

Taxes, Leverage, and the Cost of Equity Capital

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Abstract

We examine the associations between leverage, corporate and personal taxes, and the firm's implied cost of equity capital. Expanding on Modigliani and Miller [1958, 1963], the cost of equity capital can be expressed as a function of leverage and corporate and investor level taxes. This expression predicts that the cost of equity is increasing in leverage, but that corporate taxes mitigate this leverage related risk premium, while the personal tax disadvantage of debt increases the premium. We empirically test these predictions using implied cost of equity estimates and proxies for the firm's corporate tax rate and the personal tax disadvantage of debt. Our results suggest that the equity risk premium associated with leverage is decreasing in the corporate tax benefit from debt. We find some evidence that the equity risk premium associated with leverage is increasing in the personal tax penalty associated with debt.

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1. Introduction

In this paper, we examine how taxes and leverage affect a firm's cost of equity capital. A long stream of literature has sought to understand how the corporate and investor level tax consequences of capital structure affect firm value and cost of capital. Modigliani and Miller [1958] demonstrate that in the absence of taxes and transactions costs, firm value and the weighted average cost of capital are independent of capital structure. Holding the average cost of capital constant, they show that the cost of equity contains a financial risk premium that is positively related to the firm's debt-to-equity ratio. With corporate taxes, Modigliani and Miller [1963] establish that the tax benefit provided by the interest expense deduction increases firm value and reduces the leverage-related premium of the cost of equity capital. Miller [1977] introduces the effect of personal level taxes into the analysis. He argues that individual investors demand a higher pretax return on debt to compensate for the personal tax on interest income. In equilibrium, the investor level tax disadvantage of debt completely offsets the corporate tax benefit, making capital structure irrelevant. DeAngelo and Masulis [1980] argue that there is still a net tax benefit to debt, but show that in the presence of non-debt tax shields, the firm may not realize the full benefit of the interest expense deduction. In equilibrium, each firm equates the expected tax benefit of an additional dollar of debt with the expected tax cost to investors.

Numerous studies, including MacKie-Mason [1990], Dhaliwal et al. [1992], and Graham [1999], examine the effect of corporate and investor level taxes on firms' financial leverage and incremental financing decisions. In general, their findings suggest

that firms' capital structure choices correlate with corporate and investor level taxes in a predicted manner. These studies presume that economic considerations drive managers' capital structure decisions, but do not provide direct evidence that the tax implications of debt financing are reflected in firm value or the cost of equity capital. Fama and French [1998] investigate whether the tax benefit of leverage increases firm value, but find the opposite effect and conclude that non-tax explanations dominate. They also argue, "In short, good estimates of how the tax treatment of dividends and debt affects the cost of capital and firm value are a high priority for research..."(p. 819). In this paper, we examine the role of capital structure and taxes on the firm's cost of equity. By linking taxes and leverage to the cost of equity, we improve our understanding of the economic incentives to choose particular financial structures.

We use an implied cost of equity capital estimate to examine the effects of leverage and taxes on the cost of equity. The implied cost of equity approach utilizes variations on the residual income valuation model (Ohlson [1995]) to infer investors' expected return from stock price, dividends, book value of equity, and forecasted future earnings. Our main estimate of the firm's marginal tax rate is the simulated marginal corporate tax rate on earnings before financing described in Graham, Lemmon, and Schallheim [1998]. We use the top individual statutory rate on ordinary income as our proxy for the investor level tax rate on interest income. To proxy for the investor level tax rate on equity income, we use a weighted-average of tax rates on dividend and capital gain income.

We predict that corporate level taxes reduce the equity risk premium associated with leverage while the personal tax penalty associated with debt increases this premium. To test these predictions, we regress the implied cost of equity on leverage and the

interactions between leverage and the firm's estimated marginal tax rate and the personal tax penalty associated with debt. The empirical results generally support our predictions. First, the implied cost of equity capital is increasing in leverage, consistent with Modigliani and Miller [1958]. Second, the equity risk premium from leverage is decreasing in the firm's estimated marginal tax rate before financing. This result suggests that the tax benefit from debt reduces the cost of equity and increases market value. Third, the personal tax penalty associated with debt increases the equity risk premium from leverage in a pooled regression, but not in cross-sectional regressions. Overall, the results provide support for the hypothesis that the corporate tax benefit from debt reduces the equity risk premium associated with leverage. Further, the effect of personal taxes on the leverage related premium appears to be driven by temporal variation in statutory tax rates.

To our knowledge, this is the first paper that directly examines the corporate and investor level tax implications of capital structure on the firm's cost of equity capital. Generally, our findings suggest that the tax implications of capital structure decisions affect investors' expected returns. This triangulates with prior research which shows that capital structure decisions are related to the firm-specific magnitude of the corporate tax benefit of debt and the personal tax penalty associated with debt. Our analyses and results provide an important empirical foundation for understanding the impact of managers' capital structure decisions on firm value.

This paper is organized as follows. Section 2 develops the theory and hypotheses. Section 3 discusses the empirical methodology and variable selection. Section 4 presents the empirical results. Section 5 summarizes and concludes.

2. Theory and hypotheses development

2.1 LEVERAGE, TAXES, AND THE COST OF EQUITY CAPITAL

The results in Modigliani and Miller [1958, 1963] can be expanded to demonstrate how leverage and corporate and investor level taxes affect the firm's cost of equity capital (e.g. Taggart [1991]). Consider two firms with identical productive assets. The expected cash flows generated by these two firms, X , are identical. Firm U is an all equity firm and Firm L has some debt in its capital structure. Assume that the corporate tax rate is τ_c , the personal level tax rate on equity income is τ_{ps} , and the personal level tax rate on debt income is τ_{pb} . The total after-tax cash flow to capital providers of the levered firm, C_L , is

$$C_L = (X - rB_L)(1 - \tau_c)(1 - \tau_{ps}) + rB_L(1 - \tau_{pb}), \quad (1)$$

where B_L is the market value of debt in Firm L 's capital structure and r is the interest rate on the debt. The first term of Equation (1) is the after-personal tax cash flow to equity holders and the second term is the after-personal tax cash flow to debt holders. Equation (1) can be re-written as

$$C_L = X(1 - \tau_c)(1 - \tau_{ps}) + r(1 - \tau_{pb})B_L \left[1 - \frac{(1 - \tau_c)(1 - \tau_{ps})}{1 - \tau_{pb}} \right]. \quad (2)$$

Note that the first term of Equation (2) represents the after-tax cash flow to the all-equity Firm U and the second term of Equation (2) represents the cash flow benefit of debt after considering both corporate and personal level taxes on equity and debt. If we capitalize the above cash flow stream using the appropriate after-personal tax discount rates on

equity and debt income, we obtain the relation between the value of the levered Firm L , V_L , and the value of the unlevered Firm U , V_U ,

$$V_L = V_U + \left[1 - \frac{(1 - \tau_c)(1 - \tau_{ps})}{1 - \tau_{pb}} \right] B_L. \quad (3)$$

Thus, the value of the levered firm is equal to the value of an all-equity firm plus the gain from leverage. The second term in Equation (3) represents the value of the capitalized debt tax shield after considering personal tax rates on equity and debt income. Note that if $\tau_{pb} = \tau_{ps}$, then we obtain $V_L = V_U + \tau_c B_L$, as in Modigliani and Miller [1963]. Miller [1977] argues that if the tax rate on equity income is zero (i.e. $\tau_{ps} = 0$), then $(1 - \tau_{pb}) = (1 - \tau_c)$ in equilibrium and the tax benefit from debt completely disappears. However, DeAngelo and Masulis [1980] argue that $\tau_{pb} < \tau_c + \tau_{ps}(1 - \tau_c)$ in equilibrium. Thus, there is still a net gain from leverage, although less than the amount predicted by Modigliani and Miller [1963].

By definition, $V_L = S_L + B_L$ and $V_U = S_U$, where S_L (S_U) is the market value of equity for the levered (unlevered) firm. Substituting the expressions V_L and V_U into Equation (3), we obtain

$$S_L + B_L = S_U + \left[1 - \frac{(1 - \tau_c)(1 - \tau_{ps})}{1 - \tau_{pb}} \right] B_L, \quad (4)$$

which is equivalent to

$$S_U = S_L + \frac{(1 - \tau_c)(1 - \tau_{ps})}{1 - \tau_{pb}} B_L. \quad (5)$$

We are interested in determining how the relation between the cost of equity and leverage changes with corporate and personal tax rates. The value of levered and unlevered equity

can be expressed as a perpetual stream of after-corporate tax earnings capitalized at the appropriate rate to obtain

$$S_U = \frac{X(1 - \tau_c)}{K_U} \text{ and} \quad (6)$$

$$S_L = \frac{(X - rB_L)(1 - \tau_c)}{K_L}, \quad (6')$$

where K_U is the cost of unlevered equity and K_L is the cost of levered equity. We set Equations (6) and (6') equal to $X(1 - \tau_c)$ and combine to obtain

$$K_L = \frac{S_U}{S_L} K_U - r(1 - \tau_c) \frac{B_L}{S_L}. \quad (7)$$

Substituting Equation (5) into Equation (7), we obtain

$$K_L = K_U + (1 - \tau_c) \left[K_U \frac{1 - \tau_{ps}}{1 - \tau_{pb}} - r \right] \frac{B_L}{S_L}, \quad (8)$$

where B_L/S_L is the debt-to-equity ratio of the firm. Equation (8) indicates that the cost of levered equity is a function of leverage and both corporate and personal level taxes.¹

In the absence of taxes, Equation (8) simplifies to

$$K_L = K_U + (K_U - r) \frac{B_L}{S_L}. \quad (9)$$

Equation (9) is equivalent to the expression derived by Modigliani and Miller [1958, p. 272] for the cost of equity in the absence of taxes. That is, the expected yield of a share of stock is equal to the appropriate capitalization rate K_U for a pure equity stream in the firm's risk class, plus a premium related to financial risk which is equal to the product of the debt-to-equity ratio and the spread between the cost of unlevered equity and the cost of debt.

¹ Taggart (1991) derives a similar expression.

If corporate taxes are introduced, Equation (8) becomes

$$K_L = K_U + (1 - \tau_c)(K_U - r) \frac{B_L}{S_L}. \quad (10)$$

Equation (10) is equivalent to the expression in Modigliani and Miller [1963, p. 439] which incorporates the effect of corporate taxes. Note that due to corporate level taxes the equity risk premium from leverage in Equation (10), $K_U - r$, is smaller by a factor of one minus the corporate tax rate. That is, the tax benefit from debt offsets the leverage related risk premium demanded by equity holders.

When investor level taxes are introduced, the value of the tax benefit from debt depends on the marginal investors' relative tax rates on interest and equity income. If the tax rate on interest income is greater than that on equity income, the value of the tax benefit from debt will be reduced, increasing the equity risk premium associated with leverage. The following discussion utilizes Equation (8) to derive our predictions related to the effect of leverage and corporate and personal taxes on the cost of equity.

