JOURNAL OF FINANCIAL INTERMEDIATION **4**, 272–301 (1995)

Bank Loan Commitments and Corporate Leverage*

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Received December 28, 1992

This paper investigates the relationship between a firm's loan commitment demand and its overall capital structure. I develop a model which demonstrates that a loan commitment leads a firm to a higher privately optimal debt level and a lower cost of debt funds; these results are driven by the loan commitment's ability to attenuate the potential moral hazard problems attendant upon debt financing. I confront the predictions with cross-sectional data, and find that the availability of unused loan commitment financing is positively related to firm leverage and negatively related to cost of debt funds. *Journal of Economic Literature* Classification Numbers: D82, G21, G32.

1. INTRODUCTION AND MOTIVATION

As of June 1990, the volume of unused loan commitments and lines of credit held by U.S. corporations stood at over $740 *billion*, an amount which exceeded the total volume of commercial and industrial loans extended by banks in the United States ($645 billion). The purpose of this paper is to provide a rationale for holding unused loan commitments (in spite of their fees[1]) by investigating, both theoretically and empirically, the link between a firm's loan commitment demand and its capital structure.

The economic underpinnings of loan commitment demand have received much attention. Berkovitch and Greenbaum (1991), Boot *et al.* (1987,

* Special thanks go to Anjan Thakor for his helpful insight and advice. I am also grateful for the comments of the *Journal of Financial Intermediation* editors and referees, Craig Holden, Sreenivas Kamma, Bob Klemkosky, Jay Wilson, Michael Ferguson, Dennis Logue, and Fwu-Ranq Chang.

[1] Shockley (1992) documents that the mean up-front fee on corporate loan commitments in 1989 and 1990 was 27.4 basis points while the mean annual fee on unused balances was 25.2 basis points.

1042-9573/95 $12.00

1991a), Houston and Venkataraman (forthcoming), and Thakor (1989) are examples of papers which demonstrate the value of loan commitments under universal risk neutrality. The basic point of this literature is that even if bank loans are *not* inherently special, loan commitments can improve borrower welfare by providing more efficient resolutions of pre- and post-contract private information problems. Despite the growing theoretical literature on loan commitments, the implications of loan commitments for the firm's overall capital structure decision have not been exposed. It is, however, natural to expect that the availability of a bank loan commitment will influence the terms of other (possibly nonbank) credit sought by the firm. The reason is that a loan commitment can help attenuate the distortions engendered by the standard debt contract, so the tradeoff in the firm's capital structure can be expected to be tilted in favor of more debt when an unused loan commitment is present. Not only does this provide a rationale for loan commitment demand, but it also facilitates an improved understanding of corporate capital structure decisions and further illuminates a potentially significant interaction between commitment-based bank financing and nonbank financing. It is this link between loan commitments and overall corporate leverage that I formalize and test in this paper.

I show that loan commitments mitigate the Myers (1977) underinvestment problem, thereby making debt a more attractive source of finance and increasing the value of levered projects.[2] The model's primary prediction is that, *ceteris paribus*, borrowers with unused loan commitments will have higher debt ratios. A secondary prediction is that borrowers with unused loan commitments will have access to less costly debt. I confront these predictions with cross-sectional data from 300 randomly selected firms. The predictions are supported by the empirical results and are robust to the inclusion of standard capital structure control variables.

The rest of the paper is organized as follows: Section 2 presents the theoretical model, Section 3 provides the cross-sectional analyses, and Section 4 concludes. All proofs are in the Appendix.

2. THE MODEL

This section presents a two-period model in which a manager with a positive net present value (NPV) project makes an initial decision regarding capital structure and a subsequent decision to either continue or liquidate.

[2] This result is general to the other moral hazard problems faced by levered firms; underinvestment is employed here simply as an example. The loan commitment increases the value of the levered project directly by attenuating the moral hazard problem and indirectly by allowing the firm to take greater advantage of the debt tax shield.

The decision to continue may be distorted by moral hazard which, along with the debt tax shield, drives the initial leverage decision. This structure permits an analysis of the impact of loan commitments on capital structure.

The intuition behind the model is as follows. A firm with a valuable investment opportunity must choose the financing mix for the project. Tax deductibility of interest makes debt financing attractive. The firm subsequently receives private information about the project's ultimate prospects (similar to Berkovitch and Greenbaum, 1992) and must then decide whether to reinvest in the project or to abandon it. If the original debt level is sufficiently high, financing the reinvestment with short-term debt (that is, borrowing in the spot market when the funds are needed) can lead to underinvestment problems (too-frequent liquidation). On the other hand, financing the reinvestment with financial slack created by long-term debt (taken in anticipation of reinvestment) can lead to overinvestment problems (too-infrequent liquidation). Utilizing short-term debt via a *loan commitment* that includes a *material adverse change* clause mitigates the investment distortions; the commitment interest rate can be set sufficiently low to prevent a "debt overhang," while the material adverse change clause allows the bank to prohibit excessive reinvestment. The existence of the revokable loan commitment thus affects the endogenously determined level and pricing of the firm's original debt.

Consider a three-date (two-period) setting with universal risk neutrality. At time 0, a manager is endowed with a project which does not pay off until time 2. In order to undertake the project, the manager must invest \$1 through any combination of equity (E) and debt (D_0) such that $D_0 + E = 1$. Income from the project is taxed at the rate τ, and interest payments on debt may be deducted from income for tax purposes.

The (real) random payoff of the project at time 2 is given by $\tilde{X}$ which is drawn from a two-point distribution with universally known prior probabilities

$$\tilde{X} = \begin{cases} \textit{Success } (S) \textit{ with prob. } p(S) \\ \textit{Failure } (F) \textit{ with prob. } 1 - p(S). \end{cases}$$

The F outcome is assumed to be 0.

At time 1, two signals about the project's time-2 prospects will be revealed. A "public" signal $\phi \in$ {**Good**, **Uncertain**, **Bad**} will be observed by both the outside lender (the bank) and the manager, while a "private" signal $\rho \in$ {**High**, **Medium**, **Low**} will be observed only by the manager. Upon observing the signal(s), both the bank and the manager update their priors on the probability of S via Bayes' rule; the corresponding posteriors will be $p(\mathrm{S}|\phi)$ for the bank and $p(\mathrm{S}|\phi, \rho)$ for the manager. For simplicity,

TABLE I
SUMMARY OF TIME-1 SIGNALS AND POSTERIOR PROBABILITIES

Public signal	Private signal	Bank's posterior	Firm's posterior
$\phi = \mathrm{G}$	$\rho \in \{\mathrm{H, M, L}\}$	$p(\mathrm{S} \mid \mathrm{G})$	$p(\mathrm{S} \mid \mathrm{G})$
$\phi = \mathrm{U}$	$\rho = \mathrm{H}$	$p(\mathrm{S} \mid \mathrm{U})$	$p(\mathrm{S} \mid \mathrm{U, H})$
$\phi = \mathrm{U}$	$\rho = \mathrm{M}$	$p(\mathrm{S} \mid \mathrm{U})$	$p(\mathrm{S} \mid \mathrm{U, M})$
$\phi = \mathrm{U}$	$\rho = \mathrm{L}$	$p(\mathrm{S} \mid \mathrm{U})$	$p(\mathrm{S} \mid \mathrm{U, L})$
$\phi = \mathrm{B}$	$\rho \in \{\mathrm{H, M, L}\}$	$p(\mathrm{S} \mid \mathrm{B})$	$p(\mathrm{S} \mid \mathrm{B})$

the information asymmetry is confined to the Uncertain state. To do this, make the simplifying assumption that the public signal is perfectly revealing in both the (G) and (B) states:

$$p(\mathrm{S}|\mathrm{G}) = p(\mathrm{S}|\mathrm{G}, \rho) \quad \rho \in \{\mathrm{H, M, L}\}$$
$$p(\mathrm{S}|\mathrm{B}) = p(\mathrm{S}|\mathrm{B}, \rho) \quad \rho \in \{\mathrm{H, M, L}\}.$$

To give the manager better information in the (U) state, make the following assumption about the posterior probabilities:

$$p(\mathrm{S}|\mathrm{U, H}) > p(\mathrm{S}|\mathrm{U}) > p(\mathrm{S} \mid \mathrm{U, L}).$$

A summary of the signals and posteriors is given in Table I.

