NBER WORKING PAPER SERIES

TAXES AND CORPORATE CAPITAL STRUCTURE IN AN INCOMPLETE MARKET

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Working Paper No. 594

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge MA 02138

December 1980

This paper was presented at the NBER's 1980 Summer Institute in Financial Markets and Monetary Economics. While retaining full responsibility for this paper, I would like to thank David Baron, E. Han Kim, William Marshall, Merton Miller, and Joseph Williams for comments and suggestions on earlier drafts. The research reported here is part of the NBER's research program in Financial Markets and Monetary Economics. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

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ABSTRACT

This paper extends Merton Miller's 1977 analysis of corporate capital structure decisions to the incomplete capital markets case. As in Miller's model, aggregate demand for corporate leverage is curtailed as interest rates on taxable bonds rise. Unlike Miller's model, however, capital structure is not a matter of indifference to all equilibrium shareholders. Market incompleteness and tax arbitrage restrictions combine to prevent marginal rates of substitution from being equalized for all investors and hence their preferences are not unanimous. In addition, costs associated with debt induce a tendency for lower cost firms to issue a larger proportion of total corporate debt.

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Taxes and Corporate Capital Structure in an Incomplete Market

The view that a corporation's optimal captial structure is determined by balancing tax savings against bankruptcy costs has recently come under heavy attack.[1] Because this view seems to have stemmed initially from an attempt to reconcile theory with empirical observation,[2] it is ironic that some of the most damaging attacks have themselves been based on empirical facts. Jensen and Meckling [7], for example, point out that the tax saving-bankruptcy cost tradeoff implies all-equity capital structures in the absence of corporate taxes, yet this is not what we observe prior to 1913. Similarly, Miller [11] argues that the theory implies dramatic secular increases in corporate debt ratios since 1913 and more widespread issuance of income bonds, yet we observe neither.

As an alternative to the previous view, Miller has proposed an appealingly simple general equilibrium model of interest rates and security prices in the face of both corporate and personal income taxes. When ordinary income and capital gains are taxed at different rates, he concludes that the relative values of firms in a risk class must be identical, regardless of their capital structures. The original MM proposition that capital structure doesn't matter is thus reestablished, even in a world of taxes.

Since Miller's model is based on a number of simplifying assumptions, it is the purpose of this paper to try to extend the analysis to a less restrictive setting. In particular, the basic model is examined under incomplete capital market conditions, and costs associated with debt are introduced. As in Miller's model, it is found that investors have a positive demand for corporate leverage, and that this demand is curtailed as the taxable interest rate rises relative to the tax-exempt rate. Unlike Miller's model, however, the capital structure of any one firm is not found to be a matter of indifference to all shareholders at a market equilibrium. This is attributable in part to the costs of debt, which dictate a tendency for more debt to be issued by those firms with lower costs. In addition, tax arbitrage restrictions, combined with incompleteness of the capital market, prevent marginal rates of substitution between current and future consumption from being equated for all investors. Shareholder preferences are thus no longer unanimous, and equilibrium capital structures will be those which both satisfy a majority of the current shareholders and are immune from outside takeover. The determination of corporate capital structures can be interpreted as retaining a vestige of the old tax saving-bankruptcy cost tradeoff, but there are complicating features not taken into account by the original theory.

In Section I of the paper, Miller's basic model is recast in a more formal setting and results identical to his are derived under conditions of certainty. In Section II uncertainty is introduced under incomplete capital market conditions, and investors' preferences for corporate capital structure are analyzed. Special costs associated with corporate debt are also introduced in this section, and the implications of the uncertainty model are compared with available empirical evidence. Conclusions are presented in Section III.

I. A Certainty Model

A. Portfolio Equilibrium with Fixed Security Supplies

This section details a two-period model of individuals' consumption-saving decisions under certainty. In part A, security supplies are held fixed while in part B, corporate capital structure decisions are allowed to alter relative security supplies. The purpose of the certainty model is to display the workings of Miller's equilibrating mechanism as clearly as possible before dealing with the added complications introduced by uncertainty.

In the first period, each individual, i, allocates his initial wealth endowment between current consumption, C_{1i}, and saving. Funds saved may take the form of tax-exempt bonds, L_{0i}; fully taxable bonds, L_i; or corporate shares. Letting S_j be the total market value of corporation j's equity, an individual may purchase any fraction, α_{ij}, of S_j. Individuals are initially endowed with some amount of cash, Y_{1i}, and a given individual may also have an initial ownership share, $\bar{\alpha}_{ij}$, in firm j. Each firm j in turn invests an exogenously determined amount, I_{1j}, in period 1, and the required funds come from either (taxable) bond issues, B_j, or equity, $I_{1j} - B_j$. The firm's initial owners (those with $\bar{\alpha}_{ij} > 0$) may then be thought of as entrepreneurs or organizers who announce an investment and financing plan and then sell securities. Given I_{1j} and B_j, the total amount, S_j, that investors are willing to pay to buy shares in the firm's eventual profits may exceed the required equity investment, $I_{1j} - B_j$, and any surplus is assumed to be paid out (tax-free) to the initial owners. Each individual's consumption-saving plan must therefore satisfy

$$Y_{1i} + \sum_j \bar{\alpha}_{ij}(S_j - (I_{1j} - B_j)) = C_{1i} + L_{0i} + L_i + \sum_j \alpha_{ij} S_j. \qquad (1)$$

Trading in each of the three securities markets is competitive and there are no transaction costs, but it is assumed that the tax authorities have forbidden certain portfolio combinations to eliminate tax arbitrage. Investors may not borrow at the taxable rate to hold tax-exempt securities, for example, nor may any investor borrow at the tax-exempt rate.

