

Testing Trade-Off and Pecking Order Predictions About Dividends and Debt

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Confirming predictions shared by the trade-off and pecking order models, more profitable firms and firms with fewer investments have higher dividend payouts. Confirming the pecking order model but contradicting the trade-off model, more profitable firms are less levered. Firms with more investments have less market leverage, which is consistent with the trade-off 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 trade-off 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 trade-off 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

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is driven not by the trade-off 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 trade-off 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 trade-off 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 trade-off 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 articles 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 article 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 1971–1989 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 1965–1999 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 articles 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 (1973; hereafter FM), 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% 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 article 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 trade-off 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 trade-off 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 1 summarizes the trade-off and pecking order models. Section 2 briefly describes the statistical setup. Sections 3–5 present our tests of how dividends and leverage line up with the predictions of the two models. Section 6 concludes.

1. Predictions

Our discussion of the trade-off 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 Appendix Tables A1 and A2.

1.1 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 overpriced. 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 trade-off 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.

1.1.1 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.

1.1.2 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 (2001) 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 (2001) also find that firms that do not pay dividends typically have large investments relative to earnings. Thus for nonpayers 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 trade-off model (discussed next) where the costs and benefits of debt push underlevered firms up and overlevered firms down toward their leverage targets.

1.1.3 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.

1.2 The trade-off model

In the trade-off 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 trade-off forces we consider make almost unanimous predictions about how target leverage and the dividend payout vary across firms

with profitability and investment opportunities. The trade-off model's predictions about dividends are similar to those of the pecking order model. But the models have some disagreements about leverage.

1.2.1 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.

1.2.2 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 nondebt tax shields, such as R&D expenditures and depreciation. Larger nondebt 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 nondebt tax shields.

Tests of the DeAngelo and Masulis (1980) model typically focus on nondebt 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.

1.2.3 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 security holders, 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 preinterest 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.

1.2.4 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 trade-off model. But if financing costs do not overpower other factors, the trade-off 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 trade-off 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 trade-off model these costs do not overwhelm the other factors that determine target ratios.

1.3 Proxies for the driving variables

Our measures of profitability, investment opportunities, and volatility are far from perfect. We use the ratio of annual preinterest pretax earnings to end-of-year total assets, ET_t/A_t , and the ratio of preinterest after-tax earnings

to assets, E_t/A_t , 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/A_t is a measure of profitability when we look for tax effects in the trade-off model. [Some alternatives, left for future research, are the various approaches to estimating tax rates in Graham (1996b).] ET_t/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 trade-off 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 (R&D) 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 nondebt 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 trade-off 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) 5 or 10 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 by-product 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.

1.4 Market or book leverage

Do the leverage predictions of the trade-off 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 trade-off 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 underinvestment and asset substitution problems that can arise with risky debt in the trade-off 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.

2. The Framework for the Tests: A Brief Overview

In our view of the trade-off 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.

3. Dividend Regressions

The dividend predictions of the trade-off 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} ,

$$TD_{t+1} = TP * Y_{t+1}. \quad (1)$$

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

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

$$D_{t+1} - D_t = a_1 Y_{t+1} + a_2 D_t + e_{t+1}. \quad (3)$$

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

3.1 The target payout

3.1.1 Approach. Our main task is to estimate Equation (1), or more specifically, to examine how the target payout, TP , in Equation (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,

$$\begin{aligned} D_{t+1}/A_{t+1} = & a_0 + (a_1 + a_{1V}V_t/A_t + a_{1E}E_t/A_t + a_{1A}dA_t/A_t \\ & + a_{1D}RDD_t + a_{1R}RD_t/A_t + a_{1S} \ln(A_t) \\ & + a_{1L}TL_{t+1})Y_{t+1}/A_{t+1} + e_{t+1}. \end{aligned} \quad (4)$$

To simplify the notation, we omit the firm subscript that should appear on the variables and residuals in Equation (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 Equation (1) and put common stock earnings, Y_{t+1} , on the right of Equation (4). This avoids the influential observation problem that arises when earnings are near zero. Most of the variables in Equation (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 Equation (4) include our proxies for investment opportunities (V_t/A_t , dA_t/A_t , and RD_t/A_t) and the profitability of assets in place (E_t/A_t and V_t/A_t , where E_t is preinterest 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% of Compustat firms report zero R&D or do not report R&D, and it seems appropriate to allow for a nonlinearity 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. 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 Equation (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 side of Equation (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 Equation (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 Equation (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 1965–1999, 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 Equation (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.¹

3.1.2 Results. For perspective on the estimates of Equation (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, Equation (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 (2001), 0.45. The estimates of the target payout from the various versions of Equation (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 Equation (4) increases the R^2 more than 50% to 0.38 and 0.39. Thus the combination of interaction variables in Equation (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 trade-off 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 underinvestment 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 dA_t/A_t slopes in Table 1 (t -statistics less than -7.8) support this prediction. The negative RD_t/A_t slopes also support this prediction, but in the full versions of Equation (4), the 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,

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

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

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

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

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.

