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# Levered returns and capital structure imbalances

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Federal Reserve Bank of Chicago

## Levered Returns and Capital Structure Imbalances

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# Levered Returns and Capital Structure Imbalances

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## Abstract

We revisit the relation between equity returns and financial leverage through the lens of a dynamic trade-off model with costly capital structure rebalancing. The model predicts that expected equity returns depend on whether a firm's leverage is above or below its target leverage. We provide empirical evidence in support of the model predictions. Controlling for leverage, overlevered (underlevered) firms earn higher (lower) returns. A quantitative version of our model reproduces key facts about capital structure rebalancing and equity returns for U.S. corporations. Overall, our results indicate that financial flexibility crucially affects the link between leverage and equity returns.

*Keywords:* leverage, cross section of returns, target leverage, dynamic capital structure, financial frictions.

JEL Classification Numbers: G12, G32.

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## 1. Introduction

The second proposition of Modigliani and Miller (1958) (MM) is one of the pillars of the theory of corporate finance. It is widely taught in corporate finance courses and employed by practitioners around the world. The proposition establishes a positive relation between financial leverage and expected equity returns that is ordinarily applied to compute the cost of equity for different levels of leverage. Over the years, a number of academics have investigated the relation between equity returns and leverage, and have provided mixed results. In some cases, equity returns appear to be unrelated to leverage. In other cases, leverage is significantly and negatively related to equity returns.

In this paper we formalize an intuition for why the fundamental result of MM can be at odds with the data. We suggest that firms' limited financial flexibility in adjusting their capital structure crucially affects the link between leverage and returns. We show that, in a dynamic setting, firms tend to partially adjust their capital structure toward a target leverage ratio. We offer empirical and quantitative evidence that accounting for capital structure imbalances, defined as deviations from target leverage, helps in coming to terms with the contradictory evidence on "levered returns".

We begin by illustrating the intuition for our results in a simple two-period model. This stylized setup offers a "look-alike" MM equation for levered returns. In the model, firms choose their capital structure to maximize their equity value in the presence of three frictions: taxes, bankruptcy costs, and debt adjustment costs. In the absence of these three frictions, MM's second proposition holds in its traditional form. Debt adjustment costs instead create room for capital structure imbalances. Firms have a motive to raise additional debt as long as the marginal tax shield of an additional dollar of debt exceeds the marginal bankruptcy cost. The optimal financial policy of a firm is to increase its leverage as long as the margin between tax shields and bankruptcy costs is positive, and reduce its leverage otherwise. Absent adjustment costs, a firm changes leverage until the two marginal effects are perfectly equal. This happens when leverage is set equal to *target leverage*, which is defined as the optimum in the absence of adjustment costs. With adjustment costs, a firm generally finds it too costly to reach the target, and has to settle for a leverage ratio that is either too low or too high with respect to the target. This is commonly referred to as "partial adjustment", and it implies that in the cross section some firms are *underlevered* (leverage smaller than target), while others are *overlevered* (leverage larger than target).

From an asset pricing perspective, a quasi MM result can still be obtained, once a correction factor  $\gamma$  is applied to the original equation. The resulting relation between market leverage and equity returns is the following:<sup>5</sup>

$$R^E = R^A + \frac{\gamma d}{k - \gamma d} \left( R^A - \frac{R^D}{\gamma} \right), \quad (1)$$

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<sup>5</sup>For an in-depth discussion of the use of market versus book values of debt in empirical tests of structural models, see Bretscher, Feldhütter, Kane, and Schmid (2020).

where  $k$  is the market value of the assets,  $d$  is the market value of debt,  $R^A$  is the return on the unlevered assets,  $R^D$  is the market return on debt, and  $R^E$  is the levered equity return.

30 The correction factor  $\gamma$  reflects differences between average bankruptcy costs and average tax shields in correspondence of firms' optimal capital structure. As adjustment costs induce capital structure imbalances,  $\gamma$  depends both on observed leverage and on how far a firm is from its target. The correction factor is equal to one in the frictionless benchmark, in which case we revert to the standard MM equation. In general,  $\gamma$  can be greater or smaller than one. More precisely,  $\gamma$  is smaller than one if the average (per-dollar of debt outstanding) tax shield exceeds  
35 the average bankruptcy cost, and greater than one otherwise. In other words, for a firm with  $\gamma$  smaller than one, equity returns respond to leverage as if the firm had a debt load smaller than its market value  $d$ . In this case, the firm obtains higher average tax shields than bankruptcy costs and receives a net benefit from carrying debt. Instead, when  $\gamma$  is greater than one, equity returns behave as if the firm effectively had more debt than its market value  $d$ , because average bankruptcy costs are higher than average tax shields, and the firm bears a net cost of carrying its  
40 outstanding debt stock.<sup>6</sup> Observe that  $\gamma$  is different from one in the special case of static tradeoff theory, which does not include adjustment costs. Optimal capital structure choices only equate the marginal values of bankruptcy costs and tax shields, while their average values still differ in this case. This is because tax shields and bankruptcy costs, in general, vary non-linearly with firms' debt. However, as all firms are able to instantaneously respond to shocks by adjusting their capital structure to the target, capital structure imbalances play no role.

45 The key novelty of equation (1) with respect to the second proposition of MM is to show that both the amount and the unit cost (or benefit) of debt for a firm determine the effect of leverage on its equity returns. As in MM, capital structure affects how the risk of unlevered assets propagates to equity payouts through the amplification of both good and bad cash flow outcomes. We show that the amplification effect is also driven by the effective net cost (or benefit) of debt, which itself is driven by capital structure imbalances. By measuring how far a firm is from  
50 its target, *relative leverage* is a measure of a firm's capital structure imbalance. Relative leverage is defined as the difference between leverage and target leverage. It is negative for underlevered firms and positive for overlevered firms.  $\gamma$  and, consequently, equity returns depend positively on relative leverage. For a given leverage ratio, firms with higher relative leverage have higher equity returns, while firms with lower relative leverage earn lower equity returns.

55 The economic intuition for this result is the following. Take first the case of an underlevered firm and suppose that bankruptcy costs increase more than proportionally with the firm's debt stock, while tax shields increase proportionally. As long as the marginal tax shield is greater than the marginal bankruptcy cost, every dollar of debt raised by the firm brings a net benefit because it generates a positive net margin. As the firm keeps raising more debt, the margin on an extra dollar of debt shrinks because the bankruptcy costs increase faster than the tax shields.

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<sup>6</sup> $\gamma$  captures only the non-diversifiable components of bankruptcy costs and tax shields. Therefore, only the systematic component of bankruptcy costs and tax shields enters our mechanism. Thus, the effect of capital structure imbalances cannot be simply diversified away by shareholders through their portfolio allocations.

60 However, as long as the margin between tax shields and bankruptcy costs is positive on average, debt generates a net benefit for the firm. As a result, in comparison to the frictionless environment of MM, the amplification of leverage on returns is dampened. Vice versa, in the case of a sufficiently overlevered firm, debt brings a net loss to the firm, and the amplification effect of leverage on returns is stronger than in the original MM framework.

Although this simple illustration is useful to develop intuition for our key results, it is too stylized to serve as  
65 a basis for a quantitative investigation of its predictions. We then embed the key economic tradeoffs in a more general infinite-horizon dynamic environment, which we calibrate to U.S. data. The dynamic model allows for cross-sectional firm heterogeneity in the form of productivity shocks. Every period, firms make endogenous investment and financing decisions. Firms are financially constrained as external equity is costly and firms can endogenously default on their debt claims. Within the model, we extend the definition of target in the two-period illustration  
70 to a dynamic environment. In addition, we adopt a flexible asymmetric functional form for debt adjustment costs. As debt adjustment costs can arise from several sources, this choice allows us to keep the model tractable while capturing, albeit in reduced form, the direct and indirect costs of issuing and withdrawing debt.<sup>7</sup>

Within the calibrated model, we simulate artificial panels of firms and use them as a laboratory to test the empirical predictions. We complement our quantitative analysis with empirical evidence linking capital structure  
75 imbalances and equity returns on a sample from the widely used CRSP and Compustat datasets. Our empirical evidence is based on standard reduced-form estimates of target leverage in the corporate finance literature. Taken together, our quantitative and empirical analyses provide a set of consistent empirical facts, which support the key predictions of our two-period illustration. First, firms partially adjust their capital structure toward their target leverage. Second, market leverage has very little explanatory power once standard controls, namely firm's market  
80 capitalization and book-to-market equity, are considered. Third, when relative leverage is included alongside leverage as an explanatory variable for equity returns, the coefficient of relative leverage is positive, statistically significant, and economically sizable. Instead, leverage has little predictive power. This suggests that heterogeneity in target leverage ratios confounds the relation between leverage and returns.<sup>8</sup> Finally, in the cross section, we find that small firms adjust their capital structure faster than large firms toward their targets. Accordingly, the premium associated  
85 with relative leverage is more pronounced for large firms, which appear to benefit less from adjusting toward their target capital structure.

The paper is structured as follows. Section 2 develops the two-period illustration for our key results. Section 3 presents empirical evidence in support of the key model predictions. Section 4 lays out our infinite-horizon model, whose quantitative properties are assessed in Section 5. Section 6 concludes.

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<sup>7</sup>For example, Fischer, Heinkel, and Zechner (1989) and Strebulaev (2007) discuss underwriting and management fees, Acharya, Bharath, and Srinivasan (2007) study seniority issues that render large changes in the capital structure costly, and Diamond (1991) and Myers (1977) consider liquidation and agency costs associated with the use of debt.

<sup>8</sup>When target leverage and market leverage are included in the same empirical specification, the coefficient of leverage is positive, while the coefficient of target leverage is negative. Thus, the traditional positive relation between leverage and returns is restored when one controls for target leverage. Intuitively, for an underlevered firm, the higher is the target, the larger are the net benefits of debt it internalizes at any given level of leverage. On the contrary, a higher target implies a smaller net cost of leverage for an overlevered firm.

90 *Related Literature.* This paper mainly relates to the literature that examines how financing frictions introduce deviations from the Modigliani-Miller theorem and ultimately determine cross-sectional spreads in expected equity returns. Recent papers along these lines include Livdan, Saprizza, and Zhang (2009), Gomes and Schmid (2010), Caskey, Hughes, and Liu (2012), Ozdagli (2012), Obreja (2013), Ozdagli (2015), Doshi, Jacobs, Kumar, and Rabinovitch (2019), and Friewald, Nagler, and Wagner (2021). Our model and the associated empirical findings provide  
95 a number of new contributions. From a theoretical point of view, we reconcile the traditional intuition of MM’s Proposition 2 with a multi-period environment where leverage changes are costly. We also provide a rationale for the “non-result” of leverage on returns, i.e. the fact that leverage does not appear to drive equity returns (see Bhandari 1988, Fama and French 1992, Penman, Richardson, and Tuna 1992, George and Hwang 2010, Gomes and Schmid 2010). We show that once the value of debt is adjusted to account for the relevant frictions, the original insight  
100 of MM’s proposition carries on through into a more complex set up than the one assumed in their original paper. Our theoretical findings rely on simple microeconomic trade-offs and have a clear intuition that fundamentally relies on the benefits and costs of debt finance. Our model shows that MM’s result can be obtained from the production side of the firm, rather than from a no-arbitrage argument.<sup>9</sup> Finally, the model clarifies the interplay of different measures of leverage (observed leverage, target leverage, and relative leverage) and their individual relation with  
105 equity returns.

From an empirical point of view, this work is primarily related to Korteweg (2010), who uses equity prices to estimate the net benefits to leverage for a large cross section of firms in a dynamic tradeoff setting. Our results are consistent with Korteweg’s in that we provide additional evidence that the tradeoff between costs and benefits of leverage is quantitatively a first-order margin reflected in stock prices. We offer a measure of leverage that can be  
110 consistently used to predict returns. We show that relative leverage can be computed with a two-step procedure using historical accounting data and that results are not sensitive to how relative leverage is measured. We provide empirical evidence that matches well to the predictions of the model, and we document that leverage *per se* is an unreliable predictor of returns. Another related empirical paper is Caskey, Hughes, and Liu (2012). Their analysis primarily relies on the “kink” proxy in Graham (2000) to define overlevered and underlevered firms depending on  
115 variation in their marginal tax benefits. Remarkably, Caskey, Hughes, and Liu (2012) find that overlevered firms earn lower average cross-sectional return than underlevered firms. We entertain a different definition of overlevered and underlevered firms. Our empirical measures of target leverage, which are widely used in the empirical corporate finance, account for other dimensions than tax benefits, such as investment opportunities, innovation, and asset depreciation. In this context, we derive out testable hypotheses from a theoretical setup. Finally, we show that  
120 our results are quantitatively relevant in a dynamic model, which is less susceptible to measurement error in target leverage.

Our work builds on the macroeconomic literature that uses the “gap approach” to describe costly adjustments of production factors (e.g., Sargent 1978, Caballero and Engel 1993, Cooper and Willis 2004, King and Thomas

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<sup>9</sup>However, the absence of arbitrage opportunities in the market is still required.

2006, Bayer 2009). We rely on the “gap approach” to generalize the definition of target leverage in the two-period illustration to an infinite-horizon model. As in these studies, we consider adjustments toward a dynamic target, which they term “frictionless target”. We apply the gap approach to a firm’s debt stock, rather than to a factor of production. Reassuringly enough, our quantitative results based on the frictionless target are consistent with the empirical evidence based on reduced-form measures, which also define a dynamic target for each firm in the sample.

More broadly, this paper pertains to the large and growing literature that links corporate investment and financing decisions to the behavior of asset returns through the lens of production-based asset pricing models. An incomplete list includes Cochrane (1991), Jermann (1998), Gomes, Kogan, and Zhang (2003), Zhang (2005), Gomes, Yaron, and Zhang (2006), Liu, Whited, and Zhang (2009), Gomes and Schmid (2010), Belo, Lin, and Bazdresch (2014), Gomes, Jermann, and Schmid (2016), and Gomes and Schmid (2016).

## 2. A Simple Illustration

In this section we propose a stylized model to illustrate the relation between capital structure imbalances and expected equity returns. The main advantage of a stylized setup is to provide a transparent illustration of the underlying economic mechanism that drives our main empirical and quantitative results.

### 2.1. Economic Environment

Consider an economy with three periods,  $t_0$ ,  $t_1$  and  $t_2$ , populated by heterogeneous firms indexed by  $i$ . Firms have a set of physical assets  $k_i$  that is assumed constant over the three periods. The assets generate after-tax profits equal to  $r_{i,1}^A(1 - \tau)k_i$  in  $t_1$ , where  $r_{i,1}^A$  is the pre-tax return on assets and  $\tau$  is the statutory tax rate. Default takes place when the return on assets is sufficiently low, such that  $r_{i,2}^A < \overline{r_{i,2}^A}$ , where  $\overline{r_{i,2}^A}$  is a given threshold. In  $t_2$ , the assets produce  $r_{i,2}^A(1 - \tau_{i,2})k_i$ , where

$$\tau_{i,2} = \begin{cases} 0 & \text{if } r_{i,2}^A < \overline{r_{i,2}^A}, \\ \tau & \text{if } r_{i,2}^A \geq \overline{r_{i,2}^A}. \end{cases}$$

The firm is currently in period  $t_1$ , and  $r_{i,1}^A$  is known with certainty. Instead,  $r_{i,2}^A$  is a random variable with conditional distribution  $f(r_{i,2}^A | r_{i,1}^A)$ .

Firms enter  $t_1$  with an outstanding amount of debt  $d_{i,0}$ . In  $t_1$  the firm is assumed not to be in default and pays an interest amount  $(1 + \rho_{i,1}^D)d_{i,0}$ , where  $\rho_{i,1}^D$  is a known coupon rate. The interest payments on debt in  $t_2$  are stochastic, because they depend on whether default occurs or not. If there is no default,  $r_{i,2}^D(d_{i,1})$  is equal to the coupon rate  $\rho_{i,2}^D(d_{i,1})$ . In the case of default, the return on debt is equal to the recovery rate

$$r_{i,2}^D(d_{i,1}) = \frac{(1 + r_{i,2}^A(1 - \tau_{i,2}))k_i - \beta_{i,2}(d_{i,1})}{d_{i,1}} - 1, \quad (2)$$



where the term  $\beta_{i,2}(d_{i,1}) \geq 0$  represents the bankruptcy costs per dollar of outstanding debt. Total bankruptcy costs are  $\beta_{i,2}(d_{i,1})d_{i,1}$ . For analytical convenience, we assume that unit bankruptcy costs are proportional to each dollar of debt outstanding in the case of default, that is  $\beta_{i,2}(d_{i,1}) = \beta_{i,2}d_{i,1}$ , where

$$\beta_{i,2} = \begin{cases} \beta_i & \text{if } r_{i,2}^A < \overline{r_{i,2}^A}, \\ 0 & \text{if } r_{i,2}^A \geq \overline{r_{i,2}^A}. \end{cases}$$

This implies that total bankruptcy costs increase more than proportionally (quadratically) with the stock of debt outstanding in case of default.

We assume that adjusting the debt stock carries a cost  $\Theta_i(d_{i,0}, d_{i,1}) = \frac{\theta_i}{2}(d_{i,1} - d_{i,0})^2$ . The adjustment cost is a reduced form of accounting for the frictions associated with the issuance and repurchase of securities in an environment with imperfect capital markets. The convexity of the cost function implies that large debt adjustments within one period entail larger unit costs than small adjustments, such as in Croce, Kung, Nguyen, and Schmid (2012) and Belo, Lin, and Yang (2014). Convex costs of adjusting capital structure are consistent with Myers and Majluf (1984) and Krasker (1986). Although the assumption of quadratic adjustment costs is analytically convenient, we relax it in the dynamic model of Section 4. The assumption on the existence of a cost of adjusting firms' capital structure is consistent with the empirical finding that firms do not adjust immediately to their target leverage ratio.<sup>10</sup>

*Firm's Problem.* Tax shields and bankruptcy costs affect the cash flows of the firm and are thus reflected in the value of equity. In period  $t_1$ , firm  $i$  chooses  $d_{i,1}$  to maximize the market value of the firm  $V_{i,1}$ , that is:<sup>11</sup>

$$V_{i,1} \equiv \max_{d_{i,1}} \left\{ r_{i,1}^A(1 - \tau)k_i - (1 + r_{i,1}^D(1 - \tau))d_{i,0} + d_{i,1} - \Theta_i(d_{i,0}, d_{i,1}) \right. \\ \left. + E[M((1 + r_{i,2}^A(1 - \tau_{i,2}))k_i - (1 + r_{i,2}^D(1 - \tau_{i,2}))d_{i,1} - \beta_{i,2}(d_{i,1})d_{i,1})] \right\}, \quad (3)$$

where  $E[\cdot]$  denotes the expectation operator with respect to the information set available at time  $t_1$  and  $M$  represents the stochastic discount factor between  $t_1$  and  $t_2$  as given by the market. To minimize notation, from now on we will refer to firm  $i$  more simply as the firm, and drop the subscript  $i$ .