Upon observing the public and private signals at time 1, the manager must decide whether to continue or abandon the project. The project has no liquidation value if terminated. If the project is to be continued, the manager must invest an additional \$1 (denominated in time-0 real terms), which must be borrowed, and must expend a nonpecuniary investment (e.g., effort) costing the manager C.[3]

There will be no interest rate uncertainty. The single period (real) risk-free rate will be denoted r_f, so the single-period risk-free present value factor will be $(1 + r_f)$ and the two-period risk-free present value factor will

[3] The nonpecuniary cost C can be interpreted as the manager's private cost of effort, as in Rajan (1992); alternatively, one can consider C as the manager's expected loss of reputation, given a continuation that ultimately fails. Without the nonpecuniary cost, the manager would always continue the project at time 1 as there would be no downside risk to reinvesting with borrowed funds. The assumption of full leverage at time 1 will be innocuous, since no subsequent moral hazard will be introduced. The ultimate goal of this analysis is to study the time-0 debt choice.

be $(1 + r_f)^2$. Denote the borrower's time-0 two-period interest rate as r_0 and the time-1 one-period interest rate as r_1.

The analysis begins with an examination of the manager's time-1 decision (to continue or abandon). When restricted to spot borrowing at time 1, the manager continues the project if and only if the expected NPV of the terminal cash flows exceeds the nonpecuniary cost of investing. The NPV of the expected terminal cash flows for the project, evaluated at time 1, is given by

$$\frac{1}{1 + r_f} p(S\,|\,\phi, \rho)\{(1 - \tau)[S - r_0 D_0 - r_1 D_1] - D_0 - D_1\},$$

where r_0 is the interest rate on the original debt, r_1 is the interest rate on the time-1 debt, and D_1 is the amount of the time-1 debt. The first term inside the braces is after-tax income (noting that interest costs are tax deductible) and the last two terms inside the braces represent repayment of principal. The time-1 loan interest rate r_1 is set so that the bank earns the risk-free rate of return in expectation (conditioned upon the bank's information set):

$$p(S\,|\,\phi)D_1(1 + r_1) = D_1(1 + r_f)$$

or

$$r_1 = \frac{1 + r_f}{p(S\,|\,\phi)} - 1. \tag{1}$$

The quantity $(r_1 - r_f)$ can be interpreted as the risk premium on the firm's debt in the time-1 spot borrowing market.

The manager's continue/liquidate decision is predicated upon the realizations of the public and private signals *and* the initial debt level. For example, the manager will continue the project in the (U, M) state if and only if

$$\frac{1}{1 + r_f} p(S\,|\,U, M)\{(1 - \tau)[S - r_0 D_0 - 1] - D_0 - 1\} \geq C$$

(maintaining the earlier assumption that $D_1 = 1$).

To set up the potential underinvestment problem, assume that an unlevered project ($D_0 = 0$) is always valuable at time 1 in the (U, M) state,

$$\frac{1}{1 + r_f} p(S\,|\,U, M)\{(1 - \tau)[S - r_1] - 1\} > C;$$

that the unlevered project is not valuable in the (U, L) and (B) states,

$$\frac{1}{1+r_f} p(S|U, L)\{(1-\tau)[S-r_1]-1\} < C,$$

$$\frac{1}{1+r_f} p(S|B)\{(1-\tau)[S-r_1]-1\} < C;$$

and that the project is valuable in the (G) state for any level of debt,

$$\frac{1}{1+r_f} p(S|G)\{(1-\tau)[S-r_0D_0-r_1]-D_0-1\} > C \quad \forall D_0 \in [0, 1].$$

The assumptions together imply that an unlevered firm ($D_0 = 0$) optimally continues in the (G), (U, H), and (U, M) states and optimally discontinues in the (U, L) and (B) states. A Myers (1977) underinvestment problem will occur if the initial debt level D_0 is so large that a "debt overhang" develops at time 1. Specifically, the manager deviates from the social optimum investment strategy in the (U, M) state if

$$D_0 > D_0'' = \frac{(1-\tau)[S-r_1]-1-C(1+r_f)/p(S|U, M)}{1+(1-\tau)r_0} \tag{2}$$

and in the (U, H) state if

$$D_0 > D_0' = \frac{(1-\tau)[S-r_1]-1-C(1+r_f)/p(S|U, H)}{1+(1-\tau)r_0} \tag{3}$$

This takes us to the first stage of the model, the initial capital structure decision. At time 0, the manager trades off the expected benefit of the tax shield against the expected loss due to underinvestment when determining D_0. The manager will choose a debt level D_0 that satisfies inequality (2) and/or (3) if the debt tax shield is sufficiently attractive (i.e., if the tax rate is sufficiently high). Since $p(S|U, H) > p(S|U, M)$, the underinvestment problem is exacerbated as the initial debt level rises: if (3) is satisfied, suboptimal liquidation takes place in both the (U, M) and the (U, H) states.

To mitigate the potential underinvestment problem *ex ante*, the bank can offer a contract at time 0 which promises the availability of a \$1 loan at time 1 at a prespecified interest rate (i.e., a loan commitment).[4] For a given level of debt D_0, a loan commitment can be designed to attenuate the underinvestment problem if the time-1 "takedown" rate (r_{1LC}) is set

[4] A fixed *formula* (variable rate) loan commitment works identically in the more general case of market interest rate uncertainty.

sufficiently low. Lowering the time-1 borrowing rate increases the expected value of the terminal cash flows evaluated at time 1. Simply set r_{1LC} so that

$$\frac{1}{1+r_f} p(S|\phi, \rho)\{(1-\tau)[S - r_0 D_0 - r_{1LC}] - D_0 - 1\} \geq C.$$

For example, consider a firm that chooses an initial debt level D_0^* that satisfies the inequality in (3). Without a loan commitment, this firm will abandon the project in the (U, M) and (U, H) states. However, a loan commitment that offers a time-1 borrowing rate r_{1LC} that is set sufficiently low will induce the firm to continue in the (U, H) state. The takedown rate r_{1LC} satisfies

$$\frac{p(S|U, H)}{(1+r_f)}\{(1-\tau)[S - r_0 D_0^* - r_{1LC}] - D_0^* - 1\} - C = 0.$$

Given such a loan commitment, the manager never underinvests in the (U, H) state and underinvests in the (U, M) state only if

$$D_0 > D_0^{LC} = \frac{(1-\tau)[S - r_{1LC}] - 1 - C(1+r_f)/p(S|U, M)}{1 + (1-\tau)r_0} > D_0''. \quad (4)$$

The borrower pays for the expected present value of the subsidy ($r_1 - r_{1LC}$) in the time-0 loan commitment fee (which is simply the time-0 present value of the expected subsidy). The benefit of the loan commitment arises because the fee is considered a sunk cost when the time-1 decision is made. I can now establish the main result.

PROPOSITION. *For any tax rate $\tau \in (0, 1]$, the manager's optimum D_0 with a loan commitment is greater than or equal to the optimum D_0 without a loan commitment; furthermore, there exists a range of tax rates where the inequality is strict.*

A problem with an irrevocable loan commitment is that the low takedown rate necessary to overcome the underinvestment problem can actually engender an overinvestment problem at time 1; if r_{1LC} is set sufficiently low, the manager of the firm may find it optimal to continue in the (U, L) or (B) states (when the socially optimal choice is to liquidate). In other words, financing the time-1 investment with short-term debt plus an irrevocable loan commitment is equivalent to financing it with long-term debt (and carrying financial slack in the first period). To overcome this problem, the commitment seller can attach an escape clause (typically termed a "material adverse change" or "MAC" clause), which gives the bank the option to deny credit. In the model at hand, the bank would deny credit in the (B) state; this reduces the possibility of overinvestment *ex ante*. Since the initial price of the loan commitment increases as the probability of time-1 exercise increases, inclusion of the MAC clause lowers the time-0 price of the commitment.[5]

The MAC clause also benefits the borrower because it enables the bank to cope with potential asset substitution moral hazard. The loan commitment is a put option written on the borrower's debt. The manager can increase the value of the option by increasing the risk of the underlying debt. An *ambiguously* defined escape clause permits the bank to mitigate this moral hazard problem because the bank can decline to lend at its own discretion. This in turn increases the ability of the commitment to more closely align the investment incentives of the borrower and the lender, which increases the value of the borrower's project.

