Refinancing and Mean Reversion in Earnings

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ABSTRACT

We propose an alternative to the standard nonstationary earnings dynamics framework for studying refinancing decisions by building a dynamic two-stage trade-off model with refinancing for firms following mean reverting earnings. The model predicts a negative relation between profitability and leverage ratios at refinancing, showing that firms with earnings below their long-term profitability increase their leverage ratios at refinancing, whereas firms currently above their long-term profitability decrease their leverage ratios at refinancing. Our empirical results confirm the prevalence of mean reversion in earnings among US firms and largely corroborate with theoretical model predictions supporting a negative relation of profitability with leverage ratios at refinancing. We also find that on average, firms' leverage ratios increase during refinancing, driven mostly by firms on the lowest quantile with low leverage ratios.

Keywords: leverage; leverage–profitability puzzle; temporary shocks; permanent shocks; mean reversion; refinancing; capital structure

JEL classification: G30; G31; G32; G13

1. Introduction

The trade-off model of capital structure predicts that firms make capital structure decisions by balancing out the tax benefits of debt against bankruptcy costs. This theory is in line with evidence showing that firms with more tangible assets, lower volatility, and lower market-to-book (growth) have more leverage (see, e.g., Frank and Goyal, 2009; Graham and Leary, 2011). However, this theory is not able to explain the negative relation between leverage ratios and profitability. Indeed, according to static versions of the trade-off theory, more profitable firms are less exposed to bankruptcy risk and hence are expected to acquire more leverage, which can shield against additional tax benefits.

One of the goals of this paper is to provide a possible explanation of the negative relation between profitability and leverage in the context of firms' refinancing decisions within the realm of a trade-off model. We investigate whether the negative relationship between profitability and leverage can be attributed to mean reversion in earnings. To do that, we build a dynamic two-stage trade-off model with refinancing for firms following mean reverting earnings, which predicts, among other things, a negative relation between profitability and leverage ratios at refinancing.

Indeed, even recent versions of trade-off models built on option pricing theory built on the standard workhorse of Geometric Brownian motion (GBM; see Leland, 1994) predict that leverage ratios are invariant to profitability and thus fail to explain the negative relation between profitability and leverage. Goldstein, Ju, and Leland (GJL; 2001) extend Leland's (1994) setting to multiple rounds of refinancing (other examples of such models include Fischer et al., 1989; Hackbarth et al., 2006; Strebulaev, 2007; Morellec et al., 2012) within the context of GBM earnings. Two new insights emerge that can provide an avenue to explain the leverage–profitability puzzle. First, due to positive refinancing costs, inaction in adjusting leverage between refinancing points causes the relation of leverage with profitability to be negative and unconditional to refinancing events. This largely evidences a negative relation between profitability and leverage, which is not conditional on refinancing events (see Danis et al., 2014; Eckbo and Kisser 2021). Second, Danis et al. (2014) and Strebulaev's (2007) simulations of settings related to GJL's model suggest that leverage profitability should be positive at refinancing points. In fact, Danis et al. (2014) find support for this relation when using net leverage (i.e., subtracting cash balances from debt). However, considering gross market leverage measures, Eckbo and Kisser (2021) find a negative or weak relation, which they attribute as evidence against the trade-off theory. Still, Eckbo and Kisser (2021) have not considered the effects of earnings dynamics and mean reversion in earnings. The goal of our paper is to consider the dynamics of earnings following a mean reversion process and demonstrate both theoretically and empirically that such a negative relation is plausible if one properly considers earnings dynamics.

Our analysis, which focuses on firms with mean reversion in earnings, is motivated by two important facts. First, Sarkar and Zapatero (2004) theoretically show that profitability and leverage's relationship is negative in a static, single-period financing framework when earnings are mean reverting. However, their model does not predict the relationship between leverage and profitability when firms refinance, which is the goal of our paper. Second, and more broadly, we aim to contribute to the literature that identifies the factors affecting leverage dynamics, which include expensive adjustment costs (e.g., Leary and Roberts, 2005), financial flexibility (e.g., Rapp et al., 2014), financing lumpy investments (e.g., DeAngelo et al., 2007 ; Dudley 2012), macroeconomic conditions (e.g., Hackbarth et al., 2006; Cook and Tang, 2010), managerial ability (e.g., Shang, 2021), and adjustments in response to exogenous shocks like environmental risks (e.g., Nguyen and Phan, 2020). More specifically, our focus is in line with recent developments focusing on understanding the impact of stochastic process assumptions on capital structure dynamics (e.g., Gryglewicz et al., 2022). Along these lines, Amini et al. (2021) propose a machine learning approach to capture the nonlinearities involved in leverage dynamics and refinancing decisions. Bontempi et al. (2020) also propose a statistical approach that captures both firm characteristics and unpredictable events shaping observed leverage choices. In this paper, we focus instead on profitability dynamics evidencing that a substantial part of US firms' earnings exhibits mean reversion, highlighting the importance of understanding firms' leverage decisions in a mean reversion setting. Thus, our paper attempts to fill the void on refinancing decisions and the leverage–profitability relation in a mean reversion setting, both theoretically and empirically.

To study this, we build a framework based on GJL's: we consider firms that take initial debt with perpetual maturity and can adjust leverage within one refinancing round at an optimal future time. To investigate the impact of transitory earnings shocks, we build the model in a mean reversion setting. Incorporating finite rounds of refinancing is in line with practice and introduces dynamic leverage adjustments. In contrast, GJL use infinite rounds, in which case leverage ratios remain unchanged compared to previous refinancing rounds. Similarly to GJL's, our model predicts a negative relation between profitability and leverage unconditional on refinancing due to positive refinancing costs, which cause infrequent leverage adjustments. However, in contrast to static models or models focusing on nonstationary earnings, we document a negative relation between profitability and leverage ratios at refinancing. This result occurs in our mean reverting earnings because whereas debt increases at refinancing, equity increases at a higher rate, causing leverage ratios to drop as profitability increases.

In addition, our model provides new insights into firms' leverage ratio dynamics. We find that although all firms take more debt at refinancing, firms that currently have earnings below their long-term mean and thus are expected to have earnings grow exhibit a positive adjustment in market leverage ratios at refinancing compared to earlier rounds of financing.

The opposite is true for firms with earnings currently above their long-term profitability. We also provide interesting insight into the model relating the impact of mean reversion speed and volatility to refinancing timing and the dynamics of leverage ratios. For example, we find that firms with an extremely low mean reversion speed (proxying the nonstationary case) refinance earlier and increase their leverage ratios at refinancing. In comparison, firms with high mean reversion refinance later, and their leverage ratio adjustment may decrease if current profits are not high enough compared with long-term profitability levels.

Our empirical analysis builds on that of Eckbo and Kisser (2021), which uses gross leverage and pure debt refinancing events. However, in contrast, we first identify and focus on a sample of stationary firms based on an Augmented Dickey-Fuller (ADF) test. Our analysis confirms that the unconditional relation between gross market leverage and profitability is negative. In addition, we find evidence that the relation between leverage and profitability is negative for mean reverting firms at refinancing events. To compare, we also conduct analysis following Danis et al.'s (2014) framework, showing that using net leverage as the dependent variable and Danis et al.'s (2014) approach in defining refinancing events results in a positive relation of profitability with leverage at refinancing even for mean reverting firms. This comparison reaffirms Eckbo and Kisser (2021) regarding the sensitivity of the profitability–leverage relation based on the definition of rebalancing events. In view of the more conservative approach to defining rebalancing events that we use, which is based on Eckbo and Kisser (2021), our theoretical analysis and empirical analysis show some support, at least as far as the directional effect is concerned, for a simple dynamic trade-off model that properly captures mean reversion in earnings as well as inaction caused by positive refinancing costs.

With respect to the dynamics of leverage adjustments, in our empirical analysis, we find that firms that refinance generally move to higher leverage ratios. Quantile regressions show that the negative relation of leverage with profitability is not universal and is mostly driven by firms in the lower leverage quantile.

Our contributions can be summarized as follows. First, we provide a setting to study the effect of temporary earnings shocks on firms' refinancing decisions. Gorbenko and Stebulaev's (2010) analysis considers the effect of temporary shocks; however, their temporary component is driven by the arrival of Poisson jump shocks with temporary (size) effect, and they do not focus on firms' refinancing decisions. Transitory shocks have been used extensively to study other corporate problems such as optimal cash management policies (e.g., Décamps et al., 2016; Cadenillas et al., 2007). Notably Sarkar (2003), Tsekrekos (2010), Metcalf and Hasset (1995), and Raymar (1991) use a mean reversion setting to study investment financing. Although most of the aforementioned literature uses the geometric mean reverting (GMR) process, Agliardi et al. (2022) provide a model with arithmetic mean reversion (AMR) that allows for negative profitability and incorporates investment financing of growth options. In contrast, our paper mainly studies pure refinancing decisions using the AMR process. Second, besides a possible explanation for the leverage–profitability relationship, our model provides new insights into firms' dynamic leverage ratio adjustments, which relate to the relation between current levels of profitability and long-term prospects as well as the speed at which firms are expected to reach long-term profitability levels. Third, we provide the first systematic empirical study that attempts to disentangle firms' earnings dynamics and test firms' refinancing decisions regarding mean reverting (temporary shocks) in earnings.

Our analysis proceeds as follows. Section 2 provides the theoretical framework and hypotheses. Section 3 provides the empirical analysis. Section 4 concludes.

2. Theoretical framework and hypotheses

We model a firm with existing assets that generates earnings x and aligns with an arithmetic mean reverting (ARM) process as follows:

$$dx = q(\theta - x)dt + \sigma dz \quad (1)$$

where q defines the mean reversion speed, θ defines the long-term mean to which earnings revert, σ defines the earnings volatility, and *dz* is the increment to a standard Brownian motion process. The real options literature has mainly used the geometric mean reverting (GMR) process (e.g., Sarkar, 2003; Metcalf and Hasset,1995; Tsekrekos, 2010; Sarkar and Zapatero, 2003), which assumes that cash flows can never become negative and volatility increases proportionally with profitability. In contrast, the AMR process we employ allows for negative earnings, and volatility is independent of the profitability level.

The firm selects an optimal level of perpetual debt $Db(x)$ at time zero with a promised coupon payment R_0 and pays corporate taxes at a constant rate τ with a full-loss offset scheme.[1] A risk-free asset earns *r* annually and is continuously compounded. The bankruptcy trigger x_b is endogenously and optimally chosen by equity holders. When earnings x reach the low threshold level x_b, the firm goes bankrupt, and the debt holders take over and obtain the firm's unlevered assets $Ub(x)$ net of proportional bankruptcy costs b, $0 < b < 1$. In contrast, if earnings rise to a high level x_I endogenously chosen by the firm, the firm calls existing debt $Db(x)$ at par and takes new debt $Da(x)$ with coupon R_1. The optimal timing for new financing is chosen to maximize the market value of equity plus the new proceeds from the debt issue.

Following exercising of the refinance option, equity holders select the earnings level x_L, which triggers bankruptcy. We include proportional costs k paid for the issuance of each

[1] For simplicity, we do not consider tax convexity issues (Goldstein, Ju, and Leland, 2001) but assume that a constant tax rate τ is applied irrespective of the earnings level. Our analysis thus exaggerates the true tax benefits levels.

new debt issue (see Goldstein, Ju, and Leland, 2001), so the net proceeds are $(1-k)Db(x)$ at $t = 0$ and $(1-k)Da(x_I)$ at the time of refinancing. The optimization of financing is such that R_0 is chosen to maximize initial firm value (equity plus initial net proceeds from debt financing), whereas R_1 is chosen to maximize equity plus the net proceeds from the new debt issue.

In summary, and in comparison with GJL's incorporation of potentially infinite rounds of refinancing, our setting is more in line with the practice of managers expecting a finite number of refinancing rounds. Indeed, refinancing is not frequent in practice, and allowing only for finite rounds introduces interesting dynamics like debt conservatism. For example, when earnings are below long-term levels, we find that firms are more conservative with leverage, starting at lower levels and adjusting leverage ratios upward at refinancing. This is in line with the intuition and evidence of managerial conservatism (see Graham, 2022). In addition, whereas GJL implies that leverage ratios stay constant, our finite refinancing rounds framework predicts dynamic adjustments depending on the relation of current profitability to long-term profitability levels. It should be emphasized that our framework implies there is no long-term targeting leverage behavior, which is supported by evidence in Chauhan and Huseynov (2018).[2]

In addition, our framework is not complicated with issues relating to personal taxes. These could easily be incorporated; however, not much insight would be added into the effects of temporary versus permanent shocks on the dynamics leverage.

[2] Hovakimian and Li (2011) also show that even if adjustment toward a goal exists, it is slow and gradual, ranging around only 5–8% per year.