Table 1
Estimates of regression (4) to explain the dividend payout ratio

	Int	Y_{t+1}/A_{t+1}	Y_{t+1}/A_{t+1}^*							R^2	TP
			V_t/A_t	E_t/A_t	dA_t/A_t	RDD_t	RD_t/A_t	$\ln(A_t)$	TL_{t+1}		
Panel A: Regressions without interaction terms and reduced form regressions											
Mean	0.012	0.21								0.25	0.46
$t(Mn)$	10.082	10.51								6.90	21.71
Mean	0.012	0.06	0.013	1.13	-0.35	0.004	-0.39	0.010		0.38	0.42
$t(Mn)$	18.943	3.61	3.293	12.82	-8.26	0.438	-3.33	3.232		9.24	23.83
Panel B: TL_{t+1} is target book leverage											
Mean	0.012	0.08	0.019	0.93	-0.34	0.006	-0.49	0.006	0.05	0.39	0.41
$t(Mn)$	19.476	0.93	3.659	4.24	-8.31	0.756	-3.73	0.538	0.20	9.50	23.78
Mean	0.011	0.42	0.017		-0.33	0.029	-0.69	0.037	-0.91	0.38	0.41
$t(Mn)$	17.278	13.37	3.730		-8.03	2.322	-5.47	9.278	-10.22	9.33	24.16
Panel C: TL_{t+1} is target market leverage											
Mean	0.012	0.18	-0.008	0.79	-0.34	0.007	-0.57	0.015	-0.17	0.39	0.41
$t(Mean)$	19.418	2.29	-0.540	4.18	-8.25	0.766	-3.84	3.209	-0.97	9.52	23.90
Mean	0.011	0.49	-0.050		-0.33	0.029	-0.86	0.026	-0.85	0.38	0.41
$t(Mean)$	17.343	12.43	-6.307		-7.83	2.305	-7.27	9.862	-10.27	9.35	24.19

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 1965-1999 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&D expenditures 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 target payout TP is the average across years of $a_0/Mn(Y_{t+1}/A_t) + a_1 + a_{1V}Mn(V_t/A_t) + a_{1E}Mn(E_t/A_t) + a_{1A}Mn(dA_t/A_t) + a_{1D}Mn(RDD_t) + a_{1R}Mn(RD_t/A_t) + a_{1S}Mn(\ln(A_t)) + a_{1L}Mn(TL_{t+1})$, where $Mn()$ is the cross-section mean of a variable for a year, and the a_s are regression coefficients from Equation (4).

the average V_t/A_t slope in Equation (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 V_t/A_t slope in Equation (4) is close to zero ($t = -0.54$).

In the trade-off 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 E_t/A_t slopes in Equation (4) are consistent with this prediction, but in the full versions of Equation (4) their t -statistics, 4.24 and 4.18, fall a bit below our 5.0 standard error hurdle for reliability. The positive 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 V_t/A_t rather than to information about investment opportunities.

In the trade-off 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 Equation (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 Equation (4) are less than four standard errors from zero.

Both the trade-off 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 Equation (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 Equation (4)? The signs of the regression slopes are almost always consistent with the trade-off 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 Equation (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 Equation (4) leads to strong negative slopes on TL_{t+1} (more than 10 standard errors below zero), which is consistent with the negative relation between the target payout and target leverage predicted by the trade-off 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 Equation (4) lean toward the trade-off 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.

