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The Journal of Finance, Vol. 55, No. 5. (Oct., 2000), pp. 1901-1941.

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THE JOURNAL OF FINANCE • VOL. LV, NO. 5 • OCT. 2000

How Big Are the Tax Benefits of Debt?

JOHN R. GRAHAM*

ABSTRACT

I integrate under firm-specific benefit functions to estimate that the capitalized tax benefit of debt equals 9.7 percent of firm value (or as low as 4.3 percent, net of personal taxes). The typical firm could double tax benefits by issuing debt until the marginal tax benefit begins to decline. I infer how aggressively a firm uses debt by observing the shape of its tax benefit function. Paradoxically, large, liquid, profitable firms with low expected distress costs use debt conservatively. Product market factors, growth options, low asset collateral, and planning for future expenditures lead to conservative debt usage. Conservative debt policy is persistent.

DO THE TAX BENEFITS of debt affect corporate financing decisions? How much do they add to firm value? These questions have puzzled researchers since the work of Modigliani and Miller (1958, 1963). Recent evidence indicates that tax benefits are one of the factors that affect financing choice (e.g., MacKie-Mason (1990), Graham (1996a)), although opinion is not unanimous on which factors are most important or how they contribute to firm value (Shyam-Sunder and Myers (1998), Fama and French (1998)).

Researchers face several problems when they investigate how tax incentives affect corporate financial policy and firm value. Chief among these problems is the difficulty of calculating corporate tax rates due to data problems and the complexity of the tax code. Other challenges include quantifying the effects of interest taxation at the personal level and understanding the bankruptcy process and the attendant costs of financial distress. In this

* Graham is at the Fuqua School of Business, Duke University. Early conversations with Rick Green, Eric Hughson, Mike Lemmon, and S. P. Kothari were helpful in formulating some of the ideas in this paper. I thank Peter Fortune for providing the bond return data and Eli Ofek for supplying the managerial entrenchment data. I also thank three referees for detailed comments; also, Jennifer Babcock, Ron Bagley, Alon Brav, John Campbell, John Chalmers, Bob Dammon, Eugene Fama, Roger Gordon, Mark Grinblatt, Burton Hollifield, Steve Huddart, Arvind Krishnamurthy, Rich Lyons, Robert MacDonald, Ernst Maug, Ed Maydew, Roni Michaely, Phillip O'Conner, John Persons, Dick Rendleman, Oded Sarig, René Stulz (the editor), Bob Taggart, S. Viswanathan, Ralph Walkling, and Jaime Zender; seminar participants at Carnegie Mellon, Chicago, Duke, Ohio State, Rice, the University of British Columbia, the University of North Carolina, Washington University, William and Mary, and Yale; seminar participants at the NBER Public Economics and Corporate workshops, the National Tax Association annual conference, the American Economic Association meetings, and the Eighth Annual Conference on Financial Economics and Accounting for helpful suggestions and feedback. Jane Laird gathered the state tax rate information. All errors are my own. This paper previously circulated under the title "*tD* or Not *tD*? Using Benefit Functions to Value and Infer the Costs of Interest Deductions."

paper I primarily focus on calculating corporate tax benefits. I develop a new measure of the tax benefits of debt that provides information about not just the marginal tax rate but the entire tax benefit function.

A firm's tax function is defined by a series of marginal tax rates, with each rate corresponding to a specific level of interest deductions. (Each marginal tax rate incorporates the effects of non-debt tax shields, tax-loss carrybacks, carryforwards, tax credits, the alternative minimum tax, and the probability that interest tax shields will be used in a given year, based on the methodology of Graham (1996a)). The tax function is generally flat for small interest deductions but, because tax rates fall as interest expense increases, eventually becomes downward sloping as interest increases. This occurs because interest deductions reduce taxable income, which decreases the probability that a firm will be fully taxable in all current and future states, which in turn reduces the tax benefit from the incremental deductions.

Having the entire tax rate function allows me to make three contributions toward understanding how tax benefits affect corporate choices and value. First, I quantify the tax advantage of debt by integrating to determine the area under the tax benefit function. This contrasts with the traditional approach of measuring tax benefits as the product of the corporate tax rate and the amount of debt (Brealey and Myers (1996)). I estimate that the tax benefit of interest deductibility equals 9.7 percent of market value for the typical firm, in comparison to 13.2 percent according to the traditional approach. When I adjust the tax functions for the taxation of interest at the personal level, the benefit of interest deductibility falls to between four and seven percent of firm value. In certain circumstances, however, the benefits are much larger: Safeway and RJR Nabisco achieved net tax benefits equal to nearly 20 percent of asset value after they underwent leveraged buyouts.

Second, I use the tax rate functions to determine how aggressively firms use debt. I quantify how aggressively a firm uses debt by observing the "kink" in its tax benefit function, that is, the point where marginal benefits begin to decline and therefore the function begins to slope downward. More specifically, I define kink as the ratio of the amount of interest required to make the tax rate function slope downward (in the numerator) to actual interest expense (in the denominator). If kink is less than one, a firm operates on the downward-sloping part of its tax rate function. A firm with kink less than one uses debt aggressively because it expects reduced tax benefits on the last portion of its interest deductions. If kink is greater than one, a firm could increase interest expense and expect full benefit on these incremental deductions; such a firm uses debt conservatively. Therefore, debt conservatism increases with kink.

I compare this new gauge of how aggressively firms use debt with variables that measure the costs of debt, to analyze whether corporate behavior is consistent with optimal capital structure choice. Surprisingly, I find that the firms that use debt conservatively are large, profitable, liquid, in stable industries, and face low ex ante costs of distress; however, these firms also have growth options and relatively few tangible assets. I also find that debt

conservatism is persistent, positively related to excess cash holdings, and weakly related to future acquisitions. My results are consistent with some firms being overly conservative in their use of debt. Indeed, 44 percent of the sample firms have kinks of at least two (i.e., they could double interest deductions and still expect to realize full tax benefit from their tax deductions in every state of nature).

Third, I estimate how much value a debt-conservative firm could add if it used more debt. I conjecture that, in equilibrium, the cost of debt function should intersect the tax benefit function on its downward-sloping portion. This implies that firms should have (at least) as much debt as that associated with the kink in the benefit function. Levering up to the kink, the typical firm could add 15.7 percent (7.3 percent) to firm value, ignoring (considering) the personal tax penalty. Combined with Andrade and Kaplan's (1998) conclusion that financial distress costs equal between 10 and 23 percent of firm value, current debt policy is justified if levering up *increases* the probability of distress by 33 to 75 percent. Given that only one-fourth of Andrade and Kaplan's sample firms default within 10 years, even extreme estimates of distress costs do not justify observed debt policies.

My analysis is related to research by Engel, Erickson, and Maydew (1998), who use market returns to measure directly the net tax advantage of a debt-like instrument, MIPS (monthly income preferred securities). For a sample of 22 large firms issuing MIPS, Engel et al. (1998) estimate that a dollar of "interest" yields a net tax benefit of $0.315 in the mid-1990s, at a time when their sample firms faced federal and state taxes of around 40 percent. This implies a personal tax penalty no larger than 21 percent (0.21 = 0.085/0.40). In contrast, I impute the personal tax penalty using the corporate tax rate, the personal tax rate on debt, the personal tax rate on equity, and firm-specific estimates of dividend payout. Although my analysis and that of Engel et al. (1998) use different samples, time periods, and financial securities, if I use the smaller Engel et al. (1998) estimate of the personal tax penalty, the net tax advantage to debt equals seven to eight percent of market value for my sample.

The paper proceeds as follows. Section I discusses the costs and benefits of debt and describes how I estimate benefit functions. Section II discusses data and measurement issues. Section III quantifies the tax advantage of debt in aggregate and presents case studies for individual firms. Section IV compares the benefit functions to variables measuring the cost of debt. Section V estimates the tax savings firms pass up by not using more debt. Section VI concludes.

I. The Costs and Benefits of Debt

A. Estimating the Tax Costs and Benefits of Debt

The tax benefit of debt is the tax savings that result from deducting interest from taxable earnings. By deducting a single dollar of interest, a firm reduces its tax liability by τ_C, the marginal corporate tax rate. (Note that τ_C

captures both state and federal taxes.) The annual tax benefit of interest deductions is the product of τ_C and the dollar amount of interest, $r_d D$, where r_d is the interest rate on debt, D. To capitalize the benefit from current and future interest deductions, the traditional approach (Modigliani and Miller (1963)) assumes that tax shields are as risky as the debt that generates them and therefore discounts tax benefits with r_d. If debt is perpetual and interest tax shields can always be used fully, the capitalized tax benefit of debt simplifies to $\tau_C D$.

Miller (1977) points out that the traditional approach ignores personal taxes. Although interest payments help firms avoid corporate income tax, interest income is taxed at the personal level at a rate τ_P. Payments to equity holders are taxed at the corporate level (at rate τ_C) and again at the personal level (at the personal equity tax rate τ_E). Therefore, the net benefit of directing a dollar to investors as interest, rather than equity, is

$$(1 - \tau_P) - (1 - \tau_C)(1 - \tau_E). \tag{1}$$

Equation (1) can be rewritten as τ_C minus the "personal tax penalty", $\tau_P - (1 - \tau_C)\tau_E$. I use equation (1) to value the net tax advantage of a dollar of interest. Following Gordon and MacKie-Mason (1990), I estimate τ_E as $(d + (1 - d)g\alpha)\ \tau_P$, where d is the dividend–payout ratio, g is the proportion of long-term capital gains that are taxable, α measures the benefit of deferring capital gains taxes, and dividends are taxed at τ_P.

If debt is riskless and tax shields are as risky as the underlying debt, then the after-personal-tax bond rate is used to discount tax benefits in the presence of personal taxes (Taggart (1991), Benninga and Sarig (1997)). If the debt is also perpetual, the capitalized tax benefit of debt is

$$\frac{[(1 - \tau_P) - (1 - \tau_C)(1 - \tau_E)]r_d D}{(1 - \tau_P)r_d}. \tag{2}$$

Equation (2) simplifies to $\tau_C D$ if there are no personal taxes. In contrast, a Miller equilibrium would imply that expression (2) equals zero. My data assumptions imply that the personal tax penalty partially offsets the corporate tax advantage to debt on average, not fully offsets it as it would for every firm in a Miller equilibrium (see Section II.A).

Thus far, I have presented τ_C as if it is a constant. There are two important reasons why τ_C can vary across firms and through time. First, firms do not pay taxes in all states of nature. Therefore, τ_C should be measured as a weighted average, considering the probabilities that a firm does and does not pay taxes. Moreover, to reflect the carryforward and carryback provisions of the tax code, this averaging needs to account for the probability that taxes are paid in both the current and future periods. This logic is consistent with an economic interpretation of the marginal tax rate, defined as the present value tax obligation from earning an extra dollar today (Scholes and Wolfson (1992)). To reflect the interaction between U.S. tax laws and historical and

future tax payments, I estimate corporate marginal tax rates with the simulation methods of Graham (1996b) and Graham, Lemmon, and Schallheim (1998). These tax rates vary with the firm-specific effects of tax-loss carrybacks and carryforwards, investment tax credits, the alternative minimum tax, nondebt tax shields, the progressive statutory tax schedule, and earnings uncertainty. Appendix A describes the tax rate methodology in detail.

The second reason that τ_C can vary is that the effective tax rate is a function of debt and nondebt tax shields. As a firm increases its interest or other deductions, it becomes less likely that the firm will pay taxes in any given state of nature, which lowers the expected benefit from an incremental deduction. At the extreme, if a firm entirely shields its earnings in current and future periods, its marginal tax rate is zero, as is the benefit from additional deductions. This implies that each dollar of interest should be valued with a tax rate that is a function of the given level of tax shields. As I explain next, τ_C defines the tax benefit function, and therefore the fact that τ_C is a decreasing function of interest expense affects my estimate of the tax benefits of debt in important ways.