## 2.2. Optimal Leverage Policy

The presence of adjustment costs posits an economic tradeoff for all firms in the economy. Each firm optimally adjusts its capital structure by trading off sure cash flows at time  $t_1$  in exchange for expected cash flows at time  $t_2$ .

<sup>10</sup>Fama and French (2002), Leary and Roberts (2005), Flannery and Rangan (2006), Huang and Ritter (2009), Faulkender, Flannery, Hankins, and Smith (2010), Flannery and Hankins (2010), and Halling, Yu, and Zechner (2015) provide examples of the estimation of partial adjustment models of capital structure. The adjustment speed toward the target is estimated to be as low as 7% (Fama and French (2002)) and as high as 30% (Flannery and Rangan (2006)).

<sup>11</sup>The maximization problem in (3) can be equivalently expressed in terms of change in debt, defined as  $\Delta d_{i,1} \equiv d_{i,1} - d_{i,0}$ . To see this, replace  $d_{i,1}$  with  $\Delta d_{i,1} + d_{i,0}$  and maximize with respect to  $\Delta d_{i,1}$ . We can observe immediately that the maximization leads to the same first-order condition in (32). This observation highlights that, although we do not model debt maturity and seniority explicitly, what matters is the change in debt from one period to the next.

If debt claims are fairly priced in the market, that is  $E[M(1+r_2^D(d_1))] = 1$ , the first-order condition for the firm is

$$\frac{\partial \Theta(d_0, d_1)}{\partial d_1} = E \left[ M \tau_2 \frac{\partial (r_2^D(d_1)d_1)}{\partial d_1} \right] - E \left[ M \frac{\partial (\beta_2(d_1)d_1)}{\partial d_1} \right]. \quad (4)$$

and has an intuitive interpretation. The firm finds the optimal debt level at the point where the change in adjustment costs resulting from raising one additional dollar of debt at time  $t_1$  (on the left-hand side) equalizes its expected discounted marginal net benefit at time  $t_2$  (on the right-hand side). The marginal net benefit is the difference between marginal tax shields and marginal bankruptcy costs. If there were no adjustment costs, the firm would perfectly trade off the marginal tax shields with the marginal bankruptcy costs. Instead, the presence of adjustment costs implies that at the optimum, a wedge between marginal tax shields and marginal bankruptcy costs arises. The wedge can be either positive or negative. When the wedge is positive, the marginal tax shield is larger than the marginal bankruptcy cost, and the opposite holds otherwise.

The optimality condition (4) can be rearranged to unfold the relation between capital structure imbalances and expected equity returns. The following proposition first characterizes the firm's optimal leverage policy.

**Proposition 1 (Optimal Financing Policy).** Firms optimally set their leverage ratio  $\frac{d_1}{k}$  to close a fraction  $\lambda_1$  of the gap between their initial leverage ratio  $\frac{d_0}{k}$  and their target leverage ratio  $\frac{d_1^*}{k}$ , that is

$$\frac{d_1}{k} - \frac{d_0}{k} = \lambda_1 \left( \frac{d_1^*}{k} - \frac{d_0}{k} \right), \quad (5)$$

where  $\lambda_1 \equiv \frac{2\beta(1-\tau)\frac{q_D}{1+r_F}}{\theta+2\beta(1-\tau)\frac{q_D}{1+r_F}}$  and  $d_1^* \equiv \frac{\tau(r_F+q_D)}{2\beta(1-\tau)q_D}$ .  $r_F$  denotes the risk-free rate, with  $1+r_F = \frac{1}{E[M]}$ .  $q_D \equiv \int_{-\infty}^{\bar{r}_2^A} f_Q(r_2^A|r_1^A)dr_2^A$  is the probability of default under the risk neutral measure, in which  $f_Q(r_2^A|r_1^A) \equiv (1+r_F)f(r_2^A|r_1^A)M(r_2^A)$  is the risk-neutral probability density of the realization  $r_2^A$ .

**Proof.** See Appendix. ■

Equation (5) characterizes the firm's optimal financing policy as a partial adjustment model, consistent with the specifications ordinarily estimated in empirical studies, such as Flannery and Rangan (2006). The target  $\frac{d_1^*}{k}$  is increasing with the marginal benefit of one dollar of debt  $\tau$  and decreasing with its marginal bankruptcy cost  $\beta$ . The target is forward-looking in that firms anticipate future economic conditions at time  $t_2$ . Specifically, the numerator of  $d_1^*$  increases with the expected discounted value of the tax shields of debt. The larger the non-idiosyncratic probability of default  $q_D$ , the larger is the expected marginal tax shield  $\tau(r_F+q_D)$  in solvency states, because the tax-deductible credit spread that lenders charge over the risk-free rate is also larger.<sup>12</sup> Instead, the denominator shows that the target decreases with the expected discounted value of marginal bankruptcy costs in default states, the per-dollar value of which is  $2\beta$  and is realized with probability  $q_D$ . The term  $1-\tau$  in the denominator instead

<sup>12</sup>As standard, the risk-neutral probability of default measures the non-diversifiable risk of bankruptcy (i.e., the part correlated with the stochastic discount factor), and thus the part priced by the market.

accounts for the indirect tax benefit of bankruptcy costs. Higher bankruptcy costs increase the coupon rate that lenders charge to compensate for their lower recovery rate given default. The tax shield in solvency states also increases as a result of the higher required interest payment. Hence, the firm effectively bears only a fraction  $1 - \tau$  of the marginal bankruptcy cost.

The target is equal to the optimum leverage that the firm would choose in the absence of adjustment costs.<sup>13</sup> This definition of the target is consistent with the “gap” approach we use in Section 4 to define target leverage in an infinite-horizon economy. Firms adjust their leverage ratio from  $\frac{d_0}{k}$  to  $\frac{d_1}{k}$  by closing a fraction  $\lambda_1 \in (0, 1]$  of the gap  $\frac{d_1^*}{k} - \frac{d_0}{k}$  between initial leverage  $\frac{d_0}{k}$  and target leverage  $\frac{d_1^*}{k}$ . The parameter  $\lambda_1$  can be interpreted as the speed of adjustment of the firm toward its target capital structure. On the one hand, firms with low values of  $\lambda_1$  are slow in adjusting their capital structure to changes in their investment and financing conditions. On the other hand, firms with high speeds of adjustment are fast in closing the gap toward their targets.<sup>14</sup> Observe that this illustration offers a benchmark in which  $\lambda_1$  does not depend on  $k$ , i.e., the firm’s size does not affect the firm’s speed of adjustment. In the quantitative analysis of Section 5 we explore how firms’ adjustment toward the target are related to firms’ size.

Proposition 1 shows the existence of capital structure imbalances in the economy. We define relative leverage  $RL_1$  as the difference between observed leverage and target leverage, that is:

$$RL_1 \equiv \frac{d_1}{k} - \frac{d_1^*}{k}. \quad (6)$$

Accordingly, firms with  $RL_1 > 0$  are *overlevered*, i.e, their observed leverage is above the target, while firms with  $RL_1 < 0$  are *underlevered*. Equation (5) can be rewritten as:

$$\frac{d_1}{k} - \frac{d_0}{k} = -\frac{\lambda_1}{1 - \lambda_1} RL_1. \quad (7)$$

From equation (7) we can see that if  $\lambda_1 < 1$  and in  $t_1$  a firm adjusts its leverage up from  $\frac{d_0}{k}$ , the firm will be underlevered in  $t_2$ . Adjustment frictions (captured by  $\lambda < 1$ ) will prevent the firm from reaching its target leverage  $\frac{d_1^*}{k}$  in  $t_1$ . Symmetrically, if the firm deleverages in  $t_1$ , it will be overlevered in  $t_2$ .

Figure 1 presents an example of the optimal leverage policy of the firm for two different values of  $\theta$  that correspond to low adjustment costs (Panel A) and high adjustment costs (Panel B). The picture reports  $\frac{d_0}{k}$  on the horizontal axis and  $\frac{d_1}{k}$  on the vertical axis. Target leverage is at the intersection of the policy function with the 45-degree line. Firms that are already at their target do not adjust their capital structure ( $RL_1 = 0$ ). In the figure, the optimal

<sup>13</sup>To see this, rewrite (4) assuming that there are no adjustment costs. This yields

$$E \left[ M_{\tau_2} \frac{\partial (r_2^D(d_1)d_1)}{\partial d_1} \right] = E \left[ M \frac{\partial (\beta_2(d_1)d_1)}{\partial d_1} \right].$$

Carrying out the necessary substitutions and solving for the optimal leverage ratio we obtain precisely the definition of target leverage as in Proposition 1.

<sup>14</sup>When there are no adjustment costs, the speed of adjustment equals one. Equation (5) then states that  $\frac{d_1}{k} = \frac{d_1^*}{k}$ .

leverage policy is linear in  $\frac{d_0}{k}$ , and the comparison between the two panels highlights that  $\theta$  affects the slope of the optimal leverage policy. The higher  $\theta$ , the steeper the policy function, and the more sluggish is the firm's adjustment toward target leverage. To see this, consider two possible levels of  $\frac{d_0}{k}$ ,  $L_0^U$  and  $L_0^O$ , located respectively below and above the target. The policy function in Panel B shows that a firm with initial leverage  $L_0^U$  leverages up less than its counterpart in Panel A and will be more underlevered in  $t_2$ . Analogously, all else being equal, a firm with initial leverage  $L_0^O$  lowers its leverage less, and is more overlevered if it faces higher adjustment costs.

[Insert Figure 1 Here]

### 195 2.3. Levered Returns

Since  $V_1$  is the cum-dividend equity value of the firm, its realized gross stock return  $R_2^E$  between  $t_1$  and  $t_2$  is defined as

$$R_2^E = \frac{P_2 + D_2}{P_1} = \frac{D_2}{V_1 - D_1}, \quad (8)$$

where  $P_1$  and  $P_2$  are the (ex-dividend) stock prices at time  $t_1$  and at time  $t_2$ , and  $D_1$  and  $D_2$  are the dividend payments at time  $t_1$  and at time  $t_2$ . Notice that the (ex-dividend) stock price  $P_2$  at  $t_2$  is zero because there are no more cash flows after that time.<sup>15</sup> The dividend payments of the firm at  $t_1$  and  $t_2$  are

$$\begin{aligned} D_1 &\equiv (1 + r_1^A(1 - \tau))k - (1 + r_1^D(1 - \tau))d_0 + d_1 - \Theta\left(\frac{d_0}{k}, \frac{d_1}{k}\right) \\ D_2 &\equiv (1 + r_2^A(1 - \tau_2))k - (1 + r_2^D(d_1)(1 - \tau_2))d_1 - \beta_2(d_1)d_1. \end{aligned}$$

Exploiting the condition  $E[M((1 + r_2^A(1 - \tau_2)))] = 1$  and the definition of  $D_2$ , after some manipulation, equation (8) can be expressed as<sup>16</sup>

$$R_2^E = R_2^A + \frac{\gamma(d_1)d_1}{k - \gamma(d_1)d_1} \left( R_2^A - \frac{R_2^D}{\gamma(d_1)} \right), \quad (9)$$

in which we define the after-tax gross return on physical assets as  $R_2^A \equiv 1 + r_2^A(1 - \tau_2)$ , the *effective cost of debt* for the firm as  $R_2^D \equiv 1 + r_2^D(d_1)(1 - \tau_2) + \beta_2 d_1$ , and the *correction factor* as  $\gamma(d_1) \equiv E[MR_2^D]$ . As  $E[M(1 + r_2^D(d_1))] = 1$ , the correction factor is equal to

$$\gamma(d_1) = 1 - E[M(\tau_2 r_2^D(d_1) - \beta_2 d_1)]. \quad (10)$$

The expression in equation (10) has an intuitive interpretation. In a trade-off economy, the presence of tax shields  $\tau_2$  and bankruptcy costs  $\beta_2 d_1$  creates a discrepancy between the cost of each dollar of debt for the firm  $R_2^D$  and the market return on debt  $1 + r_2^D(d_1)$  earned by debt-holders. This discrepancy is the *net benefit (or cost) to leverage*

<sup>15</sup>Observe that, from (3), it follows that  $V_1 - D_1 = E[MD_2]$ . Therefore, the equity return is given by  $R_2^E = \frac{D_2}{E[MD_2]}$ .

<sup>16</sup>Note that the condition  $E[M((1 + r_2^A(1 - \tau_2)))] = 1$  can be derived under the assumption that all firms have already optimized their initial level of capital  $k_0$ , so that  $\forall i, k_i = k_0$ .  $k_0$  is fixed at  $t = 1, 2$ . Note that if firms were allowed to re-optimize their capital stock at  $t = 1$ , firms would optimally choose to stay at  $k_0$  according to  $-1 + E[M((1 + r_2^A(1 - \tau_2)))] = 0$ . However, our two-period example simply offers an illustration based on a snapshot over a firm's life cycle. The more general dynamic environment of Section 4 allows for cross-sectional firm heterogeneity, which translates into differences in firms' target capital structures.

(Korteweg, 2010) and is given by the term  $E[M(\tau_2 r_2^D(d_1) - \beta_2 d_1)]$ , which is the present value of the *average* tax shield  $\tau_2 r_2^D(d_1)$  minus the *average* bankruptcy cost  $\beta_2 d_1$ . As in MM, leverage propagates asset risk to equity payouts through the amplification of both good and bad cash flow outcomes. However, the amplification is not only driven by the amount of debt  $d_1$ , but also by the net benefit  $\gamma(d_1)$  that shareholders internalize for each dollar of debt outstanding in correspondence with their optimal leverage and the resulting capital structure imbalance.

The correction factor creates an *amplification* effect for the burden of debt when  $\gamma(d_1) > 1$ . This happens when the present value of average bankruptcy costs exceeds the present value of average tax shields. Instead, a *reduction* effect for debt occurs when  $\gamma(d_1) < 1$ , which holds when average tax shields are greater than average bankruptcy costs. Levered equity returns in (9) are computed as if for each dollar of debt the firm effectively had  $\gamma(d_1)$  dollars of debt because of its net benefits/costs to leverage. The effect of the discrepancy generated by  $\tau_2$  and  $\beta_2(d_1)$  is twofold. First, the correction factor  $\gamma(d_1)$  enters the *effective leverage ratio*  $\frac{\gamma(d_1)d_1}{k-\gamma(d_1)d_1}$ . When  $\gamma(d_1) > 1$ , the effective leverage ratio is larger than the observed leverage ratio  $\frac{d_1}{k-d_1}$ . Second, the correction factor reduces the effective cost of debt  $\frac{R_2^D}{\gamma(d_1)}$ , because the additional leverage embedded in  $\gamma(d_1)$  does not require any supplementary payment besides  $R_2^D$ .

Importantly,  $\gamma(d_1)$  captures the systematic component of tax shields and bankruptcy costs through their covariances with the pricing kernel  $M$ .<sup>17</sup> Thus, the effect of capital structure imbalances cannot be simply diversified away by shareholders through their portfolio allocations. Intuitively, since bankruptcies are concentrated in bad times while tax benefits are higher in good times, shares of overlevered firms are risky investments because their debt increases the present value of non-diversifiable bankruptcy costs and boosts the traditional MM amplification effect. We formally relate  $\gamma(d_1)$  to capital structure imbalances in the following section.

#### 2.4. Relative Leverage, Target Leverage, and Equity Returns.

As discussed above, equation (9) offers a number of new insights into the relationship between leverage and returns in the presence of frictions. The following proposition links ex-post realized equity returns and capital structure imbalances.

**Proposition 2 (Imbalances and Equity Returns).** Realized equity returns of the firm between  $t_1$  and  $t_2$  are related to relative leverage and to target leverage through the following relationship

$$R_2^E = R_2^A + \frac{\hat{d}_1}{k - \hat{d}_1} \cdot (R_2^A - \hat{R}_2^D), \quad (11)$$

where the effective debt stock  $\hat{d}_1$  is defined as  $\hat{d}_1 \equiv \gamma(\cdot) d_1$ ,  $\hat{R}_2^D \equiv \frac{R_2^D}{\gamma(\cdot)}$  and the correction factor is defined as

$$\gamma\left(\frac{d_1^*}{k}, \frac{d_1}{k}\right) \equiv 1 + \frac{\alpha d_1}{2k} - \alpha \frac{d_1^*}{k} + \frac{\tau \delta_D}{\frac{d_1}{k}} \quad (12)$$

<sup>17</sup>Observe that, as in the case of MM, our predictions do not rely on a specific asset pricing model (e.g. multi-factor model), but hold for any pricing kernel  $M$  that ensures no arbitrage in the market.

or equivalently as

$$\gamma\left(RL_1, \frac{d_1}{k}\right) \equiv 1 - \frac{\alpha d_1}{2k} + \alpha RL_1 + \frac{\tau \delta_D}{\frac{d_1}{k}} \quad (13)$$

with  $\delta_D \equiv E[M(1 + r_2^A)|r_2^A < \overline{r_2^A}]$  and  $\alpha \equiv 2\beta(1 - \tau)k \frac{qD}{1+r_F}$ .<sup>18</sup>

225 **Proof.** See Appendix. ■

Taking expectations of both sides of (11) delivers the relation between ex-ante expected returns and capital structure imbalances at the heart of our analysis of levered returns, that is

$$E[R_2^E] = E[R_2^A] + \frac{\widehat{d}_1}{k - \widehat{d}_1} \cdot \left(E[R_2^A] - E[\widehat{R}_2^D]\right). \quad (14)$$

It is worth reminding the reader that in both equations (11) and (14), leverage is expressed at market values, not at book values, because  $d_1$  and  $k$ , respectively, represent the market value of debt and of the assets. Therefore, the prediction of Proposition 2 is on the relation between leverage measured at market value and equity returns.

