Debt Capacity and the Capital Budgeting Decision: A Revisitation

John D. Martin and David F. Scott, Jr.

John D. Martin is Associate Professor of Finance at the College of Business Administration, Texas A&M University. David F. Scott, Jr., is Professor of Finance at the College of Business at Virginia Polytechnic Institute and State University

■ Our earlier *Financial Management* paper, "Debt Capacity and the Capital Budgeting Decision" [15], had as its objectives: 1) To propose a conceptual basis for assessing project debt capacity utilizing a cash flow adequacy criterion, and 2) to link this methodology with the Bower-Jenks [2] framework for project evaluations. Since the appearance of that paper, two refinements have been offered to the proposed methodology. Hong and Rappaport [8] have suggested the incorporation of bankruptcy costs into the model. This would, they contend, provide an improved approach to project evaluation, since the resulting model would provide the basis for determining the value maximizing financial structure. Specifically, their model gives explicit consideration to the "costs" of insolvency. In the current issue of this journal, Conine [3] suggests that a technical problem arises in attempting to link the use of the CAPM to the debt capacity scheme we proposed. Specifically, in a CAPM world where risky debt is issued, the simple Hamada [5] adjustment we used to produce an estimate of the beta coefficient for an unlevered firm is biased. In fact, where debt is risky, in a CAPM sense, the adjustment involves a more involved calculation that considers both the beta coefficient for the levered firm's equity and that of its risky debt.

In the pages that follow we take this opportunity to share what we have learned from these authors' refinements and provide some comments as to how far the finance discipline has come in dealing with the debt capacity issue in capital budgeting analysis.

The Costs of Insolvency

One of the most promising theoretical developments in recent years with regard to the definition of a firm's optimal debt capacity involves the use of bankruptcy or insolvency costs as a deterrent to the use of excessive financial leverage. A number of authors have made use of this approach, including Kraus and Litzenberger [12], Lee and Barker [13], Scott [22], and Kim [10]. In very general terms, the resulting value of a levered firm can be defined as

$$V_L = PV[UOCF] + PV[ITS] - PV[EBC] \quad (1)$$

where V_L equals the value of the levered firm; PV [ ] is the present value operator; UOCF equals the unlevered operating cash flows of the firm; ITS equals the interest tax shelter accruing to the levered firm which provides the marginal benefit from debt financing; and EBC equals the expected costs of bankruptcy which provide the marginal costs associated with a unit of debt financing. The value maximizing financial structure then involves utilizing that level of debt financing for which the PV [ITS] of the last unit of debt is just matched by the PV [EBC] it adds.

To get some feel for the difficulties encountered in attempting to apply such a model to project valuation, we need only try to specify the PV [ITS] and PV [EBC] terms. If we assume perpetual debt, then the Modigliani-Miller [18] prescription for PV [ITS] emerges:

$$PV[ITS] = \frac{rDt}{r} = Dt \quad (2)$$

where r equals the rate of interest on the firm's debt; D equals the value of the firm's debt; and t is the firm's tax rate (assumed to be a constant). Note that we have assumed that the interest rate on the firm's debt is the appropriate rate for discounting the interest tax shelter from debt.

Specifying the PV[EBC] term is somewhat more involved. One possible formulation might be:

$$PV[EBC] = PV[BC \cdot F(rD)] \quad (3)$$

where BC equals the level of the bankruptcy or insolvency costs associated with the firm's not being able to pay its bills on time, and F(rD) equals the cumulative probability density function for the firm's annual operating cash flows evaluated at rD (the firm's annual interest expense which also equals its finance charges under our assumption of perpetual debt financing). Thus, PV[EBC] is the present value of the product of the costs incurred in bankruptcy (BC) and the probability that operating cash flows will be so low as to make the firm insolvent [F(rD)]. Note that we have assumed that the cumulative density function for the firm's annual operating cash flows is the same for all years in order to simplify the notation. In addition, we have assumed that BC is constant for all years and that it is invariant with respect to the severity of the cash shortfall that produces the insolvency condition. In addition, we have made no attempt to specify the discount rate to be used in the present value operator for the bankruptcy cost term. We might note that Lee and Barker did attempt to use a CAPM approach in this latter situation.

The optimal financial structure can now be evaluated by substituting both Equations (2) and (3) into (1), taking the first derivative of V_L, setting this derivative equal to zero, and solving for the corresponding value of D. Our discussion does not parallel Hong and Rappaport's exactly, as they chose to specify the bankruptcy cost term in a slightly different manner. Specifically, they defined an "average insolvency cost per unit of debt" term as

$$PV[EBC] = k_I D \quad (4)$$

where k_I equals the average insolvency cost per unit of debt; and D is project or firm debt capacity. They then offer one functional form for k_I which, using our symbols, equals:

$$k_I = c\,F(rD) \quad (5)$$

where c equals a "scaling constant;" and F(rD) equals the probability that the firm's operating cash flows will fall below rD. This expression simply states that the average cost of insolvency per unit of debt (k_I) is proportional to the risk of insolvency.