Rather than using equation (2), I estimate the tax benefits of debt as the area under the tax benefit function. To estimate a benefit function, I first calculate a tax rate assuming that a firm does not have any interest deductions. This first tax rate is referred to as $MTR_{it}^{0\%}$ for Firm i in Year t and is the marginal tax rate that would apply if the firm's tax liability were based on before-financing income (EBIT, which incorporates zero percent of actual interest expense). Next, I calculate the tax rate, $MTR_{it}^{20\%}$, that would apply if the firm hypothetically had 20 percent of its actual interest deductions. I also estimate marginal tax rates based on interest deductions equal to 40, 60, 80, 100, 120, 160, 200, 300, 400, 500, 600, 700, and 800 percent of actual interest expense. (All else is held constant as interest deductions vary, including investment policy. Nondebt tax shields are deducted before interest.) By "connecting the dots," I link the sequence of tax rates to map out a tax benefit curve that is a function of the level of interest deductions. To derive a net (of personal tax effects) benefit function, I connect a sequence of tax benefits that results from running τ_C through equation (1). An interest deduction benefit function can be flat for initial interest deductions but eventually becomes negatively sloped because marginal tax rates fall as additional interest is deducted.[1]

To estimate the tax-reducing benefit provided by interest deductions for a single firm-year, I integrate to determine the area under a benefit function up to the level of actual interest expense. To estimate the present value of

[1]Talmor, Haugen, and Barnea (1985) model benefit functions with *debt* on the horizontal axis. They argue that debt benefit functions can slope upward (i.e., increasing marginal benefits to debt) because increasing the amount of debt can increase the interest rate and tax benefit faster than it increases the probability of bankruptcy. If the tax schedule is progressive, my benefit functions never slope upward because I plot *interest* on the horizontal axis, so my functions already include any effect of interest rates changing as debt increases (e.g., because of rising interest rates it may take only an 80 percent increase in debt to double interest deductions).

such benefits (from Year $t + 1$ through ∞), rather than assuming debt is perpetual as in equation (2), I capitalize annual tax benefit estimates from a time series of functions. For example, I estimate the present value benefit at year-end 1990 for Firm i by doing the following: (1) using historical data through year-end 1990 to derive an interest deduction benefit function for Firm i in 1991 (which is $t + 1$ in this case) and integrating under the function to estimate the net tax-reducing benefit of interest deductions for 1991; (2) still using historical data through 1990, I make a projection of the benefit function for 1992 ($t + 2$) and integrate under the expected $t + 2$ function to estimate the tax-reducing benefit of interest for 1992; (3) I repeat the process in (2) for each Year $t + 3$ through $t + 10$ and sum the present values of the benefits for Years $t + 1$ through $t + 10$. In much of the empirical work, I follow the traditional textbook treatment of valuing tax shields and use Moody's before-tax corporate bond yield for Year t as the discount rate; and (4) I invert the annuity formula to convert the 10-year present value into the capitalized value of all current and future tax benefits as of year-end 1990.

The benefit functions are forward-looking because the value of a dollar of current-period interest can be affected, via the carryback and carryforward rules, by the distribution of taxable income in future years. In addition, future interest deductions can compete with and affect the value of current tax shields. I assume that firms hold the interest coverage ratio constant at the Year-t value when they are profitable but maintain the Year-t interest level in unprofitable states.[2] For example, assume that income is \$500 in Year t and interest deductions are \$100. If income is forecast to rise to \$600 in $t + 1$, my assumption implies that interest deductions rise to \$120. Alternatively, if income decreases to \$400, interest falls to \$80. If income is forecast as negative in $t + 1$, interest remains constant at \$100 (implicitly assuming that the firm does not have sufficient cash to retire debt in unprofitable states). Likewise, if the firm's income is forecast to be \$400 in $t + 1$ and then negative in $t + 2$, Year-$t + 2$ interest deductions are assumed to be \$80.

This approach may misstate the tax benefits of debt if firms can optimize debt policy better than I assume. For example, if firms retire debt in unprofitable future states, Year-t interest deductions have fewer future deductions to compete with, and so my calculations understate the tax advantage of Year-t debt policy. Likewise, the likelihood increases that Year-t interest deductions will be used in the near term, and so my calculations understate the tax advantage of Year-t debt policy if (1) a financing pecking order holds; then profitable firms are likely to allow their interest coverage ratios to increase as they realize future profits and so issue less debt in the future;

[2] When determining capitalized tax benefits, future debt policy affects benefits in future years and, indirectly, the benefits in the current year. With respect to the latter, future interest deductions compete with Year-t deductions through the carryback and carryforward provisions of the tax code. To gauge the importance of my assumptions about future debt policy, I perform an unreported specification check that assumes that firms follow a partial adjustment model (i.e., they do not fully adjust their tax shielding ratios in either profitable or unprofitable states). This has little effect on the numbers reported below.

(2) there are transactions costs associated with issuing debt (e.g., Fisher, Heinkel, and Zechner (1989)), so a profitable firm may delay issuing; or (3) profitable firms choose to hedge more in the future, thereby increasing debt capacity. The converse of these situations could lead to my calculations overstating the tax benefits of debt.

In Figure 1, I plot tax benefit functions for ALC Communications (thin line) and Airborne Freight (thick line). The gross benefit curves in Panel A ignore personal taxes. Airborne issues debt conservatively, in the sense that its chosen interest level corresponds with the flat portion of its gross benefit function, indicating that the expected benefit of every dollar of deducted interest equals the top corporate tax rate in 1991 of 34 percent. (The graphs do not incorporate state taxes, although their effect is captured in the tax benefit calculations below.) In contrast, ALC issues debt aggressively enough to lose the tax shield in some states of nature, and hence the expected benefits are below the statutory tax rate for its last few dollars of interest.[3] To determine the gross tax benefit of debt for these firms in 1991, I integrate under the curves in Figure 1, over the range 0 to 100 percent. To capitalize the tax benefit of debt, I integrate under a time series of benefit functions.

The benefit curves in Panel A show the gross tax benefit of interest deductions, as measured by τ_C. The curves in Panel B are created by shifting the functions in Panel A downward to reflect the personal tax penalty, $\tau_P - (1 - \tau_C)\tau_E$. The ALC curve shifts down by more than the Airborne Freight curve because ALC has a lower dividend–payout ratio and therefore a smaller τ_E and a larger personal tax penalty. The ALC net tax benefit is nearly zero at the actual level of interest deduction, indicating that the last dollar of interest is not particularly valuable.[4]

B. Nontax Explanations of Debt Policy

In this section I describe nontax factors that affect debt policy. Later in the paper I compare these nontax factors to the tax benefit functions to analyze whether firms balance the costs and benefits of debt when they make financial decisions.

[3] Airborne's debt-to-value ratio is 29 percent, compared to ALC's 38 percent. Airborne uses interest deductions to shield 45 percent of expected operating earnings; ALC shields 79 percent.

[4] Figure 1 provides insight into whether firms have unique interior optimal capital structures. To see this, imagine an upward-sloping marginal cost curve that intersects ALC's benefit function on its downward-sloping portion. That is, assume that ALC issues debt until its expected marginal benefit falls sufficiently to equal its marginal cost. Each firm chooses an optimal capital structure based on where and how quickly its benefit function slopes downward, which is ultimately determined by its cash flow distribution. To the extent that cash flow distributions are unique, firms have unique optimal debt levels. Firms can have unique cash flow distributions, and capital structures, because they have differing amounts of nondebt tax shields (DeAngelo and Masulis (1980)). Alternatively, firms can have unique optimal debt levels without the existence of nondebt tax shields, based entirely on their underlying income distributions. Along these lines, Graham (1996a) shows that nondebt tax shields "play a fairly minor role in determining" $MTR_{it}^{100\%}$, which implies that the primary factor driving cross-sectional variation in tax incentives to use debt is cross-sectional differences in the firm-specific distribution of income.

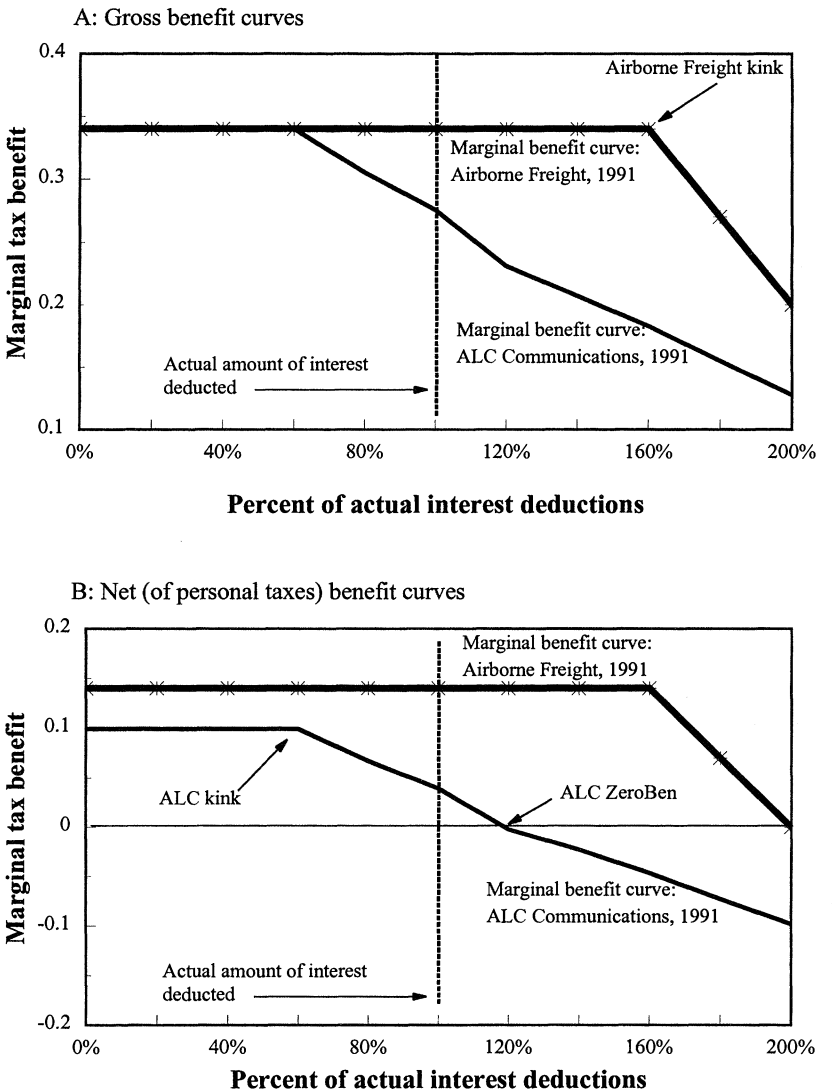

Figure 1. Marginal benefit curves measuring the tax benefit of interest deductions. The figure shows marginal benefit curves for two firms in 1991. Each curve is plotted by connecting marginal tax rates that are simulated as if the firm took interest deductions in 1991 equal to zero, 20, 40, 60, 80, 100, 120, 160, and 200 percent of those actually taken. Each point on the curves in Panel A is a marginal tax rate for a given amount of interest and therefore represents the gross benefit of interest deductions in terms of how much a firm's tax liability is reduced due to an incremental dollar of deduction. The curves in Panel B are identical to those in Panel A, except that they net out the personal tax penalty associated with interest income. The "kink" in a benefit function is defined as the point where it becomes downward sloping. For example, Airborne (ALC) has a kink of 1.6 (0.6). The "zero benefit" (ZeroBen) point is defined as the location just before the net benefit function becomes negative. For example, in Panel B, ALC has a ZeroBen of about 1.2. The area under the benefit curve to the left of actual interest deducted measures the tax benefit of debt.

B.1. Expected Costs of Financial Distress

The trade-off theory implies that firms use less debt when the expected costs of financial distress are high. I use several variables to analyze the cost of distress. To gauge the ex ante probability of distress, I use Altman's (1968) Z-score as modified by MacKie-Mason (1990): (3.3EBIT + Sales + 1.4Retained Earnings + 1.2Working Capital)/Total Assets. To measure the expected cost of distress, I use ECOST: the product of a term related to the likelihood of financial distress (the standard deviation of the first difference in the firm's historical EBIT divided by the mean level of book assets) and a term measuring the proportion of firm value likely to be lost in liquidation (asset intangibility, as measured by the sum of research and development and advertising expenses divided by sales). I also include two dummy variables to identify firms close to or in financial distress: OENEG (equals one if owners' equity is negative); and an NOL dummy (equals one if the firm has net operating loss carryforwards).

B.2. Investment Opportunities

Debt can be costly to firms with excellent investment opportunities. Myers (1977) argues that shareholders sometimes forgo positive NPV investments if project benefits accrue to a firm's existing bondholders. The severity of this problem increases with the proportion of firm value comprised of growth options, implying that growth firms should use less debt. I measure growth opportunities with Tobin's q. Given that the q-ratio is difficult to calculate, I use the approximate q-ratio (Chung and Pruitt (1994)): the sum of preferred stock, the market value of common equity, long-term debt, and net short-term liabilities, all divided by total assets. I also measure growth opportunities with the ratio of advertising expenses to sales (ADS) and research and development expenses to sales (RDS), setting the numerator of either variable to zero if it is missing.

B.3. Cash Flows and Liquidity

Cash flows and liquidity can affect the cost of borrowing. With respect to cash flows, Myers (1993) notes that perhaps the most pervasive empirical capital structure regularity is the inverse relation between debt usage and profitability. I measure cash flow with the return on assets (cash flow from operations deflated by total assets). With respect to liquidity, the most basic notion is that illiquid firms face high ex ante borrowing costs. However, Myers and Rajan (1998) point out that in certain circumstances liquid firms have a harder time credibly committing to a specific course of action, in which case their cost of external finance is larger. I measure liquidity with the quick ratio and the current ratio.

The effects of liquidity and profitability can be offset by free cash flow considerations. Jensen (1986) theorizes that managers of firms with free cash flows might lack discipline. An implication of Jensen's theory is that firms should issue debt (thereby committing to distribute free cash flows as

interest payments) to discipline management into working efficiently. Stulz (1990) emphasizes that free cash flow is not a problem for firms with profitable investment opportunities.

