

From the
Office of Tax Policy Research

WORKING PAPER SERIES

Do Taxes Affect Corporate Financing Decisions?

by

Jeffrey K. MacKie-Mason
University of Michigan and NBER

The Office of Tax Policy Research, established in 1987, promotes policy-oriented research in taxation, and serves as a liaison between the academic, business, and policy making communities. We are committed to using state-of-the-art methods to analyze tax policy issues, and to disseminate our findings, and those of a broader academic community, to people in the policy making community.

LEADING IN THOUGHT AND ACTION

Do Taxes Affect Corporate Financing Decisions?

Jeffrey K. MacKie-Mason

Working Paper No. 90-11

Do Taxes Affect Corporate Financing Decisions?

by

Jeffrey K. MacKie-Mason

University of Michigan and NBER

Current version: November 29, 1989

Abstract. This paper provides clear evidence of substantial tax effects on the choice between issuing debt or equity; most studies fail to find significant effects. The relation between tax shields and debt policy is clarified. Other papers miss the fact that most tax shields have a negligible effect on the marginal tax rate for most firms. The new predictions are strongly supported by an empirical analysis. The method is to study incremental financing decisions using discrete choice analysis. Previous researchers examined debt/equity ratios, but tests based on incremental decisions should have greater power.

Keywords. Capital structure, corporate taxes, financing decisions

Address. Prof. Jeffrey K. MacKie-Mason, Department of Economics, University of Michigan, Ann Arbor, MI 48109-1220. Internet: jmmn@um.cc.umich.edu.

Do Taxes Affect Corporate Financing Decisions?

Jeffrey K. MacKie-Mason

Nearly everyone believes taxes must be important to financing decisions, but little support has been found in empirical analyses. Myers (1984) wrote that "I know of no study clearly demonstrating that a firm's tax status has predictable, material effects on its debt policy. I think the wait for such a study will be protracted" (p. 588). A similar conclusion is reached by Poterba (1986). Recent studies that fail to find plausible or significant tax effects include Titman and Wessels (1988), Fischer, Heinkel and Zechner (1989), Ang and Peterson (1986), Long and Malitz (1985), Bradley, Jarrell and Kim (1984), and Marsh (1982).¹

This paper provides clear evidence of substantial tax effects on financing decisions. The research differs from prior studies in two important ways. First, I clarify the relationship between tax shields and the incentive to use debt. Theory predicts that firms with low expected marginal tax rates on their interest deductions are less likely to finance new investments with debt. Tax shields should matter only to the extent that they affect the marginal tax rate on interest deductions. However, although deductions and credits always lower the average tax rate, they only lower the *marginal* rate if they cause the firm to have no taxable income and thus face a zero marginal rate on interest deductions (tax exhaustion).² Other papers have ignored the fact that most tax shields have only a negligible effect on the marginal tax rate for most firms. By paying attention to the relation between tax shields and the effective marginal tax rate I obtain positive results.

The second feature of this paper is a different method for studying capital structure decisions. I study incremental financing decisions using discrete choice analysis. Most previous researchers looked at debt/equity ratios, which are the cumulative result of years

Assistant Professor of Economics, University of Michigan. I would like to thank Alan Auerbach, Rob Gertner, Roger Gordon, Jerry Hausman, Paul Healy, Myron Scholes, Greg Niehaus, Bob Pindyck, Jim Poterba, Jay Ritter, Nejat Seyhun, Glen Sueyoshi, and seminar audiences at MIT, Michigan and NBER and especially Jeff Miron and an anonymous referee for helpful comments and advice. Donna Lawson and Sue Majewski provided superb research assistance, with support from a Rackham Research Grant. The first version of this paper was prepared with financial support from the Alfred P. Sloan Foundation.

of separate decisions. Tests based on a single aggregate of different decisions are likely to have low power for effects at the margin. In addition, the leverage-ratio approach may be subject to specification biases. For example, some theories suggest that profit maximization does not yield a long-term optimal leverage ratio. Even if an optimal ratio does exist, the presence of adjustment costs requires a dynamic specification, which most researchers have ignored.³

The incremental choice approach overcomes these problems.⁴ Studying individual financing choices focuses on actual decisions made by firms, given their current situation. Tests based on incremental decisions should have greater power than those based on an historical aggregate of decisions.⁵ Further, misspecification is avoided by relying only on a weak revealed preference condition for the form of the choice model. I assume merely that whatever the firm chooses was best at the time, given any constraints it faced.

I use a large dataset with detail on incremental decisions to study two tax shields: tax loss carryforwards (TLCF) and investment tax credits (ITC). Auerbach and Poterba (1986) have found that a firm carrying forward losses has a high probability of again facing a zero tax rate. Thus loss carryforwards have a large effect on the expected marginal tax rate on interest payments, since each dollar of carryforwards is quite likely to crowd out a dollar of interest deductions. On the other hand, ITC may not have a significant effect on the tax rate on interest deductions. Many firms with high ITC are quite profitable; in fact, high ITC may occur precisely because the firm has profitable investment opportunities. Thus, we can observe two shields with different predicted effects on a firm's financing decisions. The difference between the two tax shields provides a nice experiment to test the marginal tax rate hypothesis.

The results provide strong and robust evidence that the relationship between tax shields and the marginal tax rate is important, and that the marginal tax rate does affect financing decisions. I find that firms with high TLCF are much less likely to use debt. This is expected since firms with loss carryforwards are unlikely to be able to use interest deductions. In contrast, firms with ITC are often profitable and paying taxes. As predicted, I find that, on average, ITC does not reduce the probability of a debt issue. I also interact ITC with a variable that indicates how close the firm is to tax exhaustion, to measure the

effect of ITC when it is likely to crowd out interest deductions. I find that when firms are nearly tax-exhausted ITC substantially reduces the probability of issuing debt. Thus, tax shields *do* affect financing when they are likely to change the marginal tax rate on interest deductions.⁷

The paper proceeds as follows. The first section discusses the relationship between tax shields and the effective marginal tax rate. I then discuss the testable implications for ITC and loss carryforwards. Section 2 briefly discusses other factors that may influence debt-equity choices; I control for these in the analysis. The empirical method is described in Section 3 and the results are presented in Section 4. Sample selection and data construction details are provided in an appendix.

I . TAX SHIELDS AND FINANCING CHOICES

It is difficult to test whether marginal tax rates affect a firm's debt policy. The statutory corporate tax rate has been nearly constant over many decades so that there is insufficient time-series variation for testing. Further, it is extraordinarily difficult to measure cross-sectional effective marginal tax rates without access to confidential tax returns and extremely complex calculations that take into account the dynamics of loss carrybacks and carryforwards, credit carryforwards, accelerated depreciation and asset vintages, expected and realized statutory changes, and so forth.⁶

Many papers have tried to use observed variation in tax shields as a proxy for differences in marginal tax rates, but most attempts have been unsuccessful. Two main points are made about tax shields in this section. First, tax shields matter only through their effect on the firm's marginal tax rate. Second, different tax shields are likely to have different effects on the marginal tax rate, and thus different effects on financing decisions. The difference between tax loss carryforwards and investment tax credits is exploited in the empirical analysis to test the hypothesis.

I.A Tax Shields and Marginal Tax Rates

DeAngelo and Masulis (1980) developed the current view that links non-debt tax shields with cross-sectional variation in debt policy. They showed that a firm's effective marginal

tax rate on interest deductions depends on the firm's non-debt tax shields, such as tax loss carryforwards and investment tax credits. Although all firms face the same statutory marginal rate, net taxable income is stochastic and different firms face different probabilities of paying zero taxes.⁷ The firm's effective tax rate can be thought of as the statutory rate times the probability of having positive taxable income.⁸ Firms with different tax prices on interest deductions will then have different preferred debt ratios.

A number of authors have tried to test whether taxes affect financing by regressing leverage ratios on some measure of potential tax shields. The implied hypothesis is that on average an additional dollar of tax shields reduces the firm's effective marginal tax rate by increasing the likelihood of tax exhaustion. As mentioned at the beginning of the paper these studies have not found that tax shields discourage debt use.

One problem with using tax shields as a proxy for the firm's effective marginal tax rate is that there may be confounding effects. If two firms were otherwise identical, but the second had an additional dollar of ITC, then the second firm would have a greater probability of being tax-exhausted and thus a lower effective tax rate on interest deductions. However, firms are not otherwise identical. The second firm may have high ITC because it has profitable new investments, and thus is *less* likely to be tax-exhausted. Without a good way to control for the profitability of new investments for which ITC proxies we cannot be sure that higher ITC indicates a lower effective marginal tax rate.

