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Miller's Equilibrium, Shareholder Leverage Clienteles, and Optimal Capital Structure

E. HAN KIM*

THE PURPOSE OF THIS paper is twofold. First, we examine the individual portfolio decisions when income from stocks and bonds is taxed at different rates. Second, a rationale for the existence of risky debt in the presence of leverage-related costs and differential personal income taxation is provided.

Previous studies on capital structure with differential personal income taxation have ignored either the portfolio risk consideration and/or the possibility of losing personal and corporate interest tax shields due to insufficient taxable earnings (e.g., [8], [2], [3], [14], [13], [6], [7], [1], [9], [19], [20], [21], [23]). In Section I of this paper, both the portfolio risk consideration and the possibility of losing personal and corporate interest tax shields are explicitly introduced. This enables us to provide a rationale for the shareholder leverage clientele phenomenon within a mean-variance framework. We also demonstrate a non-corner solution for the optimal corporate capital structure in a tax environment similar to that of Miller's "Debt and Taxes" [14].

In Sections II and III of this paper, Miller's world is further modified to include risky debt and the attendant costs. We re-examine and synthesize recent studies on the theory of optimal capital structure which have appeared since the publication of "Debt and Taxes" (e.g., [4], [6], [7], [13], [19], [20]).

I. Miller's Equilibrium and Leverage Clienteles

A. *The Issues*

Research on optimal capital structure has focused primarily on two issues. The first issue is concerned with the effect of a firm's capital structure on its market value. The second, and perhaps not as well-recognized but equally important, issue deals with the effect of the firm's capital structure on the welfare of individual investors. When perfect capital market assumptions are invoked, the Market Value Rule (MVR) holds; thus, the capital structure which maximizes a firm's market value also maximizes the expected utility of the firm's security-

* The University of Michigan. An earlier version of this paper was presented at the 1980 NBER Conference on Taxation and Corporation Finance and finance workshops at Harvard University, The Ohio State University, University of Florida, the University of Michigan, and University of Utah. Since then the paper has undergone a dramatic transformation, and consequently the current version has little resemblance to the original one. I would like to thank participants of the above finance workshops and the NBER conference, particularly S. Buser, P. Hess, and G. Hite, whose comments forced me to re-think many loose ends in the earlier version, and C. Hayn for editorial comments. I am especially indebted to Michael Bradley and K. Palani Rajan for their insightful comments and helpful suggestions. This work was supported by a research grant from the University of Michigan Graduate School of Business Administration.

holders. The key assumption underlying the MVR is that all investors have equal access to capital markets.

In the presence of differences in personal income tax rates across investors and across securities, investors do not have equal access to capital markets. Given the tax deductibility of interest payments, differences in income tax rates across investors result in different after-tax interest rates. Similarly, a given pre-tax cashflow will result in a different after-tax cashflow to investors in different tax brackets. Without equal access to capital markets, the MVR may no longer hold. As a consequence, the result obtained from studying the effect of capital structure on the market value of the firm may not have the same implications for individual investors' preferences about corporate leverage.

To examine the relevant issues associated with this possible inapplicability of the MVR in a world of differential personal income taxation, it is useful to recapitulate the key assumptions and results in "Debt and Taxes":

- (1) The effective personal tax rate on income from stock, τ_{ps} , is zero.
- (2) All debt securities are risk-free.
- (3) The income from corporate bonds yielding the taxable rate, r , is taxed at the ordinary marginal personal income tax rate, τ_{pb} . This rate is progressive and extends on either side of the corporate tax rate, τ_c .
- (4) Tax-exempt bonds yield the risk-free rate, r_0 , which is determined exogenously.
- (5) Neither direct tax arbitrage (e.g., borrowing on personal account to buy tax-free municipal bonds) nor short-selling of common stock is permitted.¹

With these assumptions, Miller demonstrates that the ratio between the yield on tax-exempt bonds and the yield on taxable bonds is equal to one minus the corporate tax rate:

$$r = r_0 / (1 - \tau_c), \quad (1)$$

and that the value of a firm is independent of its capital structure:

$$V_L \equiv S + B = V_U, \quad (2)$$

where V_L and V_U are the total market values of the levered and the unlevered firm, and S and B are the market values of the levered firm's stocks and bonds.

In this setting, Kim, Lewellen, and McConnell (KLM) [13] demonstrate that investors will sort themselves out into tax-induced shareholder leverage clienteles. Investors whose tax rates exceed the corporate rate will demand firms with zero leverage, while investors with tax rates less than the corporate rate will demand firms with high leverage. To illustrate this point, KLM compare the after-tax cash flows which are generated from investing in the stocks of levered versus unlevered firms and show the difference that may arise as a result of differences in personal income tax rates. The intuition underlying their results is as follows. To an investor with $\tau_{pb} < \tau_c$, the cost of borrowing through the firm is lower than

¹ If unlimited shortselling is allowed, then investors whose tax rates differ from the corporate tax rate would be able to create infinite arbitrage profit opportunities in Miller's world. Investors with $\tau_{pb} < \tau_c$ would shortsell unlevered firms' shares and use the proceeds to purchase the equity of levered firms and corporate bonds, while investors with $\tau_{pb} > \tau_c$ would undertake the opposite transaction. See Kim, Lewellen, and McConnell [13, footnote 9] for further discussions of this point and Auerback and King [1] who made a similar point in a later paper.

that incurred by borrowing on personal account because the corporate interest tax shield, $r\tau_c$, is greater than the personal interest tax shield, $r\tau_{pb}$. Conversely, to an investor with $\tau_{pb} > \tau_c$, the cost of borrowing on personal account is lower than the cost of borrowing on corporate account.

Although KLM's approach is basically sound, they treat the portfolio risk consideration as an exogeneous variable. Consequently, their leverage clientele argument is vulnerable to criticisms based on either certainty or risk neutrality. In the tax environment described by Miller, an investor with $\tau_{pb} > \tau_c$ may hold stocks and tax-exempt bonds. However, he will not hold taxable corporate bonds or lend on personal account because these securities are dominated by tax-exempt bonds, i.e., $r(1 - \tau_{pb}) < r_0 = r(1 - \tau_c)$ [Eq. (1)]. Conversely, an investor with $\tau_{pb} < \tau_c$ may hold taxable bonds but will not invest in tax-exempt bonds because they are dominated by taxable bonds. Whether or not he will also choose to hold common stocks is not as clear-cut. If either risk neutrality or certainty is assumed, then tax-exempt bonds and tax-exempt stocks are perfect substitutes in Miller's world. Investors with $\tau_{pb} < \tau_c$ will not hold tax-exempt stocks because they are also dominated by taxable corporate bonds; consequently, shareholder leverage clienteles will not occur. Alternatively, if capital markets are assumed to be complete in the sense that it is possible to create either tax-exempt or taxable contingent claim securities for every possible state of the world,² basically the same conclusion will emerge. However, this conclusion is inconsistent with the fact that tax-exempt institutions hold a large portion of the outstanding common stock. In addition, it is unlikely that the extreme form of the "complete" capital market is possible under the current U.S. tax code. Nor can risk neutrality or certainty explain diversification in individual portfolios.