B.4. Managerial Entrenchment and Private Benefits

Corporate managers might choose conservative debt policies to optimize their personal utility functions, rather than maximize shareholder value. Stulz (1990) argues that managers can best pursue their private objectives by controlling corporate resources, instead of committing to pay out excess cash flow as interest payments. Jung, Kim, and Stulz (1996) find evidence consistent with managerial discretion causing some firms to issue equity (when they should issue debt) so managers can build empires. Berger, Ofek, and Yermack (1997) find that managers prefer to use debt conservatively. In particular, entrenched managers use less leverage, all else equal, and only lever up after experiencing a threat to their job security.

I use six variables from the Berger et al. (1997) data set to gauge the degree of managerial entrenchment: the percentage of common shares owned by the CEO (CEOSTOCK), vested options held by the CEO expressed as a percentage of common shares (CEOOPT), log of the number of years the CEO has been chief executive (YRSCEO), log of number of directors (BOARDSZ), percentage of outside directors (PCTOUT), and the percentage of common shares held by non-CEO board members (BDSTOCK). Berger et al. (1997) find evidence of conservative debt policy when CEOSTOCK and CEOOPT are low, when the CEO has a long tenure (YRSCEO high), and when CEOs do not face strong monitoring (BOARDSZ high or PCTOUT low). The entrenchment hypothesis also implies a negative relation between debt conservatism and stock ownership by board members.

B.5. Product Market and Industry Effects

Industry concentration: Phillips (1995) links product market characteristics to debt usage. Chevalier (1995) finds that industry concentration can affect desired debt levels: supermarkets in concentrated markets have a competitive advantage over highly levered rivals. I use sales- and asset-Herfindahl indices to gauge industry concentration.

Product uniqueness: Titman (1984) argues that firms producing unique products should use debt conservatively. If a unique-product firm liquidates, it imposes relatively large costs on its customers because of the unique servicing requirements of its product and also on its suppliers and employees because they have product-specific skills and capital. Therefore, the firm should avoid debt to keep the probability of liquidation low. Titman and Wessels (1988) define firms in industries with three-digit SIC codes between 340 and 400 as "sensitive" firms that produce unique products. To capture the effect of product uniqueness, I use dummy variables if a firm is in the chemical, computer, or aircraft industry or in another sensitive industry (three-digit SIC codes 340–400).

Cash flow volatility: Firms may use debt conservatively if they are in an industry with volatile or cyclical cash flows. I measure industry cash flow volatility with CYCLICAL: the average coefficient of variation (operating income in the numerator, assets in the denominator) for each two-digit SIC code. The standard deviation in the numerator is based on operating earnings to measure core volatility, so the variable is not directly influenced by financing decisions.

B.6. Other Factors That Affect Debt Policy

Financial flexibility: Firms often claim that they use debt sparingly to preserve financial flexibility, to absorb economic bumps, or to fund a "war chest" for future acquisitions (Graham and Harvey (2001)). For example, a well-known treasurer says that "at Sears, we are very conscious of having been around for 110 years, and we're planning on being around for another 110 years. And when you think about what you need to do to ensure that that happens, you come to appreciate that financial conservatism allows you to live through all kinds of economic cycles and competitive changes" (Myers et al. (1998)). To determine whether firms use their financial flexibility to fund future expenditures, I analyze the sum of acquisitions in Years $t + 1$ and $t + 2$ and, separately, capital expenditures for the same years.

Informational asymmetry between corporate insiders and investors can affect a company's financing choice. Myers and Majluf (1984) argue that the asymmetry gives managers incentive to issue overvalued securities; however, the market anticipates this and reacts negatively to security issuance. To minimize negative market reaction, firms prefer to issue securities in reverse order of the degree of informational sensitivity: internal funds, external debt, and, as a last resort, external equity. Sharpe and Nguyen (1995) argue that non-dividend-paying firms are subject to large informational asymmetries, which could cause them to prefer debt over equity financing. I measure dividend status with NODIV, a dummy variable equal to one if a firm does not pay dividends.

Size: Large firms often face lower informational costs when borrowing. Large firms may also have low ex ante costs of financial distress, perhaps because they are more diversified or because their size better allows them to "weather the storm." I measure firm size with both the market value of the firm and the natural log of real sales. Sales are deflated by the implicit price deflator.

Asset collateral: A firm with valuable asset collateral can often borrow on relatively favorable terms and hence have low borrowing costs. I measure collateral with PPE-to-assets, defined as net property, plant, and equipment divided by total assets.

Although this section defines each variable relative to a specific influence on financial policy, many of the variables measure more than one effect. For example, RDS is positively related to both growth opportunities and the cost of financial distress. The fact that the variables are related to debt

policy via more than one avenue does not detract from my analysis below (in Section IV) because I use the variables in a general way to reflect the cost of debt.

II. Data and Measurement Issues

I use data from the three annual COMPUSTAT tapes: Full-Coverage; Primary, Secondary, and Tertiary; and Research. The COMPUSTAT sample starts in 1973. The source for state tax information (*Fiscal Federalism*, 1980 to 1994), ceased publication in the mid-1990s due to government budget cuts, so the analysis terminates in 1994.

A historic start-up period is required to calculate the corporate tax variables (see Appendix A). The first tax variables are calculated for 1980, leaving a seven-year start-up period for most firms. The tax rate calculations require that firms must exist at least three years to be in the sample. These data requirements result in a sample of 87,643 firm-year observations.

A. Tax Variables

Estimates of τ_E and τ_P are required to calculate the personal tax penalty. I calculate τ_E as $[d + (1 - d)g\alpha]\tau_P$. The dividend–payout ratio d is the firm-year-specific dividend distribution divided by a three-year moving average of earnings.[5] The proportion of long-term capital gains that is taxable (g) is 0.4 before 1987 and 1.0 after, although the long-term capital gains rate, $g\tau_P$, has a maximum value of 0.28 after 1986. Following Feldstein and Summers (1979), I assume that the variable measuring the benefits of deferring capital gains (or avoiding them altogether at death), α, equals 0.25.[6] Other than what is captured with α, I assume there is no sheltering of equity income (that affects the relative pricing of debt and equity) at the personal level. The sample mean τ_E is 12 percent.

Following Poterba (1989), I estimate the personal tax rate on interest income as $\tau_P = (R_{\text{taxable}} - R_{\text{tax-free}})/R_{\text{taxable}}$, where R_{taxable} is the return on one-year Treasury bills and $R_{\text{tax-free}}$ is the return on one-year prime grade munis (using data from Fortune (1996)). I assume that the relative pricing of debt and equity is determined by a marginal investor with interest taxed at this same τ_P. I estimate τ_P within different tax regimes, that is, within blocks of time when statutory tax rates are constant. This approach leads to estimates of τ_P equal to 47.4 percent in 1980 and 1981, 40.7 percent from

[5] If there are tax clienteles (see, e.g., Elton and Gruber (1970), Auerbach (1983), and Scholz (1992)), it is appropriate to use firm-specific information to determine the personal tax penalty. Firm-specific information can also help adjust for risk if the debt and equity for a firm are in the same general risk class (e.g., firms that issue junk bonds also have relatively risky equity).

[6] Green and Hollifield (1999) model the personal tax advantage to equity. Ignoring the reduced statutory tax rate on capital gains and the ability to avoid capital gains altogether at death, they find that capital gains deferral reduces the effective capital gains tax rate by about 40 to 50 percent (in comparison to the personal tax rate on dividend and interest income).

1982 to 1986, 33.1 percent in 1987, 28.7 percent from 1988 to 1992, and 29.6 percent starting in 1993.[7] (I ignore the 1991 to 1992 regime and keep τ_P fixed at the 1987 to 1990 rate of 28.7 percent during 1991 and 1992. Without this adjustment, the mean τ_P would be 24.6 percent for 1991 to 1992, which is implausibly low given that the maximum statutory rate *increased* from 28 to 31 percent in 1991.) My estimate of τ_P varies as tax regimes change but is constant for all firms within a given regime. Other than what is reflected in the pricing of T-bills and munis, I assume no sheltering of interest income at the personal level.

I incorporate state taxes into the benefits of debt financing, using the tax schedules from all 50 states to calculate before-financing statutory marginal tax rates. To capture some of the influence that uncertainty and the dynamic aspects of the tax code have on the effective state tax rate, I multiply the statutory state rate by the ratio of the simulated federal rate over the statutory federal rate. For example, if the statutory state rate is 10 percent and the statutory federal rate is 35 percent, but the effective federal rate is 27.8 percent, the state rate is computed as 7.9 percent (= 0.10(0.278/0.35)). Given that state taxes are deductible at the federal level, I measure the effective state tax burden as $(1 - \tau_{\text{Federal}})\tau_{\text{State}}$. The sample mean of $(1 - \tau_{\text{Federal}})\tau_{\text{State}}$ is 0.025.

Firms pay taxes on the net revenues they earn in each state of operation (or according to apportionment rules based on payroll or sales), although COMPUSTAT only provides information about a company's "principal location." The state tax variable implicitly assumes that each firm operates entirely in its principal location, although this is clearly not the case for many firms. To minimize the effect of state tax rate measurement error, I use state information in only some of the analysis.

The COMPUSTAT ITC and NOL carryforward data are important to the tax calculations. In raw form, the ITC and NOL variables have many missing values. I set the ITC variable to zero if it is missing. In the NOL case, I start each firm with zero carryforwards and accumulate NOLs from each firm's time series of tax losses, assuming that carrybacks are taken as soon as possible. This approach treats sample firms consistently, regardless of whether the NOL data are missing.

Table I presents summary statistics for a number of variables. The firm characteristics are winsorized, setting values from the upper and lower one percent tails from each variable's univariate distribution equal to the value at the first and 99th percentiles, respectively. This attenuates the effect of extreme values for many of the variables. (The results are similar if extreme observations are deleted.) Each of the variables exhibits reasonable varia-

[7] Skelton (1983) and Chalmers (1998) show that the implicit personal tax rate is lower if inferred from long-maturity munis and taxables. Green (1993) notes that it is better to use short-term yields to infer τ_P because complicating factors, such as the deductibility of investment interest expense at the personal level, are more pronounced for longer maturities. Also, Green (1993) estimates implicit tax rates within subperiods corresponding to different tax regimes, lending support to the approach I use.

Table I

Summary Statistics

$MTR_{it}^{0\%}$ is the simulated before-financing tax rate, based on earnings before interest and taxes, net of the personal tax penalty. $MTR_{it}^{100\%}$ is the simulated marginal tax rate based on earnings before taxes, net of the personal tax penalty. *Z-score* is the modified Altman's (1968) *Z*-score. *ECOST* is the standard deviation of the first difference in taxable earnings divided by assets, the quotient times the sum of advertising, research, and development expenses divided by sales. *NODIV* is a dummy variable equal to one if the firm does not pay dividends. *OENEG* is a dummy variable equal to one if the firm has negative owners' equity. The *q-ratio* is preferred stock plus market value of common equity plus net short-term liabilities, the sum divided by total assets. *PPE-to-assets* is net property, plant, and equipment divided by total assets. *Ln(real sales)* is the natural log of real sales (where sales are deflated by the implicit price deflator), with sales expressed in millions of dollars. The *current ratio* is short-term assets divided by short-term liabilities. *Return-on-assets* is operating cash flow divided by total assets. *RDS* is the research and development expense to sales ratio, set equal to zero if the numerator is missing. *NOL dummy* is equal to one if firm has book NOL carryforwards and is zero otherwise. *CYCLICAL* is the standard deviation of operating earnings divided by mean assets first calculated for each firm, then averaged across firms within two-digit SIC codes. *Acquisitions* and *capital expenditures* are the two-year sums of acquisitions or capital expenditures, respectively, deflated by total assets. *Asset Herfindahl* is an industry-wide Herfindahl index based on assets. *Kink* is the amount of interest at the point where the marginal benefit function becomes downward sloping, as a proportion of actual interest expense. *ZeroBen* is the amount of interest at the point where the marginal tax benefit of debt is zero, as a proportion of actual interest expense. The full sample has 87,643 observations from 1980 to 1994.

	Mean	Std. Dev.	Median	Minimum	Maximum
$MTR_{it}^{0\%}$	0.042	0.154	0.094	−0.427	0.302
$MTR_{it}^{100\%}$	0.006	0.177	0.075	−0.427	0.302
Z-score	1.011	4.186	1.889	−25.76	6.204
ECOST	0.994	4.463	0.010	0.000	36.46
NODIV	0.569	0.495	1.000	0.000	1.000
OENEG	0.074	0.262	0.000	0.000	1.000
q-ratio	1.034	1.693	0.513	−0.332	11.01
PPE-to-assets	0.330	0.262	0.270	0.000	0.930
Ln(real sales)	−0.535	2.586	−0.390	−7.569	4.944
Current ratio	2.490	2.975	1.755	0.000	21.58
Return-on-assets	0.055	0.237	0.102	−1.343	0.413
RDS	0.041	0.150	0.000	0.000	1.000
NOL dummy	0.273	0.445	0.000	0.000	1.000
CYCLICAL	0.178	0.186	0.149	0.013	1.825
Acquisitions	0.023	0.082	0.000	−0.494	3.207
Capital expenditures	0.076	0.199	0.049	−0.500	31.00
Asset Herfindahl	0.271	0.284	0.155	0.015	1.000
Kink	2.356	3.111	1.200	0.000	8.000
Zero benefit	3.540	3.311	3.000	0.000	8.000

tion across the sample. Among the tax variables, $MTR^{0\%}$ and $MTR_{it}^{100\%}$ have medians (means) of 0.094 (0.042) and 0.075 (0.006), respectively, indicating that the effective corporate tax rate is a decreasing function of interest deductions. Though not shown in the table, the means of $MTR^{0\%}$ and $MTR^{100\%}$ are 0.315 and 0.277 when the personal tax penalty is ignored.

