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Do temporary changes in earnings caused by mean reversion affect firms' refinancing decisions?

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Abstract

We develop a dynamic two-stage trade-off model with refinancing when earnings are mean reverting. Our model predicts a negative relation between profitability and leverage at refinancing due to conservative debt increases. With multiple rounds of refinancing, the leverage–profitability relation may turn positive when firms have substantial debt tax shields. Our empirical analysis of US firms reveals that firms with moderate incentives to shield tax benefits with debt internalize the temporary increase in earnings caused by mean reversion at refinancing. However, firms with strong incentives to shield tax benefits take on excessive debt despite the temporary increases in profitability.

JEL CLASSIFICATION
G13, G30, G31, G32

1 | INTRODUCTION

The trade-off model of capital structure is a standard framework for understanding firms' capital structure decisions. It relies on the principle that firms balance the tax benefits of debt against bankruptcy costs. This theory is consistent with evidence indicating that firms with more tangible assets, lower volatility, and lower market-to-book (growth) ratios tend to have higher leverage (see, e.g., Frank & Goyal, 2009; Graham & Leary, 2011; Wald, 1999).

Despite the vast theoretical and empirical literature studying firms' capital structure decisions using trade-off theory, research has primarily focused on nonstationary earnings, although evidence suggests that earnings mean reversion may be prevalent (e.g., Fama & French, 2000). According to Fama and French (2000), mean reversion in earnings is consistent with the notion of competitive markets where firms eventually mimic innovative products and technologies that produce above-normal profitability. Earnings mean reversion may result in a different response from firms to changes in profitability because of the temporary nature of earnings changes. This may lead to different firm decisions compared to the continuous random walk assumption, which assumes permanent changes, used in existing models.

Refinancing involves a firm's decision to adjust its initial debt levels when profitability rises. This provides an ideal setup for testing the predictions of trade-off models and assessing whether firms facing temporary increases in profitability due to mean reversion behave more prudently in their debt adjustment during refinancing. Motivated by the absence of such models in the literature, we develop a dynamic two-stage trade-off model with mean-reverting earnings. Our model extends the single-period financing framework proposed by Sarkar and Zapatero (2003) and predicts, among other things, a negative relation between leverage and profitability at refinancing because of the conservative increase in debt arising from the temporary nature of earnings increases. The model also predicts that with multiple rounds of refinancing, the negative relation between leverage and profitability may hold for firms with low tax-shielding incentives (e.g., low effective tax rates). In contrast, firms anticipating multiple rounds of refinancing and facing high tax-shielding incentives may rationally take more leverage as profitability increases, exploiting a period of extraordinary profitability and large tax gains.

We test our theoretical predictions using data from US nonfinancial and nonregulated firms spanning 1984–2019. Our empirical analysis builds on the work of Eckbo and Kisser (2021). However, in contrast to their study, we identify and focus on a sample of stationary mean-reverting firms based on an augmented Dickey–Fuller (ADF) test. Our analysis aligns with our theoretical predictions, showing that although firms that refinance generally move to higher leverage ratios, debt increases are conservative, leading to a negative relation between leverage and profitability.

Our empirical analysis provides further insights by distinguishing among firms with different incentives to shield benefits through adjustments in leverage at refinancing in response to temporary increases in profitability resulting from mean reversion. We find that firms with moderate incentives for shielding tax benefits with debt (low effective taxes) act conservatively, as predicted by theory, by recognizing that high profitability levels at refinancing are only temporary. For these firms, we observe that although their debt increases at refinancing, it does so at a lower rate compared to equity, resulting in lower leverage for firms with higher profitability.

In contrast, when firms face strong incentives to shield taxes using debt (high effective taxes), we find a positive relation between leverage and profitability at refinancing. This result may reflect firms' rational behavior where firms anticipating multiple rounds of refinancing may exploit temporary high tax gains from using debt.

Our contributions to the literature 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 (2010) consider the effect of temporary shocks; however, their temporary component is driven by the arrival of Poisson jump shocks with a 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., Cadenillas et al., 2007; Décamps et al., 2017) and riskiness of commodity prices (Hong & Sarkar, 2008). Lee and Rivera (2021) consider a model where firms face both temporary and permanent earnings shocks, and managers are ambiguity averse. Their setting endogenizes managers' extrapolation bias, that is, managers rationally weighing more heavily recent observations regarding the profitability of the firm. Sarkar and Zapatero (2003) use a single-period financing framework when earnings are mean reverting without studying firms' refinancing decisions. Sarkar (2003), Tsekrekos (2010), Metcalf and Hasset (1995), Raymar (1991), Briest et al. (2022), and Agliardi et al. (2024) use a mean reversion setting to study investment and growth option financing. Our focus compared to earlier work using mean reversion is to analyze firms' optimal refinancing decisions. In doing so, our theoretical framework extends earlier work to develop solutions for valuing two boundary claims within a mean reversion context. Our solutions account for the possibility that after the initial debt is in place, potential downward shifts in profitability may lead to default, whereas upward shifts may trigger a firm to raise more debt (refinancing). Such settings can be particularly useful in extending models applied to commodity or electricity markets (e.g., Fontini, 2021).

Second, we add to a growing literature using a contingent claims approach to study financing decisions. A significant part of this literature relies on nonstationary dynamics to study investment financing and debt overhang (e.g., Bensoussan et al., 2021; Charalambides & Koussis, 2018; Hirth & Uhrig-Homburg, 2010; Mauer & Sarkar, 2005; Nishihara et al., 2019; Sarkar, 2003; Shibata & Nishihara, 2015). Gryglewicz et al. (2020) formulate a dynamic agency model where a manager can take hidden actions that affect both short-term earnings and the firm's long-term growth, showing that the optimal contract can generate corporate policies with short- or long-termism, defined as short- or long-term investment levels exceeding first-best levels. Hackbarth et al. (2022) develop a related dynamic contracting model for a levered firm, explaining that short-termism may be optimal for shareholders in a levered firm because of an asymmetric effect caused by debt, where shareholders receive all gains from short-term effort but share gains from long-term effort.

Other works studying refinancing also focus on nonstationary dynamics (e.g., Fischer et al., 1989; Goldstein et al., 2001; Hackbarth et al., 2006; Morellec et al., 2012; Strebulaev, 2007). In contrast, our setting focuses on mean-reverting earnings dynamics, providing new insights into how firms adjust their leverage when facing temporary changes in profitability. In addition to the conservativeness in debt changes owing to the temporary nature of earnings increases at refinancing, we provide theoretical predictions that can guide future work. For example, we show that firms with earnings currently below (above) their long-term mean and thus expected to experience earnings growth (decrease) are also expected to exhibit a positive (negative) adjustment in market leverage ratios at refinancing compared to earlier rounds of financing.

