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9 Investment Patterns and Financial Leverage

Michael S. Long and Ileen B. Malitz

9.1 Introduction

The effect of capital structure on firm value has been a subject of controversy over the years. Most early work, such as Modigliani and Miller (1958), showed that when capital markets are perfect and investment policy is fixed, capital structure is irrelevant to firm value. Later studies (Modigliani and Miller 1963; Baxter 1967) introduced corporate taxes and/or bankruptcy costs in an effort to explain capital structure. The tax/bankruptcy arguments have been extended by Miller (1977), who showed that with personal taxes there is no corporate advantage to leverage, and DeAngelo and Masulis (1980), who hypothesized that the extent of nondebt tax shields determines a firm's optimal capital structure. Recently there has been a movement away from the traditional tax-bankruptcy cost argument toward a consideration of agency costs as the major determinant of financial leverage. Jensen and Meckling (1976) showed that with risky debt outstanding, a firm's investment policy is not fixed. Myers (1977) first recognized the underinvestment problem by noting that shareholders of firms with risky debt will invest only when (or up to the point at which) the expected return on investment is at least as great as the promised payment to bondholders. When the expected return is less than the promised payment, shareholders fail to exercise the investment option (or invest less than the optimal amount), which re-

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duces firm value. It is this decline in firm value which limits the amount of debt a given firm can issue.

Myers(1977) correctly identifies investment opportunities, including, for example, the maintenance of equipment, as leading to potential underinvestment. He notes that owners, by devising complex debt contracts, can reduce the effect of potential underinvestment and induce bondholders to pay a higher price for debt. But debt contracts can be effective only when the firm's investment opportunity set is observable.

In this study we show that because intangible, firm-specific, and therefore unobservable growth opportunities reduce the effectiveness of bond covenants, the only way in which owners of firms with a high proportion of intangible investment opportunities can control the agency costs of debt is by limiting the amount of risky debt outstanding. Conversely, this implies that if a firm's investment opportunities consist primarily of tangible assets, such as capital equipment, they can always support a greater level of debt.

The same arguments apply to the asset substitution problem (Black and Scholes 1973; Smith and Warner 1979). While riskier (more capital-intensive) equipment can always be purchased, such investments are observable. With intangible investments, it is a relatively easy matter for owners to increase firm risk without bondholders' being aware of the shift for many years. For example, a firm can concentrate its research and development (R&D) on projects with a low probability of extremely high returns. Since most firms closely guard information concerning R&D projects, this type of risk shifting is difficult for outsiders to detect.

Thus our major conclusion is that it is the type of investment opportunities facing the firm which determines financial leverage. The empirical evidence supports this conclusion.

Our analysis of the effect on investment type on corporate leverage proceeds as follows. In section 9.2 we develop a model showing the cause and effect of underinvestment and asset substitution. We then analyze the differing effects which investments in tangible or intangible assets have on firm value and present our hypothesis. Section 9.3 describes our sample and the variables used to characterize investment alternatives, and presents our empirical results. Included are tests incorporating additional variables suggested by other researchers. Finally, we present and discuss the implications of our findings in section 9.4.

9.2 Investment Choice and Financial Leverage: Theory

In this section we analyze the underinvestment and asset substitution problems as they relate to the type of investment opportunities facing a firm. We show that because investments in tangible assets, such as capital equipment, can be observed, firms with a high proportion of tangible investment opportunities can always support more debt than firms facing intangible, or firm-specific, opportunities. It is these difficult to observe firm-specific investments which provide true economic growth and at the same time reduce financial leverage.

We examine investment-related agency problems by considering a firm which operates for three periods, $t = 0, 1, 2$, in an economy characterized by state-contingent claims which promise to pay \$1.00 in period t, if and only if state S_t occurs. Capital markets are perfect so that there are no taxes or transactions costs. However, there are agency costs related to risky debt. It is assumed that some debt is advantageous because of offsetting agency costs of equity and that these costs have been minimized so that managers act on behalf of owners. The firm starts out at $t = 0$ with initial equity capitalization, an initial asset base, and a set of investment opportunities which can be exercised at $t = 1$. The investments which are accepted will provide earnings at $t = 2$ which depend both on the state of nature and the level of investment. At the end of $t = 2$, the value of the investments is zero, that is, they are fully depreciated. The following notations are used throughout the paper.

C_1 = Amount invested in period 1.
$q_0(S_t)$ = Value at $t = 0$ of a claim for \$1.00 to be delivered in period t, if and only if state S_t occurs, $t = 1, 2$; $S = 0, \ldots, \ldots,$.
$q_1(S_2)$ = Expected (or implied) value at $t = 1$ of a claim for \$1.00 to be delivered in period 2, if and only if state S_2 occurs and $q_1(S_2) = q_0(S_2) / q_0(S_1)$.
Z = The unlevered firm's investment problem at $t = 1$.
Z' = The levered firm's investment problem at $t = 1$.
V = Value of the unlevered firm.
V' = Value of the levered firm.
Ve = Value of equity when there is no risky debt.
Ve' = Value of equity when there is risky debt.
P = Promised payment to bondholders at $t = 2$.
Vd = Value of the firm's debt at $t = 0$.
B = Price paid for the firm's debt at $t = 0$.
S_{d2} = State below which operating default occurs at $t = 2$.
S_{b2} = State below which financial default occurs at $t = 2$.
$R(C_1, S_2)$ = Dollar return on investment at $t = 2$, where $\partial R(C_1, S_2) / \partial C_1 > 0$, $\partial^2 R(C_1, S_2) / \partial C_1^2 < 0$.

It is assumed that the firm derives some level of expected earnings at $t = 1$ from the initial asset base. However, for simplicity, we assume that there is no probability of operating default at $t = 1$ so that these expected earnings, which are the same for an unlevered or levered firm, are ignored in the analyses which follow.

9.2.1 The Underinvestment Problem

Consider first the choice of the level of investment for the unlevered firm. At $t = 1$, owners will maximize their wealth.

$$\max_{C_1} Z = -C_1 + \int_{S_{d2}}^{\infty} R(C_1, S_2)\, q_1(S_2) dS_2 . \tag{1}$$

This of course equals the net present value (NPV) of the investment to the firm at $t = 1$. The first-order condition for equation (1) leads to the classic microeconomic result: Invest to the point, C_1^*, where the expected marginal return on investment equals its marginal cost.

$$\partial Z/\partial C_1 = -1 + \int_{S_{d2}}^{\infty} [\partial R(C_1{}^*, S_2)/\partial C_1] \; q_1\,(S_2)\; dS_2 = 0 . \tag{2}$$

This is equivalent to investing in all projects with a NPV ≥ 0. The value of the firm equals the owners wealth in the firm, and is optimal at this point.

$$V = Ve = -C_1{}^* \int_0^{\infty} q_0(S_1) ds_1 + \int_0^{\infty} \int_{S_{d2}}^{\infty} R(C_1{}^*, S_2) q_0(S_2) dS_2 . \tag{3}$$