B. Using the Kink in the Benefit Function to Infer How Aggressively Firms Use Debt

A firm's position on its benefit function provides a unique perspective on debt policy. For example, Airborne Freight could increase interest deductions to 160 percent of those actually taken before the benefit of incremental interest would decline (thick line in Figure 1). I refer to the point where the benefit curve becomes downward sloping (technically, where the tax benefit first declines by at least 50 basis points from one interest increment to the next) as the "kink" in the curve. The larger the kink, the greater is the proportion by which interest deductions can increase without losing incremental value, and therefore the more conservative is debt policy.[8] Airborne Freight has a kink of 1.6. In contrast, ALC Communications takes interest deductions beyond the point where its marginal benefit curve becomes downward sloping and has a kink of 0.60.

I claim that firms have large values for kink if they use debt conservatively. For this to be true, firms with large kinks should remain on the flat part of their benefit functions even if they receive a negative shock to earnings. To see whether this is true, I divide the interest expense at the kink by the standard deviation of earnings; this determines the length of the flat part of the benefit curve per unit of earnings volatility. In other words, this calculation standardizes kink by earnings volatility. A firm with $100 of interest deductions, a kink of six, and an earnings standard deviation of $300, has a standardized kink of two.

Standardized kink is approximately two for firms with raw kinks between 1.2 and seven and reaches a maximum of 2.17 for firms with nonstandardized kinks of three (Table II). Overall, firms with high nonstandardized kinks have benefit functions with the flat part about two standard deviations in length. Therefore, high-kink firms could sustain a negative shock to earnings and still remain on the flat portions of their benefit functions in most scenarios. (This is less true for firms with raw kinks of eight because they have standardized kinks of only 1.1, although this number may be downward biased because I limit the maximum kink to eight.)

[8] Graham (1999) regresses debt-to-value on a simulated tax rate, a no-dividends dummy, a negative-owners'-equity dummy, the q-ratio, PPE-to-assets, the log of real sales, return on operating income, Altman's modified Z-score, and ECOST. If this regression is well specified and kink is a good measure of debt conservatism, then kink and the regression residual should be negatively correlated. Kink and the regression residual have a correlation coefficient of approximately -0.3, which is statistically significant at the one percent level.

Given that high-kink firms have excess debt capacity, one wonders if they are conservative in other corporate policies, such as cash management. Opler et al. (1999) define excess cash as the residual from regressing the log of cash-to-net-assets on various explanatory variables. Using a similar definition, I find that firms with excess cash also have a high kink, with a correlation coefficient equal to 11.4 percent. Thus, there is a positive relation between conservative debt policy and conservative use of cash, although the magnitude is not large.

Table II

Relation between the Kink in a Firm's Tax Benefit Function and Standardized Kink

The firm-year observations are grouped according to where a firm's marginal benefit function of interest deductions becomes downward sloping (i.e., the "kink" in the benefit function, where the benefit of incremental interest deductions begins to decline). The benefit function for a firm in the "kink = 1.6" group is not downward sloping for interest deductions 1.6 times those actually taken but becomes downward sloping for interest deductions greater than 1.6 times those actually taken. A firm in the group "kink = 0.2" has a downward-sloping marginal benefit curve for interest deductions greater than 20 percent of those actually taken. Firms in the 0.0* and 0.0 groups have downward-sloping benefit curves for the first dollar of interest expense. Firms in 0.0* (0.0) have a gross benefit less than (greater than or equal to) $0.15 for the first dollar of interest. *Standardized kink* is dollars of interest associated with the kink, divided by the standard deviation of earnings.

Kink	Standardized Kink	Number of Obs.
0.0*	0.00	16,983
0.0	0.00	10,855
0.2	0.14	2,763
0.4	0.31	2,241
0.6	0.52	2,129
0.8	0.83	2,202
1.0	1.36	2,539
1.2	1.64	5,052
1.6	2.11	4,378
2.0	1.75	9,496
3.0	2.17	6,580
4.0	1.91	4,376
5.0	1.77	2,810
6.0	2.09	2,074
7.0	1.95	1,646
8.0	1.10	11,519

The mean value of kink indicates that the average firm could use 2.36 times its chosen interest deductions before the marginal benefit begins to decline (see Table I). Nearly half the sample firms could double interest deductions before ending up on the negatively sloped part of their tax benefit functions (i.e., they have kinks of at least two in Table II). At the other extreme, nearly one-third of firms have net benefits that are negative and decline starting with the first increment of interest expense (i.e., kink equals zero). In Section IV, I explore the degree to which costs explain variations in kink.

I also determine the point where the benefit of incremental deductions is zero (ZeroBen). ALC has ZeroBen of 1.2 (see Figure 1). The mean ZeroBen indicates that the average firm could use 3.54 times its chosen interest before the marginal benefit goes to zero (see Table I). I only mention ZeroBen occasionally because it is highly correlated with kink.

The mean kink declines noticeably over the sample period. In 1980 the average kink is 3.1, compared to approximately 1.9 in the 1990s (Table III). ZeroBen declines from around 3.8 to 3.2 over this time frame. To make sure that the decline in kink is not driven by low-kink firms entering toward the end of the sample, I repeat the experiment for firms that existed at least 11 consecutive years. Kink also declines for this subsample of firms.

The time trend in kink provides evidence that the typical U.S. firm uses debt more aggressively now than it did in the early 1980s, before the LBO wave, and when firms faced less international competition. For example, 3M Corporation recently became more highly levered, and consequently their debt has been downgraded by Moody's Investors' Service from AAA to Aa1. Moody's reports that the downgrade resulted from

> continued growth in leverage at 3M resulting from management's decision to lever the company's capital structure through increased share repurchases and debt issuances. 3M management's tolerance for financial leverage has been increasing since the early 1990s . . . weakening the company's historically extremely strong debtholder protection . . . 3M didn't dispute Moody's rating move, but emphasized the company's increased leverage is part of a "strategy, a conscious effort to increase shareholder value" by more effectively exploiting its financial strength (*Wall Street Journal* (1998)).

Grinblatt and Titman (1998) argue that several factors, including shelf registration of securities and the globalization of capital markets, have effectively lowered the transactions costs of borrowing over the past two decades, which could encourage the use of debt. Although the typical firm uses debt more aggressively, value-weighted kink has remained at approximately 3.6 over the sample period (not tabulated), indicating that debt conservatism has remained steady for large firms.

III. Empirical Evidence on the Tax-Reducing Benefit of Interest Deductions

The tax benefit of debt equals the area under a benefit function (up to the point of actual interest expense). I include state tax effects by adding $(1 - \tau_{\text{Federal}})\tau_{\text{State}}$ to the federal benefit in each firm-year.

A. Aggregate Tax Benefits of Debt

Table III shows that the gross value of interest deductibility increases from \$9.5 million per firm in 1980 to \$15.1 million by 1986. The per-firm benefit drops slightly in 1987 and 1988, after the Tax Reform Act of 1986 reduced statutory corporate tax rates. The upward trend then resumes, reaching a high of \$18.7 million per firm in 1990, before declining to approximately \$14

Table III

The Aggregate Tax Benefit of Debt

Gross benefits equal the area under each firm's gross benefit curve (up to the point of actual interest expense), aggregated across firms. Gross benefits measure the reduction in corporate and state tax liabilities occurring because interest expense is tax deductible. Net benefits equal gross benefits minus the personal tax penalty. That is, net benefits are reduced to account for the fact that firms must pay a higher risk-adjusted return on debt than on equity, because investors demand a higher return to compensate for the higher rate of personal taxation on interest income, relative to equity income. The *Total* and *Per Firm* columns express the annual tax benefits of debt. The *Percent of Firm Value* columns express the capitalized tax benefit of debt aggregated across firms, expressed as a percentage of aggregate firm value. *Zero Benefit* is the amount of interest for which the marginal tax benefit of debt equals zero, expressed as a proportion of actual interest expense. *Kink* is the amount of interest where the marginal benefit function becomes downward sloping, expressed as a proportion of actual interest expense.

	Gross Benefit			Net Benefit					
	Total $ (millions) annual	Per Firm $ (millions) annual	Percent of Firm Value Capitalized	Total $ (millions) annual	Per Firm $ (millions) annual	Percent of Firm Value Capitalized	Zero Benefit	Kink	*N*
1980	50,830	9.5	10.1	13,156	2.5	2.6	3.79	3.10	5,335
1981	63,196	12.1	11.4	18,114	3.5	3.3	3.68	2.98	5,215
1982	65,402	12.4	11.0	24,848	4.7	4.2	3.73	2.69	5,254
1983	62,447	11.8	10.7	25,528	4.8	4.4	3.74	2.68	5,281
1984	78,736	12.6	10.9	27,111	5.0	4.3	3.80	2.75	5,461
1985	75,013	13.6	11.1	27,310	4.9	4.0	3.55	2.51	5,524
1986	83,869	15.1	11.6	30,382	5.5	4.2	3.27	2.39	5,564
1987	81,106	13.6	10.7	36,980	6.2	4.9	3.53	2.35	5,971
1988	89,593	14.7	9.9	43,559	7.1	4.8	3.70	2.30	6,115
1989	109,292	17.9	10.6	54,351	8.9	5.3	3.65	2.24	6,103
1990	113,605	18.7	10.7	56,480	9.3	5.3	3.50	2.08	6,087
1991	107,411	17.5	9.6	53,661	8.8	4.8	3.42	1.99	6,123
1992	98,345	15.7	8.7	51,419	8.2	4.6	3.53	2.07	6,282
1993	84,937	13.1	7.7	42,168	6.6	3.8	3.11	1.71	6,479
1994	94,770	13.8	7.3	45,939	6.7	3.5	3.27	1.94	6,849

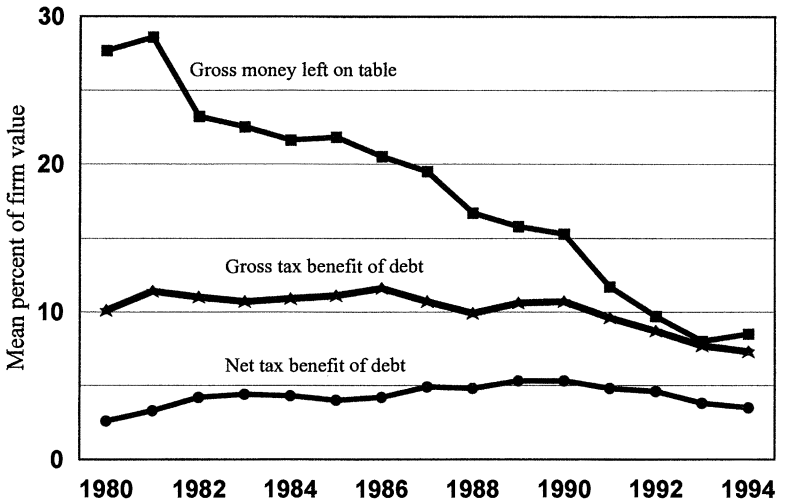

Figure 2. The tax benefits of debt. The line marked with stars shows the gross tax benefits of debt (expressed as a percentage of firm value). The line marked with circles shows a lower bound estimate of the net (of the personal tax penalty) tax benefit of debt. (It is a lower bound because the pretax cost of debt is used as discount rate, rather than an after-personal-tax discount rate.) The line marked with squares shows the *additional* tax benefit that could be obtained if firms with kink greater than one levered up to the kink in their interest benefit functions. The gross lines ignore the personal tax penalty.

million per firm by the mid-1990s. The largest aggregate savings for any year is $114 billion in 1990, with this figure representing 6,087 sample companies.

The annual reduction in taxes due to interest deductibility is $95 billion for sample firms in 1994. This understates the savings for the entire domestic economy because the COMPUSTAT sample does not contain information on the complete universe of firms. For example, 1994 income tax expense for the sample is about 80 percent of "income tax after credits" for the entire U.S. economy (U.S. Internal Revenue Service (1995)).