In the second period, individuals consume the after-tax income from their securities investments. The return per dollar of tax-exempt bonds is R_0. The pre-tax return per dollar of taxable bonds is R, but each individual is taxed on this return at the positive constant rate t_{pi}.[3] The return on corporate shares is determined by profits: each corporation earns gross pre-tax profits

X_{2j}, out of which it pays debt service RB_j and taxes at the rate t_c. The net amount available to shareholders is then $(X_{2j} - RB_j)(1 - t_c)$, and, consistent with Miller's model, it is assumed that investors pay no personal taxes on their income from corporate shares.

Individual consumption in period 2 is thus given by

$$C_{2i} = R_0 L_{0i} + R(1 - t_{pi})L_i + \sum_j \alpha_{ij}(X_{2j} - RB_j)(1 - t_c), \qquad (2)$$

and the consumption-saving decision consists of maximizing utility of current and future consumption, $U_i(C_{1i}, C_{2i})$, subject to (1) and (2). The first-order conditions for an optimal portfolio are

$$\frac{\partial U_i}{\partial L_{0i}} = -U_{i1} + U_{i2}R_0 \leq 0 \qquad (3a)$$

$$\frac{\partial U_i}{\partial L_i} = -U_{i1} + U_{i2}R(1 - t_{pi}) \leq 0 \qquad (3b)$$

$$\frac{\partial U_i}{\partial \alpha_{ij}} = -U_{i1}S_j + U_{i2}(X_{2j} - RB_j)(1 - t_c) \leq 0 \ , \qquad (3c)$$

with the inequalities necessitated by the tax-arbitrage restrictions. Equality holds for cases in which the individual has positive holdings of the security in question, but inequality may hold if he is prevented from short-selling as much as he wishes.

Given fixed supplies of securities, a <u>portfolio equilibrium</u> is defined as a set of security holdings $(L_{0i}, L_i, (\alpha_{ij}))$ for all i and a set of interest rates and stock values $(R_0, R, (S_j))$ such that (i) every investor's utility is maximized (i.e. conditions (3a) - (3c) hold) and (ii) all three securities markets clear.

For the bond markets, this implies $R > R_0$, since taxable bonds would be dominated if $R \leq R_0$. As R rises relative to R_0, investors in low tax brackets eventually find taxable bonds more attractive than tax-exempts, and in equilibrium, there is some critical personal tax rate, t^*_{pi}, such that no taxable bonds are purchased by investors for whom $t_{pi} > t^*_{pi}$, while no tax-exempt bonds are purchased if $t_{pi} < t^*_{pi}$.[4]

Since corporate shares are riskless in this world, the rates of return on riskless bonds provide the relevant opportunity costs that investors will use in determining how much to bid for a given share. From (3a) and (3b), an investor's marginal rate of substitution between current and future consumption is either R_0, if $t_{pi} \geq t^*_{pi}$, or $R(1-t_{pi})$, if $t_{pi} \leq t^*_{pi}$, and these rates can be thought of as marginal personal discount rates. An investor with $t_{pi} \geq t^*_{pi}$ would thus place a subjective value of

$$\hat{S}^i_j = \frac{(X_{2j} - RB_j)(1 - t_c)}{R_0} \tag{4a}$$

on the stock of company j at the margin, while for an investor with $t_{pi} \leq t^*_{pi}$ the subjective value of the same shares would be

$$\hat{S}^i_j = \frac{(X_{2j} - RB_j)(1 - t_c)}{R(1 - t_{pi})} \quad . \tag{4b}$$

But since $R_0 < R(1-t_{pi})$ if $t_{pi} < t^*_{pi}$, this implies that investors with $t_{pi} \geq t^*_{pi}$ will always be willing to outbid other investors for corporate shares. Thus, at a portfolio equilibrium, the market value of the shares will be given by (4a), and all corporate stock will be held by those investors who also purchase tax-exempt bonds. Indeed, this should not be surprising since tax-exempt bonds and tax-exempt corporate shares are perfect substitutes in a world of certainty.

B. The Capital Structure Decision

An initial portfolio equilibrium may be disturbed if we allow shifts in corporate security supplies.[5] Accordingly, we define a capital structure equilibrium as a set of capital structures, B_j, for all firms such that at a portfolio equilibrium relative to B_j no further changes in any firm's capital structure would unambiguously increase the welfare of that firm's shareholders.

The rationale for this definition is that shareholders will be able to sustain any unambiguous welfare increase through voting. For example, if some change exists which makes all shareholders better off, all of them would clearly vote in favor of it. Or in a case of weaker preference, if a change exists which makes some shareholders better off and none worse off, at least some would vote in favor of it and none would vote against it.

