TESTING TRADEOFF AND PECKING ORDER PREDICTIONS ABOUT DIVIDENDS AND DEBT

Eugene F. Fama and Kenneth R. French*

*Graduate School of Business, University of Chicago (Fama) and Sloan School of Management, MIT (French). We gratefully acknowledge the comments of John Graham (the referee) and Campbell Harvey (the editor). Correspondence and requests for reprints should be sent to Professor Eugene F. Fama, Graduate School of Business, University of Chicago, 1101 East 58th Street, Chicago, IL 60637. Telephone: (773) 702-7282. E-mail: eugene.fama@gsb.uchicago.edu
Abstract

Confirming predictions shared by the tradeoff and pecking order models, more profitable firms and firms with fewer investments have higher dividend payouts. Confirming the pecking order model but contradicting the tradeoff model, more profitable firms are less levered. Firms with more investments have less market leverage, which is consistent with the tradeoff model and a complex pecking order model. Firms with more investments have lower long-term dividend payouts, but dividends do not vary to accommodate short-term variation in investment. As the pecking order model predicts, short-term variation in investment and earnings is mostly absorbed by debt.
The finance literature offers two competing models of financing decisions. In the tradeoff model, firms identify their optimal leverage by weighing the costs and benefits of an additional dollar of debt. The benefits of debt include, for example, the tax deductibility of interest and the reduction of free cash flow problems. The costs of debt include potential bankruptcy costs and agency conflicts between stockholders and bondholders. At the leverage optimum, the benefit of the last dollar of debt just offsets the cost. The tradeoff model makes a similar prediction about dividends. Firms maximize value by selecting the dividend payout that equates the costs and benefits of the last dollar of dividends.

Myers (1984) develops an alternative theory known as the pecking order model of financing decisions. The pecking order arises if the costs of issuing new securities overwhelm other costs and benefits of dividends and debt. The financing costs that produce pecking order behavior include the transaction costs associated with new issues and the costs that arise because of management’s superior information about the firm’s prospects and the value of its risky securities. Because of these costs, firms finance new investments first with retained earnings, then with safe debt, then with risky debt, and finally, under duress, with equity. As a result, variation in a firm’s leverage is driven not by the tradeoff model’s costs and benefits of debt, but rather by the firm’s net cash flows (cash earnings minus investment outlays).

We test the dividend and leverage predictions of the tradeoff and pecking order models. Our menu is ambitious. We examine predictions about how long-term leverage and the dividend payout ratio vary across firms with the main driving variables proposed by the two models – profitability and investment opportunities. Moreover, to test predictions about the interdependence of long-term leverage and the dividend payout, we model dividends and leverage jointly. We test the tradeoff model’s prediction that leverage is mean-reverting. And we test pecking order predictions about how financing decisions respond to short-term variation in earnings and investment.

To our knowledge, we are the first to test tradeoff and pecking order predictions about the dividend payout ratio, and we are the first to jointly model and test the interaction between the payout ratio and leverage. But one can argue that many of our leverage results just confirm previous evidence.
Our retort is that prior evidence is a bit piecemeal, and it is subject to a statistical problem that undermines the credibility of inferences.

For example, studies of the determinants of target leverage usually estimate a single cross-section regression and do not actually examine whether leverage tends to revert to a target [Bradley, Jarrell, and Kim (1984), Long and Malitz (1985), Rajan and Zingales (1995), Titman and Wessels (1988)]. The few papers that test for mean reversion use small samples [143 firms in Auerbach (1985), 108 in Jalilvand and Harris (1984)]. Shyam-Sunder and Myers (1999) is the only paper that addresses the response of debt to short-term variation in investment and earnings. It is limited to a small sample of 157 firms that survive the entire 1971-89 period. We jointly examine target leverage, the mean reversion of leverage, and the short-term response of dividends and debt to variation in earnings and investment in annual samples that cover the 1965-99 period and on average include more than 3000 firms.

In our view, however, the most serious problem in the empirical leverage literature is understated standard errors that cloud inferences. Previous work uses either cross-section regressions or panel (pooled time-series and cross-section) regressions. When cross-section regressions are used, the inference problem due to correlation of the residuals across firms is almost always ignored. The papers that use panel regressions ignore both the cross-correlation problem and the bias in the standard errors of regression slopes that arises because the residuals are correlated across years.

In the spirit of Fama and MacBeth (FM, 1973), we use the average slopes from year-by-year cross-section regressions to study the determinants of leverage (and dividends), and we use the time-series standard errors of the average slopes to draw inferences. Our average slopes are like the slopes from a single panel (pooled time-series cross-section) regression of the type common in the literature. And the FM average slopes capture the same information as the slopes from a panel regression. The FM approach is just a simple way to obtain robust standard errors that capture whatever contributes to the precision of the average slopes. For example, our large annual cross-sections reduce the variation in the year-by-year slopes and lower the standard errors of the average slopes. Positive correlation of the regression disturbances across firms increases both the volatility of the annual slopes and the standard errors of the average slopes. The standard errors of the average slopes are also robust with respect to
heteroscedasticity, since there is no heteroscedasticity correction for a sample mean. And we can use the
time-series properties of the annual slopes to adjust for autocorrelation.

The FM approach points to serious problems in previous studies that fail to allow for cross-
correlation and autocorrelation. Cross-correlation almost always inflates the standard errors of the
average slopes in the dividend and leverage regressions by a factor of more than two and often more than
five. Autocorrelation sometimes produces an additional increase of about 250 percent in the standard
errors of the average slopes. In short, the standard errors in most previous capital structure tests are
almost surely understated by large unknown amounts. In our view, this means that inferences from
previous tests (the things we think we know about capital structure) lack credibility until they are
confirmed by robust methods. Though many of our results are new, one of the contributions of this paper
is a credible statistical foundation for many existing results.

A synopsis of our evidence is difficult since the tests are tightly linked to our view of the tradeoff
and pecking order models. Thus, we leave an overview of the results to the conclusions. For the
moment, suffice it to say that though motivated by different forces, the tradeoff and pecking order models
share many predictions about dividends and debt. These shared predictions tend to do well in our tests.
On issues where the two models differ, each suffers one major failure.

The story proceeds as follows. Section I summarizes the tradeoff and pecking order models.
Section II briefly describes the statistical setup. Sections III to V present our tests of how dividends and
leverage line up with the predictions of the two models. Section VI concludes.

I. Predictions

Our discussion of the tradeoff and pecking order models largely focuses on predictions about how
leverage and the dividend payout ratio vary with profitability and investment opportunities. For easy
reference, we summarize the predictions and the rationale for them in Charts 1 and 2.

A. The Pecking Order Model

Myers (1984) uses Myers and Majluf (1984) to motivate the pecking order. In Myers and Majluf,
managers use private information to issue risky securities when they are over-priced. Investors are aware
of this asymmetric information problem, and they discount the firm’s new and existing risky securities when new issues are announced. Managers anticipate these price discounts, and they may forego profitable investments if they must be financed with new risky securities. To avoid this distortion of investment decisions, managers prefer to finance projects with retained earnings, which involve no asymmetric information problem, and with low risk debt, for which the problem is negligible.

Myers (1984) suggests that the costs of issuing risky debt or equity overwhelm the forces that determine optimal leverage in the tradeoff model. The result is the pecking order. To minimize asymmetric information costs and other financing costs, firms finance investments first with retained earnings, then with safe debt, then with risky debt, and finally, under duress, with equity.

**Dividends** – Myers (1984) acknowledges that the pecking order model does not explain why firms pay dividends. But when firms choose (for other reasons) to pay dividends, pecking order considerations should affect dividend decisions. Specifically, since it is expensive to finance investment with new risky securities, dividends are less attractive for firms with less profitable assets in place, large current and expected investments, and high leverage. Thus, controlling for other effects, more profitable firms pay out more of their earnings as dividends. But the payout ratio is negatively related to investment opportunities and leverage. Myers (1984) also posits that in the short term, dividends are (for unknown reasons) sticky, leaving variation in net cash flows to be absorbed largely by debt.

**Leverage** – Pecking order predictions about leverage are more complicated. In a simple pecking order world, debt typically grows when investment exceeds retained earnings and falls when investment is less than retained earnings. Thus, if profitability and investment outlays are persistent, the simple version of the model predicts that, holding investment fixed, leverage is lower for more profitable firms, and given profitability, leverage is higher for firms with more investments.
In a more complex view of the model, also offered by Myers (1984), firms are concerned with future as well as current financing costs. Balancing current and future costs, it is possible that firms with large expected investments maintain low-risk debt capacity to avoid either foregoing future investments or financing them with new risky securities. It is thus possible that, controlling for other effects, firms with larger expected investments have less current leverage.

How can pecking order firms keep leverage down when investments are persistently large relative to earnings? Dividend payers can (as the model predicts) keep their payout ratio low. Firms that do not pay dividends can refrain from starting when earnings are strong. Firms going public can issue more equity in anticipation of future investment. And when publicly traded firms choose to bear the high financing costs of new equity, they can issue more of it to accommodate future investment.

It is possible that none of this works; that is, the balance of financing costs in the pecking order may force many firms with persistently large investments to have high leverage (the prediction of the simple version of the model). This seems less likely for dividend payers since they have a source of retained earnings (lower payouts) that can help maintain less leverage. Moreover, Fama and French (2000) find that (as the pecking order model predicts) dividend payers tend to be firms with high earnings relative to investment. Thus, for dividend payers, the prediction that firms with larger expected investments have less current leverage may be on solid ground. On the other hand, Fama and French (2000) also find that firms that do not pay dividends typically have large investments relative to earnings. Thus, for non-payers the negative relation between leverage and expected investment predicted by the complex pecking order is more tenuous, and the positive relation between leverage and investment of the simple pecking order may dominate.

Myers (1984) argues that in a pecking order world, firms do not have leverage targets. Our analysis seems to suggest that considering future as well as current financing costs leads to such targets. If so, the targets are soft. Firms with more expected investments may tend to have less leverage, but period-by-period variation in net cash flows is still largely absorbed by debt. Moreover, any leverage targets are one-sided; firms have no particular incentive to increase leverage when positive net cash flows push it below values that allow expected investments to be financed with retained earnings and low-risk
debt. This is in contrast to the tradeoff model (discussed next) where the costs and benefits of debt push under-levered firms up and over-levered firms down toward their leverage targets.

**Volatility** – Finally, considering future as well as current financing costs leads to a pecking order prediction about how the volatility of net cash flows affects dividends and debt. To lower the chance of issuing new risky securities or foregoing profitable investments when net cash flows are low, firms with more volatile net cash flows are likely to have lower dividend payouts and less leverage.

**B. The Tradeoff Model**

In the tradeoff model, leverage and dividend targets are driven by an amalgam of forces. Potential bankruptcy costs, for example, push firms toward less target leverage, while the agency costs of free cash flow push them toward more. The tradeoff forces we consider make almost unanimous predictions about how target leverage and the dividend payout vary across firms with profitability and investment opportunities. The tradeoff model’s predictions about dividends are similar to those of the pecking order model. But the models have some disagreements about leverage.

**Bankruptcy Costs** – Expected bankruptcy costs rise when profitability declines, and the threat of these costs pushes less profitable firms toward lower leverage targets. Similarly, expected bankruptcy costs are higher for firms with more volatile earnings, which should drive smaller less-diversified firms toward less target leverage.

**Taxes** – Taxes have two offsetting effects on optimal capital structures. The deductibility of corporate interest payments pushes firms toward more target leverage, while the higher personal tax rate on debt, relative to equity, pushes them toward less leverage. In Miller and Scholes (1978), the personal tax rate implicit in the pricing of a firm’s interest payments does not vary with its leverage. If the marginal benefit of the corporate tax deduction is also constant at all levels of profit and loss, taxes do not produce an interior optimum for leverage. Whether taxes push a firm toward maximum leverage, no leverage, or indeterminate leverage depends on whether the constant marginal corporate tax saving is greater than, less than, or equal to the constant marginal personal tax cost.
DeAngelo and Masulis (1980) develop a model that allows the marginal benefit of the corporate tax deduction of interest to vary with leverage, and so produce an interior optimum for leverage. In their model, optimal leverage depends on a firm’s non-debt tax shields, such as R&D expenditures and depreciation. Larger non-debt tax shields imply a larger chance of having no taxable income, a lower expected corporate tax rate, and a lower expected payoff from interest tax shields. DeAngelo and Masulis (1980) thus predict that leverage is inversely related to the level of non-debt tax shields.