### 2.5. Empirical Predictions

230 On the basis of Proposition 2 and the interpretation of the correction factor, we can draw predictions on the relation between expected equity returns and our three measures of leverage (relative leverage, observed leverage, and target leverage).

Consider two firms with the same observed leverage and different relative leverage. According to the definition of the correction factor provided in equation (13), the firm with higher relative leverage has a higher  $\gamma(\cdot)$ . Plugging 235 equation (13) into equation (14), we then have that the firm with higher relative leverage earns higher expected returns.

Instead, compare two firms with the same relative leverage and different observed leverage. Leverage enters equation (14) with a mixed sign because of several contrasting effects. First, the firm with higher  $\frac{d_1}{k}$  has a lower  $\gamma\left(RL_1, \frac{d_1}{k}\right)$ , as (13) shows. Second, since  $\widehat{d}_1 \equiv \gamma\left(RL_1, \frac{d_1}{k}\right) d_1$  in (14), it is unclear which of the two firms has a larger 240 amplification term  $\frac{\widehat{d}_1}{k - \widehat{d}_1}$ . Finally, the effect of leverage on  $\widehat{R}_2^D \equiv \frac{R_2^D}{\gamma\left(RL_1, \frac{d_1}{k}\right)}$  is also indeterminate. Although the firm with higher leverage plausibly bears a higher cost of debt  $R_2^D$ , it has a lower correction factor as discussed before.<sup>19</sup> Overall, the relation between leverage and expected returns is theoretically indeterminate. As a consequence, depending on which effect of leverage, if any, prevails in (14), leverage and returns could be positively, insignificantly, or negatively related in the data.

<sup>18</sup>We use the shorthand  $E[f(X)|X < K]$  for  $E[f(X)1_{\{X < K\}}]$ , where  $X$  is random variable,  $f(\cdot)$  is a function,  $1_{\{\cdot\}}$  is an indicator function, and  $K$  is a constant.

<sup>19</sup>As discussed in the online appendix,  $r_2^D(d_1)$  is increasing in  $d_1$  if investors are risk averse and bankruptcy states happen when  $M$  is high (bad states).

245 Consider next two firms with the same observed leverage and different target leverage. The firm with higher target leverage must have a lower relative leverage because  $RL_1 = \frac{d_1}{k} - \frac{d_1^*}{k}$ . Therefore, the conclusions obtained above for the relation between relative leverage and returns still hold with the opposite sign, as (12) shows. The firm with higher target leverage will earn lower average equity returns. Finally, compare two firms with the same target and different leverage, a case that can be constructed by taking two otherwise identical firms that differ only in terms  
250 of  $\frac{d_0}{k}$ . Leverage enters with mixed signs both in the definition of  $\gamma\left(\frac{d_1^*}{k}, \frac{d_1}{k}\right)$  and into equation (14). Therefore, the relation between leverage and expected returns is indeterminate even after controlling for target leverage.

### 3. Supporting Empirical Evidence

This section provides empirical evidence linking capital structure imbalances and expected equity returns. This evidence is based on standard reduced-form estimates of target leverage in the corporate finance literature and to  
255 support the following quantitative analysis.

#### 3.1. Leverage Variables

To compute the empirical counterparts of the key variables of the model, we define the *market leverage ratio* as

$$ML_{i,t} = \frac{D_{i,t}}{D_{i,t} + ME_{i,t}}, \quad (15)$$

where  $D_{i,t}$  denotes the stock of interest-bearing debt of firm  $i$  in period  $t$  and  $ME_{i,t}$  is the stock market capitalization of firm  $i$  in period  $t$ .  $ML_{i,t}$  is the empirical counterpart of optimal market leverage in the two-period model. To see this, observe that the market value of debt can be obtained as  $E[M(1 + r_{t+1}^D)]d_t = d_t$ , and similarly, that the market  
260 value of the assets is given by  $E[M(1 + r_{t+1}^A)(1 - \tau_{t+1})]k = k$ .

Defining the *target leverage ratio* as  $TL_{i,t}$ , relative leverage is obtained as the difference between observed and target leverage, that is

$$RL_{i,t} \equiv ML_{i,t} - TL_{i,t}. \quad (16)$$

#### 3.2. Estimation of Target Leverage

A natural implementation of the policy function obtained in equation (5) of Proposition 1 is the empirical model of Flannery and Rangan (2006) (FR), which is widely used in the corporate finance literature.

In the model of FR firms partially adjust their leverage over time toward the desired level  $ML_{i,t}$  at a speed of adjustment  $\lambda$ :

$$ML_{i,t} - ML_{i,t-1} = \lambda(TL_{i,t} - ML_{i,t-1}) + \epsilon_{i,t}, \quad (17)$$

with

$$TL_{i,t} = \beta X_{i,t-1}. \quad (18)$$

$TL_{i,t}$  is modeled as a linear function of a set of firm-specific characteristics  $X_{i,t-1}$ , and varies both over time and  
 265 across firms.

Equations (17) and (18) lead to the following estimable model:

$$ML_{i,t} = (\lambda\beta)X_{i,t-1} + (1 - \lambda)ML_{i,t-1} + \epsilon_{i,t}. \quad (19)$$

Differently from previous models employed in the literature (e.g. Hovakimian, Opler, and Titman 2001; Korajczyk and Levy 2003), the specification of FR allows for dynamic partial adjustment in the presence of frictions, and is thus consistent with the evidence provided by Leary and Roberts (2005) and Strebulaev (2007), according to which the existence of frictions prevents firms from instantaneously adjusting toward their desired capital structure. Excluding  
 270  $ML_{i,t-1}$  from the right-hand-side of (19) is equivalent to assuming that a firm's target leverage always coincides with its observed leverage, i.e., that there is full adjustment ( $\lambda = 1$ ) in each period.<sup>20</sup>

The estimation of  $RL_{i,t}$  requires three steps. First, we estimate equation (19) to obtain the coefficients for  $X_{i,t-1}$  and  $ML_{i,t-1}$ , that are respectively given by  $\lambda\beta$  and  $(1 - \lambda)$ . Second, we compute  $\lambda$  and  $\beta$ , and proceed to estimate  $TL_{i,t}$ . Third, we compute  $RL_{i,t}$  as the difference between observed  $ML_{i,t}$  and predicted  $TL_{i,t}$ .

275 For the estimation of equation (19), we use the Compustat annual database over the period 1965-2013 including all companies listed on AMEX, NYSE, and NASDAQ, and excluding firms that are not incorporated in the United States, financials (SIC codes 6000-6999) and utilities (SIC codes 4900-4999), because of their special characteristics.  $ML_{i,t}$  is defined as the book value of short-term plus long-term interest bearing debt (Compustat items DLTT+DLC) divided by the market value of assets (DLTT+DLC + PRCC F\*CSHO).

280 Following FR, the set of control variables  $X_{i,t-1}$  comprises the following variables. Profitability: EBIT (EBIT) over total assets (AT); Market Value over Assets: Book value of liabilities plus market value of equity (DLTT+DLC + PRCC F\*CSHO) over total assets (AT); Depreciation: Depreciation (DP) over total assets (AT); Size: Logarithm of total assets (AT)<sup>21</sup>; Tangibility: Property, plant, and equipment (PPENT) over total assets (AT); R&D expenses: R&D expenses (XRD) over total assets (AT); R&D Dummy: Dummy equal to one for firms with missing values for  
 285 R&D expenses (XRD); Industry ML: Median industry ML calculated each year for two-digit SIC code industries; a dummy for each fiscal year; and a firm fixed effect. The control variables capture the importance of tax shields and bankruptcy costs, as well as possible additional determinants of target leverage identified by the empirical literature.

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<sup>20</sup>If  $\lambda = 1$ , equation (17) simplifies to

$$ML_{i,t} = TL_{i,t}^* + \epsilon_{i,t},$$

that is

$$E[ML_{i,t}] = E[TL_{i,t}^*].$$

<sup>21</sup>Assets are deflated by the consumer price index in 2000 dollars.



Importantly, as our estimates of target leverage are included in asset pricing tests, all our estimates need to be free of look-ahead bias. Thus, future information is never used in the formation of portfolios in the context of our asset pricing tests. As the explanatory variables are lagged, our estimation of  $TL_{i,t}$  begins in 1966. We require at least five observations for the estimation to be included in the sample, that means that the first estimates of  $TL_{i,t}$  included in the sample are in 1970 for the set of firms with no gaps between 1965 and 1969. We then continue on a rolling basis each year using all the accounting information available until that year.

In their review article on estimation techniques, Flannery and Hankins (2013) run a horse race between different estimation procedures for a dynamic panel model like the one in equation (19).<sup>22</sup> The evidence on which estimation technique performs better is mixed. As the FE approach is more computationally efficient in large datasets, we employ it for the estimation of equation (19).<sup>23</sup>

More precisely, we run a regression specification as in equation (19) that contains fixed effects for each individual firm. To guarantee reliable estimates of the firm fixed effects, we exclude firms for which there are less than five years of data. We then compute the relative leverage as per equation (16).<sup>24</sup>

### 3.3. Descriptive Statistics

Table 1 provides summary statistics for observed leverage (ML), target leverage (TL) and relative leverage (RL). Panel A shows that the estimated mean for the target is close to that of the observed market leverage (0.16). TL is highly persistent over time, as can be seen from the last column, which reports the autocorrelation of degree one. RL is less persistent than TL. The findings that RL has approximately a zero mean, that TL and ML have similar means, and that RL is not very persistent are all consistent with the idea that RL represents only a temporary deviation from the target. Panel B of Table 1 reports some key statistics for the whole Compustat sample for which leverage can be measured (first row) and for the subsample for which TL can be estimated. This subsample is fairly comparable to the full sample, but mildly biased toward larger firms.

[Insert Table 1 Here]

Table 2 displays a breakdown of the sample into quintiles of RL. We observe that RL and ML are positively related. Thus, firms that are overlevered also tend to have high leverage, and vice versa. Rather differently, RL and TL are not related monotonically: TL first decreases and then increases with RL, reaching a minimum in the third quintile. This finding shows that over-leverage is not the result of having a low target, nor is under-leverage the

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<sup>22</sup>The comparison is across the following models: OLS, FE, Arellano and Bond (1991) difference GMM, Blundell and Bond (1998) system GMM, Huang and Ritter (2009) Four-Period Long Differencing, Hahn, Hausman, and Kuersteiner (2007) Longest Differencing, and Least Square Dummy Variable Correction.

<sup>23</sup>For robustness, in unreported tests we run our estimates using Blundell and Bond (1998) system GMM and obtain qualitatively similar results.

<sup>24</sup>For robustness, in the Online Appendix we consider three alternative measures of target leverage.

result of having a high target. Both the most overlevered and the most underlevered firms (fifth and first quintiles) have high targets. The fourth column reports the change in ML. Notably, overlevered firms tend to lever down in the next year, while underlevered firms tend to lever up. These findings are consistent with Figure 1 of FR, which shows that in the next year leverage drops for overlevered firms and it increases for underlevered firms. The largest decrease in leverage is for the firms in the highest quintile of RL. As already noted above, due to the monotonic relation between RL and ML, these firms are also those with the highest level of ML. The fact that high leverage firms reduce leverage in subsequent years is consistent with the findings of Figure 2 of FR. Column 4 also shows that the change in leverage is faster for overlevered firms than for underlevered ones, consistent with the findings of Warr, Elliott, Koëter-Kant, and Öztekin (2012). The remaining columns report mean values of capital stock (K), investment (I/K), profitability (ROA), market capitalization (SIZE), and Tobin’s Q (Q) for each of the quintiles of RL. Firms with higher relative leverage tend to have larger capital stocks and lower ROA.<sup>25</sup> The relations between relative leverage and investment, market capitalization, and Tobin’s Q are non-monotonic.

[Insert Table 2 Here]

### 3.4. Evidence on Returns and Capital Structure Imbalances

In our asset pricing tests, we use monthly stock prices and returns of common shares of firms on NYSE, AMEX, Nasdaq covered by the Center of Research in Security Prices (CRSP) from 1980 to 2013.<sup>26</sup> De-listing returns are included in monthly returns. We drop observations if the trading status is reported to be halted or suspended. Following the standard procedure of Fama and French (1992), we match these monthly data to annual income statement and balance sheet data from the CRSP/COMPUSTAT merged database. More precisely, we match monthly prices and returns from July of calendar year  $t$  to June of calendar year  $t + 1$  with data from each company’s latest fiscal year ending in calendar year  $t - 1$ . We apply the same matching procedure to the rolling estimates of TL and RL described in Section 3. The matching procedure ensures a minimum gap of six months between fiscal year-ends and returns. The gap is meant to conservatively avoid look-ahead biases arising from using future accounting information to predict returns.

For the purpose of our tests, we compute the natural logarithm of market capitalization (SIZE), and the natural logarithm of BM equity. Market capitalization - defined as the product of a company’s stock price times the number of outstanding shares - is measured in June of calendar year  $t$  for the returns between July of calendar year  $t$  and June of calendar year  $t + 1$ . We measure BM equity as the ratio between a firm’s book equity and its market capitalization at the end of December of calendar year  $t - 1$ . We compute book equity as the sum of shareholders’ equity and balance

<sup>25</sup>Since RL is positively correlated with ML, this evidence is consistent with Gomes and Schmid (2010), who highlight that more levered firms are also larger and less profitable.

<sup>26</sup>As discussed in Section 3 we implement rolling estimates of  $TL_{i,t}$ . Years from 1965 to 1980 are used as “burn in” period to obtain sensible initial estimates.

sheet deferred taxes and investment tax credits if available, minus the book value of preferred stocks. Depending on  
335 data availability, we estimate the book value of preferred stocks using, in this order, their redemption, liquidation  
and par value. Since we consider the natural logarithm of BM equity in our tests, we eliminate firms with negative  
book equity from our analysis.

The six-month gap between predicting variables and returns  $R_{i,t+1}$  from June/July of year  $t$  to June/July of year  
 $t + 1$  implies that, in the model, leverage variables in year  $t$  are observed at the end of the six-month gap (June/July  
340 of year  $t$ ) and that  $R_{i,t+1}$  spans from June/July of year  $t$  to June/July of year  $t + 1$ .

### 3.5. Portfolio Sorts

In this section we perform a set of univariate portfolio sorts to examine how returns vary with both observed  
leverage and capital structure imbalances. To do so, we consider sorts across different quintiles of ML and our  
measure of capital structure imbalances RL. Table 3 reports equally-weighted excess returns in the left panel and  
345 value-weighted excess returns in the right panel. The top row of both panels reports the realized returns ( $R^e$ ) in excess  
of the risk-free rate for different portfolios sorted according to ML.<sup>27</sup> In the panel with equally-weighted returns, the  
difference between the returns in the portfolio with the highest and the lowest ML is positive and equal to 6.09%. The  
Sharpe ratio of the high-minus-low strategy is 0.46. However, returns do not increase monotonically across columns.  
As ML increases across portfolios, returns first decrease and then increase. In the panel with value-weighted returns,  
350 a similar pattern emerges. The difference between the returns of the portfolio with the highest and the lowest ML is  
positive, but returns do not increase monotonically. In this case, the Sharpe ratio of the high-minus-low strategy is  
0.10.

As for RL, across the two panels we report the portfolio sorts for RL and for equally-weighted and value-weighted  
excess returns. The difference in returns between the high and the low portfolio is positive, equal to 5.56% for value-  
355 weighted portfolios, and 8.04% for equally-weighted portfolios. The growth in returns across portfolios is perfectly  
monotonic in some cases, while in others there tends to be a mild reduction in returns in the middle portfolios. The  
high-minus-low Sharpe ratios in the left panel are roughly double those obtained for the ML portfolios. Similarly, the  
high-minus-low Sharpe ratios for the value-weighted RL portfolios are approximately three times larger than those  
obtained for the ML sorts.

[Insert Table 3 Here]

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<sup>27</sup>We obtain risk-free rate data from Kenneth French's website.

Although sorts provide an immediate measure of the trading performance of simple long-short trading strategies involving RL, they might lead to portfolios with few or even no stocks and become unfeasible when multiple variables are considered at the same time. Since, as discussed in Section 2.5, our model offers predictions on the joint behavior of RL, TL, and ML, we use the Fama and MacBeth (FMB) methodology to provide direct estimates of their marginal effects after controlling for the standard predictors of expected equity returns.

Table 4 reports time-series averages of the estimated coefficients of monthly cross-sectional regressions of stock returns on size, book-to-market (BM), ML, TL and RL. We report FMB tests with a Newey-West correction with lag-length of 2 to assess which regressors have a coefficient that is significantly different from zero. In their most comprehensive specification, the FMB regressions of Table 4 take the following form:

$$R_{i,t} = \beta_0 + \beta_1 ML_{i,t-1} + \beta_2 RL_{i,t-1} + \beta_3 TL_{i,t-1} + \beta_4 \log(Size_{i,t-1}) + \beta_5 \log(BM_{i,t-1}) + \epsilon_{i,t}, \quad (20)$$

where  $R_{i,t}$  denotes realized returns,  $Size_{i,t-1}$  market capitalization, and  $BM_{i,t-1}$  BM of equity.  $ML_{i,t-1}$ ,  $RL_{i,t-1}$  and  $TL_{i,t-1}$  are never simultaneously included in the same regression specification, but  $ML_{i,t-1}$  is included together with  $RL_{i,t-1}$  in columns (4) and (5) and together with  $TL_{i,t-1}$  in column (6) and (7) to test the empirical predictions of Section 2.5.<sup>28</sup>

The leftmost column shows that leverage has a small positive and insignificant coefficient once we control for size, and BM. This “no result” for leverage shows that the results obtained in the univariate sorts of Table 3 are not robust to the controls. These slopes can be interpreted as the average monthly return of a self-financing portfolio with unit relative leverage, that hedges the effects of the controls in the sample period. In the FMB approach, the standard error is computed as the standard deviation of monthly returns on this portfolio, divided by the square root of the number of months in the sample (408). Hence, the t-statistics for the coefficients of RL can be approximately translated into annualized Sharpe ratios of 0.6 (without controls) and 0.3 (with controls).<sup>29</sup> Across all columns, size is negatively related to returns, while B/M is positively related to returns.