If k_I is defined using Equation (4), we obtain

$$k_I = \frac{PV[BC \cdot F(rD)]}{D}. \quad (6)$$

Substituting (6) for k_I in (5) and solving for c,

$$c = \frac{PV[BC \cdot F(rD)]}{D \cdot F(rD)}. \quad (7)$$

Thus, using this highly simplistic specification of PV[EBC], we see that c is a function of F(rD), BC, D, and the present value operator applicable to the expected bankruptcy cost term. Thus, reference to c as "a scaling constant" belies the severity of the problems that underlie its estimation.

Two additional caveats regarding the incorporation of bankruptcy costs into capital budgeting analyses should be noted. First, Haugen and Senbet [7] have raised a question as to the significance of formal reorganization or bankruptcy costs as a significant deterrent to the use of debt financing. These authors propose that the availability of a low cost alternative to formal reorganization via an informal reorganization effectively negates the effective use of expected bankruptcy costs as an offset to the interest tax shelter benefits of leverage. Although we do not concur that the costs of the informal reorganizations posed by Haugen and Senbet are as low as they propose (see Martin and Riener [14]), their argument is certainly relevant here. A second point relates to the necessity for going to an expected cost of bankruptcy model for firm valuation when using a risk or insolvency criterion to assess debt capacity. Myers [20] has noted three limits that may be practically important in determining the extent of a firm's use of debt financing: 1) credit rationing, 2) managerial risk aversion, and 3) the impact of bankruptcy costs on firm value. Put very succinctly, 1) the lenders chicken out first, 2) the managers chicken out first, or 3) the shareholders chicken out first [21, p. 589]. Thus, the risk of insolvency criterion is consistent with any one of Myers's "chicken theories" of corporate debt capacity, not just the third as Hong and Rappaport propose. In fact, Franke [5] has argued for the second theory based upon the presence of costly and imperfect information. We simply offer that the risk of insolvency can serve as a useful surrogate for a wide range of theoretical constructs regarding the limits of corporate debt capacity.

The Required Rate of Return on Equity with Risky Debt

Conine [3] notes that Hamada's [6] adjustment to the estimated beta of a levered firm produces a biased estimate of the beta for an unlevered firm where debt is risky (in a CAPM sense). He correctly notes that where historical returns for a levered firm are used to estimate beta (B_L) and debt is risky, then the appropriate adjustment to produce an estimate of beta for the unlevered firm (B_U) is

$$B_L = B_U \frac{S_U}{S_L} - \frac{D\,(1-t)}{S_L} B_D \qquad (8)$$

where S_U equals the value of the equity of the unlevered firm; S_L is the value of the equity of a levered firm; D is the value of the firm's risky debt; t is the income tax rate; and B_D is the beta for the firm's risky debt.

The Hamada formulation simply presumes B_D is zero such that $B_L = B_U \frac{S_U}{S_L}$. However, where B_D is nonzero, the Hamada formulation obviously overestimates B_L by an amount equal to the last term in Equation (8). The size of the bias is related to the size of B_D and the extent to which the firm has used financial leverage (*i.e.*, $\frac{D\,(1-t)}{S_L}$). Using our example, Conine demonstrates that use of (8) as opposed to the Hamada formulation produces a B_L of 1.89 compared to 2.13 and a required rate of return on the equity of the levered firm of .2309 as compared to .2517.

In summary, the use of Equation (8) will potentially impact project analysis (as we have discussed it) only in terms of the estimation of beta for the equity of the unlevered firm. If the analyst uses historical common stock returns for a proxy firm to estimate betas, and the proxy firm used financial leverage during the period when those returns were measured, then the resulting beta coefficient will be an estimate of B_L. To convert this estimate of B_L into an estimate of B_U requires the use of (8) where debt is risky. If the Hamada formulation is used, then B_U will be underestimated by an amount equal to $[\frac{D\,(1-t)}{S_U} \cdot B_D]$. Consequently, the cost of equity for the unlevered firm will be underestimated, and PV[UOCF] will be overestimated. The extent of the error thus created will, of course, depend on both B_D and $D(1-t)/S_U$. Note that B_L does not impact project valuation directly. However, in the practical application of the procedure we recommend, one usually finds it necessary to estimate B_L and then to convert this into an estimate of B_U. It is in this step that B_L is needed to evaluate (8).

Commentary

Both the studies commented upon here have made useful contributions to a more robust understanding of the problems faced in evaluating debt capacity considerations in capital budgeting. Where it is feasible to take them into account, bankruptcy cost considerations certainly offer an intuitively attractive addition to the model we proposed. Further, explicit consideration for risky debt in the CAPM framework will be necessary where B_U must be estimated via an estimate of B_L.

