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Capital structure with dividend restrictions

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Abstract

This paper develops a symmetric information model of a new firm which incorporates a constraint on dividend payments known as a balance sheet test. This test solves moral hazard problems that arise in credit markets where complete contracting over future actions is not possible. This constraint breaks down the traditional symmetric information result of separability between financial and real variables, and thus maximizing shareholder returns in this setting is not equivalent to maximizing total firm value. As a consequence, more profitable firms, those with a higher average product of capital, will have lower debt/equity ratios. Debt/equity ratios will be positively correlated with the firm's physical capital and negatively correlated with the firm's market power. © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

As Black (1976) states, firms that borrow have an incentive to pay dividends and leave creditors holding an empty shell. If returns in every state of the world could be allocated costlessly, creditors could choose an optimal dividend restric-

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tion for each firm. Creditors would contract for a restriction that left the firm enough collateral to meet debt payments in different states of the world. In reality, this contract would be overly expensive and would require updating every period. Smith and Warner (1979) hypothesize that simplified contracting can control the shareholder–bondholder conflict. They show how firms use debt covenants with a simple restriction on dividend payments as part of this contracting process.

This paper formally models the financial structure of a firm given basic dividend restrictions and profits from monopolistic competition. Because firms are restricted from capitalizing future profits into debt, firms' capital structures include equity. Firms cannot switch to 100% debt financing even if taxes make debt a cheaper source of capital.

Restating this more formally, dividend restrictions break down the separability between real and financial variables. When real and financial decisions are not separable, the Modigliani and Miller (1958) indifference results hold in a limited fashion without taxes or bankruptcy costs. A summary of the literature on real and financing decisions is available in Ravid (1988). Dotan and Ravid (1985) analyze a firm's investment and financing behavior under uncertainty with taxes, and Brander and Lewis (1986) among others analyze firm financing and oligopoly strategy. This paper adds to the literature by showing that dividend restrictions are sufficient to require the consideration of real and financial variables simultaneously. Moreover, with taxes, dividend restrictions imply that a unique capital structure exists which is not all debt, and a firm's production function determines the optimal amount of debt. Specifically, more profitable firms, those with a higher average product of capital, have more equity, as future dividends cannot be sold as debt. Dividend restrictions can thus produce the observed relation between profitability and capital structure, without the asymmetric information assumptions used by Myers and Majluf (1984). As a consequence, firms with greater market power will have lower debt/equity ratios. Firms with greater physical investment will have higher book values and thus use more debt.

Dividend restrictions can be incorporated in other models of capital structure such as those based on bankruptcy costs (Scott, 1976; Kim, 1978; Leland, 1994) or depreciation (DeAngelo and Masulis, 1980). Adding dividend restrictions to these models breaks down the separation between real and financial variables, which in turn makes maximizing the value of equity no longer equivalent to maximizing the value of the firm. Unlike prior studies, such as Scott (1976) or Kim (1978), a model with dividend restrictions only requires small bankruptcy costs to produce realistic debt/equity ratios.

Section 2 of this paper discusses the literature on dividend restrictions and why they are necessary. Section 3 develops a formal model with restrictions on dividend payments in a symmetric-information, one-period (two-date) model. Section 4 uses simulations to demonstrate how these assumptions can lead to commonly observed debt/equity ratios even if bankruptcy costs are low. Section 5 discusses the empirical implications of this model.

2. Why do we observe dividend restrictions?

John and Kalay (1982) model optimal dividend restrictions with asymmetric information and adverse selection. However, asymmetric information is not required for dividend restrictions to be a necessary part of the firm's financing decision. The problem posed by Black (1976) is one of moral hazard – firms that borrow may prefer to pay out funds rather than invest. Without dividend restrictions, creditors would not make loans since shareholders may prefer paying out all the firm's assets as dividends over making investments. Shareholders therefore make debt a viable contract by committing not to steal assets and leaving a certain amount of collateral with the firm. Basic forms of these agreements are included in state laws governing corporations, with additional restrictions sometimes included in debt covenants. The corporate statutes usually include a simple constraint: firms may not pay dividends or repurchase stock if the remaining assets are worth less than the face value of debt. [1] These restrictions are called either balance sheet tests or net worth tests, and they apply to stock repurchases, dividend payments, and any other transfer of assets to shareholders. Some states also have statutes which require payouts to come from the firm's retained earnings (see Manning and Hanks, 1990). [2]