It is important to remind the reader that the regressions in columns (1)-(3) are “model free”, in the sense that our empirical predictions are for regressions that contain at least two of the three leverage measures. We turn to these specifications in columns (4)-(7).

<sup>28</sup>Naturally, since  $RL_{i,t-1} = ML_{i,t-1} - TL_{i,t-1}$ , including all three variables at the same time would generate a multicollinearity problem.

<sup>29</sup>The average monthly risk-free rate in our sample is approximately 39 basis points.

### 3.6.1. Relative Leverage and Leverage

Columns (4) and (5) contain one of the main results of our analysis. Column (5) reports an FMB specification in which we include both ML and RL in addition to the controls. With respect to column (1), the coefficient of ML is now close to zero, and still not significant. Instead, the coefficient of RL is strongly significant, large, and positive.

385 The results of columns (4) and (5) are consistent with the prediction that RL is positively related to returns once we control for leverage. Instead, the relation between leverage and returns is undetermined because of contrasting effects. In the data, according to column (5), the positive effect of leverage on returns appears to dominate, although it remains not significant.

### 3.6.2. Leverage and Target Leverage

390 In columns (6) and (7) we report a set of regressions where we include ML and TL. Column (7) also includes the controls. The model predicts a negative relation between target leverage and returns, controlling for leverage. Indeed, this is what we observe in the data. The coefficient of TL is negative and statistically significant at the 1 percent level. After controlling for target leverage, observed leverage is positively and significantly related to returns. While consistent with the model predictions, the last result offers additional insights on the relative importance  
395 of the contrasting effects of leverage on returns we described in Section 2.5. In conjunction with the estimates on columns (4) and (5), the positive coefficient of leverage after controlling for TL suggests that the term  $\frac{\alpha}{2} \frac{d_1}{k}$  in (12) has an important effect on the correction factor and, eventually, on returns. Indeed, a comparison of (12) and (13) highlights that all other terms in observed leverage that enter (14) are common to the specifications with RL and ML, and with TL and ML. Controlling for the target, observed leverage drives  $\frac{\widehat{d}_1}{k-d_1}$  up through the correction factor, and  
400 increases expected returns as a consequence. Ultimately, accounting for firm heterogeneity in firms' target capital structure resurrects the traditional positive relationship between leverage and returns through an amplification effect a la MM.<sup>30</sup>

[Insert Table 4 Here]

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<sup>30</sup>From a purely empirical perspective, this result follows from the fact that (ignoring the controls and the error term), the specification

$$R_{i,t} = \beta_0 + \beta_1 ML_{i,t-1} + \beta_2 RL_{i,t-1}$$

implies that

$$R_{i,t} = \beta_0 + (\beta_1 + \beta_2) ML_{i,t-1} - \beta_2 TL_{i,t-1},$$

which is approximately what we observe in the data.

## 4. Dynamic Model

The simple illustration in Section 2 provides intuition for our key results. However, the model is too stylized to  
 405 serve as a basis for a quantitative investigation of its predictions. In this section, we embed the key economic trade-  
 offs of our simple illustration in a more general dynamic environment. In the dynamic model, we allow for ex-post  
 cross-sectional firm heterogeneity in the form of idiosyncratic productivity shocks to study the role of differences  
 in target leverage across firms. We also introduce aggregate shocks, which affect firms' profitability and discount  
 rates. Every period, firms make endogenous investment decisions. This allows for a more realistic analysis of the  
 410 relationship between firm size, capital structure imbalances, and equity returns. Firms are financially constrained  
 as external equity is costly and firms can endogenously default on their debt. Endogenous default creates a more  
 realistic dependence of firm bankruptcy on the cost of borrowing. Finally, we adopt an asymmetric flexible functional  
 form for debt adjustment costs. This allows for small adjustments to incur possibly large marginal costs while keeping  
 the model tractable.

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

$$\Pi_{i,t} = (1 - \tau)(e^{A_t} e^{Z_{i,t}} K_{i,t}^\alpha - F), \quad (21)$$

where  $\tau \in (0, 1)$  is the corporate tax rate,  $A_t$  is an exogenous aggregate shock,  $Z_{i,t}$  is a firm-specific shock,  $K_{i,t}$  is firm  
 $i$ 's capital stock,  $\alpha \in (0, 1)$  is the capital share in production, and  $F > 0$  is a fixed production cost. The variables  $A_t$   
 and  $Z_{i,t}$  can be interpreted as shocks to demand, input prices, or productivity.  $A_t$  and  $Z_{i,t}$  have bounded support  
 $\mathcal{A} = [\underline{A}, \bar{A}]$  and  $\mathcal{Z} = [\underline{Z}, \bar{Z}]$ , 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  $Q_Z(Z_{i,t}, Z_{i,t+1})$ . In our quantitative analysis, we  
 parameterize  $A_t$  and  $K_{i,t}$  to provide a discrete approximation to continuous AR(1) processes as follows:

$$\begin{aligned} \log A_t &= \mu_A(1 - \rho_A) + \rho_A \log A_{t-1} + \sigma_A \varepsilon_t^A, \\ \log Z_{i,t} &= \rho_Z \log Z_{i,t-1} + \sigma_Z \varepsilon_{i,t}^Z. \end{aligned}$$

415 As  $\varepsilon_t^A$  and  $\varepsilon_{i,t}^Z$  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.<sup>31</sup>

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

$$K_{i,t+1} = (1 - \delta)K_{i,t} + I_{i,t}, \quad (22)$$

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

<sup>31</sup>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).

*Financing.* Investment and distributions to shareholders can be financed with either the internal funds generated by operating profits or new issues. The latter which 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 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 fraction  $\xi \in (0, 1)$  of the firm  $i$ 's capital stock. Firms are allowed to refinance their debt stock by issuing a net amount  $\Delta B_{i,t} = B_{i,t+1} - (1 + c_{i,t})B_{i,t}$ .

Similar to Croce, Kung, Nguyen, and Schmid (2012) and Belo, Lin, and Yang (2014), firms incur costs  $\Lambda(\Delta B_{i,t})$  of adjusting their debt stock. In our quantitative analysis we choose a flexible parameterization for  $\Lambda(\Delta B_{i,t})$  to allow for asymmetries and possibly very large marginal costs for small adjustments. Debt adjustment costs can arise from different 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), agency costs associated with long-term debt (e.g., debt overhang and under-investment as in Myers 1977). Specifically, we choose a linear-exponential (LINEX) functional form (e.g., Varian 1975, Kim and Ruge-Murcia 2009, Aruoba, Bocola, and Schorfheide 2017), i.e.,

$$\Lambda(\Delta B_{i,t}) = \lambda_B(e^{\gamma_B \Delta B_{i,t}} - \gamma_B \Delta B_{i,t} - 1), \quad (23)$$

with  $\lambda_B \in (0, \infty)$ , and  $\gamma_B \in (-\infty, \infty)$ . In our context, the LINEX functional form is attractive for three main reasons. First, this flexible reduced-form functional form allows us to keep the model tractable without committing to a specific mechanism in our quantitative exercise. Second, as previous studies provide limited guidance on functional forms and economic magnitudes for debt adjustment costs, we can exploit data restrictions to calibrate them to realistic values in the context of our model. Third, the adjustment cost function is parsimonious. Varying only two parameters, the “scale”  $\lambda_B$ , and the “asymmetry”  $\gamma_B$ ,  $\Lambda(\Delta B_{i,t})$  spans a broad spectrum of functional forms.<sup>32</sup>

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  $\Lambda(E_{i,t})$  that include both a fixed and a proportional component, i.e.,

$$\Lambda(E_{i,t}) = (\lambda_0 + \lambda_1 E_{i,t})\chi_{E_{i,t} > 0}, \quad (24)$$

with  $\lambda_0 \in [0, \infty)$  and  $\lambda_1 \in [0, \infty)$ . 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:

$$\Pi_{i,t} + \Delta B_{i,t} + E_{i,t} + \tau \delta K_{i,t} + \tau c_{i,t} = I_{i,t} + c_{i,t} B_{i,t} + \Lambda(\Delta B_{i,t}), \quad (25)$$

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<sup>32</sup>The LINEX functional form nests the quadratic form as an approximation for  $\gamma_B \rightarrow 0$ .

where the terms  $\tau\delta K_{i,t}$  and  $\tau c_{i,t}$  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.,

$$D_{i,t} = -E_{i,t} - \Lambda(E_{i,t}). \quad (26)$$

*Valuation.* Following several studies in cross-sectional production-based asset pricing (e.g., Berk, Green, and Naik 1999, Zhang 2005, Gomes and Schmid 2010), we parameterize the stochastic discount factor of the economy without explicitly modeling the investor’s problem. As in Zhang (2005), we assume the following stochastic process for the stochastic discount factor:

$$\log M_t = \log \beta + \gamma_t (A_t - A_{t+1}), \quad (27)$$

where  $\beta \in (0, 1)$ ,  $\gamma_t = \gamma_0 + \gamma_1 (A_t - \mu_A)$ ,  $\gamma_0 \in (0, \infty)$ , and  $\gamma_1 \in (-\infty, 0)$ . This functional form naturally links to the time-varying risk aversion in Campbell and Cochrane (1999), in which  $\gamma_0$  is interpreted as a “risk aversion” parameter and  $\gamma_1$  as an “habit formation” parameter. However, as we do not model the household problem explicitly,  
435 we remain agnostic about the specific sources of time-varying risk aversion.

Define as  $V_{i,t}$  the equity value of the firm. We assume that shareholders strategically default on their debt obligations if  $V_{i,t} < 0$ . Thus, interest payments  $c_{i,t}$  are determined endogenously as follows:

$$B_{i,t+1} = E_t [M_{t+1} \{ (1 + c_{i,t+1}) B_{i,t+1} \chi_{\{V_{i,t+1} \geq 0\}} + \xi K_{i,t+1} \chi_{\{V_{i,t+1} < 0\}} \}], \quad (28)$$

where  $\xi \in [0, 1]$  is the fraction of capital the lenders recover in case of default. Equity holders choose investment  $I_{i,t}$  and debt issuance  $\Delta B_{i,t}$  to solve the following recursive problem:

$$V_{i,t} = \max_{I_{i,t}, \Delta B_{i,t}} \{0, D_{i,t} + E_t [M_{t+1} \cdot V_{i,t+1}]\}, \quad (29)$$

subject to (22), (25), and (28). In the recursive representation (29) the equity value  $V_{i,t} = V(S_{i,t})$  is a function of the state variables  $S_{i,t} = \{K_{i,t}, B_{i,t}, c_{i,t}, Z_{i,t}, A_t\}$ .

*Defining a Dynamic Target.* To define a dynamic leverage target, we follow the “gap approach”, which has been extensively used to describe costly adjustments of production factors (e.g., Sargent 1978, Caballero and Engel 1993,  
440 Cooper and Willis 2004, King and Thomas 2006, Bayer 2009). These studies consider adjustments toward a dynamic target, which is termed as the frictionless target. The latter corresponds to the level of a production factor to which an optimizing agent would eventually adjust to in the absence of changes in the stochastic variables. More formally, the frictionless target is constructed as the policy function in which adjustment costs are removed for a single period.

In our setup, the frictionless target debt stock  $B_{i,t}^* = B_{i,t} + \Delta B_{i,t}^*$  can be obtained from the following optimization problem:

$$\max_{I_{i,t}^*, \Delta B_{i,t}^*} \{0, D_{i,t}^* + E_t [M_{t+1} \cdot V_{i,t+1}^C]\}, \quad (30)$$



where  $D_{i,t}^*$  is the equity payout in which current-period debt adjustment costs are removed, i.e.,  $\Lambda(\Delta B_{i,t}) = 0$ . The continuation value  $V_{i,t+1}^C$  is computed using the value function  $V_{i,t}$  in (29), as adjustment costs are set to zero only for the current period. We then compute the target leverage ratio as  $\frac{B_{i,t}^*}{K_{i,t}^*}$ , where  $K_{i,t}^* = K_{i,t} + I_{i,t}^*$ . As in the gap approach, our dynamic target can be interpreted as the capital structure that, conditional on today's state of the world, optimally positions the firm to deal with the uncertain funding needs it may have in the future.

Three remarks are in order. First, the frictionless target encompasses the definition of target in the quadratic adjustment model of Section 2 as a special case. More generally, Adda, Cooper, and Cooper (2003) show that the approximation of the frictionless target as the fixed point where the state-dependent policy function crosses the 45-degree line is exact in the case of a linear-quadratic dynamic programming problem. Second, 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). The static and the frictionless target coincide in the illustration in Section 2. However, due to its dynamic nature, the frictionless target more closely maps onto the reduced-form empirical specifications commonly used in the empirical corporate finance literature in which the target depends on firm-level variables (e.g., Flannery and Rangan 2006, Lemmon, Roberts, and Zender 2008).<sup>33</sup> Third, the structure of our dynamic model does not mechanically impose convergence to the target. Thus, the calibrated model serves as a lab to quantify to what extent firms adjust their capital structure toward the target.

*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. 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 because of the presence of debt adjustment costs. Thus, we need to solve jointly for both equity values and interest rate schedules and keep track of the dynamics of our five state variables, including the coupon. The Appendix details our numerical solution method.

*Discussion.* We lay out a neoclassical dynamic model of investment and financing with endogenous default and a flexible functional form for debt adjustment costs. As debt adjustment costs can originate from several sources on which the literature provides limited guidance, we discipline their values by means of calibration. To study firms' adjustments toward target capital structures in a more realistic dynamic environment, we take advantage of the "gap approach" in the macroeconomic literature. The following quantitative analysis assesses the relevance of the mechanism we illustrate in Section 2, and for which we provide suggestive empirical evidence in Section 3.4, for leverage dynamics and equity returns.

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<sup>33</sup>DeAngelo, DeAngelo, and Whited (2011) consider a static long-run target to which firms would converge after receiving neutral shocks for many periods in a row.

## 5. Quantitative Analysis

### 475 5.1. Calibration and Model Fit

Table 5 summarizes our baseline calibration. The calibration frequency is monthly. Details about the computation of the model-based and data variables are provided in the Appendix. 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,  $\alpha$ , to 0.4, to roughly match the capital share from the Bureau of Economic Analysis (BEA). This value is similar, for example, 480 to the ones used by Kydland and Prescott (1982), Gomes (2001), and Gomes, Jermann, and Schmid (2016). The depreciation rate  $\delta$  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,  $\rho_A$ , 485 and its volatility,  $\sigma_A$ , 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,  $\mu_A$ , to -2.  $\mu_A$  is purely a scaling constant that determines the long-run average scale of the economy. As in Zhang (2005), we calibrate the persistence  $\rho_Z$  and volatility  $\sigma_Z$  of the idiosyncratic shock process to 0.97 and 0.1, respectively. The fixed cost of 490 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 3 parameters describe the dynamics of the pricing kernels. We choose  $\beta$ ,  $\gamma_0$ , and  $\gamma_1$  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 (as in Zhang 2005). This procedure yields  $\beta = 0.9928$ ,  $\gamma_0 = 52.71$ , and  $\gamma_1 = -50.19$ .

495 The remaining 6 parameters are on the financing side. We pick the fixed and proportional equity flotation costs,  $\lambda_0$  and  $\lambda_1$ , to be 0.5 and 0.025. As, for example, Kuehn and Schmid (2012) and Bolton, Wang, and Yang (2021), we choose  $\lambda_0$  to approximately match the frequency of equity issuance in the data. For the proportional component  $\lambda_1$ , 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 500 rate parameter  $\xi$  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  $\lambda_B$  and  $\gamma_B$  to approximately target the average debt issuance and the frequency of default in our sample, respectively. The scale parameter  $\lambda_B$  affects the marginal cost of issuing debt and, in the model, discourages the use of external debt financing. Instead, positive values of  $\gamma_B$  imply that 505 issuing debt is more costly than withdrawing debt. Thus, the lower  $\gamma_B$  (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 of 0.05 % of the total amount of debt issued, which is at the lower end of the range used by Strebulaev

(2007), who chooses values in the range of 0.05 % to 0.35 %. The average costs of withdrawing debt are instead larger, around 0.1 % of the total amount of debt withdrawn. 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  $\tau$  to be 0.20. This is as an approximation of the statutory corporate tax rate relative to personal tax rates.

[Insert Table 5 Here]

Table 6 summarizes overall model fit under the parameterization in Table 5. 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 US firms. The model matches quite closely the Sharpe ratios, the annual risk-free rate, and its volatility. The model produces a sizeable equity premium, which we do not target in the calibration. Both in the model and in the data, this moment is around 6%. The second set of moments in the table refer 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 in reproducing average leverage, an untargeted quantity. Model-implied leverage is 21%, a slight overestimation of 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 19% in the model, and 22% 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 fit seems reasonable, both for moments that serve as targets in the calibration, and for untargeted key statistics. In the following sections we use our baseline calibration as a lab to provide inference about capital structure rebalancing and equity returns.

[Insert Table 6 Here]

## 5.2. Adjustment toward Target Leverage

Table 7 describes capital structure dynamics around target leverage under the baseline calibration of Table 5. Panel A breaks down the simulated data into quintiles of RL. The top row reports the average values of RL for each quintile. As RL is defined as the difference between market and target leverage, 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. These findings, which are based on the frictionless target defined as in (30), are in line with the reduced-form evidence in Section 3.4.