We can investigate shareholder preferences for an increase in corporate leverage by totally differentiating investor utility with respect to B_j, holding I_{1j} constant. Using the derivatives of (1) and (2) we have[6]

$$\frac{dU_i}{dB_j} = (U_{i2}R_0 - U_{i1})\frac{dL_{0i}}{dB_j} + (U_{i2}R(1-t_{pi}) - U_{i1})\frac{dL_i}{dB_j}$$

$$+ \sum_j [(X_{2j} - RB_j)(1-t_c)U_{i2} - U_{i1}S_j]\frac{d\alpha_{ij}}{dB_j}$$

$$+ (-U_{i2}R(1-t_c) - U_{i1}\frac{dS_j}{dB_j})\alpha_{ij} + U_{i1}(\frac{dS_j}{dB_j} + 1)\bar{\alpha}_{ij} \; . \qquad (5)$$

At a portfolio equilibrium, the first four terms on the right-hand side of (5) are all zero,[7] and the direction and magnitude of investor preferences thus depend entirely on the fifth term. This yields the familiar maxim that all initial shareholders prefer that the perceived net market value of the equity be maximized. Furthermore, if investors realize that equilibrium share values will always be determined by (4a), their common forecast of the change in the market value of j's equity is

$$\frac{dS_j}{dB_j} = -\frac{R(1-t_c)}{R_0}, \tag{6}$$

so

$$\frac{dU_i}{dB_j} = U_{i1}\left(1-\frac{R(1-t_c)}{R_0}\right)\bar{\alpha}_{ij}. \tag{7}$$

From (7) initial shareholders ($\bar{\alpha}_{ij} > 0$) will unanimously prefer more leverage if $R(1-t_c) < R_0$ and less if $R(1-t_c) > R_0$. These preferences stem from a desire to economize on the combined tax bill of both the firm and its investors. As long as it has enough taxable operating income to take advantage of the interest deduction, the firm can always reduce its own tax bill by substituting more bonds for equity, but at the same time it must coax some marginal investors to purchase these new taxable bonds, thus increasing the aggregate tax bill of its bondholders. Suppose we start from a portfolio equilibrium with $R(1-t_c) < R_0$. Since the critical tax rate is defined by $R(1-t^*_{pi}) = R_0$, t^*_{pi} must be less than t_c, and hence the marginal investors, with $t_{pi} = t^*_{pi}$, will see their taxes increase by less per dollar of additional debt than the corresponding tax saving for the firm. As more debt is issued, however, the net tax advantage to corporate leverage diminishes. The increased supply of taxable bonds increases R relative to R_0 (or, equivalently, forces down prices of taxable relative to tax-exempt assets) and thus raises t^*_{pi}. Equilibrium is reached when $t^*_{pi} = t_c$, because at that point the net advantage to corporate debt has been driven to zero.[8] This establishes

<u>Proposition 1</u>: At a capital structure equilibrium, enough corporate bonds will have been issued to set $R(1-t_c) = R_0$.

The results of this certainty model thus duplicate exactly those of Miller.

C. Discussion

The sense in which capital structure "doesn't matter" in the preceding section may be looked at from one of two perspectives: from the first, market values are invariant to capital structure changes, and from the second, all shareholders are indifferent to changes in capital structure. Because of the assumptions of the model the two perspectives are equivalent, but looking at the problem from one and then the other yields slightly different insights into the working of the model.

Miller himself interprets his results from the value-invariance perspective and this highlights the importance of aggregate security supplies. Firms' total market values will be unaffected by capital structure changes only so long as $R(1 - t_c) = R_0$, but in order to enforce this equality aggregate security supplies must be held constant. Thus, a capital structure change by any one firm must be met with offsetting changes by other firms. Using the label employed by Brenner and Subrahmanyam [3], value-invariance holds in an "intra-equilibrium" sense here since we are dealing with the relative values of firms, keeping security supplies and market prices constant. Value-invariance would not hold in an "inter-equilibrium" sense, by contrast, since a change in capital structure by just one firm will alter security supplies, thus bringing about a whole new equilibrium with different relative interest rates and firm market values.[9]

Looking at Proposition 1 from the perspective of investor preferences, on the other hand, highlights the importance to this model of a homogeneous shareholder composition. Most unanimity results in finance theory hinge on the fact that all investors value identically the marginal return vector stemming from some change in the firm's financial policy.[10] In the current model that property cannot hold, since investors in different tax brackets would apply different discount rates to the same stream of after-tax future returns. Nevertheless, unanimity still goes through because, as we have seen, only investors with $t_{pi} \geq t_{pi}^*$ are holders of corporate stock in equilibrium.[11] Knowing this, all initial shareholders realize that equation (4a) will govern equilibrium share values, and all make identical forecasts (see equation (5)) of the change in share value resulting from a change in capital structure. Hence, initial shareholders have unanimous preferences, and when $R(1-t_c) = R_0$, all are indifferent to further capital structure changes.

When we turn to the uncertainty case, it will be seen that the lack of a homogeneous shareholder group causes difficulties in establishing unanimity results.