A second problem with tax shield proxies is that their effects may be too small to be measurable on average. We should expect ITC to have a near-zero effect on the effective marginal tax rate for most firms. The reason is simple: tax shields affect the tax rate by increasing the probability of tax exhaustion. But for most firms tax exhaustion is very unlikely, and an additional dollar of tax shields will have a miniscule effect on that probability. Only when a firm is close to exhausting its taxable income is an additional dollar of ITC very likely to crowd out a dollar of interest deductions, substantially reducing the value of debt.⁹

Thus, variations in available non-debt tax shields for firms far away from tax exhaustion should have little effect on debt policy. But, if we look at firms that are relatively likely to be tax-exhausted the level of tax shields should significantly determine the effective

marginal tax rate and thus have a significant effect on financing decisions. The fact that the firms under study rarely enter a zero-tax status may explain in part why most authors fail to find a tax-shield effect on financing decisions.¹⁰ I take the firm's distance from tax exhaustion into account in the empirical analysis below.

1.B Empirical Implementation

The econometric method described in Section 3 directly estimates the value of incremental debt for the firm (ΔV_B). Let T be the firm's potential tax shields; X be a measure of how close the firm is to tax exhaustion; and Z be other relevant factors. The theory predicts that

$$\Delta V_B = f \left(\underset{(-)}{T}, \underset{(-)}{T * X}, Z \right) \quad (1)$$

Tax shields lower the value of new debt, but the magnitude of the tax shield effect is greater for firms in poor financial health. Other factors are discussed in Section 2.

I use two tax variables: tax loss carryforwards and investment tax credits. The book accounting measurement of ITC (which is publicly available) is essentially identical to the tax-reported amount of ITC (which is not publicly available).¹¹ Auerbach and Poterba (1986) point out that book TLCF can differ from U.S. tax-relevant TLCF for some firms (in particular due to foreign tax loss carryforwards reported in consolidated book accounts). I test for measurement error and find no important bias (see Section 4).¹²

To further test the importance of the interaction between tax shields and the likelihood of exhaustion, I interact ITC with a measure of the firm's financial status. I use Altman's (1968) ZPROB to measure financial condition. ZPROB is a discriminant function predictor of bankruptcies. Altman correctly classified 94% of firms that did go bankrupt the next year, and 97% of those that did not.¹³ The measure is a weighted average of financial ratios for the firm, and consistent with the importance of cash flow for tax exhaustion it puts heavy weights on current earnings and sales. ZPROB is not strictly an estimated probability, but firms with lower ZPROB are expected to be less financially secure and thus should be closer to facing zero tax rates. When ZPROB is low tax shields should have a significant effect on the firm's marginal tax rate and thus we should observe a greater decrease in the value of debt from high ITC/ZPROB than from ITC alone.

To summarize, in the empirical analysis I enter the levels of ITC, TLCF, and ITC/ZPROB. Under the tax hypothesis, ITC is expected to have a relatively small effect on debt financing decisions, while TLCF and ITC/ZPROB are expected to have larger effects because these variables will indicate greater reductions in the firm's effective marginal tax rate on interest deductions.

II . OTHER FACTORS AFFECTING FINANCIAL CHOICES

A number of factors other than tax status may influence a firm's financing decisions. This paper is primarily concerned with tax effects, but omitting other factors from the specification can bias the estimates. I include a large number of the variables that other authors have found to be significant. Since these hypothesized determinants have been discussed elsewhere I shall describe only briefly the hypotheses and variables I employ.¹⁴ Detailed definitions and descriptive statistics are given in the appendix.

Two distinguishing characteristics of debt other than tax treatment are the commitment to make periodic payments, and the priority of debt claims over equity. These features lead to three differences between the values of incremental debt and equity issues: (1) marginal financial distress costs for debt due to the fixed interest commitment; (2) efficiency costs for debt due to priority of the debt claims; and, (3) signaling costs that are higher for equity because equity is the residual claim.

II.A Financial Distress Costs

If bankruptcy or financial distress reduces shareholder wealth then a firm should be reluctant to issue debt when the interest commitment increases the likelihood of distress. I use several variables as indicators of the likelihood of distress. $1/ZPROB$ is entered separately as such an indicator; firms with high $1/ZPROB$ are more likely to go bankrupt. I have also constructed two measures of the firm's operating risk: $VEARNA$ and $VEARNB$. Both are variances of changes in net income; $VEARNA$ uses first differences and $VEARNB$ the percentage change. The "correct" measure of risk depends on the stochastic process generating net income. Both have been used in prior research so I include each rather than impose a prior restriction. I also include $VEARNA/ZPROB$ because the effects may

depend on distance from financial distress, for the same reasons discussed for the tax effects.¹⁵

II.B Investment Inefficiencies

Several theories predict that conflicts of interest between managers and lenders cause investment inefficiencies, lowering the value of the firm. Conflict occurs if debt has the first claim on cash flows but managers are acting in the interest of shareholders. For example, Myers (1977) and MacKie-Mason (1987) present models in which outstanding debt causes underinvestment in future opportunities. Management will commit new resources to a project only if the expected return is sufficient to pay off the outstanding debt claims as well as earn an acceptable return on the incremental investment cost. The first-best requires only a return on incremental cost, so there is underinvestment. As another example, Jensen and Meckling (1976) suggest that firms with large debt burdens may take excessive risks because the shareholders gain if the risks succeed but the creditors lose if they fail.¹⁶

I use several controls for moral hazard costs. Moral hazard is possible when managers make investment decisions after the debt has been issued. Thus, debt should be relatively cheaper when firm value depends heavily on committed investments already in place. Therefore, I calculate the ratio of plant and equipment to total assets to indicate the importance of fixed assets that are already committed. The firm's advertising and research expenditures are also entered as measures of some specific intangible assets whose value depends on future decisions, as suggested by Bradley, Jarrell and Kim (1984) and Long and Malitz (1985).

Jensen (1986) proposed a related moral hazard problem that predicts a preference for debt over equity: firms with "free" cash flows may choose debt because the interest commitment reduces the managers' discretionary use of the cash. To control for this I construct a cash-flow deficit variable as defined by Auerbach (1985), which measures the cash deficit after normal dividends and investment expenditures.

II.C Signaling Costs

Myers and Majluf (1984) proposed a “lemons” model to explain the relative infrequency of new public equity issues. Managers acting in the interest of existing shareholders will only sell shares to new investors when the managers believe the shares are overpriced by the market. When the manager has private bad news about the firm she will sell shares as a way to transfer wealth from uninformed investors to current owners. The market understands the manager’s incentives and prices new shares at a discount to adjust for the expected value of the bad news signal.

Measures of the *ex ante* expected signaling value of an equity issue are difficult to find. I enter a dummy for dividend-paying firms on the assumption that dividends are used as a costly signal of earnings (John and Williams 1985; Miller and Rock 1985). Firms with a reputation for paying dividends should be able to issue new equity without suffering as large a lemons premium. Along similar lines, Bagnoli and Khanna (1987) argued that a firm’s stock price increases because investors have been convinced of a favorable improvement in the firm’s prospects and thus will require a smaller lemons premium on new shares after a price increase than during periods of flat or declining stock prices. Thus, I enter the prior year percentage change in the firm’s share price.

As other controls for hidden information differences across firms I include dummy variables for industries subject to regulation during much of the sample: one for trucking, trains, telephones and airplanes, and another for electric utilities. The regulatory agency may inform investors of relevant information, thus reducing signaling costs. I also include an issue dilution variable (size of the new security issue relative to the market value of existing equity) because greater dilution provides more opportunity for transferring wealth from new to existing shareholders.

II.D Other Factors

One advantage of the incremental choice approach I follow is that it avoids the assumption that firms have optimal debt ratio targets.¹⁷ Of course, if firms *do* have debt-ratio targets then we can learn something from the recent level of and change in the debt/asset ratio. I include the difference between the lagged ratio and the long-run (ten-year) average ratio.

If the firm has a stable target then the deviation from the long-run average should indicate which side of the hill needs to be climbed. However, firms that for unobserved reasons prefer high debt ratios will have high lagged ratios, which will then be correlated with a preference for debt at the margin, so I also include the lagged ratio by itself to reduce omitted variable bias.

