(0.09)	(0.04)	(0.09)	(0.08)	(0.04)	(0.09)	(0.08)	(0.03)	(0.08)
R^2	0.01	0.01	0.01	0.03	0.03	0.03	0.01	0.02	0.02

4.4 Effects of Changing Financial Flexibility

Table 6 compares counterfactual economies that differ in the degree and in the symmetry of financial inflexibility. We conduct this comparison by varying the financial inflexibility parameter λ_B and the asymmetry parameter γ_B around their baseline calibrated values, resolving the model for each case.

Panel A reports model-implied adjustment speeds, computed as in Table 4. As expected, higher values of λ_B lead to slower adjustments. In the benchmark case with full flexibility (column 1), firms fully close their leverage gaps because adjustment costs are absent. When λ_B exceeds the baseline value (column 2), adjustment speeds decline relative to the benchmark in Table 4. The relationship between λ_B and adjustment speed is nonlinear. Increases in λ_B beyond the baseline do not yield proportionally smaller reductions in the fraction of the leverage gap firms close. This finding suggests that firms encounter significant levels of financial inflexibility, aligning with previous studies that highlight the presence of substantial hysteresis in corporate capital structures (e.g., Hennessy and Whited, 2005; Lemmon, Roberts, and Zender, 2008). Columns (3) to (5) show adjustment speeds under increasing asymmetry in debt reduction costs, with more negative values of γ_B. The larger the magnitude of γ_B, the more costly it is for firms to reduce their debt. As expected, when γ_B becomes more negative, overlevered firms close a smaller portion of their leverage gaps.

Panel B presents regression coefficients from cross-sectional analyses of stock returns on leverage and leverage gaps, controlling for size and book-to-market. In columns (1) and (2), average returns increase with leverage gaps, while the direct effect of leverage is smaller. In the full flexibility benchmark (column 1), leverage gaps have no explanatory power, as they are zero by construction. Columns (3) to (5) show that leverage gaps remain relevant for returns across different values of γ_B. Although the stochastic discount factor in the model implies a constant price of risk, the estimated coefficients remain sensitive to the degree of asymmetry in debt adjustment costs. This sensitivity reflects the frictions firms face when reducing leverage, as in Chaderina, Weiss, and Zechner (2022). However, unlike in studies that emphasize countercyclical risk premia and leverage adjustments, the pattern here is not perfectly monotonic.[26]

In summary, our findings indicate that firms encounter substantial financial inflexibility, which hampers their ability to adjust their capital structure. Financial flexibility is priced in the stock market. The return-gap relationship strengthen when financial flexibility is limited and varies with the degree of asymmetry in capital structure adjustment frictions.

[26]However, for large deviations of γ_B from the baseline, the overall magnitude of adjustment costs is also affected.

Table 6

Counterfactuals: Inflexibility Parameters

The table describes capital structure adjustments and levered returns for different degrees of the financial inflexibility parameter λ_B ("Magnitude") and of the asymmetry parameter γ_B ("Asymmetry"). Panel A tabulates model-implied estimates of adjustment speeds for the full sample of firms, computed as the average fraction of closed gaps as in Table 4. "Adj. Speed (Down)" denotes the adjustment speed conditional on firms being overlevered. Panel B reports the estimated coefficients from cross-sectional regressions of stock returns on leverage ("Leverage"), leverage gaps ("Lev. Gap"), market capitalization ("Size"), and book-to-market equity ("Be/Me") on the simulated economy. Leverage targets and gaps are computed using the model-based approach described in Section 3.3. All coefficients are averages from 100 simulations of 100 randomly drawn firms over 5,000 time periods. Bootstrapped standard errors are reported in parentheses. Note that returns are monthly and expressed in percentage (multiplied by 100), and leverage gaps, leverage targets, and leverage are in levels (not in percentage). Size and Book-to-Market are expressed in log levels. All variables are defined in Appendix A.

	Magnitude			Asymmetry		
	$\lambda_B = 0.0$	$\lambda_B = 0.5$		$\gamma_B = -0.19$	$\gamma_B = -0.21$	$\gamma_B = -0.30$
	(1)	(2)		(3)	(4)	(5)
Panel A: Capital Structure Dynamics						
Adj. Speed (Total)	1.00	0.23	Adj. Speed (Down)	0.22	0.19	0.15
Panel B: Market Price of Flexibility						
Dependent Variable: Monthly Stock Return						
Leverage	0.37	0.46		0.54	0.51	0.62
	(0.20)	(0.32)		(0.30)	(0.29)	(0.35)
Lev. Gap	-	0.84		0.97	0.73	0.83
		(0.37)		(0.35)	(0.33)	(0.30)
Size	-0.19	-0.08		-0.11	-0.08	-0.04
	(0.07)	(0.07)		(0.07)	(0.07)	(0.06)
Be/Me	0.19	0.22		0.20	0.25	0.25
	(0.08)	(0.09)		(0.08)	(0.08)	(0.10)

4.5 Profitability Shocks and Levered Returns Dynamics

Figure 2 analyzes how profitability shocks affect the dynamics of leverage targets and equity returns. It provides an example from our simulated data, illustrating the response of leverage targets and returns to a sequence of persistent idiosyncratic productivity shocks $z_{i,t}$.[27] The figure reports

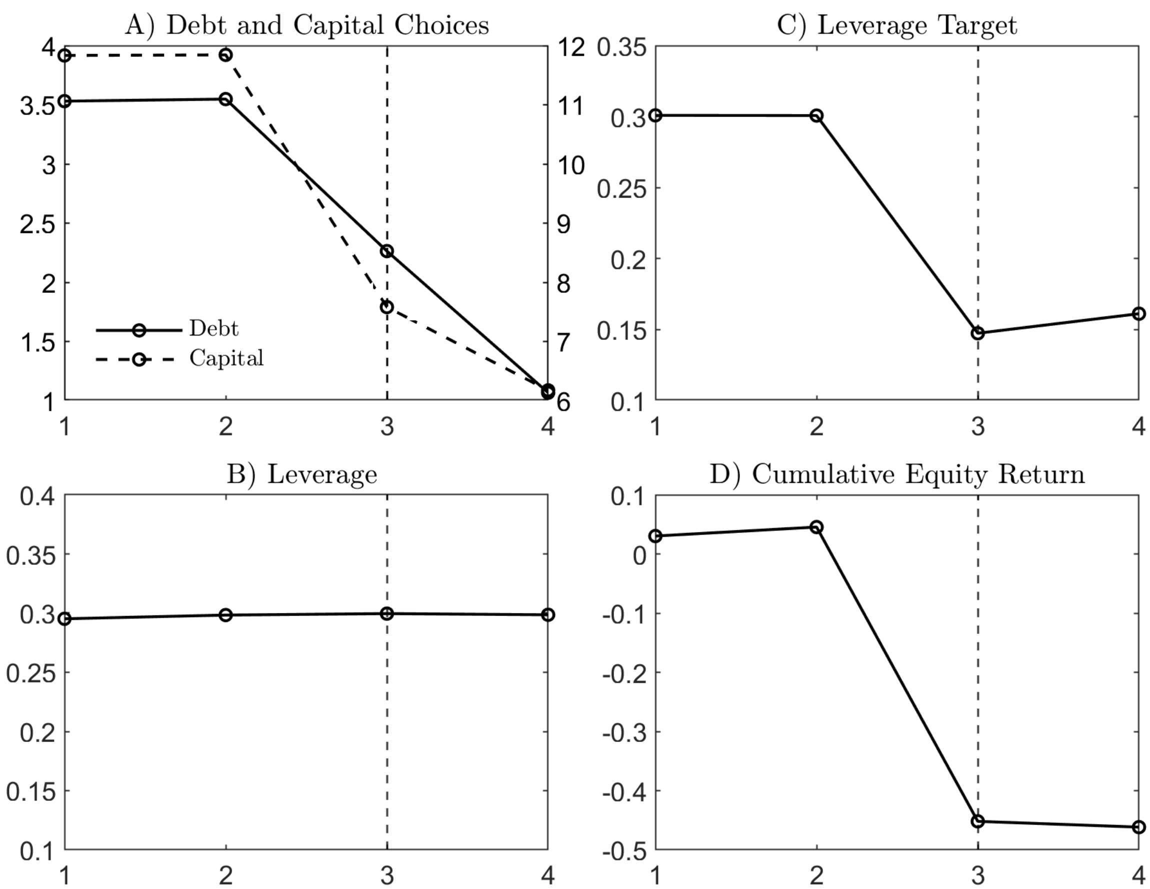
[27] We focus on idiosyncratic rather than aggregate shocks, as aggregate shocks would also affect the stochastic discount factor.