Now assume that instead of remaining all equity funded at $t = 0$, owners issue debt which promises to pay an amount P at $t = 2$. The debt is pure discount so that the amount paid, B, reflects anticipated payment at $t = 2$. Owners use these proceeds to repurchase equity at $t = 0$, and fund C_1 by issuing new equity at $t = 1$. At $t = 2$, owners default on debt if the return is less than the promised payment, $R(C_1, S_2) < P$, which occurs in all states $S_2 < S_{b2}$. Thus at $t = 1$, when maximizing their wealth, owners recognize that they receive a return if and only if $S_2 \geq S_{b2}$.

$$\max_{C_1} Z' = -C_1 + \int_{S_{b2}}^{\infty} [R(C_1, S_2) - P]\, q_1(S_2) dS_2 . \tag{4}$$

Equation (4) leads to a first-order condition, and thus a level of investment C_1', which does *not* maximize firm value.

$$\partial Z'/\partial C_1 = -1 + \int_{S_{b2}}^{\infty} [\partial R(C'_1, S_2)/\partial C_1] \; q_1\,(S_2)\; dS_2 . \tag{5}$$

The second term in equation (5) is less than the corresponding term in equation (2) because $S_{b2} > S_{d2}$. Because owners only receive payoffs after they have paid bondholders, they invest less than the optimal amount, $C' < C^*$. The value of equity is then the present value of the shareholders' portion of firm value.

$$Ve' = -C_1' \int_0^{\infty} q_0(S_1) dS_1 + \int_0^{\infty} \int_{S_{b2}}^{\infty} [R(C_1', S_2) - P]\, q_0(S_2) dS_2 . \tag{6}$$

Since the proceeds from the sale of debt are distributed to owners, their wealth depends on the price paid for debt. This in turn depends on the ability of potential bondholders to accurately assess owners' investment decisions, which requires knowledge of the firm's investment opportunity set.

Suppose first that potential bondholders do not anticipate underinvestment; that is, they assume $C_1' = C_1^*$. Then the price they are willing to pay reflects the investments they assume the firm will undertake.

$$B = P \int_0^{\infty} \int_{S_{b2}^*}^{\infty} q_0(S_2)\,dS_2 + \int_0^{\infty} \int_{S_{d2}}^{S_{b2}^*} R(C_1^*, S_2)\,q_0(S_2)\,dS_2 . \tag{7}$$

Because they assume C_1^* is invested, they also assume that the default state, S_{b2*} is lower than its actual state, S_{b2}. This results in a wealth loss equal to the price paid for the bonds less the true value of debt $(B - Vd)$.

This loss is shown graphically on figure 9.1. Bondholders priced debt as if they would receive the present value of area $OABCS_N$. However, debt is actually worth the present value of area $OA'B'CS_N$. The bondholders overpaid (and transferred to owners) an amount equal to the present value of the shaded area, $AA'BB'$. The effect on owners' wealth depends on whether the gain from bondholders exceeds the decline in the value of

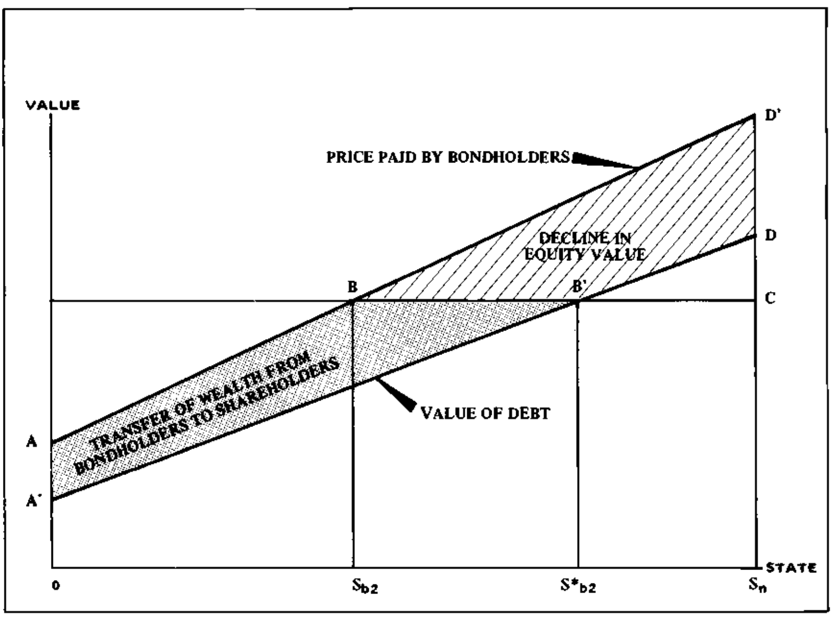

Fig. 9.1 The effect of unanticipated underinvestment on bondholder wealth.

equity (area $BB'DD'$). If owners could underinvest without bondholders anticipating their actions, they would increase their wealth.

But in a rational capital market, bondholders will attempt to anticipate underinvestment. If the firm's investment opportunities are tangible in nature, potential bondholders are able to estimate the investment opportunity set and thus fully anticipate the lower level of investment. They will then pay the true value of debt so that $B = Vd$.

$$Vd = P \int_0^\infty \int_{S_{b2}}^\infty q_0(S_2)\,dS_2 + \int_0^\infty \int_{S_{d2}}^{S_{b2}} R(C_1', S_2)\,q_0(S_2)\,dS_2. \tag{8}$$

The value of debt is equal to the present value of the promised payment in states of no default plus the present value of the firm in states of default on debt. In this case, when B is distributed to owners, the value of the levered firm is less than that of the unlevered firm.

$$V' = -C_1' \int_0^\infty q_0(S_1)\,dS_1 + \int_0^\infty \int_{S_{d2}}^\infty R(C_1', S_2)\,q_0(S_2)\,dS_2. \tag{9}$$

As long as bondholders accurately anticipate underinvestment, owners bear a loss in firm value which increases with the amount promised to bondholders. Then it is to the owner's advantage to provide monitoring of investment decisions. Whether monitoring of investment decisions is provided by bondholders (through debt covenants) or by the capital market itself (implicit monitoring), much of the negative effect of risky debt can be eliminated. Low-growth firms with tangible, generalized investment opportunities, such as plant and equipment, can support more debt because of the ability of potential bondholders to estimate underinvestment and to observe and monitor investment decisions.

But suppose that the firm's investment opportunities are intangible and/or firm specific in nature so that potential bondholders are unable to estimate either the firm's investment opportunities or the extent of underinvestment. Then normally they will assume the worst possible case, which in the limit is zero investment. While owners could promise higher payments to bondholders in order to induce them to purchase debt, Myers has shown that increasing P is not effective. Because firm value declines as the promised payment increases, beyond some point, called the firm's debt capacity, increasing P reduces rather than increases the value of debt. Further, if bondholders are unable to estimate underinvestment, they are also unable to observe or monitor the firm's investment policy. Thus the effectiveness of either bond convenants or implicit capital market monitoring is reduced. Since the market cannot effectively monitor investment decisions, it instead limits the amount of debt. Because high-growth firms cannot be effectively monitored, they will have lower financial leverage.