Third, we provide the first systematic empirical study that tests firms' refinancing decisions based on evidence suggesting the presence of mean reversion in earnings. We extend the work of Eckbo and Kisser (2021) by providing a theoretical framework to study refinancing under mean reversion and expand their empirical analysis. Our study provides evidence that firms with stronger incentives to shield tax benefits may optimally opt for excessive debt as their profitability increases, despite these increases being temporary because of mean reversion. In that respect, we contribute to the literature that identifies the factors affecting leverage dynamics, which include expensive adjustment costs (e.g., Leary & Roberts, 2005), financing lumpy investments (e.g., DeAngelo et al., 2011), macroeconomic conditions (e.g., Hackbarth et al., 2006), and strength of corporate governance mechanisms (e.g., Liao et al., 2015). Our focus is in line with recent developments focusing on understanding the impact of stochastic process assumptions on firms' corporate policies (e.g., Gryglewicz et al., 2022). Other work, such as Bontempi et al. (2020), propose statistical approaches that capture both firm characteristics and unpredictable events shaping observed leverage choices.

2 | THEORETICAL FRAMEWORK AND HYPOTHESES

We model a firm with existing assets that generate earnings x, following an arithmetic mean reversion (AMR) process as follows:

$$dx = q(\theta - x)dt + \sigma dz, \tag{1}$$

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 of a standard Brownian motion. The real options literature has mainly used the geometric mean reversion (GMR) process (e.g., Metcalf & Hasset,1995; Sarkar & Zapatero, 2003; Sarkar, 2003; Tsekrekos, 2010), 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. Levendorskii (2005) uses the AMR process to price perpetual American call and put options, and Briest et al. (2022) uses the AMR to focus on energy related investments.

The firm selects an optimal level of perpetual debt $Db(x)$ at time 0, 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_R, endogenously chosen by the firm, the firm refinances, calling existing debt $Db(x)$ at par and taking 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 the exercise of the refinancing option, equity holders select the earnings level x_L, which triggers bankruptcy. We include proportional costs k paid for the issuance of each new debt issue (see Goldstein et al., 2001), so the net proceeds are $(1-k)Db(x)$ at $t=0$ and $(1-k)Da(x_R)$ 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 comparison to Goldstein et al.'s (2001) assumption of infinite rounds of refinancing, our setting aligns more closely with the practice of managers who anticipate a finite number of refinancing rounds. In addition, our setting is cast in an earnings mean reversion setting. This finite-round approach, and the introduction of mean reversion, suggest interesting dynamics such as conservatism for firms with earnings below their long-term mean, which aligns with evidence of managerial conservatism (Graham, 2022). Moreover, unlike Goldstein et al.'s (2001) assumption of constant leverage ratios, our framework with finite refinancing rounds predicts dynamic adjustments based on the relation between current and long-term profitability levels. Thus, our framework does not imply long-term targeting leverage behavior, which is supported by evidence from Chauhan and Huseynov (2018).

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

2.1 | Security values and leverage at refinancing

To obtain values at and after refinancing, it is intuitive to use the value of basic claims. We define $B(x) = P_1(x)/P_1(x_L)$ as the value of a basic claim, which pays \$1 when x_L is reached from above, starting at x. The equation describing the value of this claim is provided in Appendix A (see Equation A5).[2] With this basic claim, we can compactly define the value of equity after refinancing as follows:

$$Ea(x) = Ea_p(x) - Ea_p(x_L)\left(\frac{P_1(x)}{P_1(x_L)}\right), \tag{2}$$

where

$$Ea_p(x) = \left(\frac{1}{q+r}x + \frac{q\theta}{r(q+r)} - \frac{R_1}{r}\right)(1-\tau). \tag{3}$$

The value of equity includes the present value of after-tax income generated from assets, net of the payments to debt holders (first term) minus an adjustment for foregone income in the event of default (second term).

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[1] For simplicity, we do not consider tax convexity issues (Goldstein et al., 2001) but assume that a constant tax rate τ is applied irrespective of the earnings level. Thus, our analysis likely exaggerates the true tax benefits levels.

[2] The associated expressions for $P_1(x)$ and $P_2(x)$ and the proof for their derivation are provided in Appendix A. Both $P_1(x)$ and $P_2(x)$ are functions of the stochastic process parameters θ, σ, q (see Appendix A).

Note that the first term of the equity value includes the value of unlevered assets after investment, which we define separately in Equation (4) to further discuss the impact of mean reversion:

$$Ua(x) = \left[\frac{1}{q+r}x + \frac{q\theta}{r(q+r)}\right](1-\tau), \tag{4}$$

where $x/(q+r)$ represents changes in value of unlevered assets driven by a current shock in profitability, whereas the constant $q\theta/r(q+r)$ is a long-term component (independent of the current profitability shock). Note that when $q = 0$, Equation (4) simplifies to $x(1-\tau)/r$. In this case, a current earnings-level change of $1 produces a "permanent" perpetual change of $(1-\tau)/r$, 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 value 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:

$$Da_1(x) = \frac{R_1}{r} + \left((1-b)\quad Ua(x_L) - \frac{R_1}{r}\right)\left(\frac{P_1(x)}{P_1(x_L)}\right). \tag{5}$$

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

$$Da_0(x) = \frac{R_0}{r}. \tag{6}$$

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

$$Lev_1(x_l) = Da_1(x_l)/(Da_1(x_l) + Ea(x_l)). \tag{7}$$

2.2 | Time 0 security values and leverage ratio

We define $H(x)$ as the basic claim that $1 is paid if x hits the refinancing trigger x_R and 0 if it hits x_b. Similarly, we define $L(x)$ as the basic claim that $1 is paid if x hits trigger x_b and 0 if it hits x_R. The solutions to these basic claims are provided in Appendix A (see Equations A8 and A9, respectively).

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

$$Ub(x) = \left[\frac{1}{q+r}x + \frac{q\theta}{r(q+r)}\right](1-\tau). \tag{8}$$

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

Using the basic claims $H(x)$ and $L(x)$, equity value before exercising the refinancing option $Eb(x)$ is given by the following:

$$\begin{aligned} Eb(x) = {} & (Ea(x_R) + (1-k)Da_1(x_R) - Eb_p(x_R) - Da_0(x_R))H(x) \\ & -Eb_p(x_b)L(x) + Eb_p(x), \end{aligned} \tag{9}$$

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 in Equation (9) is the particular solution reflecting the income initiated at $t = 0$. The second term—in parentheses multiplying $H(x)$—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 proceeds from the new debt issue (second term), an adjustment term truncating income at $t = 0$ because now this is included in $Ea(x_R)$ (third term), and the repayment of initial debt called at x_R (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:

$$Db(x) = \frac{R_0}{r} + \left((1-b)\,Ub(x_b) - \frac{R_0}{r}\right)L(x), \tag{10}$$

where $Ub(x)$ is given in Equation (8).