On the other hand, if capital market agents are risk averse and if markets are not complete for both tax-exempt and taxable securities, some investors with $\tau_{pb} < \tau_c$ will choose to hold stocks. Specifically, investors who are less risk averse than the market will find it advantageous to invest in stocks. Even in Miller's world, the expected rate of return from stocks, $E(r_s)$, must be greater than the tax-exempt riskless interest rate, r_0 , if the market is risk averse. Thus, investors with $\tau_{pb} < \tau_c$ for whom the risk premium, $E(r_s) - r_0$, is large enough to compensate them for the tax disadvantage of owning stocks will include stocks in their portfolios.

B. Shareholder Leverage Clienteles

In this section, we assume that (1) capital market agents are risk averse; (2) markets are not complete for both tax-exempt and taxable securities; and (3) beyond a certain finite amount of borrowing, the interest tax shields will start to reduce the marginal tax rate of the borrower, whether the borrower is an individual investor or a firm. The last assumption represents a point of departure from the assumptions of Miller's world in which both the personal and corporate tax rates remain constant regardless of the amount of borrowing involved. All of the other assumptions made by Miller are retained.

In this environment, investors will sort themselves into tax-induced shareholder

² See [7], [20], and [22] for further discussions of this point.

leverage clienteles. Investors whose tax rates exceed the corporate rate will demand the stocks of firms with zero leverage, while investors with tax rates less than the corporate rate will demand the equity of firms with high leverage. This will be demonstrated by first holding the marginal corporate income tax rate constant. Then the possibility of losing the corporate interest tax shields due to insufficient taxable earnings will be considered.

B.1. Constant Corporate Tax Rate

Consider the familiar minimum-variance boundary with no short-selling which is depicted in Figure 1. In contrast to the common minimum variance boundary which consists of stocks, this one consists only of firms. Any point on or inside the boundary is a portfolio of claims on firms, not of stocks (unless they are issued by unlevered firms). Since these firms can borrow and lend at an after-tax rate of $r(1 - \tau_c)$, we have a line connecting $r(1 - \tau_c)$ through the tangent portfolio T_c , where T_c is the return on a portfolio of unlevered firms. Portfolios along the line from $r(1 - \tau_c)$ through T_c and its extension represent portfolios of stocks. The lending portfolios between $r(1 - \tau_c)$ and T_c represent portfolios of stocks of firms with net corporate lending, while the borrowing portfolios on the extension represent portfolios of stocks of firms with net corporate borrowing.

If the aggregate corporate borrowing is positive and a borrowing portfolio, M , were the market portfolio of common stock, then the distance between T_c and M would reflect the size of aggregate corporate borrowing. If investors can borrow

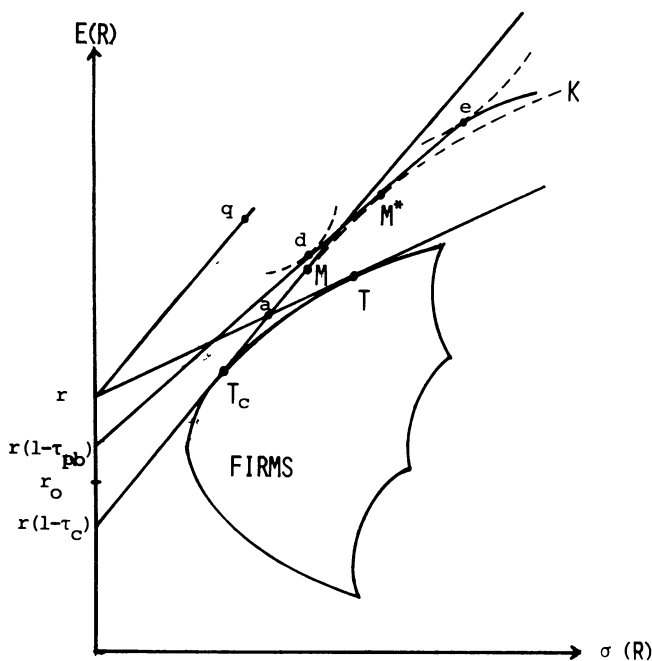


Figure 1.
The Efficient Set for Investors with $\tau_{pb} < \tau_p^*$

and lend at the same after-tax rate as firms, $r(1 - \tau_c)$, they can reach any point on the line from $r(1 - \tau_c)$ through M and beyond by engaging in personal lending and borrowing. Regardless of how much the corporate sector decides to borrow, individuals can do or undo any amount of borrowing in order to maximize their expected utility. Thus, corporate leverage should be of no concern to investors. If we assume $\tau_c = 0$, then this is the economic intuition underlying Hamada's derivation [10] of the Modigliani and Miller (MM) [16] no-tax theorem in the mean-variance framework.

Hamada's proof of MM's tax model [17] is also shown in Figure 1. MM's tax model assumes no personal taxes which means that individuals can borrow and lend at a rate $r > r(1 - \tau_c)$. Thus in Figure 1, r plots above $r(1 - \tau_c)$ and the tangent portfolio T lies above T_c . In this case, corporate leverage and personal leverage are no longer perfect substitutes. Personal lending dominates both corporate lending and borrowing up to point a ; beyond point a , corporate borrowing dominates. However, the bent line from r through a and extending further through M cannot be an efficient set. For example, a line connecting r and M would dominate this line. The efficient set is the line from r through q , the extension of which will meet the extension of the line from $r(1 - \tau_c)$ through M only at infinity. To obtain the efficient set, it is thus necessary to have firms borrow an infinite amount, i.e., the optimal capital structure for individual firms is 100 percent debt financing.

This analysis of the MM tax model is directly applicable to the case of low tax bracket investors. As long as $\tau_{pb} < \tau_c$, $r(1 - \tau_{pb})$ must be greater than $r(1 - \tau_c)$. Consequently, all of the above results will hold and an investor with $\tau_{pb} < \tau_c$ will demand firms with 100 percent debt.

In Figure 2, the efficient frontier for an investor with $\tau_{pb} > \tau_c$ is examined. In contrast to Figure 1, the after-tax borrowing and lending rate for this investor is lower than that of the corporation which equals the tax-exempt rate, r_0 . In this case, corporate leverage and personal leverage are again no longer perfect substitutes. Corporate lending dominates personal lending and borrowing up to point a . Beyond a , personal borrowing dominates. The bent line from r_0 through point a and extending further through M' cannot be an efficient set. If the slope of the line from $r(1 - \tau_{pb})$ through T_p remains constant regardless of the amount of personal borrowing involved, then the efficient set would be the line from r_0 through z , the extension of which meets the extension of the line from $r(1 - \tau_{pb})$ through T_p only at infinity. To form the efficient set, the investor would have to borrow an infinite amount on personal account.

Thus in the world described by Miller, investors whose tax rates differ from the corporate rate will demand infinite borrowing, either on corporate or on personal accounts. Consequently, there will be no interior solution in Miller's equilibrium.

B.2. Loss of Personal Interest Tax Shields.