We are interested in understanding how taxes affect the leverage related risk premium demanded by equity holders. We first take the derivative of K_L with respect to B_L/S_L in Equation (8) to obtain

$$\frac{\partial K_L}{\partial (B_L/S_L)} = (1 - \tau_c) \left[K_U \frac{1 - \tau_{ps}}{1 - \tau_{pb}} - r \right]. \quad (11)$$

This represents the theoretical equity risk premium from leverage in our model. Equation (11) is positive as long as $K_U(1 - \tau_{ps}) > r(1 - \tau_{pb})$. That is, the effect of leverage on the cost of equity is positive as long as the after-tax return on equity is greater than the after-tax return on debt. This appears reasonable over a relevant range of leverage, as

suggested in Modigliani and Miller [1958]. Consistent with prior literature, the first hypothesis is:

Hypothesis I: *The firm's cost of equity is increasing in leverage.*

To examine the effect of corporate taxes on the equity risk premium from leverage, we take the derivative of K_L with respect to B_L/S_L and τ_c in Equation (8) to obtain

$$\frac{\partial^2 K_L}{\partial(B_L/S_L)\partial\tau_c} = -K_U \frac{1 - \tau_{ps}}{1 - \tau_{pb}} + r. \quad (12)$$

Equation (12) is negative as long as $K_U(1 - \tau_{ps}) > r(1 - \tau_{pb})$. That is, the effect of corporate taxes on the equity risk premium from leverage is negative as long as the after-tax return on equity is greater than the after-tax return on debt. This implies that the effect of leverage on cost of equity is decreasing in the corporate tax benefit provided by the interest expense deduction. Thus, our second hypothesis is:

Hypothesis II: *The effect of leverage on the firm's cost of equity is decreasing in the firm's tax benefit from debt.*

To investigate how personal level taxes affect the equity risk premium from leverage, we use $(1 - \tau_{ps})/(1 - \tau_{pb})$ to proxy for the personal tax disadvantage of debt. Within the DeAngelo and Masulis [1980] framework, this ratio captures the relative pretax rates of return demanded by debt and equity investors. This term is increasing in the personal tax disadvantage of interest income and is multiplied by $(1 - \tau_c)$ in Equation (3) to determine the net gain to leverage. We take the derivative of K_L in Equation (8) with respect to B_L/S_L and $(1 - \tau_{ps})/(1 - \tau_{pb})$ to obtain

$$\frac{\partial^2 K_L}{\partial(B_L/S_L)\partial[(1 - \tau_{ps})/(1 - \tau_{pb})]} = K_U(1 - \tau_c) > 0. \quad (13)$$

Equation (13) implies that the effect of leverage on the cost of levered equity is increasing in the personal tax disadvantage associated with debt. The intuition behind this result can be argued within the theoretical context of Miller [1977] and DeAngelo and Masulis [1980]. In theory, as the tax rate on interest income increases relative to the tax rate on equity income, bondholders demand higher relative pretax returns to leave them equally well off on an after-tax basis. The resulting higher interest cost reduces the tax benefit from debt accruing to equity holders. As a result, the equity risk premium from leverage should be increasing in the personal tax penalty on interest income. Thus, the third hypothesis which we test is:

Hypothesis III: *The effect of leverage on the firm's cost of equity is increasing in the personal tax penalty associated with debt.*

Empirical evidence consistent with these hypotheses would support the view that the tax consequences of capital structure decisions are relevant to equity holders' expected returns.

2.2 THE ROLE OF DIVIDEND POLICY

Miller and Modigliani [1961] demonstrate that in the absence of taxes, dividend policy does not affect firm value. However, they acknowledge that differential taxation of dividends and capital gains can change this conclusion. Brennan (1970) shows that if the tax rate on dividends is higher than that on capital gains, the cost of equity capital should increase in dividend yield.² Recent empirical evidence is consistent with this prediction (e.g. Ayers, Cloyd, and Robinson [2002], Dhaliwal, Li, and Trezevant [2003], Dhaliwal et al. [2005]).

² The presence of dividend tax clienteles can mitigate this dividend tax effect (Litzenberger and Ramaswamy [1979, 1980, 1982]).

Equation (8) does not have an explicit role for dividend policy. However, dividend yield implicitly enters the equation through the cost of capital for the all-equity firm, K_U . If dividend income is tax disadvantaged relative to capital gains, and the marginal investor is a taxable individual, the cost of equity should increase in dividend yield. Therefore, K_U should be a function of dividend yield. We further note that τ_{ps} is a weighted average of tax rates applicable to dividends and capital gains. Thus, $(1 - \tau_{ps})/(1 - \tau_{pb})$ is likely to be correlated with the tax effects of dividend policy. If the dividend tax disadvantage is correlated with our variables of interest, we must control for its effects. As discussed in the next section, we incorporate the effect of dividend taxation into the empirical model.

3. Empirical methodology

In this section, we examine how the corporate and personal taxes affect the association between a firm's capital structure and its cost of equity capital. To operationalize tests of the theoretical predictions derived in Equations (11) to (13), we require estimates of the firm's cost of equity, leverage, corporate tax rate, and the marginal investors' tax rates on equity and debt income. We begin this section with a description of our estimate of the cost of equity, and continue with a discussion of the various corporate and personal level tax rates used in this study.

3.1 IMPLIED COST OF EQUITY CAPITAL

We use the discount rate implied from variations on the residual income valuation model to estimate the firm's cost of equity, K_L . This estimation approach utilizes theoretical relationships between observed market values and forecasted earnings,

dividends, and book values of equity to infer the pretax return required by the price-setting shareholder (e.g. the expected return or cost of equity). At a theoretical level, ex ante estimation is more appropriate for estimating the return demanded by shareholders than methods which rely on ex post realizations.

Several recent studies have used one or more implied cost of equity measures to examine various questions in accounting and finance.³ We estimate the cost of equity for our sample firms using the methodologies described in Gebhardt, Lee, and Swaminathan [2001], Claus and Thomas [2001], Gode and Mohanram [2003], and Easton [2004]. We refer to these estimates as r_{gls} , r_{ct} , r_{ojn} , and r_{mpeg} , respectively. All four of these measures have been used in the literature to estimate the firm's cost of equity, and the association between these estimates and traditional risk proxies such as market beta, firm size, and the book-to-market ratio are usually consistent. However, there does not appear to be a consensus as to the superiority of any particular model in estimating the cost of equity. For example, Botosan and Plumlee [2005] find that r_{gls} is not consistently related to risk proxies, while Guay, Kothari, and Shu [2004] find that r_{gls} is the best predictor of future realized returns. Limiting empirical analysis to just one measure may produce spurious results if particular attributes of the model are correlated with the variable of interest. To mitigate the effect that particular assumptions of each model might have on our results, we follow Hail and Leuz [2004] and use the average of the four implied cost of equity estimates in our empirical tests. We present results for the individual cost of equity estimates to understand how the associations between leverage, taxes, and the cost of equity vary across the models.

³ See, for example, Ashbaugh, Collins, and LaFond [2004], Botosan [1997], Botosan and Plumlee [2002], Hail and Leuz [2004], Francis et al. [2004], Dhaliwal et al. [2005].

The Appendix describes in detail the four models used to estimate the firm's cost of equity, the input variable definitions, and particular definitions or assumptions unique to each model. We follow Gebhardt, Lee, and Swaminathan [2001] and Gode and Mohanram [2003] and calculate the cost of equity at the end of June for each year t . For all measures, we require that the firm have one and two year-ahead earnings-per-share forecasts ($FEPS_{t+1}$ and $FEPS_{t+2}$) and either a three year-ahead earnings forecast ($FEPS_{t+3}$) or long-term growth forecast (LTG). The Gode and Mohanram [2003] application requires that $FEPS_{t+1} \geq 0$ and $FEPS_{t+2} \geq 0$, while Easton [2004] adds the condition that $FEPS_{t+2} \geq FEPS_{t+1} > 0$. We require sample firms to have all four measures in order to calculate the average equity risk premium, r_{avg} . When using r_{gls} , r_{ct} , r_{ojn} , or r_{mpeg} as the dependent variable we utilize all available observations.

Cost of equity estimates are obtained by searching over the range of 0% to 100% for the value that minimizes the difference between the discounted future earnings and the current market price. The exception is r_{ojn} , which can be estimated explicitly. The primary cost of equity proxy used in our empirical tests, r_{avg} , is the average of the four implied cost of equity estimates. To obtain the equity risk premiums used in the empirical tests, we subtract the yield on a 10-year Treasury note. Annual risk premium estimates derived from the four models, and the sample average across the four measures, are reported in panel A of Table 1. The magnitudes of the premiums are generally consistent with those obtained in prior studies. The mean (median) risk premium over the sample period is 4.95% (4.30%). Consistent with prior research, r_{mpeg} and r_{ojn} produce the largest equity risk premium estimates, whereas r_{gls} produces the smallest (e.g. Botosan and Plumlee [2005], Guay, Kothari, and Shu [2004]). Spearman correlation coefficients

between the individual risk premiums and the average measure are shown in panel B and reveal the expected positive correlations between these measures, with the highest correlation between r_{mpep} and r_{ojn} . The correlation coefficients between r_{avg} and the individual measures range from 0.676 to 0.916.

3.2 CORPORATE AND PERSONAL TAX RATES

Equation (11) predicts that the effect of leverage on the cost of equity is a function of the firm's tax rate, τ_c . If the firm expects to have positive taxable income in current and future years, τ_c is generally equal to the top marginal corporate tax rate. If the firm cannot fully utilize its interest deductions in the period paid, τ_c should depend on the tax attributes of the firm, including the effect of net operating loss (*NOL*) carryforwards, investment tax credits (*ITC*), and the alternative minimum tax (*AMT*).

An important issue is how to measure the tax benefit from debt captured by τ_c in Equation (8). In theory, the level of debt should be increasing in the marginal tax rate of the firm. Most proxies for the firm's marginal tax rate are based on earnings after interest costs are deducted.⁴ If firms that borrow more are more likely to exhaust taxable income and reduce their marginal tax rate, the empirical association between leverage and after financing marginal tax rates is likely to be negative. To address this methodological issue, Graham, Lemmon, and Schallheim [1998] develop a simulated marginal tax rate based on taxable income before financing costs are considered. This tax rate approximates the potential tax benefit of debt as if the firm had no debt. Consistent with their prediction, they find that leverage is positively (negatively) related to the simulated marginal tax rate before (after) financing. Because the before financing estimate is more

⁴ See Graham [1996b], Plesko [2003], and Shevlin [1990] for discussions and analyses of various marginal tax rate proxies.

likely to capture the tax benefit from the firm's existing debt, we use simulated marginal tax rates before financing for our empirical tests.⁵ Annual means of the simulated marginal corporate tax rate before financing are presented in Table 2.⁶ For comparative purposes, we also present the annual means for simulated marginal tax rates after financing. Average simulated marginal tax rates are higher in the early period of the sample, consistent with higher statutory corporate tax rates in effect at that time.

τ_{pb} represents the tax rate faced by the marginal investor in the firm's debt securities. Because identification of the marginal investor is generally not possible, the researcher usually assumes the tax status of the marginal investor or infers their marginal tax rate from existing data when available. As an example of the latter, Poterba [1989] estimates the marginal investor's tax rate on interest income as $(R_{taxable} - R_{tax-free})/R_{taxable}$, where $R_{taxable}$ is the yield on one-year Treasury issues which are taxable, and $R_{tax-free}$ is the yield on one-year prime grade tax-exempt municipal bonds. The primary advantage of this measure is that it uses pretax yields on differentially taxed assets of equivalent risk to back out the implicit tax rate on interest income for the marginal investor. The marginal tax rate on interest computed from this measure remains relatively stable from 1982 through 2000. Beginning in 2001, the implicit rate drops significantly and becomes more volatile.⁷ Thus, the implicit tax rate on debt income is likely to be measured with significant error in the recent period of our sample. To mitigate potential problems caused by using the implicit tax rate approach in our sample, we assume that the marginal

⁵ We discuss the results using alternative marginal tax rate proxies in the sensitivity analysis.

⁶ John Graham's simulated tax rates are available at <http://faculty.fuqua.duke.edu/~jgraham/>

⁷ For the years 1996 through 2000, the mean implicit tax rate using monthly yield data is 34.1% with a standard deviation of 2.5%. For the years 2001 through 2004, the mean implicit tax rate is 17.1% with a standard deviation of 9.2%.

investor in corporate debt is a fully taxable individual and set τ_{pb} equal to the top marginal tax rate on ordinary income.⁸ Annual values of τ_{pb} are presented in Table 2.

τ_{ps} represents the tax rate of the marginal investor in the firm's equity. Unlike income derived from debt investments, income derived from equity investments can be taxed at differential rates depending on the character of the income. Prior to 2003, dividend income earned by individuals was generally taxed at ordinary rates, while long-term capital gains income has generally been subject to preferential tax treatment. Therefore, τ_{ps} in Equation (8) represents a weighted-average tax rate on dividend and capital gains income. We assume that the marginal investor is a taxable individual and that the applicable tax rates for this investor are capitalized into equity prices, thus, payout policy becomes an important determinant of τ_{ps} . Gordon and MacKie-Mason [1990] estimate τ_{ps} as $[d + (1 - d) \cdot g \cdot \alpha] \cdot \tau_{pb}$, where d is the amount per after-corporate tax dollar of earnings that is distributed to shareholders in the form of a dividend, τ_{pb} is the personal tax rate on interest income, g represents one minus the exclusion ratio for long-term capital gains income, and α is the benefit from deferring capital gains. Note that d can be defined as either the firm-specific dividend payout ratio, or an economy-wide ratio. Graham [1999] uses the firm-specific estimate of d to calculate τ_{ps} and suggests that this specification is superior to using an economy-wide estimate of payout policy.