Smith and Warner (1979) and Kalay (1982) describe the additional covenants included in many debt contracts, which further restrict the dividend payments of the firm. Malitz (1986), Asquith and Wizman (1990) and Lehn and Poulsen (1991) examine which firms include debt covenants and their relationship with LBO's. As the model below only has short-term debt, the analysis of additional covenants is limited. However, the simulations below demonstrate that consistent with empirical findings, creditors will require more risky firms to have more stringent restrictions.

Instead, the model below clarifies the impact of a basic dividend restriction, which may be particularly relevant as, according to Asquith and Wizman (1990), additional dividend restrictions have become less common in debt covenants since 1980. The decrease of additional covenants may be due to the strengthening of dividend restrictions in corporate statutes and in the American Bar Association's Model Act after 1979 (Eisenberg, 1983).

A primary effect of dividend restrictions is that financial and real decisions are

[1] To give an example, Eisenberg (1983) summarizes the California statues as, ''a distribution to shareholders is permitted only if (1) retained earnings equal or exceed the proposed distribution, or (2) immediately after the distribution, the corporation's assets will be at least one-and-one-quarter times its liabilities, and current assets will equal or exceed current liabilities.''

[2] Under unusual circumstances, older firms with high historical retained earnings may be able to get around the balance sheet test in some states. For a detailed discussion of one such firm, see Wruck (1996).

no longer separable. As the choice of capital structure is joined with the decision of how much capital goes into the firm's production function, maximizing firm value is no longer equivalent to maximizing shareholder wealth. Maximizing firm value is the correct objective in the firm's financing decision whenever the real production decisions of the firm are fixed. However, the dividend restriction can also be written as $K \geq D$, where K is capital and D is debt. This restriction imposes a relation between a real variable and a financial variable. With dividend restrictions these two decisions are no longer separable, and therefore maximizing value and maximizing returns to shareholders are no longer equivalent.

Before presenting the formal model, I illustrate the effect of the restriction on dividend payments with a simple example. Consider an owner/entrepreneur who maximizes income and thus maximizes equity. His nascent firm can be described by the following investment opportunity: With a US$50 capital investment, a sure return of US$110 is produced next year. If the cost of debt and equity are both 10%, the owner could borrow US$50 in debt at the market rate, and collect the remaining US$55 as net revenue next year. This net revenue is worth US$50 as current equity. In a Modigliani and Miller world, the owner could finance his firm by borrowing US$100 of debt and paying himself US$50 in the beginning of the period. The firm would then be all-debt financed. However, the US$50 payment to the owner is illegal under the net worth or balance sheet restriction because it reduces the firm's capital below the level of debt. The all-debt financing implies a payment to shareholders that reduces the value of assets below the face amount of outstanding debt, and is therefore illegal. Thus the minimum equity value of this firm can never be reduced below US$50 as long as this investment is undertaken.

As dividend restrictions cause the investment decision to be simultaneous with the financing decision, maximizing firm equity, or equivalently maximizing the net present value of equity, is not equivalent to maximizing the total present value of the firm. That is, when choosing between two mutually exclusive projects, managers choose the one that maximizes the value of equity, not firm value, equal to the sum of debt and equity.

Myers (1977) also considers a case where maximizing the value of equity is not equivalent to maximizing the value of the firm. In his model, firms have existing debt and equity, and shareholders will avoid additional equity investments because debt holders have priority on the firm's revenues. Unlike Myers (1977), the model presented here focuses on a new firm, and considers the specific impact of dividend restrictions.

Scott (1976) and Kim (1978) show how bankruptcy costs imply a unique optimal capital structure. When bankruptcy costs are added to my model they have the similar effect of reducing the optimal debt/equity ratio. Miller (1977), citing a study by Warner (1977), claims that bankruptcy costs are too small to account for observed capital structure given these models. In my model, small bankruptcy costs can produce debt/equity ratios in the commonly observed range although they depend on the production function specified.