Industry dummies were estimated to control for fixed effects, such as inter-industry variations in the degree of asymmetric information between managers and investors. Year dummies were estimated to capture unobserved macroeconomic effects. All variables measuring firm magnitudes were scaled by net sales to control for scale effects; net assets were entered separately to capture any remaining size effects on financial preferences.

To summarize, the specification of the value of incremental debt relative to equity includes measures of tax status, the probability of costly bankruptcy, the potential for investment inefficiencies due to moral hazard, and signaling costs of equity. The predicted signs on the coefficients are collected in Table I.

III . EMPIRICAL METHOD

The SEC Registered Offerings Statistics tape records the registration of every security for public offering since 1977. I selected a sample of 1747 registrations from this population. The main criteria were to include only primary, seasoned offerings (not initial public offerings) by firms covered by the Compustat tapes; details are given in the appendix. Based on the number of debt and equity issues and the amount of money raised, the sample appears representative of public offerings.¹⁸ Data on firm characteristics were extracted from Compustat. All explanatory variables are measured during the year prior to the security issue to avoid simultaneity bias.

This sample is not representative of *all* financing decisions. The results concern the effect of taxes on the debt-equity choice conditional on going public; private debt and equity (primarily retained earnings) are not considered. I have elsewhere found (1989) that the distinction between managers (who decide on retentions), financial intermediaries (the providers of private debt) and market investors is very important for the firm's choices between private and public sources, apparently due to differences in the information available to different investors. Conditioning the analysis in this paper on securities

sold in public markets should hold constant the effects of information asymmetries between differently-informed providers of funds.¹⁹

The econometric analysis relies on a weak revealed preference restriction to measure the determinants of financing choices. Conditional on raising new funds from the public, a necessary and sufficient condition for optimization is that the observed choice add more to the firm's objective function than do any of the feasible alternatives. A debt issue need not mean the firm is below a long-run target leverage ratio, but simply that under the current circumstances, debt increases the firm's objective more than equity does.²⁰

Assume the increment to the value function from alternative i , $i \in \{\text{debt}, \text{equity}\}$, is

$$\begin{aligned}\Delta V_i &= x' \beta_i + \epsilon_i \\ \epsilon &\sim \mathcal{N}(0, \Sigma)\end{aligned}\tag{2}$$

where x is a K -vector of firm attributes, β_i a K -vector of parameters to be estimated, and ϵ a 2-vector of unobservable disturbances following a multivariate normal distribution.

The firm's choice is observed, but not the realization of the incremental value of the choice, ΔV_i . Let

$$y = \begin{cases} 1, & \text{if } \Delta V_B = \max\{\Delta V_B, \Delta V_E\} \\ 0, & \text{otherwise.} \end{cases}\tag{3}$$

The econometric problem is to estimate the β_i given N observations of debt or equity issues and the characteristics vector (y_n, x_n) . The probability model is

$$\begin{aligned}\Pr(y = 1 \mid x) &= \Pr(\Delta V_B > \Delta V_E) \\ &= \Pr(\epsilon_2 - \epsilon_1 < x' \beta)\end{aligned}\tag{4}$$

where the observed characteristics x are assumed to be identical across choices, and $\beta \equiv \beta_1 - \beta_2$ (only the contribution of each characteristic to the *relative* value of debt over equity is identified.) Using the properties of the multivariate normal, define $\epsilon \equiv \epsilon_2 - \epsilon_1 \sim \mathcal{N}(0, \sigma^2)$, where $\sigma^2 = \sigma_1^2 + \sigma_2^2 + 2\sigma_{12}$. Then, for observations $n = 1, \dots, N$,

$$\Pr(y_n = 1 \mid x_n) = \int_{-\infty}^{x_n' \beta} \frac{1}{\sqrt{2\pi} \sigma} \exp\left[-\frac{1}{2} \left(\frac{\epsilon}{\sigma}\right)^2\right] d\epsilon = \Phi\left(\frac{x_n' \beta}{\sigma}\right).\tag{5}$$

I obtain estimates, $\hat{\beta}$, by maximizing the log of the likelihood function for the sample.²¹

Having observations on only a subset of financing options—*viz.*, public debt and equity—raises interesting econometric issues. Obtaining consistent, *unconditional* estimates of the preference for a debt issue relative to equity requires that financial decision making be a nested process. One possibility is illustrated in Figure 1. First the firm determines whether to increase, decrease or leave unchanged its total available funds. If funds are to be increased, then the choice between private sources and public is made. If the firm decides to go public, then it decides whether to issue bonds or shares. In this scheme, estimating the public debt-equity choice in isolation is appropriate.²² The nested model assumes weak substitutability between alternatives on different branches; *e.g.*, that public debt and equity are more substitutable than are, say, public stock issues and bank debt.²³

The nested decision-making model may not be appropriate (or the true nesting may be different). In that case, unconditional consistent estimates of the public debt/equity choice require specification and estimation of the full set of simultaneous financing choices (including retained earnings, bank debt, etc.) and the investment decision.²⁴ However, conditional on a firm issuing either debt or equity, the approach with a limited choice menu still yields consistent results for the choice among the observed options. Suppose the financing choice is in fact made between public debt, bank debt, and equity. The system of equations for the three sources of finance can be transformed to a reduced form for the choice of debt or equity conditional on going public. The reduced form works because the random utility model implies that, if the firm does issue publicly, a necessary and sufficient condition for optimality is that its chosen instrument, say debt, yield a higher value of the objective function than the other public alternative, equity.

IV . EMPIRICAL RESULTS

IV.A Tax Effects

The central hypothesis is that the desirability of debt finance at the margin increases with the firm's effective marginal tax rate on deductible interest. The implications tested here concern the effects of tax shields on financing decisions. When high shields substantially

increase the probability of tax exhaustion, the firm faces a lower expected marginal tax rate and thus should be less likely to use debt.

The hypotheses are supported strongly by the results. Table II reports the estimated coefficients from the model (with and without 23 industry dummies) in the first two columns. First consider TLCF. Since loss carryforwards in one year are highly correlated with zero-tax status in following years (Auerbach and Poterba 1986), TLCF is likely to lower the effective marginal tax rate and crowd out interest deductions. As predicted, loss carryforwards are estimated to significantly reduce the probability that a firm will choose debt.²⁵

On the other hand, many firms with high ITC are quite profitable and face a negligible probability of tax exhaustion. As expected, the level of ITC itself does not have a negative effect on debt issues; in fact ITC alone has a positive coefficient. However, also as predicted, ITC does matter for firms already near tax exhaustion as indicated by the significantly negative effect of ITC/ZPROB on the probability of choosing debt. These results merit further discussion.

Many capital structure studies that have included ITC estimate an insignificant or positive coefficient for it.²⁶ Some of these authors have pointed out that ITC will tend to be high when a firm's value depends substantially on tangible assets-in-place. According to the moral hazard hypothesis, high tangible asset values should encourage debt issues by lowering the associated moral hazard costs.²⁷

The moral hazard hypothesis predicts a positive coefficient for ITC, while the tax theory predicts at most a small negative effect on debt issues since most firms are far from tax exhaustion. Thus the observed positive coefficient is not surprising, nor does it contradict the tax hypothesis. Even without the confounding factors support for the tax hypothesis should not be sought from the level of ITC, since ITC will often have an insignificant effect on the marginal tax rate. Rather, we should look at ITC primarily for those firms already near tax exhaustion.

The interactive effect is measured with ITC/ZPROB, which has the predicted negative coefficient. Further, the coefficients on both ITC and ITC/ZPROB are virtually unchanged when the industry dummies are added, providing evidence that this separation of the tax

and moral hazard effects through interaction with ZPROB is not due to spurious correlation with unobserved fixed effects. When we look in the right place—for changes in marginal tax rates through increased exhaustion likelihood—it appears that the marginal tax rate matters.²⁸

More evidence consistent with the tax hypothesis is provided by the coefficients on the year dummies. The average propensity to issue debt was significantly lower in 1981–1983, and significantly higher during 1985–1987. During the first period the economy experienced a severe recession and low corporate cash flows, and thus more firms were likely to be facing tax exhaustion and lower marginal tax rates. In addition, the 1981 tax law changes gave firms extremely generous depreciation write-offs, allowing more firms to enter zero-tax status even without suffering low cash flow. The tendency for marginal tax rates to be lower during 1981–1983 is consistent with the observed reduction in the probability of debt choices. Likewise, the economy was booming and cash flows were high during 1985–1987, increasing the number of tax-paying firms. The Tax Reform Act of 1986 repealed ITC, decelerated depreciation deductions, and stiffened the alternative minimum tax, further reducing the likelihood of tax exhaustion and a zero-tax rate on interest deductions.²⁹ The increase in debt preference during this period is thus consistent with the tax hypothesis. However, many other macroeconomic factors were varying during these periods so we should interpret the time-series evidence as consistent with the tax hypothesis but not conclusive.