We modify the equity tax rate equation from Gordon and MacKie-Mason [1990] to take into account specific tax rates on dividend income created by the Jobs and Growth Tax Relief Reconciliation Act of 2003 (JGTRRA 2003) and the statutory tax rate on long-term capital gains income. In our study, $\tau_{ps} = d \cdot \tau_d + (1 - d) \cdot \alpha \cdot \tau_{cg}$, where τ_d is the

⁸ We investigate the sensitivity of our results to the tax rate implied by the yields on Treasury and municipal securities in a later section.

marginal rate on dividend income, set equal to τ_{pb} for years prior to 2003, and 0.15 thereafter, τ_{cg} is set equal to the top statutory tax rate on long-term capital gains income, and α is the benefit of capital gains deferral. Following Graham [1999], we assume that $\alpha = 0.25$. We define d as the dividends paid for the most recent year divided by the average earnings over the prior three years and winsorize the value at zero and one. Average annual values of τ_d , τ_{cg} , τ_{ps} and d are presented in Table 2. The annual averages of d over time steadily decreases from 0.331 in 1982 to 0.176 in 2004, and likely reflects the overall drop in the number of firms that pay dividends over our sample period (Fama and French [2001]). In 1982, 88% of our sample firms paid dividends compared to only 44.2% in 2004.

The personal tax penalty associated with debt represents the relative tax disadvantage of receiving a dollar of interest income versus a dollar of equity income for individual investors. Larger values of this personal tax penalty imply that equity financing is more attractive, as potential stockholders will have a lower pretax required return relative to potential lenders. In our study, the personal tax penalty associated with debt is equal to $(1 - \tau_{ps})/(1 - \tau_{pb})$, where τ_{pb} is based upon statutory tax rates on ordinary income. To measure $(1 - \tau_{ps})/(1 - \tau_{pb})$, we assume that the marginal investor in debt and equity securities is a taxable individual. To the extent this does not hold, the personal tax penalty of debt income is measured with error, and its effect in the empirical tests will be attenuated.

Annual averages of $(1 - \tau_{ps})/(1 - \tau_{pb})$ are presented in Table 2. The penalty is relatively large in the first five years of the sample, and then drops to its lowest value beginning in 1988, when the top personal statutory tax rate on ordinary and long-term

capital gains income were both equal to 28%. Beginning in 1993, the top personal tax rate on ordinary income increased to 39.6%, and in 1997, the maximum long-term capital gains rate was reduced to 20%. The overall effect was a shock to the personal tax disadvantage of debt in 1993 and again in 1997.

3.3 EMPIRICAL MODEL

Equation (8) predicts that the cost of equity for the levered firm is a function of the cost of capital for an all-equity firm plus an adjustment for the effects of leverage and taxes. Direct empirical estimation of this nonlinear equation is not straightforward, and given the assumptions used to derive the expression, it is not clear whether it is appropriate.⁹ Rather, we use Equation (8) to extract the fundamental relations between the variables of interest which we test using a linear specification.¹⁰ To examine the effect of leverage and taxes on the cost of equity, we estimate the following empirical model using pooled and annual cross-sectional regressions:

$$\begin{aligned}
r_{avg} = & \theta_0 + \theta_1 B/A + \theta_2 \tau_c + \theta_3 (B/A) \cdot \tau_c + \theta_4 (1 - \tau_{ps}) / (1 - \tau_{pb}) \\
& + \theta_5 (B/A) \cdot (1 - \tau_{ps}) / (1 - \tau_{pb}) + \theta_6 Yield + \theta_7 (\tau_d - \tau_{cg}) / (1 - \tau_{cg}) \\
& + \theta_8 Yield \cdot (\tau_d - \tau_{cg}) / (1 - \tau_{cg}) + \theta_8 \beta_{MKT} + \theta_9 \beta_{SMB} + \theta_{10} \beta_{HML} \\
& + \theta_{11} \ln(Dispersion) + \theta_{12} LTG + \theta_{k \in [13,24]} Industry_k + \varepsilon,
\end{aligned} \tag{14}$$

where r_{avg} is equal to the average implied cost of equity premium estimated using the four methods described in the Appendix in June of year t . We calculate r_{avg} only for observations with non-missing values of r_{gls} , r_{ct} , r_{ojn} , and r_{mpeg} . B/A is long-term debt divided by the market value of assets (total assets less book value of stockholders equity

⁹ For example, dropping the assumption about the perpetuity of earnings and zero bankruptcy costs is likely to make the equation significantly more complex, though the essence of its empirical implications should remain unchanged.

¹⁰ See Bowman [1980] and Dhaliwal [1986] for similar methodologies.

plus the market value of equity) at the end of year $t - 1$.¹¹ We predict a positive coefficient on B/A , consistent with empirical findings in Botosan and Plumlee [2005] and the general proposition that leverage increases the financial risk of equity investors (Modigliani and Miller [1958]).

τ_c is defined as the simulated marginal tax rate before financing, and proxies for the estimated value of the tax benefit of debt. The coefficient on $(B/A) \cdot \tau_c$ tests whether the association between leverage and the cost of equity is a function of its corporate tax rate, holding personal taxes constant. Hypothesis II states that the effect of leverage on the cost of equity is decreasing in the corporate tax rate, thus, we predict a negative coefficient on $(B/A) \cdot \tau_c$. $(1 - \tau_{ps}) / (1 - \tau_{pb})$ is the personal tax penalty associated with debt. The coefficient on $(B/A) \cdot (1 - \tau_{ps}) / (1 - \tau_{pb})$ tests whether this penalty affects the association between leverage and the cost of equity. Consistent with Hypothesis III, we predict a positive sign for the coefficient on $(B/A) \cdot (1 - \tau_{ps}) / (1 - \tau_{pb})$.

3.4 CONTROL VARIABLES

Using implied cost of equity estimates similar to this study, Dhaliwal et al. [2005] provide evidence that dividend taxes are capitalized into stock prices. To control for the effect of dividend policy on the firm's cost of equity, we include *Yield*, which is defined as the last annualized quarterly dividend paid in year $t - 1$ divided by the stock price at the beginning of the month. Dhaliwal et al. [2005] predict and find that the effect of *Yield* on the implied cost of equity is increasing in extent to which dividends are tax disadvantaged. Similar to that study, we define the tax disadvantage of dividends as $(\tau_d - \tau_{cg}) / (1 - \tau_{cg})$, and interact it with *Yield* in the empirical model. Consistent with Dhaliwal et

¹¹ In sensitivity tests, we explore alternative measures of leverage.

al. [2005], we predict a positive coefficient on the interaction between *Yield* and $(\tau_d - \tau_{cg})/(1 - \tau_{cg})$.

We control for risk by including the Fama and French [1996] risk factors, β_{MKT} , β_{SMB} , and β_{HML} in the model. We obtain these factors for firms with at least 24 months of stock return data ending in June of year t , and estimate the regression using up to 60 months of returns. These risk factors are used to control for the effects of systematic risk, size, and the book-to-market ratio, which have been shown to be related to expected returns. We also include two controls for properties of analyst forecasts. Gebhardt, Lee, and Swaminathan [2001] and Gode and Mohanram [2003] find that analyst forecast properties explain cross-sectional variation in implied equity risk premiums.

$\ln(Dispersion)$ is the natural logarithm of the coefficient of variation in year t earnings forecasts issued in June of year t . *LTG* is the mean long-term growth estimate reported in June of year t . Because we expect analyst dispersion and expected growth to be positively correlated with risk, we predict a positive coefficient on these variables. Industry controls are based on the 12 industry classifications defined by Fama and French and are included to control for industry risk differences independent of capital structure.¹²

4. Empirical results

4.1 DATA AND SAMPLE

To estimate the implied cost of equity estimates detailed in the Appendix, we use analyst earnings estimates from the I/B/E/S Summary file and book value and dividend data from Compustat. We obtain 29,963 firm-year observations with at least one

¹² These classifications are available at: <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/>.

available cost of equity estimate from the models described in the Appendix and associated financial statement data. We eliminate 2,295 observations with insufficient stock return data in CRSP to calculate risk proxies and an additional 4,794 observations in which simulated tax rates are not available.

Our final sample of 22,874 firm-year observations covers the years 1982 through 2004 and spans five major tax regimes. Table 3 contains descriptive data and correlations for selected variables for the 20,320 observations with a non-missing value of r_{avg} . r_{avg} is measured in June of year t and financial statement information is measured as of the most recent fiscal year ending prior to April of year t . Distributional data are presented in panel A and univariate correlations are presented in panel B.¹³ r_{avg} is significantly correlated with the primary variables in the expected direction. We also note the correlations between the simulated marginal tax rates and leverage. τ_c measured after financing is negatively related to B/A (coeff. = -0.093, p -value < 0.001), while τ_c measured before financing is positive related to B/A (coeff. = 0.046, p -value < 0.001). The signs of these correlations are consistent with the findings in Graham, Lemmon, and Schallheim [1998] and suggest that inferences using marginal tax rate estimates based on earnings after financing may be incorrect.

4.2 RESULTS

Results from estimating pooled regressions of the empirical model are presented in Table 4. In column (1), we report the results for a baseline regression excluding tax variables. As expected, the coefficient on B/A is positive and highly significant,

¹³ Because of our sample selection criteria, we tend to exclude small firms, firms which are not profitable, and firms with little or no analyst coverage. Our sample represents approximately 20% of the firm-year observations in Compustat, but about 60% of the market value. The median market value for Compustat firms is \$68 million, compared to \$469 million for our sample. The median ROA for Compustat firms is 2.69%, compared to 5.14 for our sample.

consistent with Modigliani and Miller's [1958] result. The remaining control variables are generally significant and consistent with the results of prior literature. Column (2) presents the results from interacting τ_c with B/A . Consistent with Hypothesis II, the coefficient on the interaction term is negative and significant (coeff. = -12.98, t -stat = -8.15). This evidence suggests that the tax benefit of corporate debt reduces the equity risk premium associated with leverage. We next investigate whether the personal tax penalty associated with debt increases this leverage related risk premium. In column (3), we add $(1 - \tau_{ps})/(1 - \tau_{pb})$ and the interaction between B/A and $(1 - \tau_{ps})/(1 - \tau_{pb})$ to the model. Consistent with Hypothesis III, the coefficient on the interaction is positive and significant (coeff. = 5.18, t -stat = 8.06). This suggests that higher tax rates on debt income relative to equity income increase the relative cost of financing with debt, with the effect on cash flows priced by the equity holders.

In column (4) we introduce the effect of dividend yield and the dividend tax penalty into the model. Dhaliwal et al. [2005] find that the coefficient on *Yield* depends on the cost of equity estimate used, but that the coefficient on the interaction between *Yield* and $(\tau_d - \tau_{cg})/(1 - \tau_{cg})$ is consistently positive. We find similar evidence of dividend tax capitalization in our sample. Specifically, the coefficient on the interaction between *Yield* and $(\tau_d - \tau_{cg})/(1 - \tau_{cg})$ is positive and significant (coeff. = 88.28, t -stat = 13.37). We also note that the coefficient on the interaction between B/A and $(1 - \tau_{ps})/(1 - \tau_{pb})$ drops to 3.38 (t -stat = 5.10) when we control for dividend yield and the dividend tax penalty. This addresses the concern that the personal tax penalty associated with debt is correlated with dividend tax penalty effects, and supports the need to control for the effects of payout policy in the empirical analysis. In column (5) we include industry effects. The

coefficient on $(B/A) \cdot \tau_c$ falls in magnitude to -8.69 (t -stat = -5.80), which suggests that marginal corporate tax rates may be correlated with some unobserved industry effects related to the association between leverage and the cost of equity.