II. An Uncertainty Model

A. Corporate Debt Involves No Special Costs

Let us begin by making the uncertainty model as closely analogous as possible to the certainty model of Section I. Trading is assumed to occur in three securities: riskless tax-exempt bonds, riskless taxable bonds,[12] and risky, tax-exempt corporate shares. Uncertainty affects only second-period corporate output, so that $X_{2j} = X_{2j}(\theta)$, where θ is an uncertain state of nature. Implicitly, the capital market here is incomplete because it will not be possible to combine existing securities into a portfolio yielding any given pattern of contingent returns and at the same time any given tax treatment. The only risky securities are tax-exempt, and the only taxable securities are riskless, so opportunities for creating taxable contingent return streams are limited.

Under uncertainty, individual investors will be viewed as expected utility maximizers with subjective probability density functions, $f_i(\theta)$, across the states of nature, and the individual's choice problem is

$$\max_{L_{0i},\, L_i,\, \alpha_{ij}} \left(\int_\theta U_i(C_{1i}, C_{2i}(\theta)) f_i(\theta) d\theta\right) ,$$

subject to (1) and

$$C_{2i}(\theta) = R_0 L_{0i} + RL_i(1-t_{pi}) + \Sigma\alpha_{ij}(X_{2j}(\theta) - RB_j)(1 - t_c) . \tag{8}$$

The first-order portfolio optimality conditions are analogous to (3a) - (3c) and may be represented as

$$\int_\theta \rho_i(\theta)\, d\theta \leq \frac{1}{R_0} \tag{9a}$$

$$\int_\theta \rho_i(\theta)\, d\theta \leq \frac{1}{R(1-t_{pi})} \tag{9b}$$

$$\int_\theta \rho_i(\theta)(X_{2j}(\theta) - RB_j)(1-t_c)d\theta \leq S_j , \tag{9c}$$

where

$$\rho_i(\theta) = \frac{U_{2i} f_i(\theta)}{\int_\theta U_{1i} f_i(\theta) d\theta}$$

is i's implicit price of second-period consumption in state θ, or, equivalently, his marginal rate of substitution between certain current consumption and state-contingent future consumption. Although condition (9c) implies that all shareholders in firm j (those for whom (9c) is satisfied with an equality) will agree at the margin on the overall value of the return stream offered by firm j's shares, there is no guarantee in an incomplete market that implicit prices for individual states of nature will be the same for all investors.

Conditions (9a) and (9b) indicate that holders of tax-exempt and taxable bonds apply discount rates of R_0 and $R(1-t_{pi})$, respectively, to units of certain, second-period consumption. These rates will be referred to as "personal certainty discount rates," and because of tax arbitrage restrictions, personal discount rates will not be driven to equality for all investors. As in the certainty case, equilibrium in the bond markets will determine a critical personal tax rate, t^*_{pi}, such that investors in tax brackets below t^*_{pi} will hold only taxable bonds (to the extent that they hold bonds at all), while investors in higher tax brackets will favor tax-exempts. Unlike the certainty case, however, risky corporate shares and riskless tax-exempt bonds are no longer perfect substitutes, and a given investor need not hold any bonds. Furthermore, if tax arbitrage restrictions are stringent enough, the personal certainty discount rate of an investor holding only corporate shares may be higher than either R_0 or $R(1-t_{pi})$.[13]

Because investors with a taste for risk-taking have no choice but to hold tax-exempt corporate shares here, we may find, unlike the certainty case, that final shareholders range over the whole spectrum of personal tax brackets. Even though shares offer greater tax advantages to investors in higher brackets, tax considerations might be outweighed for a low tax-bracket investor who is particularly optimistic about a given company's prospects or who has a particular taste for that company's pattern of returns. While this result is more consistent with empirical observation than the limited shareholder composition of the certainty case, however, it complicates the analysis of capital structure changes.

Conceptually, we can view the establishment of a capital structure equilibrium as a kind of tatonnement process. For a given level of investment, each firm announces a capital structure (characterized by B_j) and investors engage in mock trades until a portfolio equilibrium is established relative to B_j. We can then investigate whether shareholders would prefer some different value of B_j by differentiating their expected utility at this portfolio equilibrium. If it is found that some different value of B_j would unambiguously increase shareholder welfare, the firm announces a new B_j and the process repeats itself, until a capital structure equilibrium is established.

If we assume that all shareholders act as price-takers and hence use their current implicit prices to forecast the change in S_j resulting from a change in B_j,[14] the expression analogous to (7) is

$$\frac{dE_i(U_i)}{dB_j} = E_i[U_{i1}(1 - R(1 - t_c)\int\rho_i(\theta)d\theta)\,\bar{\alpha}_{ij}] \,, \qquad (10)$$

where E_i denotes investor i's expectation operator. If firm j issues an additional dollar of debt, its shareholders receive the proceeds immediately in exchange for $R(1 - t_c)$ dollars fewer of future tax-exempt income; expression (10) simply indicates that the impact on shareholder welfare depends on how they evaluate this exchange. Since personal certainty discount factors, $\int\rho_i(\theta)d\theta$, may differ among shareholders in different tax brackets, however, their evaluations of capital structure changes may likewise differ. A shareholder who also purchases tax-exempt bonds $(\int \rho_i(\theta) d\theta = 1/R_0)$ will want more corporate debt if $R(1-t_c) < R_0$, since he will invest the proceeds from this debt in tax-exempt bonds, yielding R_0. On the other hand, a shareholder who also purchases taxable bonds $(\int \rho_i(\theta) d\theta = 1/R(1-t_{pi}))$ will desire more corporate leverage if $t_{pi} < t_c$, since his relevant opportunity cost is the taxable rate, net of personal taxes. Similarly, as was noted above, shareholders who purchase neither type of bond may evaluate the capital structure change using a personal discount rate that is higher than either R_0 or $R(1-t_{pi})$. In the certainty case, it will be recalled, only those investors with personal tax rates greater than t_c (and hence personal discount rates equal to R_0) held corporate stock in a portfolio equilibrium, and therefore all shareholders made identical evaluations of a change in B_j. In the case at hand, by contrast, investors in any tax bracket may hold shares, and thus shareholder preferences need not be unanimous.