9.2.2 Asset Substitution

Consider the investment decision as it concerns the risk of the assets purchased. It is well known that increasing firm risk may decrease bondholder wealth while increasing owners wealth. We examine this problem by assuming that the firm faces a second set of investments at $t = 1$, C_1'' with a return function at $t = 2$ of $R''(C_1'', S_2)$. To highlight the asset substitution problem, we assume that $C_1'' = C_1'$ so that owners maximize their wealth at the same level of investment. The new set of investments is riskier, implying that $S_{b2} < S_{b2}''$, $Sd_2 < Sd_2''$, and

$$\int_{S_{d2}}^{S_{b2}} R(C_1', S_2)q_1(S_2)\,dS_2 > \int_{S_{d2}}^{S_{b2}''} R''(C_1', S_2)q_1(S_2)\,dS_2$$

$$\int_{S_{b2}}^{\infty} R(C_1', S_2)q_1(S_2)\,dS_2 = \int_{S_{b2''}}^{\infty} R''(C_1', S_2)q_1(S_2)\,dS_2 .$$

These patterns of return are shown graphically on figure 9.2. The second set of investments results in a higher probability of operating default as well as a higher probability of financial default. Figure 9.2 shows that the expected marginal return on the original investment over states $S_2 \geq S_{b2}$ (area $S_{b2}A'\,CS_N$) is equal to the expected marginal return on the riskier investment over states $S_2 \geq S_{b2''}$ (area $S_{b2''}\,B'\,C'\,S_N$). This leads to identical first-order conditions for owners' wealth maximization and thus to the same level of investment. Figure 9.2 also shows that the expected marginal return on the original investment over states $S_2 \geq S_{d2}$ (area $S_{d2}\,ACS_N$)

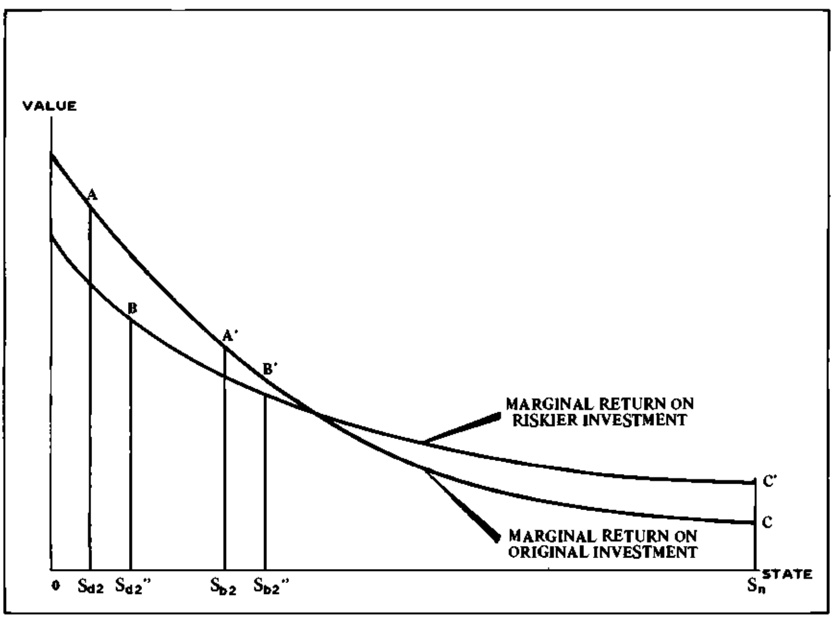

Fig. 9.2 Expected marginal returns on investment with asset substitution.

exceeds the expected marginal return on the riskier investment over states $S_2 \geq S_{d2''}$ (area $S_{d2}''BC'S_N$). Thus, given the above assumptions, the first-order conditions to maximize firm value shows that the less risky investment is preferable.[1]

The value of equity with the original investment is given by equation (6). The value of equity, Ve'', with the riskier investment depends on the returns to owners in states $S_2 \geq Sb_2''$.

$$(10) \qquad Ve = -C_1' \textstyle\int_0^\infty q_0(S_1)\,dS_1 + \int_0^\infty \int_{S_{b2''}}^\infty [R''(C_1', S_2) - P]\, q_0(S_2)\,dS_2 .$$

If the riskier investment is chosen, the value of equity changes as follows:

$$(11) \qquad Ve'' - Ve' = \textstyle\int_0^\infty \int_{S_{b2''}}^\infty [R''(C'_1, S_2) - R'(C'_1, S_2)]\, q_0(S_2)\,dS_2 - \int_0^\infty \int_{S_{b2}}^\infty [R'(C'_1, S_2) - P] q_0(S_2)\,dS_2 .$$

The first term in (11) is the difference in value of the two investments in states of no default on debt and is positive by assumption. The second term is negative, since owners do not default on debt in states $S_2 \geq Sb_2$ if they choose the original investment. The value of equity may increase if the riskier investment is chosen. Whether or not it does depends on the promised payment to bondholders.

As with underinvestment, if bondholders did not anticipate investment substitution, they would assume that the original investment would be chosen and would be willing to pay

$$(12) \qquad B = P \textstyle\int_0^\infty \int_{S_{b2}}^\infty q_0(S_2)\,dS_2 + \int_0^\infty {}_{S_{d2}}^{S_{b2}} R(C'_1, S_2) q_0(S_2)\,dS_2 .$$

But the actual value of debt, given the riskier investment, is

$$(13) \qquad Vd = P \textstyle\int_0^\infty \int_{S_{b2''}}^\infty q_0(S_2)\,dS_2 + \int_0^\infty {}_{S_{d2''}}^{S_{b2''}} R''(C_1', S_2) q_0(S_2)\,dS_2 .$$

The price paid for debt exceeds its actual value. This is shown graphically on figure 9.3. The price paid by bondholders is the present value (PV) of area $OABCS_N$. The true value of debt is the PV of area $OB'CS_N$. The overpayment (wealth loss) is the PV of area $OABB'$. This amount is transferred to owners. In addition owners gain the difference between the PVs of area DEF and area $BB'D$. Finally, firm value declines by the difference between shareholders' gain and bondholders' loss (PV of areas $DEF - OAD$). Thus owners may gain even when firm value declines.