2.1. Security values and leverage at refinancing

To obtain values at and after refinancing, it is helpful to use the value of basic claims (see Agliardi et al., 2022). First, we define terms $P_1(\cdot)$ and $P_2(\cdot)$ as follows:

$$P_1(x) = e^{\frac{1}{4}\left(\frac{(x-\theta)\sqrt{2q}}{\sigma}\right)^2} D_\nu\left(\frac{(x-\theta)\sqrt{2q}}{\sigma}\right) \tag{2a}$$

$$P_2(x) = e^{\frac{1}{4}\left(\frac{(x-\theta)\sqrt{2q}}{\sigma}\right)^2} D_\nu\left(-\frac{(x-\theta)\sqrt{2q}}{\sigma}\right) \tag{2b}$$

where $D_\nu(z) = \frac{1}{2^\xi\sqrt{\pi}}\left[\cos(\xi\pi)\,\Gamma\left(\frac{1}{2}-\xi\right)\, y_1(a,z) - \sqrt{2}\sin(\xi\pi)\,\Gamma(1-\xi)\, y_2(a,z)\right]$

$$z = \frac{x-\theta}{\bar{\sigma}}, \bar{\sigma} = \sigma/\sqrt{2q}$$

$$a = -\nu - \frac{1}{2}, \nu = -\frac{r}{q} < 0$$

$$\xi = \frac{1}{2}a + \frac{1}{4}$$

$\Gamma(\cdot)$= is the Gamma function

$$y_1(a,z) = e^{-\frac{z^2}{4}}\ {}_1F_1\left(\frac{1}{2}a + \frac{1}{4}; \frac{1}{2}; \frac{z^2}{2}\right)$$

$$y_2(a,z) = z\, e^{-\frac{z^2}{4}}\ {}_1F_1\left(\frac{1}{2}a + \frac{3}{4}; \frac{3}{2}; \frac{z^2}{2}\right)$$

In the above, ${}_1F_1(\alpha;\beta;z) = M(\alpha;\beta;z)$ is the confluent hypergeometric function (see Abramowitz and Stegun, 1972).

Note that $\frac{P_1(x)}{P_1(x_L)}$ can be interpreted as the value of a basic claim, which pays one dollar when x_L is reached from above x (see Agliardi et al., 2022). With this basic claim, we can define the value of equity after refinancing as follows:

$$Ea(x) = Ea_p(x) - Ea_p(x_L)\left(\frac{P_1(x)}{P_1(x_L)}\right) \tag{3}$$

where $Ea_p(x) = \left(\frac{1}{q+r}x + \frac{q\theta}{r(q+r)} - \frac{R_1}{r}\right)(1-\tau)$ (4)

The value of unlevered assets after investment is:

$$Ua(x) = \left[\frac{1}{q+r}x + \frac{q\theta}{r(q+r)}\right](1-\tau) \tag{5}$$

In equation (5), the term $\frac{1}{q+r}x$ represents changes in value of unlevered assets driven by a current shock in profitability, whereas the constant $\frac{q\theta}{r(q+r)}$ is a long-term component (independent of the current profitability shock). Note that when q = 0, equation (5) simplifies to x(1−τ) / r. In this case, a current earnings level change of one dollar produces a "permanent" perpetual change in value $Ua(v)$ of $\frac{1(1-\tau)}{r}$, whereas long-term profitability becomes irrelevant. In contrast, the nature of a stationary process can be readily seen when mean reversion speed q increases. In this case, the first part becomes less important, and the long-term value of earnings becomes more relevant. In fact, if q goes to infinity, the first term disappears, and the value converges to its long-term mean.

The threshold values x_A^1 after refinancing, when the value of unlevered assets becomes negative, can be found by solving $Ua(x_A^1) = 0$. To avoid negative liquidation values at bankruptcy, we focus on solutions where $x_L > x_A^1$.

The new debt value $Da_1(x)$ at refinancing is given by the following:

$$Da_1(x) = \frac{R_1}{r} + \left((1-b)\,Ua(x_L) \quad - \frac{R_1}{r}\right)\left(\frac{P_1(x)}{P_1(x_L)}\right) \tag{6}$$

Because initial debt is called and paid at par, its value after refinancing simply contains the perpetual stream of coupons:

$$Da_0(x) = \frac{R_0}{r} \tag{7}$$

Note that the leverage ratio at the refinancing point is defined as the following:

$$Lev_1(x_I) = Da_1(x_I)/(Da_1(x_I) + Ea(x_I)) \tag{8}$$

2.2. Time zero security values and leverage ratio

We define $J(x)$ as the basic claim that one dollar is paid if x hits trigger x_I and zero dollars if it hits x_b. Similarly, we define $L(x)$ as the basic claim that one dollar is paid if x hits trigger x_b and zero dollars if it hits x_I. The solutions to these basic claims are as follows (see Agliardi et al., 2022):

$$J(x) = \frac{P_2(x_b)}{D(x_I,x_b)} P_1(x) - \frac{P_1(x_b)}{D(x_I,x_b)} P_2(x) \tag{9a}$$

$$L(x) = -\frac{P_2(x_I)}{D(x_I,x_b)} P_1(x) + \frac{P_1(x_I)}{D(x_I,x_b)} P_2(x) \tag{9b}$$

where $D(x_I, x_b) = P_1(x_I)P_2(x_b) - P_1(x_b)P_2(x_I)$.

The value of unlevered assets before refinancing is given by the following:

$$Ub(x) = \left[\frac{1}{q+r} x + \frac{q\theta}{r(q+r)}\right](1-\tau) \tag{10}$$

To avoid negative liquidation values, we focus on solutions where $x_B > x_A^0$ where $Ua(x_A^0) = 0$.

Equity value before exercising the refinancing option $Eb(x)$ is given by the following:

$$Eb(x) = Eb_p(x) + \left(Ea(x_I) + (1-k)Da_1(x_I) - Eb_p(x_I) - Da_0(x_I)\right)J(x) - Eb_p(x_b)\, L(x) \tag{11}$$

where $Eb_p(x) = \left(\frac{1}{q+r} x + \frac{q\theta}{r(q+r)} - \frac{R_0}{r}\right)(1-\tau)$.

The first term is the particular solution reflecting the income initiated as of $t = 0$. The second term of equation (11)—the term in parentheses multiplying $J(x)$—introduces the expected present value that equity holders expect to obtain if the refinancing threshold is reached. This includes the equity value after refinancing (first term), the net of proportional refinancing costs proceeding from the new debt issue (second term), an adjustment term truncating income at $t = 0$ since now included in $Ea(x_I)$ (third term), and the repayment of initial debt called at x_I (fourth term). The term multiplying $L(x)$ reflects foregone income for equity holders if the default trigger is reached.

The initial ($t = 0$) debt value is given by the following:

$$Db(x) = \frac{R_0}{r} + \left((1-b)\, Ub(x_b) - \frac{R_0}{r}\right) L(x) \tag{12}$$

where $Ub(x)$ is given in equation (10).

Thus, the firm value before refinancing is the sum of equity plus debt before investment:

$$Fb(x) = Eb(x) + (1-k)Db(x) \tag{13}$$

Finally, the leverage ratio at $t = 0$ is the following:

$$Lev_b(x) = Db(x)/(Db(x) + Eb(x)) \tag{14}$$

2.3. Leverage optimization

In this section, we describe smooth pasting (optimality) conditions. First, post-refinancing, we have a smooth pasting condition to obtain the optimal bankruptcy trigger:

$$Ea'(x_L) = 0 \tag{15}$$

Similarly, the equity value before investment should be zero at the bankruptcy trigger x_b:

$$Eb'(x_b) = 0 \tag{16}$$

Finally, to determine the timing of refinancing x_I, we apply the following:

$$Eb'(x_I) = Ea'(x_I) + Da_1'(x_I) \tag{17}$$

The optimal capital structure is selected by performing a dense grid search for both the initial and subsequent coupon levels, such that R_0 and R_1 satisfy optimally chosen refinancing threshold and default levels. This optimization identifies the initial and subsequent (refinancing) leverage ratios in the firm's capital structure.

2.4. Model predictions

2.4.1. Empirical hypotheses relating profitability and leverage ratios

Our base case parameters for sensitivity analysis are motivated from earlier studies as follows. For the mean reverting stochastic process parameters, we follow Sarkar and Zapatero (2003) and Agliardi et al. (2022) and use a normalized level of current earnings at $x = 1$, $\sigma = 0.4$, mean reversion speed $q = 0.1$, and long-term mean $\theta = 1$. Note that the parameters of the AMR process are in line with empirical estimates provided in Agliardi et al. (2022). We follow Goldstein et al. (2001) and Danis et al. (2014). We use the tax rate $\tau = 0.3$, proportional bankruptcy cost $b = 0.15$, and $r = 0.06$.

Table 1 shows our sensitivity results of the theoretical model with respect to x_0, implying a different growth rate of the earnings process. Because the long-term mean is normalized to 1, $x_0 < 1$ captures firms with temporarily positive trending earnings, whereas firms with $x_0 > 1$ (earnings currently above long-term levels) are expected to have temporarily negative growth. Our approach thus follows Danis et al.'s (2014) simulation exercise of varying growth rates applied to the case of a mean reverting earnings process.

[Insert Table 1 about here]

The first panel of Table 1 shows security values, leverage, and returns. The second panel of Table 1 shows the firm's optimal policies and coupons. In the first panel, for various levels of x_0 reflecting different growth rates in earnings, we report firm ($Fb(x)$), equity ($Eb(x)$), and debt values ($Db(x)$), respectively. Note that $Fb(x) = Eb(x) + (1 - k)Db(x)$ (i.e., firm value is the net of proportional issuance costs paid for the issue of debt at $t = 0$). $Lev_b(x)$ shows the leverage ratio at $t = 0$, and x_I shows the refinancing threshold. $Lev_1(x_I)$ shows the leverage at the refinancing threshold, and ΔLev shows the change in leverage at refinancing relative to the initial leverage. In the last column, we calculate the post-tax return on assets at x_I, defined as the post-tax earnings scaled by unlevered assets.

Interestingly, we find that a higher return on assets at refinancing is associated with lower leverage ratios (i.e., the relation between the return on assets and leverage at refinancing is negative). Figure 1 shows a scatter plot where the linear relation between leverage and profitability is indeed strongly negative. This may seem counterintuitive, especially in relation to static versions of trade-off theory that imply leverage ratios increase with profitability. However, in a mean reversion setting, it appears that while debt increases, equity increases at a higher rate, which drives a decrease in leverage ratios at refinancing. Our extensive sensitivity analysis confirms this analysis is robust and shows that the relation becomes more negative the higher the mean reversion speed.

[Insert Figure 1 about here]

We also observe from panel B that coupons at refinancing are $R_1 > R_0$ irrespective of the growth rate of earnings (i.e., as expected firms take more debt at refinancing). However, interestingly, the leverage ratio lowers at refinancing relative to the initial level when firms are trending positive (the opposite holds true when firms are negative or even zero trending). This is important when considering the dynamics of firms' refinancing decisions. It may often be assumed that refinancing leads to higher leverage ratios, but this actually holds true only when the firm's earnings have a (temporary) positive growth rate.

In the appendix, we simulate the model and estimate panel regressions on the simulated data panel as follows:

$$L_{it} = \alpha_0 + \beta_0 \pi_{i,t-1} + \beta_1 \pi_{i,t-1} d_{it} + \gamma d_{it} + \varepsilon_{it} \tag{18}$$

Based on the simulations and our sensitivity analysis, we summarize the following hypotheses:

Hypothesis 1 (H1): Due to positive refinancing costs and inaction, the relation of leverage with profitability is expected to be negative unconditional to refinancing events ($\beta_0 < 0$).

Hypothesis 2 (H2): At refinancing, the relation between leverage and profitability for stationary firms is negative ($\beta_1 < 0$).

Finally, to determine the sign of coefficient γ in equation (18), we note that the change in leverage between refinancing and initial leverage is positive for firms below their long-term profits and negative for firms above their long-term means. However, our simulation exercise (see appendix) reveals that the refinancing dummy is expected to have a positive coefficient when both negative and positive growth firms are combined together in the sample (which appears to be the case, as seen in the actual sample). We thus summarize the final hypotheses as follows.

Hypothesis 3 (H3): The refinancing dummy is expected to be positive when both negative and positive growth firms are combined ($\gamma > 0$).

All our hypotheses are linked with actual panel regression coefficients in the empirical part, where a similar regression is applied in the actual data.

2.4.2. The effect of mean reversion speed and volatility

In this subsection, we provide novel insights on firms' refinancing in a mean reversion context. As noted in the model description, our focus on finite rounds of financing provides some interesting leverage ratio dynamics as opposed to, for example, GJL. In the latter's study, infinite rounds of financing and the scaling property of the GBM process imply that leverage ratios remain the same at each round of refinancing.