In addition to the leverage effect, the loan commitment affects the firm's initial borrowing rate (as I establish in the secondary result).

COROLLARY. *For any tax rate τ, the firm's time-0 loan interest rate r_0 with a loan commitment is less than or equal to the r_0 charged without a loan commitment; furthermore, there exists a range of tax rates where the inequality is strict.*

The intuition is that the capital market, given rational expectations, will demand a premium for the possibility of suboptimal liquidation—which hurts bondholders *ex post*—when pricing a firm's debt securities. By reducing the number of states in which the underinvestment problem occurs, the loan commitment decreases this premium. Since the shareholders of a levered firm bear the cost of moral hazard *ex ante*, they have an incentive to purchase a loan commitment which then increases the firm's total value.

A final point must be made regarding the relative value of loan commitments versus other risk management tools (such as forward contracts, swaps, or exchange-traded futures and options). The model highlights the fact that a firm's own spot borrowing rate is typically imperfectly correlated with the market-wide spot risk-free rate. In this setting, any risk management tool with a payoff contingent on the market-wide risk-free rate will be strictly less efficient than one with a payoff contingent on the firm's own spot borrowing rate. This is one advantage of loan commitments over alternative risk management tools: the distortions associated with the debt contract can be more efficiently resolved through the use of a contingent claim contract that is tailored to suit the idiosyncracies of the borrower.

[5] This would prove especially valuable for a liquidity-constrained firm, as the MAC clause would allow the firm to "purchase" a greater time-1 subsidy (and therefore further reduce the likelihood of underinvestment).

Another reason that bank loan commitments may be preferred to exchange-traded contingent claims is moral hazard. An exchange-traded contingent claim written to protect the firm against high realizations of its own borrowing rate would entail that the firm buy put options on the value of its own indebtedness. Although such puts can perfectly resolve the underinvestment problem addressed in this paper, they would fail to address the moral hazard related to the firm's propensity to reduce the value of its indebtedness (and thereby increase the value of the puts it owns) between the time it purchases the options and the exercise date. The bank faces this moral hazard too but copes with it through the MAC clause. Exchange-traded contingent claims have neither an analogous escape clause nor the protection of bank monitoring.[6]

3. EMPIRICAL ANALYSIS

The primary prediction of the theoretical model of Section 2 is that a firm's demand for loan commitments should be positively related to its use of debt financing; the model also makes the ancillary prediction that loan commitment volume should be negatively related to cost of debt funds. This section provides cross-sectional tests of the two hypotheses.

3.1. *Leverage Hypothesis*

The leverage prediction is limited in that the model only compares the debt level of a firm *with* a loan commitment to the debt level of the *same* firm *without* a loan commitment (i.e., the model addresses absolute levels as opposed to ratios). In order to test the model in a cross section of firms, it is necessary to transform the hypothesis into one concerning relative leverage by scaling both debt levels and unused loan commitments by firm value (measured as book value of debt plus market value of equity). To assess the *marginal* impact of unused loan commitments on leverage, it is necessary to introduce a set of variables which, according to existing evidence, help to explain cross-sectional differences in capital structure and to control for cross-sectional differences in moral hazard problems. In the following, I discuss the characteristics which need to be controlled and the variables that serve as proxies for these characteristics. The control characteristics are as follows: collateral value of assets, nondebt tax shields,

[6] See Bhattacharya and Thakor (1993) for a discussion of the differences between bank loan commitments and exchange-traded hedging devices. Boot *et al.* (1993) model the reputational aspects of the MAC clause.

Tobin's q, asset uniqueness, availability of growth opportunities, profitability, size, volatility of earnings, and asset beta.[7]

Collateral value of assets. Myers and Majluf (1984) show that, in cases where outside investors are less informed about the value of a firm's assets than the firm's managers, investors may underprice new securities, prompting the firm to forego certain positive NPV projects. In cases of extreme underpricing, the new securityholders would absorb more than the NPV of the project financed (at the expense of the existing equityholders). However, managers can mitigate the underpricing by issuing debt collateralized by assets with more recognizable values (see Stulz and Johnson, 1985). Moreover, collateral can also help resolve adverse selection and effort aversion/asset substitution moral hazard (see Boot *et al.*, 1991b). Hence, firms with more readily collateralizable assets are expected to use more debt.

Green (1984), Jensen and Meckling (1976), and Myers (1977) demonstrate that debt gives shareholders of a levered firm an incentive to pursue suboptimal investment strategies. In the first two papers, the limited liability of debt gives shareholders the incentive to adopt excessively risky projects (asset substitution); in the third paper, large debt overhangs may undermine the incentive for shareholders to contribute new financing for value-increasing projects (underinvestment). Financing a new asset with debt collateralized by that asset restricts the investment strategies of management, which again suggests a positive relationship between debt ratios and the ability of firms to secure their debt. Moreover, Harris and Raviv (1990) postulate that the debt level of a firm increases with the liquidation value of the firm. Therefore, firms with more tangible assets are likely to have more debt.

I use the fixed assets/firm value ratio (FA/VAL) as a proxy for the collateral value of a firm's assets. A firm's "brick and mortar" assets (net of accumulated depreciation), property, plant, and equipment, are expected to be more readily secured and to have a greater liquidation value.[8]

Non-debt tax shields. DeAngelo and Masulis (1980) predict a negative relationship between nondebt tax shields and debt ratios. The authors show that the beneficial tax effects of depreciation and investment tax credits are substitutes for the tax-shelter benefits of debt. However, MacKie-Mason (1990) demonstrates that the substitution effect between nondebt tax shields and interest deductions is only important for firms with a significant probability of exhausting their tax liabilities.

The control variable for nondebt tax shields, NDTS, is constructed to

[7] See Harris and Raviv (1991) for a review of theoretical and empirical studies of capital structure.

[8] Friend and Lang (1988), Marsh (1982), and Titman and Wessels (1988) find the hypothesized positive relationship between collateral value of assets and debt (the result of Titman and Wessels is positive but statistically weak).

reflect situations where nondebt tax shields are sufficient to exhaust the tax liability. NDTS is defined as the ratio of nondebt tax shields (depreciation and amortization expense, depletion allowance, R&D expense, tax-loss carryforwards, and investment tax credits) to earnings before interest, depreciation, and taxes (EBIDT); the ratio is given a maximum value of 1.0 (where the nondebt tax shields exhaust the tax liability) and a value of 1.0 when EBIDT is negative.[9]

Tobin's q. Tobin's q (the ratio of a firm's market value of assets to replacement cost of assets) is often used as a measure of firm-specific human capital, growth opportunities, and synergies that would be lost upon liquidation (see Gilson *et al.*, 1990). Further, Lindenberg and Ross (1981) show that Tobin's q is a measure of monopoly power. Specifically, a firm's market value of assets will exceed its replacement cost of assets by the capitalized value of the firm's Ricardian and monopoly rents. Firms with q greater than 1 stand to lose the discounted value of the rent stream upon bankruptcy. A negative relationship between q and leverage is predicted. To approximate Tobin's q, I employ the method of Smith and Watts (1992), where q is measured as the sum of market value of equity plus book value of total liabilities over book value of total assets.

Uniqueness. Titman (1984) argues that a firm's decision to liquidate inflicts costs on the agents in its input and output markets. More specifically, a firm that requires specialized labor/atypical product inputs and whose output is more unique will impose greater costs on its workers, suppliers, and customers upon discontinuation. Workers and suppliers will therefore charge a premium for their inputs based on the expectation of these costs; similarly, the customers will demand a premium (i.e. a lower price) upon purchase of the firm's output. As a result, uniqueness of inputs and outputs should be negatively related to debt levels.

To proxy for uniqueness, I use the ratio of research and development expense to firm value (R&D/VAL). The intuition is that firms with products that are more substitutable will expend less on R&D since their advancements may be more easily imitated by competing firms.[10]

Growth opportunities. Jensen and Meckling (1976) also suggest that firms with fewer growth opportunities will have relatively higher debt ratios since investments in growth opportunities represent opportunities for asset-

[9] Bradley *et al.* (1984) document a positive relationship between nondebt tax shields and debt ratios, while Titman and Wessels (1988) find a weak negative relationship. MacKie-Mason (1990) presents evidence of a negative relationship between nondebt tax shields and leverage for firms that are close to tax liability exhaustion.