Thus, firm value before refinancing at $t = 0$ is the sum of equity plus net debt proceeds before refinancing:

$$Fb(x) = Eb(x) + (1-k)Db(x). \tag{11}$$

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

$$Lev_b(x) = Db(x)/(Db(x) + Eb(x)). \tag{12}$$

2.3 | Leverage optimization

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

$$Ea'(x_L) = 0. \tag{13}$$

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

$$Eb'(x_b) = 0. \tag{14}$$

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

$$Eb'(x_R) = Ea'(x_R) + (1-k)Da_1'(x_R). \tag{15}$$

Optimal initial financing and new debt at refinancing are obtained by performing a double loop with 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. For each R_0 and R_1 combination, we ensure that the optimally chosen default levels conditions (see Equations 13 and 14) and the smooth pasting condition at the refinancing trigger (see Equation 15) are satisfied. From these R_0 and R_1 combinations, satisfying the optimality conditions, we select the one that maximizes initial firm value, that is, equity plus initial debt financing (see Equation 11). This optimization identifies the initial and subsequent (refinancing) leverage ratios in the firm's capital structure.

2.4 | Model predictions

Our base case parameters for sensitivity analysis are motivated by earlier studies as follows. For the mean-reverting stochastic process parameters, we follow Sarkar and Zapatero (2003) and use a normalized level of current earnings at $x = 1$, $\sigma = 0.4$, mean reversion speed $q = 0.1$, and long-term mean $\theta = 1$. We follow Goldstein et al. (2001) and Danis et al. (2014) by using a tax rate of $\tau = 0.3$ and proportional bankruptcy costs of $b = 0.15$, risk-free rate $r = 0.06$, and financing costs $k = 0.01$.

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

TABLE 1 Theoretical model predictions regarding leverage dynamics and profitability of firms with mean-reverting earnings.

x	$Fb(x)$	$Eb(x)$	$Db(x)$	$Lev_b(x)$	$Lev_1(x_R)$	ΔLev	$\pi(x_R)$	Prob. ref.
Panel A: Firm and security values, leverage, and profitability								
0.7	12.61	4.84	7.85	0.619	0.673	0.054	0.090	0.696
0.8	13.09	4.92	8.25	0.627	0.671	0.045	0.093	0.626
0.9	13.57	4.11	9.56	0.699	0.658	−0.041	0.106	0.145
1	14.07	3.96	10.21	0.720	0.657	−0.064	0.111	0.031
1.1	14.58	4.10	10.59	0.721	0.656	−0.065	0.113	0.012
1.2	15.08	4.23	10.96	0.722	0.655	−0.067	0.116	0.004
1.3	15.59	4.37	11.34	0.722	0.655	−0.067	0.118	0.001
1.4	16.09	4.59	11.62	0.717	0.655	−0.062	0.119	0.001

x	x_b	x_R	x_L	R_0	R_1
Panel B: Firms' policies and optimal coupon values					
0.7	−0.816	2.135	0.017	0.51	0.95
0.8	−0.750	2.329	0.100	0.54	1.00
0.9	−0.505	3.234	0.446	0.66	1.22
1	−0.391	3.771	0.667	0.72	1.37
1.1	−0.335	4.053	0.781	0.75	1.45
1.2	−0.280	4.343	0.892	0.78	1.53
1.3	−0.226	4.642	1.014	0.81	1.62
1.4	−0.190	4.838	1.094	0.83	1.68

Note: This table presents sensitivity results for the model described in Section 2. We use a normalized level of current earnings at $x_0 = 1$, $\sigma = 0.4$, mean reversion speed $q = 0.1$, and long-term mean $\theta = 1$. We follow Goldstein et al. (2001) and Danis et al. (2014) using a tax rate of $\tau = 0.3$ and proportional bankruptcy costs of $b = 0.15$, risk-free rate $r = 0.06$, and financing costs $k = 0.01$. Note that $\pi(x_R) = \frac{x_R(1-\tau)}{Ua(x_R)}$ is the posttax return on assets. Prob. ref. refers to the probability of refinancing first before hitting the bankruptcy threshold. This is calculated by setting the limit of the basic claim function $J(x)$ with respect to the risk-free rate tending to zero (see Hackbarth & Mauer, 2012). $Fb(x)$, $Eb(x)$, $Db(x)$, and $Lev_b(x)$ denote firm, equity, debt, and the leverage ratio at $t = 0$. $Lev_1(x_R)$ denotes the leverage ratio at refinancing.

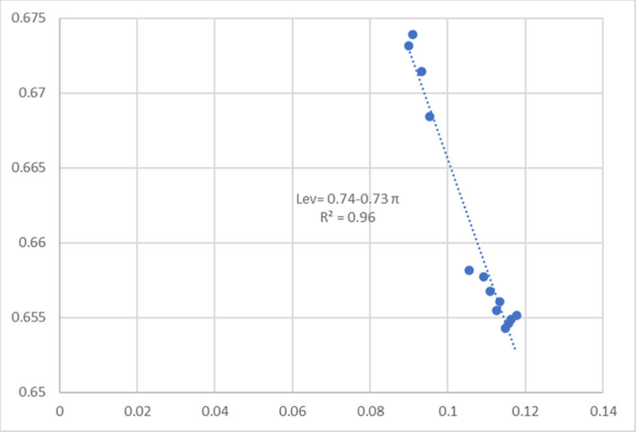

FIGURE 1 Theory-based leverage–profitability relation at refinancing for mean-reverting firms. This figure shows the relation between leverage at refinancing (Lev_1) and return on asset ($\frac{x_R(1-\tau)}{Ua(x_R)}$) based on theoretical model simulation (see Table 1). It draws on simulations based 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 between leverage and return on asset at refinancing. [Color figure can be viewed at wileyonlinelibrary.com]

Panel A of Table 1 presents security values, leverage, and returns. Panel B presents the firm's optimal policies and coupons. In Panel A, for various levels of x_0 reflecting different growth rates in earnings, we report firm ($Fb(x)$), equity ($Eb(x)$), and debt values ($Db(x)$). 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_R shows the refinancing threshold. $Lev_1(x_R)$ 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 posttax return on assets at x_R, defined as posttax earnings scaled by unlevered assets.

Table 1 reveals a negative relation between return on assets and leverage ratios at refinancing, indicating that higher profitability is associated with lower leverage. This finding is further supported by Figure 1, which depicts a denser sensitivity with a scatterplot and a regression line confirming the strong negative linear association between leverage and profitability at refinancing. This result contradicts static versions of trade-off theory or dynamic models with nonstationary dynamics, which typically suggest that leverage ratios increase with profitability (see, e.g., Strebulaev, 2007). However, in a mean reversion setting, we observe that although debt increases during refinancing, equity experiences higher growth, leading to a decrease in leverage ratios. Our comprehensive sensitivity analysis validates the robustness of this finding, demonstrating that the negative relation becomes stronger as the mean reversion speed increases. Intuitively, in a mean reversion framework, higher profitability levels at refinancing prompt conservative adjustments in coupons because of their temporary nature. Conversely, with lower levels of mean reversion, earnings exhibit more permanence, resulting in more significant upward adjustments in coupons and a weakened negative relation between leverage and profitability.[3]

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

$$L_{it} = \alpha_0 + \beta_0 \pi_{i,t-1} + \beta_1 \pi_{i,t-1} d_{it} + \gamma d_{it} + \varepsilon_{it}. \tag{16}$$

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[3] In Panel B of Table 1, we find that coupons at refinancing (R_1) are higher than coupons before refinancing (R_0), indicating that firms take on more debt during the refinancing process, as expected. However, the upward adjustment in coupons is only partial relative to the increase in earnings.