Table 2 provides sensitivity with respect to mean reversion speed q, providing insights into permanent earnings shocks (low q) versus temporary earnings shocks (high q). We observe a U-shape of the restructuring threshold as a function of q. Similar to GJL's but with finite refinancing, our results show that nonstationary firms (our very low q case) refinance earlier than firms with only temporary shocks (very high q). Importantly, leverage ratios at $t = 0$ are lower for the nonstationary cases (low q) despite the high coupon level at $t = 0$ due to the higher (earlier) default thresholds. The leverage ratios, however, adjust sooner (lower x_I) to a higher level (see panel B) when q is low compared to when the earnings are stationary. Indeed, when q is low, a firm starts with a low leverage ratio and then increases its leverage ratio at the restructuring threshold. When earnings shocks are temporary (q is high), and the current profitability is at par with long-term profits, implying a nonpositive trend, we find that the opposite is true (i.e., in our setting with finite refinancing rounds, we find that firms may decrease leverage ratios at refinancing).[3]

[Insert Table 2 about here]

In Table 3, we investigate the effect of volatility. We observe a delay in the restructuring threshold as a function of σ, which aligns with the realistic intuition of delaying costly refinancing when uncertainty increases. In addition to and in line with intuition, leverage ratios at $t = 0$ are lower for higher volatility levels. We observe that leverage ratios adjust downward to a lesser degree at refinancing when volatility is high. In fact, leverage ratios between different volatility levels at the refinancing threshold are similar, which implies that the delay in refinancing balances out the negative effect of volatility on leverage and the higher coupons used at refinancing.

[Insert Table 3 about here]

[3] This reiterates our earlier discussion where we predict that firms with mean reverting earnings increase their leverage ratios at refinancing only when their current profits are low compared to long-term levels, in which case they are expected to have a (temporary) positive trend in profits to reach their long-term levels. However, leverage ratios at refinancing drop compared to earlier financing levels when profits are high relative to long-term levels (negative trending) or even at par with long-term profit levels (zero trending, such as in the case in Table 2).

3. Empirical analysis

Our sample construction comes from the quarterly merged CRSP/Compustat (CCM) database between Q1/1984 and Q4/2019. We have chosen this date range because quarterly CCM cash flow statements are consistently available from Q1/1984. Following the previous capital structure literature (e.g., see Eckbo and Kisser 2021), we have eliminated many firms and firm quarters based on common sample restrictions, which are detailed in Table 4.

[Insert Table 4 about here]

We also excluded financial companies and regulated firms and restricted the sample to non-missing entries of key balance sheets, income statements, and cash flow characteristics. Moreover, we required that firms have quarterly operating profit data for at least forty consecutive quarters. Our final samples comprise 3,754 firms and 240,963 firm quarters.

3.1. Econometric method for mean reverting firms' detection

Mean reversion firm detection comprises two steps. In the first step, we calculate the profitability ratio, as Operating Profit (OPIBDPQ)/Total Asset (ATQ). In the second step, we follow the method in Augmented Dickey Fuller (ADF) (Dickey & Fuller 1979, 1981) to test for stationary behaviour and to identify mean reverting firms. The ADF procedure investigates whether the profitability of a firm shows a non-stationary process (mean reversion absence) or a stationary process (mean reversion).

Consider the following ADF standard regression, which is similar to the one used by Glen (2001), Santos and Veronesi (2006), and Shi et al. (2020):

$$\Delta x_t = \alpha_0 + \beta x_{t-1} + \sum_{i=1}^{k} \varphi_i \Delta x_{t-i} + \varepsilon_t \qquad (19)$$

where x_t is the profitability at time t for firm i. To simplify the notation, we remove the subscript *i* when modeling stationary and denote Δx_t the first difference of x_t (e.g., Chowdhury et al., 2022). Furthermore, α_0 is the constant term, k is the lag order of the autoregressive process, and the error term follows a normal distribution—that is, $\varepsilon \sim iidN\left(0, \sigma^2_{r_1, r_2}\right)$. The lag order k is selected by the Bayesian information criterion (BIC) with a maximum lag order of 4.[4]

We test the unit root under the null hypothesis, that is, the coefficient β=0 against the alternative hypothesis β>0. We calculate the following standard ADF test statistic:

$$ADF = \hat{\beta} / \, s.e.\, (\hat{\beta}) \tag{20}$$

The ADF test is not symmetrical; hence, we are concerned with negative ADF test statistics. When the ADF test statistic is less (more negative) than the critical value, the unit root null hypothesis is rejected in favour of non-stationary behavior in x_t. In contrast, if the ADF test statistic is more (less negative) than the critical value, we fail to reject the null hypothesis. That is, the process is stationary and exhibits mean reversion in x_t.

3.2. Types of rebalancing

In this section we explain our choice of rebalancing which is based on debt financed rebalancing events following the arguments of Eckbo and Kisser (2021). Rebalancing events can be identified by three different proxies: report debt-financed rebalancing (type a_t), cash-and-debt-financed rebalancing (type a_t^N), and cash-financed leverage rebalancing (type a_t^C) respectively. Based on previous studies (e.g., Leary and Roberts, 2005, 2010; Eckbo et al.,

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[4] As a robustness check, we also consider Akaike information criterion (AIC) lag order selection and time trend. Additionally, we set maximum lag lengths of four and eight for both AIC and BIC. The main findings of our study (see Table 8) are not affected by the lag length section criteria, leg length, or trend model. Results are available upon request.

2007; Eckbo and Kisser ,2021) we use an issue-size threshold of 5% and employ the following formulas are used to estimate rebalancing events:

$$\text{Debt-financed rebalancing: } a_t = 1 \text{ if } \frac{\Delta D_t^e}{A_t} > 5\% \text{ and } \frac{ER_t^e}{A_t} > 5\%$$

$$\text{Cash -and- debt-financed rebalancing: } a_t^N = 1 \text{ if } \frac{\Delta D_t^e - \Delta C_t}{A_t} > 5\% \text{ and } \frac{ER_t^e}{A_t} > 5\%$$

$$\text{Cash -only financed rebalancing: } a_t^C = 1 \text{ if } \frac{-\Delta C_t}{A_t} > 5\% \text{ and } \frac{ER_t^e}{A_t} > 5\%$$

where ΔD_t^e is the change in long-term debt, ΔC_t is the change in cash balances, ER_t^e equity retirement in excess of equity issues, and A is the book value of total assets.

In our empirical analysis, we require the following: i) rebalancing event periods must exclude probable confounding cash flow events, and ii) these financing must be considerable both in absolute and relative size compared to other sources and uses of funds. We can verify our requirements by examining the firm's cash flow statement in the refinancing quarter by using the following equation:

$$OCF - INV + OTH + (-CH + IVSTCH) = ER^e - DI^e \tag{21}$$

where *OCF* = operating cash flow; *INV* = total net investment outflows; *OTH* = other small financing cash flows; $-CH$ = cash balance drawdown; *IVSTCH* = net sale of short-term marketable securities; $-CH+IVSTCH$ = contribution of cash and cash equivalents; ER^e = net equity retirement (dividends and share repurchase net of equity issues); and DI^e = net debt issue (debt issues in excess of debt retirements). We scale all variables by the book value of total assets. Table 5 shows the sources and uses of funds when firms take different types of capital structure rebalancing.

[Insert Table 5 about here]

We observe that only debt-financed rebalancing (Panel A) fulfils our requirements. Net equity retirement (16%; Column 6) and net debt issue (15%; Column 7) are almost equal. Further, the left-hand side variables—*OCF* (3%; Column 1), *INV* (2%; Column 2), *OTH* (0%; Column 4), *CH* (0%; Column 5), and *IVSTCH* (0%; Column 6)—are small. The results imply that during debt-financed rebalancing, firms retire net equity by issuing net debt.

Further, we observe that net equity retirement is almost the same for cash-and-debt financed rebalancing (15%, Column 6, Panel B) and cash-only financed rebalancing (16%, Column 6, Panel C). However, the size of the net debt issue is small for both cash-and-debt financed rebalancing (5%, Column 6, Panel B) and cash-only financed rebalancing (1%, Column 6, Panel C). In addition, the cash balance drawdown ($-CH$) is large: (8%, Column 4, Panel B) for cash-and-debt financed rebalancing and (11%, Column 4, Panel C) for cash-only financed rebalancing. Overall, the results indicate that cash-and-debt financed rebalancing and cash-only financed rebalancing imply large cash balance drawdown and small debt issues. Hence, only debt-financed rebalancing events fulfil our conditions, and we employ this event as a proxy for refinancing. Our argument is in line with Eckbo and Kisser (2021).

3.3. Descriptive statistics

Table 6 provides descriptive statistics for our sample of mean reverting firms. When compared to summary statistics from other studies (e.g., see Danis et al., 2014, p. 431) we observe similar average characteristics for the sample of mean reverting firms compared to an overall sample that includes both nonstationary and mean reverting firms. One notable exemption is a lower level of risk, which may be expected given that generally higher mean reversion of earnings in our sample firms implies lower risk (also see discussion on how higher mean reversion speeds imply lower risk in Sarkar and Zapatero, 2004; Agliardi et al., 2022).

[Insert Table 6 about here]

Table 7 shows how the composition of positive and negative growth firms is quite even across time for our sample. In results shown in Table A.1 in the internet appendix, we find that the overall sample median growth rate of earnings for stationary firms is close to zero (–0.0065) and remains negative but close to zero for five-year splits of sample periods reaching a negative of –1% between 1985 and 1989 and between 1989 and 1994. Thus, the composition of firms between positive and negative growth is in direct analogy with our theoretical model simulations performed earlier, which included both negative and positive growth firms.

[Insert Table 7 about here]

3.4. Multivariate empirical model

As in Eckbo and Kisser (2021), we employ a panel regression where our dependent variable is proxied by gross market leverage, and rebalancing events are proxied by debt-financed events. The empirical linear regression model standard in the literature (Equation 3 in Danis et al., 2014, p.427, and Equation 4 in Eckbo and Kisser, 2021, p.1095) is as follows:

$$L_{it} = \alpha_0 + \beta_0 \pi_{i,t-1} + \beta_1 \pi_{i,t-1} d_{it} + \gamma d_{it} + \kappa Z_{i,t-1} + \varepsilon_{it} \tag{22}$$

Debt-financed rebalancing: a_t=1 if $\frac{\Delta D_t^e}{A_t}$>5% and $\frac{ER_t^e}{A_t}$>5%

where L_{it} is the gross market leverage ratio of firm i in quarter t, and $\pi_{i,t-1}$ is the operating profit of firm i in lagged quarter, $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indictor variable equal to one if firm i is refinancing at quarter t and zero otherwise, while ε_{it} is the remainder stochastic error term. In this model, following previous studies (e.g., Danis et al., 2014, and Eckbo and Kisser, 2021), we use pooled Ordinary Least Squares (OLS). A detailed explanation of the reasons why firm fixed effects are not included can be found in Danis et al. (2014), p.433.

Dependent variable $L_{i,t}$ is the gross market leverage ratio (=D/MV); *D* is the book value of total debt (=debt in current liabilities + long-term debt); *MV* is the sum of *D* and market value of total equity (=closing price X no. of common shares outstanding + short-term debt + long-term debt); ΔD_t^e is the change in long-term debt; ER_t^e is the equity retirement in excess of equity issues; *A* is the book value of total assets; *P* is the operating profit divided by *A*; the constant issue-size threshold *s* is in percent of *A*. The control variables include the following: *Risk* is the standard deviation of profitability calculated over four contiguous quarters; *M/B* is the market-to-book ratio (=closing price X no. of common shares outstanding + short-term debt + long-term debt / assets); *Tan* is the ratio of tangible assets to *A*; *Size* is the log (*A*) adjusted for inflation.

We winsorize the continuous variables *M/B*, *P*, *Size*, and *Risk* by 1% in both tails of the distribution, and set the naturally bounded variables (*L*, *Tan*) within the unit interval. We report the details construction of variables in the appendix Table A2, sample period 1984–2019. Rebalancing obs. and total obs. indicates the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Standard errors are clustered at the firm level.

Following our theoretical model prediction in hypothesis **H1,** we imply that $\beta_0 < 0$, which indicates that the unconditional correlation between profitability and leverage is negative during the period when firms are not adjusting their capital structure. Second, hypothesis **H2** implies that $\beta_1 < 0$; at refinancing, the relation between leverage and profitability is negative.

To compare with Eckbo and Kisser (2021) and Danis et al. (2014), we also expect that $\beta_0 + \beta_1 \neq 0$ because both $\beta_0 < 0$ and $\beta_1 < 0$. Finally, **H3** implies that we generally expect $\gamma > 0$.

Our model includes standard control variables as used in related literature (see Eckbo and Kisser 2021; Danis et al., 2014). Note that the empirical model includes the market-to-book ratio to control for firms' growth. In the tabulated results, we also include a control for earnings growth (in line with theoretical based regressions), which does not alter our main results. Table 8 reports our primary regression results. Based on previous studies (e.g., Leary and Roberts, 2005, 2010; Eckbo et al., 2007; Eckbo and Kisser, 2021), we use an issue-size threshold of 5% in our base case results and also run sensitivity tests in other columns with issue-size thresholds of 1.5% and 7.5%, respectively.