Tests of the DeAngelo and Masulis (1980) model typically focus on non-debt tax shields, but the model implies a more general prediction about leverage and profitability. The driving force in their argument is asymmetric taxation of profits and losses. The government does not subsidize losses as heavily as it taxes profits, so more profitable firms face a higher expected tax rate. For low levels of earnings, progressive corporate tax rates reinforce the link between expected profitability and the expected tax rate. As a result, the expected payoff from interest tax shields is higher for more profitable firms and for firms with less volatile earnings. The deductibility of corporate interest thus pushes more profitable and less volatile firms toward higher leverage.

Agency Stories – In the agency models of Jensen and Meckling (1976), Easterbrook (1984), and Jensen (1986), the interests of managers are not aligned with those of securityholders, and managers tend to waste free cash flow (the excess of cash earnings over profitable investments) on perquisites and bad investments. Dividends and especially debt help control this agency problem by forcing managers to pay out more of the firm’s excess cash.

A firm’s free cash flow is determined by the earnings from its assets in place and the size of its profitable investments. The model predicts that to control the agency costs created by free cash flow, firms with more profitable assets in place commit a larger fraction of their pre-interest earnings to debt payments and dividends. Thus, controlling for investment opportunities, the dividend payout and leverage are positively related to profitability. Conversely, firms with more investments relative to earnings have less need for the discipline of dividends and debt. Thus, controlling for profitability, firms with more investments have lower dividend payouts and less leverage. Incentives to control the stockholder-bondholder agency problem that arises when debt is risky [the underinvestment and asset
substitution conflicts discussed by Fama and Miller (1972), Jensen and Meckling (1976), and Myers (1977)] also lead to the prediction that firms with more investments have lower dividend payouts and less leverage. Finally, in the agency story, dividends and debt are substitutes for controlling free-cash-flow problems, so the predicted relation between target leverage and the target payout ratio is negative.

*Adjustment (Financing) Costs* – Myers (1984) builds the pecking order model on the assumption that asymmetric information problems and other financing costs overwhelm the forces that determine optimal leverage in the tradeoff model. But if financing costs do not overpower other factors, the tradeoff model survives, and firms weigh all costs and benefits when setting leverage targets. And the adjustment (financing) costs of the pecking order affect the targets. To reduce the likelihood of having to issue risky securities or forego profitable investments, firms set leverage and dividend payout targets below their no-adjustment-cost optimal values. The shift toward less debt and lower dividends is larger for firms with lower expected profits, larger expected investments, and more volatile net cash flows.

In sum, asymmetric information problems and other financing costs reinforce the tradeoff model’s predictions about target leverage and the dividend payout ratio. Controlling for other effects, firms with more profitable assets in place, fewer investments, and less volatile earnings and net cash flows have higher leverage and payout targets. Financing costs also impede movement toward the targets, but in contrast to the pecking order model, in the tradeoff model these costs do not overwhelm the other factors that determine target ratios.

**C. Proxies for the Driving Variables**

Our measures of profitability, investment opportunities, and volatility are far from perfect. We use the ratio of annual pre-interest pre-tax earnings to end-of-year total assets, $ET_t/At$, and the ratio of pre-interest after-tax earnings to assets, $E_t/At$, as proxies for the expected profitability of assets in place. $ET_t$, earnings before taxes, preferred dividends, and interest payments, is the income that could be sheltered from corporate taxes by interest deductions. Thus, $ET_t/At$ is a measure of profitability when we look for tax effects in the tradeoff model. [Some alternatives, left for future research, are the various approaches
to estimating tax rates in Graham (1996b).] ET/A_t and E_t/A_t also provide information about profitability for testing the pecking order model and the effects of other forces in the tradeoff model.

Our primary proxy for expected investment opportunities is V_t/A_t, the ratio of a firm’s total market value to its book value. But a firm’s market value measures not only the value of future investments, but also the value of assets in place. Thus, V_t/A_t (a rough proxy for Tobin’s Q) also has information about current profitability. Since research and development expenditures generate future investment, we use the ratio of R&D to assets, RD_t/A_t, as an additional proxy for expected investment. Again, however, the signal is mixed. Along with the ratio of depreciation expense to assets (Dp_t/A_t), RD_t/A_t also serves as a proxy for non-debt tax shields. Our last measure of expected investment opportunities is the growth in assets, dA_t/A_t = (A_t–A_{t-1})/A_t. The growth in assets is a direct measure of current investment and, if investment is persistent, it is also a proxy for expected investment.

The tradeoff and pecking order models predict that firms with more volatile earnings and net cash flows have less leverage and lower dividend payouts. We assume that larger more diversified firms are likely to have less volatile earnings and net cash flows, and we use firm size – specifically, the natural logarithm of total book assets, ln(A_t) – as a proxy for volatility. We recognize, however, that size may also proxy for other factors, such as age and ease of access to capital markets, that affect financing decisions. We could use time-series data to estimate volatility, but this would limit our annual samples of firms to survivors with the required data. Moreover, estimates of volatility based on (say) five or ten years of data are not clearly less noisy than the proxy provided by size.

Our tests exclude financial firms and utilities. Financial intermediaries seem inappropriate for testing the predictions of leverage models. We exclude utilities to avoid the criticism that their financing decisions are a byproduct of regulation. Excluding financials and utilities may also go a long way toward alleviating any omitted variable problems created by industry effects in financing decisions.

D. Market or Book Leverage

Do the leverage predictions of the tradeoff and pecking order models describe market leverage, L_t/V_t (the ratio of debt to the market value of assets), or book leverage, L_t/A_t? In the regressions below,
we scale most variables by assets. As a result, most predictions apply directly to book leverage, and some carry over to market leverage. Other predictions are ambiguous. Because of this ambiguity, we always present empirical results for both book and market leverage.

In the tradeoff model, agency costs, taxes, and bankruptcy costs push firms to increase debt as earnings increase. Thus, scaling earnings and debt by assets, the model predicts a positive relation between profitability, $ET_t/A_t$, and book leverage, $L_t/A_t$. Since market value increases with profitability, there is no prediction about market leverage, $L_t/V_t$. Controlling for earnings on assets in place, firms with more investments and higher dividends have less free cash flow and lower optimal levels of debt. Thus, scaling debt and investment with assets, the model predicts that book leverage is negatively related to investment and the payout ratio. Since market value grows at least in proportion to profitable investment outlays, the relation between investment opportunities and market leverage is also negative.

In the pecking order model, firms with lots of profits and few investments have little debt. Or, standardizing by book assets, firms with high profitability, given their investments, have less book leverage. Since market value increases with profitability, the negative relation between profitability and book leverage, $L_t/A_t$, also holds for market leverage, $L_t/V_t$. In the simple version of the pecking order, the level of debt is determined by accumulated differences between retained earnings and investment. Thus, scaling by assets, and assuming investment and earnings are persistent, the marginal relation between investment and book leverage is positive. There is no prediction about market leverage.

In the complex pecking order model, firms balance current and expected financing costs, and firms with larger expected investments are pushed toward keeping more low-risk debt capacity to finance future investment. (The under-investment and asset substitution problems that can arise with risky debt in the tradeoff model lead to a similar prediction.) The likely result is a negative relation between leverage and expected investment. Whether this prediction applies to book or market leverage depends on whether low risk debt capacity is a function of the book or the market value of assets, an issue on which there is ambiguity. When larger expected investments lead to less book leverage, they also produce less market leverage if the investments are expected to be profitable and so add to current market value. But when low risk debt capacity depends on market value, the relation between market leverage and expected
investment is negative, and there is no prediction about book leverage. Whether the predicted negative relation between leverage and the dividend payout ratio applies to book or market leverage also depends on whether low risk debt capacity is a function of the book or market value of assets.

II. The Framework for the Tests: A Brief Overview

In our view of the tradeoff and pecking order models, the two endogenous variables are the target dividend payout ratio and target leverage. Both are functions of profitability, investment opportunities, and other variables we take to be exogenous. The target payout depends on target leverage, and vice versa, so we estimate the structural equations for the two variables with two-stage least squares. The model also includes two partial adjustment equations to capture the movement of dividends and leverage toward their targets. We first detail the story for dividends and then turn to leverage.

III. Dividend Regressions

The dividend predictions of the tradeoff and pecking order models are tested in the context of Lintner’s (1956) model, which seems to provide a good description of dividend behavior [Allen and Michaely (1995)]. The model says that a firm has a long-term target payout ratio, TP, that relates its target dividend for year t+1, TD_{t+1}, to common stock earnings, Y_{t+1},

(1) \[ TD_{t+1} = TP \times Y_{t+1}. \]

Because of adjustment costs, the firm moves only part way to the target in year t+1,

(2) \[ D_{t+1} - D_t = SOA(TD_{t+1} - D_t) + e_{t+1} \]

Thus, the speed of adjustment, SOA = -a_2, is less than 1.0.

A. The Target Payout

Approach – Our main task is to estimate (1), or more specifically, to examine how the target payout, TP, in (1) varies across firms as a function of investment opportunities, profitability, target leverage, and other driving forces. Our approach is to estimate, each year, the cross-section regression of
dividends (scaled by assets) on common stock earnings (also scaled by assets), allowing the slope (the target payout) to vary across firms as a function of our proxies for the driving variables,

\[ \frac{D_{t+1}}{A_{t+1}} = a_0 + (a_1 + a_{1V} V_t/A_t + a_{1E} E_t/A_t + a_{1A} dA_t/A_t + a_{1RD} R_t/A_t + a_{1RR} R_t/A_t + a_{1L} \ln(A_t) + a_{1T} T_{t+1})Y_{t+1}/A_{t+1} + \epsilon_{t+1}. \]

To simplify the notation, we omit the firm subscript that should appear on the variables and residuals in (4) and the year subscript that should appear on the regression coefficients. Rather than estimating a regression for the payout ratio, \( D_{t+1}/Y_{t+1} \), we follow (1) and put common stock earnings, \( Y_{t+1} \), on the right of regression (4). This avoids the influential observation problem that arises when earnings are near zero. Most of the variables in (4) are scaled by assets. This can create influential observations when \( A_t \) is close to zero. To address this issue, each year we drop firms with assets less than $2.5 million. This causes the average number of firms per regression to drop from 1623 to 1618.

The exogenous interaction variables in (4) include our proxies for investment opportunities \((V_t/A_t, dA_t/A_t, \text{ and } RD_t/A_t)\) and the profitability of assets in place \((E_t/A_t \text{ and } V_t/A_t, \text{ where } E_t \text{ is pre-interest after-tax earnings})\). The log of firm size, \( \ln(A_t) \), proxies for volatility and other exogenous effects. \( RDD_t \) is a dummy that is 1.0 for firms with zero or no reported R&D. On average more than 60 percent of Compustat firms report zero R&D or do not report R&D, and it seems appropriate to allow for a non-linearity in the relation between R&D and dividends produced by this large group of firms. \( TL_{t+1} \) is target leverage, the fitted value from the first stage reduced form estimate of target book or market leverage for dividend payers (see Table 3, below). Finally, the interaction variables we take to be exogenous are measured in year \( t \), so they are predetermined. This mitigates any remaining endogeneity problems.