3.2 Dividends and investment

The estimates of Equation (4) are consistent with trade-off 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 model [Equation (3)], which includes normal variation in dividends due to movement toward the target payout. We use two versions of Equation (3). The simple one does not allow for variation across firms in the target payout and speed of adjustment of Equations (2) and (3). Adding a constant to Equation (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,

$$(D_{t+1} - D_t)/A_{t+1} = a_0 + a_1 Y_{t+1}/A_{t+1} + a_2 D_t/A_{t+1} + a_3 dA_{t+1}/A_{t+1} + e_{t+1}. \quad (5)$$

In dynamic models like Equation (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 Equation (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 Equation (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 Equation (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

Table 2
Lintner model regressions to explain the change in dividends, $(D_{t+1} - D_t)/A_t$

	Int	Y_{t+1}/A_t	D_t/A_t	dA_{t+1}/A_t	R^2	SOA	TP
Estimates of Equation (5)							
Mean	0.004	0.11	-0.33	-0.021	0.29	0.33	0.33
$t(Mn)$	3.658	9.46	-6.39	-2.333	7.76		
Estimates of Equation (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 Equation (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 1965–1999 period (35 years). Equation (5) estimates the augmented Lintner model with the same Y_{t+1}/A_{t+1} , D_t/A_{t+1} , and dA_t/A_{t+1} slopes for all firms in a given year. In Equation (6), the slopes on Y_{t+1}/A_{t+1} and D_t/A_{t+1} vary with V_t/A_t , E_t/A_t , dA_t/A_t , RDD_t , RD_t/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 [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 Equation (6) is the average across years of $a_1 + a_{1V}Mn(V_t/A_t) + a_{1E}Mn(E_t/A_t) + a_{1A}Mn(dA_t/A_t) + a_{1D}Mn(RDD_t) + a_{1R}Mn(RD_t/A_t) + a_{1S}Mn(\ln(A_t)) + a_{1L}Mn(TL_{t+1})$ where $Mn()$ is the cross-section mean of a variable for a given year, and the a_1 s are regression coefficients from Equation (6). The slope on D_t/A_{t+1} in the estimates of Equation (6) is the average across years of $a_2 + a_{2V}Mn(V_t/A_t) + a_{2E}Mn(E_t/A_t) + a_{2A}Mn(dA_t/A_t) + a_{2D}Mn(RDD_t) + a_{2R}Mn(RD_t/A_t) + a_{2S}Mn(\ln(A_t)) + a_{2L}Mn(TL_{t+1})$, where the a_2 s are regression coefficients from Equation (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_t/A_t . The target payout, TP, is the average slope on Y_{t+1}/A_t , divided by SOA.

time-series cross-section estimate of Equation (5).] The estimate, 0.33, is somewhat below the average aggregate payout ratio for 1963–1998 in Fama and French (2001), 0.45.

Equation (5) is misspecified. 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 Equation (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,

$$\begin{aligned}
 (D_{t+1} - D_t)/A_{t+1} = & a_0 + (a_1 + a_{1V}V_t/A_t + a_{1E}E_t/A_t + a_{1A}dA_t/A_t \\
 & + a_{1D}RDD_t + a_{1R}RD_t/A_t + a_{1S}\ln(A_t) \\
 & + a_{1L}TL_{t+1})Y_{t+1}/A_{t+1} \\
 & + (a_2 + a_{2V}V_t/A_t + a_{2E}E_t/A_t + a_{2A}dA_t/A_t \\
 & + a_{2D}RDD_t + a_{2R}RD_t/A_t + a_{2S}\ln(A_t) \\
 & + a_{2L}TL_{t+1})D_t/A_{t+1} + b_1dA_{t+1}/A_{t+1} + e_{t+1}. \quad (6)
 \end{aligned}$$

The proxy variables in Equation (6) are those used to model the target payout in Equation (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 Equation (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 Equation (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 Equation (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 Equation (6) in Table 2 are of interest. Like Equation (5), Equation (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 Equation (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 Equation (6) is 0.42 versus 0.29 for Equation (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 Equations (5) and (6) say about short-term variation in dividends in response to investment? The autocorrelations of the slopes in Equations (5) and (6) are close to zero, so 2.0 is an appropriate benchmark for the t -tests. The average dA_{t+1}/A_{t+1} slope from Equation (6) in Table 2 is negative and about -2.08 standard errors from zero, which suggests some accommodation. The dA_{t+1}/A_{t+1} slope in Equation (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 dA_{t+1}/A_{t+1} slopes from Equations (5) and (6) are economically trivial; on average, the change in dividends absorbs only about 2% 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 Equation (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 1965–1999 period, dividend payers as a group are on average net repurchasers of stock [Fama and French (2001)]. 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.