[Insert Table 8 about here]

First, our results in Table 8 show the coefficient on profit (π) is negative and significant ($p < 0.01$) for all threshold sizes, implying that a high level of profits is correlated with a lower level of leverage during the period without a rebalancing event. Overall, the results support our hypothesis **H1** that the unconditional profit–leverage correlation is negative. As noted in the section describing the theoretical framework, this effect captures infrequent rebalancing decisions of firms due to refinancing costs. This "inaction" creates a mechanically negative relation between profitability and leverage for firms with mean reversion in earnings. A similar effect due to inaction occurs in studies focusing on nonstationary dynamics (see Eckbo and Kisser 2021 and Danis et al. 2014).

Second, we find that the interaction of refinancing dummy with profitability is negative; however, this is statistically significant (at the 5% level) only for the 1.25% issue-size threshold. As noted in the theoretical section, despite the usual assumed positive relation between profitability and leverage attributed to trade-off models, with mean reversion in earnings, the predicted relation between profitability and leverage at refinancing is negative. Intuitively, at high refinancing thresholds, mean reverting firms cannot credibly carry high debt levels because a high profitability level is only temporary and is expected to revert to the firm's long-term mean. In contrast, because refinancing is triggered at a higher (compared to the initial) profitability level, equity value increases more than debt; hence, leverage ratios drop. Importantly, this feature does not hold for nonstationary firms, as shown in Danis et al. (2014). These results thus show partial support for **H2**, relating the relation of profitability with leverage at refinancing. We also note that for all thresholds, the Wald test of sum of coefficients results support that $\beta_0 + \beta_1$ is different from zero and negative, showing additional support for a negative relation. This result implies that even if more profitable firms do not fully decrease their leverage ratios compared to less profitable ones during the refinancing decision, when one also accounts for the mechanical downward adjustment in leverage during the inaction period, the overall reaction is in the expected (negative) direction.

Third, on average, we find that mean reverting firms' leverage ratios adjust upward during refinancing, as indicated by the positive coefficient of the refinancing dummy variable (statistically significant at $p < 0.01$ for all issue-size thresholds). As explained in the theoretical model, such upward adjustments are driven by firms initially below their long-term means and firms that generally have low mean reversion speeds. Intuitively, such firms initially have more conservative debt policies because they are below their long-term profitability, or they converge slower to their full long-term potential due to a low mean reversion speed. Once these firms come closer to their long-term profit levels, however, they increase their debt levels considerably because those levels of profitability are more sustainable. Zhou et al. (2016) show that the speed of adjustment toward target leverage ratios is affected by how sensitive the firm's cost of capital is when deviating from targets. Although dynamic models like the one provided in this paper do not imply a firm target leverage, our analysis highlights leverage's differing levels of adjustment depending on where a firm's profitability stands compared to its long-term potential.

Finally, we note that control variable signs are consistent with earlier studies (see Eckbo and Kisser 2021 and Danis et al. 2014). For instance, the coefficients on risk (−), size (+), market-to-book (−), and tangible assets (+). These findings also indicate our regression results are robust. In addition, the inclusion of an earnings growth dummy with the value of one for positive growth and zero for negative growth earnings firms does not alter the main findings.

In our baseline results (see Table 8), "risk" is the standard deviation of profitability calculated over four contiguous quarters. However, as a robustness test, we estimate risk using T = 20 over contiguous quarters (see Eckbo and Kisser, 2021 and Danis et al., 2014). As a result, the numbers of both observations and rebalancing events are reduced. However, the conclusion remains unchanged when we define risk based on twenty contiguous quarters (shown in Table A.2 in the internet appendix). We then conduct the same analysis, including additional control variables. Similar additional control variables have been used in prior studies (see Danis et al., 2014). As expected, the results are qualitatively similar to our baseline results (see Table 8). We report the results in Table A.3 in the internet appendix.

Eckbo and Kisser (2021) use a sample that includes both mean reverting and nonstationary firms, showing a negative relation of profitability and leverage at refinancing. Table 9 replicates the main findings of Eckbo and Kisser (2021). Taken together with our analysis, this suggests that the negative effect may be driven by the presence of firms with mean reversion in earnings.

[Insert Table 9 about here]

5. Robustness Tests

5.1. Estimation based on quantile regression

The fact that our main regression results (see Table 8) are estimated based on the conditional mean raises concern that some part of our sample distribution might produce different results. To address this concern, we estimate the same models based on quantile regression and present the results in Table 10. Frank and Goyal (2015) follow a similar approach to gauge this concern. We find that the negative relation between profitability and leverage is driven by firms in the low leverage quantile. Indeed, we observe that the relation of profitability with leverage is negative and statistically significant only for the low leverage quantile group. In addition, we notice that the upward leverage ratio adjustment becomes more significant for firms belonging in lower leverage quantile groups. Intuitively, this result aligns with our theoretical model in which firms with lower leverage adjust upward, whereas the opposite is true when initial leverage is high. This effect may also be partially driven by debt conservatism, as suggested by Graham (2022).

[Insert Table 10 about here]

5.2. Net leverage regressions

In this section, we perform regressions along the lines of Danis et al. (2014) using net leverage as the dependent variable (i.e., netting cash balances from debt). Tables 11 and 12 show net leverage (one for all firms and another for mean reverting). In contrast to our previous tables and Eckbo et al. (2021), these results focus on cash- and debt-financed rebalancing, as in Danis et al. (2014).

As one can readily see, if we follow this approach, the results for mean reverting firms are identical to Danis et al.'s (2014) paper, showing a positive relation of net leverage with profitability at refinancing. In contrast to Eckbo and Kisser (2011), Danis et al.'s (2014) inclusion of cash and debt financing events aims to capture the possibility that firms obtain debt financing they use in subsequent periods to adjust their capital structure (refinance).

Hence, the inclusion of cash adjustments is in an effort to capture possible increases in debt financing and adjustments in firms' capital structure. Eckbo and Kisser (2021) suggest this approach inflates rebalancing events and may also capture adjustments in firms' cash policy. Instead, Eckbo and Kisser's (2011) and our analyses are more conservative because we focus only on pure debt rebalancing events, excluding the possibility of events that merely reflect cash adjustments (i.e., payouts arising from cash balances accumulated through positive earnings in previous periods).

[Insert Table 11 about here]

[Insert Table 12 about here]

6. Conclusion

We build a dynamic two-stage trade-off model with mean reversion in earnings to study firms' refinancing decisions. We show that in accounting for mean reversion, we obtain a negative relation between profitability and leverage at refinancing, which appears in line with empirical evidence and helps shed light on the observed profitability–leverage puzzle. Our quantile empirical analysis shows, however, that this effect is mainly driven by firms in the lower leverage ratio quantile. Our work provides grounds for further work in the area by recognizing the importance of modeling earnings dynamics and possibly integrating other factors such as debt conservatism in the empirical setup as is also suggested by recent survey evidence in Graham's study (2022).

Our theoretical model also provides new insights with respect to the dynamics of leverage ratios, predicting that during rebalancing, firms raise more debt. However, firms' leverage ratios increase only when earnings are below their long-term profitability. This suggests that firm-specific characteristics related to firms' current state play important roles in understanding earnings dynamics. Indeed, evidence shown in Lemmon et al. (2008) points to the importance of incorporating firm-specific characteristics in future research.

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Figure 1. The theory-based relation of leverage and profitability at refinancing for mean reverting firms

This figure shows the relation between leverage at refinancing (Lev_1) and return on asset ($\frac{x_I(1-\tau)}{Ua(x_I)}$) based on theoretical model simulation (see Table 1). It draws upon simulations based on Table 1 with x = [0.7,1.3], using increments of 0.05 to increase the data points needed to investigate the linear relation of leverage with return on asset at refinancing.

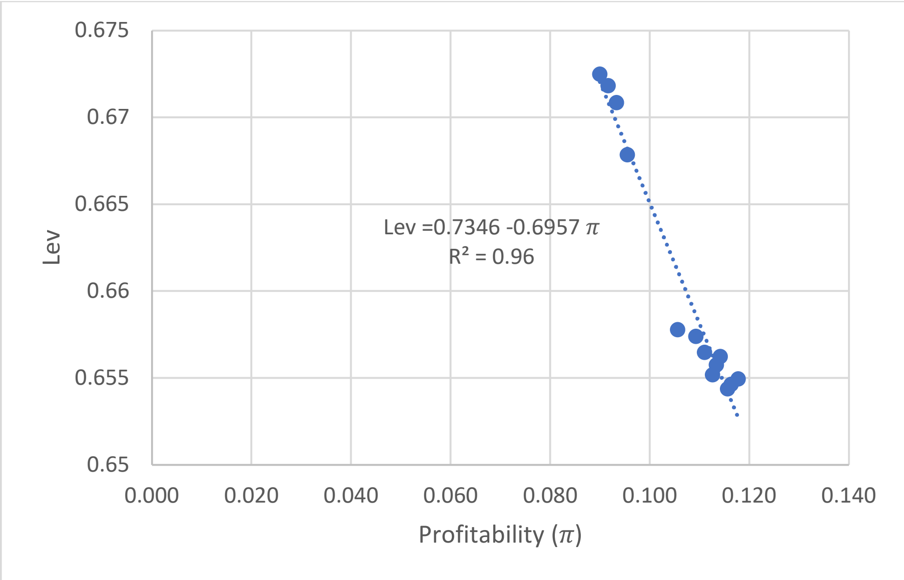

Table 1. Theoretical model predictions regarding leverage dynamics and profitability—stationary firms

This table presents sensitivity results for the model described in section 2. We use a normalized level of current earnings at $x = 1$, $\sigma = 0.4$, mean reversion speed q = 0.1, and long-term mean $\theta = 1$. The parameters of the AMR process are in line with empirical estimates provided in Agliardi et al. (2022). We follow Goldstein et al. (2001) and Danis et al. (2014) using a tax rate of $\tau = 0.3$ and proportional bankruptcy costs of $b = 0.15$ and $r = 0.06$. Note that $\pi(x_I) = \frac{x_I(1-\tau)}{Ua(x_I)}$ is the post-tax return on assets.

Panel A: Firm and security values, leverage, and profitability

x	$Fb(x)$	$Eb(x)$	$Db(x)$	$Lev_b(x)$	$Lev_1(x_I)$	ΔLev	$\pi(x_I)$
0.7	12.60	4.84	7.85	0.619	0.672	0.054	0.129
0.8	13.09	4.92	8.25	0.627	0.671	0.044	0.133
0.9	13.57	4.11	9.56	0.699	0.658	-0.042	0.151
1	14.07	3.96	10.21	0.720	0.656	-0.064	0.159
1.1	14.58	4.10	10.59	0.721	0.656	-0.065	0.162
1.2	15.08	4.23	10.96	0.722	0.654	-0.067	0.165
1.3	15.59	4.37	11.34	0.722	0.655	-0.067	0.168

Panel B: Firms' policies and optimal coupon values

x	x_b	x_I	x_L	R_0	R_1
0.7	-0.816	2.141	0.017	0.51	0.95
0.8	-0.750	2.334	0.100	0.54	1.00
0.9	-0.505	3.238	0.446	0.66	1.22
1	-0.391	3.774	0.667	0.72	1.37
1.1	-0.335	4.057	0.781	0.75	1.45
1.2	-0.280	4.346	0.892	0.78	1.53
1.3	-0.226	4.642	1.014	0.81	1.62

Table 2. The effect of mean reversion speed and volatility on values and leverage ratios

This table presents sensitivity results regarding mean reversion speed for the model described in section 2. We use a normalized level of current earnings at x = 1, σ = 0.4, mean reversion speed q = [0.025–0.175], and long-term mean θ = 1. The parameters of the AMR process are in line with empirical estimates provided in Agliardi et al. (2022). We follow Goldstein et al. (2001) and Danis et al. (2014) using a tax rate of τ = 0.3 and proportional bankruptcy costs of b = 0.15 and r = 0.06. Note that $\pi(x_I) = \frac{x_I(1-\tau)}{Ua(x_I)}$ is the after-tax return on assets.