Previous research on the Lintner (1956) model [Fama and Babiak (1968), Choe (1990)] finds that dividends adjust slowly toward target payouts; the speed of adjustment in (2) is far from 1.0. Slow adjustment implies that, for the purpose of modeling the target payout, there is noise in the dividend variable on the left of regression (4). As long as this noise is unrelated to the explanatory variables on the right, it does not bias the slopes and the regression yields unbiased estimates of the target payout ratio as a function of investment opportunities, profitability, leverage, and other effects.
In the spirit of Fama and MacBeth (1973), we use averages of the annual slopes from (4) and
time-series standard errors of the averages to draw inferences. The advantage of this approach is that the
year-by-year variation in the slopes, which determines the standard errors of the average slopes, includes
estimation error due to the correlation of the residuals across firms. The standard errors are also robust
with respect to heteroscedasticity, since there is no heteroscedasticity correction for a sample mean.

Autocorrelation of the annual slopes from (4) is also an issue. The first-order autocorrelations are
often large, sometimes reaching 0.8. The autocorrelations for longer lags decay, but they are sometimes
around 0.5 out to three lags. We could adjust the standard errors of the average slopes for the estimated
autocorrelation of the slopes. But with just 35 observations on the slopes for 1965-99, autocorrelation
estimates are imprecise, with standard errors around 0.17. We use a less formal approach. We assume
the standard errors of the average slopes in (4) should be inflated by a factor of 2.5. Thus, we require
t-statistics around 5.0, rather than the usual 2.0, to infer reliability. This adjustment is near exact if the
annual slopes are first-order autoregressions (AR1s) with first-order autocorrelation of about 0.75, which
is at the high end of the observed range, making our inferences conservative.\footnote{1}

Results – For perspective on the estimates of (4), Table 1 summarizes estimates of the cross-
section regression of $D_{t+1}/A_{t+1}$ on $Y_{t+1}/A_{t+1}$, that is, (4) without interaction terms. The average of the
annual estimates of the target payout from this regression, 0.46, is close to the estimate of the aggregate
payout for a comparable sample period reported in Fama and French (2000), 0.45. The estimates of the
target payout from the various versions of (4), 0.41 and 0.42, are similar. More interesting, the average of
the year-by-year $R^2$ from the regression of $D_{t+1}/A_{t+1}$ on $Y_{t+1}/A_{t+1}$ is 0.25, which is respectable, given the
low $R^2$ values typical in cross-section regressions for individual firms. But adding the interaction terms in
(4) increases the $R^2$ more than 50 percent, to 0.38 and 0.39. Thus, the combination of interaction
variables in (4) captures substantial variation across firms in the target payout. This result is important,
given the evidence below that the collinearity of the variables somewhat obscures their individual effects.

In the tradeoff model, firms with more investments relative to earnings have lower free cash
flows and thus less need for discipline from dividends. Lower dividends for firms with more investments
also help avoid the asset substitution and under-investment problems that can arise if investment is
instead financed with risky debt. In the pecking order model, firms with abundant investments relative to earnings pay fewer dividends to preserve low-risk debt capacity for expected investments. Thus, both models predict that, controlling for other effects, firms with more investments have lower target dividend payouts. The strong negative average $\frac{dA_t}{A_t}$ slopes in Table 1 (t-statistics less than -7.8) support this prediction. The negative $\frac{RD_t}{A_t}$ slopes also support this prediction, but in the full versions of (4), the $\frac{RD_t}{A_t}$ slopes are more than three but less than five standard errors from zero. When target book leverage is used as an explanatory variable, the average $\frac{V_t}{A_t}$ slope in (4) is positive ($t = 3.66$), which runs counter to the predicted negative relation between investment prospects and the target payout. When target market leverage is the explanatory variable, the average $\frac{V_t}{A_t}$ slope in (4) is close to zero ($t = -0.54$).

In the tradeoff model, more profitable firms have more need for the discipline of dividends to control the agency problem created by free cash flows. In the pecking order model, more profitable assets allow firms to pay higher dividends while maintaining low risk debt capacity to finance investment. Thus, the reasons again differ, but both models predict that controlling for other effects, more profitable firms have higher dividend payouts. The positive average $\frac{E_t}{A_t}$ slopes in (4) are consistent with this prediction, but in the full versions of (4) their t-statistics, 4.24 and 4.18, fall a bit below our 5.0 standard error hurdle for reliability. The positive $\frac{V_t}{A_t}$ slope observed when target book leverage is used as an explanatory variable also supports the prediction that more profitable firms choose higher target payouts, if the slope is due to the information about profitability in $\frac{V_t}{A_t}$ rather than to information about investment opportunities.

In the tradeoff model, more volatile earnings imply lower expected tax rates and higher expected bankruptcy costs, which push firms toward less leverage and lower dividend payouts. In the complex pecking order model, more volatile net cash flows push firms toward lower dividend payouts and less leverage by raising the chance that low-risk debt capacity will not be available for future investments. The positive $\ln(A_t)$ slopes in the estimates of (4) are consistent with the prediction that more volatile (i.e., smaller) firms have lower dividend payouts. But we recognize that size also proxies for other factors (like age and the cost of accessing outside capital markets) that can affect dividend decisions. Moreover, the $\ln(A_t)$ slopes in the full versions of (4) are less than four standard errors from zero.
Both the tradeoff model and the pecking order model predict that the marginal relation between the target dividend payout and target leverage is negative. This prediction gets little support in the estimates of the full version of (4). The average slope for target book leverage is slightly positive, the slope for target market leverage is slightly negative, and both are within one standard error of zero.

What can we infer about the target payout ratio from the estimates of (4)? The signs of the regression slopes are almost always consistent with the tradeoff and pecking order predictions that the payout ratio is positively related to profitability and negatively related to investment opportunities and volatility. If we ignore the autocorrelation problem (and use t’s of 2.0 rather than 5.0 to judge reliability), the evidence would also appear to be statistically strong. But when we allow for autocorrelation the evidence is rather weak. We argue that the problem is collinearity.

Table 1 shows estimates of (4) that exclude target leverage as an explanatory variable. (This first stage reduced form regression provides the estimates of the target payout used later to explain leverage.) The main effect of dropping TL_{t+1} is increased reliability of the profitability slope (t = 12.82). But this may be misleading; the enhanced precision of the E_t/A_t slope may just reflect its role in explaining target leverage (documented later). Conversely, dropping E_t/A_t from (4) leads to strong negative slopes on TL_{t+1} (more than ten standard errors below zero), which is consistent with the negative relation between the target payout and target leverage predicted by the tradeoff and pecking order models. Dropping E_t/A_t also produces statistically reliable slopes on RD_t and ln(A_t), now more than -5.4 and 9.2 standard errors from zero. But all this may just say that target leverage, R&D, and size are to some extent proxies for profitability.

We conclude that the estimates of (4) lean toward the tradeoff and pecking order predictions that the payout ratio is positively related to profitability and negatively related to investment opportunities and volatility. There is also a hint that, as predicted by the two models, the relation between the target payout and target leverage is negative. But these inferences are clouded by collinearity between profitability and most of the other explanatory variables, which makes marginal effects difficult to disentangle.

Though not entirely definitive, our results on the determinants of the target payout are new. Previous work on dividends never directly attempts to explain the payout ratio. For example, Smith and
Watts (1992) study the determinants of the dividend-price ratio, $D_t/P_t$, which is not the payout ratio. Since variation in $D_t/P_t$ is primarily due to the stock price, $D_t/P_t$ may in fact say little about dividend policy.

**B. Dividends and Investment**

The estimates of (4) are consistent with tradeoff and pecking order predictions about how investment, profitability, and volatility affect target dividends. We now examine whether firms vary dividends away from their targets to accommodate short-term variation in investment. In these tests, we turn to Lintner’s (1956) partial adjustment equation (3), which includes normal variation in dividends due to movement toward the target payout. We use two versions of (3). The simple one does not allow for variation across firms in the target payout and speed of adjustment of (2) and (3). Adding a constant to (3), scaling by total assets, and adding $dA_{t+1}/A_{t+1} = (A_{t+1} - A_t)/A_{t+1}$ to measure the response of dividends to concurrent investment, we estimate, each year, the cross-section regression,

\[
(D_{t+1}-D_t)/A_{t+1} = a_0 + a_1Y_{t+1}/A_{t+1} + a_2D_t/A_{t+1} + a_3dA_{t+1}/A_{t+1} + e_{t+1}.
\]

In dynamic models like (5), the average slopes from year-by-year Fama-MacBeth regressions are like the slopes from a panel (pooled time-series cross-section) regression that weights years equally and allows the means of the variables to change across years (which we think is sensible). An advantage of the FM approach is that it does not require a constant panel of firms for our 35-year period, which largely eliminates survivor bias and allows us to use huge annual samples (an average of 1618 firms per regression). As a result, the average slope on $dA_{t+1}/A_{t+1}$ in (5) produces a powerful test of how dividends respond to short-term variation in investment. And as usual, the standard errors of the average slopes allow for whatever contributes to the precision of the slopes.

Average slopes from the year-by-year estimates of (5) are in Table 2. Lintner’s earnings variable shows up clearly; the positive average slope on $Y_{t+1}/A_{t+1}$ is 9.46 standard errors from zero. The estimated speed of adjustment (the negative of the slope on $D_t/A_{t+1}$) is 6.39 standard errors from zero. But it is rather small, 0.33. Slow adjustment of dividends is, however, also found in time-series tests of the Lintner model for recent periods [Choe (1990), Dewenter and Warther (1998)]. We estimate the target
payout implied by the estimates of (5) as the ratio of the averages of the annual values of $a_1$ and $-a_2$. [This is like the estimate of TP from a pooled time-series cross-section estimate of (5).] The estimate, 0.33, is somewhat below the average aggregate payout ratio for 1963-98 in Fama and French (2000), 0.45.

Regression (5) is mispecified. The target payout and speed of adjustment of the Lintner model surely vary across firms. To allow variation across firms in TP and SOA, we expand (5) to include interaction terms that allow the slopes on $Y_{t+1}/A_{t+1}$ and $D_t/A_{t+1}$ to vary as functions of proxies for investment opportunities, profitability, and other effects,

$$ (6) \quad (D_{t+1}-D_t)/A_{t+1} = a_0 + (a_1 + a_{1b}E_t/A_t + a_{1d}dA_t/A_t + a_{1r}RD_t + a_{1l}L_t/A_t + a_{1l}TL_{t+1})Y_{t+1}/A_{t+1} + (a_2 + a_{2b}E_t/A_t + a_{2d}dA_t/A_t + a_{2r}RD_t + a_{2l}L_t/A_t + a_{2l}TL_{t+1})D_t/A_{t+1} + b_1dA_{t+1}/A_{t+1} + e_{t+1}. $$

The proxy variables in (6) are those used to model the target payout in (4). Since the target payout in the Lintner model depends on the slopes for $Y_{t+1}/A_t$ and $D_t/A_{t+1}$, both slopes are allowed to vary with the same interaction variables. Moreover, it seems reasonable that variables that help determine TP may also have a role in SOA.

Our main interest in (6) is not what the slopes on the interaction variables say about the target payout and speed of adjustment of the Lintner model. Indeed, using (6) to draw inferences about the target payout is hopeless because TP depends in a complicated way on the slopes on the $Y_{t+1}/A_{t+1}$ and $D_t/A_{t+1}$ interaction variables. In Table 2 we report overall $Y_{t+1}/A_{t+1}$ and $D_t/A_{t+1}$ slopes that aggregate the interaction slopes in (6). (See the table for details.) But we largely focus on our main interest, the information from the $dA_{t+1}/A_{t+1}$ slope about the short-term response of dividends to investment.

Several aspects of the estimates of the Lintner model from (6) in Table 2 are of interest. Like (5), (6) produces a low average SOA (0.27 and 0.28, depending on whether the target leverage variable is book or market), but as noted earlier, low SOA’s are also the norm in time-series tests of the Lintner model. The estimates of the overall target payout ratio from (6), 0.32 and 0.33, are again somewhat below the average aggregate payout for a comparable sample period, 0.45. Most impressive, the average
regression $R^2$ from (6) is 0.42, versus 0.29 for (5). Thus, allowing for variation across firms in the SOA and TP of the Lintner (1956) model substantially enhances the explanatory power of the regressions.