a simulated time series for a firm with a high leverage target, resulting from an initial sequence of positive shocks. At $t = 3$, marked by a vertical dashed line, the firm begins to receive a sequence of negative shocks. Panel A indicates that, because shocks are persistent, the firm chooses to gradually reduce both productive capital and loans in response to the negative profitability news. Panel B indicates that, in this case, despite adjustments in debt and capital, leverage remains roughly stable. Panels C and D show that, following the negative shock, the firm's one-period-ahead return declines, meaning that firms with high leverage targets face less favorable one-period-ahead returns.

Figure 2

Example: Dynamics of Leverage Targets, Gaps and Returns

The figure presents a snapshot of the simulated time series for a sample firm exposed to a specific sequence of idiosyncratic productivity shocks $z_{i,t}$. Panel A plots the debt (left axis, solid line) and the capital (right axis, dashed line) choices. Panel B shows book leverage. Panel C plots the leverage target. Panel D reports cumulative stock returns over the period. Initially, the firm experiences a sequence of positive shocks (highest value for $z_{i,t}$ in the discretization), followed by a sequence of negative shocks (lowest value for $z_{i,t}$), starting at the time indicated by the vertical dashed line.



With persistence in stochastic profitability shocks, firms that experience positive realizations today expect favorable conditions to continue tomorrow. This implies that adjustment costs, and thus the relevance of leverage targets for stock returns, may significantly depend on the persistence of shocks. Table 7 explores the role of shock persistence in both the data and the model.

The existing theoretical literature on corporate investment provides a useful benchmark. As Caballero (1991) notes, several studies highlight two possible effects of uncertainty about future shocks. Some predict that lower predictability leads firms to adjust capital less often to avoid current, certain adjustment costs. Intuitively, in the extreme case of i.i.d. shocks, firms would be unable to forecast future conditions, making adjustments costly and delaying investment (e.g., Bernanke, 1983; McDonald and Siegel, 1986). Other studies suggest that when shocks are unpredictable, firms may optimally bring investment forward to avoid the opportunity cost of waiting (e.g., Bar-Ilan and Strange, 1996; Dou, 2017). In our setting, with multiple frictions, the effect of shock persistence on capital structure choices and on the relevance of leverage gaps for equity returns is ultimately quantitative, depending on model parameters. Empirically, it remains an open question whether persistence leads firms to adjust leverage gaps more or less actively, and how persistence affects the return-gap relationship.

Developing a conclusive test of the effect of shock persistence on the gap-return relationship is highly challenging. To replicate a comparative statics exercise empirically, an econometrician would need to isolate a shock to persistence that does not affect other characteristics of the profitability shock process, such as its volatility or mean, or other unobservable factors that could make high- and low-persistence firms non-comparable. Moreover, because cross-sectional tests on average returns require several years of data, approaches based on specific events, as in the causal inference literature, are not well suited. For these reasons, narrowing the analysis to particular industries or short time periods would not provide a satisfactory solution.

With these caveats in mind, columns (1) to (4) of Table 7 explore the effect of firm-level profitability persistence using a matching approach. For each firm, we compute the autoregressive coefficient of profitability, the standard deviation of AR(1) residuals, and average profitability. These variables are estimated each year t using a rolling window from the start of the sample through year t, requiring at least five observations per firm. Each year, we form a control sample by matching each firm in the top tercile of profitability persistence ("High Persistence") with a firm from the bottom two terciles ("Low Persistence"), using nearest neighbor matching based on Euclidean distance in residual standard deviation and average profitability. Although high- and low-persistence firms may differ along other observable and unobservable dimensions, this procedure generates a meaningful spread in profitability persistence without large differences in mean profitability or residual volatility. High-persistence firms have an average persistence of 0.84, an average profitability of 8.5%, and a residual standard deviation of 4.7%. Low-persistence firms have an average persistence of 0.34, an average profitability of 8.8%, and a residual standard deviation of 5.2%.

The estimates in Panel A of Table 7 indicate that firms with low profitability persistence close a smaller fraction of their leverage gaps than firms with high persistence (34% vs. 37%).[28] Panel B shows that leverage gaps are more relevant for cross-sectional return regressions among low-persistence firms. Despite the loss of statistical power due to the significantly smaller sample size from the matching procedure, returns are more sensitive to leverage gaps for low-persistence firms, using both the Flannery-Rangan targets (columns 1 and 2) and the projection targets (columns 3 and 4). The coefficients on leverage gaps are economically large and statistically significant at least at the five-percent level for low-persistence firms. For high-persistence firms, the coefficients remain positive but are smaller and not statistically significant at the five-percent level. Overall, these results suggest that leverage gaps have a stronger impact on returns when profitability shocks are less persistent, and that firms adjust their capital structure more slowly.

Finally, columns (5) and (6) of Table 7 present a comparative statics exercise with respect to the model parameter ρ_z. All other parameters follow the baseline calibration in Table 2. Given the challenges discussed above, this exercise should be interpreted as a qualitative comparison to the empirical results in the four leftmost columns. Nonetheless, around the baseline calibration, the model results in columns (5) and (6) align qualitatively with the empirical patterns. In simulated economies with less persistent profitability shocks, firms close smaller fractions of their leverage gaps, and the coefficients on gaps in return regressions are economically larger than in economies with higher persistence.

[28] We compute these fractions using the projection targets, as the matching procedure generates a low-persistence group with time-series gaps. In the Flannery-Rangan approach, adjustment speeds are estimated using panel regressions, as they are less sensitive to outliers when leverage targets are not bounded between zero and one.