I now turn to the economic importance of the estimated tax coefficients. The magnitudes of the coefficients from a discrete choice model are difficult to interpret because the marginal effects of a variable on the choice probability depend on all of the data in a nonlinear manner. To aid in interpretation, I present simulated measures of the derivatives for most of the variables in the “sample derivatives” column of Table II. The sample derivatives calculate the predicted choice probability for each sample point at the sample data values, then counts the fraction of the sample that is predicted to change from equity to debt if an explanatory variable is increased by one standard deviation.³⁰

Taken individually, the tax shield effects are quite important. For instance, a one-standard-deviation increase in ITC/ZPROB is predicted to lower the percentage of debt

issues about 11 points (from about 46% of issues to 35%). Thus, the increase in corporate tax shields during the early 1980s (*e.g.*, ACRS, safe-harbor leasing, R&D tax credits, etc.) may in part explain the dramatic decline in the proportion of debt issues, both in number and in total value.³¹ Similarly, the 1986 reduction in tax shields may have the opposite effect, although the decrease in the corporate tax rate also makes interest deductibility less valuable. A one-standard-deviation increase in TLCF is predicted to reduce the frequency of debt issues by about 10 percentage points.³²

The results give clear support for substantial tax effects on financing choices. The hypothesis is that decreases in a firm's effective marginal tax rate should reduce the desirability of debt financing. This hypothesis has been supported by showing that when tax shields are likely to reduce a firm's tax rate, firms with high tax shields are less likely to issue debt. Other changes in the firm's effective tax rate may also affect debt policy, but we await greater variation in statutory tax rates for careful measurement.³³

IV.B Other Factors

I included variables to control for financial distress costs, costs of moral hazard-induced investment inefficiencies, and signaling costs of equity issues. On the whole the estimated coefficients are consistent with those in prior studies, so I shall discuss them only briefly.

Except for VEARNA/ZPROB, the indicators of the potential for financial distress all have the negative sign predicted by the desire to avoid incremental debt when the possibility of distress is high.³⁴ All of the coefficients are strongly significant except that on 1/ZPROB, which is significant only at about the 10% level.³⁵ Many researchers have expressed doubt about the importance of bankruptcy costs for debt/equity choices, since measured bankruptcy costs appear small (*see, e.g.*, Warner 1977). Yet, as noted earlier, even if bankruptcy costs are low the variables indicating bankruptcy likelihood may also be correlated with tax exhaustion, and thus be providing further confirming evidence for the tax hypothesis.

Most of the evidence on moral hazard costs of debt is also consistent with theory. A high fraction of plant and equipment (tangible assets) in the asset base makes the debt choice more likely. Intangible R&D reduces the value of debt. However, the R&D coefficient is the

only one that changes significantly when the industry dummies are introduced, suggesting that R&D may be capturing some other unobservable factors. Contrary to expectations, high advertising is associated with a greater preference for debt.³⁶ Jensen's (1986) "free cash flow" hypothesis is supported by the data: firms with uncommitted cash (negative deficits) are more likely to issue debt, which may serve to reduce moral hazard costs of leaving free cash flows in managers' hands.

The evidence on the signaling hypothesis is mixed. As has been found elsewhere (*e.g.*, Marsh 1982) firms are more likely to issue stock when their stock price has recently risen, which may be due to a lower signaling premium. On the other hand investing in costly dividends, possibly to signal financial health, makes debt more likely, rather than equity.³⁷

The ownership dilution variable has a large significant effect with the predicted sign. If a new issue is overpriced by 10% because the market is unaware of some bad news, that 10% will transfer more wealth to old shareholders for a large issue. Thus the market should be more reluctant to buy a large equity issue. This story is consistent with the finding by Asquith and Mullins (1986) that the price drop accompanying new equity issues is greater for large issues.

As predicted, regulated firms other than electric utilities seem to suffer less from signaling costs, but electric utilities prefer debt issues. This last result is puzzling because electric utilities in fact raise huge amounts of new equity. The results may reflect the fact that equity flotation costs decrease more dramatically with issue size than do debt costs, so utilities issue equity less frequently to minimize transactions costs.³⁸

IV.C Summary Statistics and Specification Analysis

The goodness-of-fit statistics for the model are quite good for a discrete choice analysis of the behavior of many diverse firms over several years.³⁹ The ρ^2 statistic indicates the percentage of the minimum possible likelihood value explained by the model, and thus is analogous to the R^2 measure from a minimum-distance estimator. The $\bar{\rho}^2$ statistic corrects for degrees of freedom (based on the Akaike Information Criterion), analogous to \bar{R}^2 . The $M-\rho^2$ statistic indicates the percentage of likelihood explained by variables other than the

constant. A naive forecast of debt-equity issues would predict the observed mean (46% debt issues), which is not much better than a coin-flip in this sample; column 1 is able to improve the likelihood value by 26% relative to this naive model.⁴⁰

Another summary measure is the ability of the model to correctly classify the observed choices in the sample. The estimates in column 1 correctly predict 78% of the debt issues, and 75% of the equity issues in the sample, with an overall success rate of 77%. As a benchmark, Marsh (1982) and Martin and Scott (1974) obtain 75% correct prediction rates. Marsh calculates a pseudo- R^2 statistic of 0.37; the same statistic for my column 1 is 0.40.⁴¹

To test the specification of the choice model I considered the possibility that optimal security choice depends on a longer history of firm characteristics. For example, managers may use more than one year of data to form expectations. Or, after reaching an optimal leverage ratio the characteristics determining the optimum may change, so the value of issuing a particular security type may depend on first differences of the explanatory variables. I reestimated the model using two years of lagged data. Both the first differences specification and the model reported in Table II are nested cases of the general model. The first differences restriction had a χ^2_{10} statistic of 56.0, and thus is easily rejected against the general two-lag model. However, restricting all of the second lag coefficients to zero (the model presented in Table II) has a χ^2_{10} of 6.2; thus not only is the first-differences model rejected, but in fact we cannot reject the more parsimonious model of Table II at even the 25% level.⁴²

Some caveats about the analysis in this paper should be noted. First is concern with the use of ZPROB to measure how close the firm is to tax exhaustion. ZPROB is a well-known and successful measure, based on observable variables. However, it might be possible to estimate a better behaved probability measure (ZPROB is estimated by classifying firms according to a binary indicator of bankruptcy). To avoid pre-test bias I did not undertake a search for the best fit in this analysis.

Second, the inclusion of the ownership dilution variable is troublesome. All of the other explanatory variables are strictly predetermined. The issue size, however, may be determined jointly with the type of issue, leading to a potential simultaneity bias in the

estimates. Therefore, I also estimated the model of Table II in a fully-reduced form, by eliminating the relative size measure from the list of factors. The effect of the potential bias was statistically insignificant on all of the other coefficients. For example, the coefficients on TLCF, ITC and ITC/ZPROB were -1.89 , 24.1 and -29.4 with asymptotic t-statistics of -2.12 , 1.85 and -2.09 respectively.

V . CONCLUSION

Most prior research has failed to find tax effects on financing choices. This study finds clear and substantial tax effects. Two major reasons are likely to explain the contrast. First, this study analyzed well-defined incremental choices made by firm managers. Focusing on actual decisions, made at the margin, is likely to provide more powerful tests than the studies of debt/asset ratios, because the ratios cumulate numerous decisions made over many years, taken under varying circumstances.

Second, I carefully specified the role of the observable tax variables in a theoretical model, and found that other researchers may have been looking for tax shield effects in the wrong places. Tax shields affect the value of incremental debt insofar as they lower the effective marginal tax rate on interest deductions. Although deductions and credits always lower the average tax rate, they only lower the realized marginal rate if the firm becomes tax-exhausted and faces a zero rate. The increased probability of tax-exhaustion from tax shields is likely to be trivial for firms that are far from the point of zero-taxable income. It is firms that are already close to tax exhaustion for whom tax shields have a large marginal effect. The empirical results clearly bear this out: when already exhausted (with loss carryforwards) or with a high probability of facing a zero tax rate the firm with high tax shields is less likely to finance with debt.