Based on the simulations and our sensitivity analysis (see Table A1 in Online Appendix C), we summarize the following hypotheses:

H1: Because of positive refinancing costs and inaction, the relation between leverage and profitability is expected to be negative unconditional on refinancing events

H2: At refinancing, the relation between leverage and profitability for stationary firms is negative ($\beta_0 < 0$).

Finally, to determine the sign of coefficient γ in Equation (16), 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 (see Table 1). However, our simulation exercise (see Online Appendix C) reveals that the refinancing dummy is expected to have a positive coefficient when both negative- and positive-growth firms are combined in the sample (which appears to be the case, as seen in the actual sample). We thus summarize the final hypotheses as follows.

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 in Section 3, where a similar regression is applied to the actual data.

In addition to the hypotheses concerning the relation between leverage and profitability discussed earlier, our analysis yields further insights into firms' dynamic financing decisions. Specifically, our findings, presented in Panel B of Table 1, indicate that a firm's leverage ratio declines during refinancing compared to the initial level when a firm exhibits a negative earnings trend, that is, when a firm's current profitability is above its long-term level.[4] Conversely, this pattern is reversed for firms with positive or zero trends (for firms starting with profitability below or at par with their long-term mean).

The hypotheses are formulated under the assumption that the firm faces a single refinancing round. In Table 1, we gain additional insights into how the relation between leverage and profitability may change under multiple refinancing rounds and various tax-shielding incentives. To investigate this, we focus on the firm's leverage choices as a function of profitability at $t = 0$ (before refinancing). We identify two regions in the leverage–profitability relation: one where the relation is positive and another where it turns negative. Case 1 in Figure 2 provides a wider range of sensitivity of initial leverage to profitability for the base case shown in Table 1, to more clearly demonstrate the two regions. In this figure, we also consider the case of lower taxes (low tax-shielding incentives) in Case 2.

We observe that the positive leverage–profitability relation holds when profitability is relatively low. In this case, the firm starts with more conservative leverage, and refinancing is more likely to occur, as indicated by the probability of refinancing (see the secondary axis in Figure 2 and the last column in Panel A of Table 1, which reports the probability of refinancing). As profitability further increases, it reaches a point where the probability of refinancing drops substantially. At this stage, the firm adjusts to a higher level of leverage, anticipating that no further refinancing will occur. However, once the probability of refinancing becomes extremely low, the leverage–profitability relation turns negative, as further increases in profitability cannot sustain further increases in leverage. In this region, the intuition for the negative leverage–profitability relation is consistent with that at the refinancing threshold, where no further rounds of refinancing are expected.

Our extensive sensitivity analysis reveals that the leverage–profitability relation is general. However, the position of the regions relative to long-term profitability depends on the tax benefits of debt that the firm has received. We find that

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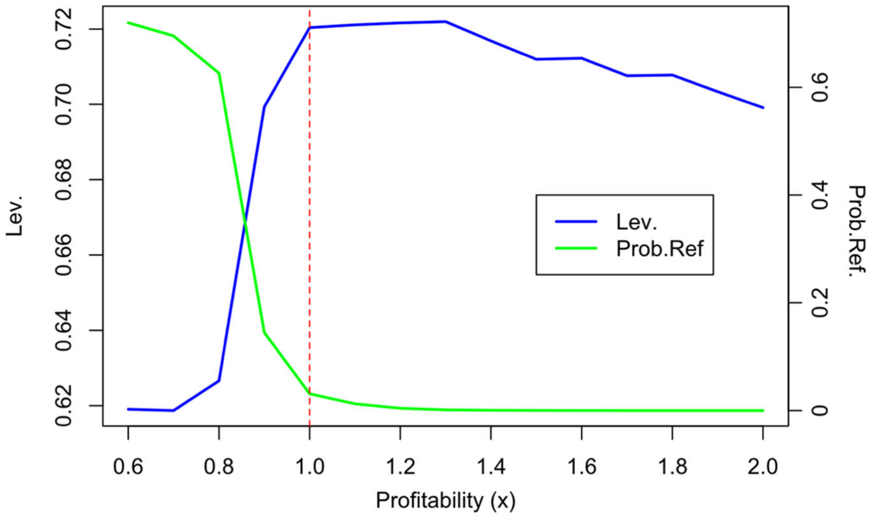
[4] Intuitively, firms in this situation may initially use their high earnings levels, relative to their long-term averages, to support high leverage ratios. However, if earnings reach even higher levels required for refinancing, these high leverage ratios are no longer sustainable, as the probability of earnings reverting soon to their long-term (normal) levels increases.

Case 1: High taxes



Case 2: Low taxes

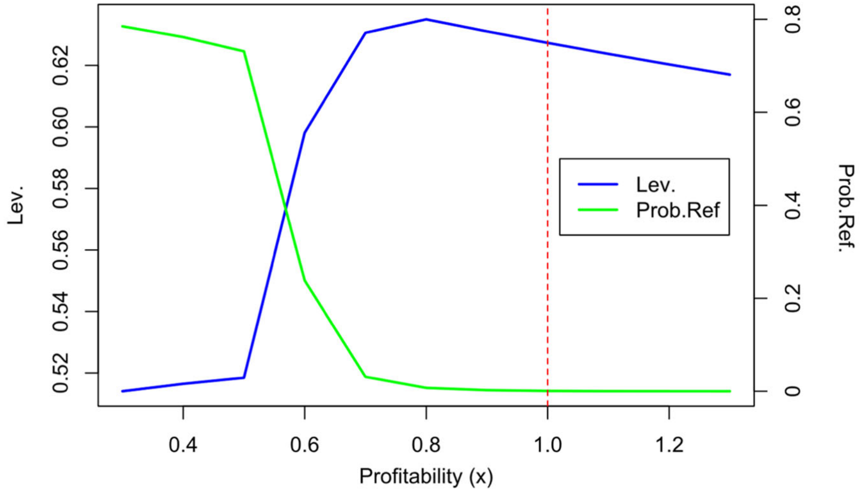


FIGURE 2 Leverage–profitability relation with multiple rounds of refinancing. This figure shows the leverage at $t = 0$ for various levels of profitability (x) for the model in Section 2. We use $\sigma = 0.4$, mean reversion speed $q = 0.1$, and long-term mean $\theta = 1$ (shown with a vertical dotted red line on the graph). For the high-tax rate (Case 1) we use the base case $\tau = 0.3$, and for the low-tax rate (Case 2) we use $\tau = 0.15$. We use proportional bankruptcy costs of $b = 0.15$, risk-free rate $r = 0.06$, and financing costs $k = 0.01$. The secondary axis shows the probability of refinancing (Prob. Ref.). [Color figure can be viewed at wileyonlinelibrary.com]

when tax incentives are low (see the example in Panel B of Table 1), the negative leverage–profitability relation is more likely to prevail in regions around the long-term mean. Because profitability levels close to the long-term mean are where profitability likely hovers for firms, we anticipate that a negative leverage–profitability relation will most likely hold for firms with lower tax-shielding incentives in a multiple-refinancing setting. It is plausible, however, that we will observe a positive relation for firms with high tax incentives (see Case 1 in Figure 2).