Suppose we were to start, then, from a portfolio equilibrium in which enough corporate bonds had been issued to set $R_0 = R(1-t_c)$. From (9a) and (10), shareholders who also held tax-exempts would be indifferent to further changes, but all other shareholders, having personal certainty discount rates greater than R_0, would prefer more leverage. Any firm which had these higher discount rate investors among its shareholders could make them better off by issuing more debt without making the other shareholders, who are indifferent, worse off. Therefore, the initial position is not a capital structure equilibrium and we have

<u>Proposition 2</u>: With incomplete markets under uncertainty, $R_0 = R(1-t_c)$ is not, in general, an equilibrium interest rate configuration.[15]

If at least some firms respond to shareholder preferences by issuing more debt, R will rise relative to R_0, and then shareholders with personal certainty discount rates of R_0 will desire less debt, while those with discount rates of $R(1 - t_{pi})$ and $t_{pi} < t_c$ will desire more debt. Since the preferences for debt of these two groups will not change as more debt is issued, two distinct clienteles will emerge, one demanding that firms have no debt at all, and the other demanding that firms have as much debt as possible.[16]

If there were a number of firms in each risk class, this standoff in investor preferences could be resolved by having all firms gravitate toward one or the other of these extreme capital structures in proportion to the relative demands from the two clienteles. Any firm with an intermediate capital structure could find a market for its shares only among investors whose personal discount rate were just equal to $R(1 - t_c)$, so such firms would tend to disappear from the market.[17] In equilibrium, corporate capital structure still "wouldn't matter," but in a more limited sense than in the certainty case. Firms would switch between low-debt and high-debt capital structures until their values were the same under either policy, so value invariance would hold subject to the restriction that capital structures be at one extreme or the other. Alternatively, from the perspective of shareholder preferences, unanimity need not obtain at any portfolio equilibrium since investors in different tax brackets may disagree as to the desirability of further leverage. Unanimity holds only in the more limited sense that once a capital structure equilibrium has been established, and firms and investors have sorted themselves out between clienteles, all shareholders will agree with the capital structure policies of the firms they own.[18]

B. Special Costs are Associated with Corporate Debt

The picture that emerges from the preceding section is that of firms in a given risk class congregating at either end of the capital structure spectrum in proportion to the relative demands from two shareholder clienteles. This picture becomes clouded, however, when special costs are associated with corporate debt.

Such costs might stem from several sources: undergoing or attempting to avoid the bankruptcy process may consume real resources, conflicts of interest between shareholders and bondholders could lead to suboptimal decisions from the standpoint of the firm as a whole, and negotiation and enforcement of debt contracts may be costly.[19] Whatever their source, let us denote by $A_j(\theta, B_j, I_{1j})$ the debt costs incurred by firm j in state of nature θ, given an amount of debt B_j and total firm investment I_{1j}. The partial derivative of A_j with respect to B_j is assumed to be positive, reflecting increasing severity of these costs as the degree of leverage increases. We could denote by A_j^S those debt costs that are borne directly by shareholders (such as the costs of restrictive covenants) and by A_j^B those debt costs borne directly by bondholders (such as monitoring expenditures or expropriation of wealth by shareholders), with $A_j = A_j^S + A_j^B$. In the face of such costs, however, contractual interest rates on corporate bonds, R_j, will be firm-specific, and higher levels of debt costs borne by bondholders will be passed back to the shareholders through increases in R_j.

Under the conditions of this section, the market value of firm j's shares is given by

$$\int_{\theta \varepsilon Z_j} \rho_i(\theta)(X_{2j}(\theta) - R_j B_j - A_j^S(\theta, B_j, I_{1j}))(1 - t_c)d\theta = S_j \qquad (11)$$

where Z_j is the set of states of nature in which firm j remains solvent, and i is a representative shareholder in firm j.[20] Investor i's preferences for a change in firm j's capital structure may be inferred from

$$\frac{dE_i(U_i)}{dB_j} = E_i[U_{i1}(1 - \int_{\theta\epsilon Z_j}\rho_i(\theta)(1-t_c)(R_j + \frac{\partial R_j}{\partial B_j}B_j + \frac{\partial A_j^S}{\partial B_j})\,d\theta)\alpha_{ij}] \,. \quad (12)$$

That is, an increase in firm j's debt has three separate influences on the cash flows to shareholders: The term containing R_j alone is analogous to expression (10) and reflects the tradeoff between shareholders' receipt of the proceeds from additional debt now and the firm's obligation to pay more in interest later at the current contractual rate; the term containing $\partial R_j/\partial B_j$ reflects changes in the contractual rate resulting both from the increased chance of default and the additional debt costs that may potentially be borne by bondholders; the term containing $\partial A_j^S/\partial B_j$ represents additional debt costs borne by shareholders.