The third column of Table III shows the capitalized tax savings from interest deductions expressed as a percentage of the market value of the firm. The present value of interest deductions averages 9.7 percent of the value of the firm, although this amount varies from year to year (see Figure 2). Using a firm-specific discount rate (interest expense divided by total debt) results in a present value tax benefit of 9.5 percent.[9] These numbers should be

[9] To investigate the degree to which the discount rate affects the present value calculations (a "stock"), I compare the year-by-year tax savings to cash flow available to investors (a "flow" that is defined as pretax income plus interest expense plus depreciation minus taxes paid). The yearly tax savings average 9.5 percent, corroborating the present value numbers. (This also suggests that one could calculate a perpetuity based on the $t + 1$ tax savings without inducing substantial measurement error.)

interpreted as a more sophisticated estimate than "$\tau_C D$" of the tax-reducing benefit provided by interest deductions. The traditional $\tau_C D$ estimate equals approximately 13.2 percent of firm value and so is one-third too large. Aggregated across all firms in the sample, I estimate that the capitalized value of interest deductibility is $1.4 trillion in 1990.[10]

The results reported above do not account for the personal tax penalty, nor do they account for nontax costs and benefits of debt. Table III shows that the net (of personal taxes) benefit of interest deductions ranges from an aggregate total of $13.2 billion in 1980 to a high of approximately $55 billion in 1989 to 1991. On a per-firm basis, the benefits are $2.5 million in 1980 and gradually increase to $9.3 million in 1990.

The capitalized value of net interest deductions is about 4.3 percent of market value over the sample period.[11] This number is a lower bound, because it is calculated using the pretax cost of debt as discount rate. If I discount with the after-personal-tax bond or equity rate, the net benefits of interest deductions average about six to seven percent of firm value. The personal tax penalty reduces gross benefits by about 60 percent in 1982 to 1986 but by less than one-half from 1987 to 1990. This implies that the Tax Reform Act of 1986 made debt financing more attractive.

Some capital structure models price assets to reflect the tax benefits they generate. In Kane, Marcus, and McDonald (1984) asset prices are bid up to the extent that assets generate tax-shielding benefit, effectively passing the tax-shielding gains to the original owner of an asset. Thus, the price of a debt-supporting asset is higher than it would be if interest were not deductible, and the asset's operating return is lower. A firm achieves its required return by earning an operating return plus a financial return provided by interest tax shields. In this environment, issuing debt does not add a tax shield "bonus" to firm value. Instead, tax benefits are the "loss avoided" by using debt appropriately. If a firm were to stop using debt but continue to

I further quantify the effect of discount rates by repeating my calculations with two alternative rates. If I use an after-personal-tax cost of equity (a variation of Miles and Ezzell (1985)), I estimate that the tax benefits of debt are approximately 12 percent of firm value. If I discount with the risk-free rate, the gross tax benefits of debt equal 14 percent of firm value.

[10] These figures could overstate the benefit of domestic interest deductibility because I assume that total interest expense can be deducted from taxable earnings, although tax rules require multinational firms to allocate a portion of interest expense to their foreign income (Froot and Hines (1995)). To check whether multinational interest allocation affects my results, I examine firms that pay at least 80 percent of their taxes domestically. The present value benefits are approximately nine percent of firm value for these firms, suggesting that treating COMPUSTAT income, debt, and taxes as domestic does not introduce a substantial bias.

[11] Poterba (1997) provides an alternative estimate of the personal tax penalty. Using Flow of Funds data, Poterba imputes a weighted average of marginal tax rates for various asset classes (stocks, bonds, etc.), in which the averaging is done across sectors of the economy (i.e., households, insurance companies, banks, etc.) to explicitly incorporate which sector owns stocks, bonds, etc. Combining Poterba's estimates of τ_P, $\tau_{\text{cap.gains}}$, and $\tau_{\text{dividends}}$ from his Table A-1 into a new measure of the personal tax penalty, I find that net tax benefits constitute 4.5 percent of firm value, corroborating my results.

use debt-supporting assets, its value would drop by approximately the magnitude of the tax benefit estimated above. Therefore, according to Kane et al. (1984), the numbers presented above measure the benefit resulting from interest tax shields, but they should be interpreted as providing required return, not a bonus to firm value.[12]

B. Firm-by-Firm Analysis of the Tax Benefits of Debt

I perform a Tobit analysis to determine what types of firms have the largest tax benefits of debt. The dependent variable is the percentage of firm value represented by net interest deductions, constrained to lie between zero and one. The explanatory variables are dummies indicating whether the firm has negative owners' equity, NOL carryforwards, or pays dividends, PPE to assets, ROA, the q-ratio, advertising-to-sales, R&D to sales, the modified Z-score, ECOST, the log of real sales, and the quick ratio. Untabulated results indicate that large, liquid, profitable, collateralized firms with low expected costs of distress and small research expenses have the largest tax benefits. Firms with below-average growth opportunities have larger benefits than do growth firms.

In Table IV, I present information based on the benefit functions of some well-known firms. Boeing is the representative "highly profitable" firm, although the information is qualitatively similar for, among others, Coca-Cola, Compaq, Eastman Kodak, Exxon, GE, Hewlett-Packard, McDonalds, Merck, Microsoft, 3M, Phillip Morris, Procter and Gamble, and Westvaco. (By "highly profitable" I mean "did not realize a loss during the sample period.") Most highly profitable firms have kinks of eight every year, indicating that they could increase interest by a factor of eight without encountering declining marginal benefit. (Recall that eight is the largest possible value of kink in my analysis.) The gross benefit of interest deductions is between one and eight percent of market value for these firms, and the net benefit is in the zero to three percent range. Most of these firms have high debt ratings and are not firms we think of as having high costs of debt. Several have great intangible value that distress could diminish. However, the ex ante probability of distress is small, implying that expected costs are also small. The *expected* net benefit of the last dollar of interest deduction is generally between \$0.13 and \$0.25 for these firms (as measured by $MTR^{100\%}$), implying that the expected costs for the last dollar of interest must be quite large if these firms equalize the expected marginal costs and benefits of interest deductions.

Two caveats are in order. First, the categorization by profitability is based on ex post observation of realized profitability. Second, some firms mentioned in this section have substantial overseas operations. For example,

[12] Kane et al. (1984) also argue that tax shields are not lost in bankruptcy but instead are recovered in what the next owner pays for the asset. To the extent this is true, my numbers underestimate the benefit of tax shields because I assume that tax benefits are zero for interest deductions that can not be used to shield the present or future income of the firm under investigation.

Table IV

The Tax Benefit of Debt and Other Characteristics for Some Individual Firms

Kink is the amount of interest required to make a firm's marginal benefit function become downward sloping expressed as a proportion of actual interest expense. *Gross benefit/market value* is the present value of gross tax savings expressed as a percentage of market value (where market value is book assets minus book equity plus market equity). *Net benefit/market value* is the present value of tax savings minus the personal tax penalty expressed as a percentage of market value. *Net benefit/total assets* is the present value of tax savings minus the personal tax penalty expressed as a percentage of book assets. *Debt/assets* is the book value of debt divided by the book value of assets. *Credit rating* is the firm's credit rating on senior debt as assigned by Standard and Poor. NA means not available. *EBIT* is earnings before interest and taxes. $MTR^{100\%}$ is the simulated marginal tax rate based on earnings before taxes, net of the personal tax penalty. Boeing is the representative "always profitable" firm. Intel is a typical "usually profitable" firm. Pacific Gas & Electric is a regulated electric utility. RJR Nabisco and Safeway both completed LBOs during the sample period; an asterisk * indicates the year they completed their respective leveraged buyouts.

Company	Characteristic	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Boeing	Kink	7.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	4.0	7.0
	Gross benefit/market value (%)	2.0	1.6	0.8	1.1	1.0	0.6	0.5	0.5	1.1	2.6	3.8
	Net benefit/market value (%)	0.7	0.5	0.2	0.3	0.4	0.3	0.3	0.2	0.4	1.0	1.5
	Debt/assets (%)	5.1	3.5	0.4	2.5	2.1	2.0	2.1	2.2	8.3	9.9	12.9
	Credit rating	NA	NA	AA−	AA−	AA−	AA−	AA−	AA	AA	AA	AA
	EBIT (millions)	517	605	883	1055	685	846	1404	2000	2261	848	2010
	$MTR^{100\%}$ (%)	14.7	13.1	13.0	13.0	16.2	15.7	16.5	15.2	14.0	13.2	13.4
Intel	Kink	5.0	8.0	0.0	2.0	1.0	5.0	5.0	6.0	7.0	8.0	8.0
	Gross benefit/market value (%)	1.4	1.8	0.0	2.7	0.0	5.7	5.7	4.9	3.4	1.5	1.0
	Net benefit/market value (%)	0.3	0.4	0.0	0.6	0.0	2.1	2.1	1.8	1.2	0.6	0.4
	Debt/assets (%)	12.4	10.4	16.7	19.2	28.9	19.6	14.3	11.6	8.5	6.9	8.1
	Credit rating	NA	NA	A	A	A	A	A	A	A	A	A+
	EBIT (millions)	202	323	31	−46	466	721	780	1089	1299	1698	3573
	$MTR^{100\%}$ (%)	7.5	7.5	−9.3	7.5	8.2	9.9	9.9	9.9	9.9	10.6	108

Pacific Gas and Electric	Kink	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Gross benefit/market value (%)	19.0	18.4	19.3	18.9	18.6	15.9	15.8	14.5	12.6	13.2	13.4
	Net benefit/market value (%)	10.2	9.5	10.1	10.0	12.7	11.8	11.8	10.8	8.3	8.7	8.8
	Debt/assets (%)	40.3	43.0	43.5	42.7	41.8	43.2	40.0	40.7	41.1	40.8	37.8
	Credit rating	NA	NA	A+	A+	A+	A	A	A	A	A	A
	EBIT (millions)	1965	2257	2506	2807	2086	1875	2424	2761	2703	2885	3000
	$MTR^{100\%}$ (%)	23.5	22.3	22.8	23.0	25.5	24.2	24.2	24.2	21.1	20.9	21.7
RJR Nabisco	Kink	6.0	7.0	6.0	6.0	5.0	5.0	2.0*	1.2	1.2	1.2	1.2
	Gross benefit/market value (%)	8.4	8.1	10.7	15.2	11.6	7.8	23.8	NA	28.0	20.6	21.1
	Net benefit/total assets (%)	3.5	3.9	4.8	8.2	7.4	7.5	14.7	15.3	11.3	7.8	7.2
	Debt/assets (%)	16.2	17.1	33.6	34.0	26.7	32.3	68.0	56.7	44.6	43.8	40.0
	Credit rating	NA	NA	NA	NA	NA	NA	BB	BB	BBB−	BBB−	BBB−
	EBIT (millions)	1751	2448	2278	2532	2784	2949	2272	2900	2893	2179	1832
	$MTR^{100\%}$ (%)	16.2	16.4	16.1	15.9	17.3	15.9	9.9	9.9	9.9	9.9	10.0
Safeway	Kink	2.0	2.0	2.0	1.0*	0.8	1.0	1.0	1.0	1.0	1.0	1.2
	Gross benefit/market value (%)	15.2	15.6	16.3	17.2	NA	NA	NA	28.8	24.8	22.8	20.9
	Net benefit/total assets (%)	6.6	6.7	7.5	12.2	18.1	13.5	13.0	12.8	11.5	9.8	9.8
	Debt/assets (%)	31.3	33.8	30.8	76.3	75.4	72.0	68.7	65.1	59.2	58.3	53.0
	Credit rating	NA	NA	A	B+	B+	B+	B+	BB−	BB	BB	BB
	EBIT (millions)	510	530	556	522	−98	520	527	634	638	467	595
	$MTR^{100\%}$ (%)	18.0	17.7	17.2	19.5	2.6	9.9	9.9	9.9	9.9	9.9	9.9

about 70 percent of Coca-Cola's income and taxes is nondomestic. The fact that I treat all income, debt, and taxes as domestic (due to COMPUSTAT data limitations) could be problematic for these firms. For example, foreign tax credit rules limit the ability of firms to use foreign interest deductions and can even limit their ability to use domestic deductions to offset domestic income (Collins and Shackelford (1992)). Boeing is chosen as the representative firm for the highly profitable group because it does not pay foreign tax. I chose Boeing knowing that it experienced financial difficulty after 1994 to highlight the arbitrary nature of my classification. Note, however, that Boeing was on sounder financial footing by the late 1990s and throughout the decade had a per dollar of interest tax benefit of debt equal to the statutory tax rate. The other firms shown in Table IV have no more than one-third of their operations overseas. In general, the magnitudes and correlations presented throughout the paper are similar on a sample of firms that pay at least 80 percent of their taxes in the United States.

In Table IV, the "usually profitable" firms are represented by Intel. (By "usually profitable" I mean "realize a loss in one or two years of the sample period.") Qualitatively similar results hold for AT&T, American Airlines, Chevron, Ford Motor Company, General Motors, IBM, Lockheed Martin, and Pepsi. In most years, these firms could substantially increase their interest deductions without encountering declining marginal benefit, although in a few years they experience declining benefit at their chosen interest expense. Even in years when they encounter declining marginal benefit, many of these firms would receive between \$0.08 and \$0.15 in expected benefit on an incremental dollar of interest (as measured by $MTR^{100\%}$). Again, we might wonder how large the expected costs of debt are for these firms. The Intel data show a consistent pattern that emerges for the usually profitable firms: After they emerge from a brief unprofitable period, they return to a very profitable state, and their leverage declines to (or below) its predifficulty level. These firms seem to prefer operating far from the downward-sloping portion of their benefit functions, and they relocate to a conservative position as soon as they are profitable enough to do so. By operating far from "the cliff," even if a bad realization occurs, these firms can quickly rebound.