Figure 3 provides further sensitivity analysis with respect to tax rates at different profitability levels. The results show that firms facing higher incentives to shield tax savings from debt—specifically, those with higher effective tax rates—are more likely to take on additional leverage at refinancing.

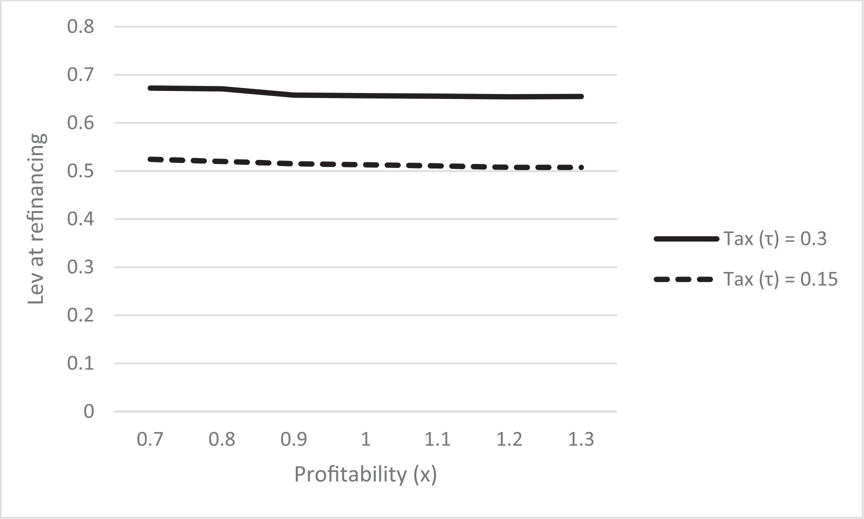


FIGURE 3 Leverage at refinancing for different tax rates. This figure presents sensitivity results for the model described in Section 2 for different tax rates. We use a normalized level of current earnings at $x_0 = 1$, $\sigma = 0.4$, mean reversion speed $q = 0.1$, and long-term mean $\theta = 1$. We use tax rates of $\tau = 0.3$ and $\tau = 0.15$ and proportional bankruptcy costs of $b = 0.15$, risk-free rate $r = 0.06$, and financing costs $k = 0.01$.

This reinforces our theoretical expectation that the negative leverage–profitability relation most likely applies to firms operating with lower effective tax rates, which offer lower tax-shielding incentives from using debt. We summarize the final prediction of our model as follows:

H4: When firms anticipate multiple rounds of refinancing, the relation between leverage and profitability is expected to be positive for firms with high tax-shielding incentives (high taxes) and negative for firms with low tax-shielding incentives (low taxes).

3 | EMPIRICAL ANALYSIS

Our sample construction comes from the quarterly Center for Research in Security Prices (CRSP)/Compustat Merged (CCM) database between 1984:Q1 and 2019:Q4. We choose this date range because quarterly CCM cash flow statements are consistently available starting from 1984:Q1. Following the capital structure literature (see, e.g., Eckbo & Kisser 2021), we eliminate many firms and firm-quarters based on common sample restrictions, as detailed in Table 2.

We also exclude financial companies and regulated firms and restrict the sample to nonmissing entries of key balance sheets, income statements, and cash flow characteristics. Moreover, we require that firms have quarterly operating profit data for at least 40 consecutive quarters. Our final samples comprise 3,754 firms and 240,963 firm-quarters.

3.1 | Econometric method for mean reversion firm detection

Mean reversion firm detection comprises two steps. In the first step, we calculate the profitability ratio as Operating profit (*oibdpq*)/Total asset (*atq*). In the second step, we follow the ADF procedure (Dickey & Fuller, 1979, 1981) to test for stationary behavior and identify mean-reverting firms. The ADF procedure investigates whether the profitability of a firm shows a nonstationary process (mean reversion absence) or a stationary process (mean reversion).

TABLE 2 Mean-reverted sample selection: Quarterly CMM samples, 1984–2019.

Sample restriction	No. of firm-quarters	No. 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
Nonmissing balance sheet data[h]	−19,859	−8
Nonmissing income statement data[i]	−3,719	−9
Nonmissing 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

[a] Our criteria exclude utilities (Standard Industrial Classification [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 Center for Research in Security Prices (CRSP)/Compustat Merged (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 nonmissing information on profitability (=*oibdpq*/*atq*).

[d] We require nonmissing 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. Because of this situation, this firm has two periods with 40 consecutive observations on 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 nonmissing data on the book value of assets (*atq*); market value of equity (*prccq* × *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 nonmissing, nonzero, and positive revenue (*saleq*) data.

[j] For cash flow data consistency, we follow the following steps: First, we set 0 for missing entries on the cash flow statement; second, we group all funding sources and uses; and third, we drop observations if the total number of sources or uses of funds equals 0 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-fourths of our risk data are missing, and we drop the first three observations.

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

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

$$\Delta x_t = \alpha_0 + \beta x_{t-1} + \sum_{i=1}^{k} \varphi_i \, \Delta x_{t-i} + \varepsilon_t, \tag{17}$$

where x_t is 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., 2024). 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, $\varepsilon \sim \text{iid}N(0, \sigma^2_{r1,r2})$. The lag order k is selected by the Bayesian information criterion (BIC) with a maximum lag order of 4.[5]

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

$$ADF = \hat{\beta} / \text{ s.e.}(\hat{\beta}). \tag{18}$$

The ADF test is not symmetrical; hence, we are concerned about 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 favor of nonstationary 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 | Descriptive statistics

Table 3 provides descriptive statistics for our sample of mean-reverting firms. When compared to summary statistics from other studies (see, e.g., 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 exception is a lower level of risk, which may be expected given that higher mean reversion of earnings in our sample firms implies lower risk (see also the discussion on how higher mean reversion speeds imply lower risk in Sarkar & Zapatero, 2003).

Table 4 shows how the composition of positive- and negative-growth firms is even across time for our sample. In results reported in Table A1 in Online Appendix A, 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 5-year splits of sample periods reaching −1% for 1985–1989 and 1989–1994. Thus, the composition of firms between positive and negative growth is in direct analogy with our theoretical model simulations performed earlier, which include both positive- and negative-growth firms.

3.3 | 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.[6] The empirical linear regression model standard in the literature (see Equation 3 in Danis et al., 2014, p. 427; Equation 4 in Eckbo & Kisser, 2021, p. 1095) is as follows:

$$L_{it} = \alpha_0 + \beta_0 \pi_{i,t-1} + \beta_1 \pi_{i,t-1} d_{it} + \gamma d_{it} + \kappa Z_{i,t-1} + \varepsilon_{it} \tag{19}$$

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[5] As a robustness check, we also consider Akaike information criterion (AIC) lag order selection and time trend. Additionally, we set maximum lag lengths of 4 and 8 for both AIC and BIC. The main findings of our study (see Table 6 later) are not affected by the lag length section criteria, leg length, or trend model.