Table 7
Persistence of Profitability Shocks

The table presents capital structure adjustments and levered returns by profitability persistence in the data and by different values of ρ_z, the persistence of idiosyncratic profitability shocks in the model. Columns (1) to (4) ("Matched Compustat Sample") report results for firms listed on the NYSE, AMEX, and NASDAQ between 1965 and 2020, covered by both Compustat and the Center for Research in Security Prices (CRSP). For each firm, we compute the autoregressive coefficient of profitability, the standard deviation of AR(1) residuals, and average profitability, defined as the ratio of EBIT to total assets. These variables are estimated each year t using a rolling procedure from the start of the sample through year t, requiring a minimum of five observations per firm. Each year, we create a control sample by matching each firm in the top tercile of profitability persistence ("High Persistence") with a firm from the bottom two terciles ("Low Persistence"), using nearest neighbor matching based on Euclidean distance in residual standard deviation and average profitability. Columns (1) and (2) use leverage gaps estimated with the Flannery–Rangan approach ("Flannery-Rangan Target"). Columns (3) and (4) use model-based targets projected onto observable variables ("Projection Target"), as detailed in Section 4.3. Columns (5) and (6) show results from simulated data with ρ_z values of 0.94 and 0.96, respectively. Panel A reports adjustment rates, measured as the average fraction of closed leverage gaps. Panel B presents coefficients from cross-sectional regressions of stock returns on leverage ("Leverage"), leverage gaps ("Lev. Gap"), market capitalization ("Size"), and book-to-market equity ("Be/Me"). For Compustat data, annual accounting variables are matched to monthly returns from July 1980 to December 2020, following Fama and French (1992). Newey-West standard errors with a lag length of four are reported in parentheses. For simulated data, coefficients are averaged over 100 simulations of 100 firms across 5,000 periods, with bootstrapped standard errors in parentheses. Size and Book-to-Market are expressed in log levels. All variables are defined in Appendix A.

	Matched Compustat Sample				Comparative Statics	
	Flannery-Rangan Target		Projection Target			
	Low Persistence	High Persistence	Low Persistence	High Persistence	Low ρ_z	High ρ_z
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Adjustment Rates						
Adj. Rate	-	-	0.34	0.37	0.29	0.35
Panel B: Market Price of Flexibility						
Dependent Variable: Monthly Stock Return						
Leverage	-0.25	0.11	-0.30	0.23	0.51	0.42
	(0.38)	(0.34)	(0.37)	(0.35)	(0.27)	(0.30)
Lev. Gap	1.28	0.67	0.63	0.19	1.32	0.61
	(0.55)	(0.40)	(0.23)	(0.21)	(0.37)	(0.41)
Size	-0.19	-0.13	-0.23	-0.14	-0.00	-0.13
	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)	(0.07)
Be/Me	0.10	0.03	0.14	0.03	0.42	0.25
	(0.08)	(0.06)	(0.09)	(0.07)	(0.08)	(0.10)

5 Conclusions

In this study, we examine the complex relationship between leverage and the dispersion of equity risk premia across firms. To do so, we build a discrete-time, infinite-horizon neoclassical investment model with heterogeneous firms. In the model, firms optimize their investment, financing, and default decisions to maximize their value in arbitrage-free markets.

Our study makes three main contributions. First, we present analytical results that illustrate the interplay between financial flexibility, firm dynamics, and the dispersion of risk premia. These findings indicate that two variables, leverage gaps and leverage targets, can provide valuable insights into levered equity risk premia in a world characterized by limited financial flexibility. Second, we uncover two novel empirical facts that align with the model's predictions: (i) there is a strong positive correlation between estimated leverage gaps and stock returns, and (ii) stocks from high-leverage firms command a premium. This premium becomes apparent when we decompose leverage gaps into leverage targets and observed leverage, with leverage targets negatively impacting risk premia. Third, we assess the model's quantitative implications through calibration.

Overall, our results suggest that limited financial flexibility is instrumental in rationalizing the puzzling empirical patterns surrounding levered returns. The costly rebalancing of capital structures gives rise to leverage gaps, which subsequently mediate the relationship between leverage and returns. Unlike previous studies, the mechanism in our model does not rely on debt adjustment asymmetries or on the cyclical behavior of the price of risk. Instead, limited financial flexibility modifies the standard amplification mechanism from the second proposition in Modigliani and Miller (1958), where leverage magnifies both positive and negative outcomes.

Our results carry potential implications for capital allocation across firms. As David, Schmid, and Zeke (2022) show, a significant portion of the dispersion in the marginal product of capital among U.S. firms is driven by risk premia. We leave the task of exploring the general-equilibrium links between limited financial flexibility and capital misallocation to future research.

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Online Appendix

A) Variable Definitions and Details on Empirical Procedures

The following table summarizes variable definitions with reference to Compustat and CRSP items.

Variable	Construction
Leverage	$\frac{DLTT+DLC}{AT-BE+PRCC\_F\cdot CSHO}$
Book Leverage	$\frac{DLTT+DLC}{AT}$
Net Market Leverage	$\frac{DLTT+DLC-CHE}{AT-BE+PRCC\_F\cdot CSHO}$
Net Book Leverage	$\frac{DLTT+DLC-CHE}{AT}$
Value of Preferred Stocks (PS)	If available, in this order: $PSTKRV$, $PSTKL$, $PSTK$.
Book Equity (BE)	$CEQ + TXDITC$ (if available) $-PS$
Leverage Growth	$\frac{F.ML-ML}{0.5(F.ML+ML)}$
Market Capitalization	$\log \frac{\|PRC\|\cdot SHROUT}{1000}$ (in June)
Book-to-Market Equity	$\log \frac{BE}{\|PRC\|\cdot SHROUT/1000}$
Investment	$\frac{AT-L.AT}{L.AT}$
Profitability	$\frac{REVT-COGS}{BE}$
Δ Lev. from Assets	$\frac{DLTT+DLC}{AT} - \frac{DLTT+DLC}{L.AT}$

The rolling estimation procedure for the multinomial logit model in Section 2.2 follows the same approach as the one used for the Flannery-Rangan measure. The period from 1965 to 1979 serves as a burn-in window. Estimation then proceeds on a rolling basis using data available up to year t. Firms must have at least five consecutive years of observations. To ensure stability in the maximum likelihood estimation, we apply a gradient method 100 times to find an initial parameter vector. We then iterate in blocks of 10 until parameter values converge, with a 1% tolerance in absolute value relative to the previous set of estimates. Firm fixed effects are also estimated on a rolling basis, controlling for the logs of total assets, median leverage, market-to-book ratio, and profitability.

In the model, following Zhang (2005), we define the average Sharpe Ratio as $S_t \equiv \frac{\sigma[M_{t+1}]}{E_t[M_{t+1}]}$ and the risk-free rate as $\frac{1}{E_t[M_{t+1}]} - 1$. We define the equity premium as the average value-weighted return in the simulated economy, where realized stock returns are computed ex-dividends as $\frac{V_{i,t}}{V_{i,t-1}-D_{i,t-1}}$. Profitability is the ratio of operating profits $\Pi_{i,t}$ to capital $K_{i,t}$, investment is the ratio of $I_{i,t}$ to capital $K_{i,t}$, leverage is the ratio of $B_{i,t}$ to $B_{i,t} + V_{i,t} - D_{i,t}$, book-to-market is the ratio of $K_{i,t}$ to

$B_{i,t} + V_{i,t} - D_{i,t}$, debt adjustments are changes in debt stock $B_{i,t} - B_{i,t-1}$ divided by capital $K_{i,t-1}$, debt issuance is $\max\{0, B_{i,t} - B_{i,t-1}\}$ divided by $K_{i,t-1}$, and equity issuance is $\max\{0, E_{i,t}\}$ scaled by capital $K_{i,t}$.