Panel A: Firm and security values, leverage, and profitability

q	$Fb(x)$	$Eb(x)$	$\mathrm{Db}(x)$	$Lev_b(x)$	$Lev_1(x_I)$	ΔLev	$\pi(x_I)$
0.025	14.62	4.62	10.10	0.686	0.742	0.056	0.075
0.05	14.23	4.48	9.86	0.688	0.712	0.024	0.087
0.075	14.08	4.33	9.85	0.695	0.686	-0.009	0.098
0.1	14.08	3.96	10.21	0.720	0.656	-0.064	0.111
0.125	14.17	3.91	10.36	0.726	0.619	-0.107	0.124
0.15	14.31	3.94	10.47	0.726	0.568	-0.158	0.138
0.175	14.47	3.95	10.63	0.729	0.498	-0.231	0.155

Panel B: Firms' policies and optimal coupon values

q	x_b	x_I	x_L	R_0	R_1
0.025	-0.227	3.251	1.113	0.87	2
0.05	-0.314	3.222	0.857	0.77	1.65
0.075	-0.38	3.31	0.688	0.72	1.44
0.1	-0.391	3.774	0.667	0.72	1.37
0.125	-0.456	4.254	0.579	0.7	1.27
0.15	-0.545	4.832	0.414	0.68	1.14
0.175	-0.632	5.663	0.147	0.67	0.98

Table 3. The effect of volatility

This table presents sensitivity results regarding volatility for the model described in section 2. We use a normalized level of current earnings at $x = 1$, $\sigma = [0.2–0.5]$, mean reversion speed q = 0.1, and long-term mean $\theta = 1$. The parameters of the AMR process are in line with empirical estimates provided in Agliardi et al. (2022). We follow Goldstein et al. (2001) and Danis et al. (2014) using a tax rate of $\tau = 0.3$ and proportional bankruptcy costs of $b = 0.15$ and $r = 0.06$. Note that $\pi(x_I) = \frac{x_I(1-\tau)}{Ua(x_I)}$ is the after-tax return on assets.

Panel A: Firm and security values, leverage, and profitability

σ	Fb(x)	Eb(x)	Db(x)	$Lev_b(x)$	$Lev_1(x_I)$	ΔLev	$\pi(x_I)$
0.2	14.74	3.25	11.61	0.781	0.660	-0.121	0.060
0.25	14.50	3.57	11.05	0.756	0.657	-0.099	0.076
0.3	14.32	3.71	10.72	0.743	0.654	-0.089	0.093
0.35	14.18	3.87	10.41	0.729	0.654	-0.075	0.101
0.4	14.08	3.96	10.21	0.720	0.656	-0.064	0.110
0.45	14.00	4.07	10.03	0.711	0.658	-0.053	0.117
0.5	13.95	4.03	10.02	0.713	0.659	-0.054	0.125

Panel B: Firms' policies and optimal coupon values

σ	x_b	x_I	x_L	R_0	R_1
0.2	0.047	2.573	0.483	0.73	0.96
0.25	-0.093	2.797	0.486	0.71	1.03
0.3	-0.196	3.148	0.547	0.71	1.14
0.35	-0.302	3.431	0.587	0.71	1.24
0.4	-0.391	3.774	0.667	0.72	1.37
0.45	-0.481	4.092	0.731	0.73	1.49
0.5	-0.537	4.573	0.862	0.76	1.66

Table 4. Mean reverted sample selection: Quarterly CRSP/Compustat samples, 1984–2019

Sample restriction	Number of firm-quarters	Number of firms
Raw sample	942,498	23,450
Industrial firms only[a]	– 278,018	– 5,894
No multiple quarterly observations[b]	– 8,546	0
Profitability data for at least 40 quarters[c,d]	– 190,060	11,561
Contiguous data for at least 40 quarters[e]	– 104,048	– 1,161
Keep only one series for at least 40 quarters[f]	– 14,074	– 2
Keep only mean reverted firms[g]	– 66,433	– 1,039
Non-missing balance sheet data[h]	– 19,859	– 8
Non-missing income statement data[i]	– 3,719	– 9
Non-missing cash flow statement data[j]	– 4,181	– 0
Estimation period for Risk is 4 quarters and lag explanatory variables[k,l]	–12,597	–22
=Final mean reverted sample used in the analysis	**240,963**	**3,754**

Notes:

[a] Our criteria exclude utilities (SIC codes 4900–4999) and financial firms (SIC codes 6000–6999).

[b] Duplicate information and changes in fiscal year dates are excluded. For example, the first fiscal quarter may be changed from March 31 to April 30. The CCM database would, therefore, contain two observations for the first quarter. Therefore, we drop the first observation from March 31 and keep the second observation from April 30.

[c] We require non-missing information on profitability (=*oibdpq*/*atq*).

[d] We require non-missing information on profitability (=*oibdpq*/*atq*) for at least 40 quarters.

[e] We require 40 contiguous observations on profitability for each firm.

[f] In some firms, there is more than one period with at least 40 contiguous observations on profitability. As an example, a company has 81 observations on profitability. However, we do not have a profitability observation for quarter 41. Due to this situation, this firm has two periods with 40 consecutive observations regarding profitability (i.e., before and after quarter 41). Based on our criteria, we exclude the first period (i.e., before quarter 41) and keep the recent period (i.e., after quarter 41).

[g] We keep only mean-reverted firms.

[h] To maintain balance sheet data consistency, we need non-missing data on the book value of assets (*atq*), the market value of equity (*prccq* X *cshoq*), total debt (*dlttq* + *dlcq*), cash holdings (*cheq*), property plant and equipment (*ppentq*), and changes in long-term debt and cash.

[i] For income statement consistency, we need non-missing, nonzero, and positive revenue (*saleq*) data.

[j] For cash-flow data consistency, we follow the following steps: i) First, we set zero for missing entries on the cash flow statement; ii) second, we group all funding sources and uses; iii) third, observations are dropped if the total number of sources or uses of funds equals zero or differs by more than 1%.

[k] We calculate risk based on the standard deviation of profitability. We do the calculation on a rolling basis. Calculating risk requires at least four consecutive observations. Consequently, the first three-quarters of our risk data are missing, and we drop first three observations.

[l] Estimation model is based on lagged key variables of interest and control variables.

Table 5. Sources and uses of funds of mean reverting firms that rebalance capital structure

The table shows aspects of firms' cash flow identity based on the three types of rebalancing event. We report debt-financed rebalancing (type a_t), cash-and-debt-financed rebalancing (type a_t^N), and cash-financed leverage rebalancing (type a_t^C) in panels A, B, and C, respectively. We use the following formulas are used to estimate rebalancing events:

$$\text{Debt-financed rebalancing: } a_t = 1 \text{ if } \frac{\Delta D_t^e}{A_t} > 5\% \text{ and } \frac{ER_t^e}{A_t} > 5\%$$

$$\text{Cash -and- debt-financed rebalancing: } a_t^N = 1 \text{ if } \frac{\Delta D_t^e - \Delta C_t}{A_t} > 5\% \text{ and } \frac{ER_t^e}{A_t} > 5\%$$

$$\text{Cash -only financed rebalancing: } a_t^C = 1 \text{ if } \frac{-\Delta C_t}{A_t} > 5\% \text{ and } \frac{ER_t^e}{A_t} > 5\%$$

where ΔD_t^e is the change in long-term debt, ΔC_t is the change in cash balances, ER_t^e equity retirement in excess of equity issues, and A is the book value of total assets. The cash flow identity of a firm can be summarized as follows.

$$OCF - INV + OTH + (-CH + IVSTCH) = ER^e - DI^e$$

where left hand side of the equations shows operating cash flow (*OCF*), total net investment outlays (*INV*), (generally small) other financing cash flows (*OTH*) and Cash and cash equivalents (*-CH+IVSTCH*). Cash and cash equivalents further be divided into two components: drawdown of cash balances (*–CH*) and the net sale of short-term marketable securities (*IVSTCH*). Right-hand side of the equations shows net equity retirement (ER^e) and net debt issues (DI^e). We scale all variables based on book value. We report the details construction of variables in the appendix Table A2, sample period 1984–2019.

				Cash and equivalents		Debt-financed rebalancing	
	OCF	*INV*	*OTH*	*-CH*	*IVSTCH*	ER^e	DI^e
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Debt-financed rebalancing (type a_t)							
All	0.03	0.02	0.00	0.00	0.00	0.16	0.15
Panel B: Cash-and-Debt-financed rebalancing (type a_t^N)							
All	0.02	0.01	0.00	0.08	0.02	0.15	0.05

Panel C: Cash-only financed rebalancing (type a_t^C)							
All	0.02	0.01	0.00	0.11	0.02	0.16	0.01

Table 6. Summary statistics of key variables

The table reports mean, standard deviation, distributions (10th, 50th and 90th) for the mean reverted firms. Our sample comes from the quarterly merged CRSP/Compustat (CCM) database between Q1/1984 and Q4/2019. We exclude utilities (SIC codes 4900-4999) and financial companies (SIC codes 6000-6999). We also exclude firms with missing data on the key variables. We winsorize the continuous variables *M/B*, *P*, *Size*, and *Risk* by 1% in both tails of the distribution, and set the naturally bounded variables (*L*, *Tan*) within the unit interval.

Variable definitions:

market leverage (gross) = [debt in current liabilities(*dlcq*) + long-term debt (*dlttq*)] / [closing price (*prccq*) X no. of common shares outstanding (*cshoq*) + short-term debt (*dlcq*) + long-term debt (*dlttq*)]; profitability = operating profit (*oibdpq*)/assets (*atq*); risk = the standard deviation of profitability calculated over four contiguous quarters; size = log(*atq*) adjusted for inflation; market-to-book (Tobin's Q) = [closing price (*prccq*) X no. of common shares outstanding (*cshoq*) + short-term debt (*dlcq*) + long-term debt (*dlttq*) / assets (*atq*); tangibility = net property plant and equipment (*ppentq*)/assets (atq).

We report the details construction of variables in the appendix Table A2, sample period 1984–2019.

			Distribution		
Variable	Mean	SD	10^{th}	50^{th}	90^{th}
Gross Market leverage (*L*)	0.217	0.221	0	0.154	0.553
Profitability (*P*)	0.023	0.049	-0.021	0.030	0.065
Risk	0.016	0.019	0.003	0.010	0.037
Size	5.194	2.115	2.477	5.060	8.113
Market-to-book (*M/B*)	1.668	1.506	0.616	1.188	3.171
Tangibility (*Tan*)	0.289	0.234	0.046	0.220	0.668
Observations	240,963				
Number of Firms	3,754				

Table 7. Fraction of firms belonging in positive growth groups versus negative growth groups

	Full sample		*Stationary firms*	
	Positive growth	Negative growth	Positive growth	Negative growth
Fiscal year	Firm-year observations	Firm-year observations	Firm-year observations	Firm-year observations
1985-2019	0.50	0.50	0.49	0.51
1985-1989	0.49	0.51	0.49	0.51
1990-1994	0.49	0.51	0.49	0.51
1995-1999	0.51	0.49	0.50	0.50
2000-2004	0.50	0.50	0.49	0.51
2005-2009	0.50	0.50	0.49	0.51
2010-2014	0.51	0.49	0.50	0.50
2015-2019	0.49	0.51	0.49	0.51

Table 8. Baseline results: The relation of leverage and profitability with debt-financed rebalancing events for mean reverted firms

This table presents coefficient estimates from the following empirical linear regressions model:

$$L_{it} = \alpha_0 + \beta_0\pi_{i,t-1} + \beta_1\pi_{i,t-1}d_{it} + \gamma d_{it} + \kappa Z_{i,t-1} + \varepsilon_{it}$$

Debt-financed rebalancing: a_t=1 if $\frac{\Delta D_t^e}{A_t}$>s and $\frac{ER_t^e}{A_t}$>s

where L_{it} is the gross market leverage ratio of firm *i* in quarter *t*, and $\pi_{i,t-1}$ is the operating profit of firm i in lagged quarter $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indictor variable equal to one if firm *i* is refinancing at quarter *t* and zero otherwise, while ε_{it} is the remainder stochastic error term.

Dependent variable $L_{i,t}$ is the gross market leverage ratio (=D/MV); *D* is the book value of total debt (=debt in current liabilities + long-term debt); *MV* is the sum of *D* and market value of total equity (=closing price X no. of common shares outstanding + short-term debt + long-term debt); ΔD_t^e is the change in long-term debt; ER_t^e is the equity retirement in excess of equity issues; *A* is the book value of total assets; *P* is the operating profit divided by *A*; the constant issue-size threshold *s* is in percent of *A*. The control variables include the following: *Risk* is the standard deviation of profitability calculated over four contiguous quarters; *M/B* is the market-to-book ratio (=closing price X no. of common shares outstanding + short-term debt + long-term debt / assets); *Tan* is the ratio of tangible assets to *A*; *Size* is the log (*A*) adjusted for inflation.

We winsorize the continuous variables *M/B*, *P*, *Size*, and *Risk* by 1% in both tails of the distribution, and set the naturally bounded variables (*L*, *Tan*) within the unit interval. We report the details construction of variables in the appendix Table A2, sample period 1984–2019. Rebalancing obs. and total obs. indicates the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Superscript *, **, and *** refer significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the firm level in parentheses.