Recent evidence suggests that the correlations between various risk proxies and the implied cost of equity vary significantly across different models (e.g. Botosan and Plumlee [2005], Guay, Kothari, and Shu [2005], Dhaliwal et al. [2005]). To determine how the effect of leverage and taxes varies across the implied cost of equity estimates, we estimate the full model, including industry effects, separately for r_{gls} , r_{ct} , r_{ojn} , and r_{mpeg} . Results are reported in Table 5. The coefficient on the interaction between B/A and τ_c ranges from -1.06 to -25.68. When r_{gls} and r_{ojn} are the dependent variables, the coefficient on $(B/A) \cdot \tau_c$ is negative and significant, however, when r_{ct} and r_{mpeg} are the dependent variables, the coefficient on $(B/A) \cdot \tau_c$ is negative but insignificant. Part of this inconsistency may be due to the variation in sample compositions. For example, we do not require positive earnings forecasts to estimate r_{gls} and r_{ct} , which is a necessary condition to estimate both r_{ojn} and r_{mpeg} . When the regressions are constrained to the subsample of firms with non-missing values for all cost of equity estimates, the coefficient on $(B/A) \cdot \tau_c$ is insignificant only when r_{mpeg} is the dependent variable. We test for the effect of investor level taxes on the equity risk premium from leverage by interacting B/A with $(1 - \tau_{ps}) / (1 - \tau_{pb})$. We predict the coefficient on this term to be positive. When the cost of equity is specified as r_{ct} , r_{ojn} , or r_{mpeg} , the coefficient is positive and significant and ranges from 4.22 to 5.65. However, when r_{gls} is the dependent variable, the coefficient estimate is insignificant (coeff. = -0.55, t -stat = -0.44).

Overall, the results provide some support for Hypotheses II and III, although our hypotheses are not uniformly supported by the individual models. Notably, we obtain insignificant results for personal tax effects when the dependent variable is r_{gls} , and insignificant results for corporate tax effects when the dependent variable is r_{ct} and r_{mpeg} . Botosan and Plumlee [2005] find that the Gebhardt, Lee, and Swaminathan [2001] specification has unstable associations with risk proxies, which may partly explain this result. At a minimum, the results in our study and in Botosan and Plumlee [2005] and Guay, Kothari, and Shu [2004] illustrate the potential risk of relying on a single implied cost of equity estimate for empirical tests.

A significant concern using a pooled specification is that cross-correlation in the residuals may bias the standard-errors downward. Annual regressions are typically used to address this concern, however, annual regressions do not use variation in statutory tax rates over time to estimate the effect of taxes on the equity risk premium associated with leverage. If cross-sectional variation in the personal tax penalty of debt is not found to affect the pricing of leverage, we are likely to conclude that time series variation in statutory tax rates drives the relation.

We estimate annual cross-sectional regressions of the full model with industry effects and test our hypotheses using the time-series of coefficient estimates. The results are reported in Table 6 for all cost of equity estimates. The coefficient on $(B/A) \cdot \tau_c$ is negative and significant within all cost of equity regressions except when r_{ct} is the dependent variable, and is generally larger than the coefficient obtained using a pooled regression. This suggests that cross-sectional variation in corporate tax rates across firms matters to

investors, and further supports the notion that the cost of equity is decreasing in the corporate tax benefit from debt, reinforcing the results in Tables 4 and 5.

Contrary to the results in Tables 4 and 5, however, the coefficient on $(B/A) \cdot (1 - \tau_{ps}) / (1 - \tau_{pb})$ is insignificantly different from zero in all models. It is important to note that within a particular year, the statutory tax rates used to estimate $(1 - \tau_{ps}) / (1 - \tau_{pb})$ do not vary. As discussed above, only pooled regressions without fixed year effects incorporate variation in statutory tax rates into the personal tax penalty measure. Cross-sectional variation is driven only by dividend policies of the sample firms. The cross-sectional results for the personal tax effect contrast with Graham [1999] who finds that personal taxes affect capital structure decisions. One possible explanation for this difference is that information used for making capital structure decisions and pricing leverage risk is somehow different between managers and equity investors. The lack of findings for the personal tax effect in the cross-section may also be due to measurement error, a lack of sufficient cross-sectional variation in the personal tax penalty in our sample, or the existence of tax clienteles for the firm's equity and debt which mitigate the effect of personal level taxes on the equity risk premium from leverage.

Overall, the results generally suggest that as the firm-level expected tax benefit from debt increases, the premium demanded by investors for a given amount of leverage falls. The personal tax penalty associated with debt also appears to affect the leverage-related equity risk premium. When moving from pooled regressions to annual regressions, the effect of corporate taxes appears to become stronger while the effect of personal taxes becomes insignificant.

4.3 ECONOMIC INTERPRETATION AND SIGNIFICANCE

Equation (12) represents the marginal effect of corporate taxes on the association between leverage and the cost of equity as a function of the cost of capital for the all-equity firm, the personal tax penalty on interest income, and the cost of debt. We use this expression to assess the reasonableness of the coefficient estimates obtained from the regressions by assuming values for the parameters based on our sample and comparing the results to the empirical estimates.

To estimate K_U , the cost of capital for the all-equity firm, we run the following regression based on Equation (8):

$$r_{avg} = \alpha_0 + \alpha_1 B / A + \varepsilon. \quad (15)$$

Following Modigliani and Miller [1958], we interpret the intercept as an estimate of K_U . In our sample, this value is 11.43%. To obtain the value for $(1 - \tau_{ps}) / (1 - \tau_{pb})$ we use the sample mean from Table 2, which is 1.428. For the value of r , which is the yield on corporate debt, we use the time-series average of Aaa rated Moody's seasoned bond yields over the years 1982 through 2004, resulting in a value of 8.56%. Utilizing Equation (12), we obtain a predicted value of -7.76 for the marginal effect of corporate taxes on the association between leverage and the cost of equity. Finally, we adjust for the fact that our measure of financial leverage uses the market value of assets (A) in the denominator rather than the market value of equity (S). Because we add the book value of debt (B) to the denominator, our measure of leverage is smaller than the measure used to derive Equation (12), and the coefficients we estimate will be larger than what is predicted by theory. To adjust for our measure, we multiply -7.76 by the coefficient δ which satisfies the following equation: $(B/S) = \delta(B/A)$. B/A is equivalent to $B/(B + S)$, thus, δ is equal to $(1 - B/S)^{-1}$. δ will vary across firms, but for the average firm with B/S

equal to 0.17, δ is approximately equal to 1.22. The theoretical coefficient on the interaction between the marginal tax rate and the debt-to-value ratio for the average firm is -7.76 multiplied by 1.22, which is equal to -9.47 . Thus, the estimated value of -8.69 in column (2) of Table 4 is plausible given reasonable values for leverage, corporate and personal taxes, and the cost of debt and equity.

We obtain similar evidence on the reasonableness of the personal tax effect. Equation (13) expresses the theoretical coefficient on the interaction between B/S and $(1 - \tau_{ps})/(1 - \tau_{pb})$. Using the estimated value of K_U obtained above and the sample average simulated marginal tax rate before financing of 35.8%, the predicted coefficient on the interaction is 7.34. Thus, the coefficient estimate of 3.07 obtained in column (5) of Table 4 appears to be reasonable, although less than that predicted by theory.

To gauge the economic significance of the tax effect, we consider the coefficients reported in column (5) of Table (4) and assume a one standard deviation change in the debt-to-value ratio equal to 15%. Let $\tau_{ps} = \tau_{pb}$, thus, $[(1 - \tau_{ps})/(1 - \tau_{pb})] = 1$. If $\tau_c = 0$, the change in leverage increases the cost of equity by 125 basis points $[(5.31+3.07) \cdot 0.15]$.¹⁴ If τ_c is equal to the present top marginal corporate tax rate of 35% and personal taxes do not change, the interest deduction benefit obtained from the additional debt reduces the cost of equity by 46 basis points $(-8.69 \cdot 0.35 \cdot 0.15)$. On the other hand, if corporate taxes are held static, and the personal tax penalty is increased to the recent level of 1.45 within our sample, the change in leverage will increase the cost of equity by an additional 21 basis points $(3.07 \cdot 0.45 \cdot 0.15)$.

4.4 SENSITIVITY ANALYSES

¹⁴ The total coefficient estimate on B/A is equal to the sum of coefficient estimates on B/A , $B/A \cdot \tau_c$, and $B/A \cdot (1 - \tau_{ps})/(1 - \tau_{pb})$

4.4.1. Bankruptcy costs and earnings variability

It is likely that the simulated corporate tax rates we use to define τ_c are correlated with the financial health of the firm. For example, if a firm expects to incur losses over the next several periods, this both reduces its marginal tax rate estimate and increases the likelihood of bankruptcy. Thus, we examine the sensitivity of the results controlling for potential distress costs. We proxy for the cost of financial distress using *Z-Score*, which is based on an alternative specification of the original Altman [1968] *Z-score* as described in Altman [2000]. We define *Z-Score* as $[6.56 \cdot (\text{working capital}/\text{total assets}) + 3.26 \cdot (\text{retained earnings}/\text{total assets}) + 6.72 \cdot (\text{EBIT}/\text{total assets}) + 1.05 \cdot (\text{book value of equity}/\text{book value of liabilities})]$.¹⁵ Note that *Z-Score* is constructed such that it is decreasing in financial distress. We interact *Z-Score* with *B/A* to control for the effects of financial distress on the association between leverage and the cost of equity. If the effect of leverage on the firm's cost of equity is increasing in financial distress, we expect the coefficient on the interaction term to be negative.

Simulated marginal corporate tax rates incorporate information on historical earnings variability. Thus, there is also a potential that the simulated tax rates used in this study capture some aspect of operating risk not captured by our risk proxies. For the subsample of firm-year observations with sufficient data (18,527 observations), Panel B of Table 3 shows that the correlation coefficient between the standard deviation of earnings before interest and taxes over the last five years, denoted as $\sigma(EBIT)$, and the simulated tax rate before (after) financing is -0.309 (-0.289). To control for the effect of operating

¹⁵ We exclude the specification of *Z-score* which includes a term for asset turnover ($\text{sales}/\text{total assets}$) because strong positive correlations between *Z-score* and cost of capital result. Altman (2000) explains that the *Z-score* is highly sensitive to industry membership when asset turnover is included, and that this revised model performs substantially similar to the original *Z-score* model.

risk on the pricing of leverage, we include $\sigma(EBIT)$ and the interaction between B/A and $\sigma(EBIT)$ in the model.

Table 7 presents results from annual regressions which include $Z\text{-Score}$, $\sigma(EBIT)$, and their interactions with B/A in the model for the sub-sample of firms with sufficient historical data to calculate $\sigma(EBIT)$. The reduced sample contains 18,527 observations where r_{avg} is the dependent variable, with similar reductions for r_{gls} , r_{ct} , r_{ojn} , and r_{mpeg} . We present results for all five cost of equity estimates, however, we only discuss the results when r_{avg} is the dependent variable. $Z\text{-Score}$ is negatively related to the cost of equity (coeff. -0.04, $t\text{-stat} = -3.76$), consistent with the cost of equity being lower for firms in better financial health. The effect of bankruptcy costs on the pricing of leverage is insignificantly different from zero (coeff. -0.17, $t\text{-stat} = -1.34$). The association between $\sigma(EBIT)$ and the r_{avg} is positive and significant, as expected (coeff. = 6.76, $t\text{-stat} = 9.59$). The interaction between B/A and $\sigma(EBIT)$ is also positive and significant (coeff. = 18.46, $t\text{-stat} = 3.16$), which suggests that the equity risk premium associated with leverage is increasing in the operating risk of the firm. Most importantly, we note that including the effects of bankruptcy costs and operating risk in the model do not qualitatively change the results concerning the effect of corporate taxes. Specifically, the coefficient on the interaction between B/A and τ_c remains negative and significant in this sub-sample (coeff. = -13.79, $t\text{-stat} = -3.70$). This evidence suggests that the effect of τ_c on the association between leverage and the cost of equity does not arise from its correlation with financial distress or operating risk.