Finally, we briefly note two recent developments that have a direct bearing on the problem of project valuation. First, Miller [16] and several others have noted the debilitating impact of personal taxes on the original MM tax-adjusted valuation model. To the extent that their arguments withstand challenge, a dark cloud rests over the fundamental premise underlying the tax-adjusted valuation model as it was used here and elsewhere. Finally, to exit on a note of optimism, we point to the agency cost framework posited by

Jensen and Meckling [9] and a related working paper by Franke [5]. The agency cost theory views the firm as a contractual arrangement among several classes of security holders. Agency costs then provide the impetus for both positive and negative incentives for the use of debt financing. In a related work, Franke has proposed that the existence of imperfect and costly information creates decision and information rights which effectively "separate firm ownership and control." This separation, it will be recalled, provides the basis for Myers's second "chicken theory" of corporate debt policy. A complete evaluation of the implications of these theories for firm financial policies awaits further research, although Myers [19] has taken an initial step toward that objective.

References

1. Fisher Black, "Taxes and Capital Market Equilibrium," Working paper No. 21A, Associates of Finance, Belmont, Mass., 1971.
2. Richard S. Bower and Jeffrey M. Jenks, "Divisional Screening Rates," *Financial Management* (Autumn 1975), pp. 42–48.
3. Thomas E. Conine, Jr., "Debt Capacity and the Capital Budgeting Decision: A Comment," *Financial Management* (Spring 1980), pp. 20–22.
4. D. Farrar and L. L. Selwyn, "Taxes, Corporate Financial Policy, and Returns to Investors," *National Tax Journal* (December 1967), pp. 444–454.
5. Gunter Franke, "Information, Property Rights and the Theory of Corporate Finance," Proceedings of *Financial Management of Corporate Resource Allocations*, The Netherlands School of Business, Breukelen, Netherlands, August 7–10, 1979.
6. Robert S. Hamada, "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks," *Journal of Finance* (May 1972), pp. 435–452.
7. R. A. Haugen and L. Senbet, "The Insignificance of Bankruptcy Costs to the Theory of Optimal Capital Structure," *Journal of Finance* (May 1978), pp. 383–394.
8. Hai Hong and Alfred Rappaport, "Debt Capacity, Optimal Capital Structure, and Capital Budgeting," *Financial Management* (Autumn 1978), pp. 7–11.
9. Michael C. Jensen and W. H. Meckling, "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure," *Journal of Financial Economics* (October 1976), pp. 305–361.
10. E. Han Kim, "A Mean-Variance Theory of the Optimal Capital Structure and Corporate Debt Capacity," *Journal of Finance* (March 1978), pp. 45–64.
11. E. Han Kim, Wilbur G. Lewellen, and John J. McConnell, "Financial Leverage Clienteles — Theory and Evidence," *Journal of Financial Economics* (March 1979), pp. 83–109.
12. A. Kraus and Robert Litzenberger, "A State Preference Model of Optimal Financial Leverage," *Journal of Finance* (September 1973), pp. 911–922.
13. Wayne Y. Lee and H. Barker, "Bankruptcy Costs and the Firm's Optimal Debt Capacity: A Positive Theory of Capital Structure," *Southern Economic Journal* (January 1977), pp. 1453–1465.
14. John Martin and Kenneth Riener, "A Note On the Costs of Indebtedness and the Existence of an Optimal Capital Structure," Working Paper, Texas A&M University (August 1979).
15. John D. Martin and David F. Scott, Jr., "Debt Capacity and the Capital Budgeting Decision," *Financial Management* (Summer 1976), pp. 7–14.
16. Merton H. Miller, "Debt and Taxes," *Journal of Finance* (May 1977), pp. 261–275.
17. Merton H. Miller, "Taxes and Capital Market Equilibrium Under Uncertainty," Working paper No. 21B, Associates in Finance, Belmont, Mass., 1973.
18. Franco Modigliani and Merton H. Miller, "Corporate Income Taxes and the Cost of Capital: A Correction," *American Economic Review* (June 1963), pp. 433–443.
19. Stewart C. Myers, "Determinants of Corporate Debt Policies," *Journal of Financial Economics* (November 1977), pp. 147–175.
20. Stewart C. Myers, "Interactions of Corporate Financing and Investment Decisions — Implications for Capital Budgeting," *Journal of Finance* (March 1974), pp. 1–25.
21. Stewart C. Myers and Gerald A. Pogue, "A Programming Approach to Corporate Financial Management," *Journal of Finance* (May 1974), pp. 579–600.
22. James H. Scott, "Bankruptcy, Secured Debt and Optimal Capital Structure," *Journal of Finance* (March 1977), pp. 1–19.
23. R. C. Stapleton, "Taxes, the Cost of Capital and the Theory of Investment," *The Economic Journal* (December 1972), pp. 1273–1292.
24. J. Stiglitz, "Taxation, Corporate Financial Policy, and the Cost of Capital," *Journal of Public Economics* (April 1973), pp. 1–34.