Panel B reports model-implied and data estimates of adjustment speeds, both in the model and in the data. Panel B also investigates the role of firm’s size for capital structure adjustments. Data estimates are from the estimation of the model of Flannery and Rangan (2006) in (19), in which the speed of adjustment  $\lambda$  in (19) now has a fixed component and a component related to size (total assets  $AT$ ), i.e.,  $\lambda = \lambda_0 + \lambda_1 \log(AT)$ . As in the model, target leverage is observable, and model-implied estimates are from the following specification:

$$\Delta ML_{i,t+1} = \lambda_{i,t}(-RL_{i,t}) + \epsilon_{i,t+1}, \tag{31}$$

where  $\Delta ML_{i,t+1} = ML_{i,t+1} - ML_{i,t}$  and  $\lambda_{i,t} = \lambda_0 + \lambda_1 \log(K_{i,t})$ . Notice that the minus sign in front of  $RL_{i,t}$  captures the fact that adjustments toward the target imply that positive values of  $RL_{i,t}$  are associated with negative values of  $\Delta ML_{i,t+1}$ , 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. Both in the model and in the data, the adjustment speed in Panel B for the full sample (“all firms”) is computed in correspondence of average size. Adjustment speeds for large (small) firms are instead evaluated in correspondence of one standard deviation above (below) average size. The row labeled “All Firms” shows that the average adjustment speed in the model is 0.17, close to its 0.21 data counterpart. Both in the model and in the data, small firms tend to adjust faster toward target leverage. Estimated adjustment speeds in the “Small Firms” row are 0.22 (model) and 0.27 (data), versus 0.12 (model) and 0.25 (data) in the “Large Firms” row.

Taken together, the results in Table 7 suggest that firms adjust their capital structure toward a dynamic target leverage ratio, consistent with the intuition in Proposition 1. In the cross section of size, this pattern is present for both large and small firms.

[Insert Table 7 Here]

### 5.3. Returns and Capital Structure Imbalances

Table 8 reports average annualized value-weighted stock returns under the baseline parameterization of Table 5. The table shows the results of double sorts on relative leverage (rows) and on leverage (columns). Panel A tabulates returns for all firms in the simulated economy. Across all leverage portfolios, overlevered firms earn higher average returns than underlevered firms. The spreads in average returns is more pronounced for firms with high leverage. Leverage is also generally positively related to returns, with the exception of underlevered firms, for which low-leverage firms earn higher average returns than high-leverage firms.

Panels B and C, instead, report returns for large and small firms, defined as those for which  $K_{i,t}$  is, respectively, above and below its median. Average returns are positively related to relative leverage, and the spread is more pronounced for large firms, whose adjustment speeds are lower. Instead, the relationship between leverage and returns

560 appears less stable. High-leverage firms earn lower average returns than low-leverage firms among underlevered large firms. In addition, spreads in returns are economically small for all small firms, for each bin of relative leverage.

[Insert Table 8 Here]

Table 9 reports estimates of cross-sectional regressions of stock returns on relative leverage and leverage on the same simulated data. Columns (1) to (3) tabulate estimates for the full simulated sample. The results mimic the patterns in Table 8 and are broadly in line with the non-targeted empirical evidence of Section 3.4. The coefficient on relative leverage is larger in magnitude than the one on leverage. When size and book-to-market are included as controls in Column (3), the coefficient on leverage becomes negative. This confirms that the relationship between leverage and returns is ambiguous. Columns (4) to (6) and (7) to (9) refer, respectively, to firms above and below the median value of size  $K_{i,t}$ . The coefficient on relative leverage is positive for both groups of firms, but bigger for large firms. Thus, as before, capital structure imbalances appear to be more important for larger firms.

570 All in all, the results in Table 8 and Table 9 corroborate the key intuition of Proposition 2 in a more realistic environment. Capital structure imbalances are important drivers of the relationship between leverage and cross-sectional returns.

[Insert Table 9 Here]

## 6. Conclusions

In this paper we present a model in which firms maximize the value of equity by choosing an optimal amount of debt finance. There are three frictions: corporate taxes, bankruptcy costs and debt adjustment costs. We show that the optimal leverage policy for the firm requires a partial adjustment toward a target leverage. Partial adjustment occurs because there are costs in adjusting debt. We then derive the implications of this optimal policy for the relation between equity returns and leverage in the presence of capital structure imbalances. We illustrate our key ideas in a stylized setup, which provides a transparent illustration of the economic forces underlying our empirical results. In this context, we derive a formula that is similar to the celebrated equation of the second proposition of Modigliani and Miller (1958).

In the presence of the above frictions, we show that one cannot analyze the relation between leverage and returns without controlling for either target or relative leverage. We show that controlling for leverage, equity returns are increasing in relative leverage, which is defined as the difference between leverage and target leverage. Instead, controlling for relative leverage, equity returns are decreasing in target leverage. We find that the sign of the relation between returns and leverage is theoretically indeterminate (controlling for either relative or target leverage), because there are different counteracting effects at work.

In our setup, both the amount of debt and its unit cost determine the overall effect of leverage on returns. As in the second proposition of Modigliani and Miller (1958), leverage decisions affect how cash flow risk propagates to equity payouts through the amplification of both good and bad outcomes. Given leverage, capital structure imbalances influence the unit cost of debt through the non-diversifiable components of bankruptcy costs and tax shields, which are reflected in the correction factor. Overlevered firms are riskier investments than underlevered firms because they carry costly debt with high expected (non-diversifiable) bankruptcy costs. As a consequence, capital structure imbalances either boost or dampen the traditional amplification effect of Modigliani and Miller (1958).

We embed the key economic trade-offs in this simple illustration in a more general dynamic environment, in which firms make endogenous investment and default decisions. A quantitative version of our model reproduces the key facts about leverage, capital structure imbalances, and equity returns for U.S. corporations. We also provide reduced-form empirical evidence, based on standard proxies for target leverage from the corporate finance literature. Overall, our quantitative and empirical analyses corroborate the key intuition from the two-period illustration.

Our work represents a step toward a closer integration between the theory of capital structure, as developed in the field of corporate finance, and production-based asset pricing theory. Our results indicate that financial flexibility crucially affects the link between leverage and equity returns. We acknowledge two limitations of our study. First, for tractability, we are agnostic about the sources of adjustment costs in firms' capital structure. Although incorporating issues such as seniority and maturity poses conceptual and computational challenges, the literature is currently missing a quantitative analysis of the frictions that limit firms' financial flexibility. Second, although it is reassuring that model-based and reduced-form evidence agree, the mapping between target leverage in the model and its empirical estimates is not fully understood. Albeit outside of the scope of this paper, a thorough evaluation of common empirical estimates of target leverage through the lens of structural models would be informative. We leave these tasks to future research.

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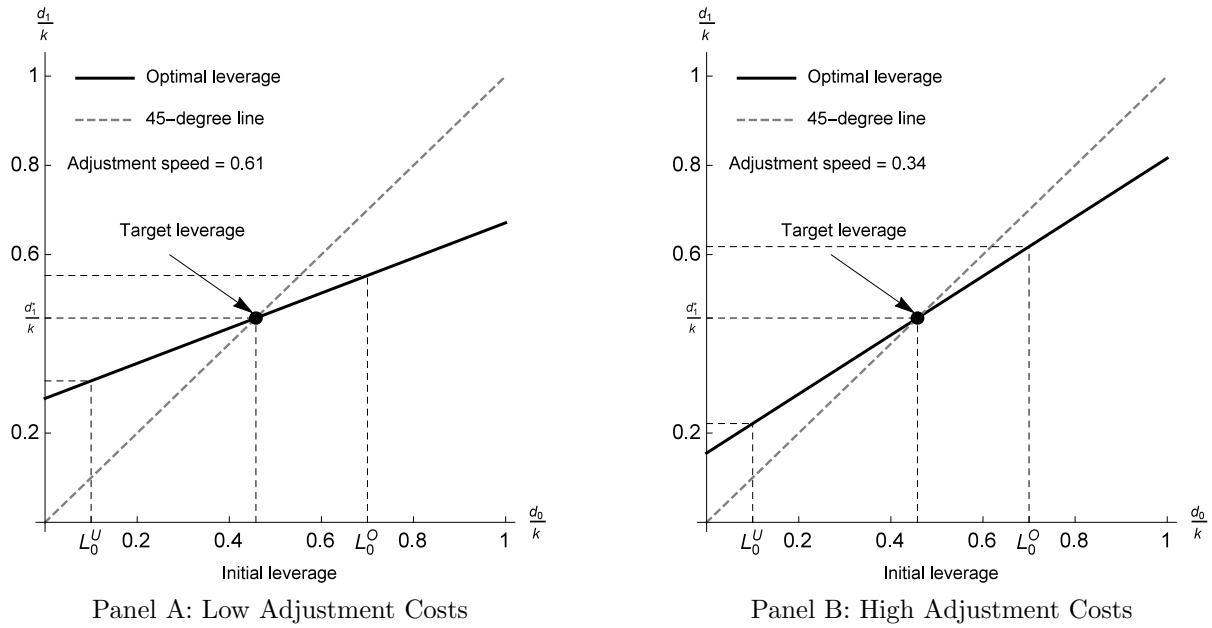
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**Figure 1**  
ADJUSTMENTS TOWARD TARGET LEVERAGE

Figure 1 depicts the optimal leverage policy of a firm for two different values of the adjustment cost parameter  $\theta$ . Panel A refers to the case of low adjustment costs ( $\theta = 0.1$ ), while Panel B refers to the case of high adjustment costs ( $\theta = 0.3$ ). Both panels report initial leverage ( $d_0/k$ ) on the horizontal axis and optimal leverage ( $d_1/k$ ) on the vertical axis. Target leverage is at the intersection of the policy function with the 45-degree line.  $L_0^U$  and  $L_0^O$  respectively denote two possible levels of initial leverage below the target and above the target. The model is solved numerically with three possible states (H, M and L) at time  $t_2$  that can occur with probability 0.3, 0.5 and 0.2 respectively. In the low state L firms are insolvent with  $\beta_2(L) = 0.5$ . In the non-default states, the tax rate is  $\tau = 0.3$ . The remaining parameters are as follows:  $M(H) = 0.8$ ,  $M(M) = 1.05$ ,  $M(L) = 1.1$ ,  $r_2^A(H) = 0.9$ ,  $r_2^A(M) = -0.1$ ,  $R_2^A(L) = -0.45205$ ,  $k = 1$ .



**Table 1**  
LEVERAGE DECOMPOSITION: DESCRIPTIVE STATISTICS

The table provides summary statistics for our four measures of target leverage and for key firm characteristics. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013. Financial firms and utilities are excluded. ML is the market debt ratio, TL is the estimated target debt ratio, RL is relative leverage, defined as the difference between ML and TL. TL is obtained from the estimation of the model of Flannery and Rangan (2006) with firm fixed effects and at least 5 observations for each firm. The estimation of TL begins in 1970 (using data since 1965) and is done on a rolling basis as described in Section 3, each year using all the accounting information available until that year. Panel A reports means, standard deviations, and autocorrelation coefficients for market leverage and for target and relative leverage. Panel B reports average market leverage, target leverage, relative leverage, capital stock (K), investment (I/K), profitability (ROA), market capitalization (SIZE), Tobin Q (Q) and the number of observations. All nominal magnitudes are deflated by the consumer price index, to express all nominal values in 2000 dollars. All variables are winsorized at the 1 percent level and are measured as described in the appendix.

Panel A: Leverage Decomposition									
	Mean			St. Dev.			AC(1)		
ML: Observed Leverage	0.16			0.17			0.87		
TL: FR with Firm FE (min 5 obs)	0.17			0.15			0.90		
RL: ML - TL	0.00			0.10			0.67		

Panel B: Firm Characteristics and Sample Selection									
	Leverage			Investment			Valuation		N
	LEV	TL	RL	K	I/K	ROA	SIZE	Q	
Full Sample	0.16			2.49	0.10	0.10	2.64	2.26	81978
TL (min 5 obs)	0.17	0.17	0.00	3.05	0.08	0.11	3.22	2.10	61683

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**Table 2**  
FIRM CHARACTERISTICS ACROSS QUINTILES OF RELATIVE LEVERAGE

The table provides summary statistics for key firm characteristics across quintiles of firms sorted by estimated relative leverage. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013. Financial firms and utilities are excluded. ML is the market debt ratio, TL is the estimated target debt ratio, RL is relative leverage, defined as the difference between ML and RL and  $\Delta ML$  is the rate of change of market leverage in the following year. Our measure of target leverage is obtained from the estimation of the model of Flannery and Rangan (2006) with firm fixed effects and at least 5 observations for each firm. The estimation of TL begins in 1970 (using data since 1965) and is done on a rolling basis as described in Section 3, each year using all the accounting information available until that year. The table reports average market leverage, target leverage, relative leverage, capital stock (K), investment (I/K), profitability (ROA), market capitalization (SIZE), Tobin Q (Q) and the number of observations. All nominal magnitudes are deflated by the consumer price index, to express all nominal values in 2000 dollars. All variables are winsorized at the 1 percent level and are measured as described in the appendix.

RL - FR with Firm FE (min 5 obs)									
Group of RL	Leverage				Investment			Valuation	
	ML	TL	RL	$\Delta ML$	K	I/K	ROA	SIZE	Q
Low	0.11	0.24	-0.13	0.04	1.84	0.10	0.14	2.26	2.17
2	0.12	0.16	-0.04	0.00	1.97	0.09	0.13	2.37	2.37
3	0.12	0.12	0.00	-0.02	2.02	0.08	0.11	2.10	2.34
4	0.17	0.13	0.04	-0.08	3.36	0.07	0.10	2.40	2.07
High	0.31	0.18	0.13	-0.13	6.05	0.08	0.09	2.33	1.51

**Table 3**  
UNIVARIATE PORTFOLIO SORTS

In the table stocks are sorted every June in deciles based on their values of market leverage (ML) and relative leverage (RL). RL is obtained from the estimation of TL from the model of Flannery and Rangan (2006) with firm fixed effects and at least 5 observations for each firm. The estimation of TL begins in 1970 (using data since 1965) and is done on a rolling basis as described in Section 3, each year using all the accounting information available until that year. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013 and covered by the Center of Research in Security Prices (CRSP). Financial firms and utilities are excluded. The breakpoints for portfolio sorts are computed on the subset of firms traded on the NYSE market. The table reports returns in excess of the risk-free rate, t-statistics and Sharpe ratios for the bottom decile (L), the top decile (H) and for the third, fifth and seventh decile. We also report the difference for the excess returns, the t-statistics and the Sharpe ratio between the top decile and the bottom decile (H-L). The left panel reports equally-weighted returns, while the right panel reports value-weighted returns. The sorting variables are matched to monthly returns as described in Section 4.

Sorting Variable	Excess Returns											
	Equally-Weighted					Value-Weighted						
	H-L	L	3	5	7	H	H-L	L	3	5	7	H
ML	$R^e$	15.20	14.55	14.60	15.85	21.29	1.73	7.80	9.07	7.56	11.33	9.53
	[t]	3.41	3.65	3.92	4.09	4.10	0.51	1.99	3.11	2.84	3.76	2.30
	SR	0.46	0.73	0.77	0.82	0.91	0.10	0.35	0.54	0.49	0.67	0.44
RL	$R^e$	12.29	15.02	15.44	15.45	20.33	5.56	5.06	8.98	9.62	9.30	10.62
	[t]	3.05	3.90	4.16	4.10	4.35	1.97	1.28	2.73	3.40	3.30	3.22
	SR	0.86	0.76	0.82	0.82	0.94	0.35	0.24	0.50	0.60	0.58	0.57

**Table 4**  
LEVERED RETURNS: RELATIVE, OBSERVED AND TARGET LEVERAGE

For each month between July 1980 and December 2013, we estimate cross-sectional regressions of stock returns on relative leverage (RL), market leverage (ML), target leverage (TL), market capitalization (SIZE), and book-to-market equity (B/M). TL is obtained from the estimation of the model of Flannery and Rangan (2006) with firm fixed effects and at least 5 observations for each firm. The estimation of TL begins in 1970 (using data since 1965) and is done on a rolling basis as described in Section 3, each year using all the accounting information available until that year. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013 and covered by the Center of Research in Security Prices (CRSP). Financial firms and utilities are excluded. De-listing returns are included in monthly returns. The table reports Fama-MacBeth coefficient estimates. t-statistics are in parentheses.  $R^2$  and N denote the cross-sectional R-squared and the number of observations respectively. The independent variables are matched to monthly returns as described in Section 3. All variables are described in the appendix. The symbols (\*\*\*), (\*\*) and (\*) denote statistical significance at the 1, 5 and 10 percent levels respectively.

	Observed vs Relative vs Target Leverage						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ML	0.14 (0.47)			0.61* (1.84)	0.05 (0.19)	1.77*** (4.38)	0.92*** (2.82)
RL		1.69*** (4.53)	1.16*** (3.57)	0.91*** (3.14)	0.86*** (2.99)		
TL						-1.16*** (-3.57)	-0.87*** (-2.99)
SIZE	-0.24*** (-5.28)		-0.20*** (-4.84)		-0.20*** (-4.93)		-0.20*** (-4.93)
B/M	0.17** (2.46)		0.14* (1.96)		0.14** (2.06)		0.14** (2.06)
$R^2$	0.02	0.01	0.02	0.01	0.02	0.01	0.02
N	931438	748724	727164	748724	727164	748724	727164



**Table 5**  
PARAMETER VALUES

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

Category	Description	Symbol	Value
Technology	Capital share	$\alpha$	0.4
	Depreciation	$\delta$	0.01
	Persistence of aggregate shock	$\rho_A$	$0.95^{\frac{1}{3}}$
	Standard deviation of aggregate shock	$\sigma_A$	0.007/3
	Mean of aggregate shock	$\mu_A$	-2
	Persistence of idiosyncratic shock	$\rho_z$	0.97
	Standard deviation of idiosyncratic shock	$\sigma_z$	.1
	Mean of idiosyncratic shock	$\mu_z$	0
	Fixed cost of operations	$F$	0.18
Pricing Kernel	Time discount	$\beta$	0.9928
	Constant “risk aversion”	$\gamma_0$	52.71
	Time varying “risk aversion”	$\gamma_1$	-50.19
Financing	Fixed equity flotation cost	$\lambda_0$	0.5
	Proportional equity flotation cost	$\lambda_1$	0.025
	Debt recovery in bankruptcy	$\xi$	0.125
	Debt adjustment cost (“scale”)	$\lambda_B$	.4
	Debt adjustment cost (“asymmetry”)	$\gamma_B$	-0.2
	Corporate tax rate	$\tau$	0.2

**Table 6**  
MOMENTS

The table reports model-implied and data moments for the baseline calibration of Table 5. The model-implied moments are calculated as averages of simulations of 10,000 firms and 2000 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 the Appendix.