[10] Titman and Wessels (1988) find evidence to support the hypothesized negative relationship between uniqueness and leverage.

substitution moral hazard. Stulz (1990) posits that debt payments reduce "free" cash and thus reduce the ability of firms to make profitable investments. For these reasons, the availability of growth opportunities should be negatively related to debt ratios.

I use the ratio of capital expenditures to firm value (CAP/VAL) to measure growth opportunities. Capital expenditures represent the exercise of growth options; using CAP/VAL therefore assumes that firms that exercise these options (relative to their size) have the most options available to exercise.[11]

Profitability. The "pecking order" theory of financing (Myers, 1984) argues that firms prefer retained earnings to debt and in turn prefer debt to equity when funding new investments. This may be due to transactions costs or to the costs associated with asymmetric information (Myers and Majluf, 1984). A firm's ability to generate retained earnings (i.e., profits) should therefore be negatively related to leverage.

I utilize the ratio of operating income to firm value (OI/VAL) to proxy for profitability. Operating income is a firm's income before interest, depreciation, taxes, and extraordinary items and thus reflects the cash flow from operations before adjusting for debt cost and nondebt tax shields.[12]

Size. Warner (1977) shows that the direct costs of bankruptcy may be greater for smaller firms. Harris and Raviv (1990) suggest that debt levels increase as default costs decrease. Larger firms are therefore expected to have more debt than smaller firms. Additionally, the transactions costs of issuing equity may be higher for smaller firms (again suggesting a positive relationship).

Previous capital structure analyses have generally found no significant relationship between size and leverage; however, Marsh (1982) documents a positive relationship. I employ the natural logarithm of total assets (ln A) to measure size, as in Marsh (1982). Taking the logarithm of total assets reduces the skewness of this variable.

Volatility. Kale *et al.* (1991) demonstrate that the relationship between firm leverage and firm volatility should be roughly U-shaped. In DeAngelo and Masulis (1980), the corporate tax liability represents a portfolio of options, held by the taxing body, that is long in the corporate tax option and short in the personal tax option. The optimal debt level seeks to

[11] Kim and Sorensen (1986) document a negative relationship between debt ratios and growth opportunities (measured by percentage change in EBIT). Titman and Wessels (1988), who scale capital expenditures by total assets, find a negative but insignificant relationship.

[12] Friend and Lang (1988) and Titman and Wessels (1988) provide support for this hypothesis.

minimize the value of this option portfolio and thus *decreases* with volatility at low levels of volatility but *increases* at high levels of volatility.

I measure volatility by the standard deviation of the first difference in quarterly earnings before interest, depreciation, and taxes (EBIDT) over the sample period, scaled by average assets over the sample period ($\sigma\{\Delta \text{EBIDT}\}/\bar{A}$).[13] To test for the hypothesized nonmonotonicity, I include both $\sigma\{\Delta \text{EBIDT}\}/\bar{A}$ and $[\sigma\{\Delta \text{EBIDT}\}/\bar{A}]^2$ in the analysis.

Asset beta. Ross (1985) derives a negative theoretical relationship between a firm's cash flow beta and its leverage. When the tax schedule is convex, and when capital gains are taxed preferentially, the debt tax shield will be more valuable in low consumption states while the capital gains offset will be more valuable in high consumption states. Thus, firms with cash flows that are highly correlated with aggregate consumption will tend to use less debt. I use a firm's asset beta to control for this effect. I obtain the asset beta by calculating the firm's equity beta over the 24 months preceding the beginning of each year using the CRSP monthly return tapes and unlevering this value using the firm's total liabilities to market value of equity ratio.

Leverage. I measure a firm's leverage by the ratio of total book liabilities to the sum of book liabilities and market value of equity (D/VAL). Previous analyses of capital structure have omitted short-term liabilities for the purpose of focusing on permanent levels of debt. Houston and Venkataraman (forthcoming) show that the maturity structure of debt is a strategic decision faced by firms; a combination of short- and long-term debt may allow the firm to achieve a first-best liquidation policy in situations where long-term debt alone leads to suboptimal liquidation strategies. Barnea *et al.* (1980) demonstrate that short-term debt can be used to mitigate certain agency problems associated with debt. We thus should expect that certain firms optimally use short-term debt as permanent financing. For these reasons, I include a measure of leverage which includes short-term debt. Although the market value of debt might be preferable to book liabilities, Kim and Sorensen (1986) and Bowman (1980) show that the cost of misspecification from using a book measure of debt is likely to be small.

Unused loan commitments. Unused loan commitments are measured

[13] This proxy was used by Bradley *et al.* (1984), who document a negative relationship between volatility and leverage. Friend and Lang (1988) also report a negative relationship, while Kim and Sorensen (1986) discover a positive relationship. Friend and Lang (1988) measure volatility as the standard deviation of the ratio of EBIDT to book value of assets. I repeated the analysis using the Friend and Lang (1988) measure of volatility; the results did not change. I also repeated the analysis by deflating each year's EBIDT by the firm's average assets for that year and then taking the standard deviation of this series. Again, the results did not change.

by the ratio of the total value of a firm's unused loan commitments to total book liabilities plus market value of equity (LC/VAL). The unused loan commitments data are taken from Moody's Industrial Guides.

Commercial paper. Firms with ongoing commercial paper programs often use lines of credit or loan commitments to support their paper (Kanatas, 1987). If commercial paper financing is positively related to debt levels, a spurious correlation between loan commitments and leverage may exist. To disentangle this effect, I include a dummy variable that takes a value of 1 if the firm had Moody's-rated commercial paper outstanding at any time during the sample period (and 0 otherwise).

The data for all variables discussed above, except for asset beta and unused loan commitments, come from the Compustat files. Three hundred firms were randomly selected from the Compustat Primary–Secondary–Tertiary, Full Coverage, and Research files which had complete data records for all of the leverage and control variables in at least one year during the period 1984–1988 (excluding public utilities, banks, insurers, and other financial service firms). Except for the volatility, asset beta, and commercial paper proxies, all variables used in the analysis are on a five-year average basis. Five-year averages were used to mitigate measurement errors that arise due to random year-to-year fluctuations in the variables.

Table II provides summary statistics for the sample of 300 firms. The mean D/VAL ratio for the sample is 0.41. Unused loan commitments total 6% of firm value, on average.

Table III presents the simple correlations among the explanatory variables, while Table IV presents the analysis of variance results of industry classification (using 2-digit SIC codes) on the measure of leverage and the empirical proxy variables. Using the dummy variable approach, industry classification explains approximately 24% of the cross-sectional variation in leverage ratios.[14] Industry classification accounts for 11% of the variation in unused loan commitments (LC/VAL). The variables FA/VAL, NDTS, Q, R&D/VAL, CAP/VAL, OI/VAL, ln A, and BETA appear to be good candidates to control for intraindustry variance in leverage; however, the relative weakness of $\sigma\{\Delta\text{EBIDT}\}/\bar{A}$ suggests that this variable may not be important in explaining intraindustry variance in debt ratios.

Table V presents the Kendall and Pearson coefficients for measuring the simple correlations between leverage and the various explanatory variables for the cross section of firms in the sample. The Kendall test is nonparametric; the Kendall rank-order coefficient is normally distributed in large samples. The Pearson product moment coefficient is a parametric measure of

[14] This compares with the $R^2 = 0.24$ for a similar analysis reported in Bradley, *et al.* (1984). If short-term debt is ignored in the leverage calculation, industry classification accounts for about 15% of the cross-sectional variance.