If the tax rates are treated as endogeneous variables in Miller's world, the investors will not demand infinite borrowing; as a result, there may exist a stable equilibrium. To the investor with $\tau_{pb} > \tau_c$, the interest tax shields from personal borrowing will reduce the taxable income and his marginal tax rate will be

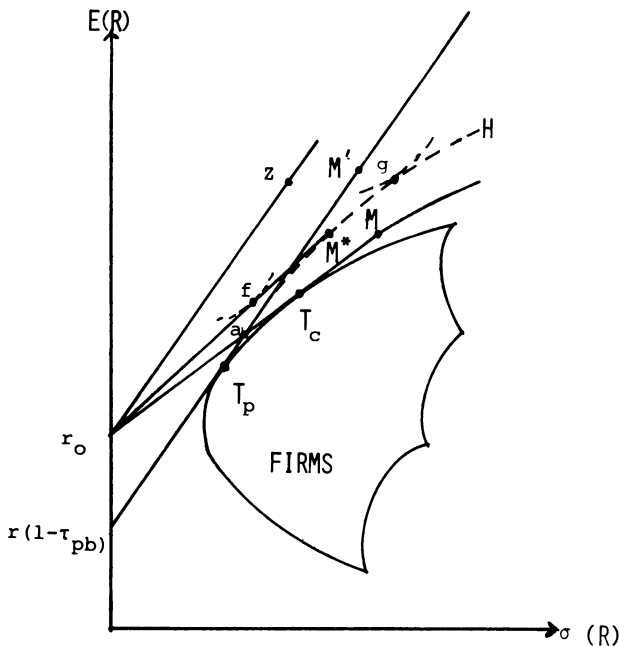


Figure 2.
The Efficient Set for Investors with $\tau_{pb} > \tau_c$

lowered. In the limiting case where the personal interest tax shields and various tax-shelter instruments (such as life insurance policies, pension funds, Keough plans, trust funds, and investments in real estate) shelter the investor's entire income, his τ_{pb} will approach zero.³ Consequently, the personal interest tax shields, $r\tau_{pb}$, will also approach zero. Thus, although the slope of the line from $r(1 - \tau_{pb})$ through T_p is initially a constant, $[E(R_{T_p}) - r(1 - \tau_{pb})]/\sigma(R_{T_p})$, it will start to decline as the personal interest tax shields, $r\tau_{pb}$, start to decline. This decline in the slope is depicted by the broken curve H , which is a part of a new enlarged boundary. Combining the enlarged boundary $r(1 - \tau_{pb})$. $T_p.a.H$ with the investor's ability to lend at r_0 (by holding tax-exempt bonds), we obtain a new efficient set which starts at r_0 and is tangent to the broken curve H at M^* and extends into H .⁴

The new tangent portfolio M^* is the optimal portfolio. It consists of personal borrowing and a tangent portfolio which is made up solely of unlevered firms. If the investor is relatively more risk averse, he will hold a lending portfolio, e.g., portfolio f , which consists of a portfolio of unlevered firms and tax-exempt bonds.⁵

³ See Miller and Scholes [15] for further discussions of this point.

⁴ Note that beyond M^* this investor cannot reach points on the extension of the straight line connecting r_0 and M^* by borrowing on corporate account (holding levered firms' stocks). For him to borrow on both corporate and personal accounts, he would have to hold a corporate borrowing portfolio (e.g., M) and lever it further on personal account, i.e., a point on the extension of the line connecting $r(1 - \tau_{pb})$ and M , which is inside the enlarged efficient boundary.

⁵ Note that his investment in tax-exempt bonds and borrowing on personal account do not violate Assumption 5 which prohibits direct tax arbitrage. These personal borrowings are made in order to invest in the portfolio of unlevered firms, and hence are equivalent to borrowing on a margin account.

If the investor is relatively less risk averse, he will hold a borrowing portfolio, e.g., portfolio g , which contains no tax-exempt bonds and requires more personal borrowing. In either case, investors with $\tau_{pb} > \tau_c$ will demand unlevered firms and will borrow on personal account. In contrast to the earlier cases, the amount borrowed will be finite.

B.3. Loss of Corporate Interest Tax Shields.

In Figure 1, the investor with $\tau_{pb} < \tau_c$ requires an infinite amount of corporate borrowing because the slope of the line from $r(1 - \tau_c)$ through M remains constant regardless of the amount borrowed. This requires the assumption that for all states of the world, firms will either have sufficient taxable earnings to fully utilize the interest tax shields or will be able to sell these shields for their full values by trading tax losses. If this assumption is relaxed and the possibility of losing corporate interest tax shields is allowed, then there will be an interior solution for the optimal corporate capital structure and investors with $\tau_{pb} < \tau_c$ will not demand firms with 100 percent debt. Further, Miller [14, p.271] and DeAngelo and Masulis [7] suggest that the general equilibrium relationship between the taxable interest rate and the tax-exempt rate will be different from that specified by Eq. (1). The marginal bondholder's tax rate, τ_p^* , will be less than τ_c and hence the riskfree taxable interest rate will be

$$r = r_0 / (1 - \tau_p^*) < r_0 / (1 - \tau_c). \quad (3)$$

This modified general equilibrium relationship necessitates separating investors according to their tax brackets into three distinct groups: (1) investors with $\tau_{pb} < \tau_p^*$, (2) those with $\tau_p^* < \tau_{pb} < \tau_c$, and (3) those investors with $\tau_{pb} > \tau_c$.⁶ Graphically, this means that there will be three intercept points: (1) the personal after-tax interest rate, $r(1 - \tau_{pb})$; (2) the tax-exempt rate, $r_0 = r(1 - \tau_p^*)$; and (3) the corporate after-tax interest rate, $r(1 - \tau_c)$.

To re-examine the case of investors with $\tau_{pb} < \tau_c$, first consider an investor with $\tau_{pb} < \tau_p^*$ and the limiting case where the interest and non-debt tax shields (such as depreciation and investment tax credits) exceed the maximum possible taxable earnings for the corporate sector as a whole. In such a case, the marginal corporate tax rate will approach zero and hence the interest tax shields, $r\tau_c$, will also approach zero even if there are no trading restrictions on tax losses. In Figure 1, $r(1 - \tau_{pb})$ plots above r_0 and r_0 plots above $r(1 - \tau_c)$, because $r(1 - \tau_{pb}) > r_0 = r(1 - \tau_p^*) > r(1 - \tau_c)$. The slope of the line from $r(1 - \tau_c)$ through M is initially a constant, $[E(R_T) - r(1 - \tau_c)] / \sigma(R_T)$. However, as corporate borrowing increases and the probability of losing the interest tax shields, $r\tau_c$, becomes positive, the slope of the line from $r(1 - \tau_c)$ through M will start to decline, as depicted by the broken curve K . Combining the enlarged boundary, $r(1 - \tau_c).T_c.M.K$, with the investor's ability to lend and borrow at $r(1 - \tau_{pb})$, we obtain a new efficient set which starts at $r(1 - \tau_{pb})$ and is tangent to curve K at M^* . This efficient set dominates any portfolio that can be obtained with a positive investment in tax-exempt bonds.

The new tangent portfolio M^* is the optimal risky portfolio of stocks of firms

⁶ This general equilibrium relationship and its implications for firm valuation will be examined in greater detail in Section III.

for the investor with $\tau_{pb} < \tau_p^*$. In contrast to the *MM* tax case (or the case of $\tau_{pb} < \tau_c$ with a constant slope), the efficient set involves a corporate capital structure which is less than 100 percent debt.⁷ Since M^* is a portfolio consisting of a relatively large amount of net corporate borrowing, those investors who choose lending portfolios, e.g., portfolio d , will demand stocks of highly levered firms and hold corporate bonds (and/or lend on personal account). Investors who choose to hold borrowing portfolios, e.g., portfolio e , will further lever their already levered portfolios to an even greater extent.⁸ In either case, investors with $\tau_{pb} < \tau_p^*$ will hold portfolios with high corporate leverage.