What do regressions (5) and (6) say about short-term variation in dividends in response to investment? The autocorrelations of the slopes in (5) and (6) are close to zero, so 2.0 is an appropriate benchmark for the t-tests. The average $d_A_{t+1}/A_{t+1}$ slope from (6) in Table 2 is negative and about -2.08 standard errors from zero, which suggests some accommodation. The $d_A_{t+1}/A_{t+1}$ slope in (5), which does not allow for variation across firms in SOA and TP, is also negative and 2.33 standard errors below zero. But the $d_A_{t+1}/A_{t+1}$ slopes from (5) and (6) are economically trivial; on average, the change in dividends absorbs only about two percent of the change in assets. And the problem is not statistical power. The fact that a slope as small as -0.021 is 2.33 standard errors from zero says that the regressions have power to identify meaningful variation in dividends in response to investment – if it is there.

In the pecking order, financing with retained earnings avoids the asymmetric information problem that arises when firms issue risky debt or equity. The model thus seems to predict that firms adjust dividends to absorb short-term variation in investment. But this prediction is not firm. The estimates of (4) suggest that, as predicted by the model, firms with more investments choose lower target payouts. If this negative relation between investment and long-term payouts leaves dividend payers with enough retained earnings and low risk debt capacity to absorb variation in investment, the insensitivity of dividends to investment does not violate the pecking order. For the 1965-99 period, dividend payers as a group are on average net repurchasers of stock [Fama and French (2000)]. Thus, consistent with the pecking order, firms do not typically pay dividends and issue stock. Note, though, that in a pecking order world, the weak response of dividends to short-term variation in investment does suggest that the adjustment costs (asymmetric information problems and other financing costs) of varying dividends are larger than for debt.

It is widely acknowledged that dividends are insensitive to short-term variation in investment [Myers (1984), Shyam-Sunder and Myers (1999)]. But the only evidence we are aware of is Fama (1974). We extend his results, obtained from time-series tests of the Lintner model on a limited sample of large firms, to a later time period and annual samples that include all dividend-paying firms.
IV. Leverage Regressions

Our final tests attempt to explain the behavior of leverage. We address three questions. (i) Does the level of leverage vary across firms in the manner predicted by the tradeoff model or the pecking order model? (ii) Do firms have leverage targets and does leverage return to its target? (iii) To what extent is debt used to absorb short-term variation in earnings and investment?

The framework for the tests is a standard partial adjustment model in which the change in book leverage partially absorbs the difference between target leverage, $TL_{t+1}$, and lagged leverage, $L_t/A_t$,

$$L_{t+1}/A_{t+1} - L_t/A_t = a_0 + a_1[TL_{t+1} - L_t/A_t] + a_2Z + e_{t+1}.$$ \hfill (7)

$Z$ is a vector of current and past investment and earnings, included to test whether these variables produce temporary movement in leverage away from its target.

We estimate (7) with a two-step cross-section regression approach. Each year $t+1$, we first regress book leverage $L_{t+1}/A_{t+1}$ on the variables assumed to determine target leverage,

$$L_{t+1}/A_{t+1} = b_0 + b_1V_t/A_t + b_2ET_t/A_t + b_3D_p/A_t + b_4RDD_t + b_5RD_t/A_t + b_6\ln(A_t) + b_7TP_{t+1} + e_{t+1}.$$ \hfill (8)

We then use the fitted values from (8) as the proxy for $TL_{t+1}$ in the estimate of (7). In the market leverage model, we substitute market leverage variables for the book leverage variables in (7) and (8).

The partial adjustment framework of (7) and (8) nests the tradeoff and pecking order models. In the trade-off model, firms have leverage targets and they move toward the targets every period. The fitted values from (8) are estimates of the targets, and the speed-of-adjustment $a_1$ in (7) measures how adjustment costs slow the movement of leverage toward its target. In contrast, in the pecking order model, the costs of issuing new risky securities swamp all other forces. As a result, firms do not have leverage targets, and (8) simply describes how leverage varies across firms as a function of profitability, investment opportunities, firm size, and the target payout. The simple pecking order model predicts that in the estimates of (7) the speed-of-adjustment, $a_1$, is indistinguishable from zero, whereas the tradeoff model says it is reliably positive. Finally, because dividends are sticky and the costs of adjusting debt are less than the costs of adjusting equity, the pecking order model predicts a strong short-term response of leverage to short-term variation in earnings and investment (the $Z$ variables in (7)).
In the tradeoff and pecking order models, the exogenous driving variables for the level of leverage are the profitability of assets in place, investment opportunities, non-debt tax shields, and volatility. The proxies for profitability in (8) are $ET_t/A_t$ ($ET_t$ is earnings before interest and taxes) and $V_t/A_t$. But $V_t/A_t$ is primarily a proxy for investment opportunities, along with $RD_t/A_t$. $RD_t/A_t$ is also a proxy for non-debt tax shields, along with depreciation, $D_p/A_t$. The log of assets, $\ln(A_t)$, proxies for the volatility of earnings and net cash flows and other effects related to firm size. The target payout ratio affects leverage, but $TP_{t+1}$ is endogenous. $TP_{t+1}$ in (8) is from the first stage reduced form estimates of the dividend regression (4) in Table 1. The explanatory variables assumed to be exogenous in (8) are predetermined. This mitigates any remaining endogeneity problems.

A. Comments on Methodology

Variants of the target leverage regression (8) are common in the literature. Estimation of (8) with a single cross-section regression is typical [e.g., Bradley, Jarrell, and Kim (1984), Long and Malitz (1985), Rajan and Zingales (1995)]. Panel (pooled time-series cross-section) regressions are the weapon of choice in partial adjustment models like (7) [Auerbach (1985), Jalilvand and Harris (1984), Shyam-Sunder and Myers (1999)]. In the earlier work that uses a single cross-section regression, the inference problem created by correlation of the regression residuals across firms is almost uniformly ignored. The papers that use panel regressions ignore both the cross-correlation problem and the potential inference problem caused by autocorrelation of the regression residuals.²

We estimate (7) and (8) with year-by-year cross-section regressions, and we use Fama-MacBeth time-series standard errors, which incorporate estimation error caused by correlation of the residuals across firms, to draw inferences about the average slopes. Residual cross-correlation is important. The average slopes from our regressions are like the slopes from a pooled time-series cross-section regression that weights years equally and uses annual dummies to allow the average values of the variables to change through time. Skipping the details, the FM standard errors of our average slopes are almost always more than twice and often more than five times OLS standard errors from pooled time-series cross-section regressions that ignore residual cross-correlation.
Autocorrelation of the annual slopes from regression (7) to explain changes in leverage is not a serious problem. But in regression (8) for the level of leverage, the first-order autocorrelations of the slopes are typically above 0.4 and sometimes reach 0.7. The autocorrelations for longer lags decay, more or less like an AR1. As in the dividend regression (4), we use a conservative approach to account for the autocorrelation of the slopes in (8). We assume the standard errors of the average slopes should be inflated by a factor of 2.0. Thus, we require t-statistics around 4.0, rather than 2.0, to infer reliability. This adjustment is near exact if the annual slopes are AR1s with first-order autocorrelation of about 0.6, which is at the high end of the observed range. (See fn.1.)

Note that these autocorrelation adjustments are in addition to the implicit adjustment for cross-correlation provided by the FM standard errors. Again, both adjustments are almost always missing in previous work. Thus, though many of our leverage results are in line with previous evidence, our approach adds statistical credibility that is currently missing.

B. The Level of Leverage

Table 3 shows average slopes from variants of regression (8). Since the pecking order model suggests that the relation between leverage and investment may differ for dividend payers and non-payers, separate regressions are shown for the two groups. The payer samples in the leverage regressions of Table 3 match the samples in the dividend regressions of Tables 1 and 2.

1. Leverage and Profitability

In the tradeoff model, agency costs, taxes, and bankruptcy costs push more profitable firms toward higher book leverage. In contrast, in the pecking order model, higher earnings result in less book and market leverage. The regressions in Table 3 support the profitability prediction of the pecking order. For book and market leverage, and for dividend payers and non-payers, the estimates of (8) produce negative average slopes on profitability, $ET_t/At$, that are at least 12.5 standard errors below zero. In the market leverage regressions, the average $V_t/At$ slopes are more than 11.5 standard errors below zero. In the book leverage regressions, however, the average $V_t/At$ slopes are mostly positive, but only the slope in the full version of (8) for non-payers exceeds our four standard error reliability hurdle.
The ETt/Ai slopes in (8) may overstate the long-term relation between leverage and profitability. The estimates of the partial adjustment model (7) will show that there is a strong offsetting response of leverage to changes in earnings. It is thus possible that the negative ETt/Ai slopes in (8) in part pick up transitory variation in leverage rather than variation in target leverage. Note, however, that this is a problem for interpreting the ETt/Ai slopes as tests of tradeoff predictions about target leverage. But it is not a problem for the pecking order model, which predicts that earnings indeed generate opposite variation in leverage in the short-term as well as in the long-term.

Our results confirm the evidence of Long and Malitz (1985) and Rajan and Zingales (1995) that more profitable firms have less book leverage. And like us, Titman and Wessels (1988) and Rajan and Zingales (1995) report that more profitable firms have less market leverage. Graham, Lemmon, and Schallheim (1998) and Graham (1999) find that market leverage is positively related to a measure of the expected tax rate that should be positively related to profitability. But Graham (2000) and Graham and Harvey (2000) confirm the more typical finding that more profitable firms have less leverage.

2. Leverage and Investment Opportunities

The tradeoff model predicts that, controlling for the profitability of assets in place, firms with more investments have less leverage because (i) they have stronger incentives to avoid under-investment and asset substitution inefficiencies that can arise from stockholder-bondholder agency problems, and (ii) they have less need for the discipline of debt payments to control free cash flow problems. The complex version of the pecking order model also predicts a negative relation between leverage and expected investment opportunities (especially for dividend payers), but the prediction is based on the desire to have more low-risk debt capacity available to finance expected investments. In contrast, the simple version of the pecking order predicts a positive marginal relation between leverage and investment.

Table 3 produces conflicting evidence on the relation between book leverage and investment opportunities. The RDt/Ai slopes in the book leverage regressions are all at least 4.6 standard errors below zero, which suggests that firms with more investment opportunities have less book leverage. But the Vt/Ai slopes in the estimates of the full version of (8) are positive and the slope for non-payers is 4.22
standard errors from zero. In contrast, the measured relation between market leverage and investment opportunities is consistently negative. In the estimates of (8) to explain the market leverage of dividend payers and non-payers, the $V_t/A_t$ and $RD_t/A_t$ slopes are all negative and at least -5.4 standard errors from zero.

If debt capacity depends on the market value of assets, the evidence that firms with more investments have less market leverage can be read as support for a complex pecking order and for tradeoff predictions about how bondholder-stockholder agency problems affect target leverage. But there is a more prosaic story for the negative relation between market leverage and investment opportunities. It may be a mechanical result of better investments producing higher market values, rather than the workings of the tradeoff and pecking order models. [Titman and Wessels (1988) make a related point.]


3. Other Effects

The tradeoff model predicts that because firms with more non-debt tax shields (e.g., deductions for depreciation and R&D) have lower expected tax rates, they have less book leverage. The regressions in Table 3 provide some support for this prediction. As noted above, the $RD_t/A_t$ slopes in the book (and market) leverage regressions are all strongly negative. [As an aside, there is indeed nonlinearity in the relation between leverage and R&D. The $RDD_t$ slopes are always positive, and most are more than four standard errors from zero. Thus, firms that report no R&D tend to have higher leverage than predicted by the $RD_t/A_t$ slopes in (8).] In the book leverage estimates of the full regression (8) for dividend payers, the average depreciation slope ($Dp_t/A_t$) is reliably negative ($t = -8.63$). The $DP_t/A_t$ slope for non-payers is, however, positive but less than one standard error from zero. It may in any case be inappropriate to treat
the RD/At and DP/At slopes as evidence about non-debt tax shields, given Graham’s (1996a) evidence that non-debt tax shields have at best a weak role in determining the expected tax rates of firms.