	Model	Data
Average Sharpe Ratio	0.43	0.43
Average risk-free rate	0.02	0.02
Volatility of risk-free rate	0.04	0.03
Average equity premium	0.06	0.06
Average profitability	0.16	0.15
Volatility of profitability	0.07	0.09
Autocorrelation of profitability	0.61	0.75
Average investment	0.16	0.14
Average leverage	0.21	0.16
Frequency of default	0.03	0.02
Average book-to-market ratio	0.48	0.57
Average debt issuance	0.19	0.22
Frequency of positive debt adjustments	0.62	0.59
Frequency of negative debt adjustments	0.38	0.41
Frequency of equity issuance	0.05	0.04

**Table 7**  
ADJUSTMENTS TOWARD TARGET LEVERAGE - MODEL

Panel A describes firms' capital structure adjustments toward target leverage under the baseline calibration of Table 5. RL denotes relative leverage (defined as the difference between market and target leverage) 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, for small firms and for large firms. Data figures are obtained with the measure of target leverage obtained from the estimation of the model of Flannery and Rangan (2006) in Equation 19, with firm fixed effects and at least 5 observations for each firm. The speed of adjustment  $\lambda$  in (19) has a fixed component and a component related to size (total assets AT), i.e.,  $\lambda = \lambda_0 + \lambda_1 \log(AT)$ . Model-implied figures are based on a regression of leverage adjustments on RL,  $K_{i,t}$ , and their interaction, as described in Equation 31. Both in the model and in the data, adjustment speeds for all firms are computed in correspondence of average size. Adjustment speeds for large (small) firms are computed in correspondence of one standard deviation above (below) average size. All model-implied quantities are based on simulations of 10,000 firms and 2000 time periods.

Panel A: Leverage Adjustments					
	Group of RL				
	Low	2	3	4	High
RL	-0.029	-0.002	0.000	0.015	0.065
Adjustment	0.023	0.002	0.001	-0.008	-0.019

Panel B: Adjustment Speeds		
	Model	Data
All Firms	0.17	0.21
Small Firms	0.22	0.27
Large Firms	0.12	0.15

**Table 8**  
AVERAGE RETURNS AND CAPITAL STRUCTURE IMBALANCES

The table reports average annualized value-weighted returns of portfolios sorted by terciles of relative leverage (defined as the difference between market and target leverage) and then by terciles of leverage. All figures are based on simulations of 10,000 firms and 2000 time periods under the baseline calibration of Table 5. Panel A refers to the entire simulated economy. Panels B and C refer, respectively, to firms above and below the median value of size  $K_{i,t}$ . The cells labeled “OL minus UL” report the difference between the average return of the highest- and the lowest-tercile portfolio of stocks sorted by relative leverage, for each leverage group. The cells labeled “High minus Low” report the difference between the average return of the highest- and the lowest-tercile portfolio of stocks sorted by leverage, for each relative leverage group.

Panel A: All Firms				
Relative Leverage	Leverage			High minus Low
	Low	2	High	
Underlevered (UL)	7.21	6.86	7.06	-0.15
2	7.45	6.72	8.18	0.73
Overlevered (OL)	7.48	7.53	14.89	7.41
OL minus UL	0.27	0.67	7.83	

Panel B: Large Firms				
Relative Leverage	Leverage			High minus Low
	Low	2	High	
Underlevered (UL)	8.18	7.66	5.67	-2.51
2	8.26	8.39	9.35	1.09
Overlevered (OL)	9.38	10.31	20.80	11.42
OL minus UL	1.20	2.65	15.13	

Panel C: Small Firms				
Relative Leverage	Leverage			High minus Low
	Low	2	High	
Underlevered (UL)	7.09	6.36	6.28	-0.81
2	6.90	6.89	6.94	0.04
Overlevered (OL)	7.57	7.52	7.86	0.29
OL minus UL	0.48	1.16	1.58	

**Table 9**  
 AVERAGE RETURNS AND CAPITAL STRUCTURE IMBALANCES: REGRESSIONS

The table reports estimated coefficients from cross-sectional regressions of stock returns on relative leverage, market leverage, target leverage, market capitalization, and book-to-market equity. All figures are based on simulations of 10,000 firms and 2000 time periods under the baseline calibration of Table 5. Columns (1) to (3) refer to the entire simulated economy, columns (4) to (6) and (7) to (9) refer, respectively, to firms above and below the median value of size  $K_{i,t}$ .

	All Firms			Large Firms			Small Firms		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Relative Leverage	0.58	0.70	0.71	1.12	1.06	1.45	0.37	0.36	0.46
Leverage		0.13	0.11		-0.45	-0.66		0.18	0.13
Size			-0.03			0.00			-0.05
Book-to-Market			0.02			-0.10			0.01

## Appendix

### Proofs of Propositions

**Proposition 1.** The FOC for the firm is:

$$1 - \frac{\partial \Theta(d_0, d_1)}{\partial d_1} = \frac{\partial \{E[M((1 + r_2^D(d_1)(1 - \tau_2))d_1 + \beta_2(d_1)d_1)]\}}{\partial d_1}. \quad (32)$$

From the no arbitrage condition in the debt market, we have that  $E[M(1 + r_2^D(d_1))] = 1$ . Observe that upon bankruptcy occurring  $\beta_2(d_1) = \beta d_1$ . Then, the following holds

$$\int_{\frac{r_2^A}{r_2^A}}^{\infty} \int_{\frac{r_2^A}{r_2^A}}^{\infty} M(1 + \rho_2^D(d_1)) f(r_2^A | r_1^A) dr_2^A dM + \int_{-\infty}^{\frac{r_2^A}{r_2^A}} M \frac{(1 + r_2^A)k - \beta_2(d_1)d_1}{d_1} f(r_2^A | r_1^A) dr_2^A dM = 1,$$

that is

$$(1 + \rho_2^D(d_1)) \frac{1 - q_D}{1 + r_F} + \frac{E[M(1 + r_2^A) | r_2^A < \overline{r_2^A}]k}{d_1} - \beta d_1 \frac{q_D}{1 + r_F} = 1.$$

Solving for the coupon rate yields

$$\rho_2^D(d_1) = \beta d_1 \frac{q_D}{1 - q_D} - \frac{E[M(1 + r_2^A) | r_2^A < \overline{r_2^A}]k}{d_1} \frac{1 + r_F}{1 - q_D} + \frac{r_F + q_D}{1 - q_D}. \quad (33)$$

Observe that taxes are only paid when there is no default. Thus, the tax shield is

$$\tau_2 r_2^D(d_1) d_1 = \begin{cases} \tau \rho_2^D(d_1) d_1 & \text{if no default occurs,} \\ 0 & \text{if default occurs.} \end{cases}$$

Observing that

$$\frac{\partial (\rho_2^D(d_1) d_1)}{\partial d_1} = \frac{r_F + q_D + 2\beta d_1 q_D}{1 - q_D}$$

one obtains

$$\tau_2 \frac{\partial (r_2^D(d_1) d_1)}{\partial d_1} = \begin{cases} \tau \left( \frac{r_F + q_D + 2\beta d_1 q_D}{1 - q_D} \right) & \text{if no default occurs} \\ 0 & \text{if default occurs.} \end{cases}$$

Substituting in equation (4) yields

$$d_1 - d_0 = E \left[ M \tau \left( \frac{r_F + q_D + 2\beta d_1 q_D}{1 - q_D} \right) | r_2^A \geq \overline{r_2^A} \right] - E \left[ M (2d_1 \beta) | r_2^A < \overline{r_2^A} \right],$$

which simplifies to

$$\theta (d_1 - d_0) = \tau \left( \frac{r_F + q_D + 2\beta d_1 q_D}{1 - q_D} \right) \frac{1 - q_D}{1 + r_F} - 2d_1 \beta \frac{q_D}{1 + r_F}.$$

Collecting all terms with  $\frac{d_1}{k}$  on the left-hand side and all the rest on the right-hand side one obtains

$$\left( \theta k - 2\beta k \tau \frac{q_D}{1 + r_F} + 2\beta k \frac{q_D}{1 + r_F} \right) \frac{d_1}{k} = \tau \frac{r_F + q_D}{1 + r_F} + \theta d_0,$$

which, after dividing by the coefficient of  $\frac{d_1}{k}$  on the left hand side and subtracting  $\frac{d_0}{k}$  from both sides can be rearranged as

$$\frac{d_1}{k} - \frac{d_0}{k} = \frac{2\beta(1 - \tau) \frac{q_D}{1 + r_F}}{\theta + 2\beta(1 - \tau) \frac{q_D}{1 + r_F}} \left( \frac{\tau \frac{r_F + q_D}{1 + r_F}}{2\beta(1 - \tau) k \frac{q_D}{1 + r_F}} - \frac{d_0}{k} \right).$$

Using the definitions of target leverage and adjustment speed given in the proposition gives the result.

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**Proposition 2.** Observe that

$$\frac{\partial \Theta(d_0, d_1)}{\partial d_1} = \theta(d_1 - d_0) = \theta k \left( -\frac{\lambda_1}{1 - \lambda_1} RL_1 \right).$$

where the first equality follows from the derivative of the adjustment cost, and the second equality follows from equation (7). Then, equation (4) can be written as

$$k\theta \left( -\frac{\lambda_1}{1 - \lambda_1} RL_1 \right) = E \left[ M\tau_2 \frac{\partial (r_2^D(d_1)d_1)}{\partial d_1} \right] - E \left[ M \frac{\partial (\beta_2(d_1)d_1)}{\partial d_1} \right]. \quad (34)$$

From the definition of  $\lambda_1$  one obtains

$$\frac{\lambda_1}{1 - \lambda_1} = \frac{2\beta(1 - \tau) \frac{q_D}{1 + r_F}}{\theta}. \quad (35)$$

Combining (34) with (35), simplifying the left-hand side of (34), and expanding the derivatives on its right-hand side, we obtain

$$-2\beta(1 - \tau)k \frac{q_D}{1 + r_F} RL_1 = E [M\tau_2 r_2^D(d_1)] - E [M\beta_2 d_1] + E \left[ M\tau_2 \frac{\partial r_2^D(d_1)}{\partial d_1} d_1 \right] - E [M\beta_2 d_1],$$

or, equivalently,

$$E [M\tau_2 r_2^D(d_1)] - E [M\beta_2 d_1] = -\alpha RL_1 - \tau \left( \beta \frac{q_D d_1}{1 - q_D} + \frac{\delta_D k}{d_1} \frac{1 + r_F}{1 - q_D} \right) + E [M\beta_2 d_1]. \quad (36)$$

Inserting (36) into the definition of the correction factor (10) and observing that  $E [M\beta_2] d_1 = \beta \frac{q_D}{1 + r_F} d_1$  we obtain

$$\gamma(d_1) = 1 + \alpha RL_1 + \tau \left( \beta \frac{q_D d_1}{1 - q_D} + \frac{\delta_D k}{d_1} \frac{1 + r_F}{1 - q_D} \right) - \beta \frac{q_D}{1 + r_F} d_1.$$

Therefore, the correction factor can be written as

$$\begin{aligned} \gamma(d_1) &= 1 + \alpha RL_1 - \frac{\alpha}{2} \frac{d_1}{k} + \frac{\tau \delta_D}{\frac{d_1}{k}} \\ &= 1 + \frac{\alpha}{2} \frac{d_1}{k} - \alpha \frac{d_1^*}{k} + \frac{\tau \delta_D}{\frac{d_1}{k}}. \end{aligned}$$

The proposition follows immediately.

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

Variable	Construction
Value of Preferred Stocks ( $PS$ )	If available, in this order: $PSTKR$ , $PSTKL$ , $PSTK$ .
Book Equity ( $BE$ )	$CEQ + TXDITC$ (if available) $- PS$
Market Leverage ( $ML$ )	$\frac{DLTT+DLC}{AT-BE+PRCC \cdot F \cdot CSHO}$
Market Leverage Growth ( $\Delta ML$ )	$\frac{F \cdot ML - ML}{0.5(F \cdot ML + ML)}$
Real Assets ( $K$ )	$\frac{AT \cdot CPI_{2000}}{1000}$
Investment/Capital Ratio ( $I/K$ )	$\frac{AT-L \cdot AT}{0.5(AT+L \cdot AT)}$
Return on Assets ( $ROA$ )	$\frac{OIBDP}{AT}$
Tobin's Q ( $Q$ )	$\frac{PRCC \cdot F \cdot CSHO + DLTT + DLC}{BE + DLTT + DLC}$
Market Capitalization ( $SIZE$ )	$\log \frac{ PRC  \cdot SHROUT}{1000}$ (in June)
Book-to-Market Equity ( $B/M$ )	$\log \frac{BE}{ PRC  \cdot SHROUT / 1000}$

In the model, following Zhang (2005), we define the average Sharpe Ratio as  $S_t \equiv \frac{\sigma_t[M_{t+1}]}{E_t[M_{t+1}]}$  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  $R_{i,t} \equiv \frac{V_{i,t}}{V_{i,t-1} - D_{i,t-1}}$ . 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  $K_{i,t}$ .

### Numerical Solution Method

We solve the model using a combination of value function iteration (VFI) and simulation.

Each firm  $i$ 's problem is characterized by five state variables, i.e.  $x_{i,t} \equiv (K_{i,t}, B_{i,t}, c_{i,t}, z_{i,t}, A_t)$ . We approximate the value function  $V(x_{i,t})$  with piece-wise linear interpolation on a grid  $7 \times 7 \times 5 \times 5 \times 3$ , respectively. Note that the projection of  $V(x_{i,t})$  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  $x_{i,t}$ , 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  $\mathcal{I}(x_t)$ . Choices  $K_{i,t+1}$  and  $B_{i,t+1}$  are evaluated on a grid  $30 \times 30$ , 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  $7 \times 7 \times 5 \times 5 \times 3 \times 30 \times 30$  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  $\{K(x_{i,t}), B(x_{i,t}), c(x_{i,t}), \mathcal{I}(x_{i,t})\}$  to perform a long simulation of our economy ( $T = 2000$ ) with a panel of  $i = 1, \dots, 10000$  firms, given random draws of idiosyncratic shocks  $\{\{z_{i,t}\}_{t=0}^T\}_{i=1}^{10000}$  and aggregate shocks  $\{a_t\}_{t=0}^T$ .



## Online Appendix (Not for Publication)

### OA1. Two-Period Example: Additional Content

#### 790 Notable Special Cases: Sticky Leverage and Modigliani-Miller

Equation (9) nests a notable special case. Absent taxes and bankruptcy costs, the first-order condition in (32) simplifies to

$$1 - \frac{\partial \Theta \left( \frac{d_0}{k}, \frac{d_1}{k} \right)}{\partial d_1} = \frac{\partial \{ E[M(1 + r_2^D(d_1))]d_1 \}}{\partial d_1}. \quad (\text{OA1})$$

If debt is fairly priced, the right hand side of (OA1) is equal to one. Therefore, to maximize firm value the firm should not change its level of debt and set  $d_1 = d_0$ . With this policy the firm does not bear any costs of adjustment and the first derivative of the adjustment cost function is zero. In this case  $\gamma(d_1) = 1$  and equation (9) collapses to the celebrated second proposition of MM, that is

$$R_2^E = R_2^A + \frac{d_1}{k - d_1} (R_2^A - R_2^D). \quad (\text{OA2})$$

Equation (OA2) should not be read to mean that firms can costlessly change capital structure and returns (as instead is the case in MM). Instead, the meaning of equation (OA2) is that if there is cross-sectional heterogeneity in  $k$  and  $d_0$  across firms, firms with higher leverage will earn higher returns. Firms are “stuck” at their level of leverage and returns. A simple subcase of this special case is when there are no adjustment costs, in addition to the exclusion of  
795 taxes and bankruptcy costs. Equation (OA1) holds trivially and equation (OA2) also holds. We have the original setup of MM, where capital structure is irrelevant and firms are indifferent in their choice of  $d_1$ .

### Geometric Interpretation

Figure OA1 provides a representation of the trade-offs in our model and offers a geometric interpretation of the correction factor. To start with, it is useful to reinterpret target leverage as the leverage ratio  $\frac{d}{k}$  that equalizes the net  
800 marginal bankruptcy cost of leverage  $\alpha \frac{d}{k}$  and the net marginal tax shield of leverage  $\frac{\tau(r_F + qD)}{1 + r_F}$ .<sup>34</sup> In Panel A, which refers to the case of an overlevered firm, the net marginal cost of debt  $\alpha \frac{d}{k}$  is represented by the straight line through  $A$  and  $C$ . The straight line through  $B$  and  $C$  represents the present value of the marginal tax shield  $\frac{\tau(r_F + qD)}{1 + r_F}$ . The two lines intersect at point  $C$ , in correspondence of target leverage  $\frac{d_1^*}{k}$ .

Consider now the representations of the correction factor  $\gamma \left( \frac{d_1^*}{k}, \frac{d_1}{k} \right)$  in (12), as a function of target leverage and  
805 leverage, and  $\gamma \left( RL_1, \frac{d_1}{k} \right)$  in (13), as a function of relative leverage and leverage. In (12) and (13), the first term (“1”) is the present value of one dollar of debt in the absence of frictions.

The second and third term in both (12) and (13) illustrate the economic tradeoffs at work and their effect on the correction factor. Notice that their sum  $\frac{\alpha}{2} \frac{d_1}{k} - \alpha \frac{d_1^*}{k}$  in (12) and  $-\frac{\alpha}{2} \frac{d_1}{k} + \alpha RL_1$  in (13) can both be decomposed as  $-\frac{\alpha}{2} \frac{d_1^*}{k} + \frac{\alpha}{2} RL_1$  by simply exploiting the definition of relative leverage in (6). With reference to Figure OA1 Panel A,  
810 the term  $\frac{\alpha}{2} \frac{d_1^*}{k}$  is equal to the area of the triangle  $ABC$  divided by its base  $\frac{d_1^*}{k}$ , and accordingly captures the average net surplus from debt that the firm receives when its leverage is equal to target leverage. The surplus arises from the fact that the marginal tax shield is always greater than the marginal bankruptcy cost up to the target. This term enters the definition of  $\gamma(\cdot)$  with a negative sign, because it decreases the effective cost of debt for the firm. The term  $\frac{\alpha}{2} RL_1$  is equal to the area of the triangle  $CDE$  divided by the length of its base,  $RL_1$ . The term with relative

<sup>34</sup>To see this, notice that the first-order condition (4) can be simplified using the definition of  $\alpha$  in Proposition 2, and target leverage  $\frac{d_1^*}{k}$  can be obtained as the solution of  $\alpha \frac{d_1^*}{k} = \frac{\tau(r_F + qD)}{1 + r_F}$ . Target leverage is the leverage ratio that firms would choose in the absence of adjustment frictions, in correspondence of which the present value of the marginal tax shield  $\frac{\tau(r_F + qD)}{1 + r_F}$  is equal to the present value of the net marginal bankruptcy cost  $\alpha = 2\beta(1 - \tau)k \frac{qD}{1 + r_F}$ .