The investor whose tax rate is in the intermediate range, $\tau_p^* < \tau_{pb} < \tau_c$, will borrow on both corporate and personal account. If he is relatively more risk averse, he will hold a portfolio of stocks of levered firms, further lever it on personal account, and invest in tax-exempt bonds. If he is relatively less risk averse, his personal borrowing will increase even further and he will invest the entire proceeds from the personal borrowing into a portfolio of stocks of levered firms. Figure 3 illustrates these points. The investor holds a portfolio of stocks of levered firm, M^* , and further levers it by borrowing on personal account to reach M^{**} , at which point the line starting at r_0 is tangent to the enlarged boundary $r(1 - \tau_{pb}).M^*.M^{**}.E$. The efficient set is the line connecting r_0 and M^{**} and the broken curve E .

Thus, this investor's lending behavior is identical to that of the investor with $\tau_{pb} > \tau_c$,⁹ while his borrowing behavior and demand for corporate leverage is similar to that of the investor with $\tau_{pb} < \tau_p^*$. The intuition is as follows. The investor prefers to borrow on corporate account because the corporate interest tax shields, $r\tau_c$, are greater than the personal interest tax shields, $r\tau_{pb}$. But, he prefers to lend by holding tax-exempt bonds because the return from holding such bonds, $r_0 = r(1 - \tau_p^*)$, is greater than the after-tax return from holding corporate bonds, $r(1 - \tau_{pb})$. The reason the investor levers the portfolio of stocks of levered firms further on personal account is to take advantage of the arbitrage profit that is available by borrowing on personal account and using the proceeds to invest in tax-exempt bonds, i.e., $r(1 - \tau_p^*) - r(1 - \tau_{pb}) = r(\tau_{pb} - \tau_p^*) > 0$. Although such a transaction violates Assumption 5 in spirit, it will not be considered by the IRS as a tax arbitrage transaction because the personal borrowings were made against the portfolio of stocks, i.e., borrowing on a margin account.

To summarize, even when the possibility of losing corporate interest tax shields

⁷ Although there are important differences, this is basically in a similar spirit to the arguments of Brennan and Schwart [5] and Kim [12] that the possibility of losing interest tax shields may be sufficient to lead to an interior optimum for corporate capital structures.

⁸ For the *additional* leverage required for portfolio e , these investors will borrow on personal account. The possibility of losing personal interest tax shield causes the slope of the new efficient set to decline and converge eventually to the broken curve K . Since the trading restrictions on personal tax losses are likely to be much more severe than those on corporate tax losses, the decline in the slope of the new efficient set will occur soon after M^* is reached.

⁹ For the investor with $\tau_{pb} > \tau_c$, the earlier analysis in Figure 2 is still applicable and the same conclusion holds. Portfolios that can be obtained by lending and borrowing through firms must lie on a line starting at a point which plots between r_0 and $r(1 - \tau_{pb})$. It can be easily demonstrated that these portfolios are dominated either by the lending portfolios that can be obtained by investing in tax-exempt bonds or by borrowing portfolios that can be obtained by personal borrowing.

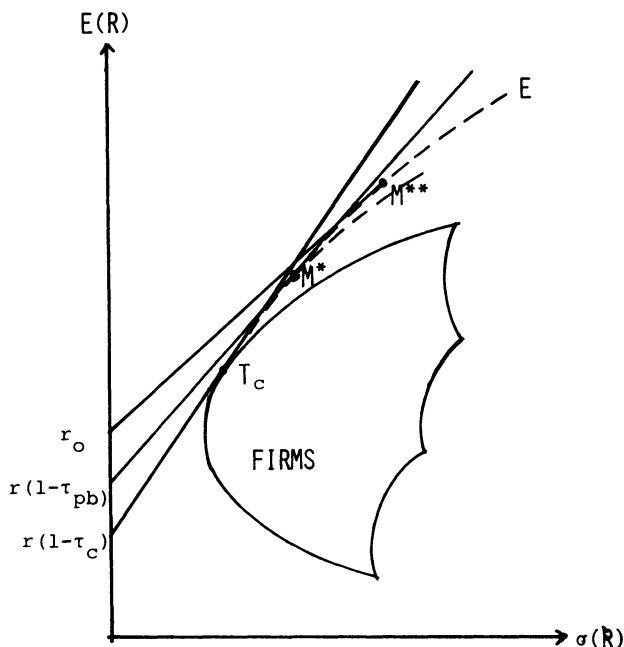


Figure 3.

The Efficient Set for Investors with $\tau_p^* < \tau_{pb} < \tau_c$

is allowed and the ensuing change in the general equilibrium condition is explicitly recognized, the notion of shareholder leverage clienteles remains viable. Investors with $\tau_{pb} > \tau_c$ will demand portfolios of stocks of unlevered firms, while investors with $\tau_{pb} < \tau_c$ will demand portfolios of stocks of highly levered firms. Further, the possibility of losing corporate interest tax shields explains why investors with $\tau_{pb} < \tau_c$ do not demand firms with 100 percent debt.

C. Implications and Empirical Evidence

In Miller's world where both corporate and personal income tax rates are assumed to be constant, all investors whose tax rates differ from the corporate rate will demand an infinite amount of (either corporate or personal) borrowing. This suggests that there is only a corner solution in Miller's equilibrium. However, if both the corporate and personal tax rates are treated as endogenous variables, the investors no longer demand infinite borrowing; consequently, there may exist a stable equilibrium in this modified Miller's world.

In order to draw the appropriate empirical implications on shareholder leverage clienteles, it is important to note that the shareholder leverage clienteles are defined in terms of portfolios, not firms. Since the portfolios of firms in Figures 1 and 2 may contain many firms in common which are held by both high and low tax bracket investors, a test of leverage clienteles at the firm level, such as a cross-sectional test of the relationship between firms' leverage ratios and shareholders' personal tax rates, is likely to be rejected. As the analysis in the preceding section suggests, the shareholder leverage clienteles should be defined in terms of portfolios, not individual firms. Thus, a proper empirical test of leverage clienteles

should be based on individual portfolio compositions in order to examine the relationship between investors' tax brackets and the ways in which they borrow or lend.

Kim, Lewellen, and McConnell (KLM) [13] test for the existence of shareholder leverage clienteles at the firm level. In spite of the tendency to reject the hypothesis due to mis-specification, their results from regressing corporate debt ratios against shareholder tax brackets still indicate a statistically significant negative relationship, although the explanatory power of the independent variable is weak. The more interesting finding by KLM is that corporate leverage ratios have a bimodal distribution with one mode centered at zero and the other spread over the range from 20 percent to 60 percent debt/value ratios. The existence of no-debt firms is consistent with the shareholder leverage clienteles. The clientele hypothesis is also consistent with the existence of firms with positive leverage. However, it does not fully explain the moderate leverage ratios in the higher mode. Perhaps a more detailed examination of the supply side of corporate leverage may provide a better explanation for the financing behavior of firms in the higher mode.