4. 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 trade-off 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 ,

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

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 Equation (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,

$$L_{t+1}/A_{t+1} = b_0 + b_1V_t/A_t + b_2ET_t/A_t + b_3DP_t/A_t + b_4RDD_t + b_5RD_t/A_t + b_6 \ln(A_t) + b_7TP_{t+1} + e_{t+1}. \quad (8)$$

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

The partial adjustment framework of Equations (7) and (8) nests the trade-off 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 Equation (8) are estimates of the targets, and the speed of adjustment a_1 in Equation (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 Equation (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 Equation (7) the speed of adjustment, a_1 , is indistinguishable from zero, whereas the trade-off 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 Equation (7)].

In the trade-off and pecking order models, the exogenous driving variables for the level of leverage are the profitability of assets in place, investment opportunities, nondebt tax shields, and volatility. The proxies for profitability in Equation (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 nondebt tax shields, along with depreciation, Dp_t/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 Equation (8) is from the first-stage reduced form estimates of the dividend regression [Equation (4)] in Table 1. The explanatory variables assumed to be exogenous in Equation (8) are predetermined. This mitigates any remaining endogeneity problems.

4.1 Comments on methodology

Variants of the target leverage regression [Equation (8)] are common in the literature. Estimation of Equation (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 Equation (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 articles that use panel regressions ignore both the cross-correlation problem and the potential inference problem caused by autocorrelation of the regression residuals.²

² The 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 articles 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.

We estimate Equations (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 Equation (7) to explain changes in leverage is not a serious problem. But in Equation (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 of Equation (4), we use a conservative approach to account for the autocorrelation of the slopes in Equation (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 note 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.

4.2 The level of leverage

Table 3 shows average slopes from variants of Equation (8). Since the pecking order model suggests that the relation between leverage and investment may differ for dividend payers and nonpayers, 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.

4.2.1 Leverage and profitability. In the trade-off 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 nonpayers, the estimates of Equation (8) produce negative average slopes on profitability, ET_t/A_t , that are at least 12.5 standard errors below zero. In the market leverage regressions, the average V_t/A_t slopes are more than 11.5 standard errors below zero. In the book leverage

Table 3
Regressions to explain the level of book (L_{t+1}/A_{t+1}) and market (L_{t+1}/V_{t+1}) leverage

	Int	V_t/A_t	ET_t/A_t	DP_t/A_t	RDD_t	RD_t/A_t	$\ln(A_t)$	TP_{t+1}	R^2
Panel A: Book leverage (L_{t+1}/A_{t+1}) regressions for dividend payers									
Mean	0.43	0.011	-0.81	-0.51	0.024	-0.37	0.027		0.21
$t(Mn)$	32.89	3.495	-23.42	-8.98	6.641	-6.47	14.954		22.66
Mean	0.43	0.012	-0.77	-0.46	0.009	-0.50	0.032	-0.11	0.23
$t(Mn)$	9.94	2.790	-16.21	-8.63	1.403	-5.25	22.046	-1.16	25.73
Mean	0.64	-0.005		-0.24	0.024	-0.54	0.038	-0.85	0.18
$t(Mn)$	11.84	-0.845		-3.98	2.901	-4.60	22.822	-7.84	21.35
Panel B: Book leverage (L_{t+1}/A_{t+1}) regressions for nonpayers									
Mean	0.39	0.027	-0.74	0.06	0.052	-0.75	0.046		0.15
$t(Mn)$	29.07	4.221	-16.92	0.53	5.759	-8.38	21.514		9.17
Mean	0.35	0.023		0.57	0.079	-0.35	0.034		0.06
$t(Mn)$	29.38	3.523		4.50	8.009	-4.70	11.306		9.41
Panel C: Market leverage (L_{t+1}/V_{t+1}) regressions for dividend payers									
Mean	0.56	-0.074	-0.90	-0.63	0.026	-0.58	0.017		0.42
$t(Mn)$	27.59	-12.704	-19.00	-12.91	12.485	-11.37	13.460		51.99
Mean	0.50	-0.075	-0.96	-0.62	0.014	-0.62	0.019	0.10	0.42
$t(Mn)$	12.67	-11.594	-20.75	-12.86	2.045	-9.82	15.151	1.29	52.13
Mean	0.73	-0.096		-0.36	0.030	-0.68	0.028	-0.79	0.36
$t(Mn)$	16.65	-15.397		-6.62	4.972	-6.41	13.127	-8.67	44.45
Panel D: Market leverage (L_{t+1}/V_{t+1}) regressions for nonpayers									
Mean	0.42	-0.061	-0.42	-0.25	0.065	-0.60	0.041		0.33
$t(Mn)$	17.57	-13.886	-12.50	-3.96	6.189	-6.81	20.759		26.11
Mean	0.39	-0.067		-0.01	0.076	-0.42	0.037		0.27
$t(Mn)$	18.68	-11.575		-0.09	7.423	-5.40	15.202		23.91