The results confirm the theory: the desirability of debt finance at the margin varies positively with the effective marginal tax rate. The only tax variables that are measured well and vary enough in this sample are those that matter primarily for firms near exhaustion. The results are consistent, however, with the broader hypothesis that changes in the marginal rate for any firm should affect financing choices, regardless of the likelihood of tax exhaustion.

APPENDIX

Data Definitions

The COMPUSTAT tape provides financial statement data on several thousand large or otherwise "important" firms. All dollar-denominated variables were deflated to constant (1982) dollars, using the GNP deflator for gross private domestic investment. All amounts are measured in millions of dollars, except net assets which is reported in billions of dollars. The definitions in the paper follow the COMPUSTAT definitions, unless otherwise noted. Mean and standard deviation for variables appearing as regressors are given in parentheses following the definition.

I use book values of firm assets and liabilities. Auerbach [1985] and others attempt to approximate market values, but the results have usually indicated that book debt works equally well as a determinant of financial decisions. Myers [1977, 1984] suggests that managers may rely on book measures because book value represents the fixed, or sunk value of firm assets. Market values include the value of intangible assets and future discretionary investments, which are predicted to reduce the firm's debt capacity.

Many of the explanatory variables are not reported by Compustat for electric utilities. Rather than exclude this important sector (utilities undertake a disproportionate share of public issues) I collected the needed data from Moody's Utilities Manual.

Market value of equity = shares outstanding × stock price (as of 12/31).

Tax loss carryforward = book tax loss carryforward / net sales; (0.0113, 0.0832).

Investment tax credit = investment tax credits / net sales; (0.00504, 0.00605).

ZPROB: Altman's [1968] *ZPROB* included the ratio of market equity to book debt. I have excluded that term since I am studying precisely capital structure, and thus enter the debt ratio directly into the analysis.

$$ZPROB = 3.3 \frac{EBIT}{total\ assets} + 1.0 \frac{sales}{total\ assets} + 1.4 \frac{retained\ earnings}{total\ assets} + 1.2 \frac{working\ capital}{total\ assets}$$

where EBIT is earnings before interest and taxes. $1/ZPROB$ (0.489, 0.554); $ITC/ZPROB$ (0.00306, 0.00597); $VEARNA/ZPROB$ (0.0248, 0.0548).

Research and development = R&D / net sales; (0.0141,0.0256). If R&D is missing, the variable is coded as zero. A specification test indicated no significant bias from this recoding.

Advertising = advertising expenditures / net sales; (0.0140,0.0259). Recoding was done as for R&D.

EBIDT = earnings before interest, depreciation and taxes.

Earnings variance, Type A = standard deviation of $(EBIDT_t - EBIDT_{t-1})$, divided by the mean of total assets, for 10 years prior to registration (at least six years if data are missing); (0.0512,0.0480).

Earnings variance, Type B = standard deviation of $[(EBIDT_t - EBIDT_{t-1})/|EBIDT_{t-1}|]$, for 10 years prior to registration (at least six years if data are missing); (1.28,12.4).

Fraction of assets in plant & equipment = (plant - accumulated depreciation) / (total assets - current liabilities); (0.537,0.233).

Cash deficit = (capital expenditures + average dividends - (cash flow + capital expenditures \times [total debt/net assets])) / net sales, where average dividends is the mean of total dividend payments over the previous 10 years; (-0.0319,0.0962). See Auerbach [1985].

Current debt/assets ratio = book long-term debt / total assets; (0.246,0.133).

Δ *Debt/assets* = current debt/assets ratio - (mean of debt/assets ratio over previous 10 years); (0.00172,0.105).

Dilution = issue value / market value of equity; (0.169,0.303).

Δ *stock price* = (end-of-year price in year previous to registration) - (end-of-year price two years previously); (0.208,0.630).

Net assets = total assets - current payables; (1.12,4.29).

Sample Selection

The initial source of data was the Registered Offerings Statistics (ROS) tape from the SEC. This file contains financial and other information reported for all public security registrations. The tape contains registered offerings covering 1970–1987. Because this data source is not well-known, I describe my sample selection procedure in some detail.

Issues were dropped if: (1) the issuing firm is not on the COMPUSTAT tape; (2) the registration is for an initial public offering; (3) the registration is for a noncash transaction; (4) the issuing firm was not listed on the NYSE or AMEX; (5) the security was registered before January 1, 1977; (6) the security was not one of either straight debt or common stock.

Some of these restrictions are necessary to obtain stock market information and data on firm characteristics. Initial offerings were dropped because historical firm data are unavailable, and the IPO decision is likely to be fundamentally different from ongoing financing decisions. Noncash offerings are mostly exchanges, conversions and other transaction types which are not obviously intended to raise new capital. Pre-1977 issues were deleted because the SEC reformatted the tape in 1977 and introduced unrecoverable errors into the earlier records.⁴³ Since convertible debt has many of the characteristics of equity, and vice versa for preferred stock, I chose not to classify these securities as debt and equity. A multinomial analysis for the several security types might be preferable, but there were far too few issues of these mixed types to permit such estimation.

Registrations by foreign firms, registrations with warrants to purchasers (0.1% of the subsample), and registrations for rights offerings (0.6%) were also dropped. The final selection dropped financial services, real estate firms, and firms for which required data was missing.⁴⁴ I dropped the selected industries because their capital market interactions are known to be quite different than other firms, due to regulation or the financial nature of the business.

References

- Altman, E. I. (1968) "Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy," *Journal of Finance*, 23, 589-609.
- Altman, E. I., R. G. Haldeman, and P. Narayanan (1977) "ZETA Analysis: An New Model to Identify Bankruptcy Risk of Corporations," *Journal of Banking and Finance*, 1, 29-54.
- Altshuler, R. and A. J. Auerbach (1989) "The Significance of Tax Law Asymmetries: An Empirical Investigation," Forthcoming, *Quarterly Journal of Economics*.
- Ang, J. S. and D. R. Peterson (1986) "Optimal Debt Versus Debt Capacity: A Disequilibrium Model of Corporate Debt Behavior," in *Research in Finance*, vol. 6, ed. Chen, A. W.. Greenwich, CT: JAI Press.
- Asquith, P. and D. W. Mullins (1986) "Equity Issues and Offering Dilution," *Journal of Financial Economics*, 15, 61-89.
- Asquith, P., R. F. Bruner, and D. W. Mullins (1987) "Merger Returns and the Form of Financing," Harvard Business School Working Paper.
- Auerbach, A. J. (1985) "Real Determinants of Corporate Leverage," in *Corporate Capital Structures in the United States*, ed. Friedman, B. M.. Chicago: University of Chicago Press.
- Auerbach, A. J. and J. M. Poterba (1986) "Tax Loss Carryforwards and Corporate Tax Incentives," Working paper, Dept. of Economics, MIT.
- Bagnoli, M. and N. Khanna (1987) "Equilibrium with Debt and Equity Financing of New Projects: Why More Equity Financing Occurs When Stock Prices are High," Working Paper, Dept. of Economics, University of Michigan.

- Bartholdy, J., G. Fisher, and J. Mintz (1989) "An Empirical Study of the Impact of Corporate Taxation on The Debt Policy of Canadian Firms," Working Paper, Queen's University, Ontario.
- Baxter, N. D. and J. G. Cragg (1970) "Corporate Choice Among Long-Term Financing Instruments," *Review of Economics and Statistics*, 52, 225-35.
- Ben-Akiva, M. and S. R. Lerman (1985) *Discrete Choice Analysis: Theory and Application to Travel Demand*. Cambridge, MA: MIT Press.
- Bradley, M., G. A. Jarrell, and E. H. Kim (1984) "On the Existence of an Optimal Capital Structure: Theory and Evidence," *Journal of Finance*, 39, 857-878.
- DeAngelo, H. and R. W. Masulis (1980) "Optimal Capital Structure Under Corporate and Personal Taxation," *Journal of Financial Economics*, 8, 3-29.
- Fischer, E., R. Heinkel, and J. Zechner (1989) "Dynamic Capital Structure Choice: Theory and Tests," *Journal of Finance*, 44, 19-40.
- Gordon, R. and J. MacKie-Mason (1989a) "Effects of the Tax Reform Act of 1986 on Corporate Financial Policy and Organizational Form," in *Economic Effects of the Tax Reform Act of 1986*, forthcoming, ed. Slemrod, J.. Cambridge, MA: MIT Press.
- Jensen, M. C. (1986) "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *American Economic Review*, 76, 323-329.
- Jensen, M. C. and W. H. Meckling (1976) "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure," *Journal of Financial Economics*, 3, 305-60.
- John, K. and J. Williams (1985) "Dividends, Dilution, and Taxes: Signalling Equilibrium," *Journal of Finance*, 40, 1053-1070.