II. Firm Valuation

In the preceding section, debt is assumed to be riskless and hence there are no leverage-related costs. However, the collective works by various authors, e.g., [11], [12], [18], [7], and [21], seem to suggest that there are sound theoretical reasons to believe that the leverage-related costs, such as the agency costs of issuing risky debt, bankruptcy costs, and the potential loss of non-debt tax shields in non-default states, are of economic significance. In this section, the assumptions of riskless debt and a zero personal tax rate on income from stocks are dropped, and a partial equilibrium relationship between firm valuation and corporate leverage is derived. The partial equilibrium valuation result is then generalized in the following section.

Consider a single-period setting in which the value of all securities depends only upon the distribution of after-tax cash flows. The end-of-period before-tax payoffs of the value-maximizing investment equals $\tilde{X}^*$, which is non-negative for all states of the world. If the firm chooses to finance the entire investment by equity alone, there are no bondholders; consequently, no agency problem between stockholders and bondholders arises and the firm chooses the value-maximizing investment. The end-of-period before-tax cashflows from this investment, $\tilde{X}^*$, are assumed to be sufficiently large to ensure full utilization of all non-debt tax shields, such as depreciation tax shelters and investment tax credits, for all states of the world. The non-debt tax shields have an end-of-period after-tax value of ϕ . Thus, the after-tax return to the firm's stockholders equals:

$$\tilde{Y}_U = [\tilde{X}^*(1 - \tau_c) + \phi](1 - \tau_{ps}) \quad (4)$$

If the firm finances its investment by borrowing an amount B , it must promise to pay $\hat{Y}$ to its bondholders at the end of the period. The difference between $\hat{Y}$ and B , the amount of the promised interest payment, reflects the risk of the bond, the time value of money, and leverage-related costs. The levered firm will be

subject to the type of agency problems pointed out by Jensen and Meckling [11] and Myers [18], who argue that the presence of risky debt may induce the firm to undertake suboptimal investments. Letting $\tilde{X}$ represent the end-of-period cashflows to the levered firm, the difference between $\tilde{X}^*$ and $\tilde{X}$, $\Delta\tilde{X}$, reflects the change in cashflows due to both the change in investment policy and the monitoring and bonding costs.¹⁰ The present value of $\Delta\tilde{X}$ is negative and represents what Jensen-Meckling and Myers define as the ex-ante agency costs of debt. Since the incentive for suboptimal investments increases as the amount of risky debt outstanding increases, the absolute value of the ex-ante agency costs, $V(\Delta\tilde{X})$, is assumed to be an increasing function of the promised payoff to bondholders, i.e., $dV(\Delta\tilde{X})/d\hat{Y} \geq 0$.

If the levered firm's earnings are sufficiently large such that it can fully utilize the non-debt tax shields, the stockholders' before-tax returns at the end of the period are $[(\tilde{X} - \hat{Y})(1 - \tau_c) + \phi]$. However, if the firm's earnings are such that the tax bill without the non-debt tax shields, $\tau_c(\tilde{X} - \hat{Y})$, is less than ϕ , then there will be more tax shields than can be utilized by the firm. If the firm cannot sell the unused tax shields and if it has no unsheltered income to apply the unused tax shields against, then this unused portion of the shields will go to waste. Consequently, the stockholders' before-tax returns at the end of the period are assumed to be $\tilde{X} - \hat{Y}$,¹¹ if $\tau_c(\tilde{X} - \hat{Y}) < \phi$, or equivalently:

$$\tilde{X} < \phi/\tau_c + \hat{Y} \equiv s_1(\hat{Y}). \quad (5)$$

When the levered firm's earnings are sufficiently low relative to its debt obligation, the firm will be bankrupt. We define $s_2(\hat{Y})$ as the maximum level of the firm's earnings at which bankruptcy will occur. This critical point for bankruptcy increases with the amount of the firm's total debt obligations, i.e., $\partial s_2(\hat{Y})/\partial \hat{Y} > 0$.¹² When the firm is bankrupt, ownership of the firm is transferred to the bondholders. The costly recontracting and/or the indirect and direct costs involved in reorganization and/or outright liquidation reduce the firm's terminal value by $b(\tilde{X})$, the "explicit" bankruptcy costs. These costs tend to increase as $\tilde{X}$ increases and are bounded from above by $\tilde{X}$. The "implicit" bankruptcy cost stems from the firm's inability to sell its non-debt tax shields, ϕ , in bankruptcy states. A pre-tax cashflow of $\phi/(1 - \tau_c)$ would have been generated had the non-debt tax shields been sold in a perfectly competitive market. Thus, the omission of this term from the pre-tax cashflows to bankrupt firms' bondholders, $\tilde{X} - b(\tilde{X})$, reflects the "implicit" bankruptcy costs (Kim, [12, p. 50]).

¹⁰ $\Delta\tilde{X}$ may be either positive or negative. It captures the change in the probability distribution of the firm's cashflows that are due to the possible future, as well as the present, deviations from the value maximizing investment policy which the firm would have followed had there been no risky debt outstanding. It also captures the optimal level of monitoring and bonding costs associated with the agency problem between stockholders and bondholders.

¹¹ Since there are markets for tax losses, it is unlikely that the entire unused tax shields will go to waste. As it will become evident later, dropping this assumption has no effect on the generality of the model.

¹² If stockholders exercise their limited liability by declaring a formal bankruptcy as soon as the return to equity is negative, i.e., $\tilde{X} - \hat{Y} < 0$, then $s_2(\hat{Y})$ will equal $\hat{Y}$. However, this is overly restrictive. There are various multi-period considerations, which cannot be modeled explicitly in a single period framework that may cause $s_2(\hat{Y})$ to be substantially less than $\hat{Y}$.

To summarize, the gross after-tax returns to the levered firm's stockholders and bondholders at the end of the period are:¹³

$$\tilde{Y}_S = (1 - \tau_{ps}) \begin{cases} (\tilde{X} - \hat{Y})(1 - \tau_c) + \phi, & \tilde{X} \geq s_1(\hat{Y}) \\ \tilde{X} - \hat{Y} & s_2(\hat{Y}) \leq \tilde{X} < s_1(\hat{Y}) \\ 0 & x < s_2(\hat{Y}) \end{cases}, \quad (6)$$

$$\tilde{Y}_B = (1 - \tau_{pb}) \begin{cases} \hat{Y} & \tilde{X} \geq s_2(\hat{Y}) \\ \tilde{X} - b(\tilde{X}) & \tilde{X} < s_2(\hat{Y}) \end{cases} \quad (7)$$