B) Two-Period Case: Derivations and Proofs

Proof of Proposition 1. Part a). Equations (12) and (14) yield

$$B_2 = \frac{\lambda_B B_1 + \tau\left(1 - \rho \mathbb{E}[M_2 | S_1]\right)}{\lambda_B + (1-\tau)(1-\rho)\mathbb{E}[M_2 | S_1]\xi_B}. \tag{A1}$$

Equation (15) follows after subtracting B_1 from both sides of (A1) and collecting λ_1 as defined in (16). Part b). Equation (15) can be rewritten as

$$\frac{B_2}{K_2} - \frac{B_1}{K_1} + \frac{B_1}{K_1} - \frac{B_1}{K_2} = \lambda_1 \left(\frac{B_2^*}{K_2} - \frac{B_1}{K_1} + \frac{B_1}{K_1} - \frac{B_1}{K_2} \right), \tag{A2}$$

after dividing both sides by K_2 and summing and subtracting $\frac{B_1}{K_1}$ from both sides. (18) immediately follows after collecting $\frac{B_1}{K_2} - \frac{B_1}{K_1}$ on the right-hand side of (A2). ■

Proof of Proposition 2. Part a). Substituting the definition of D_2 in the definition (19) of the equity return R_2^E yields

$$R_2^E = \frac{R_2^A K_2 - R_2^D B_2}{\mathbb{E}[M_2 R_2^A | S_1] K_2 - \mathbb{E}[M_2 R_2^D | S_1] B_2}.$$

Using the definition of $R_2^D = \frac{DR_2 - TS_2 + BC_2}{B_2}$ and defining $\gamma_A(K_2) \equiv \mathbb{E}[M_2 R_2^A \,|\, S_1]$, one obtains

$$R_2^E = \frac{R_2^A K_2 - R_2^D B_2}{\gamma_A(K_2) K_2 - \mathbb{E}\left[M_2 \left(\frac{DR_2 - TS_2 + BC_2}{B_2} \right) \middle| S_1 \right] B_2},$$

Because $\frac{DR_2}{B_2} = 1 + r_2^D$, the debt pricing equation (12) implies that

$$R_2^E = \frac{1}{\gamma_A(K_2)} \frac{R_2^A K_2 - R_2^D B_2}{K_2 - \frac{\gamma_D(B_2)}{\gamma_A(K_2)} B_2}. \tag{A3}$$

Summing and subtracting $R_2^A B_2 \frac{\gamma_D(B_2)}{\gamma_A(K_2)}$ from the numerator of (A3), simplifying, and collecting $B_2 \frac{\gamma_D(B_2)}{\gamma_A(K_2)}$, one obtains

$$R_2^E = \frac{1}{\gamma_A(K_2)} \left(R_2^A + \frac{B_2 \gamma_D(B_2)}{K_2 - B_2 \frac{\gamma_D(B_2)}{\gamma_A(K_2)}} \left(\frac{R_2^A}{\gamma_A(K_2)} - \frac{R_2^D}{\gamma_D(B_2)} \right) \right),$$

which is equivalent to (20). (21) simply follows by taking expectations of both sides of (20).

Part b). To link the expected cost of debt $\gamma_D(B_2)$ to leverage gaps, observe that the first-order condition with respect to debt can be rearranged as

$$\frac{\partial D_1}{\partial B_2} + \rho \mathbb{E}\left[M_2 \frac{\partial D_2}{\partial B_2} \right| DEF_2 = 0, S_1 \Bigg] + (1-\rho)\mathbb{E}\left[M_2 \frac{\partial D_2}{\partial B_2} \right| DEF_2 = 1, S_1 \Bigg] = 0. \tag{A4}$$

Observe that $\left.\frac{\partial D_2}{\partial B_2}\right| DEF_2 = 0$ is equal to $-(1+c_2) + \tau c_2$, that is

$$\begin{aligned} \left(\frac{\partial D_2}{\partial B_2} \right| DEF_2 = 0 \Bigg) &= \\ &= -\frac{\partial DR_2^D | DEF_2 = 0}{\partial B_2} + \frac{\partial TS_2 | DEF_2 = 0}{\partial B_2} \\ &= -\frac{DR_2^D | DEF_2 = 0}{B_2} + \frac{TS_2 | DEF_2 = 0}{B_2}. \end{aligned}$$

Summing and subtracting $\frac{1-\rho}{\rho} \frac{DR_2^D | DEF_2 = 1}{B_2}$, one obtains

$$\begin{aligned} \left(\frac{\partial D_2}{\partial B_2} \right| DEF_2 = 0 \Bigg) &= \\ &= -\frac{DR_2^D | DEF_2 = 0}{B_2} - \frac{1-\rho}{\rho} \frac{DR_2^D | DEF_2 = 1}{B_2} \\ &\quad + \frac{1-\rho}{\rho} \frac{\left(R_2^A K_2 - BC_2 \right) | DEF_2 = 1}{B_2} + \frac{TS_2 | DEF_2 = 0}{B_2}. \end{aligned}$$

Instead,

$$\begin{aligned} \left(\frac{\partial D_2}{\partial B_2} \right| DEF_2 = 1 \Bigg) &= \\ &= -\frac{\partial DR_2^D | DEF_2 = 1}{\partial B_2} - \frac{\partial BC_2 | DEF_2 = 1}{\partial B_2} \\ &= -\frac{\partial L_2}{\partial B_2} + \frac{\partial L_2}{\partial B_2} = 0. \end{aligned}$$

The first-order condition (A4) can then be expressed as

$$\begin{aligned} 1 - \lambda_B(B_2 - B_1) &= \rho \mathbb{E}\left[M_2 \frac{DR_2^D | DEF_2 = 0}{B_2} \right| S_1 \Bigg] + (1-\rho)\, \mathbb{E}\left[M_2 \frac{DR_2^D | DEF_2 = 1}{B_2} \right| S_1 \Bigg] \\ &\quad -(1-\rho)\mathbb{E}\left[M_2 \frac{R_2^A K_2 - BC_2}{B_2} \right| DEF_2 = 1, S_1 \Bigg] - \rho \mathbb{E}\left[M_2 \frac{TS_2}{B_2} \right| DEF_2 = 0, S_1 \Bigg], \end{aligned}$$

which, after using the debt pricing equation $\mathbb{E}\left[M_2 \frac{DR_2}{B_2} \right| S_1 \Big] = 1$, boils down to

$$\lambda_B(B_2 - B_1) = (1-\rho)\mathbb{E}\left[M_2 \frac{R_2^A K_2}{B_2} \right| DEF_2 = 1, S_1 \Bigg] + \frac{\mathbb{E}[M_2 (TS_2 - BC_2) | \, S_1]}{B_2}. \tag{A5}$$

From (A5) and using the definition of $\gamma_D(B_2)$, it follows that

$$\gamma_D(B_2) = 1 - \lambda_B(B_2 - B_1) + (1-\rho)\mathbb{E}\left[M_2 \frac{R_2^A}{\frac{B_2}{K_2}} \middle| DEF_2 = 1, S_1 \right]. \tag{A6}$$

Summing and subtracting $-\lambda_1 B_2$ from the right-hand side of (15), one obtains

$$\frac{B_2}{K_2} - \frac{B_1}{K_2} = -\frac{\lambda_1}{1-\lambda_1} Gap_2^L. \tag{A7}$$