Dependent variable	Market leverage					
Issue size threshold s	s = 5%		s = 1.25%		s = 7.5%	
	(1)	(2)	(3)	(4)	(5)	(6)
π (β_0)	-0.605***	-0.592***	-0.600***	-0.587***	-0.605***	-0.592***
	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
***d* (γ)**	0.047***	0.046***	0.015**	0.017***	0.073***	0.073***
	(0.011)	(0.011)	(0.006)	(0.006)	(0.012)	(0.013)
***d X* π (β_1)**	-0.083	-0.092	-0.282**	-0.307**	-0.043	-0.061
	(0.232)	(0.242)	(0.125)	(0.130)	(0.277)	(0.286)
Risk	-0.138	-0.165*	-0.136	-0.164*	-0.138	-0.165*
	(0.085)	(0.085)	(0.085)	(0.085)	(0.085)	(0.086)
Size	0.014***	0.015***	0.014***	0.015***	0.014***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
M/B	-0.052***	-0.052***	-0.052***	-0.051***	-0.052***	-0.052***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tan	0.203***	0.203***	0.203***	0.203***	0.203***	0.203***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Growth Dummy		-0.009***		-0.010***		-0.009***
		(0.001)		(0.001)		(0.001)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.224	0.224	0.224	0.224	0.224	0.224
Rebalancing obs.	998	976	6,011	5,762	556	548
Total obs.	240,963	237,334	240,963	237,334	240,963	237,334
Hypothesis H_0: $\beta_0 + \beta_1 = 0$						
$\beta_0 + \beta_1$	**-0.689*** **	**-0.683*** **	**-0.882*** **	**-0.894*** **	**-0.649** **	**-0.653** **
Wald test ($\beta_0 + \beta_1 = 0$)	0.000	0.000	0.000	0.000	0.021	0.025

Table 9. The relation of leverage and profitability with debt-financed rebalancing events for all firms

This table presents coefficient estimates from the following empirical linear regressions model:

$$L_{it} = \alpha_0 + \beta_0\pi_{i,t-1} + \beta_1\pi_{i,t-1}d_{it} + \gamma d_{it} + \kappa Z_{i,t-1} + \varepsilon_{it}$$

$$\text{Debt-financed rebalancing: } a_t = 1 \text{ if } \frac{\Delta D_t^e}{A_t} > 5\% \text{ and } \frac{ER_t^e}{A_t} > 5\%$$

where L_{it} is the gross market leverage ratio of firm *i* in quarter *t*, and $\pi_{i,t-1}$ is the operating profit of firm i in lagged quarter $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indictor variable equal to one if firm *i* is refinancing at quarter *t* and zero otherwise, while ε_{it} is the remainder stochastic error term.

Dependent variable $L_{i,t}$ is the gross market leverage ratio (=D/MV); *D* is the book value of total debt (=debt in current liabilities + long-term debt); *MV* is the sum of *D* and market value of total equity (=closing price X no. of common shares outstanding + short-term debt + long-term debt); ΔD_t^e is the change in long-term debt; ER_t^e is the equity retirement in excess of equity issues; *A* is the book value of total assets; *P* is the operating profit divided by A; the constant issue-size threshold *s* is in percent of *A*. The control variables include the following: *Risk* is the standard deviation of profitability calculated over four contiguous quarters; *M/B* is the market-to-book ratio (=closing price X no. of common shares outstanding + short-term debt + long-term debt / assets); *Tan* is the ratio of tangible assets to *A*; *Size* is the log (*A*) adjusted for inflation.

We winsorize the continuous variables *M/B*, *P*, *Size*, and *Risk* by 1% in both tails of the distribution, and set the naturally bounded variables (*L*, *Tan*) within the unit interval. We report the details construction of variables in the appendix Table A2, sample period 1984–2019. Rebalancing obs. and total obs. indicates the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Superscript *, **, and *** refer significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the firm level in parentheses.

Dependent variable	Market leverage					
Issue size threshold *s*	*s* = 5%		*s* = 1.25%		*s* = 7.5%	
	(1)	(2)	(3)	(4)	(5)	(6)
π (β_0)	-0.554***	-0.538***	-0.549***	-0.533***	-0.554***	-0.538***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
d (γ)	0.041***	0.041***	0.012**	0.014**	0.065***	0.065***
	(0.009)	(0.010)	(0.005)	(0.005)	(0.011)	(0.012)
d X π (β_1)	0.018	0.014	-0.277**	-0.299**	0.078	0.057
	(0.194)	(0.203)	(0.115)	(0.118)	(0.234)	(0.241)
Risk	-0.102	-0.131*	-0.099	-0.130	-0.102	-0.131*
	(0.078)	(0.079)	(0.078)	(0.079)	(0.079)	(0.079)
Size	0.015***	0.016***	0.015***	0.016***	0.015***	0.016***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
M/B	-0.048***	-0.048***	-0.048***	-0.048***	-0.048***	-0.048***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tan	0.223***	0.223***	0.223***	0.223***	0.223***	0.223***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Growth Dummy		-0.009***		-0.009***		-0.009***
		(0.001)		(0.001)		(0.001)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.236	0.236	0.236	0.236	0.236	0.236
Rebalancing obs.	1,243	1,214	7,229	6,954	698	689
Total obs.	296,526	292,275	296,526	292,275	296,526	292,275
Hypothesis H0: $\beta_0 + \beta_1 = 0$						
$\beta_0 + \beta_1$	**-0.536*****	**-0.523****	**-0.826*****	**-0.831*****	**-0.475****	**-0.480****
Wald test ($\beta_0 + \beta_1 = 0$)	0.000	0.011	0.000	0.000	0.046	0.047

Table 10. The leverage and profitability quantile's relation with debt-financed rebalancing events for mean reverted firms

This table presents coefficient estimates from the following empirical linear regressions model:

$$L_{it} = \alpha_0 + \beta_0\pi_{i,t-1} + \beta_1\pi_{i,t-1}d_{it} + \gamma d_{it} + \kappa Z_{i,t-1} + \varepsilon_{it}$$

$$\text{Debt-financed rebalancing: } a_t = 1 \text{ if } \frac{\Delta D_t^e}{A_t} > 5\% \text{ and } \frac{ER_t^e}{A_t} > 5\%$$

where L_{it} is the gross market leverage ratio of firm *i* in quarter *t*, and $\pi_{i,t-1}$ is the operating profit of firm i in lagged quarter $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indictor variable equal to one if firm *i* is refinancing at quarter *t* and zero otherwise, while ε_{it} is the remainder stochastic error term.

Dependent variable $L_{i,t}$ is the gross market leverage ratio (=D/MV); *D* is the book value of total debt (=debt in current liabilities + long-term debt); *MV* is the sum of *D* and market value of total equity (=closing price X no. of common shares outstanding + short-term debt + long-term debt); ΔD_t^e is the change in long-term debt; ER_t^e is the equity retirement in excess of equity issues; *A* is the book value of total assets; *P* is the operating profit divided by A; the constant issue-size threshold *s* is in percent of *A*. The control variables include the following: *Risk* is the standard deviation of profitability calculated over four contiguous quarters; *M/B* is the market-to-book ratio (=closing price X no. of common shares outstanding + short-term debt + long-term debt / assets); *Tan* is the ratio of tangible assets to *A*; *Size* is the log (*A*) adjusted for inflation.

We winsorize the continuous variables *M/B*, *P*, *Size*, and *Risk* by 1% in both tails of the distribution, and set the naturally bounded variables (*L*, *Tan*) within the unit interval. We report the details construction of variables in the appendix Table A2, sample period 1984–2019. Rebalancing obs. and total obs. indicates the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Superscript *, **, and *** refer significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the firm level in parentheses.

Dependent variable	**Market leverage** (Issue size threshold s = 5%)					
Quantile q	q = 25		q = 50		q = 75	
	(1)	(2)	(3)	(4)	(5)	(6)
$\boldsymbol{\pi}$ $(\boldsymbol{\beta_0})$	-0.226***	-0.221***	-0.561***	-0.548***	-1.064***	-1.054***
	(0.016)	(0.016)	(0.034)	(0.033)	(0.051)	(0.051)
$\boldsymbol{d}$ $(\boldsymbol{\gamma})$	0.080***	0.081***	0.076***	0.0691***	0.033**	0.036**
	(0.008)	(0.009)	(0.021)	(0.008)	(0.016)	(0.014)
$\boldsymbol{d \, X \, \pi}$ $(\boldsymbol{\beta_1})$	-0.490***	-0.501***	-0.400	-0.244	0.146	0.0183
	(0.134)	(0.142)	(0.454)	(0.153)	(0.227)	(0.236)
Risk	-0.043	-0.042	-0.130	-0.131	-0.192	-0.222*
	(0.042)	(0.043)	(0.079)	(0.079)	(0.124)	(0.128)
Size	0.014***	0.014***	0.016***	0.016***	0.010***	0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
M/B	-0.017***	-0.017***	-0.039***	-0.039***	-0.058***	-0.057***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tan	0.154***	0.156***	0.221***	0.222***	0.275***	0.275***
	(0.008)	(0.008)	(0.011)	(0.011)	(0.018)	(0.018)
Growth Dummy		-0.001		-0.007***		-0.020***
		(0.001)		(0.001)		(0.001)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. $R^{\wedge 2}$	0.187	0.188	0.218	0.218	0.214	0.214
Rebalancing obs.	998	976	998	976	998	976
Total obs.	240,963	237,334	240,963	237,334	240,963	237,334
Hypothesis H0: $\boldsymbol{\beta_0 + \beta_1 = 0}$						
$\boldsymbol{\beta_0 + \beta_1}$	**-0.716*** **	**-0.722*** **	**-0.962** **	**-0.792*** **	**-0.919*** **	**-1.035*** **
Wald test ($\boldsymbol{\beta_0 + \beta_1}$=0)	0.000	0.000	0.035	0.000	0.000	0.000

Table 11. Net leverage and profitability's relation with cash- and debt-financed rebalancing for all firms

This table presents coefficient estimates from the following empirical linear regressions model:

$$L_{it}^{N} = \alpha_0 + \beta_0 \pi_{i,t-1} + \beta_1 \pi_{i,t-1} d_{it} + \gamma d_{it} + \kappa Z_{i,t-1} + \varepsilon_{it}$$

Cash -and- debt-financed rebalancing: $a_t^N = 1$ if $\frac{\Delta D_t^e - \Delta C_t}{A_t} > 5\%$ and $\frac{ER_t^e}{A_t} > 5\%$

where L_{it}^{N} is the net market leverage ratio of firm i in quarter *t*, and $\pi_{i,t-1}$ is the operating profit of firm *i* in lagged quarter. $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indictor variable equal to one if firm *i* is refinancing at quarter *t* and zero otherwise, while ε_{it} is the remainder stochastic error term.

Dependent variable L_{it}^{N} is the net market leverage ratio (=book debt of net cash holding/ book debt of net cash holding +market equity); ΔD_t^e is the change in long-term debt; ΔC_t is the change in cash holdings, ER_t^e is the equity retirement in excess of equity issues; *A* is the book value of total assets; *P* is the operating profit divided by *A*; the constant issue-size threshold *s* is in percent of *A*. The control variables include the following: *Risk* is the standard deviation of profitability calculated over 20 contiguous quarters; *M/B* is the market-to-book ratio (=closing price X no. of common shares outstanding + short-term debt + long-term debt / assets); *Tan* is the ratio of tangible assets to *A*; *Size* is the log (*A*) adjusted for inflation.

We winsorize the continuous variables *M/B*, *P*, *Size*, and *Risk* by 1% in both tails of the distribution, and truncate naturally bounded variables (*L*, *Tan*) within the unit interval. We report the details construction of variables in the appendix Table A2, sample period 1984–2019. Rebalancing obs. and total obs. indicates the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Superscript *, **, and *** refer significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the firm level in parentheses.