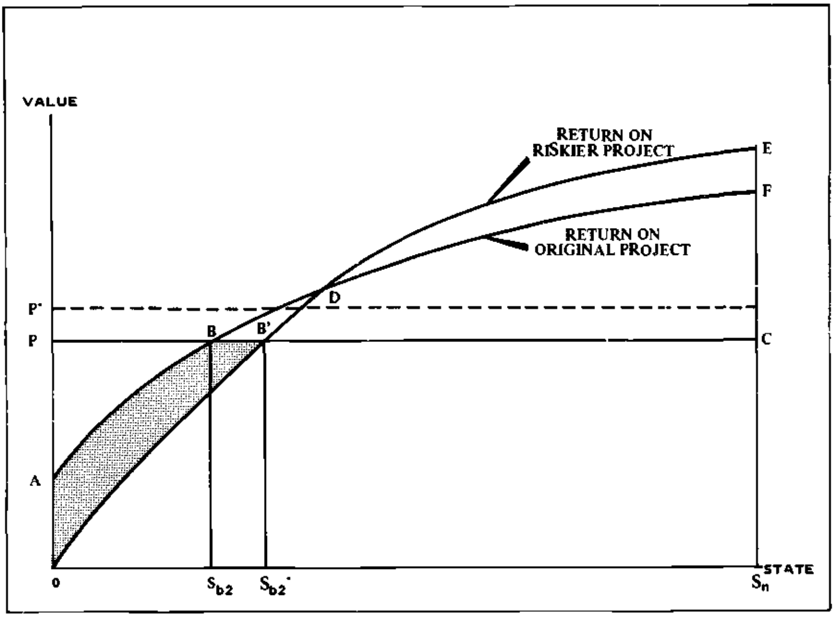

Fig. 9.3 The effect of unanticipated asset substitution on bondholder wealth.

But again, in a rational market the amount paid for debt equals its true expected value; $B = Vd$, so that *any* potential loss in firm value is borne by owners. If bondholders have reason to suspect that owners will move toward riskier investments, the price of debt will be discounted in the capital market. In the extreme, investors may anticipate losses so great that additional debt will not be purchased at *any* promised payment.

Again, it is intangible investment which leads to the problem. When a firm invests in capital equipment, it is relatively simple to estimate the owner's incentives to substitute riskier investments and to observe their contribution to firm risk. This means that it is more likely that bondholders can accurately anticipate asset substitution.[2] But when a firm faces many firm-specific investment opportunities, it is a relatively simple matter for owners to increase firm risk over time. Because of the intangible nature of these investments, market participants often have difficulty estimating their risk and return. Further, since the ultimate effect of increasing the risk of intangible investments may not be known for several years, it is almost impossible for bondholders or the capital market to monitor such investments. For these reasons, we hypothesize that firms with a high proportion of value due to intangible investment opportunities can support less debt than those whose value depends on tangible assets.

9.3 Empirical Results

We test our hypothesis that a firm's choice of capital depends on the type of investment opportunities it faces by examining the cross-sectional behavior of firms during the period 1978–80.

Our primary source of data is the COMPUSTAT Annual Industrial File. All manufacturing firms (SIC four-digit classification 2000–3999) which contained a full set of data for 1978–80 were considered as our initial sample.[3] Additional data were obtained from the CRSP Daily Return Tape. This limited our sample to firms listed on either the New York (NYSE) or American Stock Exchange (AMEX). Our final sample consists of 545 firms of which 139 are in the Standard and Poor 500, 216 are non-Standard and Poor 500 NYSE firms, and 190 are listed on the AMEX. We require two sets of variables: those measuring financial leverage and those measuring the type of investment opportunities.

Measuring financial leverage is relatively straightforward. Our previous analysis suggests that firms will choose a capital structure which reflects the type of investment opportunities they face. However, it is well known that firms do not instantaneously adjust their financing mix to reflect changes in underlying characteristics. Rather, the issue or retirement of debt occurs at fixed points in time as the firm adjusts to its target debt ratio. Thus, the average stock of debt outstanding during any period of time should provide a better indication of a firm's target capital structure than changes in the level of debt. In addition, since our hypothesis centers on the effect of long-term investments on the firm's financing decisions, we wish to consider only long-term, funded debt.[4] We thus measure financial leverage as the book value of all long-term, funded debt.[5]

When considering the effect of investment type on financial leverage, we must devise measures which capture the realization that firms raise capital prior to funding investments. This implies that our investment measures should be current flows rather than stocks.[6] In addition, we must recognize that, as Myers (1977) pointed out, all investments are discretionary in nature and thus may lead to agency problems. But we hypothesize that it is only firm-specific, intangible investment opportunities that reduce the firm's debt capacity and thus their financial leverage. Because all investments provide some growth in the firm's assets, we need variables which distinguish between growth due merely to expansion (NPV = 0) and true economic growth (NPV > 0). True economic growth results from a firm's ability to select investments which create a unique product or process. Two such investments for which there are readily available data are R&D and advertising. To capture the flow of funds into alternative investments, we use the firm's reported R&D and advertising expenditures as our proxies for firm-specific, intangible investments and the firm's reported capital expenditures to measure expansionary or tangible investments.

All of the above variables, financial leverage, R&D, advertising, and capital expenditures, are measured using accounting data. Because there is a large variation in the size of firms, a direct comparison of these variables is impossible. To standardize our measures, we use a size-related denominator and compute ratios. Since we are primarily interested in how firms have raised capital to fund their mix of investments, we seek a standardizing variable which reflects invested capital. We define invested capital as the book values of long-term debt and equity. We then modify this measure by recognizing that there are several categories of capital, such as R&D and advertising, which, because of the difficulty in measuring future benefits, are currently required by GAAP to be expensed. The expensing, rather than the capitalization, of these items is in contrast to the treatment of tangible assets, which are capitalized initially and then depreciated. Because the items which are expensed are precisely those which we hypothesize can support little debt, we adjust our denominator by adding capitalized advertising and R&D. We assume a five-year life for R&D, a three-year life for advertising, and straight-line amortization. Because the use of capitalized R&D and advertising reduces the financial leverage variable for firms with higher such expenditures, there is a potential bias in our results. For this reason, we examine alternative standardizing variables: total assets and invested capital (without capitalized R&D and advertising). To control for any unusual conditions which might affect a variable at any point in time, we average our ratios over a three-year period from 1978 through 1980.

We also wish to consider the effect of the firm's asset (operating) risk on capital structure decisions. The traditional finance literature assumes that operating and financial risk are offsetting decisions, so that firms with greater operating risk will have lower financial leverage. By including a measure of operating risk, we are better able to isolate the effects of investment choice on financial leverage. We are interested in the firm's systematic risk, or beta, which is assumed to capture all of its business or asset risk. We first compute the firm's equity beta, using the geometric average of 20 daily returns to approximate one month.[7] We then unlever the beta as suggested by Hamada (1972) and Rubenstein (1973) using the market value of equity and the book value of debt as a percentage of total value to weight equity and debt, respectively. Because we assume debt is riskless, our measure underestimates systematic risk for high-leverage firms.[8] We include the unlevered beta as an independent variable in all tests using individual firm data.

In addition, to completely neutralize a firm's underlying business risk, we also form equal beta portfolios by first determining the median unlevered beta. We then list all firms in decreasing order of financial leverage and place them into one of two groups: those with unlevered betas above the median and those with unlevered betas below the median. Next we place the first four firms in each group into a 8-firm portfolio. We weight the portfolio so that its unlevered beta is equal to the median beta. We continue the process until all firms are assigned to a portfolio. This process, which creates 68 equal beta portfolios, each with a different degree of financial leverage, greatly reduces the random variation in our predictor variables. This reduction in variation can be seen on table 9.1.