Using (A7) to substitute for $B_2 - B_1$ in (A6) leads to the result in (22). ■

Expected Asset Return for the Firm ($\gamma_A(K_2)$). In the text, we claim that $\gamma_A(K_2)$ is constant for a production function that is homogeneous of degree α, that is under the assumption that

$$\frac{f(A_2, Z_2, K_2)}{K_2} = \alpha \cdot f_k(A_2, Z_2, K_2),$$

Then

$$\begin{aligned}
\gamma_A(K_2) &= \mathbb{E}\left[M_2 R_2^A \middle| S_1 \right] = \\
&= \mathbb{E}\left[M_2 \left(1 + (1-\tau)\left(\alpha \cdot f_k(A_2, Z_2, K_2) - \delta\right)\right) \middle| S_1 \right] \\
&= \mathbb{E}\left[M_2 \left(\alpha + (1-\tau)\left(\alpha \cdot f_k(A_2, Z_2, K_2) - \alpha\delta\right)\right) \middle| S_1 \right] \\
&+ \mathbb{E}\left[M_2(1-\alpha) \middle| S_1 \right] - \mathbb{E}\left[M_2(1-\tau)(1-\alpha)\delta \middle| S_1 \right] \\
&= \alpha\mathbb{E}\left[M_2 \left(1 + (1-\tau)\left(f_k(A_2, Z_2, K_2) - \delta\right)\right) \middle| S_1 \right] + \frac{1-\delta(1-\tau)}{1+r_F}.
\end{aligned}$$

Combining equations (12) and (13), we get the following analytical expression for K_2

$$K_2 = f_k^{-1}\left[\frac{r_F + 1 - \rho + \rho(1-\tau)\left(\delta - \frac{1-\rho}{\rho}\xi_K\right)}{(1+r_F)\rho(1-\tau)\mathbb{E}[M_2 A_2 Z_2 | S_1]} \right]. \tag{A8}$$

Because $f(\cdot)$ is increasing and strictly concave, its derivative $f_k(\cdot)$ is strictly decreasing, hence invertible. From(A8), one obtains

$$\gamma_A(K_2) = \alpha\left(1 - \frac{1}{1+r_F}(1-\tau)\frac{1-\rho}{\rho}\frac{\partial L_2}{\partial K_2}\right) + \frac{1-\delta(1-\tau)}{1+r_F},$$

which is constant because $\frac{\partial L_2}{\partial K_2} = \xi_K$. Adding a fixed cost of production does not change this result.

Extension with Equity Issuance Costs. We consider the following equity maximization problem:

$$V_1 \equiv \max_{K_2, B_2} -E_1 - \Lambda^E(E_1) + \mathbb{E}[M_2 D_2 | S_1],$$

where firms may issue external equity at $t = 1$, incurring an issuance cost $\Lambda^E(E_1)$, a differentiable function. The first-order conditions with respect to capital and debt are:

$$1 = \mathbb{E}\left[M_2 \cdot \frac{1}{1 + \frac{\partial \Lambda^E(E_1)}{\partial E_1}} \cdot P_2^S \cdot \left(\frac{\partial \Pi_2}{\partial K_2} + 1 - \delta(1-\tau) - \frac{\partial c_2}{\partial K_2}(1-\tau)B_2 \right) \middle| S_1 \right],$$

and

$$1 - \frac{\partial \Lambda^B(B_2 - B_1)}{\partial B_2} = \mathbb{E}\left[M_2 \cdot \frac{1}{1 + \frac{\partial \Lambda^E(E_1)}{\partial E_1}} \cdot P_2^S \cdot \left(1 + (1-\tau)\left(c_2 + \frac{\partial c_2}{\partial B_2} B_2 \right) \right) \middle| S_1 \right],$$

where $P_2^S = \rho$. These conditions mirror those in the dynamic model (30) and (31), with the distinction that equity issuance is only allowed at $t = 1$ due to the finite horizon. Using similar steps as in the proofs of Propositions 1 and 2, the following adjustments apply:

$$\lambda_1 = \frac{\mathbb{E}[M_2^F|S_1](1-\tau)(1-\rho)\xi_B}{\lambda_B + \mathbb{E}[M_2^F|S_1](1-\tau)(1-\rho)\xi_B},$$

and

$$B_2^* = \frac{\frac{\partial \Lambda^E(E_1)}{\partial E_1} + \tau\left(1 - \rho \mathbb{E}\left[M_2|S_1\right]\right)}{\mathbb{E}[M_2|S_1](1-\tau)(1-\rho)\xi_B},$$

where the firm's stochastic discount factor is defined as $M_2^F \equiv \frac{M_2}{1 + \frac{\partial \Lambda^E(E_1)}{\partial E_1}}$. The optimal capital stock is:

$$K_2 = f_k^{-1}\left[\frac{1 + r_F - \rho + \rho(1-\tau)\left(\delta - \frac{1-\rho}{\rho}\frac{\partial L_2}{\partial K_2}\right)}{(1+r_F)\rho\,(1-\tau)\,\mathbb{E}[M_2^F A_2 Z_2|S_1]} \right].$$

Observe that the previous expressions do not provide a fully closed-form solution, as E_1 remains endogenous. The firm's expected cost of debt is now given by:

$$\gamma_D(B_2) = 1 + \kappa_1 K_2 Gap_2^L + \mathbb{E}\left[M_2 \left((1-\rho)\frac{R_2^A}{\frac{B_2}{K_2}} - \rho \frac{\partial c_2}{\partial B_2} B_2 (1-\tau) \right) \middle| S_1 \right] + \frac{\partial \Lambda^E(E_1)}{\partial E_1},$$

where $\kappa_1 \equiv \mathbb{E}[M_2^F|S_1](1-\tau)(1-\rho)\xi_B$.

Extension with Capital Adjustment Costs. We introduce the following capital adjustment cost function:

$$\Lambda^K(K_2 - (1-\delta)K_1) = \frac{\lambda_K}{2}(K_2 - (1-\delta)K_1)^2.$$

The expression for dividends at $t = 1$ becomes:

$$D_1 = R_1^A K_1 - K_2 + B_2 - (1 + c_1(1-\tau))B_1 - \Lambda^B(B_2 - B_1) - \Lambda^K(K_2 - (1-\delta)K_1).$$

The first-order condition with respect to capital K_2 is:

$$1+\frac{\partial\Lambda^K(K_2-(1-\delta)K_1)}{\partial K_2}=\rho\mathbb{E}\left[M_2\left(1+(1-\tau)\left(f_k(A_2,Z_2,K_2)-\delta+\frac{1-\rho}{\rho}\frac{\partial L_2}{\partial K_2}\right)\right)\middle| S_1\right],$$

while the condition with respect to debt B_2 remains unchanged.

Accordingly, the statements in Propositions 1 and 2 can be amended by defining a new level of capital K_2 as:

$$K_2=g^{-1}\left(\frac{(1+r_F)(1-\lambda_K(1-\delta)K_1)-\rho+\rho(1-\tau)\left(\delta-\frac{1-\rho}{\rho}\frac{\partial R_2}{\partial K_2}\right)}{(1+r_F)\rho(1-\tau)\mathbb{E}1[M2A_2Z_2|S_1]}\right),$$

where the function

$$g(K)\equiv f_k(K)-\frac{\lambda_K}{\rho\mathbb{E}[M_2A_2Z_2|S_1](1-\tau)}K$$

is strictly monotonic and therefore invertible.