The "regulated utility" group is represented by Pacific Gas and Electric, but the results are similar for most utilities, including Commonwealth Edison, Southern California Edison, and Virginia Electric and Power Company. Perhaps because of their steady cash flows or the regulatory process, these firms are highly levered. After considering the personal tax penalty, the tax benefit of interest deductions contributes approximately 10 percent to firm value. These utilities could realize over \$0.20 of benefit per dollar of additional interest.

The leveraged buyout (LBO) group is represented by RJR Nabisco (LBO in 1989) and Safeway (LBO in 1986). Prior to their LBOs, these firms had highly rated debt, and net tax benefits contributed about five to eight percent of asset value. After their LBOs, they had debt-to-assets ratios of approximately 70 percent, with the net contribution of tax benefits doubling to

15 to 20 percent of asset value. Even in this highly leveraged position, however, their chosen interest expense did not place them on the downward-sloping part of their benefit functions (except for Safeway in 1987).[13] In fact, $MTR^{100\%}$ indicates that these firms would have realized tax benefits worth \$0.10 on the dollar had they used even more interest. As is typical with LBOs, RJR and Safeway's leverage ratios decline noticeably in the years following their leveraged buyouts, as does the contribution of tax deductions to firm value.

IV. Using Benefit Curves to Examine the Cost of Debt

Why do some firms take interest deductions to the point of declining marginal benefit whereas others are more conservative? The trade-off theory implies that firms with large kinks do not pursue debt aggressively because the cost of doing so is high. In this section, I examine whether this is true by comparing the kink to cost variables. Recall that the benefit functions explicitly incorporate personal tax costs and the probability of losing tax shields due to tax exhaustion.

Before comparing the kink to cost variables, I examine the relation between debt-to-value and the kink in the marginal benefit function. Debt-to-value is positively related to kink up to a kink of one but negatively related for kink greater than one (see Table V). The latter relation makes sense if firms choose conservative debt policy (i.e., have large values of kink) when facing large ex ante costs. However, this negative relation between kink and debt-to-value could be caused by data realizations. Suppose a firm has a very good realization in Year t. This could cause both market value and kink to increase, and if the firm does not promptly rebalance its debt, its kink and debt ratio will be negatively related. The former relation (i.e., the positive relation between kink and debt-to-value up to kink of one) could also be affected by data realizations. Firms with very low kinks are likely in or near financial distress and often have negative net tax benefits for the first dollar of interest. It seems unlikely that they chose ex ante to issue debt for tax purposes; instead these firms may end up with low kinks after experiencing distress, and their benefit functions therefore largely reflect ex post data influences. If these conjectures are correct, I need to control ex ante and ex post data influences in my analysis.

A. *Relating Benefit Curves to Measures of the Cost of Debt*

In Table VI, I perform a multivariate Tobit analysis to determine how variables measuring the cost of debt are related to the kink. The regressions include the nontax factors defined in Section I as explanatory variables,

[13] Using "$\tau_C D$" to estimate the contribution of tax benefits is reasonable for these firms because they are not on the downward-sloping portion of their benefit functions (see Kaplan and Ruback (1995)).

Table V

Relation between the Kink in a Firm's Tax Benefit Function and Firm Characteristics

The firm-year observations are grouped according to where a firm's marginal benefit function of interest deductions becomes downward sloping (i.e., the "kink" in the benefit function, where the benefits of incremental interest begin to decline). The benefit function for a firm in the "kink = 1.6" group becomes downward sloping for interest deductions greater than 1.6 times those actually taken. Firms in the 0.0* and 0.0 groups have downward-sloping benefit curves for the first dollar of interest expense. Firms in 0.0* (0.0) have a gross benefit less than (greater than or equal to) $0.15 for the first dollar of interest. The table presents mean values for firm characteristics for the years 1980 to 1994. *Debt-to-value* is long-term debt plus debt in current liabilities, the sum divided by the market value of the firm. The *market value* of the firm is book assets minus book equity plus market equity. *Z-score* is the modified Altman's (1968) *Z*-score. *NODIV* is a dummy variable equal to one if the firm does not pay dividends. *RDS* is research and development expense to sales ratio, set equal to zero if the numerator is missing. The *q-ratio* is preferred stock plus market value of common equity plus net short-term liabilities, the sum divided by total assets. *PPE-to-assets* is net property, plant, and equipment divided by total assets. *Ln(real sales)* is the natural log of real sales (where sales are deflated by the implicit price deflator), with sales expressed in millions of dollars. The *current ratio* is short-term assets divided by short-term liabilities. *CYC* is the standard deviation of operating earnings divided by mean assets first calculated for each firm, then averaged across firms within two-digit SIC codes. *ROA*, return-on-assets, is operating cash flow divided by total assets.

Kink	Debt-to-Value	*Z*-Score	NODIV	RDS	*q*-ratio	PPE-to-Assets	Ln(real Sales)	Market Value	Current Ratio	CYC	ROA
0.0*	0.328	−2.902	0.911	0.137	2.095	0.305	−2.901	328	2.934	0.247	−0.198
0.0	0.400	0.155	0.843	0.035	0.926	0.312	−1.722	590	2.383	0.216	0.020
0.2	0.441	1.215	0.816	0.020	0.585	0.322	−1.110	684	2.189	0.189	0.050
0.4	0.459	1.651	0.779	0.015	0.497	0.335	−0.769	673	1.990	0.182	0.071
0.6	0.458	1.761	0.752	0.013	0.408	0.334	−0.527	1005	1.989	0.176	0.082
0.8	0.471	1.941	0.715	0.012	0.384	0.339	−0.396	1042	1.876	0.167	0.088
1.0	0.518	2.001	0.621	0.010	0.418	0.298	−0.019	2352	1.778	0.164	0.095
1.2	0.498	2.131	0.541	0.009	0.390	0.311	0.178	1996	1.825	0.149	0.105
1.6	0.414	2.130	0.447	0.010	0.426	0.364	0.395	2131	1.849	0.148	0.114
2.0	0.358	2.155	0.335	0.010	0.500	0.422	0.763	2159	1.878	0.138	0.127
3.0	0.317	2.342	0.303	0.013	0.593	0.406	0.876	2024	2.055	0.141	0.143
4.0	0.257	2.599	0.284	0.016	0.766	0.362	0.971	2473	2.279	0.145	0.156
5.0	0.221	2.713	0.270	0.019	0.832	0.334	0.961	2707	2.464	0.146	0.159
6.0	0.192	2.741	0.279	0.019	0.901	0.318	0.933	3007	2.579	0.143	0.161
7.0	0.176	2.833	0.283	0.020	0.963	0.323	0.758	3235	2.623	0.145	0.171
8.0	0.115	3.058	0.315	0.024	1.480	0.254	0.169	2103	3.827	0.151	0.182

with squared terms to account for potential nonlinearities. (The capital expenditure, managerial ownership, and Herfindahl variables have many missing values and are examined separately below.) Titman's (1984) theory implies that dummy variables for computers (three-digit SIC 357); semiconductors (367); chemicals and allied products including drugs (280–289); wholesale chemicals (516); aircraft, guided missiles, and space vehicles (372/376); and other sensitive industries (340–400 except 357, 367, 372, and 376) should be positively related to kink.

The regression results in column VIa indicate that firms use debt conservatively when they pay dividends, have positive owners' equity, do not have NOLs, are highly profitable (large ROA), and have low expected costs of distress (low ECOST, high Z-score). These coefficients suggest that conservative firms face *low* costs from debt financing. Firms that pay dividends should face low information asymmetry costs (Sharpe and Nguyen (1995)) and use debt somewhat aggressively, opposite from what I find. Firms with positive owners' equity, no NOLs, and low expected costs of distress should use more debt, opposite from my results. High-ROA companies are unlikely to face large costs of using debt.[14] Rather than use more debt, profitable firms use less. (This last result may simply reflect that firms do not use debt if they have sufficient profits, as suggested by the pecking order theory, which I examine below.) Note from Table V that the univariate relations between each of the variables discussed thus far and kink are nearly monotonic.

The regression coefficients in column VIa also reveal that large (high sales), liquid (high current and quick ratios) firms that are not in cyclical industries use debt conservatively, again indicating that high-kink firms face low debt costs. The liquidity ratios might indicate that high-kink firms are required by lenders to remain liquid to obtain financing (the numerators of the ratios are large), have a difficult time borrowing (the denominators are small), or build up a cache of short-term assets to avoid the need for external financing (Calomiris and Himmelberg (1997)).

Some of the regression coefficients do indicate that high costs cause firms to use debt conservatively. High-kink firms have growth opportunities (high RDS and q-ratio), have low collateral (low PPE-to-assets), and may be in the wholesale chemical (coefficient of 0.665), computer (0.276), or chemical and allied products (0.067) industries or other sensitive industries (0.114); all these coefficients are statistically significant. These items indicate that firms with intangible assets and growth options, or in sensitive industries, are

[14] This relation could be partially spurious because of the cost of issuing or retiring debt (e.g., Fisher et al. (1989)). Recapitalization costs could discourage unprofitable firms from immediately retiring debt, whereas a profitable firm might have an apparently conservative debt policy because issuance costs discourage debt issuance. Given the magnitude of the potential tax benefits for very profitable firms, it seems unlikely that recapitalization costs completely explain the relation between kink and ROA. Moreover, executives state that recapitalization and issuance costs have only a modest effect on debt retirement and issuance (Graham and Harvey (2001)).

Table VI

Tobit Regressions Using the Kink in the Benefit Function as Dependent Variable

I(.) defines a dummy variable equal to one if a firm is in a certain industry or meets the listed condition. *CYCLICAL* is the standard deviation of operating earnings divided by mean assets first calculated for each firm, then averaged across firms within two-digit SIC codes. *Return-on-assets* is operating cash flow divided by total assets. *Ln(real sales)* is the natural log of real sales (where sales are deflated by the implicit price deflator), with sales expressed in millions of dollars. *Z-score* is the modified Altman's (1968) *Z*-score. *ECOST* is the standard deviation of the first difference in taxable earnings divided by assets, the quotient times the sum of advertising, research, and development expenses divided by sales. The *current ratio* is short-term assets divided by short-term liabilities. The *quick ratio* is cash, short-term investments, and receivables, the sum divided by current liabilities. *PPE-to-assets* is net property, plant, and equipment divided by total assets. The *q-ratio* is preferred stock plus market value of common equity plus net short-term liabilities, the sum divided by total assets. *Advertising-to-sales* is the ratio of advertising expense to sales and *R&D-to-sales* is research and development expense to sales ratio, with either variable set equal to zero if its numerator is missing. The *Herfindahl* indices are calculated within two-digit SIC codes for *assets* and *sales*, respectively. *Capital expenditures* and *acquisitions* are from the statement of cash flows and measure the sum of investing activities in Years $t + 1$ and $t + 2$. *CEOSTOCK* is the percentage of common shares owned directly by the CEO. *BDSTOCK* is the percentage of common shares held by non-CEO board members. *CEOOPT* measures vested options held by the CEO expressed as a percentage of total common shares. *YRSCEO* is the log of the number of years the CEO has been chief executive. *BOARDSZ* is the log of the number of directors, and *PCTOUT* measures the percentage of directors that are outsiders.

	Estimated Coefficients						
	Column VIa		Column VIb		Column VIc	Column VId	
	Variable	(Variable)^2	Variable	(Variable)^2	Variable	Variable	(Variable)^2
Intercept	0.354*		0.412*		1.635*	1.260*	
I(No dividend)	−0.483*		−0.384*			−0.273*	
I(Negative owners' equity)	−0.426*		−0.456*			−0.076	
I(NOL carryforward)	−0.459*		−0.456*			−0.277*	
I(chemicals and allied products)	0.067*		0.054**			0.069	
I(computers)	0.276*		0.263*			0.426*	
I(semiconductors)	0.040		0.008			0.318**	
I(wholesale chemicals)	0.665*					9.835	

I(aircraft/guided space vehicles)	0.052		0.056			0.285*	
I(other sensitive industries)	0.114*		0.117*			0.194*	
CYCLICAL	−0.308*		−0.176*			−0.992*	
Return on assets	2.334*	2.700*	2.130*	2.887*	7.029*	1.603*	4.413*
Ln(real sales)	0.048*	−0.002**	0.049*	−0.002*	−0.092*	−0.330*	0.046
Z-score	0.126*	0.004*	0.124*	0.004*		0.513*	−0.063*
ECOST	−0.117*	0.003*	−0.119*	0.003*		−0.647**	−0.324***
Current ratio	0.127*	−0.009*	0.135*	−0.009*		−0.009	0.002
Quick ratio	0.253*	−0.006*	0.250*	−0.006*		0.262*	−0.014
PPE-to-assets	−1.395*	1.375*	−1.428	1.355*	−0.865*	−2.194*	2.276*
Q-ratio	0.503*	−0.046*	0.527*	−0.047*		0.573*	−0.579*
Advertising-to-sales	−0.155	11.74*	−0.558	14.39*		−0.479	7.071
R&D-to-sales	1.466*	−0.891*	1.417*	−1.034*	0.899**	3.285*	−6.581*
Asset Herfindahl			−0.515*	0.569*			
Sales Herfindahl			0.247	−0.323***			
Capital expenditures			0.215***	−0.078			
Acquisitions			0.749*	−2.176*			
CEOSTOCK					−0.591*	0.071	
CEOOPT					−11.46**	−6.705	
YRSCEO					0.039*	−0.003	
BOARDSZ					−0.105**	0.014	
PCTOUT					−0.294*	−0.351*	
BDSTOCK					0.213	0.014	
OLS R^2	50.2%		49.5%		44.5%	61.2%	
Number of observations.	65,373		55,644		2,910	2,773	

*, **, *** Significant at the 1 percent, 5 percent, and 10 percent level, respectively.

conservative in their use of debt. However, among the industry dummies, only the wholesale chemical and computer coefficients are economically important. Note from Table V that neither q-ratio, RDS, nor PPE-to-assets has a strong univariate relation with kink.