Dependent variable	Net market leverage					
Issue size threshold *s*	*s* = 5 %		*s* = 1.25%		*s* = 7.5%	
	(1)	(2)	(3)	(4)	(5)	(6)
π (β_0)	-0.180***	-0.161***	-0.171***	-0.153***	-0.183***	-0.164***
	(0.053)	(0.054)	(0.054)	(0.055)	(0.053)	(0.054)
d **(γ)**	-0.149***	-0.153***	-0.125***	-0.127***	-0.166***	-0.172***
	(0.016)	(0.016)	(0.008)	(0.008)	(0.022)	(0.022)
d X **π (β_1)**	1.365***	1.409***	0.880***	0.911***	1.816***	1.891***
	(0.244)	(0.250)	(0.134)	(0.135)	(0.339)	(0.351)
Risk	-1.570***	-1.565***	-1.591***	-1.589***	-1.568***	-1.562***
	(0.197)	(0.198)	(0.197)	(0.198)	(0.197)	(0.198)
Size	0.029***	0.030***	0.030***	0.0314***	0.029***	0.030***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
M/B	-0.022***	-0.021***	-0.021***	-0.020***	-0.022***	-0.021***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tan	0.463***	0.462***	0.460***	0.459***	0.463***	0.462***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Growth Dummy		-0.004**		-0.004***		-0.003**
		(0.001)		(0.001)		(0.001)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.170	0.170	0.172	0.173	0.169	0.169
Rebalancing obs.	3,021	2,971	15,092	14,685	1,632	1,613
Total obs.	226,219	222,596	226,219	222,596	226,219	222,596
Hypothesis H_0: $\beta_0 + \beta_1 = 0$						
$\beta_0 + \beta_1$	**1.184*** **	**1.247*** **	**0.709*** **	**0.758*** **	**1.632*** **	**1.726*** **
Wald test ($\beta_0 + \beta_1 = 0$)	0.000	0.000	0.000	0.000	0.000	0.000

Table 12. Net leverage and profitability's relation with cash- and debt-financed rebalancing for mean reverted firms

This table presents coefficient estimates from the following empirical linear regressions model:

$$L_{it}^{N} = \alpha_0 + \beta_0 \pi_{i,t-1} + \beta_1 \pi_{i,t-1} d_{it} + \gamma d_{it} + \kappa Z_{i,t-1} + \varepsilon_{it}$$

Cash -and- debt-financed rebalancing: a_t^N =1 if $\frac{\Delta D_t^e - \Delta C_t}{A_t}$>5% and $\frac{ER_t^e}{A_t}$>5%

where L_{it}^{N} is the net market leverage ratio of firm *i* in quarter *t*, and $\pi_{i,t-1}$ is the operating profit of firm *i* in lagged quarter. $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indictor variable equal to one if firm *i* is refinancing at quarter t and zero otherwise, while ε_{it} is the remainder stochastic error term.

Dependent variable L_{it}^{N} is the net market leverage ratio (=book debt of net cash holding/ book debt of net cash holding +market equity); ΔD_t^e is the change in long-term debt; ΔC_t is the change in cash holdings, ER_t^e is the equity retirement in excess of equity issues; *A* is the book value of total assets; *P* is the operating profit divided by *A*; the constant issue-size threshold *s* is in percent of *A*. The control variables include the following: *Risk* is the standard deviation of profitability calculated over 20 contiguous quarters; *M/B* is the market-to-book ratio (=closing price X no. of common shares outstanding + short-term debt + long-term debt / assets); *Tan* is the ratio of tangible assets to *A*; *Size* is the log (*A*) adjusted for inflation.

We winsorize the continuous variables *M/B*, *P*, *Size*, and *Risk* by 1% in both tails of the distribution, and truncate naturally bounded variables (*L*, *Tan*) within the unit interval. We report the details construction of variables in the appendix Table A2, sample period 1984–2019. Rebalancing obs. and total obs. indicates the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Superscript *, **, and *** refer significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the firm level in parentheses.

Dependent variable	Net market leverage					
Issue size threshold *s*	*s* = 5 %		*s* = 1.25%		*s* = 7.5%	
	(1)	(2)	(3)	(4)	(5)	(6)
π (β_0)	-0.248***	-0.236***	-0.235***	-0.225***	-0.251***	-0.240***
	(0.060)	(0.061)	(0.060)	(0.061)	(0.060)	(0.061)
***d* (γ)**	-0.150***	-0.155***	-0.123***	-0.126***	-0.163***	-0.171***
	(0.018)	(0.018)	(0.008)	(0.009)	(0.025)	(0.026)
***d X* π (β_1)**	1.276***	1.326***	0.806***	0.843***	1.656***	1.759***
	(0.286)	(0.293)	(0.148)	(0.150)	(0.399)	(0.417)
Risk	-1.514***	-1.499***	-1.532***	-1.519***	-1.512***	-1.496***
	(0.216)	(0.218)	(0.216)	(0.217)	(0.216)	(0.218)
Size	0.028***	0.029***	0.029***	0.030***	0.0283***	0.029***
	(0.002)	(0.00)	(0.002)	(0.002)	(0.002)	(0.002)
M/B	-0.026***	-0.026***	-0.025***	-0.025***	-0.026***	-0.026***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tan	0.426***	0.425***	0.424***	0.423***	0.426***	0.426***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.0173)	(0.017)
Growth Dummy		-0.004**		-0.004**		-0.004**
		(0.001)		(0.001)		(0.001)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.157	0.157	0.160	0.160	0.157	0.157
Rebalancing obs.	2,359	2,321	12,254	11,898	1,246	1,231
Total obs.	185,794	182,714	185,794	182,714	185,794	182,714
Hypothesis H0: $\beta_0 + \beta_1 = 0$						
$\beta_0 + \beta_1$	**1.028*** **	**1.090*** **	**0.571*** **	**0.617*** **	**1.404*** **	**1.518*** **
Wald test ($\beta_0 + \beta_1 = 0$)	0.000	0.000	0.000	0.000	0.000	0.000

Appendix A1. Simulation approach

To simulate leverage and profitability dynamics analogously to empirical studies, we follow the following approach. To create different paths for the mean reverting process (1) $dx = q(\theta - x)dt + \sigma dz$, we vary the initial profits level $x = x_0$. Note that depending on whether θ is higher (lower) than x_0, firms start above (below) the long-term mean and hence are expected to have a temporarily positive (negative) drift. Thus, our approach for the mean reverting process is closely related to Danis et al.'s (2014) approach used for the GBM case about varying growth rates to generate cross-sectional variation in leverage ratios.

We focus on a group of firms with temporary positive growth ($x_0 > \theta$) and one group with temporary negative growth ($x_0 < \theta$). We then simulate 5,000 firms for the high x_0 case and pick all refinancing events N_l for the low-growth firms' group. A large number of firms is employed to increase the number of events. Note that each firm in our simulation is simulated for 200 time steps (periods). We then select an equal number of events from the high-growth sample. For the 1,000 firms simulated in this group, we pick $N_h = N_l$ and then let 1,000 − N_h', where N_h' is the number of refinancing events for the high-growth firms. We finally add a randomly selected sample of 1,000 − N_h' from the low-growth firms with no refinancing. This approach creates an equal number of refinancing and non-refinancing firms for the two groups.

For the mean reverting process, the earnings process (1) is as follows (see Dixit and Pindyck, 1994, p. 76, eq. 19):

$$\Delta x_t = \theta(1 - e^{-qd}\ ) + (e^{-qdt} - 1)x_{t-1} + \sigma_\varepsilon Z_t \qquad \text{(A1)}$$

where $Z_t \sim N(0,1)$ and the error volatility per unit of interval is $\sigma_\varepsilon = \sigma\sqrt{\frac{1-e^{-2qdt}}{2q}}$.

For each panel, we store the leverage ratio for each firm and time period. $Lev_b(x_0)$ arises from the theoretical model leverage at time 0 for x_0. In calculating the leverage ratio for each firm in each period, we apply the theoretical model valuation, assuming (as in the theoretical model) the firm does not adjust debt financing and thus calculating a new leverage ratio for each new $x(t)$ at *t*. For each firm, depending on its corresponding optimal policies for different x_0, we check if $x(t) \geq x_I$. We store the firm's leverage ratio in a generated data set with $Lev_1(x_I)$ (i.e., the leverage ratio at the refinancing threshold and then stop the simulation path for that firm[5]). For each firm and simulation path, we also check if $x(t) \leq x_b$, in which case we interrupt the simulation path (because the firm has reached the default threshold before refinancing). In our simulated data sets, we also keep track of the state of each firm using a dummy variable d_{it}, which equals zero if the firm is not at a refinancing threshold and one if it is. For each firm's *x*(t), we also calculate the theoretical measure of return on asset as $\pi_{i,t-1} = \frac{x(t)(1-\tau)}{Ub(x(t-1))}$. Our simulated data sets allow us to estimate panel regressions on the simulated data panel as follows:

$$L_{it} = \alpha_0 + \beta_0 \pi_{i,t-1} + \beta_1 \pi_{i,t-1} d_{it} + \gamma d_{it} + \varepsilon_{it}\,. \qquad \text{(A2)}$$

where L_{it} is the gross market leverage ratio, $\pi_{i,t-1}$ is the operating profit of firm *i* in the lagged period, and d_{it} is the indicator variable (equal to one if firm *i* is in the refinancing period and zero if not). ε_{it} denotes the error term.

Our simulation and estimation exercise provides predictions on β_0, β_1, and γ as well as $\beta_0 + \beta_1$.

Simulation results and hypotheses

Our base case parameters are motivated from earlier studies as follows. For the mean reverting stochastic process parameters, we follow Sarkar and Zapatero (2003) and Agliardi et al. (2022) and use a normalized level of current earnings at *x* = 1, σ = 0.4, mean reversion speed q = 0.1, and long-term mean *θ* = 1. The parameters of the AMR process are in line with empirical estimates provided in Agliardi et al. (2022). We

[5] In principle, we could have continued calculating leverage ratios until the firm defaults at x_L; however, this creates only some additional passive variations in leverage ratios similar to the initial period and does not offer any new insights in the periods of interest, the initial and refinancing periods.

follow Goldstein et al. (2001) and Danis et al. (2014) using a tax rate of $\tau = 0.3$ and proportional bankruptcy costs of $b = 0.15$ and $r = 0.06$. Because the long-term mean is normalized to 1, $x_0 < 1$ implies positive trending earnings firms; it is vice versa when $x_0 > 1$. To illustrate, we pick $x_0 = 0.5$ and $x_0 = 1.15$. For $x_0 = 1.15$ (used in our analysis for 5,000 firms), we obtain $N_l = 46$ events. Our analysis demonstrates that using more symmetric deviations from the long-term mean may affect the statistical significance of the interaction dummy of refinancing with profitability, something that is also observed in the actual data.

Table A1 presents our simulation exercises regarding the estimation of model (A2) using the theoretical model predictions as input (as described in section 2.3). In all models, we use pooled regression, as in the empirical literature. We provide more general predictions below.

First, we obtain $\beta_0 < 0$. This is as expected and is driven by firms' inaction in frequently adjusting leverage. Second, we observe that the dummy variable coefficient $\gamma > 0$ when negative growth firms are combined with positive growth firms. Third, we obtain predictions regarding the interaction term between the refinancing dummy and profits. We obtain $\beta_1 < 0$ and find that $\beta_0 + \beta_1 = 0$ is strongly rejected. However, unlike Danis et al.'s (2014) suggestion for positive adjustments ($\beta_0 + \beta_1 > 0$), our results for mean reverting firms suggest the opposite. From the above, we empirically test the following empirical hypotheses for our sample of mean reverting firms:

$$\text{H1: } \beta_0 < 0 \text{ and } \beta_1 < 0 \quad \beta_0 + \beta_1 < 0 \qquad \text{(A2)}$$

Table A1. Leverage and profitability's relation based on the simulated model panel data

π (β_0)	-2.013***
	(0.036)
d (γ)	0.323***
	(0.023)
d X π (β_1)	-1.185***
	(0.150)
Intercept	0.680***
	(0.002)
Model	Pooled
Rebalancing obs.	92
Total obs.	19,732
% of events	0.005
Growth group control	Yes
Adj. R^2	0.633
Wald test ($\beta_0 + \beta_1 = 0$)	0.000

Appendix

Table A2. Construction of variables

Symbol	Variable name	Compustat mnemonics	Definitions
Panel A: Balance sheet and income statement variables[a]			
D	Total debt	*dlcq* + *dlttq*	Short-term debt+ Long-term debt
MV	Market value of firm	*dlcq* + *dlttq* + *prccq X cshoq*	Total debt + Market equity
C	Cash holdings	*cheq*	Cash and equivalents
A	Total book assets	*atq*	
L	Market leverage	(*dlcq* +*dlttq*)/(*prccq* X *cshoq* + *dlcq* +*dlttq*)	Total debt/ (Total debt + Market equity)
ΔD_t^e	Change long-term debt	*dlttq -lag(dlttq)*	Long-term debt -Lag (Long-term debt)
CR	Cash ratio	*cheq/atq*	Cash and equivalents/ Total book assets
ΔC	Change in cash holdings	*cheq* −*lag* (*cheq*)	Cash and equivalents-lag (Cash and equivalents)
π	Profitability	*oibdpq*/*atq*	Operating profit/Total book assets

Risk	Standard deviation (SD) of Profitability calculated over 4 contiguous quarters		
Size	Firm size	*log(atq)*	Natural logarithm of total book assets.
M/B	Tobin's Q	(*dlcq* +*dlttq*+ *prccq* X *cshoq*)/(*atq*)	(Total debt + Market equity)/ Total book assets
Tan	Tangibility	*ppentq*/*atq*	Net property/plant/equipment/ Total book assets
Panel B: Cash flow statement variables[b,c]			
EI	Equity Issues	*sstkq*	
ER	Distributions to equity-holders	*dvq* + *prstkcq*	
ER^e	Equity retirement in excess of equity issues	ER-EI	
DI^e	Net debt issues (CF)	*dltisq* + *dlcchq* − *dltrq*	
CH	Cash component of ΔC	chechq	
IVSTCH	Short-term securities component of ΔC	*ivstchq*	
Capex	Capital expenditures	*capxq*/*atq*	

OCF	Operating cash flow	*oancfq* + *exreq*
INV	Total investment	*capxq* + *aqcq* + *ivchq* − *sivq* − *sppeq* − *ivacoq*
OTH	Other financing cash flows (generally small)	*fiaoq* + *txbcofq*
Panel C: Rebalancing definitions (dummy variables)		
a_t	Debt-financed rebalancing (ignores ΔC)	=1 if $\frac{\Delta D_t^e}{A_t}$>s and $\frac{ER_t^e}{A_t}$>s (=0 otherwise)
a_t^N	Mixed cash-and-debt-financed rebalancing	=1 if $\frac{\Delta D_t^e - \Delta C_t}{A_t}$>s and $\frac{ER_t^e}{A_t}$>s (=0 otherwise)
a_t^C	Cash -only financed rebalancing	=1 if $\frac{-\Delta C_t}{A_t}$>s and $\frac{ER_t^e}{A_t}$>s (=0 otherwise)

Notes

[a] We use Consumer price index (CPI) to adjust size for inflation. We collect CPI data from the Bureau of Labour Statistics. Our base period is 1984 =100. The continuous variables *M*/*B*, *P*, Size, and Risk are winsorized by 1% in both tails of the distribution. We set naturally bounded variables (*L*, *Tan*, *CR*) within the unit interval.