C) Dynamic Model: Derivations and Proofs

Proof of Proposition 3. Part a). To compute the expected outside option in case of default, we evaluate the following indefinite integral:

$$\int \xi_{i,t}dF^{\xi}(\xi_{i,t})=-\xi_{i,t}\cdot\frac{e^{-\xi_{i,t}/s}}{1+e^{-\xi_{i,t}/s}}-s\ln\left(1+e^{-\frac{\xi_{i,t}}{s}}\right)+C, \tag{A9}$$

where C is an integrating constant. Evaluating (A9) from $V^C(S_{i,t})$ to ∞ gives

$$\int_{V^C(S_{i,t})}^{\infty}\xi_{i,t}dF^{\xi}(\xi_{i,t})=V^C(S_{i,t})\frac{e^{-\frac{V^C(S_{i,t})}{s}}}{1+e^{-\frac{V^C(S_{i,t})}{s}}}+s\ln\left(1+e^{-\frac{V^C(S_{i,t})}{s}}\right).$$

Substituting (5) and (25) into (24) and simplifying yields (26). To derive (27), note that $V_{i,t+1}\leq\xi_{i,t+1}$ if and only if $V^C_{i,t+1}\leq\xi_{i,t+1}$. Thus,

$$\begin{aligned}
B_{i,t+1} &= \mathbb{E}\left[M_{t+1}\left((1+c_{i,t+1})B_{i,t+1}\mathbb{E}^{\zeta}\left[\chi_{\{V^C_{i,t+1}>\xi_{i,t+1}\}}|S_{i,t}\right]+L_{i,t+1}\mathbb{E}^{\zeta}\left[\chi_{\{V^C_{i,t+1}\leq\xi_{i,t+1}\}}|S_{i,t}\right]\right)\middle| S_{i,t}\right]\\
&= \mathbb{E}\left[M_{t+1}\left((1+c_{i,t+1})B_{i,t+1}\mathbb{E}^{\zeta}[1-DEF_{i,t}|S_{i,t}]+L_{i,t+1}\mathbb{E}^{\zeta}[DEF_{i,t}|S_{i,t}]\right)\middle| S_{i,t}\right]\\
&= \mathbb{E}\left[M_{t+1}\left((1+c_{i,t+1})B_{i,t+1}P^S_{i,t+1}+L_{i,t+1}(1-P^S_{i,t+1})\right)\middle| S_{i,t}\right].
\end{aligned}$$

Part b). For small s, $\xi_{i,t}$ converges to its mean, which is 0. The probability of solvency approaches

$$\lim_{s\to 0^+}P^S_{i,t} = \begin{cases}1 & \text{if } V^C(S_{i,t})>0\\ 0.5 & \text{if } V^C(S_{i,t})=0\\ 0 & \text{if } V^C(S_{i,t})<0.\end{cases} \tag{A10}$$

Additionally, $\lim_{s\to 0^+}\int_{V^C(S_{i,t})}^{\infty}\xi_{i,t}dF^{\xi}(\xi_{i,t})$ converges to zero for any $V^C(S_{i,t})$. Thus,

$$\lim_{s\to 0^+}\mathbb{E}^{\zeta}[\max\{\xi_{i,t},V^C(S_{i,t})\}]=\begin{cases} V^C(S_{i,t}) & \text{if } V^C(S_{i,t})>0 \\ 0 & \text{if } V^C(S_{i,t})\le 0. \end{cases}$$

As $s\to 0^+$, (26) simplifies to

$$V(S_{i,t})=\mathbb{E}^{\zeta}[\max\{\xi_{i,t},V^C(S_{i,t})\}]=\max\{0,V^C(S_{i,t})\},$$

which leads to (28). The derivation of (29) follows directly from combining (27) and (A10). ■

Extension with Capital Adjustment Costs. We introduce a differentiable capital adjustment cost function $\Lambda^K(I_{i,t})$ into the baseline model. This modifies the budget constraint as follows:

$$\Pi_{i,t}+\Delta B_{i,t}+E_{i,t}+\tau\delta K_{i,t}+\tau c_{i,t}B_{i,t}=I_{i,t}+c_{i,t}B_{i,t}+\Lambda^B(\Delta B_{i,t})+\Lambda^K(I_{i,t}).$$

Relative to the baseline model, the optimality condition for debt remains unchanged. The optimality condition for capital becomes:

$$1+\frac{\partial\Lambda^K(I_{i,t})}{\partial K_{i,t+1}}=\mathbb{E}\left[M_{t+1}\cdot P^S_{i,t+1}\cdot\left(\frac{1+\frac{\partial\Lambda^E(E_{i,t+1})}{\partial E_{i,t+1}}}{1+\frac{\partial\Lambda^E(E_{i,t})}{\partial E_{i,t}}}\right)\cdot R^k_{i,t+1}\,\middle|\,S_{i,t}\right],$$

where

$$R^k_{i,t+1}\equiv\frac{\partial\Pi_{i,t+1}}{\partial K_{i,t+1}}+1-\delta(1-\tau)+(1-\delta)\frac{\partial\Lambda^K(I_{i,t+1})}{\partial I_{i,t+1}}-\frac{\partial c_{i,t+1}}{\partial K_{i,t+1}}B_{i,t+1}(1-\tau).$$

Intuitively, investment now involves an additional expense due to adjustment costs.

D) Numerical Solution Method

We solve the model corresponding to $s\to 0^+$ using a combination of value function iteration (VFI) and simulation. Each firm i's problem is characterized by five state variables, i.e., $S_{i,t}\equiv(K_{i,t},B_{i,t},c_{i,t},z_{i,t},A_t)$. We approximate the value function $V(S_{i,t})$ with piece-wise linear interpolation on a grid $7\times7\times5\times5\times3$, respectively. Note that the projection of $V(S_{i,t})$ onto an interpolated structure allows for a precise solution with a relatively parsimonious number of grid points. We check the robustness of our numerical solution by experimenting with finer grids.

Given $S_{i,t}$, each firm faces three continuous choices, i.e., $(K_{i,t+1},B_{i,t+1},c_{i,t+1})$, and one discrete choice, i.e., whether to default or not $DEF_{i,t}$. Choices $K_{i,t+1}$ and $B_{i,t+1}$ are evaluated on a grid 30×30, and we solve numerically at each step of the VFI for $c_{i,t+1}$ given each fix evaluation of $(K_{i,t},B_{i,t},c_{i,t},z_{i,t},A_t,K_{i,t+1},B_{i,t+1})$. This requires to solve for $7\times7\times5\times5\times3\times30\times30$ non-linear equations at each step of the VFI, given the guess of the value function and future default. We solve for the coupon using golden search.

The solution with VFI proceed in two steps. First, we find the equilibrium value function $\tilde{V}(_{i,t})$ associated with an identical model but without endogenous default. Second, we use $\tilde{V}(_{i,t})$ as an initial guess for the model with endogenous default and we progressively increase the fixed cost F, re-converge the value function and re-initialize. The convergence criteria on the value function is defined as a max absolute difference between the value functions in two consecutive iterations of the VFI of 10^{-4}, or lower.