To explore whether industry effects drive corporate debt policy, I perform two additional experiments. First, I replace the dependent variable with the industry-adjusted kink (i.e., I subtract the mean kink for the appropriate three-digit SIC code from the kink for each observation). If industry structure is the only factor that explains where firms locate on their benefit functions, then there should be no relation between the industry-adjusted kink and firm characteristics. On the contrary, an untabulated regression shows that the observed patterns in the data are nearly identical to those reported above, indicating that more than just product market influences are at work. Second, I include asset- and sales-based Herfindahl indices in the regression, using 1987 to 1994 data from the COMPUSTAT segment tape (see column VIb in Table VI). The results indicate that firms in concentrated industries (high asset Herfindahl) use debt aggressively. This finding is surprising given that Chevalier (1995) finds that highly levered supermarkets can be taken advantage of in concentrated markets.

Next, I test whether firms preserve debt capacity for future acquisitions. The estimated coefficients are consistent with conservative firms making significantly larger future acquisitions and capital expenditures than their peers (see column VIb). The economic effect is very small, however, with a one-standard-deviation increase in either variable leading to a 0.04 increase in kink.

I also investigate whether managerial entrenchment leads to debt conservatism. Initially, I analyze a specification similar to that in Berger et al. (1997) (i.e., I include only size, ROA, PPE-to-assets, and R&D-to-sales as control variables). The main difference between this initial experiment and Berger et al. (1997) is that I use kink as a dependent variable and they use debt-to-value. Using just these few control variables, my results are similar to those in Berger et al. (1997): debt conservatism increases with managerial entrenchment. Conservatism decreases with CEO holdings of stock and vested options and with the portion of the board comprised by outsiders, and it increases with CEO tenure (see column VIc). However, when I use the full set of control variables, these findings are largely overturned: only the portion of outsiders on the board remains significant (see column VId). The insignificance of the entrenchment variables is notable because it is not consistent with the Berger et al. (1997) result that nearly all of the entrenchment variables are significant.[15]

[15] I repeat the column VId analysis using the Berger et al. (1997) dependent variable, debt-to-value. In an untabulated Tobit (OLS) specification with debt-to-value as dependent variable, only one (two) of the entrenchment variables are significant. This corroborates my finding that, when the full set of controls is used, the entrenchment variables do not explain debt conservatism very well.

It is possible that the column VId regression coefficients are biased and inconsistent because a number of the right-hand-side variables could be endogenously affected by managerial entrenchment (e.g., the q-ratio). If this is the case, this might explain the lack of significance in the entrenchment variables in column VId. Although the column VIc regression coefficients could also be affected by this econometric issue, they might be more trustworthy because they are estimated in an equation with fewer potentially endogenous right-hand-side variables. Alternatively, perhaps the entrenchment variables proxy for nonentrenchment effects and therefore are not significant in column VId when the full set of control variables is included. Given that I can not distinguish between these hypotheses, I interpret my results as weak evidence that managerial entrenchment permits debt conservatism.

I perform a number of robustness checks on the regression results. First, I repeat the analysis in Table VI using two-year-lagged values for the explanatory variables to ensure that they are measured ex ante, to minimize potential endogeneity and ex post data effects. The correlation patterns are qualitatively similar to those reported. The analysis is also repeated using only "healthy firms" (i.e., dividend-paying firms that have positive owners' equity and no NOL carryforwards). Using a healthy-firm subset reduces the effects of ex post distress realizations and focuses the analysis on ex ante influences. The healthy-firm results are similar to those in Table VI. I also repeat the analysis comparing twice-lagged kink with current-period explanatory variables. This attenuates the influence that large realized profits have on the kink and explanatory variables. Again, the general patterns are almost identical to those shown in Table VI. This series of experiments indicates that the observed data patterns are not driven by ex post data influences. Finally, I repeat the analysis using standardized kink as the dependent variable. The findings are qualitatively unchanged.

B. Persistence, the Peso Problem, and the Pecking Order as Possible Explanations of Debt Conservatism

A firm might adjust its debt level slowly, if at all, if it feels profits are transitory or cyclical. Such an adjustment policy could induce patterns between kink and the cost variables. The above analyses of lagged dependent and explanatory variables indicates that transitory profitability with slow debt policy adjustment is probably not driving the results. However, to investigate further whether transitory profitability affects the observed empirical patterns, I examine the persistence of debt conservatism.

Table VII groups firms according to when they first appear in the most conservative kink quartile, to study the persistence of conservative debt policy. In Year $t + 1$, 82 percent (93 percent) of the firms are still in the most conservative quartile (half) of the sample. Sixty-nine percent (85 percent) are in the most conservative quartile (half) in $t + 2$. By Year $t + 5$, 39 percent (66 percent) are still conservative. Also, although when firms move from

Table VII

How Persistent Is Debt Conservatism?

This table shows the persistence of debt conservatism as defined by *kink*, where kink is the amount of interest required to make a firm's marginal benefit function become downward sloping expressed as a proportion of actual interest expense. A large value of kink indicates that a firm uses debt conservatively. The table follows firms after they first enter the highest (most conservative) quartile of kink. These high-quartile firms are followed over the subsequent five years. Year 0 is the year the firm enters quartile 4 (the most conservative). The number of firm-year observations is in parentheses.

	% in quartile 4	% in quartile 3	% in quartile 2	% in quartile 1
Year 0 (N = 4,960)	100.0			
Year 1 (N = 4,540)	82.4	10.3	4.9	2.5
Year 2 (N = 4,135)	69.2	16.2	9.4	5.2
Year 3 (N = 3,666)	56.0	21.6	13.6	8.7
Year 4 (N = 3,189)	47.0	25.1	16.8	11.1
Year 5 (N = 2,745)	39.2	26.6	20.4	13.8

the most conservative quartile in Year t to the least conservative quartile in Year $t + 1$ their mean kink drops from 4.8 to about 0.1, by Year $t + 2$ the mean kink for this group is 1.7. Overall, debt conservatism is fairly persistent, and when things turn sour, firms quickly rebound. Therefore, it seems unlikely that transitory profitability combined with slow capital structure adjustment drives the inverse pattern between kink and costs.

The negative relation between costs and kink could also be driven by a "peso problem": perhaps there is a disastrous state of nature that very rarely appears in the data but nonetheless causes firms to use debt conservatively in anticipation of its possible occurrence; or that, because it is ignored in my analysis, makes cash flow forecasts too optimistic and hence the expected benefits of debt appear too large. For example, in my sample period, Boeing is a highly profitable firm and looks like it could easily manage more debt. However, in 1997 Boeing announced its first loss in 50 years in association with the takeover of McDonnell Douglas.

The peso possibility cannot be refuted entirely (e.g., the data do not contain a disastrous scenario that simultaneously affects all firms), but it seems unlikely that it completely explains debt conservatism. In the cross section, firms should occasionally encounter a disastrous outcome. However, the large firms that encounter distress (e.g., Intel, as shown in Table IV) return to profitability fairly quickly. Further, even if the benefits are entirely wiped out during the disastrous state, the probability of disaster would need to be large to result in an *expected* cost large enough to offset potential gains to leverage. But if the probability is large, then the event no longer satisfies the definition of a peso problem. To explore whether the peso problem could drive the results, I repeat the entire analysis drawing earnings innovations from a "fat-tailed" Cauchy distribution, to increase the occurrence of ex-

treme events relative to the normal distribution that underlies most of the analysis (see Appendix A). The results do not provide evidence that a peso problem causes the relation between kink and costs.

Myers (1993) interprets the finding that profitable firms use little debt as support for the pecking order of financing choice: firms fund internally whenever possible and only use debt and, finally, equity as last resorts. The pecking order theory assumes that balancing the costs and tax benefits of debt in the sense of the traditional trade-off theory is of second-order importance (Shyam-Sunder and Myers (1998)). And yet, when RJR Nabisco and Safeway became highly levered, my calculations suggest that the incremental interest added approximately 10 percent to firm value. This hardly seems to be a second-order effect. It seems likely that many high-kink firms could obtain reasonably large tax benefits by issuing debt and still remaining financially healthy.

If the pecking order theory explains financing choice, then firms that issue debt sparingly should use equity even more conservatively because equity is more severely underpriced than debt (due to informational asymmetries). Untabulated analysis indicates the opposite. The relative use of equity increases with kink, which is inconsistent with the pecking order. (Unfortunately, the COMPUSTAT issuance variables are not pure debt versus equity measures; the equity measure includes both common and preferred stock issues, conversion of debt into common stock, and the exercise of stock options. Future research that utilizes new issue data may help clarify this analysis.) Further, dividend-paying firms issue debt more conservatively than do non-dividend-paying firms, even though they presumably have less severe informational problems. In sum, although the trade-off theory does not explain why firms use debt conservatively, neither does the pecking order model provide a complete explanation.

V. Is Money Left on the Table?

My results suggest that some firms use debt conservatively. How large is the forgone benefit that results from debt conservatism? To estimate the tax savings that firms could achieve if they were less conservative, I assume that firms with kinks greater than one lever up to the kink in their benefit function (e.g., a firm with a kink of three triples its interest deductions), much the way RJR and Safeway did with their leveraged buyouts (see Table IV). I do this because firms with kinks greater than one are on the horizontal portions of their benefit functions and so expect to have positive profits in all states over this range, or losses small enough that current-period interest is valued fully. If, over this same range, the cost function does not increase with interest, the trade-off theory implies that a firm should locate at or to the right of the kink in its benefit function (because the cost function will not cross the benefit function anywhere to the left of the kink). Under these conditions, it is reasonable to integrate under the benefit function up to the kink to determine forgone benefit.

The incremental gross tax benefit produced by levering up to the kink equals between 28 percent (in the early 1980s) and 8 percent (in 1993) of the market value of the average firm (see Figure 2). The mean is 15.7 percent over the entire sample period. After netting out the personal tax penalty, levering up to the kink adds between 10 percent (in 1983 and 1987) and 4.5 percent (in 1993) to the value of the typical firm (not shown in figure). The mean incremental net benefit is 7.5 percent. These numbers suggest that the consequences of being underlevered are notable but have been declining.[16]

In 1994, the typical firm could add 4.7 percent to firm value by levering up to the kink in its benefit function, in addition to the 3.5 percent net benefit it achieves with current debt policy (the 3.5 percent is from Table III). Therefore, if the typical mid-1990s firm levered up to its kink, net tax benefits would constitute 8.2 percent of firm value. This number compares favorably with the theoretical optimum estimated by Goldstein, Ju, and Leland (1998). In a dynamic contingent-claims model in which firms can restructure their debt, Goldstein et al. estimate that the typical firm should have net tax benefits equal to between eight and nine percent of value.

By equating the expected costs and benefits of levering up, I can back out what the probability of distress must be to justify observed debt policy. Andrade and Kaplan (1998) estimate that the direct and indirect costs of financial distress are between 10 and 23 percent of firm value. Given that the mean net tax benefit left on the table is 7.5 percent, this implies that firms expect that the probability of encountering distress will *increase* by between one-third (one-third of 0.23 = 0.075) and three-quarters (three-quarters of 0.10 = 0.075) if they lever up to the kink. (These fractions are about 40 percent smaller if they are based on the estimated mid-1990s money left on the table.) Given that the annual default rates for bonds rated BB, B, and CCC are 0.4, 2.4, and 7.2 percent (Altman (1989)), respectively, and that RJR Nabisco and Safeway were assigned bond ratings of BB and B+, respectively, following their LBOs, these numbers imply that many firms overestimate the effect that using additional debt would have on the probability (or cost) of distress.

VI. Conclusion

I construct interest-deduction benefit functions by estimating a series of marginal tax rates, where the tax rates are calculated as if a firm used interest equal to 0, 20, 40, . . . , up to 800 percent of actual interest expense. The benefit functions are simulated to account for the tax-loss carryback and carryforward, ITC, and AMT features of the tax code and also uncer-

[16] One disadvantage of the dependent variable in the Table VI regressions is that kink is a proportion relative to existing interest expense; therefore, kink can be very large if existing interest is small. As an alternative, I repeat the analysis in Table VI using "money left on the table, as a percentage of market value" as the dependent variable; this variable is a scaled difference, rather than a proportion. The untabulated results are qualitatively similar to those reported in Table VI except that q-ratio and Z-score are negatively related to kink.

tainty about future taxable earnings. Less than half the sample firms use debt to the point that they operate on the downward-sloping portion of their marginal tax benefit functions.