Table 9.1 shows that for each variable, the standard deviation is lower when portfolio data are used. However, because the use of portfolios results in a loss of data, all results are reported for both individual firms and portfolios of firms. Our basic models of the predictors of financial leverage are presented below.

(14) $$\text{Leverage} = B_0 + B_1\,(\text{advertising}) + B_2\,(\text{R\&D}) + B_3\,(\text{capital expenditures})$$

(15) $$\text{Leverage} = C_0 + C_1\,(\text{advertising}) + C_2\,(\text{R\&D}) + C_3\,(\text{capital expenditures}) + C_4\,(\text{unlevered beta})$$

Equation (14) is the model used to test data for the 68 portfolios, while equation (15) is used to test data for the 545 firms. Both models are tested using ordinary least squares regression. Table 9.2 presents the results of tests of equation (14) using the three alternative denominators discussed above, while table 9.3 presents the results using firm data.

Table 9.2 shows that, depending on the denominator used, between 35% and 41% of the variation in debt is explained by investment type. In each case, the signs are as predicted. The results using invested capital plus capitalized R&D and advertising and those using totals assets are quite similar. The results using only invested capital also are similar,

Table 9.1 **Summary Statistics**

	545 Firms		68 Portfolios	
Variable	Mean	Standard Deviation	Mean	Standard Deviation
Advertising	.0253	.0382	.0402	.0303
Capital expenditure	.0964	.0523	.1240	.0260
R&D	.0241	.0269	.0366	.0217
Unlevered beta	.9229	.4649	N.A.	N.A.
Long-term debt	.2506	.1470	.2560	.1339

Table 9.2 Advertising, Research and Development and Capital Expenditure as Determinants of Financial Leverage for 68 Portfolios

	Denominator		
Variable	Invested Capital	Invested Capital, Capitalized R&D and Advertising	Total Assets
Constant	.107	.107	.064
Advertising	−1.211	−1.314	−1.416
	(1.88)	(2.80)	(2.20)
R&D	−2.497	−2.182	−2.370
	(2.36)	(3.22)	(2.23)
Capital expenditure	2.647	2.269	2.820
	(4.33)	(4.39)	(4.60)
Adjusted R^2	.35	.41	.39

Note: Absolute value of *t*-ratios in parentheses.

Table 9.3 Advertising, R&D, Capital Expenditures, and Unlevered Beta as Determinants of Financial Leverage for 545 Firms

Variable	Coefficient	*t*-Statistic (Absolute Value)
Constant (C_0)	.325	
Advertising (C_1)	−.522	3.43
R&D (C_2)	−.867	3.87
Capital expenditure (C_3)	.520	4.68
Unlevered beta (C_4)	−.098	7.54

Note: Adjusted R^2 = .21.

except that the significance of the advertising variable declines. Because the results are similar, and because we feel that it is appropriate to capitalize rather than expense R&D and advertising, all future tests will use variables standardized by invested capital plus capitalized R&D and advertising.

Table 9.3 shows that, for individual firms, systematic risk and investment type explain 21% of the variation in debt. Not surprisingly, the most significant variable is systematic asset risk, with riskier firms having lower financial leverage.[9] All variables measuring investment type have the predicted sign and are statistically significant. Firms with discretionary investment opportunities have lower financial leverage than those facing tangible investments.[10]

We now wish to determine whether or not the above results indicate a true moral hazard problem. It is possible that our results reflect spurious correlation of our proxies for investment type with other, more important determinants of financial leverage. We investigate this possibility by examining the effect of variables suggested by other researchers on the power of the model. These determinants include non-interest-related tax shields, firm specific (unsystematic) risk, and the availability of internal funds.[11] In addition, we examine whether or not agency problems affect short-term borrowing decisions. Because several of our variables exhibit multicollinearity, we examine the correlation matrices for both firms and portfolios before presenting our results.

Tables 9.4 and 9.5 show that there is a high degree of multicollinearity between capital expenditures and investment-related tax shields, which might affect either the sign or interpretation of the tax variable. However, it is interesting to note that the tax shield is positively related to long-term debt.

In addition, a comparison of tables 9.4 and 9.5 shows that when we neutralize risk, advertising and R&D are positively correlated with operating cash flows. These correlations are not present in individual firm data. Thus when we consider the effect of operating cash flow on the power of the moral hazard model, we might expect different results for the two sets of data. Table 9.4 also shows that while systematic and unsystematic risk are positively correlated, their effect on debt is opposite. With these relationships in mind, we now examine each variable separately and determine its effect on the moral hazard model.

We first examine the effect of investment-related tax shields on the power of our model. Expanding on Miller (1977), DeAngelo and Masulis (1980) first suggested that a firm's financial leverage depends on the availability of investment-related tax shields, such as depreciation and investment tax credits. They show that when such tax shields are available, corporate capital structure is relevant to individual firms. They argue that the presence of nondebt tax shields affects the extent to which corporations can gain from the substitution of debt for equity. Since higher financial leverage increases the probability that nondebt tax shields will be lost, they hypothesize that firms with lower tax shields will employ more debt in their capital structure. This implies that firms investing heavily in capital equipment, which generates large tax shields, should have less debt. We have already observed that the relationship between capital expenditures and financial leverage is positive. However, we wish to test the effect of tax shields directly. We compute the depreciation tax shield as depreciation expense times the corporate marginal tax rate plus the change in deferred taxes. The total investment-related tax shield is the sum of the depreciation tax shield and the investment tax credit.[12]

Table 9.4 **Correlation Matrix, 545 Firms**

	Advertising	Capital Expenditures	R&D	Unlevered Beta	Operating Cash Flow	Unsystematic Risk	Tax Shield	Short-term Debt	Long-term Debt
Advertising	1.000	−.254	−.018	−.011	−.172	.034	−.239	.052	−.176
Capital expenditures		1.000	.004	.068	.368	−.116	.671	.039	.198
R&D			1.000	.368	−.091	.023	−.022	−.115	−.270
Unlevered beta				1.000	.211	.238	−.007	−.253	−.355
Operating cash flow					1.000	−.096	.242	−.082	−.244
Unsystematic risk						1.000	−.105	.141	.133
Tax shield							1.000	−.013	.123
Short-term debt								1.000	.280
Long-term debt									1.000

Note: Standard error of correlation coefficients ≈ .043.

Table 9.5 **Correlation Matrix, 68 Portfolios**

	Advertising	Capital Expenditures	R&D	Operating Cash Flow	Unsystematic Risk	Tax Shield	Short-term Debt	Long-term Debt
Advertising	1.000	−.096	.416	.501	−.215	−.417	.081	−.487
Capital expenditures		1.000	.270	.158	.040	.562	.166	.373
R&D			1.000	.505	−.121	−.165	.089	−.359
Operating cash flow				1.000	−.268	−.176	−.125	−.642
Unsystematic risk					1.000	−.005	.239	.345
Tax shield						1.000	.033	.378
Short-term debt							1.000	.319
Long-term debt								1.000

Note: Standard error of correlation coefficients = .121.