The tradeoff model predicts that firms with less variable earnings have more leverage. Similarly, the complex pecking order model predicts a negative relation between the volatility of net cash flows and leverage. We hypothesize that larger firms have less volatile earnings and net cash flows. Confirming much previous work [see Harris and Raviv (1991)] and consistent with the predictions of the models, the ln(At) slopes in (8) are all positive and more than eleven standard errors from zero. Again, however, the positive relation between size and leverage may also be the result of factors other than volatility. For example, it seems likely that large firms access the debt market at lower cost than small firms.

Finally, a common prediction of the tradeoff and pecking order models is that the marginal relation between leverage and the target dividend payout is negative. The TP_{t+1} slope in the full book leverage version of (8) is negative but only -1.16 standard errors from zero. The TP_{t+1} slope in the market leverage version of (8) is slightly positive (t = 1.29). The problem is collinearity between TP_{t+1}, and pre-tax profitability, ET/A_t. When ET/A_t is dropped from (8), the slopes on TP_{t+1} become strongly negative. The ET/A_t slopes are, however, strongly negative regardless of whether TP_{t+1} is in the regressions. Thus, as in Table 1, the appropriate conclusion from Table 3 is that there is little evidence for the negative relation between the target payout and leverage predicted by the tradeoff and pecking order models.

C. Is Leverage Mean-Reverting?

Panels A and B of Table 4 summarize estimates of the partial adjustment model (7) for book and market leverage. The estimates suggest that, as predicted by the tradeoff model, leverage is mean reverting. The average slopes on the proxies for target leverage, TL_{t+1} (market or book), are positive. And the large t-statistics (4.30 to 12.41) on the target leverage slopes suggest that the fitted values from the first-stage estimates of (8) capture meaningful differences in target leverage across firms. As predicted by the partial adjustment model, the average slopes on lagged leverage, L_t/A_t or L_t/V_t, in the estimates of (7) are negative (t-statistics from -4.04 to -12.25), and the slopes on target and lagged
leverage in each regression are close in absolute value. The mean reversion of leverage is, however, at a
snail’s pace, seven to ten percent per year for dividend payers and 15 to 18 percent for non-payers.

Shyam-Sunder and Myers (1999) argue that a pecking order world in which firms do not have
leverage targets can generate a false appearance that leverage is slowly mean-reverting simply because of
autocorrelated variation in net cash flows. Slow mean reversion is, however, also consistent with the
survey results of Graham and Harvey (2000). They find that most firms claim to have leverage targets
but achieving the target is not of prime importance. Their results and ours can be interpreted as consistent
with the tradeoff model or the soft leverage targets of the complex pecking order model.

D. Debt, Earnings, and Investment

The pecking order model says that dividends are (for unknown reasons) sticky. Since financing
costs are higher for equity than for debt, the model predicts that short-term variation in earnings and
investment is largely absorbed by debt. The slopes for the Z variables in (7) support this prediction. The
Z variables are current and lagged investment, \( \frac{dA_{t+1}}{A_{t+1}} = \frac{(A_{t+1} - A_t)}{A_{t+1}} \) and \( \frac{dA_t}{A_{t+1}} = \frac{(A_t - A_{t-1})}{A_{t+1}} \), and
changes in after-tax earnings, \( \frac{dE_{t+1}}{A_{t+1}} = \frac{(E_{t+1} - E_t)}{A_{t+1}} \) and \( \frac{dE_t}{A_{t+1}} = \frac{(E_t - E_{t-1})}{A_{t+1}} \). [We use before-tax
earnings, \( ET_t \), in (8) to judge how taxes affect long-term leverage, but after-tax earnings are relevant in
(7) for measuring short-term variation in leverage in response to the earnings available to firms.]

Leverage clearly varies to absorb changes in earnings; the average \( \frac{dE_{t+1}}{A_{t+1}} \) slopes in (7) are
negative and -7.61 to -10.59 standard errors from zero (Panels A and B of Table 4). There is an
additional lagged response of leverage to earnings; the \( \frac{dE_t}{A_{t+1}} \) slopes are -5.70 to -10.36 standard errors
from zero. A potential explanation is that because debt cannot vary quickly at low cost, there is some
spillover from one year to the next in the response of leverage to earnings.

There is also strong evidence that investment produces concurrent variation in leverage. With
one exception, the average slopes on \( \frac{dA_{t+1}}{A_{t+1}} \) in Table 4 are positive and more than 5.4 standard errors
from zero. Positive slopes on \( \frac{dA_{t+1}}{A_{t+1}} \) imply that debt’s share of short-term financing is higher than its
share of the long-term capital structure. And at least for book leverage, reversion to the long-term capital
structure begins quickly. The average slopes on \( \frac{dA_t}{A_{t+1}} \) in the book leverage regressions are negative
and more than 4.1 standard errors below zero. Thus, part of the change in book leverage induced by investment last year is reversed this year. In contrast, the average slopes on \( \frac{dA_t}{A_{t+1}} \) in the market leverage regressions are statistically and economically tiny.

The response of leverage to short-term variation in investment explains why we do not include investment as an explanatory variable in (8), which attempts to identify the determinants of long-term leverage. We can report that adding investment to (8) does typically produce reliably positive slopes. In other words, as predicted by the complex pecking order model, in the near term leverage moves in the same direction as investment. But at least for market leverage, the relation between leverage and long-term expected investment opportunities (as measured by \( \frac{V_t}{A_t} \)) tends to be negative (Table 4).

To measure the dollar response of debt to earnings and investment, Panel C of Table 4 shows estimates of (7) that explain the scaled change in debt, \( \frac{dL_{t+1}}{A_{t+1}} = \frac{(L_{t+1} - L_t)}{A_{t+1}} \), rather than the change in leverage, \( \frac{d(L_{t+1}/A_{t+1})}{L_{t+1}/A_t} = \frac{L_{t+1}/A_{t+1} - L_t/A_t}{L_{t+1}/A_t} \). Debt has a big role in financing investment. The regressions for the change in debt say that, controlling for changes in earnings, dividend payers finance 80 percent (\( t = 34.79 \)) of current investment with debt, with a three percent reversal (\( t = -4.64 \)) the following year. Non-payers finance 73 percent (\( t = 19.98 \)) of investment with debt, with a three percent reversal (\( t = -2.11 \)) the following year. Thus, variation in investment produces a bigger change in debt for dividend payers than for non-payers. This is consistent with the evidence in Fama and French (2000) that net new issues of equity are trivial for payers but more important for non-payers. The fact that short-term variation in investment is mostly absorbed by debt is consistent with the pecking order model.

In the regressions for the change in debt, the slopes on current and lagged earnings changes are -0.51 (\( t = -13.42 \)) and -0.25 (\( t = -9.87 \)) for dividend payers, and -0.62 (\( t = -12.93 \)) and -0.23 (\( t = -7.24 \)) for non-payers. Thus, controlling for investment, a $1 increase in earnings produces combined concurrent and lagged declines in debt of $0.76 for dividend payers and $0.85 for non-payers. The larger response by non-payers suggests that payers in part absorb earnings changes with dividend changes. At a minimum, however, it is safe to conclude that, as predicted by the pecking order model, much of the short-term variation in earnings is absorbed by debt.
The pecking order model does predict that changes in earnings are largely absorbed by changes in debt. But it also predicts that, given investment, variation in the level of earnings generates opposite variation in debt. Thus one can argue that the concurrent level of (scaled) earnings, \( E_{t+1}/A_{t+1} \), should replace the change in earnings, \( \Delta E_{t+1}/A_{t+1} \), for measuring the change in debt in response to variation in earnings. We can report that when we make this substitution, the slopes on \( E_{t+1}/A_{t+1} \) [-0.69 (t = -14.12) for dividend payers and -0.75 (t = -15.22) for non-payers] are again large and produce conclusions like those for \( \Delta E_{t+1}/A_{t+1} \). We prefer the change in earnings as the explanatory variable since it in effect uses the firm’s most recent earnings as the base for measuring variation in earnings. In contrast, using \( E_{t+1}/A_{t+1} \) as the explanatory variable uses the cross-section mean of scaled earnings as the base.

Our estimates of the slow rate of mean reversion of leverage and the strong short-term response of debt to earnings and investment are similar to those of Shyam-Sunder and Myers (1999). They use panel (pooled time-series cross-section) regressions and the rather small sample of 157 firms that have complete Compustat data for 1971-89 on the variables they require. Our approach, a time-series of annual cross-section regressions, allows us to use much larger samples of firms (an average of 1618 for dividend payers and 1646 for non-payers) and produces more reliable standard errors for the regression coefficients. Still, it is comforting that the two approaches yield similar results.

V. A Contradiction of the Pecking Order

In the one sharp face-off produced by the regressions, the pecking order model beats the tradeoff model: more profitable firms have less book leverage. There is, however, an important result more consistent with the tradeoff model.

Table 5 summarizes annual sorts of dividend payers (or non-payers) into book (or market) leverage quintiles. The table shows averages of various ratios of aggregates for each of the five portfolios. The ratios are leverage, the dividend payout, some of their determinants, and \( \text{NI}/A_t \) (equity issues minus repurchases divided by assets). A ratio of aggregates is the aggregate of the numerator for a quintile divided by the aggregate of the denominator. In effect, then, a quintile is treated as one big firm. Ratios of aggregates are also size-weighted averages of the ratios for individual firms. For example, the ratio of
aggregate earnings, $E_t$, to aggregate assets, $A_t$, is the weighted average of individual $E_t/A_t$ ratios, where each firm’s ratio is weighted by its assets. As always, the time period for the sorts is 1965-99, except for stock issues and repurchases which are not on Compustat until 1971.

The leverage sorts show that less levered non-payers are more profitable, which is consistent with the pecking order model. But less levered non-payers also have better investments (higher $V_t/A_t$, $RD_t/A_t$, and $dA_t/A_t$). And in the market leverage sorts, the spread between investment ($dA_t/A_t$) and earnings ($E_t/A_t$) is higher for less levered non-payers. From the perspective of the simple pecking order model, the low leverage (book and market) of these firms is anomalous. Lower leverage for firms with higher spreads of investment over earnings (lower free cash flows) is, however, consistent with the tradeoff model.

The less levered non-payers are typically small growth firms. It is possible that these firms conform to the complex rather than the simple version of the pecking order model; they keep leverage low to have low-risk debt capacity available to finance future growth. But Table 5 shows they seem to achieve this result by violating the pecking order. Specifically, the least levered non-payers make the largest net new issues of stock. In the market leverage sorts, the annual new issues of stock of the least levered non-payers are on average 5.8 percent of total assets. And, at 29 percent of assets and 11 percent of market value, the book and market leverage of the least levered non-payers are low. Thus, the least levered non-payers make large net new issues of stock (the form of financing most subject to asymmetric information problems), even though they appear to have low risk debt capacity. This is not proper pecking order behavior.

Perhaps less levered non-payers issue lots of stock because their investments do not generate the kind of fixed tangible assets efficiently financed with debt [Myers (1977)]. But Table 5 shows that the ratio of depreciation to assets, $Dp_t/A_t$, does not vary much across leverage quintiles. Thus less levered non-payers have average proportions of fixed tangible assets. Finally, perhaps the small growth firms that are the less levered non-payers do not face serious asymmetric information problems in issuing new equity. But it is not in the spirit of the pecking order model that small non-payers whose prime asset is expected growth are less subject to asymmetric information problems [Sharpe and Nguyen (1995)].
VI. Conclusions

Who wins the confrontation between the tradeoff and pecking order models? On many issues there is no conflict. Though motivated by different forces, the two models share many predictions about dividends and leverage. These shared predictions tend to be confirmed in our tests. For example, the two models predict that controlling for other effects, more profitable firms have higher dividend payouts, and firms with more investments have lower payouts. Though far from statistically overpowering, the dividend regressions (Table 1) are consistent with these predictions.