The regressions are run for each year $t+1$ of the 1965–1999 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 panels A and C require that firms pay dividends in year $t-1$. The regressions in panels B and D are for firms that do not 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 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 , DP_t , and RD_t 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 $a_0/(Y_{t+1}/A_t) + a_1 + a_{1V}V_t/A_t + a_{1E}E_t/A_t + a_{1A}dA_t/A_t + a_{1D}RDD_t + a_{1R}RD_t/A_t + a_{1S}\ln(A_t)$, where the a s are regression coefficients from the reduced form estimates of the dividend equation [Equation (4)] in Table 1. The regression R^2 are adjusted for degrees of freedom.

regressions, however, the average V_t/A_t slopes are mostly positive, but only the slope in the full version of Equation (8) for nonpayers exceeds our four standard error reliability hurdle.

The ET_t/A_t slopes in Equation (8) may overstate the long-term relation between leverage and profitability. The estimates of the partial adjustment model [Equation (7)] will show that there is a strong offsetting response of leverage to changes in earnings. It is thus possible that the negative ET_t/A_t slopes in Equation (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 ET_t/A_t slopes as tests of trade-off 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.

4.2.2 Leverage and investment opportunities. The trade-off 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 underinvestment 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 RD_t/A_t 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 V_t/A_t slopes in the estimates of the full version of Equation (8) are positive and the slope for nonpayers 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 Equation (8) to explain the market leverage of dividend payers and nonpayers, 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 trade-off 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 trade-off and pecking order models. [Titman and Wessels (1988) make a related point.]

The negative relation between leverage and R&D observed in our tests is a common result [Bradley, Jarrell, and Kim (1984), Long and Malitz (1985), Titman and Wessels (1988)]. Like us, Rajan and Zingales (1995) find a negative relation between market leverage and investment opportunities, proxied by the market-to-book ratio. But Titman and Wessels (1988) find no reliable relation between leverage and their measures of growth opportunities.

4.2.3 Other effects. The trade-off model predicts that because firms with more nondebt 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 Equation (8).] In the book leverage estimates of the full regression [Equation (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 nonpayers is, however, positive but less than one standard error from zero. It may in any case be inappropriate to treat the RD_t/A_t and DP_t/A_t slopes as evidence about nondebt tax shields, given Graham's (1996a) evidence that nondebt tax shields have at best a weak role in determining the expected tax rates of firms.

The trade-off 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 $\ln(A_t)$ slopes in Equation (8) are all positive and more than 11 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 trade-off 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 Equation (8) is negative but only -1.16 standard errors from zero. The TP_{t+1} slope in the market leverage version of Equation (8) is slightly positive ($t = 1.29$). The problem is collinearity between TP_{t+1} , and pretax profitability, ET_t/A_t . When ET_t/A_t is dropped from Equation (8), the slopes on TP_{t+1} become strongly negative. The ET_t/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 trade-off and pecking order models.

4.3 Is leverage mean-reverting?

Panels A and B of Table 4 summarize estimates of the partial adjustment model [Equation (7)] for book and market leverage. The estimates suggest that, as predicted by the trade-off model, leverage is mean-reverting. The average slopes on the proxies for target leverage, TL_{t+1} (market or book),

Table 4
Regressions to explain changes in book leverage, market leverage, and book debt