815 leverage captures the average lost surplus at the optimum, which is different from the target. This term carries a positive sign in  $\gamma(\cdot)$ , because if the optimum is different from the target, the firm is not internalizing all the surplus from its debt and some potential surplus is lost. All else equal, the lost surplus increases the effective cost of debt. The difference between the areas  $ABC$  and  $CDE$  (or equivalently  $CD'E'$ ) is therefore the net benefit to leverage, depicted as the trapezoid  $ABE'D'$  in Panel A. If the firm is sufficiently overlevered, the area of  $CDE$  becomes larger  
820 than that of  $ABC$ , resulting in a correction factor that is greater than one. In this case there is a net loss to carrying so much debt, because the average tax shield is smaller than the average net bankruptcy cost.

Finally, the term  $\tau \frac{\delta D k}{d_1}$  in (12) and (13) is the product of the tax rate times the recovery rate per unit of debt in case of bankruptcy.<sup>35</sup> All else equal, the recovery rate of debt in bankruptcy states lowers the coupon that lenders would otherwise require, and reduces the interest expense and the tax shield in solvency states. This term carries a  
825 positive sign, because it captures a loss of tax shields and thus, all else equal, a higher cost of debt.

Panel B of Figure OA1 instead refers to the case of an underlevered firm with the same target leverage of the firm in Panel A. Following the same logic, the triangle  $ABC$  represents the total surplus that the firm gets from debt when leverage is set equal to the target, and the triangle  $CDE$  represents the surplus that the firm loses by choosing an optimum leverage that is below target leverage. For an underlevered firm, the correction factor is smaller than  
830 one, because the firm always internalizes a net benefit to leverage, which lowers its effective average cost of debt.

### *Cost of Debt and Leverage*

The realized return on debt in a given state is  $\rho_{i,2}^D(d_{i,1})$  in case of solvency, and the recovery rate in case of default. By the expression of the coupon in (33) it is immediate to conclude that the return on debt is decreasing with leverage in default states, and increasing in leverage in solvency states. Intuitively, the lender requires a nominal  
835 interest rate on the loan such that it is fairly priced, that is  $E[M(1+r_2^D(d_1))] = 1$ . The latter no arbitrage condition implies that lenders require higher coupons to offset lower recovery rates. Following standard arguments (see, for example, Cochrane (2001), Chapter 1), the no-arbitrage condition implies that expected return on debt is given by the following expression:

$$E[r_2^D(d_1)] - r_F = -(1+r_F)Cov(M, r_2^D(d_1)),$$

840 which emphasizes that, in the presence of risk-averse investors, the expected return on debt increases with leverage if bankruptcy occurs in bad times, in which  $M$  takes higher values. In other words, low recovery rates occur in more valuable states, and must be offset by disproportionately higher coupons in solvency states to preserve no arbitrage in the market. Accordingly, higher leverage drives the expected return on debt up, as common intuition suggests.

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<sup>35</sup>This term and the term (“1”) are not depicted in Figure OA1 because they do not capture marginal effects.

## OA2. Empirical Evidence: Robustness Checks

### Alternative Measures of Target Leverage

845 We implement three additional estimations of the target leverage ratio. The first, which we denote as TL2, is still based on the partial adjustment model of Flannery and Rangan (2006) (FR) with firm fixed effects. The second and third alternative measures of target leverage, TL3 and TL4, are non-parametric. We, respectively, construct them using the rolling median leverage at the firm level and at the industry level. More precisely:

**TL2: Flannery-Rangan with convergence in firm fixed effects.** As for TL1, we run a regression specification as in equation (19) that contains fixed effects for each individual firm. Differently from TL1, we guarantee reliable estimates of the fixed effects by excluding firms for which the estimate of the fixed effects does not converge to a stable value. More specifically, stability of the estimate for firm  $i$  in year  $t$  is achieved if and only if there exists a period  $t^*$  such that the fixed effect estimate  $F_{i,t^*}$  can be computed and satisfies<sup>36</sup>

$$|F_{i,t^*} - F_{i,t^*-1}| < 0.05 \text{ and } |F_{i,t^*} - F_{i,t^*-2}| < 0.05.$$

850 Once the stability criterion is satisfied for firm  $i$ , the fixed effect estimate  $F_{i,t^*}$  at  $t^*$  is used to compute target leverage  $TL_{i,t}$  for every year following  $t^*$  and for which equation (19) produces a valid estimate of target leverage for firm  $i$ .<sup>37</sup>

**TL3: Firm median leverage with at least five observations.** The third measure of target leverage is computed as the rolling median at the firm level for all firms in the sample with at least five observations.

**TL4: 4-digit SIC code industry median leverage.** The fourth measure of target leverage is computed as the four-digit SIC rolling median ML. In this case there is no requirement on the minimum number of observations.

855 A possible concern with the measures of target leverage based on FR is that target and consequently relative leverage are potentially functions of previously identified determinants of equity returns (indeed some of these variables like profitability, size and market-to-book are related to well known asset pricing anomalies). This may make it difficult to interpret our results in the empirical section. To address this concern, TL3 and TL4 are based on a non-parametric approach.

860 Table OA1 shows that descriptive statistics are consistent across our baseline measure of target TL, TL2, and TL3 (0.16-0.17). TL4 yields a lower predicted target (0.13). The TL, TL2, and TL3 have a mean that is close to zero, while RL4 has a slightly larger mean (0.03), which reflects the difference in average between TL4 and ML.

865 Also, consistency in results across measures is reassuring, because it indicates that our estimates of TL are not very sensitive to the exact specification of the leverage measure.<sup>38</sup> TL4 is the least stringent measure in terms of data requirements. Accordingly, the sample for which TL4 can be measured is the one that is most similar to the Compustat universe.

870 Panels A, B and C of Table OA2 broadly confirm the patterns observed in Table 2, thus providing a robustness check. Similarly, Table OA3 and Table OA4 are replicas of Table 3 and Table 4, respectively. Overall, the results in Table OA3 and Table OA4 indicate that the relationship between returns and capital structure imbalances is robust to different empirical proxies for target leverage.

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<sup>36</sup>We require that there are no gaps in the firm  $i$ 's time series of  $F_{i,s}$ , for  $t^* < s < t$ .

<sup>37</sup>Occasionally, due to missing data for one or more regressors in  $X_{i,t-1}$ , it is not possible to estimate  $MDR_{i,t}^*$  for all years following  $t^*$ . When this occurs, we temporarily remove the firm from the analysis, and start checking again the stability criterion.

<sup>38</sup>In unreported results we find that the average of individual firm-level correlations is high (about 0.87) between TL-TL2 and TL3, and much lower for TL4 (about 0.54). TL and TL2 have a correlation of 1, which stems from the fact that both are estimated with FR. More precisely, TL is estimated only if there are 5 observations, and TL2 is estimated only if stability is achieved. If both measures can be estimated, they yield the same value. This does not mean that having two measures is redundant, because the number of observations in the sample is different across measures.

## Book and Net Leverage

Different strands of the literature highlight the importance of distinguishing between leverage measured at market or at book values, and the importance of accounting for cash holdings in the balance sheet.<sup>39</sup> Bates, Kahle, and Stulz (2009) show that firms in the lower quintiles of size consistently have larger cash-to-assets ratios. Therefore, when leverage is measured net of cash (both for book and market leverage) smaller firms will appear to have less leverage. Additionally, book leverage tends to differ significantly from market leverage for firms with high market-to-book ratios. Therefore, it is possible that by adjusting for cash and by using book values, the distribution of relative leverage changes unevenly in a way that correlates with size and market-to-book ratios. We define *book leverage ratio* as

$$BL_{i,t} = \frac{D_{i,t}}{D_{i,t} + BE_{i,t}}, \quad (\text{OA3})$$

where  $BE_{i,t}$  is the book value of equity of firm  $i$  in period  $t$ .

In this spirit, Table OA5 replicates the analysis of Tables 4 and OA4 by looking at market leverage measured net of cash and at book leverage, both gross and net of cash. More precisely, for both debt at market and at book values, we subtract cash and marketable securities (CHE) from total debt. TL and RL are also re-estimated accordingly. Table OA5 reports the coefficients of leverage and relative leverage obtained from a set of FMB regressions that include Size, BM (unreported due to space considerations). Across the three panels, the coefficient of leverage is volatile, taking both positive and negative signs, and is generally insignificant. Instead, relative leverage is positive and significant in all (but one) specification. Similarly, when target leverage is included along with leverage, the results are in line with those in Table 4.

From this analysis, we conclude that the measure of leverage that one chooses to employ does not have a first-order impact on the results. This is an important robustness check, because the previous literature has found contrasting results on the relation between leverage and returns, depending on the measure of leverage adopted. Our results suggest that the instability in the results is not driven by the measure of leverage, but by the fact that the relation between leverage and returns is a priori unclear, as discussed in the model section.

## Additional Controls

As a robustness check, we also include post-ranking CAPM betas ( $\beta$ ), momentum, profitability, and investment in our tests. Post-ranking betas are computed following the procedure in Fama and French (1992). We measure momentum as the continuously compounded return from month  $m - 12$  to month  $m - 2$ . Consistent with Novy-Marx (2013) and Hou, Xue, and Zhang (2014) we measure investment (INV) as the growth rate of total assets (AT) and profitability (PROF) as the differences between operating revenues (REVT) and the cost of goods sold (COGS), divided by total assets (AT). Including investment and profitability as controls helps alleviate concerns that the effect of capital structure imbalances on returns is driven by omitted variables that affect cross-sectional differences in  $E[R_2^A]$  and that are not already captured by the control variables in the baseline specification (20).

Table OA6 shows that relative leverage remains largely unaffected by the introduction of the new controls. Both investment and profitability are significant and with the expected sign. Instead, the little explanatory power of CAPM betas ( $\beta$ ) should be interpreted with caution. As standard<sup>40</sup>, our dynamic model has one source of aggregate risk and predicts a conditional one-factor model, in which leverage variables affect conditional betas. Instead, the rolling estimates of post-ranking betas are unconditional.

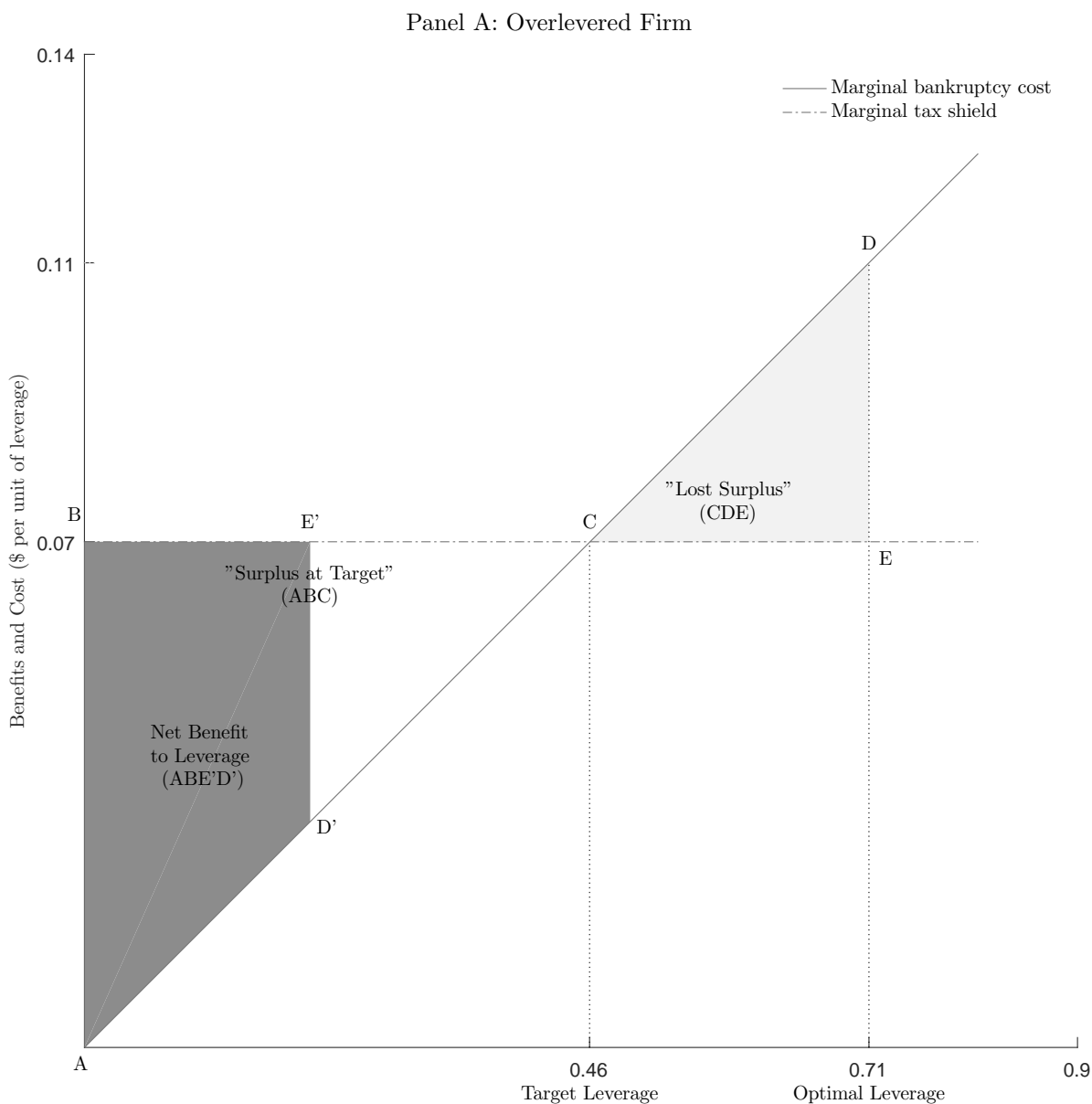
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<sup>39</sup>See Fama and French (1992), Fama and French (2002) and Flannery and Rangan (2006) for the distinction between market and book leverage. See Opler, Pinkowitz, Stulz, and Williamson (1999) and Bates, Kahle, and Stulz (2009) for the evidence on cash holdings.

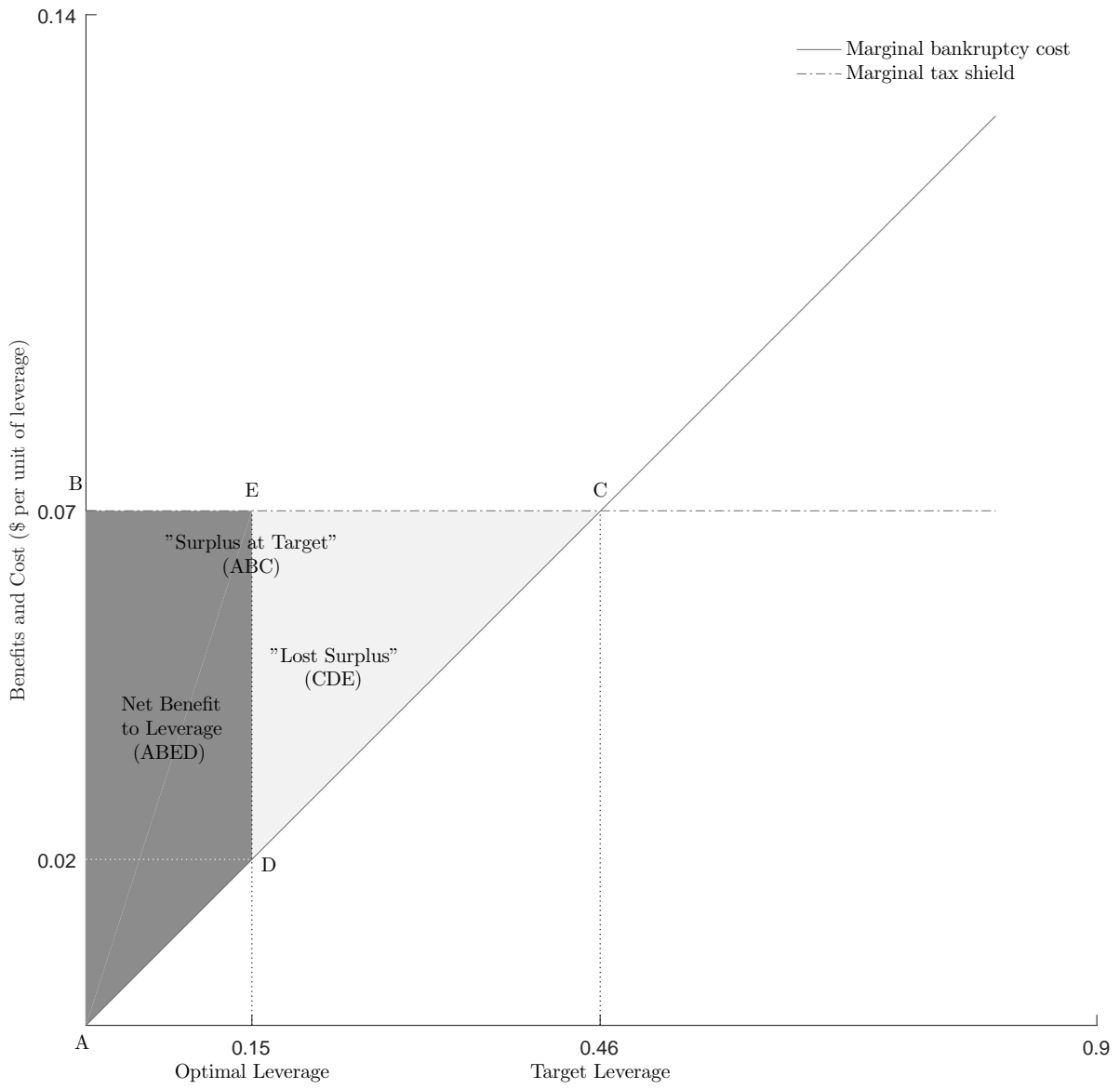
<sup>40</sup>See, for example, Zhang (2005) and Gomes and Schmid (2010).