Controlling for other effects, most tradeoff forces posit that firms with more investments have less book leverage. The complex pecking order model also predicts a negative relation between expected investment and book leverage, if debt capacity is determined by the book value of assets. In the simple pecking order model, however, the relation between book leverage and investment is positive. In our tests (Table 3), different proxies for investment opportunities produce conflicting evidence about the relation between investment and book leverage, so we cannot rule on book leverage predictions. The evidence that firms with more investments have less market leverage is, however, strong. This can be read as support for a complex pecking order and for tradeoff predictions about how bondholder-stockholder agency problems affect target leverage when debt capacity depends on the market value of assets.

There are positive relations between leverage and firm size, and between dividend payout and size. If larger firms have less volatile earnings and net cash flows, these results are in line with the negative effect of volatility on the payout ratio and leverage predicted by the tradeoff and pecking order models. The leverage tests also suggest that as predicted by the tradeoff model, firms with more non-debt tax shields (deductions for depreciation and R&D expenditures) have less leverage.

The final common prediction of the tradeoff and pecking order models is that the marginal relation between leverage and the target dividend payout ratio is negative. Our tests of this prediction lack power. The problem seems to be collinearity: the target payout and leverage are both related to profitability, and profitability effects obscure any relation between the target payout and leverage.
The tradeoff and pecking order models do disagree on two important issues. On one, the evidence favors the pecking order model. On the other, the tests are inconclusive. And there is a third issue on which the pecking order model stumbles badly.

Specifically, controlling for investment opportunities, the tradeoff model predicts that more profitable firms have more book leverage. The pecking order model predicts that more profitable firms have less book and market leverage. The leverage regressions in Table 3 support the pecking order model. This is the important failure of the tradeoff model.

In the tradeoff model, firms have leverage targets, and leverage moves inexorably toward its target. In the simple pecking order model, firms do not have leverage targets and leverage is not mean reverting. Our results on these predictions are difficult to interpret. The regressions (Table 4) produce statistically reliable evidence that leverage is mean reverting. But the rate of mean reversion (seven to 17 percent per year) is suspiciously slow. Such slow mean reversion may be the spurious result of autocorrelated variation in net cash flows [Shyam-Sunder and Myers (1999)]. The soft leverage targets of the complex pecking order model, or tradeoff forces somewhat lacking in vigor, are also possibilities.

Our tests produce a clear story about short-term financing decisions in response to earnings and investment. For dividend payers, it is a pecking order story. The pecking order model posits that dividends are sticky, leaving variation in earnings and investment to be absorbed largely by debt. The dividend regressions (Table 2) say that long-term dividend policy conforms to the Lintner model, and there is little evidence that dividends vary to accommodate short-term variation in investment. Table 5 confirms the evidence in Fama and French (2000) that net new issues of common stock are trivial for dividend payers, which is consistent with the pecking order. The leverage and debt regressions (Table 4) then confirm that, for dividend payers, debt is indeed the residual variable in financing decisions.

Like dividend payers, non-payers primarily use debt to absorb short-term variation in earnings and investment. But, confirming Fama and French (2000), Table 5 shows that non-payers finance more of their investments with net new issues of equity. This is in line with the pecking order if the new issues of equity are done in extremis. But Table 5 shows the opposite; the least levered non-payers (typically small growth firms) make the largest net new issues of equity.
In sum, we identify one scar on the tradeoff model (the negative relation between leverage and profitability), one deep wound on the pecking order (the large equity issues of small low-leverage growth firms), and one area of conflict (the mean reversion of leverage) on which the data speak softly. The many shared predictions of the two models tend to do well in our tests. But when shared predictions are confirmed, attributing causation is elusive: we cannot tell whether the results are due to tradeoff forces, pecking order forces, or indeed other factors overlooked by both.
Appendix: Data and Variable Definitions

Each fiscal year t+1 from 1965 to 1999 we screen Compustat for firms that have data for years t+1, t, and t-1 on the following required variables (Compustat data item): total assets (6), liabilities (181), stock price (199) and shares outstanding (25) at the end of the fiscal year, income before extraordinary items (18), income before extraordinary items available for common (237), interest expense (15), depreciation expense (14), tax expense (16), common stock dividends (21), and preferred stock liquidating value (10) and/or preferred stock redemption value (56) and/or preferred stock carrying value (130). We also include, but do not require, data for years t+1, t, and t-1 on balance sheet deferred taxes and investment tax credit (35), R&D expenditures (46), purchases of common and preferred stock (115), and sales of common and preferred stock (108). Utilities (SIC codes 6000 to 6999) and financial firms (SIC codes 4900 to 4999) are excluded from the tests.

Derived variables are:

Preferred Stock = liquidating value (10) if available, else redemption value (56) if available, else carrying value;

Market Equity (MEt) = stock price (199) times shares outstanding (25);

Market Value of Firm (Vt) = liabilities (181) - balance sheet deferred taxes and investment tax credit (35) + preferred stock + market equity;

Book Equity (Be) = total assets (6) – liabilities (181) + balance sheet deferred taxes and investment tax credit (if available) (35) – preferred stock;

Earnings before Interest (Et) = earnings before extraordinary items (18) + interest expense (15);

Earnings before Interest and Taxes (ETt) = earnings before interest + tax expense (16);

Net Stock Issues (NI) = sales of common and preferred stock (108) – purchases of common and preferred stock (115).
Footnotes

1If $x_t$ is an AR1 variable with variance $\sigma^2(x)$ and first-order autocorrelation $\alpha$, the variance of the sum of a sequence of $N$ observations on $x_t$ is,

$$\sigma^2\left(\sum_{t=1}^{N} x_t\right) = N\sigma^2(x) + 2\sigma^2(x)\sum_{j=1}^{N-1} \sum_{i=j+1}^{N} \alpha^{i-j}.$$ 

For large $N$, the variance of the sum is approximately,

$$\sigma^2\left(\sum_{t=1}^{N} x_t\right) \approx N\sigma^2(x) + 2\sigma^2(x)N \frac{\alpha}{1-\alpha}.$$ 

For $\alpha = 0.75$, the variance of the sum is approximately $7N\sigma^2(x)$, and the standard error of the mean of the $N$ observations on $x_t$ is approximately 2.65 times the standard error when the observations are uncorrelated ($\alpha = 0.0$). We use 2.5 rather than 2.65 to allow for the fact that $N$ is finite.

2The only exceptions are Graham, Lemmon, and Schallheim (1998) and Graham (1999). As a robustness check on their main inference about the effect of taxes on market leverage, these papers report FM standard errors (adjusted for autocorrelation) for the critical tax coefficient in their models. Inferences for all other variables use OLS standard errors that are not adjusted for cross-correlation or autocorrelation.
References


Table 1 – Estimates of Regression (4) to Explain the Dividend Payout Ratio

<table>
<thead>
<tr>
<th></th>
<th>Y_{t+1}/A_{t+1} *</th>
<th>Int</th>
<th>Y_{t+1}/A_{t+1}</th>
<th>V/A_{t}</th>
<th>E/A_{t}</th>
<th>dA/A_{t}</th>
<th>RDD_{t}</th>
<th>RD/A_{t}</th>
<th>ln(A_{t})</th>
<th>TL_{t+1}</th>
<th>R²</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A:</strong> Regressions without Interaction Terms and Reduced Form Regressions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.012</td>
<td>0.21</td>
<td>0.012</td>
<td>0.21</td>
<td>0.25</td>
<td>0.46</td>
<td>0.010</td>
<td>0.38</td>
<td>0.42</td>
<td>0.25</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>t(Mn)</td>
<td>10.082</td>
<td>10.51</td>
<td>18.943</td>
<td>3.61</td>
<td>3.293</td>
<td>12.82</td>
<td>-8.26</td>
<td>0.438</td>
<td>3.232</td>
<td>6.90</td>
<td>21.71</td>
<td></td>
</tr>
<tr>
<td><strong>Panel B:</strong> TL_{t+1} Is Target Book Leverage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.012</td>
<td>0.06</td>
<td>0.012</td>
<td>0.06</td>
<td>0.013</td>
<td>1.13</td>
<td>-0.35</td>
<td>0.004</td>
<td>-0.39</td>
<td>0.010</td>
<td>0.38</td>
<td>0.42</td>
</tr>
<tr>
<td>t(Mn)</td>
<td>19.476</td>
<td>3.61</td>
<td>3.659</td>
<td>4.24</td>
<td>3.659</td>
<td>4.24</td>
<td>-8.31</td>
<td>0.756</td>
<td>-3.73</td>
<td>0.538</td>
<td>0.20</td>
<td>9.50</td>
</tr>
<tr>
<td><strong>Panel C:</strong> TL_{t+1} Is Target Market Leverage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.011</td>
<td>0.42</td>
<td>0.011</td>
<td>0.42</td>
<td>0.017</td>
<td>0.93</td>
<td>-0.34</td>
<td>0.006</td>
<td>-0.49</td>
<td>0.006</td>
<td>0.05</td>
<td>0.39</td>
</tr>
<tr>
<td>t(Mn)</td>
<td>17.278</td>
<td>13.37</td>
<td>17.343</td>
<td>12.43</td>
<td>12.43</td>
<td>6.30</td>
<td>-0.33</td>
<td>0.029</td>
<td>-0.69</td>
<td>0.037</td>
<td>-0.91</td>
<td>0.38</td>
</tr>
<tr>
<td><strong>The dependent variable is D_{t+1}/A_{t+1}, dividends for fiscal year t+1 divided by assets at the end of t+1. The regressions are run for each year t+1 of the 1965-99 period (35 years). The table shows means (across years) of the regression intercepts (Int) and slopes, and t-statistics for the means, t(Mn), defined as the mean divided by its standard error [the times-series standard deviation of the regression coefficient divided by (35)^{1/2}]. The regressions require that firms pay dividends in year t-1. A_{t}, BE_{t}, ME_{t}, L_{t}=A_{t}-BE_{t}, and V_{t}=L_{t}+ME_{t} are aggregate assets, book common equity, market value of common equity, book liabilities, and total market value, at the end of fiscal year t. Y_{t} and RD_{t} are after-tax earnings available for common stock and R&amp;D expenditures for fiscal year t. RDD_{t} is a dummy that is 1.0 for firms that do not report R&amp;D expenditures for t and zero otherwise. Investment, dA_{t}, is A_{t}-A_{t-1}. Target leverage, TL_{t+1}, is the fitted value of the reduced form (book or market) leverage regression in Table 3. The regression R² are adjusted for degrees of freedom. The target payout TP is the average across years of a_{0}/Mn(Y_{t+1}/A_{t})+a_{1}/Mn(V/A_{t})+a_{2}/Mn(E/A_{t})+a_{3}/Mn(dA/A_{t})+a_{4}/Mn(RDD)+a_{5}/Mn(RD/A_{t})+a_{6}/Mn(ln(A_{t}))+a_{7}/Mn(TL_{t+1}), where Mn() is the cross-section mean of a variable for a year, and the a’s are regression coefficients from (4).</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2 – Lintner Model Regressions to Explain the Change in Dividends, \((D_{t+1} - D_t)/A_t\)

<table>
<thead>
<tr>
<th>Int</th>
<th>(Y_{t+1}/A_t)</th>
<th>(D/A_t)</th>
<th>(dA_{t+1}/A_t)</th>
<th>(R^2)</th>
<th>SOA</th>
<th>TP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimates of Regression (5)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.004</td>
<td>0.11</td>
<td>-0.33</td>
<td>-0.021</td>
<td>0.29</td>
<td>0.33</td>
</tr>
<tr>
<td>t(Mn)</td>
<td>3.658</td>
<td>9.46</td>
<td>-6.39</td>
<td>-2.333</td>
<td>7.76</td>
<td></td>
</tr>
</tbody>
</table>

| **Estimates of Regression (6): TL_{t+1} is Target Book Leverage** |
| Mean | 0.003 | 0.09 | -0.27 | -0.018 | 0.42 | 0.27 | 0.33 |
| t(Mn) | 3.497 | 8.36 | -6.54 | -2.081 | 10.76 | |

| **Estimates of Regression (6): TL_{t+1} is Target Market Leverage** |
| Mean | 0.003 | 0.09 | -0.28 | -0.018 | 0.42 | 0.28 | 0.32 |
| t(Mn) | 3.549 | 8.36 | -6.58 | -2.083 | 10.80 | |