While precise conclusions are difficult in the face of divergences across investors in the implicit state prices, $\rho_i(\theta)$, it may nevertheless be concluded that the presence of debt costs will lead to some specialization in debt issuance among the lower cost firms. If investor i has equal holdings in two firms, j and k, for example, then he can be made unequivocally better off if firm j were to retire a dollar of debt and firm k to issue an additional dollar of debt as long as

$$\int_{\theta\epsilon Z_j}\rho_i(\theta)(R_j + \frac{\partial R_j}{\partial B_j}B_j + \frac{\partial A_j^S}{\partial B_j})\,d\theta > \int_{\theta\epsilon Z_k}\rho_i(\theta)(R_k + \frac{\partial R_k}{\partial B_k} + \frac{\partial A_k^S}{\partial B_k})\,d\theta \,. \quad (13)$$

Since contractual interest rates depend on the costs associated with debt, condition (13) is likely to be satisfied if k is a lower-cost issuer of debt than j (because, say, k starts with less debt or k's opportunities for expropriating bondholder wealth are otherwise smaller).

By themselves, tax considerations dictate that some investors have a demand for corporate leverage generally, but the demand is not necessarily directed toward specific firms. Thus when debt issues involve special costs, the demand for corporate leverage will tend to be satisfied by those firms that face the lowest debt costs.

C. Implications of Costly Debt

The model of Section II.B. has several implications that need emphasis. First, to the extent that debt costs, A_j, are associated with the notion of business risk classes, there should be more specialization of capital structures by firms in a given risk class than is predicted by the model of Section II.A. When debt entails no special costs, the model of Section II.A. predicts that all firms in a given risk class will cluster around either of two extreme capital structures. On the other hand, if one risk class entails lower debt costs than another, it will be more economical for firms in the first risk class to issue a greater proportion of the economy's total supply of corporate debt than firms in the second. Thus, while there might still be a tendency for firms in the aggregate to cluster around either low-debt or high-debt capital structures, firms within a given risk class would tend to have relatively similar capital structures.

Second, in the face of capital structure specialization by firms in a risk class, conflicting investor preferences will persist, and unanimity will not obtain even among final shareholders. If, for example, firms with high degrees of business risk tended to be unlevered, and if investors selected firms purely on the basis of capital structure, then the portfolios of high tax-bracket investors would be top-heavy with high-risk stocks. Instead, the desire for diversification will lead investors to choose firms in a number of different risk classes, even though the capital structures of these firms may not match their personal preferences. Since this eliminates the possibility of unanimous preferences even among final shareholders, however, a capital structure equilibrium must be established in terms of majority rule. The definition of equilibrium proposed by Grossman and Stiglitz [5] is particularly useful in this context: the equilibrium capital structure policy for any firm must be simultaneously preferred by a majority of the shareholders and immune from outside takeover. Thus, among those capital structures that a majority of the shareholders would vote for, the equilibrium will be that which gives the firm the highest market value.

Third, movement toward a capital structure equilibrium in the model of Section II.B. retains a vestige of the old tradeoff between tax savings and bankruptcy costs, but much of the thrust of Miller's [11] analysis still remains. A representative shareholder's preference for an increase in his firm's debt is given in expression (12), and the term $(1 - \int \rho_i(\theta) R_j (1 - t_c) d\theta)$ may be interpreted as the investor's evaluation of the tax saving from an additional dollar of debt.[21] Since the two terms involving $\partial R_j / \partial B_j$ and $\partial A_j^S / \partial B_j$ reflect the special costs associated with an additional dollar of debt, the representative investor can be thought of as desiring additional debt until the value of the marginal tax savings is just balanced by the marginal debt cost. Nevertheless, because investors do not evaluate expression (12) identically, it is impossible to derive any simple decision rule for firm behavior. In addition, Miller's basic conclusion that the tax saving from debt is not as important as was previously thought still holds here. Investors in high tax brackets may well place a negative value on the tax saving from corporate debt (since they could achieve an even higher tax saving by borrowing themselves) so it is perfectly rational that some firms have no debt at all. And even for investors with a positive preference for debt, the presence of personal taxes will render the corporate tax saving less valuable.[22]

D. Consistency of These Implications With Empirical Observations

Empirical observations on corporate capital structures are somewhat fragmentary, but the implications of the preceding section do seem consistent with some of the bits and pieces that are available. Although Kim, Lewellen and McConnell [8] have found that the aggregate distribution of corporate debt ratios is bimodal, for example, it has generally been observed that capital structures tend to be more similar within industry groups than across industries (see Schwartz and Aronson [15], Scott [16] and Scott and Martin [17]. To the extent that costs associated with debt tend to be similar for firms within an industry, this observation is consistent with the idea that there will be capital structure specialization among firms with similar debt costs.[23] In addition, there is a small amount of evidence that firms specializing in high or low leverage policies tend to be those we might expect on the basis of potential debt costs. Jensen and Meckling [7], for instance, argue that regulated firms such as public utilities face lower debt costs because regulatory authorities restrict the firm's ability to shift its investment plan and thus expropriate wealth from the bondholders; hence the tendency for public utilities to be highly levered relative to other firms. Similarly, Williamson [21] has found some evidence that firms with growth opportunities have lower leverage policies; this is consistent with Myers' [12] argument that debt can reduce the value of a high-growth firm by weakening its incentive to invest.