[6] As in Eckbo and Kisser (2021), our definition of rebalancing events satisfies the following criteria: (1) rebalancing event periods must exclude probable confounding cash flow events and (2) this financing must be considerable in both absolute and relative size compared to other sources and uses of funds. We verify our requirements by examining the firm's sources and uses of funds in the refinancing period for our sample of mean-reverting firms (see Online Appendix B).

TABLE 3 Summary statistics for key variables.

Variable	Mean	*SD*	Distribution 10th	50th	90th
L	0.217	0.221	0	0.154	0.553
π	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
M/B	1.668	1.506	0.616	1.188	3.171
Tan	0.289	0.234	0.046	0.220	0.668
Observations	240,963				
No. of firms	3,754				

Note: This table reports mean, standard deviation, and distributions (10th, 50th and 90th) for the mean-reverting firms. Our sample comes from the quarterly Center for Research in Security Prices (CRSP)/Compustat Merged (CCM) database between 1984:Q1 and 2019:Q4. We exclude utilities (Standard Industrial Classification [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. See Appendix B for variable definitions.

TABLE 4 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

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

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, and $Z_{i,t-1}$ is the lagged control variables of firm *i*. Furthermore, d_{it} is an indicator variable equal to 1 if firm *i* is refinancing at quarter *t*, and 0 otherwise, and ε_{it} is the remainder stochastic error term. In this model, following previous studies (e.g., Danis et al., 2014; Eckbo & Kisser, 2021), we use pooled ordinary least squares (OLS). A detailed explanation for why firm fixed effects are not included can be found in Danis et al. (2014, p. 433). The 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 × number 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, π is the operating profit divided by A, and the constant issue-size threshold s is in percent of A. The control variables are as follows: *Risk* is the standard deviation of profitability calculated over four contiguous quarters, *M/B* is the market-to-book ratio (=closing price × number of common shares outstanding + short-term debt + long-term debt/assets), *Tan* is the ratio of tangible assets to A, and *Size* is log(A) adjusted for inflation.

We winsorize the continuous variables *M/B*, π, *Size*, and *Risk* by 1% in both tails of the distribution, and set the naturally bounded variables (L, *Tan*) within the unit interval. We define the variables in Appendix B. Rebalancing obs. and total obs. indicate 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 H1, we expect that $\beta_0 < 0$, which indicates that the unconditional correlation between profitability and leverage is negative when firms are not adjusting their capital structure. Second, H2 implies that $\beta_1 < 0$, which indicates that 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 the standard control variables used in the related literature (see Danis et al., 2014; Eckbo & Kisser 2021). Note that the empirical model includes market-to-book ratio to control for firms' growth. In untabulated results, we also include a control for earnings growth (in line with theoretical-based regressions), which does not alter our main results. Table 5 reports our primary regression results. Based on previous studies (e.g., Eckbo et al., 2007; Eckbo & Kisser, 2021; Leary & Roberts, 2005, 2010), we use an issue-size threshold of 5% in our base case results and run sensitivity tests in other columns with issue-size thresholds of 1.5% and 7.5%, respectively.

First, our results in Table 5 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 H1 that the unconditional leverage–profitability relation is negative. As noted in Section 2 describing the theoretical framework, this effect captures infrequent rebalancing decisions of firms due to refinancing costs. This "inaction" creates a mechanically negative relation between leverage and profitability for firms with mean reversion in earnings. A similar effect due to inaction occurs in studies focusing on nonstationary dynamics (see Danis et al., 2014; Eckbo & Kisser, 2021).

Second, our study reveals a negative interaction between the refinancing dummy and profitability, although this relation is statistically significant (at the 5% level) only for the 1.25% issue-size threshold. As discussed in Section 2, contrary to the conventional assumption of a positive association between leverage and profitability in trade-off models, the presence of mean reversion in earnings leads to a predicted negative relation between leverage and profitability during refinancing.

Intuitively, when firms with mean-reverting earnings reach high refinancing thresholds, they cannot sustain high levels of debt because of the temporary nature of their profitability, which is expected to revert to the long-term mean. Consequently, as refinancing is triggered at a higher profitability level, debt only partially increases, resulting in a decrease in leverage ratios due to the higher increase in equity relative to debt. As pointed out in the theoretical predictions, the negative relation between leverage and profitability may be weakened or even reversed when firms anticipate multiple rounds of refinancing and face high incentives for shielding tax savings (e.g., high tax rates).

Therefore, our findings provide partial support for H2, which pertains to the leverage–profitability relation during refinancing. Additionally, we observe that the Wald test of the sum of coefficients supports the notion that the combined effect of β_0 and β_1 is significantly different from zero and negative across all thresholds. This result implies that when accounting for the mechanical downward adjustment in leverage during the inaction period, the overall response aligns with the expected negative relation between leverage and profitability.

Third, our analysis reveals that, on average, firms with mean-reverting earnings experience upward adjustments in their leverage ratios during refinancing, which is consistent with H3. This is supported by the positive coefficient of the refinancing dummy variable, which is statistically significant at $p < 0.01$ for all issue-size thresholds. According

TABLE 5 Baseline results: Leverage–profitability relation with debt-financed rebalancing events for mean-reverting firms.

	Dependent variable: Market leverage					
	s = 5%		**s = 1.25%**		**s = 7.5%**	
Variable	**(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)
$d \times \pi$ (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
H0: $\beta_0 + \beta_1 = 0$						
$\beta_0 + \beta_1$	−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

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

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

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 the lagged quarter, and $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indicator variable equal to 1 if firm i is refinancing at quarter t, and 0 otherwise, and ε_{it} is the remainder stochastic error term. *Growth Dummy* equals 1 for positive-growth-earnings firms and 0 for negative-growth-earnings firms. See Appendix B for all other variable definitions. Rebalancing obs. and total obs. indicate the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Standard errors are clustered at the firm level and reported in parentheses.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

to our theoretical model, these upward adjustments could primarily occur for firms that are initially below their long-term means. Intuitively, such firms tend to adopt more conservative debt policies initially because of their below-average profitability or slower convergence to their full long-term potential. However, as these firms approach their long-term profit levels, they significantly increase their debt levels, as those profitability levels are deemed more sustainable. Zhou et al. (2016) demonstrate that the adjustment toward target leverage ratios is influenced by the firm's current cost of capital relative to the firm's target cost of capital. Although our dynamic model does not imply a specific target leverage ratio, our analysis highlights that there may be varying degrees of leverage adjustment depending on a firm's profitability relative to its long-term potential.

Finally, we note that control variable signs are consistent with earlier studies (see Danis et al., 2014; Eckbo & Kisser, 2021), for instance, the coefficients on risk (−), size (+), market-to-book (−), and tangible assets (+). These findings also indicate that our regression results are robust. In addition, the inclusion of an earnings growth dummy that equals 1 for positive-growth-earnings firms and 0 for negative-growth-earnings firms does not alter the main findings.