As restrictions on payouts are accounted at book value, managers will be concerned with the book value of capital as well as the market value. If a firm has a monopolistic position in an industry, it will earn profits above its cost of capital, and thus the value of equity will be positive regardless of whether there is an initial equity investment. [3]

Kalay (1982) examines the degree to which dividend restrictions are binding for firms. He finds that firms maintain a reservoir of additional equity capital so as not to be exactly at the dividend constraint. This reservoir may be explained by adding bankruptcy costs to the model, or following Kalay, by arguing that firms need liquidity reservoirs to avoid underinvestment or overinvestment problems.

3. A symmetric information model of the firm with equity maximizing managers

3.1. Model setup

To motivate the model, consider the case of an entrepreneur/owner with a 'business opportunity' that produces profits under monopolistic competition. [4] The owner may sell this opportunity as stock without expansion, or invest her own money to expand the firm's capital. The owner may also enter into a contract with a bank or other creditor to finance this opportunity. Increasing the firm's capital allows for increased production, and, as with many models of monopolistic competition, the firm will face diminishing returns to investment. The owner then faces a capital problem with two variables, debt and equity investment, as possible choices for expanding capital.

Variables used in this model

R	firm earnings before interest or taxes
D	the amount of debt the firm borrows
M	the amount of capital invested in the firm by stockholders
K	total firm capital. By definition, $K = D + M$
$F(R,K)$	the cumulative distribution function (cdf) from which R is drawn
$F_R(R,K)$	the probability distribution function for R, that is, the derivative of the cdf with respect to R

[3] While a firm could recapitalize and increase the book value up to market value by adding goodwill, there are a number of legal limitations which do not allow firms to avoid dividend constraints in this way. I follow Smith and Warner (1979) and John and Kalay (1982) in assuming that recapitalizations are costly and therefore do not change the basic model.

[4] These results hold if the firm is a simple monopolist. Under oligopoly, the firm is still restricted from capitalizing future profits, but strategic interactions may apply as well (see Brander and Lewis, 1986, among others). Under perfect competition, no profits exist and the firm may be all debt financed.

i	the interest rate charged by creditors
r_s	the opportunity cost of stockholders' capital investment before corporate taxes, this is equal to the expected return on equity investments before corporate taxes
r_d	the opportunity cost of debt capital, equal to the expected return on debt before taxes
B	bankruptcy costs incurred if the firm does not earn enough to pay back creditors
τ_{co}	the corporate tax rate
τ_{ps}	the personal tax rate on equity
τ_{pb}	the personal tax rate on debt

3.1.1. Assumptions

A1. Managers' and equity's interests are perfectly aligned. Firm managers therefore maximize the expected value of equity.

A2. $F_K(R,K) < 0$. Distributions of earnings before interest based on higher capital stocks first order stochastically dominate distributions with lower financing. Another way to phrase this assumption is that investing more in the beginning of the period increases the probability of having more cash at the end of the period.

A3. $F_{KK}(R,K) > 0$ and $\lim_{K\to\infty} F_K(R,K) = 0$. While investing additional money produces a first order stochastically dominating distribution, this dominance is of diminishing strength as K grows large. That is, marginal investment is of decreasing value to the firm, or the firm faces diminishing returns to scale.

A4. Credit markets are perfectly competitive. This means that the expected value of creditor's investments must equal $1 + r_d$, the creditor's opportunity cost.

A5. Both creditors and equity holders are risk neutral.

A6. Interest and principal payments are fully deductible from corporate taxes.

A7. D and M are constrained to be greater than or equal to 0.

Notice that assumption A7 is critical to this model and could also be rewritten as $K \geq D$. If M were allowed to be negative, the balance sheet constraint would not be satisfied; investors could separate the real and financial decisions of the firm and standard results would hold. While the firm may be certain to receive future profits which are more than sufficient to cover debt payments, the law nevertheless restricts payments to shareholders unless the book value of the firm's assets are greater than debt. [5] Future profits do not count as assets in this calculation.

To make the model manageable, I assume a one-period (two-date) model. In the beginning of the period, the owners choose the amounts of debt and stockholders' investment, D and M. Creditors then competitively set an interest rate i for debt payments. At the end of the period, the firm's production is drawn from $F(R,K)$. Debt is paid, and all remaining earnings go to the shareholders.