	Int	TL_{t+1}	L_t/A_t or L_t/V_t	dE_{t+1}/A_{t+1}	dA_{t+1}/A_{t+1}	dE_t/A_{t+1}	dA_t/A_{t+1}	R^2
Panel A: Dependent variable is the change in book leverage, $L_{t+1}/A_{t+1} - L_t/A_t$								
Dividend payers								
Mean	-0.011	0.10	-0.09	-0.31	0.18	-0.21	-0.03	0.30
$t(Mn)$	-1.316	4.68	-9.05	-10.59	7.30	-8.61	-4.11	12.61
Nonpayers								
Mean	0.002	0.18	-0.15	-0.39	-0.08	-0.24	-0.06	0.31
$t(Mn)$.102	5.28	-4.04	-8.73	-1.86	-5.70	-4.28	8.62
Panel B: Dependent variable is the change in market leverage, $L_{t+1}/V_{t+1} - L_t/V_t$								
Dividend payers								
Mean	.005	0.07	-0.10	-0.56	0.17	-0.23	0.01	0.22
$t(Mn)$.963	4.30	-10.12	-9.23	9.32	-10.36	0.94	17.10
Nonpayers								
Mean	0.016	0.15	-0.16	-0.31	0.06	-0.14	-0.00	0.17
$t(Mn)$	2.269	12.41	-12.25	-7.61	5.43	-6.16	-0.12	12.13
Panel C: Dependent variable is the change in book debt, $(L_{t+1} - L_t)/A_{t+1}$								
Dividend payers								
Mean	-0.066	0.11	0.01	-0.51	0.80	-0.25	-0.03	0.80
$t(Mn)$	-8.981	5.64	1.46	-13.42	34.79	-9.87	-4.64	28.24
Nonpayers								
Mean	-0.143	0.31	-0.08	-0.62	0.73	-0.23	-0.03	0.68
$t(Mn)$	-6.495	8.44	-4.01	-12.93	19.98	-7.24	-2.11	21.25

The regressions are run for each year $t + 1$ of the 1965–1999 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 nonpayer regressions are for year $t - 1$ non-payers. 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, 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}/A_{t+1} (or L_{t+1}/V_{t+1}) on V_t/A_t , ET_t/A_t , Dp_t/A_{t-1} , RDD_t , RD_t/A_t , $\ln(A_t)$, and TP_{t+1} . The target payout TP_{t+1} is $a_0/(Y_{t+1}/A_t) + a_1 + a_{1V}V_t/A_t + a_{1E}E_t/A_t + a_{1A}dA_t/A_t + a_{1D}RDD_t + a_{1R}RRD_t/A_t + a_{1S}\ln(A_t)$, where the a s are regression coefficients from the reduced form estimates of the dividend equation [Equation (4)] in Table 1. The regression R^2 are adjusted for degrees of freedom.

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 Equation (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 Equation (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, 7–10% per year for dividend payers and 15–18% for nonpayers.

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

trade-off model or the soft leverage targets of the complex pecking order model.

4.4 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 Equation (7) support this prediction. The Z variables are current and lagged investment, $dA_{t+1}/A_{t+1} = (A_{t+1} - A_t)/A_{t+1}$ and $dA_t/A_{t+1} = (A_t - A_{t-1})/A_{t+1}$, and changes in after-tax earnings, $dE_{t+1}/A_{t+1} = (E_{t+1} - E_t)/A_{t+1}$ and $dE_t/A_{t+1} = (E_t - E_{t-1})/A_{t+1}$. [We use before-tax earnings, ET_t , in Equation (8) to judge how taxes affect long-term leverage, but after-tax earnings are relevant in Equation (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 dE_{t+1}/A_{t+1} slopes in Equation (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 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 dA_{t+1}/A_{t+1} in Table 4 are positive and more than 5.4 standard errors from zero. Positive slopes on 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 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 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 Equation (8), which attempts to identify the determinants of long-term leverage. We can report that adding investment to Equation (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 V_t/A_t) tends to be negative (Table 3).

To measure the dollar response of debt to earnings and investment, panel C of Table 4 shows estimates of Equation (7) that explain the scaled change

in debt, $dL_{t+1}/A_{t+1} = (L_{t+1} - L_t)/A_{t+1}$, rather than the change in leverage, $d(L_{t+1}/A_{t+1}) = L_{t+1}/A_{t+1} - L_t/A_t$. 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% ($t = 34.79$) of current investment with debt, with a 3% reversal ($t = -4.64$) the following year. Nonpayers finance 73% ($t = 19.98$) of investment with debt, with a 3% reversal ($t = -2.11$) the following year. Thus variation in investment produces a bigger change in debt for dividend payers than for nonpayers. This is consistent with the evidence in Fama and French (2001) that net new issues of equity are trivial for payers but more important for nonpayers. 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 nonpayers. 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 nonpayers. The larger response by nonpayers 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, dE_{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 nonpayers] are again large and produce conclusions like those for dE_{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 1971–1989 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 nonpayers) and produces more reliable standard errors for the regression coefficients. Still, it is comforting that the two approaches yield similar results.