Table 9.6 The Effect of Investment-related Tax Shields on Financial Leverage

	Firms	Portfolios
Constant	.332	.137
Advertising	−.542	−1.436
	(3.55)	(2.89)
R&D	−.870	−2.316
	(3.88)	(3.30)
Capital expenditure	.654	2.580
	(4.46)	(3.94)
Tax shield	−.571	−1.858
	(1.40)	(.78)
Unlevered beta	−.099	N.A.
	(7.62)	
Adjusted R^2	.21	.41

Note: Absolute value of *t*-statistic in parentheses.

Table 9.6 presents the results of including the investment-related tax shield in our model. We see that because of multicollinearity, the coefficients are negative but insignificant. The coefficients of our moral hazard variables remain as predicted, and all are significant. Thus while we cannot exclude the possibility of tax effect, we can conclude that the moral hazard problem remains and is important in determining financial leverage.

We next turn to the question of whether or not a firm's total risk influences its financial leverage. Agency theory contends that the higher the variance of the firm's returns, the less the underinvestment problem. Because investments which reduce firm risk provide a capital gain to bondholders at the expense of shareholders, owners are likely to forgo such investments. Conversely, because they hold claim to the upper portion of a firm's distribution of return, shareholders are more likely invest in high-variance projects. Thus, all other factors equal, high-variance firms will lower agency costs of debt due to underinvestment and thus higher financial leverage.[13] If, however, we consider the possibility that bankruptcy costs matter, higher-variance firms would have less debt.[14] Thus, if total risk has a positive effect on leverage, we assume that the moral hazard problem outweighs the increased probability of bankruptcy, and vice versa if the effect is negative. If both problems are important, then they should offset each other and the effect of total risk on financial leverage should be neutralized.

We measure total risk as the unsystematic, firm-specific, residual variance of the firm's stock returns, standardized by the market variance.[15]

Table 9.7 **The Effect of Firm-specific Risk on Financial Leverage**

	Firms	Portfolios
Constant	.299	.034
Advertising	−.523	−1.119
	(3.58)	(2.44)
R&D	−.756	−2.110
	(3.50)	(3.24)
Capital expenditures	.617	2.227
	(5.72)	(4.48)
Firm-specific risk	.005	.010
	(6.72)	(2.50)
Unlevered beta	−.121	N.A.
	(9.32)	
Adjusted R^2	.27	.46

Note: Absolute value of *t*-statistics in parentheses.

Table 9.7 shows that when using data for individual firms or portfolios, unsystematic risk has a significantly positive effect on financial leverage. We note that with firm data, the effect of unlevered beta on financial leverage is negative. To attempt to determine the overall affect of risk, we also used the firm's total variance of stock returns, unlevered to remove the effect of debt. Our results showed that total risk also is significantly positively correlated with financial leverage. This indicates that control of underinvestment exerts a greater influence on debt capacity than does the increased probability of bankruptcy. While we cannot conclude that bankruptcy costs are irrelevant, we can state that inclusion of risk measures does not affect the ability of the moral hazard variables to explain financial leverage.

We next examine the possibility that the size of a firm's operating cash flows determines financial leverage. There are two possible explanations why cash flows might influence corporate borrowing.

First, as Donaldson (1961) noted, managers may prefer to minimize their costs and constraints by using internally generated funds. This is consistent with Miller's (1977) argument that with personal taxes and no transactions costs firms are indifferent to capital structure. If we then introduce transactions costs, we would expect that firms will choose the form of financing which is least expensive. Therefore, firms with adequate internal funds will provide most of their capital requirements internally, while less liquid firms will be forced to resort to outside funding.

However, it is also possible that a firm's cash flows are a proxy for the type of investment opportunities they face. In the absence of positive net present valued investments, we would expect that if risk were held constant, all firms would have the same before tax operating cash flows. Any observed variation in cash flows can be attributed to variation in economic growth. True economic growth results from a firm's ability to select investments which create unique products or processes. When investment opportunities are firm specific or intangible, they are more likely to generate positive net present values and thus higher cash flows. Thus it is possible that the size of a firm's cash flows is a proxy for firm-specific investment opportunities instead of growth opportunities.

We measure operating cash flows as earnings before interest, depreciation and taxes. If either explanation is correct, we expect cash flow to have a negative relationship with financial leverage.

Table 9.8 indicates that operating cash flow is indeed negatively related to financial leverage. In the model using firm data, inclusion of cash flow does not affect the explanatory power of the moral hazard variables. However, since firms with higher systematic risk should have higher profitability, we consider these results inconclusive. When we examine the effect of cash flow when risk is neutralized, we see that the importance of both advertising and R&D is reduced below statistical significance. This is due to the previously noted high positive correlation among the variables. There are three possible explanations for this phenomenon. First, because our portfolios are ordered by financial leverage, it is

Table 9.8 The Effect of Operating Cash Flow on Financial Leverage

	Firms	Portfolios
Constant	.418	.471
Advertising	−.644	−.297
	(4.52)	(.76)
Capital expenditures	.851	2.608
	(7.72)	(6.49)
R&D	−1.235	−.991
	(5.79)	(1.79)
Operating cash flow	−.629	−1.733
	(8.94)	(6.67)
Unlevered beta	−.069	N.A.
	(5.49)	
Adjusted R^2	.31	.65

Note: Absolute value of t-statistics in parentheses.

possible that low leverage firms have high cash flows and independently have high advertising and R&D expenditures. In this case, because cash flows exert a stronger influence on leverage, the importance of advertising and R&D is reduced, but the variables do not proxy for each other. A second possibility is that advertising and R&D create high cash flows and therefore proxy for the availability of internal funds. Finally, it is possible that cash flows are a proxy for all firm-specific investment opportunities, including advertising and R&D.

While we cannot empirically distinguish among the alternative explanations, it appears likely that the first is correct and the variables are independent determinants of leverage. Because capital expenditures is not strongly correlated with cash flows, it is still statistically significant. Capital expenditures also measures the extent of moral hazard problems and its inclusion in the model (after the influence of cash flows has been considered) increases the explained variation in financial leverage by 25%. Thus, while we cannot explain the relationship between advertising, R&D, and cash flows, we can conclude that the moral hazard problem is important.

Finally, we look at whether or not our basic model can explain a firm's use of short-term sources of funds. If short-term borrowing is used in order to resolve agency problems, advertising and R&D should exert a positive effect. But if firms turn to short-term borrowing solely to finance cyclical, short-term requirements, while choosing to finance longer-term requirements by issuing long-term, funded debt, the effect of our variables on the level of short-term debt should be negligible. Table 9.9 shows the results of our basic model using short-term debt as our dependent variable.