4 | ROBUSTNESS AND ADDITIONAL TESTS

4.1 | Benchmarking against literature findings

In our baseline results (see Table 5), "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 Danis et al., 2014; Eckbo & Kisser, 2021). As a result, the number of both observations and rebalancing events is reduced. However, the conclusion remains unchanged when we define risk based on 20 contiguous quarters (see Table A2 in Online Appendix A). 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 6). We report the results in Panel A of Table A3. Our findings are qualitatively similar when we control for industry fixed effects (proxied by two-digit Standard Industrial Classification [SIC] codes). We present the results in Panel B of Table A3.

4.2 | Estimation based on subsamples

In this section, we explore sample partitions related to the effective tax rate facing firms. These sample partitions enable us to investigate how firms' incentives to shield taxes influence their refinancing behavior in response to shifts in profitability.

Table 6 focuses on a sample partition based on the median effective tax rate that firms face.[7] Firms with high effective tax rates (see Panel A) have stronger incentives to shield taxable income with debt. We find that these firms use more debt as profitability rises, despite the temporary nature of the profitability increases. Firms may rationally behave this way when they face multiple rounds of refinancing and expect high tax savings because they may increase leverage to take advantage of a period of extraordinary profitability and high tax shields from debt. Thus, this finding is consistent with the theoretical model predictions assuming multiple rounds of refinancing (see H4). However, if firms do not anticipate multiple rounds of refinancing, this finding indicates that firms are taking excessive debt without properly internalizing the temporary nature of increases in profitability.[8]

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[7] Effective tax rate = Total tax expense/Pretax income.

[8] In the theoretical model we find that even with a higher tax rate compared to the base case, the negative leverage–profitability relation at refinancing is maintained. Thus, a positive relation between leverage and profitability in the data indicates excessive use of debt for firms planning only a single round of refinancing.

TABLE 6 Leverage–profitability regression with debt-financed rebalancing events for mean-reverting firms facing high versus low effective tax.

Issue size thresholds	Dependent variable: Market leverage					
	$s = 5\%$		$s = 1.25\%$		$s = 7.5\%$	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Panel A: High effective tax						
π (β_0)	−1.053***	−1.050***	−1.062***	−1.058***	−1.051***	−1.048***
	(0.056)	(0.058)	(0.056)	(0.058)	(0.056)	(0.058)
d	−0.007	−0.024	−0.021**	−0.023**	0.011	−0.0072
	(0.021)	(0.020)	(0.009)	(0.009)	(0.024)	(0.024)
$d \times \pi$ (β_1)	1.096***	1.347***	0.692***	0.721***	1.228***	1.494***
	(0.385)	(0.377)	(0.187)	(0.187)	(0.445)	(0.452)
Risk	−0.936***	−0.973***	−0.939***	−0.976***	−0.936***	−0.973***
	(0.146)	(0.149)	(0.146)	(0.149)	(0.146)	(0.149)
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	−0.056***	−0.056***	−0.056***	−0.056***	−0.056***	−0.056***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tan	0.159***	0.162***	0.159***	0.162***	0.159***	0.162***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
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	0.241	0.243	0.241	0.243	0.241	0.243
Rebalancing obs.	577	559	3,199	3,064	319	312
Total obs.	106,315	104,685	106,315	104,685	106,315	104,685
Trade-off hypothesis H1: $\beta_0 < 0$ and $\beta_0 + \beta_1 > 0$						
$\beta_0 + \beta_1$	0.042	0.297	-0.370*	-0.337*	0.177	0.4457
Wald test ($\beta_0 + \beta_1 = 0$)	0.914	0.441	0.057	0.086*	0.695	0.333
Panel B: Low effective tax rate						
π (β_0)	−0.321***	−0.292***	−0.313***	−0.285***	−0.321***	−0.293***
	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)
d	0.050***	0.051***	0.009	0.013	0.076***	0.076***
	(0.014)	(0.014)	(0.009)	(0.009)	(0.016)	(0.016)
$d \times \pi$ (β_1)	−0.703***	−0.739***	−0.759***	−0.770***	−0.631*	−0.671**
	(0.267)	(0.264)	(0.166)	(0.172)	(0.332)	(0.328)
Risk	0.151*	0.115	0.151*	0.115	0.151*	0.115
	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)	(0.087)

TABLE 6 (Continued)

Issue size thresholds	Dependent variable: Market leverage					
	$s = 5\%$		$s = 1.25\%$		$s = 7.5\%$	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Size	0.016***	0.017***	0.0171***	0.017***	0.016***	0.017***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
M/B	−0.042***	−0.041***	−0.042***	−0.041***	−0.042***	−0.041***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tan	0.263***	0.262***	0.264***	0.262***	0.263***	0.262***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.01)
Growth Dummy		−0.011***		−0.011***		−0.011***
		(0.001)		(0.0015)		(0.001)
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.243	0.242	0.244	0.242	0.243	0.242
Rebalancing obs.	297	293	2,227	2,115		
Total obs.	94,254	92,350	94,254	92,350	94,254	92,350
Trade-off hypothesis H1: $\beta_0 < 0$ and $\beta_0 + \beta_1 > 0$						
$\beta_0 + \beta_1$	−1.024***	−1.031***	−1.072***	−1.055***	−0.952***	−0.964***
Wald test ($\beta_0 + \beta_1 = 0$)	0.000	0.000	0.000	0.0000	0.004	0.003

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

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

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 the lagged quarter, and $Z_{i,t-1}$ is the lagged control variables of firm i. Furthermore, d_{it} is an indicator variable equal to 1 if firm i is refinancing at quarter t, and 0 otherwise, and ε_{it} is the remainder stochastic error term. Growth Dummy equals 1 for positive-growth-earnings firms and 0 for negative-growth-earnings firms. See Appendix B for all other variable definitions. Rebalancing obs. and total obs. indicate the number of refinancing firm-quarter observations and total firm-quarter observations, respectively. Effective tax rate is defined as Total tax expense/Pretax income, and firms are defined as facing high (low) effective tax when their effective tax rate is above (below) the median. Standard errors are clustered at the firm level and reported in parentheses.

$^*p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$

In the absence of strong incentives to acquire excessive debt, which is the case for low-tax firms (see Panel B of Table 6), firms consider the temporary nature of earnings shocks, aligning with the theoretical trade-off model predictions from Section 2.4 (see H4). For these firms, we observe a negative relation between leverage and profitability. Interestingly, firms in the low-tax group increase their debt at refinancing. However, the temporary (mean-reverting) nature of profits does not lead to debt increases at the same rate as equity when profitability rises, resulting in a negative relation between leverage and profitability at refinancing. Our findings are consistent with the results of Longstaff and Strebulaev (2014), who show that the smallest firms, facing lower income and effective tax rates, are more influenced by external shocks than larger firms. The varying sensitivity and adjustment in financing policies of firms at different tax levels are also in line with Faccio and Xu (2015) and Kaviani et al. (2020).[9]

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[9] Faccio and Xu (2015) find that both corporate and personal income taxes are significant determinants of capital structure. Kaviani et al. (2020) focus on the impact of economic policy uncertainty shocks, showing that firms facing higher effective tax schemes have more sensitivity to economic policy uncertainty.