4.4.2. *Alternative proxies for leverage and tax rates*

We next examine the sensitivity of our results to alternative measures of leverage and corporate tax rates. The theoretical measure of leverage used by Modigliani and Miller [1958] is the market value of debt divided by the market value of equity. The primary measure of financial leverage used in our study, B/A , is long-term debt divided by the market value of assets. We adopt this specification because it is frequently used in the empirical literature to proxy for the capital structure of the firm. Leverage ratios using book value of equity or assets in the denominator are also used. Our primary measure of τ_c is the simulated marginal tax rate before financing as described in Graham [1996a]. We utilize this measure because it is more likely to capture the tax benefit of a firm's existing capital structure. Marginal tax rate proxies based on taxable income after financing are more frequently used, but are most appropriate for examining incremental financing decisions.

To provide comprehensive evidence on the relation between taxes, leverage, and the cost of equity capital, we compare results obtained using four estimates of leverage and three estimates of the marginal corporate tax rate. The numerator in all measures of leverage is the book value of long-term debt, which is used to approximate its market value consistent with prior research. B/A_M (B/A_B) is equal to long-term debt divided by market (book) value of assets. B/S_M (B/S_B) is equal to long-term debt divided by market (book) value of stockholders' equity.¹⁶ Our three proxies for τ_c include the simulated marginal tax rates before and after financing and the trichotomous marginal tax rate described in Shevlin [1990]. The trichotomous marginal tax rate is equal to the top marginal corporate tax rate when pretax income is positive and *NOLs* are zero, one-half the top marginal corporate tax rate if the firm has either negative pretax income or *NOLs*,

¹⁶ Note that B/A_M is the leverage measure used throughout this study

but not both, and zero if the firm has both negative pretax income and *NOLs*. We test the sensitivity of our results across these alternative measures using both pooled and annual regressions.

When τ_c is defined as the simulated marginal tax rate before financing, the interaction between leverage and τ_c is negative and significant for all measures of leverage except B/S_B , which is negative and only marginally significant. When τ_c is defined as the simulated marginal tax rate after financing, the interaction between leverage and τ_c is significant and in the predicted direction only when leverage is defined as B/A_B . A similar pattern emerges when τ_c is defined as the trichotomous marginal tax rate. We obtain a qualitatively similar set of results for the marginal tax rate proxies using annual regressions. The conflicting evidence obtained using alternative marginal tax rate proxies is related to Graham, Lemmon, and Schallheim [1998], who find that marginal tax rates before (after) financing are positively (negatively) related to the firms existing capital structure. If the marginal tax rate proxy based on earnings after financing explains incremental financing decisions but does not explain the firm's existing capital structure consistent with theory, then it may also not explain how the tax benefits of debt are priced by equity investors.

The interaction between $(1 - \tau_{ps})/(1 - \tau_{pb})$ and leverage is positive and significant for all specifications of leverage in pooled regressions. When we run annual regressions, the interaction between leverage and $(1 - \tau_{ps})/(1 - \tau_{pb})$ is positive and significant when B/E_B or B/E_M are used as the measure of leverage, and weakly significant when B/A_B is used as the measure of leverage.¹⁷ This contrasts with our earlier results which found that the personal tax penalty had no effect on the association between leverage and the cost of

¹⁷ The results are not tabulated in the paper but are available on request.

equity in cross-sectional tests. While we do not have an explanation for these results, it does suggest the importance of considering the effect of leverage and taxes across a multitude of measures.

4.4.3. Addressing the marginal investor

In constructing $(1 - \tau_{ps})/(1 - \tau_{pb})$, we assume that the marginal investor in the firm's equity is a fully taxable individual. To the extent that the marginal investor is not subject to individual tax rates, our proxy for the personal tax penalty associated with debt, $(1 - \tau_{ps})/(1 - \tau_{pb})$, is measured with error. Prior research has used the percentage of institutional ownership to proxy for the likelihood that the marginal investor in the firm's equity is not an individual (e.g. Ayers, Lefanowicz, and Robinson [2003, 2004]). In our study, τ_{ps} is a weighted-average of tax rates on dividend and capital gains income.

Although there is wide variation in the tax-status of institutional investors, we expect that on average, institutions will face a lower τ_{ps} than individuals.¹⁸ Thus, $(1 - \tau_{ps})/(1 - \tau_{pb})$ understates the personal tax penalty associated with debt when institutions are the marginal investor in equity. To test whether institutional ownership improves the ability of $(1 - \tau_{ps})/(1 - \tau_{pb})$ to capture the personal tax penalty of the marginal investors, we interact $(B/A) \cdot (1 - \tau_{ps})/(1 - \tau_{pb})$ with institutional ownership for the sub-sample of firms with available data.¹⁹ If $(1 - \tau_{ps})/(1 - \tau_{pb})$ is understated when the marginal equity investor is not an individual, the coefficient on the interaction between B/A , $(1 - \tau_{ps})/(1 - \tau_{pb})$, and institutional ownership should be positive. The estimated coefficient on this interaction using pooled regressions is 1.63 (t -stat = 2.77), which suggests that the personal tax penalty associated with debt is increasing in institutional ownership. However, the

¹⁸ For example, tax-exempt institutions generally pay no tax and corporate institutions can deduct 70% of dividends received from income.

¹⁹ Due to data availability, this sample covers 10,019 firm-years from 1989 through 2001.

coefficient on this interaction estimated using cross-sectional regressions is only 0.58 (t -stat = 0.85).

We also examine the sensitivity of our results to the assumption that the marginal investor in the firm's debt faces the top marginal tax rate for individuals. Poterba [1989] and Graham [1999] utilize the relation between taxable and nontaxable issues to estimate the marginal tax rate implied by the relative yields. Following this research, we redefine t_{pb} as $(R_{taxable} - R_{tax-free})/R_{taxable}$, where $R_{taxable}$ is the yield on one-year Treasury issues, and $R_{tax-free}$ is the yield on one-year prime grade tax-exempt municipal bonds.²⁰ The results (not tabulated) are qualitatively similar using this alternative specification and our inferences on the effect of personal taxes on the equity risk premium associated with leverage are unchanged.

4.4.4. *The effect of entity level risk*

Scholes et al. [2005] show that the marginal effect of taxes on the expected return of an asset is a function of the asset's underlying risk. This is captured in Equations (12) and (13), which show that the marginal effect of corporate or personal taxes on the equity risk premium associated with leverage is a function of the operating risk of the firm, as measured by K_U . This suggests that the marginal effect of taxes on the equity risk premium associated with leverage is an increasing function of the underlying risk of the firm. To examine whether the effect of corporate and personal taxes on the equity risk premium from leverage are a function of firm risk, we sort firms into three equal groups

²⁰ We use the implicit rates reported in Graham [1999, p. 158] through 1996. These are: 40.7% from 1982 through 1986, 33.1% in 1987, 28.7% from 1988 through 1992, and 29.6% from 1993 through 1996. For 1997 through 2004, we calculate the implicit tax rate as in Poterba [1989] using monthly observations on one-year Treasury and municipal bond yields. Following Graham [1999], we average the monthly implicit tax rates within tax regime and estimate the implicit tax rate as 28.55% for 1997 through 2002, and 16.0% for 2003 and 2004.

each year based on their value of $\sigma(EBIT)$. We choose to sort firms by $\sigma(EBIT)$ as that is a reasonable approximation of the operating risk of the firm before capital structure decisions are made. We then estimate Equation (14) using both pooled and annual regressions.

The results for the partitioned sample are presented in Table 8. We predict that the coefficient on the interaction between B/A and τ_c (B/A and $(1 - \tau_{ps})/(1 - \tau_{pb})$) will be decreasing (increasing) as the operating risk increases. The evidence generally supports these predictions. For the pooled regression, the coefficient on $(B/A) \cdot \tau_c$ is 6.42 (t -stat = 2.51) for the low $\sigma(EBIT)$ group. It decreases to -6.44 (t -stat = -2.16) for the medium $\sigma(EBIT)$ group and further to -15.05 (t -stat = -5.63) for the high $\sigma(EBIT)$ group. The coefficient $(B/A) \cdot (1 - \tau_{ps})/(1 - \tau_{pb})$ is insignificant for both the low and medium $\sigma(EBIT)$ groups, but increases to 5.30 (t -stat = 3.92) for the high $\sigma(EBIT)$ group. We find a similar pattern in annual regressions. Thus, the evidence in Table 8 is generally consistent with the proposition that the effect of taxes on the equity risk premium from leverage is increasing in firm risk.

4.4.5. Fiscal year-ends

Finally, we examine whether our results are robust to the sub-sample of firms with December fiscal year-ends. This is potentially important as we calculate the implied cost of capital at a fixed date and variation in firm-specific information since the last financial statement release may bias our estimates of the cost of equity for some firms. The results for both corporate and personal taxes are qualitatively similar to those presented earlier using both pooled and annual cross-sectional regressions.

5. Conclusions

Expanding Modigliani and Miller [1958, 1963], we show that the theoretical association between leverage and the cost of equity capital is decreasing in the corporate tax benefit from debt and increasing in the personal tax disadvantage of debt. Using various estimates for the implied cost of equity, we investigate the effects of corporate and personal taxes on the association between financial leverage and the cost of equity. We find that simulated corporate marginal tax rates before financing consistently explain the association between leverage and the cost of equity. Although the results are sensitive to the cost of equity and leverage estimates used, we interpret the overall evidence to be consistent with the prediction that the corporate tax benefit reduces the leverage related risk premium demanded by equity holders.

We find that when the marginal tax rate is based on earnings after financing, corporate taxes do not appear to affect the association between leverage and the cost of equity. These tax rates best capture the tax benefit from incremental financing choices. Thus, our results are not surprising if proxies for the marginal tax rate after financing do not capture the tax benefit of the firm's existing capital structure.

We find some results for the effect of personal taxes on the equity risk premium from leverage. In cross-sectional tests, the effect of the personal tax penalty on the association between leverage and the cost of equity is generally small or nonexistent. However, if we allow the personal tax penalty proxy to take into account temporal variation in statutory tax rates using pooled regressions, the effect of the personal tax penalty on the association between leverage and the cost of equity is generally positive and significant.

This suggests that time-series variation in statutory tax rates, and not cross-sectional variation due to dividend policy, explains the relation.

The cross-sectional results for the personal tax effect provide contrast with Graham [1999] who finds that personal taxes impact capital structure decisions. One explanation is that information used for making capital structure decisions and pricing leverage risk is somehow different between managers and equity investors. The lack of findings for the personal tax effect in cross-sectional tests may also be due to measurement error, a lack of cross-sectional variation in the personal tax penalty for our sample, or the existence of tax clienteles for the firm's equity and debt which mitigate the personal tax penalty.

Overall, the results provide initial evidence that the linkage between capital structure and the cost of equity is affected by taxes. The findings provide empirical support for several important papers such as Modigliani and Miller [1963] and DeAngelo and Masulis [1980]. To our knowledge, this is the first paper that directly examines the corporate and investor level tax implications of capital structure on the cost of equity capital. This paper triangulates with prior research which shows that capital structure decisions are related to the firm-specific magnitude of the corporate tax benefit of debt and the personal tax penalty associated with debt, and provides an important empirical foundation for understanding the impact of managers' capital structure decisions on firm value.

APPENDIX

Models used to estimate the cost of equity capital

The following definitions are common to the four models. Specific assumptions and modifications to these variables are described with the model.

- P_t = Price per share of common stock in June of year t as reported by I/B/E/S
 B_t = Book value at the beginning of the year divided by the number of common shares outstanding in June of year t
 DPS_0 = Dividends per share paid during year $t - 1$
 EPS_0 = Actual earnings per share reported by I/B/E/S for year $t - 1$
 LTG = Consensus long-term growth forecast reported in June of year t
 $FEPS_{t+i}$ = Forecasted earnings per share for year $t + 1$. $FEPS_1$ and $FEPS_2$ are equal to the one and two year-ahead consensus EPS forecasts reported in I/B/E/S in June of year t . $FEPS_3$ is equal to the three year-ahead consensus EPS forecast when available, and $FEPS_2 \cdot (1 + LTG)$ when not available.
 k = Expected dividend payout ratio, calculated as DPS_0/EP_0 . If $EPS_0 \leq 0$, then k is equal to six percent of total assets at the beginning of year t
 r_j = Implied cost of equity estimate for each of the four models.
 r_{rf} = Risk-free rate equal to the yield on a 10-year Treasury note in June of year t .