Table 9.9 shows that when we use firm data, advertising and capital expenditures have a positive effect on short-term borrowing while R&D has a negative effect. Our results with portfolio data are similar, except that R&D does not enter the equation. In both cases, our explained variation is extremely small. It appears as if firms make short-term borrowing decisions independent of long-term investment requirements and do not attempt to resolve agency problems by the substitution of short-term for long-term debt.

9.4 Conclusions and Implications

We have shown that moral hazard problem, which affects a firm's investment decisions, is a major determinant of corporate leverage. Specifically, we developed a model in which a firm's financial leverage depends on whether it invests in tangible, capital assets or in intangible, firm-specific assets. We tested our model using both a large sample of

Table 9.9 The Effect of Moral Hazard of Short-Term Borrowing

	Firms	Portfolios
Constant	.118	.040
Advertising	.205 (1.56)	.218 (.80)
Capital expenditures	.163 (1.69)	.457 (1.43)
R&D	−.099 (.51)	Did not enter (.00)
Unlevered beta	−.063 (5.57)	N.A.
Adjusted R^2	.06	.01

Note: Absolute value of *t*-statistics in parentheses.

individual firms and 68 eight-firm portfolios formed to neutralize systematic operating risk. We were able to explain 21% of the variation for individual firms and 41% of the variation when risk was held constant.

We then examined the robustness of our model by including various variables which other researchers have suggested may influence financial leverage. Our intent was not to prove or disprove alternative theories but rather to determine the power of the moral hazard model. We found that including investment-related tax shields or firm-specific risk did not affect our results. When we included a variable measuring before-tax operating cash flow, we found that two of our variables, advertising and R&D, did lose power. While we were unable to determine precisely the relationship among the variables, we did find evidence that they are independent measures. It appears that while the availability of internal funds may be the most important determinant of whether or not a firm seeks external sources of funds, the moral hazard problem can still explain the choice of debt or equity.

We conclude that a major factor which influences corporate leverage decisions is the type of investments a firm undertakes. Given that a firm must seek an outside source of funds, its choice between debt or equity will depend in part on the magnitude of potential agency costs of debt. Because of these costs, corporations which invest heavily in intangibles, such as R&D and advertising, have a tighter capital market imposed debt capacity than those investing in tangible assets. Our findings provide direct empirical evidence that the moral hazard problem is important and that investment and financing decisions are not independent.

Notes

1. The first-order conditions for the two investments are as follows:

$$\text{(i)} \qquad -1 + \int_{S_{d2}}^{\infty} [\partial R(C_1', S_2)/\partial C_1']\, q_1(S_2)\, dS_2 = 0,$$

$$\text{(ii)} \qquad -1 + \int_{S_{d2''}}^{\infty} [\partial R''(C_1', S_2)/\partial C_1']\, q_1(S_2)\, dS_2 = 0.$$

Since the second term in eq. (i) exceeds that of eq. (ii), when the level of investment is constant the less risky investment is optimal for the firm. It can be shown (see Myers 1977) that when the level of investment varies, the less risky investment may lead to greater underinvestment, that is, area $S_{d2}\, AA'\, S_{b2}$ may be greater than $S_{d2}''\, BB'\, S_{b2}''$ on fig. 9.2.

2. For example, if alternative capital equipment with different contributions to operating risk is available, this is likely to be known and the effect of the riskier investment on debt values can be anticipated. Or, if the shift in risk is accomplished by replacing existing equipment, it is likely that the price paid for the equipment will approximate its true value. Then all bondholders need be concerned about is that the expected NPV of the new equipment is nonnegative.

3. When there were missing data, the values were collected from *Moody's Industrial Manual.*

4. Myers (1977) has shown that because short-term debt is retired prior to investment choice it does not affect owner's investment decisions. We examine this proposition later in this paper.

5. We investigate the possibility that since agency problems can be circumvented either by issuing convertible debt (Jensen and Meckling 1976) or by leasing the inclusion of these items in our measure of debt may bias our results. However, when we remove convertible debt and leases from our measure of financial leverage, we achieve identical results for both the portfolios and individual firms.

6. The use of investment stocks would seriously bias our results. The stock of debt reflects the current level of debt. The stock of investments reflects all previous investment decisions, many of which were made prior to issuing any of the long-term debt which is currently outstanding. The flow of funds into alternative investments adequately reflects the use to which the funds raised from the sale of debt were put.

7. Betas are determined using 60 "months" of data where possible. Where 60 months are not available less are used except that at least 36 "months" are required.

8. If debt is not riskless, our estimate underestimates the asset beta by a factor equal to the firm's leverage ratio times its true debt beta. If we assume that debt of higher-leverage firms has greater systematic risk, this underestimation is magnified.

9. This relationship is due in part to the negative bias in our computation of unlevered beta for high-leverage firms.

10. It is suggested that our results might be due to a few firms which have extremely high advertising or R&D expenditures. To test this, we eliminated firms in the pharmaceutical industry, which have high R&D expenses, and those in the cosmetics industry, which have above-average advertising outlays. Our results did not significantly change.

11. We also examined the possibility, suggested by Dasgupta and Stiglitz (1980), that a firm's competitive environment determines both whether or not intangible investments are undertaken, and its financial leverage. According to their model, one would expect that firms in medium concentration industries would have greater expenditures in R&D and advertising. Since these firms also face greater demand uncertainty, they can support less debt. We tested the proposition that financial leverage is determined by a firm's competitive environment by considering a model which incorporates industry concentration. We define industry concentration in two ways. First, we compute the percentage of industry output

produced by the four largest firms in each four-digit SIC. We also compute a second measure, designed to reach a maximum at 50% concentration (100% concentration − concentration^2). We found that neither measure is correlated with either the type of investment or with financial leverage and thus had no effect on the power of our model.

12. There are two methods used in accounting for investment tax credits. The flow-through method reports the entire tax benefit in the year of purchase, so that our measure is taken directly from each firm's income statement. The deferral method capitalizes the benefit and amortizes it over five years. For these firms we use the income statement value plus balance sheet changes in investment tax credit accounts.

13. We recognize the potential agency costs involved in the substitution of the same quantity of risky projects for those with less risk and greater value. However, if more positive valued projects are undertaken, then firm value will show a net increase. In most cases, the underinvestment problem dominates the asset substitution problem.

14. Studies of actual bankruptcy costs find that they are quite small and increase less than proportionally with the size of the firm. For example, see Warner (1977) and Ang, Chua, and McConnell (1982).

15. There is a slight negative bias in our measure. We compute unsystematic risk as the total variance of stock returns, standardized by the market variance less the square of the stock beta. It can be shown that, all other things equal, the change in unsystematic risk with respect to the debt-to-equity ratio is slightly negative.

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Comment Stewart C. Myers

A firm's optimal debt ratio is usually viewed as determined by a trade off of the costs and benefits of borrowing, holding the firm's assets and investment plans constant. The firm is portrayed as balancing the value of interest tax shields against various costs of financial embarrassment. Of course, there is controversy about how valuable the tax shields are and whether the costs of financial embarrassment are material, but these give only variations on a theme. The firm is supposed to substitute debt for equity, or equity for debt, until the value of the firm is maximized.