TABLE II

SUMMARY STATISTICS FOR REGRESSION VARIABLES FOR THE 1984–1988 SAMPLE (N = 300)

Variable[a]	Mean	Std. dev.	Median	Minimum	Maximum
D/VAL	0.41	0.18	0.41	0.03	0.94
FA/VAL	0.27	0.13	0.24	0.00	0.73
NDTS	0.58	0.23	0.57	0.11	1.00
Q	1.47	0.84	1.28	0.68	10.85
R&D/VAL	0.03	0.03	0.02	0.00	0.23
CAP/VAL	0.06	0.03	0.05	0.00	0.17
OI/VAL	0.19	0.14	0.18	−0.34	1.71
ln A	5.55	1.67	5.39	1.34	9.81
$\sigma\{\Delta\text{EBIDT}\}/\bar{A}$	0.06	0.07	0.04	0.01	0.77
BETA	0.67	0.30	0.66	−0.51	1.81
LC/VAL	0.06	0.08	0.04	0.00	0.86

[a] D/VAL is the ratio of book value of debt to book value of debt plus market value of equity; FA/VAL is the ratio of fixed assets to book value of debt plus market value of equity; NDTS is the ratio of nondebt tax shields (depreciation, depletion, amortization, R&D expense, and tax loss carryforwards) to earnings before interest, depreciation and taxes (with an upper bound of 1 and a value of 1 when EBIDT is negative); Q is Tobin's q; R&D/VAL is the ratio of research and development expenditures to book value of debt plus market value of equity; CAP/VAL is the ratio of capital expenditures to book value of debt plus market value of equity; OI/VAL is the ratio of operating income to book value of debt plus market value of equity; ln A is the natural logarithm of total assets; $\sigma/\{\Delta\text{EBIDT}\}/\bar{A}$ is the ratio of the standard deviation of the first difference in quarterly EBIDT to average assets calculated over the entire sample period; BETA is the beta of assets (the unlevered beta of equity calculated over the 24 months preceding the beginning of each sample year); and LC/VAL is the ratio of unused loan commitments to book value of debt plus market value of equity. All variables are calculated as averages over the sample period except when otherwise noted.

TABLE III

CORRELATION MATRIX OF REGRESSION VARIABLES FOR THE 1984–1988 SAMPLE (N = 300)[a,b]

	FA/ VAL	NDTS	Q	R&DVAL	CAP/ VAL	OI/ VAL	ln A	$\sigma\{\Delta\text{EBIDT}\}/\bar{A}$	BETA
NDTS	.18								
Q	−.40	−.18							
R&D/VAL	−.10	.54	−.10						
CAP/VAL	.56	.17	−.24	.06					
OI/VAL	.09	.21	−.11	−.30	.08				
ln A	.13	.01	−.07	−.01	−.03	.23			
$\sigma\{\Delta\text{EBIDT}\}/\bar{A}$	−.06	.18	.05	.13	−.01	−.20	−.40		
BETA	−.30	−.16	.42	.13	−.07	−.04	−.07	.11	
LC/VAL	.13	.06	−.22	.02	−.02	.04	−.03	−.04	−.04

[a] Variables are defined in Table II.

[b] The correlations among the leverage variables and the explanatory variables are given in Table V.

TABLE IV
RESULTS FROM ANALYSIS OF VARIANCE OF INDUSTRIAL CLASSIFICATION ON MEASURES OF LEVERAGE, MEASURES OF UNUSED LOAN COMMITMENTS, AND EMPIRICAL PROXY VARIABLES ($N = 300$)[a,b]

	Adjusted R^2	F statistic
D/VAL	.24	4.09
LC/VAL	.11	1.52
FA/VAL	.24	4.07
NDTS	.30	5.25
Q	.56	14.92
R&D/VAL	.29	6.29
CAP/VAL	.19	2.86
OI/VAL	.19	3.06
ln A	.13	1.80
$\sigma\{\Delta\text{EBIDT}\}/\overline{A}$	.06	0.83
BETA	.18	2.72

[a] Variables are defined in Table II.
[b] Industries are differentiated by two-digit SIC code.

the correlation between two variables and has a t distribution with N-2 degrees of freedom. A test of zero correlation between two variables based on the Pearson coefficient is equivalent to a t test on the estimated coefficient in a univariate regression; the Pearson coefficients are thus presented for comparison purposes only.

The nonparametric tests in Table V suggest that leverage is positively correlated with unused loan commitment volume; the Kendall correlation coefficient between LC/VAL and D/VAL is a statistically significant 0.24.

The Kendall coefficients also reveal a negative correlation among leverage and nondebt tax shields (NDTS), Q, uniqueness (R&D/VAL), growth opportunities (CAP/VAL), and asset beta. The correlation between profitability (OI/VAL) and D/VAL is negative but weak. The correlation between size (ln A) and leverage is positive and significant.[15] Collateral value of assets (FA/VAL) exhibits a significant positive correlation with leverage. The correlations shown in Table V are generally consistent with the theoretical predictions.

The results from a multivariate regression analysis coincide with the nonparametric results. Table VI presents the estimated coefficients for six OLS regression equations using D/VAL as the dependent variable, where White's (1980) heteroskedasticity-consistent standard errors are given in

[15] However, the correlation between size and leverage is insignificant if short-term debt is excluded from the leverage measure.

TABLE V
CORRELATION ANALYSIS OF LEVERAGE WITH HYPOTHESIZED EXPLANATORY VARIABLES
(N = 300)[a,b]

	Correlation with D/VAL	
	Kendall	Pearson
FA/VAL	.31	.46
	(.0001)	(.0001)
NDTS	−.14	−.24
	(.0002)	(.0001)
Q	−.53	−.51
	(.0001)	(.0001)
R&D/VAL	−.06	−.11
	(.0001)	(.05)
CAP/VAL	−.15	−.21
	(.0001)	(.001)
OI/VAL	−.04	−.04
	(.36)	(.48)
ln A	.10	.16
	(.006)	(.003)
$\sigma\{\Delta\text{EBIDT}\}/\overline{\text{A}}$	.06	−.04
	(.16)	(.52)
BETA	−.54	−.68
	(.0001)	(.0001)
LC/VAL	.24	.28
	(.0001)	(.0001)

[a] The Kendall rank-order coefficient has a normal distribution in large samples, while the Pearson product-moment coefficient has a Student's t distribution with N-2 degrees of freedom. The levels of significance for the one-tailed tests are given in parentheses, where the null hypothesis is $\rho = 0$.

[b] Variables are defined in Table II.

parenthesis. Columns 1, 2, and 3 reflect the estimated regression coefficients when industry dummy variables are excluded, while columns 4, 5, and 6 provide the coefficients when industry dummies are included.[16]

In each case, the coefficient on the variable for unused loan commitments (LC/VAL) is positive and statistically significant, as predicted. Including

[16] Because the proxy variables are inexact measures of the true characteristics, the cross-sectional regressions may suffer from errors-in-variables problems (see Titman and Wessels, 1988). Moreover, leverage and loan commitment demand may be simultaneously determined by a firm's overall debt capacity.

TABLE VI
ORDINARY LEAST SQUARES ANALYSIS OF HYPOTHESIZED EXPLANATORY VARIABLES ON LEVERAGE (N = 300)[a,b]

	Without industry indicators			With industry indicators		
	1	2	3	4	5	6
Intercept	.475	.459	.452	.490	.477	.472
	(.059)	(.059)	(.058)	(.090)	(0.91)	(.090)
FA/VAL	.201	.169	.179	.100	.077	.082
	(.064)	(.061)	(.061)	(.083)	(.080)	(.080)
NDTS	−.095	−.095	−.085	−0.86	−.089	−.080
	(.037)	(.035)	(.034)	(.041)	(.039)	(.039)
Q	−.048	−.045	−.045	−.080	−.074	−.075
	(.019)	(.019)	(.019)	(.040)	(.039)	(.039)
R&D/VAL	−1.093	−1.111	−1.067	−1.043	−1.045	−.955
	(.321)	(.299)	(.303)	(.346)	(.334)	(.331)
CAP/VAL	−.205	−.296	−.244	−.409	−.434	−.385
	(.247)	(.249)	(.243)	(.275)	(.266)	(.269)
OI/VAL	−.504	−.563	−.519	−.428	−.473	−.430
	(.150)	(.143)	(.143)	(.157)	(.154)	(.151)
ln A	.024	.024	.024	.025	.026	.025
	(.005)	(.005)	(.005)	(.005)	(.005)	(.005)
$\sigma\{\Delta\text{EBIDT}\}/\overline{\text{A}}$	.250	.223	.241	.303	.282	.294
	(.193)	(.181)	(.180)	(.188)	(.177)	(.171)
$[\sigma\{\Delta\text{EBIDT}\}/\overline{\text{A}}]^2$	−.035	−.029	−.029	−.037	−.032	−.031
	(.222)	(.209)	(.209)	(.235)	(.212)	(.207)
BETA	−.265	−.260	−.262	−.227	−.225	−.226
	(.037)	(.040)	(.040)	(.039)	(.039)	(.039)
CP dummy[c]	−.052	−.053	−.053	−.052	−.054	−.051
	(.017)	(.017)	(.017)	(.015)	(.015)	(.015)
LC/VAL	—	.359	—	—	.307	—
		(.085)			(.100)	
LC dummy[d]	—	—	.046	—	—	.046
			(.012)			(.013)
Adjusted R^2	.62	.64	.65	.64	.66	.66

[a] The dependent variable is D/VAL for all specifications. White's (1980) heteroskedasticity-consistent standard errors are given in parenthesis.