[b] We winsorize the continuous variable Capex by 1% in both tails of the distribution.

[c] In Compustat, cash flow statement variables ending with the letter "y" indicate year-to-date data. For example, second-quarter cash flow statement items are the sum of first-quarter and second-quarter cash flows. Hence, we compute quarterly changes in the variables to obtain quarterly cash flow statement variables. In the mnemonic, we add a *q* to refer to this variable.

Internet Appendix for

Refinancing and Mean Reversion in Earnings

Abstract

The internet appendix includes alternative risk measures and additional control variables.

Keywords: leverage; leverage–profitability puzzle; temporary and permanent shocks; mean-reversion; refinancing; capital structure

JEL classification: G30; G31; G32; G13

Table A.1. Summary statistics of earnings growth

Variable	Earnings Growth			Positive Earnings Growth			Negative Earnings Growth		
Fiscal Year	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Full Sample									
1985-2019	-0.0241	-0.0008	28.8931	1.6196	0.2375	28.3314	-1.6621	-0.2812	29.3508
1985-1989	-0.1856	-0.0066	26.6032	1.4277	0.2792	9.70186	-1.7532	-0.3131	36.0421
1990-1994	0.1222	-0.0052	13.1917	1.72739	0.2620	15.6323	-1.4415	-0.3208	10.0266
1995-1999	-0.1890	0.0109	30.8408	1.5483	0.2405	24.1647	-2.0313	-0.2995	36.5238
2000-2004	0.1952	-0.0038	45.2122	2.1322	0.2482	52.0638	-1.7069	-0.3035	37.1801
2005-2009	-0.0999	-0.0022	21.4971	1.4868	0.2323	18.9284	-1.6685	-0.2763	23.6610
2010-2014	-0.0969	0.0035	29.7486	1.4742	0.2113	25.1095	-1.7015	-0.2357	33.7612
2015-2019	0.0288	-0.0069	12.4207	1.3469	0.2059	14.7466	-1.2301	-0.2351	9.5226
Stationary Firms									
1985-2019	-0.0236	-0.0065	30.4639	1.7531	0.2553	30.6645	-1.7443	-0.2999	30.1690
1985-1989	-0.2392	-0.0130	28.6819	1.5137	0.2985	9.4466	-1.8964	-0.3300	38.8642
1990-1994	0.1676	-0.0118	13.8350	1.9042	0.2789	16.9762	-1.4798	-0.3437	9.6965
1995-1999	-0.1462	0.0035	30.6973	1.6669	0.2600	25.9239	-1.9877	-0.3157	34.7871
2000-2004	0.1901	-0.0097	49.7103	2.3361	0.2630	57.3064	-1.8597	-0.3202	41.0627
2005-2009	-0.2126	-0.0072	22.3011	1.4724	0.2505	17.3738	-1.8377	-0.2902	26.0866
2010-2014	-0.0295	-0.0026	29.8986	1.7071	0.2315	28.3403	-1.7429	-0.2554	31.2666
2015-2019	0.0456	0.0094	13.2390	1.4680	0.2188	16.1611	-1.2991	-0.2566	9.5047

Table A.2. Leverage and profitability's relation with debt-financed rebalancing events for mean reverted firms: Risk is calculated over twenty contiguous quarters

This table presents coefficient estimates from the following empirical linear regressions model:

$$L_{it} = \alpha_0 + \beta_0\pi_{i,t-1} + \beta_1\pi_{i,t-1}d_{it} + \gamma d_{it} + \kappa Z_{i,t-1} + \varepsilon_{it}$$

Debt-financed rebalancing: a_t=1 if $\frac{\Delta D_t^e}{A_t}$>s and $\frac{ER_t^e}{A_t}$>s

where L_{it} is the gross market leverage ratio of firm *i* in quarter *t*, and $\pi_{i,t-1}$ is the operating profit of firm i in lagged quarter $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indictor variable equal to one if firm *i* is refinancing at quarter *t* and zero otherwise, while ε_{it} is the remainder stochastic error term.

Dependent variable $L_{i,t}$ is the gross market leverage ratio (=D/MV); *D* is the book value of total debt (=debt in current liabilities + long-term debt); *MV* is the sum of *D* and market value of total equity (=closing price X no. of common shares outstanding + short-term debt + long-term debt); ΔD_t^e is the change in long-term debt; ER_t^e is the equity retirement in excess of equity issues; *A* is the book value of total assets; *P* is the operating profit divided by *A*; the constant issue-size threshold *s* is in percent of *A*. The control variables include the following: *Risk* is the standard deviation of profitability calculated over twenty contiguous quarters; *M/B* is the market-to-book ratio (=closing price X no. of common shares outstanding + short-term debt + long-term debt / assets); *Tan* is the ratio of tangible assets to *A*; *Size* is the log (*A*) adjusted for inflation.

We winsorize the continuous variables *M/B*, *P*, *Size*, and *Risk* by 1% in both tails of the distribution, and set the naturally bounded variables (*L*, *Tan*) within the unit interval. We report the details construction of variables in the appendix Table A.1, sample period 1984–2019. Rebalancing obs. and total obs. indicates the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Superscript *, **, and *** refer significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the firm level in parentheses.

Dependent variable	**Market leverage**					
Issue size threshold *s*	*s* = 5 %		*s* = 1.25%		*s* = 7.5%	
	(1)	(2)	(3)	(4)	(5)	(6)
π (β_0)	-0.717***	-0.700***	-0.713***	-0.696***	-0.717***	-0.700***
	(0.036)	(0.037)	(0.036)	(0.037)	(0.036)	(0.037)
***d* (γ)**	0.050***	0.049***	0.012*	0.013*	0.081***	0.0811***
	(0.012)	(0.012)	(0.007)	(0.007)	(0.013)	(0.013)
***d X* π (β_1)**	-0.189	-0.195	-0.235*	-0.265*	-0.260	-0.281
	(0.249)	(0.263)	(0.143)	(0.149)	(0.267)	(0.279)
Risk	-0.414***	-0.426***	-0.413***	-0.426***	-0.414***	-0.426***
	(0.129)	(0.129)	(0.129)	(0.129)	(0.129)	(0.129)
Size	0.014***	0.015***	0.014***	0.015***	0.014***	0.015***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
M/B	-0.054***	-0.053***	-0.054***	-0.053***	-0.054***	-0.053***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tan	0.209***	0.209***	0.209***	0.210***	0.209***	0.210***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Growth Dummy		-0.010***		-0.011***		-0.010***
		(0.001)		(0.001)		(0.001)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes

Adj. R^2	0.226	0.226	0.226	0.226	0.226	0.226
Rebalancing obs.	804	785	5,059	4,840	438	430
Total obs.	189,009	185,888	189,009	185,888	189,009	185,888
Hypothesis H_0: $\beta_0 + \beta_1 = 0$						
$\beta_0 + \beta_1$	**-0.906*** **	**-0.895*** **	**-0.948*** **	**-0.961*** **	**-0.977*** **	**-0.981*** **
Wald test ($\beta_0 + \beta_1 = 0$)	0.000	0.000	0.000	0.000	0.000	0.000

Table A.3. Leverage and profitability relation with debt-financed rebalancing events and additional controls for mean-reverted firms

This table presents coefficient estimates from the following empirical linear regressions model:

$$L_{it} = \alpha_0 + \beta_0 \pi_{i,t-1} + \beta_1 \pi_{i,t-1} d_{it} + \gamma d_{it} + \kappa Z_{i,t-1} + \varepsilon_{it}$$

Debt-financed rebalancing: a_t=1 if $\frac{\Delta D_t^e}{A_t}$>s and $\frac{ER_t^e}{A_t}$>s

where L_{it} is the gross market leverage ratio of firm *i* in quarter *t*, and $\pi_{i,t-1}$ is the operating profit of firm i in lagged quarter $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indictor variable equal to one if firm *i* is refinancing at quarter *t* and zero otherwise, while ε_{it} is the remainder stochastic error term.

Dependent variable $L_{i,t}$ is the gross market leverage ratio (=D/MV); *D* is the book value of total debt (=debt in current liabilities + long-term debt); *MV* is the sum of *D* and market value of total equity (=closing price X no. of common shares outstanding + short-term debt + long-term debt); ΔD_t^e is the change in long-term debt; ER_t^e is the equity retirement in excess of equity issues; *A* is the book value of total assets; *P* is the operating profit divided by A; the constant issue-size threshold *s* is in percent of *A*. The control variables include the following: *Risk* is the standard deviation of profitability calculated over four contiguous quarters; *M/B* is the market-to-book ratio (=closing price X no. of common shares outstanding + short-term debt + long-term debt / assets); *Tan* is the ratio of tangible assets to *A*; *Size* is the log (*A*) adjusted for inflation; *HHI* is the Herfindahl industry concentration measure; *Rating* dummy variable indicates whether a company holds an S&P rating in a particular quarter; *ILev* is mean industry leverage. We set the naturally bounded variables (*L*, *Tan*) within the unit interval and winsorize all other variables by 1% in both tails of the distribution. We report the details construction of variables in the appendix Table A.1, sample period 1984–2019. Rebalancing obs. and total obs. indicates the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Superscript *, **, and *** refer significance at the 10%, 5%, and 1% levels, respectively. Standard errors are clustered at the firm level in parentheses.

Dependent variable	Market leverage					
Issue size threshold *s*	*s* = 5 %		*s* = 1.25%		*s* = 7.5%	
	(1)	(2)	(3)	(4)	(5)	(6)
π (β_0)	-0.609***	-0.592***	-0.604***	-0.587***	-0.609***	-0.593***
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
***d* (γ)**	0.047***	0.045***	0.011*	0.012**	0.071***	0.070***
	(0.010)	(0.011)	(0.005)	(0.006)	(0.012)	(0.012)
***d X* π (β_1)**	-0.191	-0.174	-0.320***	-0.327***	-0.119	-0.125
	(0.205)	(0.213)	(0.116)	(0.120)	(0.242)	(0.250)
Risk	-0.170**	-0.201**	-0.169**	-0.199**	-0.171**	-0.201**
	(0.083)	(0.084)	(0.083)	(0.084)	(0.083)	(0.084)
Size	0.010***	0.010***	0.010***	0.010***	0.010***	0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
M/B	-0.050***	-0.050***	-0.050***	-0.050***	-0.050***	-0.050***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tan	0.176***	0.177***	0.176***	0.177***	0.176***	0.177***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Rating	0.102***	0.104***	0.103***	0.104***	0.102***	0.104***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
HHI	0.052***	0.051***	0.052***	0.051***	0.052***	0.0517***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
ILev	0.380***	0.375***	0.380***	0.375***	0.380***	0.375***
	(0.061)	(0.061)	(0.061)	(0.062)	(0.0614)	(0.061)

Growth Dummy		-0.009***		-0.009***		-0.009***
		(0.001)		(0.001)		(0.000971)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.249	0.249	0.249	0.249	0.249	0.249
Rebalancing obs.	998	976	6,011	5,762	556	548
Total obs.	240,963	237,334	240,963	237,334	240,963	237,334
Hypothesis H_0: $\beta_0 + \beta_1 = 0$						
$\boldsymbol{\beta_0 + \beta_1}$	**-0.800*** **	**-0.767*** **	**-0.923*** **	**-0.915*** **	**-0.729*** **	**-0.718*** **
Wald test ($\beta_0 + \beta_1 = 0$)	0.000	0.000	0.000	0.000	0.000	0.000