- Long, M. S. and I. B. Malitz (1985) "Investment Patterns and Financial Leverage," in *Corporate Capital Structures in the United States*, ed. Friedman, B. M.. Chicago: University of Chicago Press.
- MacKie-Mason, J. K. (1987) "Sequential Investment Decisions with Asymmetric Learning," CREST Working Paper, Dept. of Economics, Univ. of Michigan.
- MacKie-Mason, J. K. (1988) "Do Taxes Affect Corporate Financing Decisions?," NBER Working Paper No. 2632.
- MacKie-Mason, J. K. (1989a) "Do Firms Care Who Provides Their Financing?," in *Information, Investment and Credit Markets*, ed. Hubbard, R. G.. Chicago: University of Chicago Press.
- MacKie-Mason, J. K. (1989b) "Some Nonlinear Tax Effects on Asset Values and Investment Decisions Under Uncertainty," Forthcoming, *Journal of Public Economics*.
- Marsh, P. R. (1982) "The Choice Between Equity and Debt: An Empirical Study," *Journal of Finance*, 37, 121-144.
- Martin, J. D. and D. F. Scott (1974) "A Discriminant Analysis of the Corporate Debt-Equity Decision," *Financial Management*, Winter, 71-79.
- McFadden, D. (1974) "Conditional Logit Analysis of Qualitative Choice Behavior," in *Frontiers in Econometrics*, ed. Zarembka, P.. New York: Academic Press.
- McFadden, D. (1981) "Econometric Models of Probabilistic Choice," in *Structural Analysis of Discrete Data with Econometric Applications*, ed. Manski, C. F. and D. McFadden. Cambridge, MA: MIT Press.
- Miller, M. and K. Rock (1985) "Dividend Policy Under Asymmetric Information," *Journal of Finance*, 40, 1031-1051.

- Myers, S. C. (1977) "Determinants of Corporate Borrowing," *Journal of Financial Economics*, 5, 147-175.
- Myers, S. C. (1984) "The Capital Structure Puzzle," *Journal of Finance*, 39, 572-592.
- Myers, S. C. and N. S. Majluf (1984) "Corporate Financing and Investment Decisions When Firms have Information that Investors Do Not Have," *Journal of Financial Economics*, 13, 187-221.
- Poterba, J. M. (1986) "Taxation and Corporate Capital Structure," Comments prepared for the IV John Deutsch Roundtable of Economic Policy, The Impact of Taxation on Business Activity, Ottawa, November 11-13, 1985.
- Scholes, M. S. and M. A. Wolfson (1987) "Issues in the Theory of Optimal Capital Structure," in *Frontiers of Modern Finance*, ed. Bhattacharya, S. and G. Constantinides. : Rowman and Littlefield.
- Scholes, M., R. Wilson, M. Wolfson (1989) "Tax Planning, Regulatory Capital Planning, and Financial Reporting Strategy for Commercial Banks," Stanford Graduate School of Business Working Paper.
- Securities and Exchange Commission, U.S. (1957) *Costs of Flotation of Directly Placed Corporate Securities, 1951-1955*. Washington, DC: U.S. Government Printing Office.
- Taub, A. (1975) "The Determinants of the Firm's Capital Structure," *Review of Economics and Statistics*, 57, 410-416.
- Titman, S. and R. Wessels (1988) "The Determinants of Capital Structure Choice," *Journal of Finance*, 43, 1-19.
- Warner, J. (1977) "Bankruptcy, Absolute Priority, and the Pricing of Risky Debt Claims," *Journal of Financial Economics*, 4, 239-276.

Wolfson, M. A. (1985) "Empirical Evidence of Incentive Problems and Their Mitigation in Oil and Gas Tax Shelter Programs," in *Principals and Agents: The Structure of Business*, ed. J. Pratt and R. Zeckhauser. Boston: Harvard Business School Press.

Footnotes

1. One exception is Scholes, Wilson and Wolfson (1989), who find that tax loss carryforwards have a significant effect on the financial portfolios held by commercial banks. Also, Bartholdy, Fisher and Mintz (1989) do not find convincing non-debt tax shield effects, but use variation in Canadian corporate tax rates to identify significant marginal tax rate effects.
2. In fact, corporations with taxable income between \$0 and \$100,000 faced an intermediate tax rate, but this does not change the analysis. The point is that deductions only affect the marginal rate to the extent that they shift firms into a lower bracket, which will happen only very near or below zero taxable income.
3. Auerbach (1985) is an exception.
4. A few other papers use a similar statistical approach. Marsh (1982) uses older, British data, and ignores any tax effects. Baxter and Cragg (1970), Martin and Scott (1974), and Taub (1975) are primarily classification studies; they test essentially none of the modern capital structure hypotheses.
5. Another approach is to study specific episodes of legislative change that affect specific financial policies. This is the approach taken by Scholes, Wilson and Wolfson (1989).
6. For an example of the difficulty in handling even a few of these details, see Altshuler and Auerbach (1986). They had access to the necessary data only because Altshuler was a U.S. Treasury Department employee at the time.
7. The U.S. corporate income tax has a graduated rate schedule for very small firms, but all firms earning more than about \$100,00 during my sample period faced the same statutory rate.
8. In fact, tax claims are usually nonlinear functions of cash flows, and thus the effective tax rate requires a more complicated calculation since a nonlinear function of an expected value is not equal to the expected value of the function. MacKie-Mason [1989b] shows how to use option pricing methods to measure some effects of nonlinear tax functions.

9. The interaction between tax shields and the probability of tax exhaustion can be demonstrated in a simple formal model. An appendix available from the author illustrates the result using a contingent claims approach to valuing the firm's securities.
10. In my sample the fraction of firms with tax loss carryforwards in any given year ranges from 7% to 14%. Auerbach and Poterba (1986) find that 15% of the firms in the nonfinancial sector had loss carryforwards in 1984, but these firms are mostly quite small, accounting for only three percent of total market value.
11. 92% of the firms on the Compustat Primary, Secondary and Tertiary tape reported the same amount of ITC for both tax and book purposes, according to Form 10-K footnotes.
12. Other potential tax shields are badly mismeasured by book accounts. In particular, book depreciation deductions are almost entirely uncorrelated with tax depreciation in a given year, especially during my sample period (1977-86) when large tax depreciation incentives were available. In response to comments on the first version of this paper I reestimated the model with book measures of both depreciation and deferred taxes to check the robustness of the results. As expected with measurement error, the coefficients had signs consistent with the results reported below, but were insignificantly different from zero. The coefficients on other variables did not change substantially so omitted variable bias appears to be unimportant.
13. The function was retested in Altman, Haldeman and Narayanan (1977) with similarly strong results.
14. Titman and Wessels (1988), Auerbach (1985) and Bartholdy, Fisher and Mintz (1989) present useful surveys of the relevant theories and literature.
15. The effect of distress probability on debt/equity choices may also be due to taxes. A firm near bankruptcy is likely to pay zero taxes and so face a lower effective tax rate. Thus negative coefficients on these variables might be providing more evidence in support of the tax hypothesis.