Gebhardt, Lee, and Swaminathan [2001]

$$P_t = B_t + \frac{FROE_{t+1} - r_{gls}}{(1 + r_{gls})} B_t + \frac{FROE_{t+2} - r_{gls}}{(1 + r_{gls})^2} B_{t+1} + TV$$

$$TV = \sum_{i=3}^{T-1} \frac{FROE_{t+i} - r_{gls}}{(1 + r_{gls})^i} B_{t+i-1} + \frac{FROE_{t+T} - r_{gls}}{r_{gls} (1 + r_{gls})^{T-1}} B_{t+T-1}$$

where:

- $FROE_{t+i}$ = Forecasted ROE for period $t + i$. For years one through three, this variable is equal to $FEPS_{t+i}/B_{t+i-1}$. Beyond year three, $FROE_{t+i}$ is a linear interpolation to the industry median ROE. Industry median ROE is defined as the moving median ROE for the prior 5 to 10 years for the firms industry (excluding loss firm-years). Industries are defined using the 48 classifications in Fama and French (1997)
 B_{t+i} = $B_{t+i-1} + FEPS_{t+i} \cdot (1 - k)$
 T = Forecast horizon. $T = 12$

Claus and Thomas [2001]

$$P_t = B_t + \frac{ae_1}{(1+r_{ct})} + \frac{ae_2}{(1+r_{ct})^2} + \frac{ae_3}{(1+r_{ct})^3} + \frac{ae_4}{(1+r_{ct})^4} + \frac{ae_5}{(1+r_{ct})^5} + \frac{ae_5(1+g_{ae})}{(r_{ct}-g_{ae})(1+r_{ct})^5}$$

where:

- ae_{t+i} = Abnormal earnings calculated as $FEPS_{t+i} - r_{ct} \cdot B_t$. For year +3, +4, and +5, $FEPS_{t+i}$ is equal to the consensus forecast for that year, if available, otherwise $FEPS_{t+i} = FEPS_{t+i-1} \cdot (1 + LTG)$
- B_{t+i} = $B_{t+i-1} + k \cdot FEPS_{t+i}$. k is assumed to be 0.5 in Claus and Thomas (2001)
- g_{ae} = Growth in abnormal earnings, calculated as $r_{rf} - 0.03$.

Gode and Mohanram [2003]

$$r_{ojn} = A + \sqrt{A^2 + \left(\frac{FEPS_{t+1}}{P_t} \right) (g_2 - (r_{rf} - 0.03))}$$

where

$$A = 0.5 \left((r_f - 0.03) + \frac{DPS_{t+1}}{P_t} \right)$$

and

$$g_2 = \frac{(FEPS_{t+2} - FEPS_{t+1})}{FEPS_{t+1}}$$

g_2 = Short term growth rate defined as $(STG + LTG)/2$. STG is equal to $(FEPS_{t+2}/FEPS_{t+1} - 1)$

DPS_{t+1} = DPS_0

Note: This model requires $FEPS_{t+1} > 0$ and $FEPS_{t+2} > 0$

Easton [2004]

$$P_t = \left(\frac{FEPS_{t+2} + r_{mpeg} DPS_{t+1} - FEPS_{t+1}}{r_{mpeg}^2} \right)$$

DPS_{t+1} = DPS_0

Note: This model requires $FEPS_{t+2} \geq FEPS_{t+1} > 0$.

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TABLE 1

Descriptive data and correlation coefficients for implied equity premiums

This table presents annual sample means of annual equity risk premium estimates. r_{gls} , r_{ct} , r_{ojn} , and r_{mpeg} are the implied cost of equity estimates derived from the models described in the Appendix less the rate on a 10-year Treasury note. r_{avg} is the average of r_{gls} , r_{ct} , r_{ojn} , and r_{mpeg} for firms with cost of capital estimates available from all four models. Correlation coefficients are average annual Spearman correlations.

Panel A: Annual average of cost of equity premiums

| <i>Year</i> | <i>N</i> (r_{avg}) | r_{avg} | r_{gls} | r_{ct} | r_{ojn} | r_{mpeg} |
|-------------|------------------------|-----------|-----------|----------|-----------|------------|
| 1982 | 719 | 5.09 | 1.97 | 5.53 | 6.81 | 6.37 |
| 1983 | 820 | 4.22 | 1.82 | 3.59 | 6.60 | 5.89 |
| 1984 | 913 | 3.85 | 0.95 | 4.69 | 5.67 | 4.65 |
| 1985 | 883 | 4.43 | 2.33 | 4.56 | 5.97 | 5.30 |
| 1986 | 865 | 4.59 | 3.09 | 5.11 | 6.03 | 5.88 |
| 1987 | 866 | 4.13 | 2.24 | 4.28 | 5.66 | 5.56 |
| 1988 | 807 | 4.08 | 2.89 | 4.74 | 5.20 | 6.76 |
| 1989 | 803 | 4.19 | 3.21 | 5.04 | 5.19 | 4.63 |
| 1990 | 829 | 4.48 | 2.62 | 4.66 | 5.66 | 5.52 |
| 1991 | 848 | 4.58 | 2.95 | 4.71 | 6.03 | 6.11 |
| 1992 | 885 | 5.40 | 3.51 | 4.94 | 6.80 | 7.22 |
| 1993 | 907 | 5.67 | 4.37 | 5.38 | 6.83 | 7.26 |
| 1994 | 973 | 4.80 | 3.60 | 5.05 | 5.96 | 5.90 |
| 1995 | 1,030 | 5.47 | 4.13 | 5.61 | 6.51 | 6.60 |
| 1996 | 997 | 4.38 | 3.12 | 4.57 | 5.51 | 5.41 |
| 1997 | 1,187 | 4.80 | 3.88 | 5.38 | 5.77 | 5.77 |
| 1998 | 1,273 | 5.62 | 5.27 | 6.64 | 6.65 | 6.79 |
| 1999 | 1,135 | 5.50 | 5.21 | 6.69 | 6.37 | 6.56 |
| 2000 | 994 | 5.99 | 5.60 | 7.45 | 6.71 | 6.89 |
| 2001 | 753 | 5.46 | 6.12 | 7.06 | 6.23 | 6.69 |
| 2002 | 731 | 5.63 | 6.32 | 6.74 | 6.60 | 7.39 |
| 2003 | 514 | 5.68 | 7.52 | 6.35 | 7.08 | 8.05 |
| 2004 | 588 | 5.02 | 6.10 | 4.73 | 5.66 | 6.04 |
| | <i>N</i> | 20,320 | 22,873 | 22,769 | 20,537 | 20,377 |
| | Mean | 4.95 | 3.87 | 5.43 | 6.14 | 6.11 |
| | Median | 4.30 | 2.71 | 3.69 | 5.49 | 4.98 |

Panel B: Spearman correlation coefficients between cost of equity estimates

| | r_{gls} | r_{ct} | r_{ojn} | r_{mpeg} | r_{avg} |
|------------|-----------|----------|-----------|------------|-----------|
| r_{gls} | 1.000 | 0.464 | 0.451 | 0.470 | 0.689 |
| r_{ct} | | 1.000 | 0.493 | 0.415 | 0.676 |
| r_{ojn} | | | 1.000 | 0.942 | 0.916 |
| r_{mpeg} | | | | 1.000 | 0.899 |
| r_{avg} | | | | | 1.000 |

All correlation coefficients significant at the 0.001 level

TABLE 2

Summary statistics for personal and corporate tax rate variables

This table presents the annual values of economy wide and firm-specific tax rate variables and dividend payout ratios used in this study for firms with non-missing values of r_{avg} . There are 20,320 firm-year observations over the period 1982 through 2004. *Year* references the calendar year in which the implied cost of equity estimate is made. d is equal to the dividends paid in the most recent fiscal year divided by average earnings before extraordinary items over the prior three years. τ_{pb} is the highest statutory tax rate on interest income. τ_d is the highest statutory tax rate on dividend income, which equal to τ_{pb} for years 1982 through 2002, and 0.15 thereafter. τ_{cg} is the highest statutory tax rate on capital gains income. τ_{ps} is the average tax rate on equity income, and is equal to $d \cdot \tau_d + [1 - d] \cdot \alpha \cdot \tau_{cg}$, where $\alpha = .25$. τ_c is equal to the simulated marginal corporate tax rate.

| <i>Year</i> | d | τ_{pb} | τ_d | τ_{cg} | τ_{ps} | $(1 - \tau_{ps}) / (1 - \tau_{pb})$ | τ_c | |
|-------------|-------|-------------|----------|-------------|-------------|-------------------------------------|------------------|-----------------|
| | | | | | | | before financing | after financing |
| 1982 | 0.331 | 0.500 | 0.500 | 0.200 | 0.198 | 1.602 | 0.455 | 0.402 |
| 1983 | 0.331 | 0.500 | 0.500 | 0.200 | 0.199 | 1.602 | 0.448 | 0.376 |
| 1984 | 0.322 | 0.500 | 0.500 | 0.200 | 0.195 | 1.610 | 0.447 | 0.365 |
| 1985 | 0.326 | 0.500 | 0.500 | 0.200 | 0.197 | 1.606 | 0.447 | 0.377 |
| 1986 | 0.312 | 0.500 | 0.500 | 0.200 | 0.190 | 1.619 | 0.444 | 0.361 |
| 1987 | 0.295 | 0.390 | 0.390 | 0.280 | 0.165 | 1.369 | 0.444 | 0.351 |
| 1988 | 0.288 | 0.280 | 0.280 | 0.280 | 0.131 | 1.208 | 0.383 | 0.301 |
| 1989 | 0.278 | 0.280 | 0.280 | 0.280 | 0.128 | 1.211 | 0.334 | 0.278 |
| 1990 | 0.284 | 0.280 | 0.280 | 0.280 | 0.130 | 1.209 | 0.331 | 0.274 |
| 1991 | 0.281 | 0.310 | 0.310 | 0.280 | 0.137 | 1.250 | 0.332 | 0.271 |
| 1992 | 0.295 | 0.310 | 0.310 | 0.280 | 0.141 | 1.245 | 0.333 | 0.267 |
| 1993 | 0.289 | 0.396 | 0.396 | 0.280 | 0.164 | 1.383 | 0.327 | 0.252 |
| 1994 | 0.275 | 0.396 | 0.396 | 0.280 | 0.160 | 1.391 | 0.325 | 0.259 |
| 1995 | 0.242 | 0.396 | 0.396 | 0.280 | 0.149 | 1.409 | 0.331 | 0.266 |
| 1996 | 0.234 | 0.396 | 0.396 | 0.280 | 0.146 | 1.413 | 0.335 | 0.265 |
| 1997 | 0.183 | 0.396 | 0.396 | 0.200 | 0.113 | 1.468 | 0.325 | 0.261 |
| 1998 | 0.175 | 0.396 | 0.396 | 0.200 | 0.110 | 1.473 | 0.316 | 0.261 |
| 1999 | 0.186 | 0.396 | 0.396 | 0.200 | 0.115 | 1.466 | 0.325 | 0.247 |
| 2000 | 0.180 | 0.396 | 0.396 | 0.200 | 0.112 | 1.469 | 0.321 | 0.253 |
| 2001 | 0.185 | 0.386 | 0.386 | 0.200 | 0.112 | 1.446 | 0.333 | 0.244 |
| 2002 | 0.173 | 0.386 | 0.386 | 0.200 | 0.108 | 1.452 | 0.321 | 0.227 |
| 2003 | 0.179 | 0.350 | 0.150 | 0.150 | 0.058 | 1.450 | 0.314 | 0.251 |
| 2004 | 0.176 | 0.350 | 0.150 | 0.150 | 0.057 | 1.450 | 0.305 | 0.237 |
| 1982-2004 | 0.252 | 0.392 | 0.373 | 0.232 | 0.141 | 1.428 | 0.358 | 0.288 |

TABLE 3*Descriptive statistics and correlations*

Panel A presents summary statistics and panel B presents Pearson and Spearman correlations for 20,320 firm-year observations over the period 1982 through 2004 (18,527 observations for $\sigma(EBIT)$). r_{avg} equals the average of r_{gls} , r_{cts} , r_{ojms} , and r_{mpeg} for observations with all four estimates available. Except where noted otherwise, τ_c equals the simulated marginal tax rate before financing for year $t - 1$. $(1 - \tau_{ps})/(1 - \tau_{pb})$ is the personal tax penalty associated with debt. B/A equals long-term debt divided by market value of assets at the end of year $t - 1$. *Yield* is equal to the last annualized quarterly dividend paid in year $t - 1$ divided by the stock price at the beginning of the month. *MVE* equals the market value of common equity at the end of year $t - 1$. *BTM* equals the book value of equity divided by market value of equity at the end of year $t - 1$. *Dispersion* equals the standard deviation of analyst estimates for year t earnings divided by the consensus forecast for year t earnings. *LTG* equals the mean long-term growth forecast available in June of year t . *Z-Score* equals the modified Altman (1968) Z-score. $\sigma(EBIT)$ equals the standard deviation of earnings before interest and taxes divided by total assets over the five years ending in year $t - 1$.