**Figure OA1**  
CORRECTION FACTOR DECOMPOSITION

Figure OA1 illustrates the decomposition of the correction factor  $\gamma(d_{i,1})$  as discussed in Section 2. The model is solved numerically with three possible cash-flow states (H, M, and L) at time  $t_2$  that can occur with probability 0.3, 0.5 and 0.2 respectively. Panel A and Panel B depict two firms with the same target leverage but different initial leverage ratios, namely 0.75 in Panel A and 0.1 in Panel B. In the low state L firms are insolvent with  $\beta_{i,2}(L) = 0.5$ . In the non-default states, the tax rate is  $\tau = 0.3$ . The remaining parameters are as follows:  $\theta_i = 1$ ,  $M(H) = 0.8$ ,  $M(M) = 1.05$ ,  $M(L) = 1.1$ ,  $r_{i,2}^A(H) = 0.9$ ,  $r_{i,2}^A(M) = -0.1$ ,  $R_{i,2}^A(L) = -0.45205$ ,  $k_i = 1$ .



Panel B: Underlevered Firm



**Table OA1**  
LEVERAGE DECOMPOSITION: DESCRIPTIVE STATISTICS

The table provides summary statistics for our four measures of target leverage and for key firm characteristics. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013. Financial firms and utilities are excluded. ML is the market debt ratio, TL is the estimated target debt ratio, RL is relative leverage, defined as the difference between ML and RL. We consider three alternative measures of target leverage. TL2 is from the estimation of the model of Flannery and Rangan (2006) with firm fixed effects and at least 5 observations for each firm. The estimation of TL2 begins in 1970 (using data since 1965) and is done on a rolling basis as described in Section 3, each year using all the accounting information available until that year. TL2 requires convergence on the estimate of firm fixed effects. TL3 is computed as the rolling median firm leverage for firms with at least 5 observations. TL4 is computed as the rolling median industry leverage at the 4-digit SIC code level. Reported descriptive statistics refer to firm-year observations for which, TL2, TL3, and TL4 are not missing. Panel A reports means, standard deviations, and autocorrelation coefficients for market leverage and for the four measures of target and relative leverage. Panel B reports average market leverage, target leverage, relative leverage, capital stock (K), investment (I/K), profitability (ROA), market capitalization (SIZE), Tobin Q (Q) and the number of observations for the four measures of target leverage. All nominal magnitudes are deflated by the consumer price index, to express all nominal values in 2000 dollars. All variables are winsorized at the 1 percent level and are measured as described in the appendix.

Panel A: Leverage Decomposition			
	Mean	St. Dev.	AC(1)
ML: Observed Leverage	0.16	0.17	0.87
TL2: FR with Firm FE (convergence)	0.16	0.15	0.90
TL3: Median Firm Leverage (min 5 obs)	0.16	0.15	0.99
TL4: Median Industry Leverage	0.13	0.12	0.91
RL2: ML - TL2	0.00	0.10	0.66
RL3: ML - TL3	0.01	0.12	0.78
RL4: ML - TL4	0.03	0.14	0.83

Panel B: Firm Characteristics and Sample Selection

Measure of TL	Leverage			Investment			Valuation		N
	LEV	TL	RL	K	I/K	ROA	SIZE	Q	
	0.16			2.49	0.10	0.10	2.64	2.26	81978
TL2	0.16	0.16	0.00	3.00	0.09	0.11	3.17	2.18	62868
TL3	0.17	0.16	0.01	3.04	0.09	0.11	3.22	2.10	61940
TL4	0.16	0.13	0.03	2.42	0.11	0.10	2.60	2.29	75441



**Table OA2**

## FIRM CHARACTERISTICS ACROSS QUINTILES OF RELATIVE LEVERAGE

The table provides summary statistics for key firm characteristics across quintiles of firms sorted by estimated relative leverage. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013. Financial firms and utilities are excluded. ML is the market debt ratio, TL is the estimated target debt ratio, RL is relative leverage, defined as the difference between ML and RL and  $\Delta ML$  is the rate of change of market leverage in the following year. We consider three alternative measures of relative leverage. Panel A refers to TL2, which is from the estimation of the model of Flannery and Rangan (2006) with firm fixed effects and at least 5 observations for each firm. The estimation of TL2 begins in 1970 (using data since 1965) and is done on a rolling basis as described in Section 3, each year using all the accounting information available until that year. TL2 requires convergence on the estimate of firm fixed effects. TL3 is computed as the rolling median firm leverage for firms with at least 5 observations. Panel B refers to TL3, which is computed as the rolling median firm leverage for firms with at least 5 observations. Panel C refers to TL4, which is computed as the rolling median industry leverage at the 4-digit SIC code level. The table reports average market leverage, target leverage, relative leverage, capital stock (K), investment (I/K), profitability (ROA), market capitalization (SIZE), Tobin Q (Q) and the number of observations for the three measures of target leverage. All nominal magnitudes are deflated by the consumer price index, to express all nominal values in 2000 dollars. All variables are winsorized at the 1 percent level and are measured as described in the appendix.

Panel A: RL2 - FR with Firm FE (convergence)									
Group of RL	Leverage				Investment			Valuation	
	ML	TL	RL	$\Delta ML$	K	I/K	ROA	SIZE	Q
Low	0.11	0.23	-0.12	0.04	1.92	0.09	0.14	2.33	2.18
2	0.11	0.15	-0.04	0.00	1.94	0.09	0.12	2.33	2.43
3	0.11	0.11	0.00	-0.01	1.85	0.08	0.10	1.96	2.47
4	0.15	0.12	0.03	-0.07	3.19	0.07	0.10	2.32	2.19
High	0.30	0.17	0.13	-0.13	6.09	0.08	0.09	2.40	1.57

Panel B: RL3 - Median Firm Leverage (min 5 obs)									
Group of RL	Leverage				Investment			Valuation	
	ML	TL	RL	$\Delta$ ML	K	I/K	ROA	SIZE	Q
Low	0.12	0.26	-0.14	0.03	2.59	0.08	0.15	2.24	2.02
2	0.11	0.15	-0.04	-0.01	2.64	0.08	0.13	2.85	2.37
3	0.09	0.09	0.00	0.07	1.44	0.09	0.10	1.73	2.74
4	0.19	0.15	0.04	-0.10	3.76	0.08	0.11	2.78	1.94
High	0.33	0.16	0.17	-0.15	4.91	0.08	0.09	1.88	1.36

Panel C: RL4 - Median Industry Leverage									
Group of RL	Leverage				Investment			Valuation	
	ML	TL	RL	$\Delta$ ML	K	I/K	ROA	SIZE	Q
Low	0.06	0.21	-0.15	0.13	2.37	0.09	0.14	2.11	2.45
2	0.07	0.10	-0.03	0.06	1.89	0.10	0.08	1.91	2.90
3	0.08	0.08	0.00	-0.01	1.75	0.11	0.08	2.03	2.98
4	0.20	0.14	0.06	-0.11	2.97	0.09	0.10	2.28	1.82
High	0.38	0.14	0.24	-0.14	3.13	0.08	0.09	1.11	1.26

**Table OA3**  
UNIVARIATE PORTFOLIO SORTS

In the table stocks are sorted every June in deciles based on their values of market leverage (ML) and relative leverage (RL). RL is obtained from the estimation of TL from the model of Flannery and Rangan (2006) with firm fixed effects and at least 5 observations for each firm. The estimation of TL begins in 1970 (using data since 1965) and is done on a rolling basis as described in Section 3, each year using all the accounting information available until that year. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013 and covered by the Center of Research in Security Prices (CRSP). Financial firms and utilities are excluded. The breakpoints for portfolio sorts are computed on the subset of firms traded on the NYSE market. We consider three alternative measures of relative leverage, as described in Table OA1. The table reports returns in excess of the risk-free rate, t-statistics and Sharpe ratios for the bottom decile (L), the top decile (H) and for the third, fifth and seventh decile. We also report the difference for the excess returns, the t-statistics and the Sharpe ratio between the top decile and the bottom decile (H-L). The left panel reports equally-weighted returns, while the right panel reports value-weighted returns. The sorting variables are matched to monthly returns as described in Section 4.

Sorting Variable	Excess Returns											
	Equally-Weighted					Value-Weighted						
	H-L	L	3	5	7	H	H-L	L	3	5	7	H
$R^e$	6.09	15.20	14.55	14.60	15.85	21.29	1.73	7.80	9.07	7.56	11.33	9.53
ML [t]	2.03	3.41	3.65	3.92	4.09	4.10	0.51	1.99	3.11	2.84	3.76	2.30
SR	0.46	0.66	0.73	0.77	0.82	0.91	0.10	0.35	0.54	0.49	0.67	0.44
$R^e$	8.36	11.56	14.97	15.31	15.72	19.92	5.24	5.11	8.91	9.71	7.88	10.35
RL2 [t]	4.35	2.91	3.89	4.02	4.09	4.32	1.85	1.30	2.68	3.46	2.50	3.13
SR	0.89	0.56	0.75	0.79	0.82	0.93	0.33	0.24	0.49	0.61	0.46	0.56
$R^e$	7.95	12.60	14.15	14.66	14.74	20.55	5.31	6.34	8.83	7.77	9.02	11.65
RL3 [t]	3.79	3.30	3.88	3.80	3.81	4.23	2.14	1.78	2.77	2.28	3.23	3.01
SR	0.87	0.65	0.77	0.75	0.75	0.90	0.37	0.33	0.50	0.43	0.53	0.55
$R^e$	8.59	12.74	13.68	15.71	15.44	21.33	2.69	8.52	7.48	8.51	9.26	11.21
RL4 [t]	4.56	3.57	3.57	3.48	3.82	4.31	1.15	2.80	2.62	2.69	3.13	2.65
SR	0.93	0.72	0.71	0.66	0.76	0.93	0.19	0.51	0.47	0.46	0.55	0.49

**Table OA4**  
 LEVERED RETURNS: RELATIVE, OBSERVED AND TARGET LEVERAGE

For each month between July 1980 and December 2013, we estimate cross-sectional regressions of stock returns on relative leverage (RL), market leverage (ML), target leverage (TL), market capitalization (SIZE), and book-to-market equity (B/M). We consider three alternative measures of target and relative leverage, as described in Table OA1. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013 and covered by the Center of Research in Security Prices (CRSP). Financial firms and utilities are excluded. De-listing returns are included in monthly returns. The table reports Fama-MacBeth coefficient estimates. t-statistics are in parentheses.  $R^2$  and N denote the cross-sectional R-squared and the number of observations respectively. The independent variables are matched to monthly returns as described in Section 4. All variables are described in the appendix. The symbols (\*\*\*) (\*\* and \*) denote statistical significance at the 1, 5 and 10 percent levels respectively.

Panel A: Observed and Relative Leverage				
	(1)	(2)	(3)	(4)
ML	0.14 (0.47)			
RL2		0.78*** (2.78)		
RL3			0.86*** (3.54)	
RL4				0.56*** (2.72)
SIZE	-0.24*** (-5.28)	-0.20*** (-4.78)	-0.20*** (-4.86)	-0.23*** (-5.19)
B/M	0.17** (2.46)	0.16** (2.11)	0.14* (1.90)	0.17** (2.09)
$R^2$	0.02	0.02	0.02	0.02
N	931438	738975	730793	856307
Panel B: Relative Leverage vs Observed Leverage				
	(1)	(2)	(3)	
ML	-0.09 (-0.27)	-0.09 (-0.28)	-0.55 (-1.00)	
RL2	0.85*** (2.86)			
RL3		0.89*** (2.98)		
RL4			1.03** (2.03)	
SIZE	-0.20*** (-4.90)	-0.20*** (-4.94)	-0.23*** (-5.30)	
B/M	0.16** (2.44)	0.15** (2.24)	0.20*** (3.05)	
$R^2$	0.02	0.02	0.02	
N	738975	730793	856307	

905

Panel C: Observed Leverage vs Target Leverage			
	(2)	(3)	(4)
ML	0.77** (2.37)	0.80*** (2.81)	0.49** (2.22)
TL2	-0.85*** (-2.87)		
TL3		-0.89*** (-2.98)	
TL4			-1.03** (-2.03)
SIZE	-0.20*** (-4.90)	-0.20*** (-4.94)	-0.23*** (-5.30)
B/M	0.16** (2.44)	0.15** (2.24)	0.20*** (3.05)
$R^2$	0.02	0.02	0.02
N	738975	730793	856307

**Table OA5**  
BOOK AND NET LEVERAGE

For each month between July 1980 and December 2013, we estimate cross-sectional regressions of stock returns on relative leverage (RL), market leverage (ML), target leverage (TL), market capitalization (SIZE), and book-to-market equity (B/M). On top of our baseline measure of TL from the model of Flannery and Rangan (2006), which we denote as TL1, we consider three alternative measures of target and relative leverage, as described in Table OA1. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013 and covered by the Center of Research in Security Prices (CRSP). Financial firms and utilities are excluded. De-listing returns are included in monthly returns. The table reports Fama-MacBeth coefficient estimates. *t*-statistics are in parentheses. The independent variables are matched to monthly returns as described in Section 4. All variables are described in the appendix. The symbols (\*\*\*), (\*\*), (\*) and (·) denote statistical significance at the 1, 5 and 10 percent levels respectively.

Panel A: Net Market Leverage									
	(LEV)	(RL1)	(RL2)	(RL3)	(RL4)	(TL1)	(TL2)	(TL3)	(TL4)
LEV	-0.14 (-0.58)	-0.06 (-0.26)	-0.06 (-0.24)	-0.20 (-0.74)	-0.84* (-1.66)				
RL		0.47** (2.23)	0.41* (1.81)	0.63*** (2.84)	1.01** (2.34)	0.41* (1.70)	0.35 (1.41)	0.43** (2.07)	0.18 (1.07)
TL						-0.47** (-2.23)	-0.41* (-1.81)	-0.63*** (-2.84)	-1.02** (-2.34)

Panel B: Book Leverage									
	(LEV)	(RL1)	(RL2)	(RL3)	(RL4)	(TL1)	(TL2)	(TL3)	(TL4)
LEV	0.02 (0.09)	0.02 (0.08)	-0.14 (-0.52)	-0.03 (-0.09)	-0.57 (-1.16)				
RL		0.52** (2.03)	0.70*** (2.66)	0.48** (2.21)	0.91** (2.04)	0.54* (1.96)	0.56** (2.03)	0.45* (1.96)	0.34* (1.91)
TL						-0.52** (-2.03)	-0.70*** (-2.66)	-0.48** (-2.21)	-0.91** (-2.03)

Panel C: Net Book Leverage

	(LEV)	(RL1)	(RL2)	(RL3)	(RL4)	(TL1)	(TL2)	(TL3)	(TL4)
LEV	-0.13 (-0.63)	-0.10 (-0.46)	-0.17 (-0.86)	-0.12 (-0.53)	-0.58* (-1.68)				
RL		0.54*** (3.04)	0.53*** (2.93)	0.52*** (3.21)	0.78*** (2.74)	0.45** (2.26)	0.37* (1.80)	0.41** (2.50)	0.19 (1.53)
TL						-0.54*** (-3.04)	-0.53*** (-2.93)	-0.52*** (-3.21)	-0.78*** (-2.74)

**Table OA6**  
ADDITIONAL CONTROLS

For each month between July 1980 and December 2013, we estimate cross-sectional regressions of stock returns on relative leverage (RL), market leverage (ML), target leverage (TL), investment (INV), profitability (PROF), market capitalization (SIZE), book-to-market equity (B/M), post-ranking CAPM beta ( $\beta$ ) and momentum (Momentum). Investment is measured as the growth of firm assets. Profitability is measured as the ratio of operating profits to book equity. On top of our baseline measure of TL from the model of Flannery and Rangan (2006), which we denote as TL1, we consider three alternative measures of target and relative leverage, as described in Table OA1. The sample includes all Compustat firms traded on NYSE, AMEX and NASDAQ between 1965 and 2013 and covered by the Center of Research in Security Prices (CRSP). Financial firms and utilities are excluded. De-listing returns are included in monthly returns. The table reports Fama-MacBeth coefficient estimates.  $t$ -statistics are in parentheses.  $R^2$  and N denote the cross-sectional R-squared and the number of observations respectively. The independent variables are matched to monthly returns as described in Section 4. All variables are described in the appendix. The symbols (\*\*\*) (\*\* and \*) denote statistical significance at the 1, 5 and 10 percent levels respectively.

	(1)	(2)	(3)	(4)	(5)
ML	-0.09 (-0.39)	-0.17 (-0.74)	-0.33 (-1.29)	-0.32 (-1.28)	-0.87** (-2.03)
RL1		0.95*** (3.41)			
RL2			0.94*** (3.32)		
RL3				1.01*** (3.99)	
RL4					1.14*** (2.91)
INV	-0.26*** (-5.26)	-0.26*** (-4.24)	-0.22*** (-3.54)	-0.28*** (-4.71)	-0.26*** (-5.20)
PROF	0.06***	0.05***	0.06***	0.05***	0.06***
SIZE	(5.22)	(3.14)	(4.74)	(3.19)	(5.33)
B/M	-0.22*** (-5.59)	-0.19*** (-4.98)	-0.19*** (-4.99)	-0.19*** (-4.99)	-0.22*** (-5.51)
$\beta$	0.20*** (3.45)	0.16*** (2.76)	0.19*** (3.35)	0.17*** (2.87)	0.22*** (4.05)
Momentum	0.02 (0.09)	0.18 (0.18)	0.06 (0.26)	0.02 (0.08)	-0.05 (-0.22)
	0.12 (0.68)	0.05 (0.87)	0.11 (0.59)	0.15 (0.83)	0.10 (0.53)
$R^2$	0.04	0.04	0.04	0.04	0.04
N	925112	726056	737667	729644	850563