There are also some bits of evidence to indicate that shareholder clienteles are not sharply demarcated by personal tax brackets, and that therefore preferences for capital structure policy may be less than unanimous. Using data on the shareholdings of individual investors, Kim, Lewellen and McConnell [8] regressed corporate debt ratios on a number of shareholder characteristics.

While they found a statistically significant inverse relationship between these debt ratios and shareholder tax brackets, the overall explanatory power of their regressions is quite low. Furthermore, when firms in their sample are broken into deciles according to debt ratios, the mean tax brackets of shareholders across these deciles differ very little. The indication is that while personal tax considerations are definitely a factor in investors' choice of firms with differing capital structures, they are far from the only factor or even the most important factor.

A final bit of evidence along these lines is the occurrence of takeover bids apparently aimed at changing capital structures. If shareholder preferences are not unanimous, we should occasionally observe such takeover bids, and one example is the recent attempt by APL Corporation to buy Pabst Brewing.[24] At the time of the bid, Pabst had no debt on its balance sheet, and APL offered Pabst's shareholders debentures in exchange for their shares, a move which would have substantially leveraged Pabst's assets.

III. Conclusions

This paper has attempted to extend Miller's [11] analysis of the relationship between tax considerations and corporate capital structures to conditions of incomplete capital markets and special costs associated with corporate debt. Miller's conclusions are upheld to the extent that the tax saving from corporate debt is seen as less valuable than was previously supposed, and all-equity capital structures are seen as perfectly rational for at least some firms. Certain implications of the current model are different from Miller's, however, and it has been argued that these are broadly consistent with available empirical observations.[25] The reintroduction of debt costs, for example, provides a rationale for capital structure specialization among firm types or industry groups and suggests that a given firm's capital structure is not a matter of indifference. In addition, incompleteness of capital markets implies that investors will not line up perfectly in tax bracket clienteles and that shareholders' preferences for capital structure policy will not be unanimous.

FOOTNOTES

[1]See, for example, Jensen and Meckling [7], Miller [11], and Haugen and Senbet [6].

[2]See Robichek and Myers [13] for an early discussion of bankruptcy costs, apparently motivated by the observation that "firms do not take advantage of leverage to fullest possible extent" (p. 15).

[3]For ease of analysis, it is assumed that marginal tax rates are unaffected by portfolio choices. It should also be noted that R and R_0 are gross ($R, R_0 > 1$) interest rates, and thus it is implicitly assumed that both principal and interest are taxed on bond holdings and deductible on borrowings. This is clearly unrealistic, but it allows the derivation of expressions identical to those of Miller, who deals with the infinite horizon case.

[4]The importance of the tax arbitrage restrictions is suggested by the fact that, from (3a) and (3b), $R_0 = R(1-t_{pi})$ for any individual i for whom the restrictions are not binding. But then the only individuals who do not encounter a binding restriction are those with $t_{pi} = t^*_{pi}$.

[5]The supply of tax-exempt bonds continues to be exogenous.

[6]Note that the derivation of (5) contains a strong implicit assumption of perceived competitive behavior. Investors are assumed to believe that changes in the capital structure of one firm have no effect on interest rates or on the capital structures of other firms.

[7]If i is a purchaser of tax-exempt bonds, for example, $U_{i2}R_0 = U_{i1}$, while if i is not a purchaser of tax-exempts, $dL_{0i}/dB_j = 0$. The fourth term is likewise zero since either $\alpha_{ij} = 0$ or (3c) holds with equality. But in the latter case, differentiating (3c) with respect to B_j yields

$$-U_{i2}R(1-t_c) = U_{i1}\frac{dS_j}{dB_j} .$$

[8]This analysis ignores secondary effects that might arise if the government attempts to recoup any tax revenue it loses as a result of tax-avoidance activities by investors and firms. If the government maintains its budget by borrowing, for example, it will drive up R relative to R_0 and thus induce corporations to cut back on their own bond issues. Similarly, an increase in personal tax rates increases the value of tax-exempt income to investors, drives down R_0 relative to R and discourages corporate leverage. Offsetting revenue-raising by the government will not necessarily discourage or negate tax-avoidance activities, however. An increase in corporate tax rates, for example, enhances the value of the interest tax shield and, abstracting from relative interest rate effects, encourages still more corporate debt. Furthermore, investors and firms may see such activities as a means for shifting the incidence of the tax burden, even if the total magnitude of this burden remains unchanged.

[9] Baron [1] and Litzenberger and Sosin [10] address a similar issue when they talk about circumstances under which relative (i.e. intra-equilibrium) market values will be unaffected by changes in capital structure as opposed to circumstances in which absolute (i.e. inter-equilibrium) market values will be unaffected. Both conclude that the conditions required for absolute market value invariance are much more stringent than for relative market value invariance.

[10] See Baron [2], Grossman and Stiglitz [5] and Leland [9] for discussions of the investor unanimity issue.