Contrast this *static trade-off* theory with a competing popular theory, which dates back at least to Gordon Donaldson's 1961 book, *Corporate Debt Capacity*. This *pecking order* theory goes as follows: (1) Firms prefer internal finance. (2) They adapt their target dividend payout ratios to their investment requirements, although dividends are sticky and target payout ratios are only gradually adjusted to shifts in investment

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opportunities. (3) If external finance is required, firms issue the safest security first. That is, they start with debt, then possibly hybrid securities such as convertible bonds, then equity. (However, firms are reluctant to issue stock if they fall into financial distress.)

I used to ignore the pecking order theory because I could think of no theoretical foundation for it. However, recent work based on asymmetrical information, problems of adverse selection, moral hazard, and signaling gives predictions roughly in line with the pecking order theory (see, e.g., Myers and Majluf 1983).

I mention these two theories only to make my own a priori view explicit. I believe both are operating at once. Firms are adjusting toward a target debt ratio, reflecting the benefits and costs that the static trade-off theory emphasizes. However, the sequence of security issues firms make cannot be described as a smooth, gradual adjustment toward a target ratio.

If I am right, it will be extremely difficult to take a cross-section of firms in a particular year and obtain an accurate test of the impact of variables which come from the static trade-off theory. Even if the tested variables truly determine the target ratio, they may not explain the actual ratio, because firms may take extended and erratic excursions away from the target.

Let me now turn to the Long-Malitz paper. They started with the hypothesis that firms borrow more against assets in place than intangibles and growth opportunities. This hypothesis has a good theoretical foundation within the static trade-off framework. They had the excellent idea of using advertising and research and development (R&D) expenditures as a proxy for the value of intangibles and growth opportunities.

These are likely to be robust proxies. There are relatively few problems in measuring R&D and advertising. Moreover, tests of their effects should be relatively insensitive to problems in measuring other things. For example, the authors would have liked to use the replacement instead of the book value of assets as a scaling variable for their regressions. I agree, but I do not think that use of book assets undermined their tests of the impact of advertising and R&D.

Long and Malitz conclude that asset *type* matters for debt policy, holding asset risk constant. The more intangibles and growth opportunities the firm has, the lower its target debt ratio. This is an important positive result.[1]

Long and Malitz's other results are harder to interpret. Consider, for example, the relationship between operating cash flow and capital structure. The problem is to choose a hypothesis. Long and Malitz view high cash flow as a proxy for high profitability and the existence of valuable growth opportunities. However, if the pecking order theory is correct, cash flow also indicates ample internal sources of funds. Either argument implies a negative relationship between cash flow and debt ratios. It is therefore not clear which theory is being tested.

Long and Malitz's tax variables do not perform well, which is disturbing: we would expect to find a strong tax effect in any cross-sectional capital structure test, regardless of whose theory of "debt and taxes" you believe in.

Figure 9.C.1 plots the net tax gain from corporate borrowing against the firm's effective marginal tax rate. In the original Modigliani-Miller theory, which ignores personal taxes, any tax-paying corporation gains by borrowing; the greater the marginal tax rate, the greater the gain. This gives the top line in the figure. In Miller's (1977) paper, the personal income taxes on interest receipts would exactly offset the corporate interest tax shield, providing the firm paid the full 46% statutory tax rate. However, any firm paying less than 46% would see a net tax loss to corporate borrowing. This gives the bottom line.

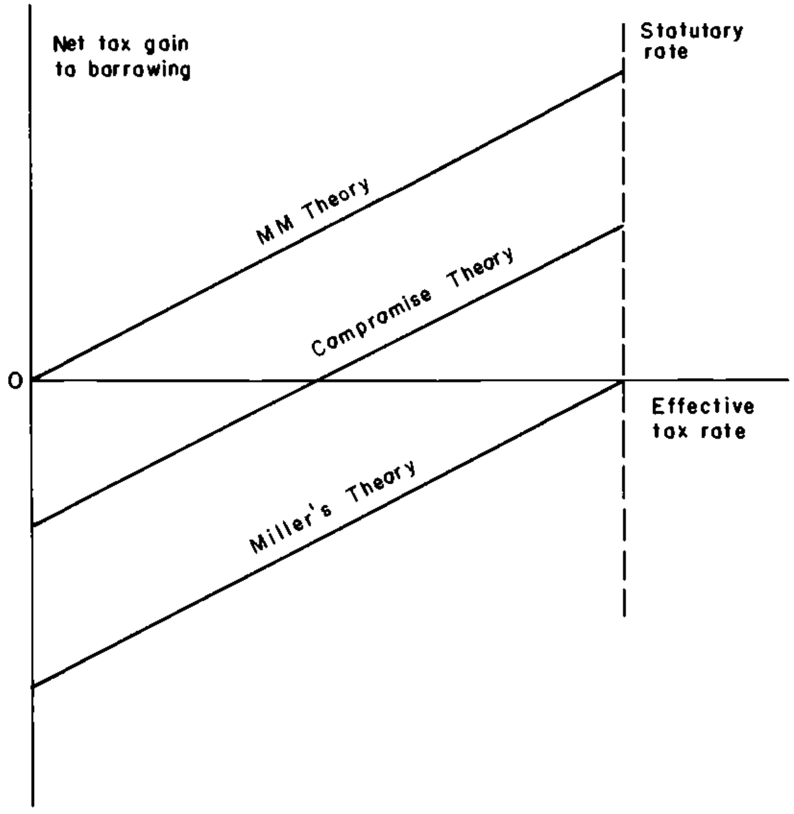

Fig. 9.C.1

Of course, we now have compromise theories, indicated by the dashed line in the figure (DeAngelo and Masulis 1980). But regardless of which theory holds, the slope of the line is always positive. Therefore it is puzzling that Long and Malitz find no cross-sectional relationship between the firm's tax status and financial leverage.

Perhaps the difficulty is finding a good proxy for "tax status." I disagree with Long and Malitz's use of depreciation tax shields and investment tax credits, for two reasons. First, there are many other noninterest tax shields, for example, R&D expenditures, which can be written off immediately. One could argue that investments in intangible assets are given better treatment under our tax law than investment in tangible assets. Second, noninterest tax shields are at best indirect measures of unshielded income, that is, income after all deductions except interest. This, however, can be measured directly.

However, looking at unshielded income takes us right back to looking at operating cash flow, which consequently must play three parts: high cash flow may indicate (1) valuable intangible assets and growth opportunities, (2) ample internal sources of funds, or (3) a high demand for interest tax shields. You cannot test three hypotheses with one variable.

Note

1. Scott H. Williamson (1981) reached the same conclusion after extensive empirical tests. Williamson's proxy for a firm's intangibles and growth opportunities was the difference between the market value of its debt and equity securities and the replacement cost of its tangible assets.

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