Panel A: Summary statistics

| | Mean | Std. dev. | Q1 | Median | Q3 |
|-----------------------------------|-------|-----------|-------|--------|-------|
| r_{avg} | 4.950 | 3.110 | 2.870 | 4.298 | 6.268 |
| τ_c (before financing) | 0.358 | 0.081 | 0.340 | 0.350 | 0.390 |
| τ_c (after financing) | 0.288 | 0.156 | 0.253 | 0.343 | 0.353 |
| $(1 - \tau_{ps})/(1 - \tau_{pb})$ | 1.428 | 0.206 | 1.292 | 1.465 | 1.568 |
| <i>B/A</i> | 0.170 | 0.149 | 0.042 | 0.140 | 0.261 |
| <i>Yield</i> | 0.017 | 0.021 | 0.000 | 0.009 | 0.027 |
| <i>BTM</i> | 0.561 | 0.364 | 0.310 | 0.493 | 0.728 |
| <i>MVE</i> | 3.413 | 15.764 | 0.150 | 0.469 | 1.690 |
| <i>Dispersion</i> | 0.112 | 0.216 | 0.021 | 0.045 | 0.103 |
| <i>LTG</i> | 0.162 | 0.076 | 0.112 | 0.148 | 0.200 |
| $\sigma(EBIT)$ | 0.054 | 0.059 | 0.021 | 0.037 | 0.066 |
| <i>Z-Score</i> | 4.843 | 3.297 | 2.408 | 4.293 | 6.470 |

Panel B: Pearson (Spearman) correlations above (below) the diagonal^a

| | r_{avg} | τ_c (before financing) | τ_c (after financing) | <i>B/A</i> | $\ln(BTM)$ | $\ln(MVE)$ | <i>Z-Score</i> | $\sigma(EBIT)$ |
|-----------------------------|-----------|-----------------------------------|----------------------------------|------------|---------------|--------------|----------------|----------------|
| r_{avg} | 1.000 | -0.211 | -0.251 | 0.255 | 0.289 | -0.282 | -0.181 | 0.221 |
| τ_c (before financing) | -0.185 | 1.000 | 0.461 | 0.041 | 0.143 | <i>0.002</i> | 0.262 | -0.309 |
| τ_c (after financing) | -0.267 | 0.621 | 1.000 | -0.117 | <i>-0.012</i> | 0.052 | 0.289 | -0.289 |
| <i>B/A</i> | 0.215 | 0.046 | -0.093 | 1.000 | 0.484 | -0.094 | -0.518 | -0.158 |
| $\ln(BTM)$ | 0.317 | 0.091 | -0.031 | 0.521 | 1.000 | -0.378 | -0.164 | -0.159 |
| $\ln(MVE)$ | -0.303 | 0.033 | 0.079 | -0.029 | -0.347 | 1.000 | -0.089 | -0.206 |
| <i>Z-Score</i> | -0.137 | 0.169 | 0.273 | -0.603 | -0.219 | -0.136 | 1.000 | -0.113 |
| $\sigma(EBIT)$ | 0.284 | -0.180 | -0.278 | -0.204 | -0.083 | -0.253 | 0.079 | 1.000 |

^aAll correlations (except those in italics) are significant at the 0.05 level.

TABLE 4

Regression of average implied equity premiums on leverage and personal and corporate tax variables

This table presents regression results from estimating a pooled time-series cross-sectional regression containing 20,320 observations over 1982 through 2004. The dependent variable is r_{avg} , which equals the average of r_{gls} , r_{ct} , r_{ojn} , and r_{mpeg} for observations with all four estimates available. B/A is the market value of debt divided by market value of assets at the end of year $t - 1$. τ_c equals the simulated marginal tax rate before financing for year $t - 1$. $(1 - \tau_{ps})/(1 - \tau_{pb})$ is the personal tax penalty associated with debt. $Yield$ is equal to the last annualized quarterly dividend paid in year $t - 1$ divided by the stock price at the beginning of the month. $(\tau_d - \tau_{cg})/(1 - \tau_{cg})$ is the dividend tax penalty. β_{MKT} , β_{SMB} , and β_{HML} are the Fama and French risk factors estimated using at least 24 and up to 60 monthly returns ending in June of year t . $Dispersion$ equals the standard deviation of analyst estimates for year t earnings divided by the consensus forecast for year t earnings. LTG equals the mean long-term growth forecast available in June of year t . t -statistics are reported in parentheses.

| Variable Name | Dependent Variable = r_{avg} | | | | | |
|--|--------------------------------|-----------------|-------------------|-------------------|-------------------|-------------------|
| | (1) | (2) | (3) | (4) | (5) | |
| B/A | + | 5.19 (34.23) | 9.95 (16.92) | 2.94 (2.81) | 6.00 (5.59) | 5.31 (5.11) |
| τ_c | ? | | -6.08 (-18.02) | -6.15 (-17.99) | -6.04 (-17.38) | -6.38 (-18.32) |
| $(B/A) \cdot \tau_c$ | - | | -12.98 (-8.15) | -14.03 (-8.79) | -15.05 (-9.38) | -8.69 (-5.80) |
| $(1 - \tau_{ps})/(1 - \tau_{pb})$ | ? | | | -0.49 (-3.00) | 0.19 (1.00) | 0.50 (2.53) |
| $(B/A) \cdot (1 - \tau_{ps})/(1 - \tau_{pb})$ | + | | | 5.18 (8.06) | 3.38 (5.10) | 3.07 (4.66) |
| $Yield$ | ? | | | -18.18 (-9.63) | -8.04 (-4.17) | |
| $(\tau_d - \tau_{cg})/(1 - \tau_{cg})$ | ? | | | -2.41 (-9.38) | -1.58 (-6.12) | |
| $Yield \cdot (\tau_d - \tau_{cg})/(1 - \tau_{cg})$ | + | | | 88.28 (13.37) | 69.73 (10.50) | |
| β_{MKT} | + | 0.46 (12.25) | 0.44 (12.13) | 0.42 (11.57) | 0.39 (10.74) | 0.26 (6.89) |
| β_{SMB} | + | 0.49 (21.04) | 0.48 (21.02) | 0.45 (19.60) | 0.44 (18.73) | 0.31 (13.00) |
| β_{HML} | + | 0.16 (19.40) | 0.12 (5.50) | 0.12 (5.53) | 0.13 (5.99) | 0.21 (9.33) |
| $\ln(Dispersion)$ | + | 0.29 (27.10) | 0.28 (26.56) | 0.28 (26.89) | 0.29 (26.91) | 0.30 (27.91) |
| LTG | + | 6.71 (21.93) | 5.54 (18.48) | 5.21 (16.44) | 4.97 (15.26) | 6.08 (18.32) |
| Fixed effects | | None | None | None | None | Industry |
| Adj. R^2 | | 17.02% | 21.77% | 22.10% | 22.80% | 26.65% |

TABLE 5

Regression of individual implied equity premiums on leverage and personal and corporate tax variables

This table presents regression results from estimating a pooled time-series cross-sectional regression using all observations available for each cost of equity estimate over 1982 through 2004. Industry fixed effects were included in the estimation (not reported). B/A is the market value of debt divided by market value of assets at the end of year $t - 1$. τ_c equals the simulated marginal tax rate before financing for year $t - 1$. $(1 - \tau_{ps})/(1 - \tau_{pb})$ is the personal tax penalty associated with debt. $Yield$ is equal to the last annualized quarterly dividend paid in year $t - 1$ divided by the stock price at the beginning of the month. $(\tau_d - \tau_{cg})/(1 - \tau_{cg})$ is the dividend tax penalty. β_{MKT} , β_{SMB} , and β_{HML} are the Fama and French risk factors estimated using at least 24 and up to 60 monthly returns ending in June of year t . $Dispersion$ equals the standard deviation of analyst estimates for year t earnings divided by the consensus forecast for year t earnings. LTG equals the mean long-term growth forecast available in June of year t . t -statistics are reported in parentheses.

| | | Dependent variable = cost of equity | | | |
|--|---|-------------------------------------|--------------------|-------------------|--------------------|
| | | r_{gls} | r_{ct} | r_{oim} | r_{mpeg} |
| B/A | + | 19.49 (9.89) | -0.03 (-0.02) | 1.48 (1.30) | 3.35 (2.11) |
| τ_c | ? | -17.01 (-31.43) | -17.01 (-26.72) | -5.28 (-13.87) | -12.24 (-22.92) |
| $(B/A) \cdot \tau_c$ | - | -25.68 (-11.50) | -1.06 (-0.41) | -4.96 (-3.03) | -2.82 (-1.23) |
| $(1 - \tau_{ps})/(1 - \tau_{pb})$ | ? | 4.36 (11.00) | 1.99 (4.36) | -1.70 (-7.90) | -0.61 (-2.03) |
| $(B/A) \cdot (1 - \tau_{ps})/(1 - \tau_{pb})$ | + | -0.55 (-0.44) | 5.65 (3.89) | 4.40 (6.11) | 4.22 (4.19) |
| $Yield$ | ? | -35.01 (-9.20) | 1.36 (1.44) | 14.33 (6.84) | -0.33 (-0.11) |
| $(\tau_d - \tau_{cg})/(1 - \tau_{cg})$ | ? | -3.30 (-6.44) | 1.52 (2.56) | 0.69 (2.43) | -0.21 (-0.52) |
| $Yield \cdot (\tau_d - \tau_{cg})/(1 - \tau_{cg})$ | + | 126.81 (9.56) | 2.21 (1.44) | 61.36 (8.45) | 92.57 (9.15) |
| β_{MKT} | + | 0.48 (6.65) | 0.86 (10.37) | 0.27 (6.60) | 0.47 (14.91) |
| β_{SMB} | + | 0.26 (5.63) | 0.71 (13.26) | 0.37 (14.22) | 0.54 (14.91) |
| β_{HML} | + | -0.06 (-1.49) | -0.35 (-7.18) | 0.14 (5.84) | 0.10 (3.04) |
| $\ln(Dispersion)$ | + | -0.30 (-17.97) | -0.74 (-38.00) | 0.41 (34.38) | 0.71 (42.71) |
| LTG | | -5.87 (-10.38) | 5.53 (8.19) | 11.94 (32.98) | 4.08 (8.02) |
| $N =$ | | 22,873 | 22,769 | 20,535 | 20,375 |
| Adj. R^2 | | 24.52% | 21.31% | 26.01% | 27.40% |

TABLE 6

Annual regressions of implied equity premiums on leverage and personal and corporate tax variables