5. A Contradiction of the Pecking Order

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

Table 5 summarizes annual sorts of dividend payers (or nonpayers) 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 NI_t/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 1965–1999, except for stock issues and repurchases which are not on Compustat until 1971.

Table 5
Book and market leverage sorts for dividend payers and nonpayers: 1965–1999

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

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 1965–1999, 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 , Dp_t , 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 1971–1999.

The leverage sorts show that less-levered nonpayers are more profitable, which is consistent with the pecking order model. But less-levered nonpayers 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 nonpayers. 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 trade-off model.

The less-levered nonpayers 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 nonpayers make the largest net new issues of stock. In the market leverage sorts, the annual new issues of stock of the least-levered nonpayers are on average 5.8% of total assets. And, at 29% of assets and 11% of market value, the book and market leverage of the least-levered nonpayers are low. Thus the least-levered nonpayers 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 nonpayers 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 nonpayers have average proportions of fixed tangible assets. Finally, perhaps the small growth firms that are the less-levered nonpayers 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 nonpayers whose prime asset is expected growth are less subject to asymmetric information problems [Sharpe and Nguyen (1995)].

6. Conclusion

Who wins the confrontation between the trade-off 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 trade-off 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 trade-off 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 trade-off and pecking order models. The leverage tests also suggest that as predicted by the trade-off model, firms with more nondebt tax shields (deductions for depreciation and R&D expenditures) have less leverage.

The final common prediction of the trade-off 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 trade-off 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 trade-off 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 trade-off model.

In the trade-off 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 (7–17% 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 trade-off 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 (2001) 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, nonpayers primarily use debt to absorb short-term variation in earnings and investment. But, confirming Fama and French (2001), Table 5 shows that nonpayers 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 nonpayers (typically small growth firms) make the largest net new issues of equity.

In sum, we identify one scar on the trade-off 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 trade-off 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), preferred stock redemption value (56), 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 6000–6999) and financial firms (SIC codes 4900–4999) 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 (ME_t) = stock price (199) times shares outstanding (25);

Table A.1
Rationale for predictions of the trade-off 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.

Trade-off 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 nondebt 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 underinvestment) 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.

Market value of firm (V_t) = liabilities (181)– balance sheet deferred taxes and investment tax credit (35)+ preferred stock + market equity;

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

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

Earnings before interest and taxes (ET_t) = earnings before interest + tax expense (16);

Net stock issues (NI_t) = sales of common and preferred stock (108)– purchases of common and preferred stock (115).

Table A.2
Summary of predictions and proxies for testing trade-off and pecking order models

	Proxies	Pecking order model			Trade-off model		
		Payout	Leverage		Payout	Leverage	
			Book	Market		Book	Market
Profitability	$ET_t/A_t, E_t/A_t, V_t/A_t$	+	-	-	+	+	
Investment opportunities	$dA_t/A_t, V_t/A_t, RD_t/A_t$	-	+	-	-	-	-
			(Simple*)	(Complex*)			
Volatility	$\ln(A_t)$	-	-		-	-	
Nondebt tax shields	$RD_t/A_t, DP_t/A_t$						
Target leverage		-			-	-	
Target payout			-	-		-	-
			(Complex*)	(Complex*)			

*The simple pecking order model predicts that book leverage increases with investment opportunities. The complex pecking order model predicts that market leverage decreases with investment opportunities. If low-risk debt capacity depends on book assets, the complex model also predicts that book leverage declines with investment opportunities. Similarly, the complex pecking order predicts that book (market) leverage and the target payout are negatively related if low-risk debt capacity depends on the book (market) value of assets.

Proxies:

ET_t/A_t Preinterest, pretax earnings in fiscal year t divided by assets at the end of fiscal year t .

E_t/A_t Preinterest, after-tax earnings in fiscal year t divided by assets at the end of fiscal year t .

V_t/A_t The ratio of market to book value of assets at the end of fiscal year t .

dA_t/A_t The change in assets from fiscal year $t - 1$ to fiscal year t divided by assets at the end of fiscal year $t, (A_t - A_{t-1})/A_t$.

RD_t/A_t Research and development in fiscal year t divided by assets at the end of fiscal year t .

$\ln(A_t)$ The natural logarithm of assets at the end of fiscal year t .

DP_t/A_t Depreciation expense in fiscal year t divided by assets at the end of fiscal year t .

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