We then use the four policy functions $\{K(S_{i,t}), B_(S_{i,t}), c(S_{i,t}), DEF_{i,t}(S_{i,t})\}$ to perform a long simulation of our economy ($T = 5000$) with a panel of $i = 1, ..., 5000$ firms, given random draws of idiosyncratic shocks $\{\{z_{i,t}\}_{t=0}^{T}\}_{i=1}^{5000}$ and aggregate shocks $\{A_t\}_{t=0}^{T}$. To compute regression coefficients and standard errors in model-based regressions, we bootstrap 100 randomly selected firms over 5,000 time periods across 100 simulations.

E) Robustness Checks and Sensitivity Analysis

Table A1

ROBUSTNESS: ALTERNATIVE LEVERAGE MEASURES

The table reports coefficient estimates of Fama-MacBeth cross-sectional regression of monthly stock returns on leverage variables and controls. Columns (1) to (3) refer to market leverage net of cash ("Net Market Lev."). Columns (4) to (6) refer to book leverage ("Book Lev."). Columns (7) to (9) refer to book leverage net of cash ("Net Book Lev."). The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2020 and covered by the Center of Research in Security Prices (CRSP). Leverage targets and leverage gaps are the results of the rolling estimation procedure described in Section 2. "Lev. Gap (FR)" refers to leverage gaps estimated using the Flannery–Rangan approach. "Lev. Gap (Proj.)" refers to leverage gaps derived from the dynamic model, where model-based targets are projected onto a set of variables observed in the data. The resulting functional form is then used to estimate a multinomial logit model, as discussed in Section 4.3. Years from 1965 to 1979 are used as a "burn in" period. Annual accounting variables are matched to monthly returns from July 1980 to December 2020 following the standard procedure of Fama and French (1992). Newey-West standard errors with lag-length of 4 are in parentheses. R^2 and N. Obs denote the cross-sectional R-squared and the number of observations respectively. All variables are described in Appendix A.

	Dependent Variable: Monthly Stock Return								
	Net Market Lev.			Book Lev.			Net Book Lev.		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Leverage	-0.06	0.05	-0.01	0.17	0.12	0.08	-0.03	-0.01	-0.05
	(0.29)	(0.27)	(0.27)	(0.29)	(0.27)	(0.27)	(0.22)	(0.22)	(0.22)
Lev. Gap (FR)		0.45			0.60			0.55	
		(0.20)			(0.23)			(0.18)	
Lev. Gap (Proj.)			0.55			0.60			0.56
			(0.15)			(0.15)			(0.16)
Size	-0.21	-0.19	-0.20	-0.21	-0.19	-0.20	-0.21	-0.18	-0.20
	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Be/Me	0.18	0.13	0.13	0.18	0.13	0.13	0.17	0.13	0.13
	(0.07)	(0.07)	(0.06)	(0.08)	(0.07)	(0.07)	(0.06)	(0.06)	(0.07)
R^2	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
N. Obs.	1221663	880356	761211	1221663	880380	761211	1221663	880356	761,211

Table A2
Specifications with Leverage and Leverage Targets

The table reports coefficient estimates from cross-sectional regressions of monthly stock returns on leverage variables and controls. In the columns labeled "Data", leverage targets result from the rolling estimation procedure described in Section 2. The sample includes all Compustat firms traded on the NYSE, AMEX, and NASDAQ between 1965 and 2020 and covered by the Center for Research in Security Prices (CRSP). In the columns labeled "Model", coefficients are averages from 100 simulations of 100 randomly drawn firms over 5,000 time periods, using the baseline calibration in Table 2. "Lev. Gap (FR)"" refers to leverage gaps estimated using the Flannery–Rangan approach. "Lev. Gap (Proj.)" refers to leverage gaps derived from the dynamic model, where model-based targets are projected onto a set of variables observed in the data. The resulting functional form is then used to estimate a multinomial logit model, as discussed in Section 4.3. In column (3), leverage targets are computed using the model-based approach described in Section 3.3, denoted as "Lev. Target (Model)". Columns (4) and (5) report results based on leverage targets and gaps estimated on simulated data by applying the Flannery–Rangan approach, as detailed in Section 4.3. In the data, the years from 1965 to 1979 serve as a burn-in period. Annual accounting variables are matched to monthly returns from July 1980 to December 2020, following the standard procedure of Fama and French (1992). Newey–West standard errors with a lag length of 4 are reported in parentheses. For the model, bootstrapped standard errors are in parentheses. R^2 denotes the cross-sectional R-squared. All data variables are described in Appendix A.

	Data		Model		
	(1)	(2)	(3)	(4)	(5)
Leverage	0.97	0.66	1.41	0.27	1.10
	(0.38)	(0.33)	(0.47)	(0.23)	(0.35)
Lev. Target (FR)	-0.79			-0.41	
	(0.29)			(0.18)	
Lev. Target (Proj.)		-0.49			-0.86
		(0.15)			(0.28)
Lev. Target (Model)			-0.85		
			(0.35)		
Size	-0.18	-0.20	-0.10	-0.30	-0.14
	(0.04)	(0.04)	(0.07)	(0.09)	(0.06)
Be/Me	0.10	0.09	0.21	0.18	0.12
	(0.06)	(0.06)	(0.09)	(0.06)	(0.07)
R^2	0.02	0.02	0.01	0.02	0.02

Table A3

Robustness: Controlling for Profitability and Investment

The table reports coefficient estimates of Fama-MacBeth cross-sectional regression of monthly stock returns on leverage variables and controls. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2020 and covered by the Center of Research in Security Prices (CRSP). Leverage targets and leverage gaps are the results of the rolling estimation procedure described in Section 2. Columns (2) and (3) report results based on leverage gaps estimated using the Flannery–Rangan approach ("Flannery-Rangan Target"). Columns (4) and (5) use leverage targets derived from the dynamic model, where model-based targets are projected onto a set of variables observed in the data ("Projection Target"). The resulting functional form is then used to estimate a multinomial logit model, as discussed in Section 4.3. Years from 1965 to 1979 are used as a "burn in" period. Annual accounting variables are matched to monthly returns from July 1980 to December 2020 following the standard procedure of Fama and French (1992). Newey-West standard errors with lag-length of 4 are in parentheses. R^2 and N. Obs denote the cross-sectional R-squared and the number of observations respectively. All variables are described in Appendix A.

Dependent Variable: Monthly Stock Return					
		Flannery-Rangan Target		Projection Target	
	(1)	(2)	(3)	(4)	(5)
Leverage	0.10		0.02		-0.04
	(0.34)		(0.31)		(0.30)
Lev. Gap		0.90	0.84	0.41	0.44
		(0.33)	(0.29)	(0.17)	(0.16)
Size	-0.20	-0.17	-0.17	-0.17	-0.18
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)
Be/Me	0.16	0.13	0.13	0.18	0.18
	(0.07)	(0.08)	(0.07)	(0.08)	(0.07)
Prof	0.06	0.05	0.05	0.10	0.10
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
Inv	-0.27	-0.28	-0.26	-0.28	-0.26
	(0.04)	(0.06)	(0.06)	(0.07)	(0.07)
R^2	0.02	0.02	0.03	0.02	0.03
N. Obs	1140792	880338	880338	761192	761192

Table A4

ROBUSTNESS: INVESTMENT, DISINVESTMENT, AND LEVERAGE RATIOS

The table reports coefficient estimates of Fama-MacBeth cross-sectional regression of monthly stock returns on leverage variables and controls. "Neg. Inv." is an indicator variable equal to one for disinvesting firms. "Δ Lev. from Assets" measures the change in leverage resulting from variations in the denominator, keeping the debt stock constant. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2020 and covered by the Center of Research in Security Prices (CRSP). Leverage targets and leverage gaps are the results of the rolling estimation procedure described in Section 2. Columns (1) to (4) report results based on leverage gaps estimated using the Flannery–Rangan approach ("Flannery-Rangan Target"). Columns (5) to (8) use leverage targets derived from the dynamic model, where model-based targets are projected onto a set of variables observed in the data ("Projection Target"). The resulting functional form is then used to estimate a multinomial logit model, as discussed in Section 4.3. Years from 1965 to 1979 are used as a "burn in" period. Annual accounting variables are matched to monthly returns from July 1980 to December 2020 following the standard procedure of Fama and French (1992). Newey-West standard errors with lag-length of 4 are in parentheses. R^2 and N. Obs denote the cross-sectional R-squared and the number of observations respectively. All variables are described in Appendix A.