[11] Analogous results hold in the case where income from corporate shares is taxed at a capital gains rate, t_{gi}, where $0 < t_{gi} < t_{pi}$. In equilibrium there will be two critical personal tax rates, t^{*}_{pi} and t^{**}_{pi}, such that all tax-exempt bonds are held by investors with $t_{pi} \geq t^{*}_{pi}$, all taxable bonds are held by investors with $t_{pi} \leq t^{**}_{pi}$, and all corporate shares by investors in the range $t^{**}_{pi} \leq t_{pi} \leq t^{*}_{pi}$. Because of the relative homogeneity of shareholders, it is not difficult to show that unanimity will once again obtain.

[12] To ensure that corporate bonds remain riskless, there must be implicit limits on the amount of debt any firm may issue.

[13] Suppose $R = .10$, $R_0 = .05$, $B_j = 5$, $t_c = .5$ and there are two states of the world. If $\theta = 1$ occurs, the firm will receive operating cash flows of $X_{2j} = 1$ annually forever. If $\theta = 2$, $X_{2j} = 2$ annually forever. An investor i whose implicit prices are $\rho_i(1) = \rho_i(2) = 10$ places a value of 10 on the firm's equity $(10(1 - .10(5))(.5) + 10(2 - .10(5))(.5) = 10)$. This investor's personal certainty discount rate is $1/(\rho_i(1) + \rho_i(2)) = .05 = R_0$. But an investor k whose implicit prices were $\rho_k(1) = 7$, $\rho_k(2) = 11$ would place the same value on firm j as investor i, even though his personal certainty discount rate would be .056. If investor k were in the 60% personal tax bracket, his personal certainty discount rate would be higher than either R_0 or $R(1 - t_{pi})$. Nevertheless, he might be unable to eliminate this difference between market and personal discount rates if, say, purchasing stock on margin were restricted on the grounds that it constituted short-selling a taxable security (personal debt) in order to buy a tax-exempt security (corporate stock under the assumptions of this section).

[14] This assumption is standard in competitive analyses. See Baron [2] and Rubinstein [14] for arguments about the merits of the assumption.

[15] Miller's statement [11, footnote 23] that his analysis applies to the complete markets case is still correct, however. If markets were truly complete, it would be possible to create any arbitrary contingent return pattern and at the same time tailor it to one's personal tax situation. This implies the existence of both taxable and tax-exempt state contingent securities. In such a case, low tax-bracket investors with a taste for risk-bearing

would hold only taxable contingent claims, while high tax-bracket investors would confine themselves to tax-exempt contingent claims (e.g. corporate shares). As in the certainty case, all corporate shares would be held by high tax-bracket investors at any portfolio equilibrium, and a capital structure equilibrium would be established when enough corporate bonds had been issued to set $R_0 = R(1-t_c)$. The key to the differing incomplete markets result, then, is the inability to confine all holdings of corporate shares to a homogeneous tax-bracket group.

[16]Investors for whom (10) is negative would even prefer negative leverage (i.e. corporate purchases of taxable bonds) but the tax authorities would presumably restrict this practice.

[17]If each firm is in a unique risk class to begin with, Stiglitz [19] has argued that there would be an intermediate optimal capital structure for each firm, with the exact amount of leverage depending on the relative demands from the two clienteles. The case in which each firm is in a unique risk class, however, is not conducive to the kind of competitive analysis used in this paper, and hence will not be further explored here.

[18]Put differently, unanimity holds here in the ex post, but not in the ex ante sense. In the certainty case, by contrast, unanimity holds ex ante as well, since initial investors are able to agree on dS_j/dB_j. See Leland [9] and Baron [2] for discussions of the distinction between ex ante and ex post unanimity concepts.

[19]Robichek and Myers [13] enumerate potential costs associated with bankruptcy. See also Haugen and Senbet [6], however. Jensen and Meckling [7] and Myers [12] discuss conflicts of interest between shareholders and bondholders, while Jensen and Meckling, and Smith and Warner [18] discuss costs of negotiating and enforcing debt contracts.

[20]The debt costs, A_j^S, borne by shareholders have been implicitly assumed to be tax-deductible, although this is not necessary to the analysis.

[21]Note that if there are no personal taxes and debt is riskless, $R_j = R$ for all firms and $\int\rho_i(\theta)d\theta = 1/R$ for all investors. Hence the term $(1 - \int\rho_i(\theta)R(1-t_c)d\theta)$ would reduce to t_c, which represents the present value of the tax saving from an additional dollar of debt.

[22]If we take again the case where debt is riskless, an investor in a low tax bracket for whom $\int\rho_i(\theta)d\theta = 1/R(1 - t_{pi})$ will place a value of $(1 - \frac{1-t_c}{1-t_{pi}}) < t_c$ on the corporate tax saving from an additional dollar of debt.

[23]Although the association between industry and capital structure is statistically significant, however, the debt ratios of firms within a given industry are still far from homogeneous (see Ferri and Jones [4]). Some degree of dispersion is to be expected, in fact, in view of conflicting personal tax situations of shareholders.

[24]See [20] for details of this takeover bid.

[25]It should be noted, however, that tax benefits provide the only reason for issuing corporate debt in this paper. The current model is incomplete in that, in the face of debt costs it cannot explain why corporations would have issued debt before income taxes were imposed. See Jensen and Meckling [7] for a discussion of this point.

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