16. Similar inefficiencies have been identified for limited partnerships by Wolfson (1985), because the limited partners have a prior claim on project cash flows while the general partner (and sole decisionmaker) claims the residual.
17. This point is discussed in MacKie-Mason (1988).
18. A table comparing population and sample characteristics is given in MacKie-Mason (1988).
19. The asymmetric information cost that Myers and Majluf use to explain a preference for debt depends on the priority of debt claims, not different information available to purchasers of debt and equity.
20. Firms may not have stable target debt ratios. As Myers (1984) pointed out, the relative prices of new debt and equity may change over time due to changing asymmetries of information between managers and investors. Then the observed debt ratio is the result of the firm's history and changes in market information, but the current financing choice depends on current conditions, with the "target" moving up or down as conditions change.
21. Since the likelihood function is globally concave, the estimates of β are unique, if bounded. The standard deviation, σ is normalized to unity because it is not separately identified. The maximum likelihood method is consistent only if the error terms in the specification of the incremental value functions are in fact distributed normally. However, I have re-estimated the same choice on a somewhat smaller sample under the assumption that the error distribution is logistic, and obtained virtually the same results. The logistic results are reported in MacKie-Mason (1989a), which however concerns a different financing question. Thus the inferences appear robust to at least some different error specifications.
22. McFadden (1981) discusses the utility theory underlying a nested preference model of this sort. Terminal branches of the tree, such as the public issue branch of Figure 1, can be consistently estimated with standard discrete choice methods, such as the probit technique employed below.

23. I have reported the results of estimating the other branches of a nested model in MacKie-Mason (1989a).
24. Scholes and Wolfson (1987) discuss the important simultaneities between investment and financing. The point is illustrated by Asquith, Brunner and Mullins (1987), who find that the share price effect of takeover announcements varies with the type of financing.
25. Auerbach and Poterba (1986) show that book TLCF mismeasures true tax-account TLCF for some firms. To test for the possibility of measurement error bias I obtained their corrections to TLCF for the four years of their sample and reestimated the model for that limited subsample. The TLCF coefficient remained negative but was statistically insignificant because of the increased standard error from relying on only about half as many observations. Thus measurement error does not seem to be important to the inferences.
26. See, e.g., Bradley, Jarrell and Kim (1984), Titman and Wessels (1988), Ang and Peterson (1986), Bartholdy, Fisher and Mintz (1989), and Long and Malitz (1985).
27. Alan Auerbach has pointed out to me that equipment often has an active resale market, and thus a *disinvestment* problem may exist, possibly rendering equipment a poor form of fixed implicit collateral for reducing the moral hazard costs of debt.
28. I reestimated the model after adding $ITC/(ZPROB^2)$ to test for nonlinear effects. Rather than indicating a turning point in the relationship, the quadratic term also had a significantly negative coefficient, and $ITC/ZPROB$ remained negative but became insignificant. Thus the inference is reinforced, not changed. However, rather than mine the data for the best fit, I report only the results of the first model without the quadratic term.
29. See Gordon and MacKie-Mason (1989) for an empirical examination of the effects of the Tax Reform Act of 1986 on corporate financing.
30. I also calculated "standardized derivatives" by evaluating the derivative with respect to a one standard deviation change at the sample means for all the data, to check the robustness of the sample derivative measures. The nonlinearity of the econometric model may render the inferences sensitive to the evaluation point; I am grateful to an anonymous

referee for alerting me to this concern. However, the estimated derivatives were quite similar for all of the variables; for instance, ITC was -8% rather than -11%.

31. Debt issues were 59% of the value of total issues during 1981–1983; over 1977–1987 debt constituted 73.3% of issue value. Source: *SEC Monthly Statistical Review*.

32. The experiment for TLCF is not quite what we would expect to see in the real world. Any policy shift that reduced taxable income would increase TLCF for those firms already reporting losses, shift some firms into a loss status and thus increase TLCF for them, but still leave most firms reporting zero TLCF. However, the calculations are intended to give a sense of the relative economic responsiveness of financial choices to changes in marginal tax rates, not to forecast particular policy experiments.

33. Gordon and MacKie-Mason [1989] calculate the predicted effect of the 1986 Tax Reform Act changes on debt policy, then find that there has been less change in leverage during the first two years since the legislation than expected.

34. Various stories can explain the “wrong” sign on VEARNA/ZPROB. One is that VEARNA/ZPROB may in fact be indicating a severe signalling cost for an equity issue (see MacKie-Mason 1988). However, any such explanation is *ex post* rationalization; we need further research to establish a clearer interpretation for this variable.

35. Since $1/ZPROB$ appears twice as an interacted variable multicollinearity may be reducing the precision of this estimate.

36. Rather than measuring an intangible asset (goodwill) advertising may indicate that a firm is in a mature, easy-to-understand business, and thus subject to lower signaling premia on equity from hidden information problems. In particular, advertising is particularly high for retail and consumer products firms, which may not be subject to surprises that are known privately only by managers.

37. MacKie-Mason (1989a) finds more plausible evidence for signaling effects, but on the choice between public and private sources of funds, rather than between debt and equity.

38. Bunching is less plausible for other firms since few of them issue enough equity to save substantially on flotation costs through bunching. A study by the SEC (1957) found larger scale effects in flotation costs for equity than for debt; there seems to be no contradictory recent evidence.
39. Also, since I used prior year data to avoid endogeneity, I ignore some recent information. The same specification with more informative data might have an even better fit.
40. The statistics are: $\rho^2 = 1 - \{l(\hat{\beta})/l(0)\}$, where $l(\hat{\beta})$ is the value of the log likelihood function at the estimated parameter vector, and $l(0)$ is the value if no parameters are estimated; $\bar{\rho}^2 = 1 - \{[l(\hat{\beta}) - K]/l(0)\}$, where K is the number of parameters estimated; and $M\text{-}\rho^2 = 1 - \{l(\hat{\beta})/l(c)\}$, where $l(c)$ is the log likelihood value if just a constant is estimated. The latter measure was suggested by McFadden (1974); for a discussion of the first two, see Ben-Akiva and Lerman (1985).
41. The R^2 is defined as $\left\{1 - \exp\left(\frac{2}{N}[l(c) - l(\hat{\beta})]\right)\right\} / \left\{1 - \exp\left(\frac{2}{N}l(c)\right)\right\}$.
42. The coefficients for the alternative specifications are reported in MacKie-Mason (1988).
43. This was determined after analysis of the tape and codebooks, and with the aid of a programmer at the SEC.
44. An extensive hand search of Moody's Industrial Manual and individual 10K reports recovered enough missing data to keep about 200 observations in the sample.

Table I

Hypothesized effects of firm characteristics on the firm's probability of choosing to issue debt rather than equity when issuing public securities, under various hypotheses. "+" indicates a higher probability of debt issue. Blanks indicate no hypothesized effect.

Variable	Tax Hypothesis	Financial Distress and Moral Hazard	Signaling
Tax loss carryforwards	-		
Investment tax credit (ITC)	-	+	
ITC/ZPROB ^a	-		
Research & Development	-	-	+
Advertising	-	-	
Earnings variance, Type A ^b		-	+
Earnings variance, Type B ^b		-	
1/ZPROB ^a	-	-	
Fraction assets in plant		+	
(Free) Cash flow		+	
Ownership Dilution		+	+
Change in stock price			-
Paying Dividends			-
Regulated Firm			-

^a 1/ZPROB is a version of Altman's (1966) predictor of bankruptcy; a high value indicates a greater probability of bankruptcy.

^b The two different earnings variance measures are the variance of the first differences of accounting earnings (Type A), and the variance of the percentage change in accounting earnings (Type B).

Table II

Estimated coefficients from a probit model of firm choices between publicly-issued debt and equity. Estimation by maximum likelihood. A positive coefficient indicates a higher probability of choosing debt. Asymptotic t-statistics in parentheses. 1747 observations; 1977-1987. Sample derivatives are the fraction of the sample that changes from a predicted equity to a predicted debt choice if the corresponding explanatory variable is increased by one standard deviation.