By substituting Eq. (4) into the sum of Eqs. (6) and (7) and rearranging terms, the following result is obtained:¹⁴

$$\tilde{Y}_S + \tilde{Y}_B = \tilde{Y}_U + \left[1 - \frac{(1 - \tau_c)(1 - \tau_{ps})}{1 - \tau_{pb}} \right] \tilde{Y}_B - (1 - \tau_c)(1 - \tau_{ps})(\Delta\tilde{X} + \tilde{\delta} + \tilde{\Phi}) \quad (8)$$

where

$$\begin{aligned} \tilde{\delta} &= b(\tilde{X}) + \phi/(1 - \tau_c) \\ &\quad \text{if } \tilde{X} < s_2(\hat{Y}); \text{ and } \tilde{\delta} = 0, \text{ otherwise.} \\ \tilde{\Phi} &= [\phi - (\tilde{X} - \hat{Y})\tau_c]/(1 - \tau_c) \\ &\quad \text{if } s_2(\hat{Y}) < \tilde{X} < s_1(\hat{Y}); \text{ and } \tilde{\Phi} = 0, \text{ otherwise.} \end{aligned}$$

The variable, $\tilde{\delta}$, measures the total ex-post bankruptcy costs which consist of the explicit bankruptcy costs, $b(\tilde{X})$, and the implicit bankruptcy costs, $\phi/(1 - \tau_c)$. The variable, $\tilde{\Phi}$, measures the ex-post amount of the unused non-debt tax shields that go to waste even when the firm is not in bankruptcy.¹⁵

Let S , B , V_U , $V(\Delta\tilde{X})$, $V(\tilde{\delta})$, $V(\tilde{\Phi})$ be the present value of the end-of-period corporate and personal after-tax cashflows $\tilde{Y}_S$, $\tilde{Y}_B$, $\tilde{Y}_U$, $(1 - \tau_c)(1 - \tau_{ps})\Delta\tilde{X}$, $(1 - \tau_c)(1 - \tau_{ps})\tilde{\delta}$, and $(1 - \tau_c)(1 - \tau_{ps})\tilde{\Phi}$, respectively. Since the Value Additivity Principle also holds with differential personal taxes (Schall [19]), Eq. (8) implies that the equilibrium value of the levered firm is:

$$V_L \equiv S + B = V_U + \left[1 - \frac{(1 - \tau_c)(1 - \tau_{ps})}{(1 - \tau_{pb})} \right] B - L(\hat{Y}) \quad (9)$$

¹³ Note that Eqs. (4), (6), and (7) assume a wealth-tax in which both the interest and principal payments of corporate debt are tax deductible. Although an income-tax system is more realistic, the wealth-tax simplifies the analysis a great deal. Furthermore, as pointed out by Kim [12], the wealth-tax in a single-period framework yields the same present value of future corporate interest tax shields as an income-tax in the perpetuity framework.

¹⁴ Derivation of Eq. (8) requires a rather time consuming procedure which consists of numerous rearrangement of terms and substitutions. Due to the space constraint, it is not reported here. The key to the derivation is the following relationship:

$$\tilde{X}^*(1 - \tau_{pb}) = (\tilde{X} + \Delta\tilde{X})(1 - \tau_{pb}) = [\tilde{X} - b(\tilde{X})](1 - \tau_{pb}) + [\Delta\tilde{X} + b(\tilde{X})](1 - \tau_{pb}).$$

¹⁵ When $s_2(\hat{Y}) < \tilde{X} < s_1(\hat{Y})$, the amount of unused non-debt tax shields are $\phi - \tau_c(\tilde{X} - \hat{Y})$. If the firm could sell the tax shields in a perfectly competitive market, a before-tax cashflow of $[\phi - \tau_c(\tilde{X} - \hat{Y})]/(1 - \tau_c)$ would have been generated. This is the amount these tax shields are worth to another firm that can fully utilize them.

where $L(\hat{Y}) = V(\Delta\tilde{X}) + V(\tilde{b}) + V(\tilde{\Phi})$. Eq. (9) states that the value of the levered firm is the value of the unlevered firm plus the tax effect of corporate leverage minus the leverage-related costs. These costs consist of the ex-ante agency costs of debt, $V(\Delta\tilde{X})$, the present value of total bankruptcy costs, $V(\tilde{b})$, and the present value of the loss of non-debt tax shields in non-bankruptcy states, $V(\tilde{\Phi})$. Under reasonable assumptions, each of these costs increases with an increase in $\hat{Y}$. Hence, the total leverage-related costs also increase with corporate leverage:

$$dL(\hat{Y})/d\hat{Y} > 0. \quad (10)$$

If we relax the assumption that the unused non-debt tax shields will go to waste even in non-bankruptcy states, Eq. (9) remains unchanged except for the fact that $V(\tilde{\Phi})$ takes on a value of zero. If we assume zero agency and bankruptcy costs and full utilization of non-debt tax shields, Eq. (9) will reduce to Miller's pre-general equilibrium equation:

$$V_L = V_U + [1 - (1 - \tau_c)(1 - \tau_{ps})/(1 - \tau_{pb})]B. \quad (11)$$

This derivation of Miller's equation with risky debt requires only that there be no arbitrage profit opportunities between assets within the same personal tax category.¹⁶

Note that neither Eqs. (9) nor (11) specify the equilibrium relationship between τ_c , τ_{ps} , and τ_{pb} . In order to determine the general valuation implications from these equations, we must identify the τ_{ps} and τ_{pb} of the investor who is indifferent between holding stocks and bonds, i.e., the marginal investor. We turn now to an analysis of this relationship.

III. A Theory of Optimal Capital Structure

To identify the marginal investor's τ_{ps} and τ_{pb} , it is necessary to examine the aggregate supply of and demand for corporate securities. Essentially the same logic used in Miller's model is employed. The modifications made to incorporate risky debt and leverage-related costs are similar to those made by DeAngelo and Masulis [7]. Consequently, in Sections A and B, risk neutrality is assumed and τ_{ps} is assumed to be zero. In Section C, the assumption of risk neutrality is dropped and the effects of risk aversion on the equilibrium conditions derived in Sections A and B are re-examined.

A. Relationship between Expected Returns on Bonds and Stocks

If there are no leverage-related costs, then the assumptions of risk neutrality and $\tau_{ps} = 0$ reduce the model to that in Miller's world. Miller's general equilibrium condition as specified by Eq. (1) must hold and Eq. (11) will reduce to Eq. (2).

If there are leverage-related costs, the issue becomes more complicated and the question of who bears the ex-ante leverage-related costs arises. From the aggregate perspective of determining the general equilibrium expected rate of return on corporate bonds, stockholders will not issue risky debt if they must bear the

¹⁶ A personal tax category is defined in such a way that all income streams in a given personal tax category are identical in terms of the personal tax characteristics that they have for investors and potential arbitrageurs. See Schall [19] for a more detailed discussion on this point.

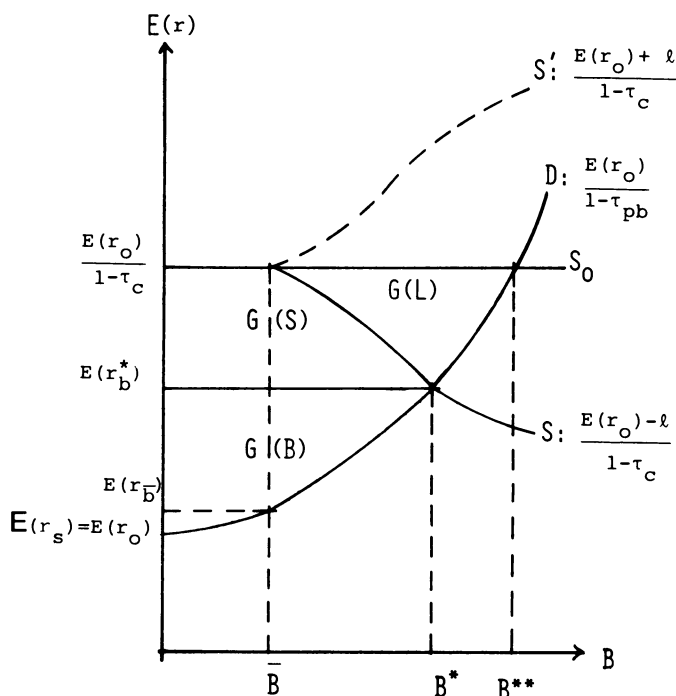


Figure 4.