This table presents regression results from annual cross-sectional regression using all observations available for each cost of equity estimate from 1982 through 2004. Industry fixed effects were included in the estimation (not reported). B/A is the market value of debt divided by market value of assets at the end of year $t - 1$. τ_c equals the simulated marginal tax rate before financing for year $t - 1$. $(1 - \tau_{ps})/(1 - \tau_{pb})$ is the personal tax penalty associated with debt. $Yield$ is equal to the last annualized quarterly dividend paid in year $t - 1$ divided by the stock price at the beginning of the month. β_{MKT} , β_{SMB} , and β_{HML} are the Fama and French risk factors estimated using at least 24 and up to 60 monthly returns ending in June of year t . $Dispersion$ equals the standard deviation of analyst estimates for year t earnings divided by the consensus forecast for year t earnings. LTG equals the mean long-term growth forecast available in June of year t . t -statistics are based on the time-series of estimated coefficients and are reported in parentheses.

| | | Dependent variable = cost of equity | | | | |
|---|---|-------------------------------------|-------------------|-------------------|-------------------|-------------------|
| | | r_{avg} | r_{gls} | r_{ct} | r_{ojn} | r_{mpeg} |
| B/A | + | 10.08 (4.33) | 17.98 (2.15) | -2.05 (-0.28) | 11.10 (4.73) | 16.01 (4.58) |
| τ_c | ? | -3.75 (-5.03) | -9.99 (-3.41) | -17.63 (-5.28) | -4.33 (-4.40) | -10.07 (-6.50) |
| $(B/A) \cdot \tau_c$ | - | -13.29 (-2.83) | -32.55 (-2.69) | 1.36 (0.11) | -14.43 (-3.57) | -13.62 (-2.51) |
| $(1 - \tau_{ps})/(1 - \tau_{pb})$ | ? | 1.54 (2.37) | 5.19 (4.41) | 2.24 (1.95) | -1.70 (-2.32) | -0.03 (-0.04) |
| $(B/A) \cdot (1 - \tau_{ps})/(1 - \tau_{pb})$ | + | 0.69 (0.44) | 2.32 (0.61) | 6.23 (1.69) | -0.13 (-0.07) | -2.20 (-0.79) |
| $Yield$ | + | 14.82 (8.14) | -7.35 (-1.57) | -1.52 (-0.45) | 29.44 (14.17) | 22.76 (7.50) |
| β_{MKT} | + | 0.42 (4.33) | 0.52 (4.50) | 0.88 (6.71) | 0.44 (3.90) | 0.68 (4.57) |
| β_{SMB} | + | 0.48 (8.96) | 0.37 (2.79) | 0.65 (5.74) | 0.55 (9.19) | 0.81 (9.99) |
| β_{HML} | + | 0.07 (1.22) | -0.13 (-1.01) | -0.32 (-2.15) | 0.04 (0.62) | -0.08 (-1.18) |
| $\ln(Dispersion)$ | + | 0.34 (16.47) | -0.24 (-4.34) | -0.67 (-8.99) | 0.43 (14.91) | 0.74 (15.56) |
| LTG | + | 5.97 (7.27) | -5.88 (-5.47) | 4.33 (3.08) | 11.94 (11.83) | 3.15 (3.11) |
| Average Adj. R^2 | | 32.20% | 24.76% | 23.70% | 32.26% | 32.39% |

TABLE 7

Annual regressions of implied equity premiums on leverage and personal and corporate tax variables controlling for operating risk and bankruptcy risk

This table presents regression results from annual cross-sectional regression using all observations available for each cost of equity estimate from 1982 through 2004. Industry fixed effects were included in the estimation (not reported). B/A is the market value of debt divided by market value of assets at the end of year $t - 1$. τ_c equals the simulated marginal tax rate before financing for year $t - 1$. $(1 - \tau_{ps})/(1 - \tau_{pb})$ is the personal tax penalty associated with debt. $Yield$ is equal to the last annualized quarterly dividend paid in year $t - 1$ divided by the stock price at the beginning of the month. $Z-Score$ equals the modified Altman (1968) Z -score. $\sigma(EBIT)$ is the standard deviation of earnings before interest and taxes divided by total assets over the five years ending in year $t - 1$. β_{MKT} , β_{SMB} , and β_{HML} are the Fama and French risk factors estimated using at least 24 and up to 60 monthly returns ending in June of year t . $Dispersion$ equals the standard deviation of analyst estimates for year t earnings divided by the consensus forecast for year t earnings. LTG equals the mean long-term growth forecast available in June of year t . t -statistics are based on the time-series of estimated coefficients and are reported in parentheses.

| | | Dependent variable | | | | |
|---|---|--------------------|-------------------|-------------------|-------------------|-------------------|
| | | r_{avg} | r_{gls} | r_{ct} | r_{ojn} | r_{mpeg} |
| B/A | + | 10.98 (7.26) | 14.95 (2.55) | -0.47 (-0.10) | 12.46 (7.67) | 18.03 (8.06) |
| τ_c | ? | -1.05 (-1.47) | -2.51 (-1.27) | -10.23 (-4.14) | -1.56 (-1.48) | -5.59 (-4.47) |
| $(B/A) \cdot \tau_c$ | - | -13.79 (-3.70) | -32.52 (-3.44) | -7.62 (-0.89) | -17.00 (-4.69) | -17.78 (-3.90) |
| $(1 - \tau_{ps})/(1 - \tau_{pb})$ | ? | 1.44 (2.99) | 5.10 (5.64) | 1.99 (2.57) | -1.87 (-3.93) | -0.24 (-0.51) |
| $(B/A) \cdot (1 - \tau_{ps})/(1 - \tau_{pb})$ | + | 0.02 (0.02) | 3.33 (1.32) | 7.32 (2.84) | -0.90 (-0.69) | -3.34 (-1.89) |
| $Yield$ | + | 16.91 (13.75) | -5.55 (-1.72) | 1.01 (0.41) | 31.78 (22.33) | 25.69 (-11.82) |
| $Z-Score$ | - | -0.04 (-3.76) | -0.31 (-6.43) | -0.10 (-3.10) | -0.03 (-3.07) | -0.01 (-5.52) |
| $(B/A) \cdot Z-Score$ | - | -0.17 (-1.34) | -2.17 (-8.34) | -0.65 (-2.43) | 0.39 (3.74) | 0.50 (3.69) |
| $\sigma(EBIT)$ | + | 6.76 (9.59) | 6.10 (4.95) | 7.96 (6.18) | 7.05 (7.22) | 10.14 (7.56) |
| $(B/A) \cdot \sigma(EBIT)$ | + | 18.46 (3.16) | 26.58 (2.90) | -0.24 (-0.02) | 16.22 (3.17) | 27.21 (4.27) |
| β_{MKT} | + | 0.40 (6.10) | 0.45 (6.28) | 0.79 (6.18) | 0.44 (5.84) | 0.70 (7.56) |
| β_{SMB} | + | 0.45 (12.72) | 0.26 (3.01) | 0.61 (8.68) | 0.52 (13.30) | 0.77 (14.63) |
| β_{HML} | + | 0.09 (2.47) | -0.05 (-8.02) | -0.20 (-1.73) | 0.05 (1.28) | -0.10 (-2.04) |
| $\ln(Dispersion)$ | + | 0.30 (19.37) | -0.19 (-6.13) | -0.65 (-12.64) | 0.39 (20.16) | 0.69 (20.36) |
| LTG | + | 5.77 | -5.78 | 4.38 | 12.06 | 2.47 |

| | | | | | |
|------------------------------|---------|---------|--------|---------|--------|
| | (10.30) | (-8.02) | (4.31) | (17.02) | (3.40) |
| <i>N</i> (Total all years) = | 18,527 | 20,749 | 20,663 | 18,721 | 18,584 |
| Average Adj. R^2 | 36.97% | 32.61% | 26.93% | 36.66% | 36.80% |

TABLE 8

Regressions of average implied equity premium within operating risk partitions

This table reports results from regressions estimated within groups where observations are partitioned annually into three equal-sized groups (*Low, Medium, High*) on the basis of $\sigma(EBIT)$. The first three columns present results from estimating the pooled regression. The second three columns present results from estimating annual regressions within group. Industry fixed effects were included in the estimation (not reported). The dependent variable is r_{avg} , which equals the average of r_{gls} , r_{ct} , r_{ojn} , and r_{mpeg} for observations with all four estimates available. B/A is the market value of debt divided by market value of assets at the end of year $t - 1$. τ_c equals the simulated marginal tax rate before financing for year $t - 1$. $(1 - \tau_{ps})/(1 - \tau_{pb})$ is the personal tax penalty associated with debt. $Yield$ is equal to the last annualized quarterly dividend paid in year $t - 1$ divided by the stock price at the beginning of the month. β_{MKT} , β_{SMB} , and β_{HML} are the Fama and French risk factors estimated using at least 24 and up to 60 monthly returns ending in June of year t . $Dispersion$ equals the standard deviation of analyst estimates for year t earnings divided by the consensus forecast for year t earnings. LTG equals the mean long-term growth forecast available in June of year t . t -statistics (based on the time-series of coefficient estimates for the annual regressions) are reported in parentheses.

| | | Pooled regressions | | | Annual regressions | | |
|--|---|--------------------|------------------|-------------------|--------------------|------------------|-------------------|
| | | <i>Low</i> | <i>Medium</i> | <i>High</i> | <i>Low</i> | <i>Medium</i> | <i>High</i> |
| B/A | + | 2.38 (1.51) | 9.48 (5.18) | 3.97 (1.88) | 5.89 (0.61) | 2.91 (0.37) | 5.59 (1.28) |
| τ_c | ? | -9.87 (-12.88) | -7.71 (-9.98) | -3.86 (-6.67) | -20.37 (-2.83) | -5.09 (-1.58) | -2.08 (-1.66) |
| $(B/A) \cdot \tau_c$ | - | 6.42 (2.51) | -6.44 (-2.16) | -15.05 (-5.63) | 13.35 (0.75) | 1.98 (0.14) | -14.65 (-2.14) |
| $(1 - \tau_{ps})/(1 - \tau_{pb})$ | ? | 1.28 (4.08) | 1.40 (3.99) | -0.07 (-0.19) | 2.79 (2.84) | 0.60 (0.91) | 0.83 (1.06) |
| $(B/A) \cdot (1 - \tau_{ps})/(1 - \tau_{pb})$ | + | 1.11 (1.13) | -0.01 (-0.01) | 5.30 (3.92) | -4.63 (-1.28) | 2.05 (0.55) | 3.91 (1.77) |
| $Yield$ | ? | 6.86 (2.82) | -5.15 (-1.45) | -19.17 (-4.11) | 23.57 (6.31) | 22.81 (6.94) | 4.66 (0.92) |
| $(\tau_d - \tau_{cg})/(1 - \tau_{cg})$ | ? | -0.69 (-1.93) | -2.43 (-5.37) | -1.45 (-2.75) | | | |
| $Yield \cdot (\tau_d - \tau_{cg})/(1 - \tau_{cg})$ | + | 14.45 (1.77) | 92.69 (7.57) | 104.91 (6.71) | | | |
| β_{MKT} | + | 0.32 (4.55) | 0.29 (3.92) | 0.22 (3.00) | 0.39 (3.59) | 0.48 (3.42) | 0.38 (3.01) |
| β_{SMB} | + | 0.35 (8.29) | 0.18 (4.00) | 0.24 (5.15) | 0.59 (6.46) | 0.55 (7.60) | 0.41 (4.78) |
| β_{HML} | + | 0.42 (10.42) | 0.39 (8.55) | 0.20 (4.69) | 0.09 (1.64) | 0.02 (0.29) | 0.14 (1.90) |
| $\ln(Dispersion)$ | + | 0.19 (11.23) | 0.28 (14.05) | 0.31 (14.03) | 0.21 (6.93) | 0.33 (10.58) | 0.36 (11.06) |
| LTG | + | 4.16 (6.39) | 7.66 (11.93) | 5.75 (9.70) | 4.01 (3.87) | 7.02 (7.00) | 6.25 (5.32) |
| $N =$ | | 6,168 | 6,183 | 6,176 | 6,168 | 6,183 | 6,176 |
| $Adj. R^2$ | | 32.77% | 29.37% | 19.71% | 42.18% | 38.74% | 31.41% |