Variable		Model 1	Model 2 ^c	Sample Deriv. (In Percentage points)	
Constant		-0.131 (0.491)	-0.312 (0.692)		
TAXES	Tax Loss	-1.86	-2.02	-9.36	
	Carryforwards	(2.04)	(2.00)		
	Investment	28.8	27.8	8.54	
	Tax Credit	(2.18)	(1.91)		
ITC/ZPROB ^d		-33.8 (2.37)	-33.2 (2.18)	-10.8	
FINANCIAL DISTRESS	Earnings Variance (Type A)	-9.88 (5.61)	-9.86 (5.17)	-21.6	
	VEARNA/ZPROB ^d		12.5 (4.04)	13.5 (4.03)	24.3
	Earnings Variance (Type B)	-0.0661 (3.37)	-0.0750 (3.86)	-31.5	
	1/ZPROB ^d		-0.406 (1.63)	-0.478 (1.62)	
MORAL HAZARD	Fraction of assets in plant & equip	0.461 (2.33)	0.393 (1.61)	4.72	
	Research and Development	-4.41 (2.76)	-0.969 (0.448)	-6.90	
	Advertising	3.67 (3.51)	4.57 (3.88)	4.44	
	Cash Deficit	-1.55 (2.83)	-1.46 (2.35)		

Continued

Table II
Continued

Variable		Model 1	Model 2 ^c	Sample Deriv. (In Percentage points)
SIGNALING	Relative Size (Ownership Dilution)	0.525 (10.5)	0.546 (10.6)	7.38
	Δ Stock Price	-0.597 (7.14)	-0.605 (6.90)	-17.6
	Paying Dividends	0.413 (3.07)	0.319 (2.21)	
	Regulated	-0.829 (4.88)	-0.233 (0.397)	
	Electric Utilities	0.968 (4.43)	0.660 (1.39)	
OTHER	Net Assets	0.0264 (4.08)	0.0187 (2.50)	4.78
	Debt/Assets	-0.490 (1.38)	-0.219 (0.543)	-3.96
	Δ Debt/Assets	-0.463 (1.10)	-0.586 (1.27)	-3.14
	1978	-0.0328	-0.00003	
	1979	-0.320	-0.271	
	1980	-0.162	-0.0981	
	1981	-0.348 ^a	-0.317	
	1982	-0.410 ^b	-0.426 ^b	
	1983	-1.25 ^b	-1.24 ^b	
	1984	-0.228	-0.190	
	1985	0.436 ^b	0.429 ^b	
	1986	0.595 ^b	0.569 ^b	
	1987	0.428 ^b	0.438 ^b	
	ln \mathcal{L}	-897.0	-865.9	
	M- ρ^2	0.256	0.281	
ρ^2	0.259	0.285		
$\bar{\rho}^2$	0.235	0.241		
% Right Debt	77.9%	75.1%		
% Right Equity	75.4%	80.5%		
% Right Total	76.6%	78.0%		

^a Indicates year dummy significant at 10% level.

^b Indicates year dummy significant at 5% level.

^c This specification included 23 industry dummy variables.

^d 1/ZPROB is a version of Altman's (1966) predictor of bankruptcy; a high value indicates a greater probability of bankruptcy. VEARN denotes the "Earnings Variance (Type A)" variable.

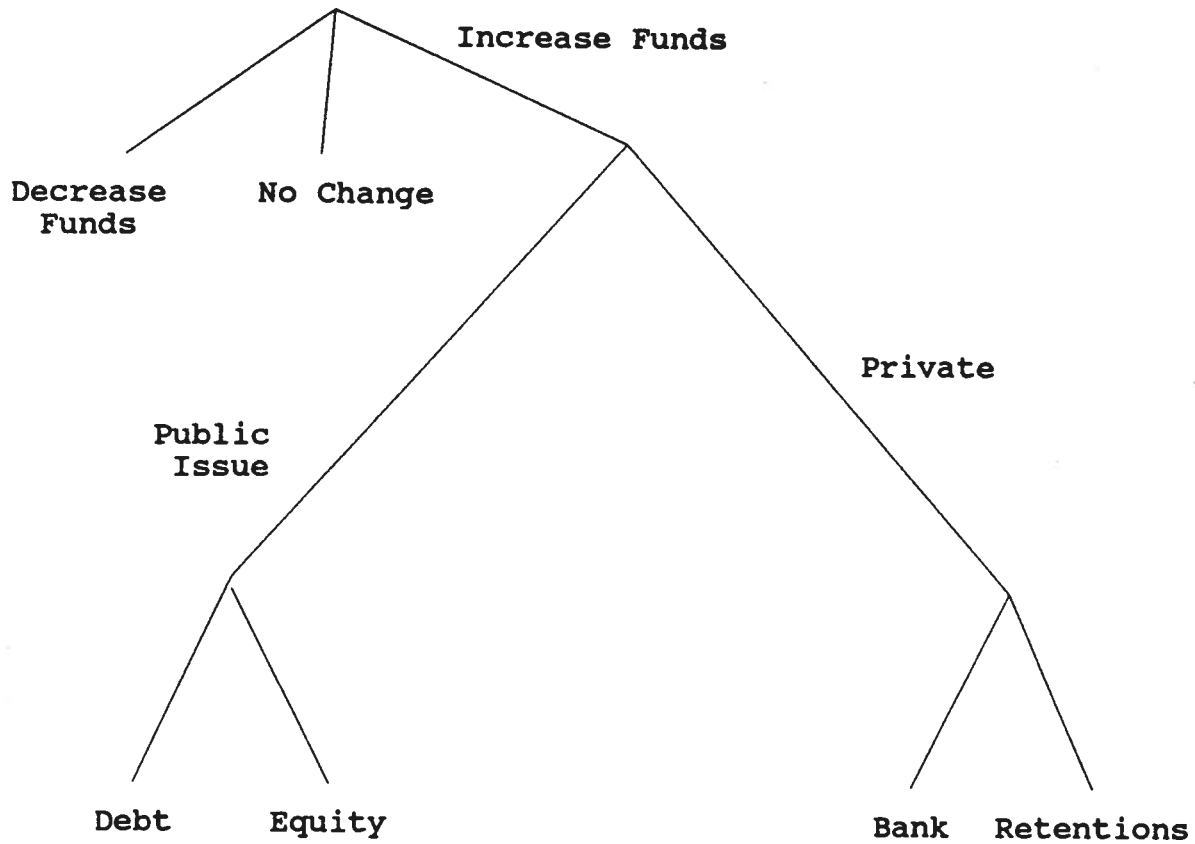


Figure 1. A sequential process for financing decisions.

If the firm chooses to increase funds, it then chooses either a private or a public issue, and then chooses either debt or equity.

Figure Captions

Figure 1. A sequential process for financing decisions

If the firm chooses to increase funds, it then chooses either a private or a public issue, and then chooses either debt or equity.

OFFICE OF TAX POLICY RESEARCH

Working Paper Series

- No. 90-1 Joel Slemrod, "Do Taxes Matter?: The Economic Impact of the Tax Reform Act of 1986"
- No. 90-2 Alan J. Auerbach and Kevin Hassett, "Investment, Tax Policy and the Tax Reform Act of 1986"
- No. 90-3 Jonathan Skinner and Daniel Feenberg, "The Impact of the 1986 Tax Reform Act on Personal Saving"
- No. 90-4 Roger H. Gordon and Jeffrey K. MacKie-Mason, "Effects of the Tax Reform Act of 1986 on Corporate Financial Policy and Organizational Form"
- No. 90-5 James M. Poterba, "Taxation and Housing Markets: Preliminary Evidence on the Effects of Recent Tax Reforms"
- No. 90-6 Joel Slemrod, "The Impact of the Tax Reform Act of 1986 on Foreign Direct Investment to and from the United States"
- No. 90-7 Charles T. Clotfelter, "The Impact of Tax Reform on Charitable Giving: A 1989 Perspective"
- No. 90-8 Paul N. Courant and Edward M. Gramlich, "The Impact of TRA on State and Local Fiscal Behavior"
- No. 90-9 John Whalley, "Foreign Responses to U.S. Tax Reform"
- No. 90-10 Henry J. Aaron, "Lessons for Tax Reform"
- No. 90-11 Jeffrey K. MacKie-Mason, "Do Taxes Affect Corporate Financing Decisions?"
- No. 90-12 Jeffrey K. MacKie-Mason, "Some Nonlinear Tax Effects on Asset Values and Investment Decisions Under Uncertainty"
- No. 90-13 Jeffrey K. MacKie-Mason, "Do Firms Care Who Provides Their Financing?"
- No. 90-14 Susan Chaplinsky and Greg Niehaus, "The Tax and Distributional Effects of Leveraged ESOPs"

- No. 90-15 Michelle J. White, "Why are Taxes So Complex and Who Benefits?"
- No. 90-16 Bibliography on Tax Compliance and Tax Law Enforcement
- No. 90-17 Stanley Langbein, "A Modified Fractional Apportionment Proposal For Tax Transfer Pricing"
- No. 90-18 Charles H. Berry, David F. Bradford, and James R. Hines, Jr., "Arm's Length Pricing -- Some Economic Perspectives"

Office of Tax Policy Research Working papers can be obtained by sending \$2 per paper to:

Office of Tax Policy Research
School of Business Administration
University of Michigan
Ann Arbor, MI 48109-1234

Checks should be made out to the University of Michigan.