5 | CONCLUSION

We develop a dynamic two-stage trade-off model with mean reversion in earnings to examine firms' refinancing decisions. We demonstrate that by accounting for mean reversion, we observe a negative relation between leverage and profitability at the time of refinancing. Our theoretical analysis also identifies two regions in the leverage–profitability relation when firms have multiple rounds of refinancing: one where the relation is positive, for firms with significant tax shields from using debt, and another where it turns negative, for firms with low tax shields from using debt. Our comprehensive empirical analysis, which focuses on a subsample of firms, confirms the theoretical model's predictions. This suggests that firm-specific characteristics related to firms' earnings dynamics, combined with incentives to leverage debt for tax purposes, influence refinancing behavior. Indeed, prior research (e.g., Lemmon et al., 2008), has emphasized the significance of incorporating firm-specific characteristics when analyzing firms' financing decisions. Future extensions of our model could include exploring such features, such as incorporating firms' financing constraints in a mean reversion context.

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CONFLICTS OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX A: DERIVATION OF BASIC CLAIMS FOR MODELING FIRMS' REFINANCING DECISION IN A MEAN REVERSION SETTING

A contingent claim $P(x)$ on x, which follows the arithmetic mean reversion (AMR) process defined in Equation (1), should satisfy the following differential equation:

$$T(P(x)) = \frac{1}{2}\sigma^2 P''(x) - q(x-\theta)P'(x) - rP(x) = 0. \tag{A1}$$

Equation (A1) follows from standard replication arguments for valuing contingent claims (see, e.g., Dixit & Pindyck, 1994).

The general solution of the homogeneous differential Equation (A1) for any $P(x)$ contingent claim can be defined as follows:

$$P(x) = C_1 P_1(x) + C_2 P_2(x), \tag{A2}$$

with C_1 and C_2 general constants. It can be shown that $P_1(x)$ and $P_2(x)$ are two linearly independent solutions of Equation (A1), defined by (A3a) and (A3b):

$$P_1(x) = e^{\frac{1}{4}\left(\frac{(x-\theta)\sqrt{2q}}{\sigma}\right)^2} D_v\left(\frac{(x-\theta)\sqrt{2q}}{\sigma}\right), \tag{A3a}$$

$$P_2(x) = e^{\frac{1}{4}\left(\frac{(x-\theta)\sqrt{2q}}{\sigma}\right)^2} D_v\left(-\frac{(x-\theta)\sqrt{2q}}{\sigma}\right), \tag{A3b}$$

where

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

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

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

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

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

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

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

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

Consider now a basic claim $B(x)$ that pays \$1 in the event of bankruptcy, that is, when x hits x_L from above following a firm's refinancing decision. This basic claim being a contingent claim on x satisfies Equation (A1) with the following boundary conditions:

$$T(B(x)) = 0 \tag{A4a}$$

$$\lim_{x\to\infty} B(x) = 0 \tag{A4b}$$

$$B(x_L) = 1. \tag{A4c}$$

The solution for $B(x)$ is given by applying the general solution in Equation (A2) for $B(x)$ with boundary conditions (A4a)–(A4c) resulting in $C_2 = 0$ and $C_1 = 1/P_1(x_L)$ and thus providing the solution for the basic claim paying \$1 at x_L as follows:

$$B(x) = \frac{P_1(x)}{P_1(x_L)}. \tag{A5}$$

$H(x)$ and $L(x)$ are double boundary basic claims defined as follows: $H(x)$ pays \$1 at refinancing trigger x_R and 0 if the default boundary x_b is reached. $L(x)$, in contrast, pays \$1 at x_b and 0 when the refinancing x_R is reached. In detail, $H(x)$ satisfies the following boundary conditions:

$$T(H(x)) = 0 \tag{A6a}$$

$$H(x_R) = 1 \tag{A6b}$$

$$J(x_b) = 0. \tag{A6c}$$

Relatedly, $L(x)$ satisfies the following boundary conditions:

$$T(L(x)) = 0 \tag{A7a}$$

$$L(x_R) = 0 \tag{A7b}$$

$$L(x_b) = 1. \tag{A7c}$$

Using the general solution in (A2) and applying the boundary conditions for $H(x)$ in Equations (A6a)–(A6c) obtain $C_1 = P_2(x_b)/D(x_R, x_b)$, $C_2 = -P_1(x_b)/D(x_R, x_b)$, where $D(x_R, x_b) = P_1(x_R)P_2(x_b) - P_1(x_b)P_2(x_R)$. The solution for $H(x)$ capturing the expected present value of \$1 when refinancing is triggered is thus:

$$H(x) = \frac{P_2(x_b)}{D(x_R, x_b)}P_1(x) - \frac{P_1(x_b)}{D(x_R, x_b)} \quad P_2(x). \tag{A8}$$

Using the general solution in (A2) and applying the boundary conditions for $L(x)$ in Equations (A7a)–(A7c) obtain $C_1 = -P_2(x_R)/D(x_R, x_b)$, $C_2 = P_1(x_R)/D(x_R, x_b)$. Hence, $L(x)$ is expressed by:

$$L(x) = -\frac{P_2(x_l)}{D(x_l, x_b)}P_1(x) + \frac{P_1(x_l)}{D(x_l, x_b)} \quad P_2(x). \tag{A9}$$

APPENDIX B

See Table B1.

TABLE B1 Variable definitions.

Symbol	Variable	Compustat mnemonic	Definition
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 × *cshoq*	Total debt + Market equity
C	Cash holdings	*cheq*	Cash and equivalents
A	Total book assets	*atq*	
L	Market leverage	(*dlcq* + *dlttq*)/(*prccq* × *cshoq* + *dlcq* + *dlttq*)	Total debt/(Total debt + Market equity)
ΔD_t^e	Change in 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 of profitability calculated over four contiguous quarters		

TABLE B1 (Continued)

Symbol	Variable	Compustat mnemonic	Definition
Size	Firm size	log(*atq*)	Natural logarithm of total book assets
M/B	Tobin's Q	(*dlcq* + *dlttq* + *prccq* × *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,[bc]			
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 $\frac{\Delta D^e_t}{A_t} > s$ and $\frac{ER^e_t}{A_t} > s$ (= 0 otherwise)	
a^N_t	Mixed cash- and debt-financed rebalancing	= 1 if $\frac{\Delta D^e_t - \Delta C_t}{A_t} > s$ and $\frac{ER^e_t}{A_t} > s$ (= 0 otherwise)	
a^C_t	Cash-only financed rebalancing	= 1 if $\frac{-\Delta C_t}{A_t} > s$ and $\frac{ER^e_t}{A_t} > s$ (= 0 otherwise)	

[a] We use the Consumer Price Index (CPI) to adjust size for inflation. We collect CPI data from the Bureau of Labor Statistics. Our base period is 1984–2019. The continuous variables *M/B*,

π, *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 *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 *q* to refer to this variable.