Equilibrium for Corporate Bonds with Risk Neutrality, Leverage-Related Costs, and $\tau_{ps} = 0$.

ex-ante leverage-related costs. Instead bondholders as a group bear the ex-ante cost of leverage. This phenomenon requires that the marginal bondholder's tax rate, τ_p^* , be less than τ_c .

To illustrate these points, consider the aggregate supply and demand curves depicted in Figure 4. Denote $\bar{B}$ as the maximum amount of corporate debt that can be issued without incurring any leverage-related costs and B^{**} as the optimal aggregate amount of corporate borrowing in a world of no leverage-related costs. S_0 is the supply curve of bonds in Miller's equilibrium and the distance between the curves S_0 and S measures the marginal ex-ante before-tax leverage-related cost per dollar unit of debt issued by the corporate sector, $\ell/(1 - \tau_c)$,¹⁷ where $\ell = \partial[\sum_j L_j(\hat{Y})]/\partial[\sum_j B_j]$ and j denotes firms. If the stockholders continue to pay $E(r) = E(r_0)/(1 - \tau_c)$ to the bondholders beyond $\bar{B}$ (i.e., follow S_0) and if they bear the entire ex-ante leverage-related costs, the before-tax expected cost of corporate borrowing will be $[E(r_0) + \ell]/(1 - \tau_c)$, which is depicted by the broken curve S' . Then the after-tax cost of borrowing will be $E(r_0) + \ell$, which is greater than the expected rate of return on equity, $E(r_s) = E(r_0)$ (because with risk neutrality, tax-exempt stocks and tax-exempt bonds are perfect substitutes for one another). Under these conditions, stockholders will never issue bonds beyond $\bar{B}$. Instead, they will issue equity. But at $\bar{B}$, as the demand curve D illustrates, there will be an unfulfilled demand for corporate bonds.

¹⁷ Recall that in the previous section, $L(\hat{Y})$ was defined as the after-tax total leverage-related costs.

The area between S_0 and D represents the amount of the bondholders surplus in Miller's equilibrium. If the aggregate corporate borrowing stop at $\bar{B}$, a much smaller bondholders surplus would result and the situation would not be Pareto-optimal. Bondholders could be made better off without making the stockholders any worse off by allowing the bondholders to bear the ex-ante costs of leverage and thus earn more bondholders surplus. To make stockholders indifferent between issuing stocks and bonds, the marginal after-tax cost of issuing bonds, $(1 - \tau_c)[E(r_b) + \ell/(1 - \tau_c)]$, must equal the marginal expected rate of return on stocks, $E(r_s) = E(r_0)$, i.e., $(1 - \tau_c)E(r_b) + \ell = E(r_0)$. Rearranging this, we obtain the supply curve of corporate bonds:

$$E(r_b) = [E(r_0) - \ell]/(1 - \tau_c), \quad (12)$$

which is depicted by S in Figure 4. The supply and demand curves meet at B^* , which is less than the aggregate borrowing, B^{**} , in Miller's equilibrium. The optimal level of aggregate borrowing, B^* , represents the optimal tradeoff between the tax savings and the leverage-related costs for the corporate sector as a whole. At B^* , $\ell = \ell^* > 0$. Letting τ_p^* denote the marginal bondholder's tax rate at B^* , the expected rate of return demanded by the marginal bondholder can be expressed as:

$$E(r_b)^* = E(r_0)/(1 - \tau_p^*). \quad (13)$$

By equating Eqs. (12) and (13), we obtain $(1 - \tau_p^*)/(1 - \tau_c) = E(r_0)/[E(r_0) - \ell^*]$, which must be greater than 1 if $\ell^* > 0$. Thus, the marginal bondholder's tax rate, τ_p^* , is less than τ_c . As a result, the after-tax cost of corporate borrowing, $E(r_b)^*(1 - \tau_c) = E(r_0)(1 - \tau_c)/(1 - \tau_p^*)$, is less than the cost of issuing new equity, $E(r_s) = E(r_0)$. Therefore, there exists a positive tax advantage associated with issuing corporate bonds. As Figure 4 demonstrates, the source of this tax advantage is what used to be the bondholders surplus. In a world with no leverage-related costs, bondholders capture the entire area between S_0 and D as bondholders surplus. In the presence of leverage-related costs, this surplus must be shared with stockholders and the deadweight loss due to leverage; area $G(S)$ in Figure 4 goes to stockholders and area $G(L)$ represents the leverage-related costs.

B. Optimal Capital Structure

Substituting $\tau_{ps} = 0$ and $\tau_{pb} = \tau_p^*$ into (9), and adding subscript j to denote individual firms, we obtain:

$$V_{Lj} = V_{Uj} + [(\tau_c - \tau_p^*)/(1 - \tau_p^*)]B_j - L_j(\hat{Y}_j), \quad (14)$$

which describes the general equilibrium relationship between firm valuation and corporate leverage. Differentiating (14) with respect to B_j , we obtain the first-order condition:

$$\partial V_{Lj}/\partial B_j = (\tau_c - \tau_p^*)/(1 - \tau_p^*) - c_j^* = 0, \quad (15)$$

where $c_j = \partial L_j(\hat{Y}_j)/\partial B_j$ is firm j 's marginal ex-ante leverage-related costs per dollar unit of debt issued.

Eq. (15) indicates that firms will borrow up to the point where the marginal tax benefit is equal to the marginal ex-ante leverage-related costs.

If the level of borrowing is sufficiently low such that the present value of leverage-related costs is zero, the firm can borrow at an after-tax expected rate of $E(r_b)^*(1 - \tau_c)$, which is less than the expected rate of return on equity, $E(r_s) = E(r_0)$. Thus, the firm will increase its financial leverage and the present value of the leverage related costs will become positive. As bondholders pass on the ex-ante costs, c_j , in the form of a higher promised interest rate, the firm's after-tax expected interest cost increases to $E(r_b)^*(1 - \tau_c) + c_j$, while the expected rate of return to bondholders still remains $E(r_b)^*$. The firm will stop issuing bonds when the after-tax expected interest cost equals the expected rate of return on equity, that is, $E(r_b)^*(1 - \tau_c) + c_j = E(r_0)$. Substituting Eq. (13) into this equation, we obtain the optimal level of the marginal ex-ante leverage-related costs for individual firms:

$$c_j^* = E(r_0)(\tau_c - \tau_p^*)/(1 - \tau_p^*). \quad (16)$$

Bondholders bear the ex-ante costs of leverage only from the aggregate perspective of determining the general equilibrium expected rate of return on corporate bonds, $E(r_b)^*$. At the individual firm level, they still price out the leverage-related costs in order to prevent the expected rates of return on individual firms' bonds from falling below $E(r_b)^*$. As a consequence, individual firms' stockholders face an expected interest rate schedule that is an increasing function of the leverage-related costs, i.e., $E(r_b)^* + c_j/(1 - \tau_c)$.