[b] Variables are defined in Table II.

[c] CP dummy is an indicator variable which takes the value 1 if the firm has Moody's rated commercial paper outstanding any time during the sample period, and 0 otherwise.

[d] LC dummy is an indicator variable which takes the value 1 if the firm has unused loan commitments, and 0 otherwise.

the unused loan commitment measure improves the explanatory power of the regressions (with and without industry dummy variables) without substantially impacting the other explanatory variables.

In all six specifications, the estimated coefficients on the volatility variable ($\sigma\{\Delta\text{EBIDT}\}/\bar{A}$) are positive while the estimated coefficients on the square of this variable are negative (and insignificant).[17] These results provide no empirical support for the hypothesized U-shaped relationship between business risk and leverage. As mentioned before, a negative relationship between volatility and optimal leverage is expected only when the direct costs of bankruptcy are significant. If the expected direct costs of bankruptcy are largely fixed, then the marginal expected default costs per unit of leverage may be smaller for larger firms; Castanais (1983) documents a negative relationship between size and failure rates. Note also from Table III that the size variable (ln A) is negatively correlated with the volatility variable (-0.40), indicating that the larger firms in the sample have a lower variability of earnings. Together, these facts suggest that the sample may be biased toward larger firms in the population.

The OLS regressions indicate a negative coefficient on the nondebt tax shields variable (NDTS). Table VI also documents significant negative coefficients, as predicted, for the variables proxying Q, uniqueness (R&D/VAL), profitability (OI/VAL), and asset beta (BETA), and a significant positive coefficient for the firm size variable (ln A). The coefficient for the variable proxying collateral value of assets (FA/VAL) is positive but significant only when industry dummies are omitted; the growth opportunity variable (CAP/TA) takes its predicted negative sign but is statistically weak.[18]

Table VII presents the OLS regression results when leverage is measured ignoring short-term debt; the dependent variable is the ratio of book value of long-term debt to book value of long-term debt plus market value of equity (LTD/LTVAL), and all variables scaled by firm value ignore short-term debt in that measure. Once again, the coefficient on the variable for unused loan commitments (LC/LTVAL) is significant and positive. Including the measure of unused loan commitments again improves the explanatory power of the regression equations, with and without industry dummy variables, without impacting the significance of the control variables. The results are virtually identical to those given in Table VI, although

[17] This finding is consistent with the results of Kim and Sorensen (1986) but inconsistent with those of Bradley *et al.* (1984).

[18] To check the effects of scaling the dependent variable (D/VAL) by the same factor as the loan commitment variable (LC/VAL), I split the sample into quintiles based on firm value (book value of debt plus market value of equity) and repeated the OLS regressions. The coefficients on the loan commitment variable were positive and significant in all five subsamples.

TABLE VII
ORDINARY LEAST-SQUARES ANALYSIS OF HYPOTHESIZED EXPLANATORY VARIABLES ON LEVERAGE (N = 300)[a,b]

	Without industry indicators			With industry indicators		
	1	2	3	4	5	6
Intercept	.279	.273	.248	.275	.283	.251
	(.061)	(.067)	(.060)	(.078)	(.083)	(.077)
FA/LTVAL	−.007	−.013	−.009	.003	−.003	.001
	(.008)	(.007)	(.007)	(.009)	(.009)	(.009)
NDTS	−.061	−.051	−.051	−.059	−.044	−.052
	(.037)	(.040)	(.035)	(.041)	(.043)	(.040)
Q	−.025	−.023	−.021	−.041	−.038	−.035
	(.013)	(.013)	(.012)	(.029)	(.030)	(.028)
R&D/LTVAL	−.995	−.965	−.972	−.871	−.744	−.811
	(.211)	(.247)	(.209)	(.246)	(.276)	(.243)
CAP/LTVAL	−.654	−.660	−.657	−.643	−.613	−.615
	(.144)	(.143)	(.149)	(.175)	(.179)	(.178)
OI/LTVAL	−.348	−.376	−.348	−.317	−.356	−.312
	(.073)	(.091)	(.078)	(.084)	(.095)	(.085)
ln A	.021	.020	.020	.021	.020	.020
	(.005)	(.006)	(.006)	(.006)	(.006)	(.006)
$\sigma\{\Delta\text{EBIDT}\}/\overline{\text{A}}$	.075	.133	.063	.155	.372	.138
	(.229)	(.216)	(.208)	(.220)	(.218)	(.206)
$[\sigma\{\Delta\text{EBIDT}\}/\overline{\text{A}}]^2$	−.025	−.048	−.189	−.032	−.085	−.025
	(.250)	(.247)	(.238)	(.255)	(.250)	(.239)
BETA	−.209	−.202	−.204	−.182	−.181	−.181
	(.034)	(.035)	(.034)	(.034)	(.035)	(.034)
CP dummy[c]	−.073	−.075	−.073	−.067	−.066	−.066
	(.019)	(.019)	(.019)	(.018)	(.018)	(.018)
LC/LTVAL	—	.152	—	—	.172	—
		(0.71)			(.081)	
LC dummy[d]	—	—	.051	—	—	.048
			(.013)			(.014)
Adjusted R^2	.41	.42	.44	.41	.42	.43

[a] The dependent variable is the ratio of the book value of long-term debt to the book value of long-term debt plus market value of equity for all specifications. White's (1980) heteroskedasticity-consistent standard errors are given in parenthesis.

[b] FA/LTVAL is the ratio of fixed assets to book value of long-term debt plus market value of equity; R&D/LTVAL is the ratio of research and development expenditures to book value of long-term debt plus market value of equity; CAP/LTVAL is the ratio of capital expenditures to book value of long-term debt plus market value of equity; OI/LTVAL is the ratio of operating income to book value of long-term debt plus market value of equity; and LC/LTVAL is the ratio of unused load commitments to book value of long-term debt plus market value of equity. All other variables are as defined in Table II.

[c] CP dummy is an indicator variable that takes the value 1 if the firm has Moody's rated commercial paper outstanding in any year during the sample period, and 0 otherwise.

[d] LC dummy is an indicator variable which takes the value 1 if the firm has unused load commitments, and 0 otherwise.

TABLE VIII
MEAN VALUES OF REGRESSION VARIABLES FOR THE 1984–1988 SAMPLE (N = 300)[a]

	Firms with commercial paper outstanding $N = 64$[b]	Firms without commercial paper outstanding $N = 236$
D/VAL	.38	.41
LTD/LTVAL	.16	.22
FA/VAL	.27	.26
NDTS	.54	.59
Q	1.48	1.46
R&D/VAL	.03	.03
CAP/VAL	.05	.06
OI/VAL	.20	.19
ln A	7.60	5.00
$\sigma\{\Delta\text{EBIDT}\}/\bar{A}$	.03	.07
BETA	.70	.66
LC/VAL	.02	.07

[a] Variables are defined in Table II.
[b] A firm is determined to have commercial paper outstanding if it has Moody's rated commercial paper at any time during the sample period.

the statistical significance of the variables proxying fixed asset intensity, nondebt tax shields, Q, and volatility weaken with the exclusion of short-term debt from the leverage measure.

A striking result from both Table VI and Table VII is the significant coefficient on the commercial paper dummy variable: firms in the sample with commercial paper outstanding tend to use *less* debt finance than firms without commercial paper. Moreover, as documented in Table VIII, the firms in the sample with commercial paper programs hold smaller loan commitments (as a fraction of total debt) than do the firms without commercial paper programs. The fact that firms with commercial paper tend to use smaller loan commitments relative to total debt is intuitive and consistent: the sample firms with commercial paper programs have fewer growth opportunities (measured by CAP/VAL) and higher collateral value of assets (measured by FA/VAL).[19]

Table IX presents the results from estimating equation 2 in Table VI on a year-by-year basis. In Table IX, $\sigma\{\Delta\text{EBIDT}\}/\bar{A}$ is measured as before while all other variables are measured on a yearly basis. Interestingly, the coefficients on several of the variables (including LC/VAL) change

[19] The common notion that most loan commitments exist to backup commercial paper appears to be mistaken. "Accounting Trends and Techniques" (1992 edition) reports that of 600 randomly chosen major firms, 535 disclosed revolving credit agreements or lines of credit in their 1991 annual reports while only 63 disclosed commercial paper financing.