By integrating to determine the area under the benefit functions, I estimate the tax-reducing value of deducting interest. The tax savings are about $15 million per year for a typical firm, or about $0.20 per dollar of pretax income. The savings aggregated across sample firms are as high as $114 billion in a given year. The capitalized tax-reducing benefit of interest deductions is about 10 percent of firm value. If firms were to lever up to the point where their interest-deduction benefit functions first become downward sloping, they would obtain additional gross tax benefits equal to about 15 percent of firm value. These numbers suggest that either the expected costs of incremental leverage are quite large or else that firms use debt too conservatively.

The personal tax penalty associated with interest income implies that firms must offer a higher risk-adjusted pretax return on debt relative to equity. The personal tax penalty reduces the corporate advantage to the deductibility of interest expense by nearly two-thirds before the Tax Reform Act of 1986 and by slightly less than half after tax reform. Further, the personal tax penalty effectively results in firms sharing the tax benefit of interest deductibility with investors. Given the magnitude of the tax benefit numbers, there are important public policy issues related to why the government allows firms to deduct interest expense from their tax base, with the resulting benefits substantially reallocated to investors.

I infer how aggressively firms use debt by observing where they locate on their interest benefit functions. Growth firms that produce unique products use debt conservatively. Surprisingly, large, profitable, liquid firms also use debt sparingly. The trend indicates that firms use debt more aggressively now than they did in the 1980s. This trend notwithstanding, there are many unanswered questions as to why some firms appear to be underlevered. This area is fertile ground for future research.

Finally, there are costs and nontax benefits associated with debt financing that are not factored into my estimates. It would be interesting to determine the contribution of debt financing to firm value after accounting for these costs and benefits. However, for a cost to explain the apparently conservative debt policy that we observe for many firms, its *expected* effect must be large. In a related paper, Parrino and Weisbach (1999) empirically estimate that the agency costs of debt are too small to offset the tax benefits. More research is needed in this area.

Appendix A

Estimating Corporate Marginal Tax Rates

Recent research indicates that when estimating a firm's tax rate, it is important to consider uncertainty about future earnings, in addition to relief provided by various provisions of the tax code (such as net operating losses (NOL), the investment tax credit (ITC), the alternative minimum tax

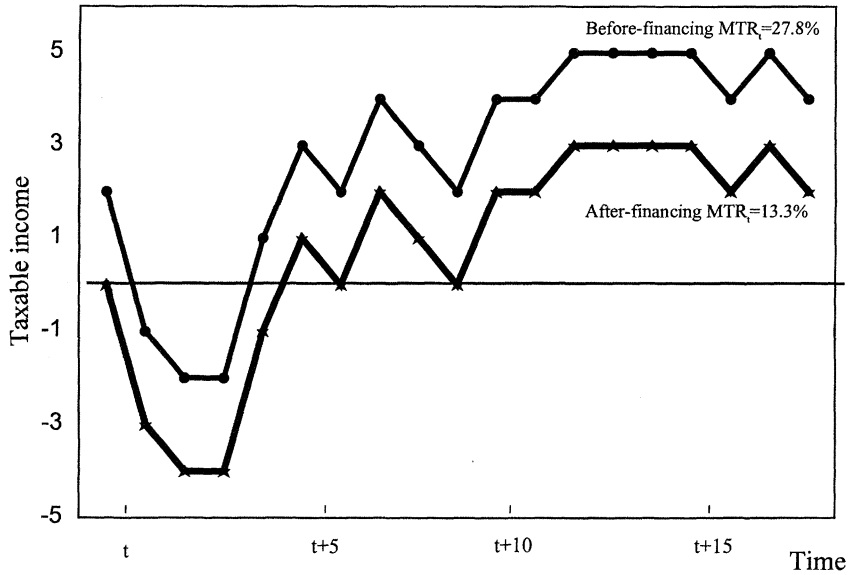

Figure A1. An example of calculating simulated marginal tax rates, assuming a statutory tax rate of 35 percent. The top line shows a firm's forecasted *before-financing* taxable income for a single simulation. As a direct result of earning an extra dollar in period t, the firm pays \$0.35 in taxes in period t (relative to a "no extra dollar scenario"), obtains a \$0.35 refund in $t + 2$ because it has tax losses to carryback, and then pays \$0.35 in tax in $t + 5$ because it exhausts its tax-loss carryforward (see Table AI). Assuming a discount rate of 10 percent, the present value of taxes owed on the extra dollar of income earned in period t, and hence the firm's marginal tax rate in period t, is 27.8% ($0.278 = 0.35–0.35/(1.1)^2 + 0.35/(1.1)^5$). Although not depicted in the figure, in practice the forecasting procedure is repeated 50 times for each firm-year observation, with the resulting marginal tax rates averaged to obtain the expected before-financing marginal tax rate. The bottom line depicts the forecasted *after-financing* taxable income stream, assuming that debt is issued and produces \$2 of annual interest deductions. In this case, the after-financing marginal tax rate is 13.3% $\left(0.133 = 0.35 - 0.35/(1.1) + 0.35/(1.1)^{13}\right)$. In practice, the procedure is repeated 50 times and averaged to obtain the expected after-financing marginal tax rate. In general, taking additional interest expense lowers a firm's expected marginal tax rate.

(AMT)) and the progressivity of the statutory tax code (Graham (1996a, 1996b)). Consider the income streams in Figure A1. Assume that earnings are taxed at 35 percent and that losses can be carried backward and forward. For the scenario depicted by the top line, taxes of \$0.70 are paid on \$2 of $t = 0$ earnings; however, \$1 of the $t = 1$ loss is carried back to offset \$1 of $t = 0$ profits, resulting in a tax refund of \$0.35 that is received in $t = 1$ (see Table AI, Panel A). In $t = 2$ the firm experiences a loss of \$2, one dollar of which is carried back to obtain a refund of \$0.35 for taxes paid in $t = 0$, with the other dollar accumulated as a tax-loss carryforward. In $t = 3$ two additional dollars are added to the cumulative tax-loss carryforward. Next, one dollar of the carryforward is used to shield \$1 of $t = 4$ earnings. Finally, the

Table AI

Calculating a marginal tax rate. The top panel shows taxes paid on the base case income stream, assuming a tax rate of 35 percent. (The base case income stream represents the top line in Figure A1.) The middle panel shows tax liabilities for the same firm if it earns one extra dollar in $t = 0$. The bottom panel shows the incremental tax liability associated with the extra $t = 0$ dollar. The marginal tax rate is the present value tax liability associated with the extra dollar of $t = 0$ income. The present value calculation at the bottom assumes a 10 percent discount rate. All numbers are dollars. The marginal tax rate is defined as the present value of incremental tax liabilities due from earning and extra dollar of $t = 0$ income and equals 27.8 percent $\left(0.278 = 0.35 - (0.35/1.1^2) + (0.35/1.1^5)\right)$ in this table.

	$t = 0$	$t = 1$	$t = 2$	$t = 3$	$t = 4$	$t = 5$
Panel A: Base Case (top line in Figure A1)						
Income	2	−1	−2	−2	1	3
Tax-loss carryforward	0	0	1	3	2	0
Tax liability	0.70	−0.35	−0.35	0	0	0.35
Panel B: Earning an Extra Dollar in $t = 0$						
Income	3	−1	−2	−2	1	3
Tax-loss carryforward	0	0	0	2	1	0
Tax liability	1.05	−0.35	−0.70	0	0	0.70
Panel C: Incremental Tax Liabilities from Earning an Extra Dollar in $t = 0$						
Tax liability	0.35	0	−0.35	0	0	0.35

remaining \$2 of tax-loss carryforward is used to shield \$2 of income in $t = 5$, with the remaining income taxed at 35 percent. (Assume that taxes are paid without any chance of refund after $t = 5$.)

This firm's $t = 0$ marginal tax rate is defined as the present value of taxes owed on an extra dollar of $t = 0$ income. As shown in the lower panel of Table AI, the extra dollar of $t = 0$ income causes the firm to pay an extra \$0.35 of tax in $t = 0$, followed by an extra \$0.35 refund in $t = 2$, and finally an additional \$0.35 tax payment in $t = 5$. If the firm has a 10 percent discount rate, its marginal tax rate is 27.8 percent $\left(0.278 = 0.35 - (0.35/1.1^2) + (0.35/1.1^5)\right)$. This example shows why it is desirable to consider forecasted income when determining a firm's current tax status.[17] Uncertainty about earnings can be factored into the example by considering a variety of projections of future income, with each projection made by a forecasting model that reflects earnings uncertainty.

[17] This example relies on the tax-loss carryback and carryforward provisions of the federal income tax code. The marginal tax rate can also be affected by tax rules allowing firms to carry alternative minimum tax credits forward indefinitely or carry investment tax credits back three years and forward up to 15 years (see Graham (1996b)). This last feature indicates that ITC can affect some firm's tax rates through the year 2000 even though the Tax Reform Act of 1986 eliminated the possibility of firms accumulating new ITC.

To account for the dynamic nature of the tax code (e.g., three-year carryback and 15-year carryforward periods for both NOLs and ITC),[18] I follow the procedure outlined in Graham (1996b) to simulate tax rates. (Shevlin (1987, 1990) pioneered this approach.) To estimate a before-financing tax rate for Firm i in Year t, a firm's earnings before income and tax are considered from Year $t-3$ to $t+18$.[19] To forecast earnings, I use Graham's (1996b) main model, which states that Firm i's earnings follow a pseudo-random walk with drift:

$$\Delta \mathrm{EBIT}_{it} = \mu_i + \epsilon_{it}, \tag{A1}$$

where $\Delta \mathrm{EBIT}_{it}$ is the first difference in earnings, μ_i is the maximum of the mean of $\Delta \mathrm{EBIT}_i$ and zero, and ϵ_{it} is distributed normally with mean zero and variance equal to that of $\Delta \mathrm{EBIT}_i$.[20] The means and variances are estimated on a "rolling historical" basis; that is, they are based on data up to Year $t-1$ for each Year-t calculation. Earnings are estimated from the COMPUSTAT tapes as accounting earnings before interest and taxes (EBIT). Earnings are adjusted for discontinued and extraordinary items, with these terms grossed up by one minus the appropriate statutory tax rate so they are expressed on a pretax basis, although these items are not included in the calculation of the means and variances of $\Delta EBIT_i$.

When estimating a before-financing MTR_{it}, a forecast of Firm i's earnings for Years $t+1$ through $t+18$ is obtained by drawing 18 random normal realizations of ϵ_{it} and using equation (A1). (This produces an earnings forecast analogous to the one shown as the top line in Figure A1.) Next, the present value of the tax bill from $t-3$ (to account for carrybacks) through $t+18$ (to account for carryforwards) is calculated assuming that the statutory tax rules are held fixed at Year-t specifications. Taxes paid in Years $t+1$ through $t+18$ are discounted using the average corporate bond yield (from Moody's Bond Record); taxes for Years $t-3$ through t are not discounted or grossed-up because, for all practical purposes, tax refunds are not paid with interest. The tax bill is calculated using the entire corporate tax schedule, and not just the top statutory rate, as gathered from Commerce Clearing House publications. Next, \$10,000 is added to Year-t earnings and the present value of the tax bill is recalculated.[21] The difference between the two tax

[18] The tax laws cited herein apply to data through 1996. For losses incurred in tax years that ended after August 5, 1997, a firm can carry losses back two years or forward 20 years. See Graham and Lemmon (1998) for a summary of recent changes in the tax laws.

[19] The tax consequences of income earned today may not be realized for 15 years if a firm is not expected to have positive taxable income (TI) for the next 14 years. Furthermore, TI_{t+15} can be affected by TI_{t+18} due to carryback rules; therefore, 18 years of future income are forecasted to calculate current-period marginal tax rates.

[20] Graham (1996b) shows that the pseudo-random walk, where the drift is constrained to be nonnegative, predicts the true marginal tax rate better than a model that does not constrain the drift term. The pseudo-random walk also outperforms an AR1 model.

[21] In practice, marginal tax rates are calculated by adding \$10,000 because of COMPUSTAT units of measure.

bills (divided by $10,000) represents the present value of taxes owed on an extra dollar of income earned by Firm i in Year t (i.e., a single estimate of MTR_{it}).

To incorporate earnings uncertainty, the simulation procedure just described is repeated 50 times to obtain 50 estimates of MTR_i in Year t; each simulation is based on a new forecast of 18 years of earnings. The 50 estimates of the marginal tax rate are averaged (with the probability associated with each draw of ϵ_{it} used as the weights) to determine the expected MTR_{it} for Firm i in Year t. This provides an expected MTR_{it} for a single firm-year. This technique is repeated for each company in the sample, for each year between 1980 and 1994.

Deducting interest expense lowers a firm's income stream and consequently can reduce its expected marginal tax rate. For example, the bottom line in Figure A1 shows that the firm's tax rate is reduced from 27.8 to 13.3 percent if it takes on $2 in annual interest deductions.

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[7] **Default Risk Cannot Explain the Muni Puzzle: Evidence from Municipal Bonds That are Secured by U.S. Treasury Obligations**
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