Finally, note that the right hand side of Eq. (16) is the same for all firms. Accordingly, the optimal level of the marginal ex-ante leverage costs must also be the same for all firms, that is, $c_j^* = \ell^*$ for all j . This may explain the cross-sectional differences in capital structure among firms. Those firms which reach ℓ^* , the marginal economy-wide leverage-related cost at the optimum aggregate corporate borrowing level, relatively faster than average will have less corporate leverage. Conversely, those firms which reach ℓ^* relatively slower than average will have higher leverage.

C. Risk Aversion and Leverage Clienteles

As mentioned in Section I, when we assume risk neutrality there are no shareholder leverage clienteles. When we further assume leverage-related costs, we get essentially the same result except for the fact that the separating point is now τ_p^* instead of τ_c , i.e., those with $\tau_{pb} > \tau_p^*$ will hold only stocks and tax-exempt bonds, while those with $\tau_{pb} < \tau_p^*$ will hold only taxable bonds.

On the other hand, if capital market agents are risk averse, for reasons similar to those given in Section I, there will be investors with $\tau_{pb} < \tau_p^*$ who will find it advantageous to hold stocks in their portfolios. Investors will also sort themselves into shareholder leverage clienteles as described earlier. The existence of such clienteles raises several issues. First, the issue of who bears the ex-ante leverage-related costs becomes ambiguous. In contrast to the case of risk neutrality in which shareholders and bondholders are clearly demarcated by personal tax brackets, investors in low tax brackets hold both stocks and bonds and may

supply risky corporate debt even when they have to bear a portion of the leverage-related costs. Thus, even from the aggregate perspective, stockholders may also bear a portion of the economy-wide leverage-related costs. This sharing of costs by stockholders will take the form of a certainty equivalent corporate interest rate that is higher than the $E(r_b)^*$ under risk neutrality. Consequently, the marginal bondholder's tax rate will also be higher than τ_p^* and closer to the corporate rate τ_c . This in turn implies that the tax advantage of corporate debt financing will be smaller than that shown under risk neutrality. Therefore, the shareholder leverage clientele phenomenon may reduce the magnitude of the tax advantage associated with corporate debt financing.

The same shareholder leverage clientele phenomenon may also reduce the magnitude of the leverage-related costs. Since low tax bracket investors demand firms with high corporate leverage, they may represent an important segment of issuers of corporate bonds. But these investors are also holders of corporate bonds. Thus for those firms whose shareholders and bondholders constitute the same group of investors, the contractual arrangements to avoid the possible conflict of interests between stockholders and bondholders could be devised more efficiently, thereby reducing the magnitude of the agency costs of debt.¹⁸ Similar arguments could also be made about the reduction of bankruptcy costs and the loss of non-debt tax shields in non-default states.

Therefore, when risk aversion and the shareholder leverage clienteles are considered, the tax benefits and leverage-related costs may not have as significant of an effect on the decision regarding corporate capital structure as was implied in the risk neutrality case. They certainly do not represent the sole determinants of the firm's capital structure. The demand for the equity of firms with either high or low leverage, which arises from differences in personal tax rates across investors, may play just as important a role in determining corporate financing behavior.

IV. Summary and Conclusions

This paper has attempted to examine both the demand and the supply side of corporate leverage when differences exist in personal income tax rates across investors and across securities. Due to the complicated nature of the problem, the two sides are not examined in the same setting. To examine the demand side for corporate leverage, both the portfolio risk consideration and the personal and corporate marginal tax rates are treated as endogeneous variables and debt is assumed to be riskless. This investigation provides a rationale for shareholder leverage clienteles in a mean-variance framework and demonstrates the existence of an interior solution for the optimal corporate capital structure. The setting in which the supply side is investigated is less general. This part of the paper is

¹⁸ On the other hand, it is possible that the existence of risky debt may in turn weaken the argument for the shareholder leverage clienteles. If investors can form a portfolio of risky debt that would provide sufficient portfolio risk without investing in stocks, the low tax bracket investors' incentive to hold stocks will be diminished. However, the notion that portfolios of risky debt could provide perfect substitutes for portfolios of stocks (in terms of risk) to all investors is essentially the same as arguing that capital markets are complete for both tax-exempt and taxable securities.

largely a synthesis of recent studies on the theory of optimal capital structure with some new insights concerning (1) firm valuation with various forms of leverage-related costs, (2) the source of tax benefits at the firm level, (3) the issue of who bears the leverage-related costs, and (4) how the resolution of these issues relates to individual firm's value maximizing capital structure.

When the results from the analyses on the demand and the supply sides are combined, it appears that shareholder leverage clienteles may reduce both the magnitude of the tax advantages and the agency costs associated with corporate debt financing. The demand for the equity of firms with either high or low leverage arising from differences in personal tax rates across investors may be just as important a determinant of corporate capital structure as are the tax advantages and leverage-related costs. However, to provide an unambiguous description of how optimization at the firm level (the trade off involving tax-benefits and leverage-related costs) interacts with the demands arising from shareholder leverage clienteles would require a more comprehensive model in which the portfolio risk consideration, the marginal tax rates, and the leverage-related costs are treated simultaneously as endogeneous variables. Development of such a model and a closer examination of the ensuing general equilibrium conditions remain important tasks for further research.

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DISCUSSION

J. R. RITTER*: Over the past decade, a considerable literature has arisen dealing with what has come to be called the principal-agent relationship. An agency relationship exists whenever decision-making authority must be delegated, as in a corporation where stockholders and managers are not one and the same. When either managers are risk-neutral or if their actions can be monitored costlessly, the problem is simply resolved. It is the more interesting, and more realistic, case of a risk-averse manager whose actions cannot be costlessly monitored that is the focus of attention in Diamond and Verrecchia's innovative paper on optimal managerial compensation schedules.

With the cash flows of a corporation depending upon both the manager's actions and "luck," shareholders can gain by setting up a managerial incentive contract that uses mutually-observable information to separate the action and luck components. This follows from the result in the literature that information allowing a better decomposition of outcomes into effort and luck will improve social welfare when incorporated into an incentive contract. In the context of a top manager's contract, one piece of information that is potentially of use is the change in a firm's market value, for stock market prices can (at least partially) aggregate investors' diverse information about a firm's value, even if no investor would have an incentive to reveal his information directly in a noncooperative equilibrium.

Diamond and Verrecchia find that, by decomposing the change in a firm's market value into "systematic" and "non-systematic" components, a maximum amount of information about the manager's effort can be extracted. They associate the systematic component with luck and the non-systematic component with actions and derive the intuitively-plausible result that a manager's "bonus" should not be tied to industry-wide or economy-wide (systematic) factors, because by removing this element of variability from the manager's compensation, the risk-averse manager will be willing to accept lower expected compensation, making the shareholders better off. Furthermore, by reducing the noise in the link between actions and compensation, the manager is induced to work harder, once again to the benefit of the shareholders.

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