The regressions are run for each year \(t+1\) of the 1965-99 period (35 years). Regression (5) estimates the augmented Lintner model with the same \(Y_{t+1}/A_{t+1}\), \(D_{t+1}/A_{t+1}\), and \(dA_{t+1}/A_{t+1}\) slopes for all firms in a given year. In regression (6), the slopes on \(Y_{t+1}/A_{t+1}\) and \(D_{t+1}/A_{t+1}\) vary with \(V/A_t\), \(E/A_t\), \(dA/A_t\), \(RDD_t\), \(RD/A_t\), \(ln(A_t)\), and \(TL_{t+1}\). The table shows means (across years) of the regression intercepts (Int) and slopes, and t-statistics for the means, t(Mn), defined as the mean divided by its standard error \([\text{the times-series standard deviation of the regression coefficient divided by (35)^{1/2}]}\). The regressions include only firms that pay dividends in year \(t-1\). The slope on \(Y_{t+1}/A_{t+1}\) in the estimates of (6) is the average across years of \(a_1 + a_1 V Mn(V/A_t) + a_1 E Mn(E/A_t) + a_1 dA Mn(dA/A_t) + a_1 RDD Mn(RDD_t) + a_1 RD Mn(RD/A_t) + a_1 ln Mn(ln(A_t)) + a_1 TL Mn(TL_{t+1})\) where \(Mn( )\) is the cross-section mean of a variable for a given year, and the \(a_1\)'s are regression coefficients from (6). The slope on \(D_{t+1}/A_{t+1}\) in the estimates of (6) is the average across years of \(a_2 + a_2 V Mn(V/A_t) + a_2 E Mn(E/A_t) + a_2 dA Mn(dA/A_t) + a_2 RDD Mn(RDD_t) + a_2 RD Mn(RD/A_t) + a_2 ln Mn(ln(A_t)) + a_2 TL Mn(TL_{t+1})\), where the \(a_2\)'s are regression coefficients from (6). \(A_t\), \(BE_t\), \(ME_t\), \(L_t = A_t - BE_t\), and \(V_t = L_t + ME_t\) are aggregate assets, book common equity, market value of common equity, book liabilities, and total market value, at the end of fiscal year \(t\). \(Y_t\), \(RD_t\), and \(D_t\) are after tax earnings available for common stock, R&D expenditures, and dividends for fiscal year \(t\). \(RDD_t\) is a dummy that is 1.0 for firms that do not report R&D expenditures for \(t\) and zero otherwise. Investment, \(dA_t\), is \(A_t - A_{t-1}\). Target leverage, \(TL_{t+1}\), is the fitted value of the reduced form (book or market) leverage regression in Table 3. The regression \(R^2\) are adjusted for degrees of freedom. The speed-of-adjustment, SOA, is the negative of the average slope on \(D/A_t\). The target payout, TP, is the average slope on \(Y_{t+1}/A_t\) divided by SOA.
Table 3 – Regressions to Explain the Level of Book ($L_{t+1}/A_{t+1}$) and Market ($L_{t+1}/V_{t+1}$) Leverage

<table>
<thead>
<tr>
<th></th>
<th>Int</th>
<th>$V_t/A_t$</th>
<th>$E_T/A_t$</th>
<th>$D_p/A_t$</th>
<th>RDD</th>
<th>RD/$A_t$</th>
<th>$\ln(A_t)$</th>
<th>TP$_{t+1}$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: Book Leverage ($L_{t+1}/A_{t+1}$) Regressions for Dividend Payers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.43</td>
<td>0.011</td>
<td>-0.81</td>
<td>-0.51</td>
<td>0.024</td>
<td>-0.37</td>
<td>0.027</td>
<td>0.21</td>
<td></td>
</tr>
<tr>
<td>t(Mn)</td>
<td>32.89</td>
<td>3.495</td>
<td>-23.42</td>
<td>-8.98</td>
<td>6.641</td>
<td>-6.47</td>
<td>14.954</td>
<td>22.66</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.43</td>
<td>0.012</td>
<td>-0.77</td>
<td>-0.46</td>
<td>0.009</td>
<td>-0.50</td>
<td>0.032</td>
<td>-0.11</td>
<td>0.23</td>
</tr>
<tr>
<td>t(Mn)</td>
<td>9.94</td>
<td>2.790</td>
<td>-16.21</td>
<td>-8.63</td>
<td>1.403</td>
<td>-5.25</td>
<td>22.046</td>
<td>-1.16</td>
<td>25.73</td>
</tr>
<tr>
<td>Mean</td>
<td>0.64</td>
<td>-0.005</td>
<td>-0.24</td>
<td>0.024</td>
<td>-0.54</td>
<td>0.038</td>
<td>-0.85</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>t(Mn)</td>
<td>11.84</td>
<td>-0.845</td>
<td>-3.98</td>
<td>2.901</td>
<td>-4.60</td>
<td>22.822</td>
<td>-7.84</td>
<td>21.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Panel B: Book Leverage ($L_{t+1}/A_{t+1}$) Regressions for Non-Payers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.39</td>
<td>0.027</td>
<td>-0.74</td>
<td>0.06</td>
<td>0.052</td>
<td>-0.75</td>
<td>0.046</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>t(Mn)</td>
<td>29.07</td>
<td>4.221</td>
<td>-16.92</td>
<td>0.53</td>
<td>5.759</td>
<td>-8.38</td>
<td>21.514</td>
<td>9.17</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.35</td>
<td>0.023</td>
<td>0.57</td>
<td>0.079</td>
<td>-0.35</td>
<td>0.034</td>
<td>-0.11</td>
<td>0.23</td>
<td></td>
</tr>
<tr>
<td>t(Mn)</td>
<td>29.38</td>
<td>3.523</td>
<td>4.50</td>
<td>8.009</td>
<td>-4.70</td>
<td>11.306</td>
<td>-0.11</td>
<td>25.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Panel C: Market Leverage ($L_{t+1}/V_{t+1}$) Regressions for Dividend Payers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.56</td>
<td>-0.074</td>
<td>-0.90</td>
<td>-0.63</td>
<td>0.026</td>
<td>-0.58</td>
<td>0.017</td>
<td>0.42</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.50</td>
<td>-0.075</td>
<td>-0.96</td>
<td>-0.62</td>
<td>0.014</td>
<td>-0.62</td>
<td>0.019</td>
<td>0.10</td>
<td>0.42</td>
</tr>
<tr>
<td>t(Mn)</td>
<td>12.67</td>
<td>-11.594</td>
<td>-20.75</td>
<td>-12.86</td>
<td>2.045</td>
<td>-9.82</td>
<td>15.151</td>
<td>1.29</td>
<td>52.13</td>
</tr>
<tr>
<td>Mean</td>
<td>0.73</td>
<td>-0.096</td>
<td>-0.36</td>
<td>0.030</td>
<td>-0.68</td>
<td>0.028</td>
<td>-0.79</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>t(Mn)</td>
<td>16.65</td>
<td>-15.397</td>
<td>-6.62</td>
<td>4.972</td>
<td>-6.41</td>
<td>13.127</td>
<td>-8.67</td>
<td>44.45</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Panel D: Market Leverage ($L_{t+1}/V_{t+1}$) Regressions for Non-Payers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.42</td>
<td>-0.061</td>
<td>-0.42</td>
<td>-0.253</td>
<td>0.065</td>
<td>-0.596</td>
<td>0.041</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>t(Mn)</td>
<td>17.57</td>
<td>-13.886</td>
<td>-12.50</td>
<td>-3.956</td>
<td>6.189</td>
<td>-6.814</td>
<td>20.759</td>
<td>26.11</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.39</td>
<td>-0.067</td>
<td>-0.006</td>
<td>0.076</td>
<td>-0.419</td>
<td>0.037</td>
<td>0.27</td>
<td>23.91</td>
<td></td>
</tr>
<tr>
<td>t(Mn)</td>
<td>18.68</td>
<td>-11.575</td>
<td>-0.087</td>
<td>7.423</td>
<td>-5.400</td>
<td>15.202</td>
<td>2.7</td>
<td>23.91</td>
<td></td>
</tr>
</tbody>
</table>

The regressions are run for each year $t+1$ of the 1965-99 period (35 years). The table shows means (across years) of the regression intercepts (Int) and slopes, and t-statistics for the means, t(Mn), defined as the mean divided by its standard error [the times-series standard deviation of the regression coefficient divided by $(35)^{1/2}$]. The regressions in Parts A and C require that firms pay dividends in year $t-1$. The regressions in Parts B and D are for firms that do not pay dividends in year $t-1$. $A_t$, $B_E$, $ME_t$, $L_t = A_t - BE_t$ and $V_t = L_t + ME_t$, and are assets, book common equity, market value of common equity, total liabilities, and total market value, at the end of fiscal year $t$. $D_t$, $E_T$, $D_P$, and $R_D$ are dividends, earnings before interest and taxes, depreciation expense, and R&D expenditures for fiscal year $t$. RDD$_{t-1}$ is a dummy variable that is 1.0 for firms that report no R&D. The target payout $TP_{t+1}$ is $a_0/(Y_{t+1}/A_t)+a_1V/A_t+a_1E_t/A_t+a_1D_t/A_t+a_1RDD_t+a_1R_D/A_t+a_1\ln(A_t)$, where the a’s are regression coefficients from the reduced form estimates of the dividend regression (4) in Table 1. The regression $R^2$ are adjusted for degrees of freedom.
Table 4 – Regressions to Explain Changes in Book Leverage, Market Leverage, and Book Debt

### Panel A: Dependent Variable is the Change in Book Leverage, $L_{t+1}/At+1 - L_t/A_t$

<table>
<thead>
<tr>
<th>Int</th>
<th>TL &lt;t+1&gt;</th>
<th>$L_t/A_t$</th>
<th>$dE_{t+1}/At+1$</th>
<th>$dA_{t+1}/At+1$</th>
<th>$dE_t/A_{t+1}$</th>
<th>$dA_t/A_{t+1}$</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dividend Payers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>-0.011</td>
<td>0.10</td>
<td>-0.09</td>
<td>-0.31</td>
<td>0.18</td>
<td>-0.21</td>
<td>-0.03</td>
</tr>
<tr>
<td>t(Mn)</td>
<td>-1.316</td>
<td>4.68</td>
<td>-9.05</td>
<td>-10.59</td>
<td>7.30</td>
<td>-8.61</td>
<td>-4.11</td>
</tr>
<tr>
<td><strong>Non-Payers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.002</td>
<td>0.18</td>
<td>-0.15</td>
<td>-0.39</td>
<td>-0.08</td>
<td>-0.24</td>
<td>-0.06</td>
</tr>
<tr>
<td>t(Mn)</td>
<td>.102</td>
<td>5.28</td>
<td>-4.04</td>
<td>-8.73</td>
<td>-1.86</td>
<td>-5.70</td>
<td>-4.28</td>
</tr>
</tbody>
</table>