TABLE IX
YEARLY OLS ANALYSIS OF HYPOTHESIZED EXPLANATORY VARIABLES ON LEVERAGE (N = 300)[a,b]

	1984	1985	1986	1987	1988
Intercept	.510	.458	.357	.578	.593
	(.089)	(.065)	(.081)	(.081)	(.071)
FA/VAL	.271	.311	.344	.109	.217
	(.085)	(.072)	(.071)	(.076)	(.083)
NDTS	−.061	−.030	−.080	−.028	−.035
	(.028)	(.025)	(.038)	(.032)	(.034)
Q	−.088	−.053	−.015	−.073	−.060
	(.040)	(.021)	(.007)	(.033)	(.026)
R&D/VAL	−1.040	−.718	−.830	−.007	.505
	(.348)	(.308)	(.305)	(.265)	(.310)
CAP/VAL	−.217	.292	−.057	.268	−.155
	(.180)	(.249)	(.214)	(.254)	(.361)
OI/VAL	−.455	−.662	−.369	−.481	−.978
	(.143)	(.156)	(.167)	(.145)	(.166)
ln A	.017	.020	.028	.028	.034
	(.007)	(.006)	(.007)	(.007)	(.007)
$\sigma\{\Delta\mathrm{EBIDT}\}/\overline{\mathrm{A}}$	.708	.138	.354	.523	.888
	(.334)	(.251)	(.241)	(.254)	(.263)
$(\sigma\{\Delta\mathrm{EBIDT}\}/\overline{\mathrm{A}})^2$	−.253	−.015	−.025	−.064	−.117
	(1.353)	(.299)	(.292)	(.303)	(.303)
BETA	−.189	−.232	−.302	−.351	−.367
	(.038)	(.046)	(.054)	(.039)	(.039)
CP dummy[c]	−.032	−.041	−.055	−.074	−.069
	(.018)	(.018)	(.023)	(.022)	(.021)
LC/VAL	.294	.299	.285	.187	.188
	(.079)	(.102)	(.083)	(.086)	(.099)
Adjusted R^2	.62	.62	.56	.43	.42

[a] The dependent variable is D/VAL for each year. White's (1980) heteroskedasticity-consistent standard errors are given in parentheses. Industry indicator variables are not included as independent variables.

[b] Variables are defined in Table II.

[c] CP dummay is an indicator variable which takes the value 1 if the firm has Moody's rated commercial paper outstanding during the year, and 0 otherwise.

substantially in the last two years of the sample period, and the regression results are much stronger in the 1984–1986 period than in the 1987–1988 period.[20] This may be due to the Tax Reform Act of 1986 (TRA), which changed corporate and personal tax treatment (Ben-Horim *et al.*, 1987). Although the TRA lowered the statutory marginal tax rate on corporate taxable income, the act also eliminated certain deductions and credits. Thus,

[20] When short-term debt is excluded from the leverage measure, the difference is magnified.

the TRA actually increased the marginal tax rate for many firms. The impact of the TRA was probably not felt equally by all firms for two reasons. First, the removal of certain deductions and credits shifted the tax burden to those firms that were the beneficiaries of these tax breaks prior to the TRA. Second, if dividend clienteles exist, then the changes in personal taxation policies would impact firms differently through the differential impact on their dividend clienteles. Thus, some firms may have drawn down existing loan commitments in order to change their capital structures, while others may have recapitalized while keeping their loan commitments in place.[21]

3.2. *Interest Cost Hypothesis*

Unused loan commitment volume should be negatively related to the firm's cost of debt, according to the theory presented in Section 2. In Table X, the average interest rate on short-term debt (as calculated by Compustat) is the dependent variable. Using the average interest rate on short-term debt provides two advantages. First, GAAP allows firms with commercial paper backed by loan commitments to carry the paper as *long-term debt* for balance-sheet purposes. Thus, the test will not be confounded by commitment-backed commercial paper (which tends to be inexpensive, especially for the largest firms). Second, using only interest on short-term debt reduces the influence of cross-sectional differences in maturity structure of debt.

Since a firm's cost of debt includes a default-risk premium (related to the level of debt), an additional variable proxying for default risk is warranted. Altman's Z is introduced to control for the default risk premium in the cost of debt. The proxies for collateral value of assets, asset uniqueness, growth opportunities, asset beta, and volatility are used to control for the nature of the firm's assets. The size variable is included as well.

The results are consistent with predictions; the coefficient on the unused loan commitment variable is negative and significant. The test also indicates a significant negative relationship between short-term interest cost and Altman's Z (a lower value of Z represents a higher probability of bankruptcy). Interestingly, the size variable is also negative and significant.

4. SUMMARY AND CONCLUSION

This paper has developed a model to analyze a firm's capital structure decision when loan commitments may be used to attenuate potential moral hazard problems. The model predicts that unused loan commitments lead

[21] Further analysis of the impact of the TRA on leverage is provided in Givoly *et al.* (1992).

TABLE X
ORDINARY LEAST SQUARES ANALYSIS OF LOAN COMMITMENT AVAILABILITY AND CONTROL VARIABLES ON COST OF DEBT FUNDS (N = 300)[a,b]

	Without industry indicators		With industry indicators	
	1	2	3	4
Intercept	.107	.109	.088	.089
	(.007)	(.023)	(.031)	(.035)
FA/VAL	−.049	−.048	−.042	−.041
	(.037)	(.038)	(.045)	(.045)
R&D/VAL	−.131	−.132	−.124	−.127
	(.123)	(.124)	(.145)	(.146)
CAP/VAL	−.022	−.029	−.020	−.026
	(.163)	(.169)	(.178)	(.180)
ln A	−.015	−.015	−.013	−.013
	(.003)	(.003)	(.003)	(.002)
VAR	.070	.068	.039	.037
	(.047)	(.048)	(.045)	(.046)
BETA	.017	.017	.013	.013
	(.011)	(.011)	(.011)	(.010)
Z	−.023	−.023	−.018	−.018
	(.006)	(.006)	(.007)	(.007)
LC/VAL	—	−.008	—	−.008
		(.002)		(.002)
Adjusted R^2	.14	.15	.17	.18

[a] The dependent variable is the average interest rate on short-term debt. White's (1980) heteroskedasticity-consistent standard errors are given in parentheses.
[b] Z is Altman's Z. All other variables are as defined in Table II.

firms to higher (privately) optimal debt levels. The results of both parametric and nonparametric tests support this prediction. The results are robust to the inclusion of traditional capital structure determinants such as collateral value of assets, nondebt tax shields, uniqueness, growth opportunities, profitability, size, asset beta, volatility, and Tobin's q.

Since a loan commitment can reduce the distortions that arise from the standard debt contract, the implication is that a firm's access to bank loan commitments may have an important impact on the terms of its other debt, regardless of the source of that debt. For example, a manufacturer that relies heavily on trade credit from its suppliers may be able to negotiate better credit terms if it has unused loan commitments. In this scenario, the bank is underwriting the credit risk while the supplier is funding the debt. If the loan commitment contract is designed to mitigate moral hazard problems, or if the bank's monitoring capability is superior to the trade creditor's, then the net effect will be to decrease the firm's cost of debt and thus increase its value.

This paper is a part of a growing literature on "off-balance-sheet" banking and the value of bank-contingent claim products. The results highlight the fact that banks can play an important role in the allocation of credit whether or not they actually fund loans. This is germane given the current debate regarding the relevance of banks, vis-à-vis the capital markets, in the allocation of credit.