	Dependent Variable: Monthly Stock Return							
	Flannery-Rangan Target				Projection Target			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Leverage	0.27	0.16	-0.02	0.01	0.24	0.12	-0.06	-0.06
	(0.33)	(0.32)	(0.31)	(0.31)	(0.32)	(0.31)	(0.31)	(0.30)
Lev. Gap	0.83	0.74	0.84	0.79	0.51	0.48	0.45	0.45
	(0.29)	(0.28)	(0.30)	(0.29)	(0.16)	(0.16)	(0.16)	(0.16)
Δ Lev. from Assets	0.65		-0.14		0.69		-0.12	
	(0.19)		(0.26)		(0.20)		(0.32)	
Neg. Inv.		0.21		0.13		0.22		0.13
		(0.07)		(0.08)		(0.07)		(0.07)
Size	-0.18	-0.17	-0.17	-0.17	-0.20	-0.19	-0.18	-0.18
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Be/Me	0.09	0.10	0.13	0.13	0.11	0.12	0.18	0.18
	(0.06)	(0.06)	(0.07)	(0.07)	(0.06)	(0.06)	(0.07)	(0.07)
Prof			0.05	0.05			0.10	0.10
			(0.02)	(0.02)			(0.02)	(0.02)
Inv			-0.29	-0.23			-0.29	-0.22
			(0.10)	(0.06)			(0.12)	(0.06)
R^2	0.02	0.02	0.03	0.03	0.02	0.02	0.03	0.03
N. Obs	880452	880452	880338	880338	761294	761294	761192	761192

Table A5

Robustness: Zero Leverage and Negative Net Leverage Firms

The table reports coefficient estimates of Fama-MacBeth cross-sectional regression of monthly stock returns on leverage variables and controls. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2020 and covered by the Center of Research in Security Prices (CRSP). Columns (1) and (4) exclude zero-leverage firms and firms with negative net leverage (net of cash). Columns (2) and (5) focus on the subsample of these firms. Columns (3), (4), (7), and (8) include indicator variables for zero-leverage ("Zero Lev.") and negative net leverage ("Neg. Lev.") firms as controls. Leverage targets and leverage gaps are the results of the rolling estimation procedure described in Section 2. Columns (1) to (4) report results based on leverage gaps estimated using the Flannery–Rangan approach ("Flannery-Rangan Target"). Columns (5) to (8) use leverage targets derived from the dynamic model, where model-based targets are projected onto a set of variables observed in the data ("Projection Target"). The resulting functional form is then used to estimate a multinomial logit model, as discussed in Section 4.3. Years from 1965 to 1979 are used as a "burn in" period. Annual accounting variables are matched to monthly returns from July 1980 to December 2020 following the standard procedure of Fama and French (1992). Newey-West standard errors with lag-length of 4 are in parentheses. R^2 and N. Obs denote the cross-sectional R-squared and the number of observations respectively. All variables are described in Appendix A.

Dependent Variable: Monthly Stock Return								
	Flannery-Rangan Target				Projection Target			
	Lev > 0	Lev ≤ 0	Controls		Lev > 0	Lev ≤ 0	Controls	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Leverage	0.16	1.62	0.15	0.26	0.15	2.30	0.17	0.24
	(0.31)	(0.67)	(0.32)	(0.28)	(0.32)	(0.77)	(0.32)	(0.29)
Lev. Gap	0.70	1.26	0.80	0.79	0.37	0.62	0.47	0.45
	(0.31)	(0.53)	(0.29)	(0.29)	(0.22)	(0.19)	(0.16)	(0.16)
Zero Lev.			-0.04				0.06	
			(0.06)				(0.19)	
Neg. Lev.				0.04				0.05
				(0.09)				(0.10)
Size	-0.20	-0.15	-0.18	-0.18	-0.22	-0.16	-0.20	-0.20
	(0.04)	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)
Be/Me	0.08	0.13	0.10	0.10	0.10	0.13	0.12	0.12
	(0.06)	(0.09)	(0.06)	(0.06)	(0.06)	(0.09)	(0.06)	(0.06)
R^2	0.02	0.03	0.02	0.02	0.02	0.03	0.02	0.02
N. Obs	548131	332321	880452	880380	544799	216495	761294	761211

Table A6

Financial Flexibility and Firm Size

Panels A and B describe the small and large firms' capital structure adjustments toward leverage targets under the baseline calibration of Table 2. Firms are split into large and small using the median size (total assets in the data, $K_{i,t}$ in the model). "Lev. Gap" denotes leverage gaps, (defined as the difference between leverage and target leverage), and "Adjustment" denotes the one-period-ahead change in leverage. Panel C reports model-implied and data estimates of adjustment speeds for the full sample of firms and for small and large firms separately. Model-implied adjustment speeds are computed as the average fraction of closed gaps. Data figures are obtained with the measure of target leverage obtained from the estimation of the model of Flannery and Rangan (2006) in Equation (1). Panel D reports the estimated coefficients from cross-sectional regressions of stock returns on leverage ("Leverage") and leverage gaps ("Lev. Gap") for small and large firms separately. The coefficients in Panel D are averages from 100 simulations of 100 randomly drawn firms over 5,000 time periods under the baseline calibration of Table 2. Bootstrapped standard errors are reported in parentheses. Note that returns are monthly and expressed in percentage (multiplied by 100), and leverage gaps and leverage are in levels (not in percentage). All variables are defined in Appendix A.

Panel A: Leverage Adjustments Small Firms

	Group of Lev. Gap				
	Low	2	3	4	High
Lev. Gap	-4.88	-2.32	-0.55	0.25	7.33
Adjustment	4.07	2.00	0.51	-0.03	-6.06

Panel B: Leverage Adjustments Large Firms

	Group of Lev. Gap				
	Low	2	3	4	High
Lev. Gap	-1.66	-0.24	0.29	1.07	7.67
Adjustment	0.67	-0.01	-0.07	-0.25	-0.87

Panel C: Adjustment Speeds

	Model	Data
Small Firms	0.46	0.37
Large Firms	0.26	0.30

Panel D: Monthly Stock Return

	Small Firms	Large Firms
	(1)	(2)
Leverage	0.02	-0.09
	(0.04)	(0.04)
Lev. Gap	0.99	0.36
	(0.18)	(0.09)