The regressions are run for each year $t+1$ of the 1965-99 period (35 years). The table shows means (across years) of the regression intercepts (Int) and slopes, and t-statistics for the means, t(Mn), defined as the mean divided by its standard error [the times-series standard deviation of the regression coefficient divided by $(35)^{1/2}$]. The dividend payer regressions require that firms pay dividends in year $t-1$. The non-payer regressions are for year $t-1$ non-payers. A, BE, ME, $L_t = A_t - BE_t$ and $V_t = L_t + ME_t$, and are assets, book common equity, market value of common equity, total liabilities, and total market value, at the end of fiscal year $t$. $D_t$, $ET_t$, $E_t$, $DP_t$, and $RD_t$ are dividends, earnings before interest and taxes, earnings before interest but after taxes, depreciation expense, and R&D expenditures for fiscal year $t$. $RDD_{t-1}$ is a dummy variable that is 1.0 for firms that report no R&D. $dE_t = E_t - E_{t-1}$ and $dA_t = A_t - A_{t-1}$. Target leverage $TL_{t+1}$ is the fitted value from the regression of $L_{t+1}/At+1$ (or $L_{t+1}/V_{t+1}$) on $V_{t}/A_{t}$, $ET_{t}/A_{t}$, $DP_{t}/A_{t-1}$, $RDD_{t}/A_{t}$, $ln(A_t)$, and $TP_{t+1}$. The target payout $TP_{t+1}$ is $a_0(Y_{t+1}/A_t) + a_1V_{t}/A_t + a_2E_t/A_t + a_3A_t/dA_t/A_{t+1} + a_4RDD_{t}/A_t + a_{13}ln(A_t)$, where the $a$’s are regression coefficients from the reduced form estimates of the dividend regression (4) in Table 1. The regression $R^2$ are adjusted for degrees of freedom.
Table 5 – Book and Market Leverage Sorts for Dividend Payers and Non-Payers: 1965-99

<table>
<thead>
<tr>
<th></th>
<th>(D_t/Y_t)</th>
<th>(L_t/A_t)</th>
<th>(L_t/V_t)</th>
<th>(E_t/A_t)</th>
<th>(V_t/A_t)</th>
<th>(dA_t/A_t)</th>
<th>(RD_t/A_t)</th>
<th>(A_t/C_t)</th>
<th>(Dpt/A_t)</th>
<th>(NI_t/A_t)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sorts of Dividend Payers on Book Leverage, (L_t/A_t)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.41</td>
<td>0.24</td>
<td>0.13</td>
<td>0.104</td>
<td>1.92</td>
<td>0.097</td>
<td>0.020</td>
<td>363</td>
<td>0.047</td>
<td>-0.001</td>
</tr>
<tr>
<td>Q 2</td>
<td>0.47</td>
<td>0.38</td>
<td>0.26</td>
<td>0.088</td>
<td>1.50</td>
<td>0.079</td>
<td>0.017</td>
<td>1496</td>
<td>0.057</td>
<td>-0.001</td>
</tr>
<tr>
<td>Q 3</td>
<td>0.46</td>
<td>0.47</td>
<td>0.37</td>
<td>0.078</td>
<td>1.32</td>
<td>0.077</td>
<td>0.014</td>
<td>1830</td>
<td>0.052</td>
<td>-0.001</td>
</tr>
<tr>
<td>Q 4</td>
<td>0.47</td>
<td>0.56</td>
<td>0.45</td>
<td>0.073</td>
<td>1.32</td>
<td>0.084</td>
<td>0.016</td>
<td>2141</td>
<td>0.049</td>
<td>0.002</td>
</tr>
<tr>
<td>High</td>
<td>0.54</td>
<td>0.73</td>
<td>0.62</td>
<td>0.061</td>
<td>1.21</td>
<td>0.105</td>
<td>0.015</td>
<td>3652</td>
<td>0.041</td>
<td>0.001</td>
</tr>
<tr>
<td><strong>Sorts of Dividend Payers on Market Leverage, (L_t/V_t)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.41</td>
<td>0.33</td>
<td>0.13</td>
<td>0.129</td>
<td>2.87</td>
<td>0.119</td>
<td>0.035</td>
<td>746</td>
<td>0.052</td>
<td>-0.005</td>
</tr>
<tr>
<td>Q 2</td>
<td>0.42</td>
<td>0.43</td>
<td>0.27</td>
<td>0.094</td>
<td>1.65</td>
<td>0.095</td>
<td>0.019</td>
<td>1306</td>
<td>0.051</td>
<td>-0.003</td>
</tr>
<tr>
<td>Q 3</td>
<td>0.46</td>
<td>0.49</td>
<td>0.39</td>
<td>0.078</td>
<td>1.27</td>
<td>0.080</td>
<td>0.013</td>
<td>2072</td>
<td>0.052</td>
<td>-0.001</td>
</tr>
<tr>
<td>Q 4</td>
<td>0.51</td>
<td>0.55</td>
<td>0.52</td>
<td>0.066</td>
<td>1.10</td>
<td>0.074</td>
<td>0.013</td>
<td>2279</td>
<td>0.050</td>
<td>0.002</td>
</tr>
<tr>
<td>High</td>
<td>2.53</td>
<td>0.69</td>
<td>0.71</td>
<td>0.053</td>
<td>0.98</td>
<td>0.084</td>
<td>0.013</td>
<td>3084</td>
<td>0.041</td>
<td>0.002</td>
</tr>
<tr>
<td><strong>Sorts of Non-Payers on Book Leverage, (L_t/A_t)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.23</td>
<td>0.12</td>
<td>0.069</td>
<td>2.31</td>
<td>0.134</td>
<td>0.054</td>
<td>63</td>
<td>0.044</td>
<td>0.053</td>
<td></td>
</tr>
<tr>
<td>Q 2</td>
<td>0.40</td>
<td>0.27</td>
<td>0.065</td>
<td>1.70</td>
<td>0.122</td>
<td>0.037</td>
<td>110</td>
<td>0.047</td>
<td>0.023</td>
<td></td>
</tr>
<tr>
<td>Q 3</td>
<td>0.53</td>
<td>0.40</td>
<td>0.055</td>
<td>1.42</td>
<td>0.112</td>
<td>0.022</td>
<td>142</td>
<td>0.047</td>
<td>0.013</td>
<td></td>
</tr>
<tr>
<td>Q 4</td>
<td>0.65</td>
<td>0.56</td>
<td>0.048</td>
<td>1.25</td>
<td>0.102</td>
<td>0.011</td>
<td>205</td>
<td>0.045</td>
<td>0.012</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>0.83</td>
<td>0.71</td>
<td>0.037</td>
<td>1.20</td>
<td>0.092</td>
<td>0.007</td>
<td>310</td>
<td>0.045</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td><strong>Sorts of Non-Payers on Market Leverage, (L_t/V_t)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.29</td>
<td>0.11</td>
<td>0.090</td>
<td>3.28</td>
<td>0.202</td>
<td>0.060</td>
<td>77</td>
<td>0.044</td>
<td>0.058</td>
<td></td>
</tr>
<tr>
<td>Q 2</td>
<td>0.45</td>
<td>0.29</td>
<td>0.072</td>
<td>1.76</td>
<td>0.167</td>
<td>0.033</td>
<td>119</td>
<td>0.046</td>
<td>0.020</td>
<td></td>
</tr>
<tr>
<td>Q 3</td>
<td>0.55</td>
<td>0.45</td>
<td>0.053</td>
<td>1.31</td>
<td>0.131</td>
<td>0.021</td>
<td>129</td>
<td>0.047</td>
<td>0.017</td>
<td></td>
</tr>
<tr>
<td>Q 4</td>
<td>0.66</td>
<td>0.61</td>
<td>0.044</td>
<td>1.13</td>
<td>0.088</td>
<td>0.010</td>
<td>199</td>
<td>0.046</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>0.77</td>
<td>0.80</td>
<td>0.032</td>
<td>0.97</td>
<td>0.055</td>
<td>0.007</td>
<td>306</td>
<td>0.043</td>
<td>0.006</td>
<td></td>
</tr>
</tbody>
</table>

Each year \(t\) firms that pay dividends in \(t\) are sorted into quintiles on book or market leverage. For each sorting variable, we show various ratios of aggregates for each quintile. The table shows averages, for 1965-99, of the ratios of aggregates. \(C_t\) is the number of firms. \(A_t, BE_t, ME_t, L_t=A_t-BE_t,\) and \(V_t=L_t+ME_t\) are assets, book common equity, market value of common equity, book liabilities, and total market value, at the end of fiscal year \(t.\) \(E_t, Y_t, RD_t, D_t, Dpt,\) and \(NI_t\) are earnings before interest but after taxes, after tax earnings to common stock, R&D expenditures, dividends, depreciation and net stock issues for fiscal year \(t.\) Investment, \(dA_t,\) is \(A_t-A_{t-1}\.\) The period for \(NI_t\) is 1971-99.
Chart 1 – Rationale for Predictions of the Tradeoff and Pecking Order Models

**Pecking Order Model** [Myers (1984)]

Predictions are driven by financing costs, including transactions costs and the asymmetric information problem that arises when investment must be financed with new issues of risky securities (risky debt and especially new stock).

1. Controlling for investment opportunities, firms with more profitable assets in place have higher long-term dividend payouts and less book and market leverage.
2. Controlling for profitability, firms with more current and expected investments have lower long-term dividend payouts.
3. In the simple version of the model, given the profitability of assets in place, firms with more investments have more book leverage.
4. In a more complex version of the model, where firms balance current and expected future financing costs, dividend payers with more volatile net cash flows have lower dividend payouts and less leverage. Firms (especially dividend payers) with more expected investments have less current leverage. The relation between leverage and the dividend payout ratio is also negative. Whether these leverage predictions apply to book or market leverage depends on whether low risk debt capacity is a function of the book or the market value of assets.
5. Dividends are (for unknown reasons) sticky, leaving short-term variation in earnings and investment to be absorbed primarily by variation in debt.

**Tradeoff Model**

**Bankruptcy Costs**

1. More profitable firms have more book leverage.
2. Firms with more variable earnings have less book leverage.

**Taxes** [Miller and Scholes (1978), DeAngelo and Masulis (1980)]

1. Firms with higher expected tax rates (more profitable firms and firms with less variable earnings) have more book leverage.
2. Controlling for profitability, firms with more non-debt tax shields (e.g., deductions for depreciation and R&D) have less book leverage.

**Free-Cash Flow Agency Problems** [Jensen and Meckling (1976), Easterbrook (1984), Jensen (1986)] – Predictions are driven by the benefits of dividends and debt in controlling the agency problem created by free cash flow (the excess of earnings over profitable investments).

1. Controlling for investment opportunities, firms with more profitable assets in place have higher dividend payouts and more book leverage.
2. Controlling for profitability, firms with larger profitable investments have lower dividend payouts and less book and market leverage.
3. Dividends and debt are substitutes for controlling the free-cash-flow agency problem, and the relation between the payout ratio and book leverage is negative.

**Stockholder-Bondholder Agency (Asset Substitution and Under-Investment) Problems** [Fama and Miller (1972), Jensen and Meckling (1976), Myers (1977)]

1. Firms (especially dividend payers) with more expected investments have less current leverage. Whether the prediction applies to book or market leverage depends on whether low risk debt capacity is a function of the book or the market value of assets.
## Chart 2 – Summary of Predictions and Proxies for Testing Tradeoff and Pecking Order Models

<table>
<thead>
<tr>
<th>Proxies</th>
<th>Pecking Order Model</th>
<th>Tradeoff Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Leverage</td>
<td>Leverage</td>
</tr>
<tr>
<td></td>
<td>Payout</td>
<td>Book</td>
</tr>
</tbody>
</table>
| Profitability | ET/A,

**ET/A**: Pre-interest, pre-tax earnings in fiscal year t divided by assets at the end of fiscal year t.

**E/A**: Pre-interest, after-tax earnings in fiscal year t divided by assets at the end of fiscal year t.

**V/A**: The ratio of market to book value of assets at the end of fiscal year t.

**dA/A**: The change in assets from fiscal year t-1 to fiscal year t divided by assets at the end of fiscal year t, (At-At-1)/At.

**RD/A**: Research and development in fiscal year t divided by assets at the end of fiscal year t.

**ln(A)**: The natural logarithm of assets at the end of fiscal year t.

**Dp/A**: Depreciation expense in fiscal year t divided by assets at the end of fiscal year t.