5. APPENDIX

Proof of the Proposition

Since the moral hazard problem in the model is driven by the time-0 debt choice, I will refer to a firm as unlevered at time 0 if $D_0 = 0$. Maintaining the assumption that $D_1 = 1$, the value of the unlevered firm at time 0 is given by

$$\begin{aligned} V(\text{time } 0 \mid D_0 = 0) = {} & \frac{1}{(1+r_f)^2} p(\mathrm{G}) p(\mathrm{S} \mid \mathrm{G})[(1-\tau)(\mathrm{S} - r_f) - 1] \\ & + \frac{1}{(1+r_f)^2} p(\mathrm{U,H}) p(\mathrm{S} \mid \mathrm{U,H})[(1-\tau)(\mathrm{S} - r_1) - 1] \\ & + \frac{1}{(1+r_f)^2} p(\mathrm{U,M}) p(\mathrm{S} \mid \mathrm{U,M})[(1-\tau)(\mathrm{S} - r_1) - 1] \\ & - (p(\mathrm{G}) + p(\mathrm{U,H}) + p(\mathrm{U,M})) \frac{C}{(1+r_f)} - 1. \end{aligned}$$

The firm will underinvest in both the (U, M) and (U, H) states if the value of the tax shield in the (G) state is sufficiently large. In such cases, the firm's optimal debt choice D_0 will satisfy inequality (3) from the text. If the firm's optimal D_0 satisfies (3), the firm will fully lever (since there will be no cost to further adding debt). Thus, the firm will choose full leverage and expect to underinvest in both the (U, M) and (U, H) states when

$$\begin{aligned} p(\mathrm{G}) p(\mathrm{S} \mid \mathrm{G}) \tau r_0 D_0 > {} & (p(\mathrm{U,H}) p(\mathrm{S} \mid \mathrm{U,H}) \\ & + p(\mathrm{U,M}) p(\mathrm{S} \mid \mathrm{U,M}))[(1-\tau)(\mathrm{S} - r_1) - 1] \\ & - (p(\mathrm{U,H}) + p(\mathrm{U,M})) C (1 + r_f). \end{aligned}$$

In other words, the firm optimally chooses full leverage when

$$\tau > \tau^* = \frac{(p(\mathrm{U,H})p(\mathrm{S}|\mathrm{U,H}) + p(\mathrm{U,M})p(\mathrm{S}|\mathrm{U,M}))[\mathrm{S} - r_1 - 1] - (p(\mathrm{U,H}) + p(\mathrm{U,M}))C(1 + r_f)}{(p(\mathrm{U,H})p(\mathrm{S}|\mathrm{U,H}) + p(\mathrm{U,M})p(\mathrm{S}|\mathrm{U,M}))[\mathrm{S} - r_1] + p(\mathrm{G})p(\mathrm{S}|\mathrm{G})r_0 D_0'},$$

where D_0' is given in (3). By a similar argument, if the firm's optimal debt level implies underinvestment in the (U, M) state only (that is, if D_0 satisfies (2) but not (3)), then the firm's optimal debt level will be equal to D_0'. The firm will choose D_0' if $\tau \leq \tau^*$ and

$$\tau > \tau^{**} = \frac{p(\mathrm{U,M})p(\mathrm{S}|\mathrm{U,M})[\mathrm{S} - r_1 - 1] - p(\mathrm{U,M})\mathrm{C}(1 + r_f)}{p(\mathrm{U,M})p(\mathrm{S}|\mathrm{U,M})[\mathrm{S} - r_1] + (p(\mathrm{G})p(\mathrm{S}|\mathrm{G}) + p(\mathrm{U,H})p(\mathrm{S}|\mathrm{U,H}))r_0 D_0''},$$

where D_0'' is given in (2). The firm will not underinvest if $\tau \in [0, \tau^{**}]$. If $\tau \in (0, \tau^{**}]$, the firm will choose D_0 equal to D_0''. If $\tau = 0$, the firm will randomly choose any debt level in $[0, D_0'']$.

To summarize for a firm with no loan commitment,

$$D_0 = \begin{cases} 1 & \text{if } \tau > \tau^* \\ D_0' & \text{if } \tau \in (\tau^{**}, \tau^*] \\ D_0'' & \text{if } \tau \in (0, \tau^{**}] \\ \in [0, D_0''] & \text{if } \tau = 0, \end{cases}$$

where D_0' is given in (3) and D_0'' is given in (2).

Consider a loan commitment whose take-down rate is set such that a levered firm always continues the project (and draws down the commitment) in the (U, H) state and that $r_1 > r_{1\mathrm{LC}} > r_f$ (the commitment is not exercised in the (G) state). The value of the unlevered firm holding such a commitment at time 0 is given by

$$\begin{aligned} V(&\text{time } 0 | D_0 = 0, \mathrm{LC}) \\ &= \frac{1}{(1 + r_f)^2} p(\mathrm{G})p(\mathrm{S}|\mathrm{G})[(1 - \tau)(\mathrm{S} - r_f) - 1] \\ &+ \frac{1}{(1 + r_f)^2} p(\mathrm{U,H})p(\mathrm{S}|\mathrm{U,H})[(1 - \tau)(\mathrm{S} - r_{1\mathrm{LC}}) - 1] \\ &+ \frac{1}{(1 + r_f)^2} p(\mathrm{U,M})p(\mathrm{S}|\mathrm{U,M})[(1 - \tau)(\mathrm{S} - r_{1\mathrm{LC}}) - 1] \\ &- (p(\mathrm{G}) + p(\mathrm{U,H}) + p(\mathrm{U,M}))\frac{C}{(1 + r_f)} - 1 - (1 - \tau)\Pi_{\mathrm{LC}}, \end{aligned}$$

using the fact that the price paid for the loan commitment is itself tax deductible. The price of the loan commitment is simply the present value of the expected subsidy,

$$\Pi_{LC} = \frac{1}{(1 + r_f)^2} [p(U, H)p(S|U, H) + p(U, M)p(S|U, M)](r_1 - r_{1LC}).$$

By substituting the price of the loan commitment (with the material adverse change clause) into the valuation equation, it can be seen that the time-0 value of the unlevered firm with a loan commitment is identical to the time-0 value of the unlevered firm without a loan commitment. The loan commitment impacts the time-0 value of the firm via the incentive effect, which makes the debt tax shield more valuable.

With the loan commitment described above, the firm will never underinvest in the (U, H) state. The firm with a loan commitment will underinvest in the (U, M) state if inequality (4) is satisfied; in this instance, the firm will set $D_0 = 1$. Thus, the firm with a loan commitment chooses full leverage at time 0 if $\tau > \tau^{**}$.

The firm with a loan commitment will not underinvest if $\tau \leq \tau^{**}$. If $\tau \in (0, \tau^{**}]$, the firm will set D_0 equal to D_0^{LC}, which is given in (4). Any D_0 in $[0, D'_{0LC}]$ will be chosen if $\tau = 0$.

$$D_0 \text{ (with a commitment) } = \begin{cases} 1 & \text{if } \tau > \tau^{**} \\ D_0^{LC} & \text{if } \tau \in (0, \tau^{**}] \\ \in [0, D_0^{LC}] & \text{if } \tau = 0. \end{cases}$$

To summarize, for tax rates $\tau \in (0,\tau^{**}]$ the firm without a commitment chooses $D_0 = D_0''$ while the same firm with a commitment chooses the larger $D_0 = D_0^{LC}$. Similarly, for $\tau \in (\tau^{**}, \tau^*]$, the firm without a commitment chooses $D_0 = D_0'$ while the firm with a commitment chooses $D_0 = 1$. Both firms choose full leverage when $\tau > \tau^*$. This completes the proof.

Proof of the Corollary

The initial two-period interest rate r_0 depends on the expected level of underinvestment, which depends on the firm's choice of D_0 (which in turn depends on τ). For tax rates $\tau \leq \tau^*$, the commitment described in the text has a capital structure effect but no ultimate effect on the continue/liquidate decision. However, for $\tau > \tau^*$, the firm without a commitment underinvests in both the (U, M) and (U, H) states while the firm with a commitment underinvests in only the (U, M) states. Thus, for $\tau > \tau^*$, the time-0 two-period interest rate charged to the firm without a commitment is

$$r_0 = \frac{(1 + r_f)^2}{p(\mathrm{G})p(\mathrm{S}|\mathrm{G})} - 1,$$

while the rate for a firm with a loan commitment is

$$r_0^{\mathrm{LC}} = \frac{(1 + r_f)^2}{(p(\mathrm{G})p(\mathrm{S}|\mathrm{G}) + p(\mathrm{U},\mathrm{H})p(\mathrm{S}|\mathrm{U},\mathrm{H}))} - 1.$$

Clearly, $r_0^{\mathrm{LC}} < r_0$. This completes the proof.

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