As this is a one-period model, there are no reputation effects, and additional debt covenants are expressed in the announced capital structure. For example, in a multiperiod model creditors may want capital to be kept greater than 150% of debt before a dividend payment can be made. In this one period model, creditors know that $M \geq 0.5D$ before they make the loan, and thus additional dividend restrictions are, in this highly simplified setting, chosen endogenously by positive values of M. Moreover, as the simulations below show, more risky firms will choose higher levels of equity investment. In this simple model, this corresponds to more risky firms choosing more restrictive covenants.

The firm borrows D, and has to repay $D(1+i)$ at the end of the period. If the firm's earnings before interest or taxes, R, are too small to pay $D(1+i)$, then the firm pays back $R-B$, where B is the cost associated with bankruptcy proceedings. If revenues are sufficient to pay principal plus interest, equity holders keep the resulting profit after taxes. Maximizing expected end of period profit is equivalent to maximizing the value of the entrepreneur's stock at the beginning of the period. While cash flows are not explicitly discounted from the end of the period, the solution is the same in this risk-neutral model.

Personal taxes only enter the model to determine the opportunity cost of debt and equity capital. As in Miller (1977), in an economy-wide equilibrium, after-tax rates of return should be equal. Because capital gains are taxed at a lower rate, τ_{ps}, the effective personal tax rate on equity, is less than τ_{pb}, the personal tax rate on debt. Then, following Miller (1977), in equilibrium:

$$r_s(1-\tau_{co})(1-\tau_{ps}) = r_d(1-\tau_{pb}). \tag{1}$$

Given current American tax rates, this equation suggests that r_s may be larger than r_d, although as Miller discusses, marginal tax rates may make r_s equal to r_d. [6] In either case, firms may choose an optimal capital structure which includes

[5] Actually, $M \geq 0$ only in the case of a no-par stock and with the simplest dividend restriction. Otherwise, M must be greater than or equal to the stated par of the stock. Similarly, if the dividend restriction called for capital to be 125% of debt, $M \geq 0.25D$. A corporation chooses stated par upon first issuing stock, but can change it over time. Stated par is currently often very low.

[6] An additional determinant of these rates is that assets held by tax-free institutions, such as pension funds or IRA's, have to pay corporate taxes on equity earnings but are exempt from personal taxes. They may therefore favor debt over equity investments relative to taxed assets (for $\tau_{pb} > \tau_{ps}$). This preference suggests that an equilibrium could exist where the marginal investor holds debt in tax-free accounts and equity in taxed deposits: $r_s(1-\tau_{co})(1-\tau_{ps}) \geq r_d(1-\tau_{pb})$ and $r_s(1-\tau_{co}) \leq r_d$.

equity because of bankruptcy costs, tax shelters, and dividend restrictions. I consider the implications of dividend restrictions on capital structure where r_s is greater than, equal to, or less than r_d below.

3.2. Model solution

This sequential game is solved by backward induction. First, consider the creditor solving the second move problem, choosing an interest rate i for a given D and M. Then the firm, knowing what interest rate it will be charged for any capital structure, chooses D and M in the first move to maximize expected profits. Because the creditor chooses a unique i for any D, the firm simply maximizes expected profit.

The creditor's expected income is given by

$$D(1+r_d)=\int_0^{D(1+i)}(R-B)F_R(R,K)\,\mathrm{d}R+\int_{D(1+i)}^{\infty}D(1+i)F_R(R,K)\,\mathrm{d}R. \quad (2)$$

Eq. (2) thus implicitly specifies the interest rate i chosen by the creditor. The firm solves

$$\max_{D,M}(1-\tau_{co})\left\{\int_{D(1+i)}^{\infty}[R-D(1+i)]F_R(R,K)\,\mathrm{d}R-M(1+r_s)\right\} \quad (3)$$

subject to:

$$D(1+r_d)=\int_0^{D(1+i)}(R-B)F_R(R,K)\,\mathrm{d}R+\int_{D(1+i)}^{\infty}D(1+i)F_R(R,K)\,\mathrm{d}R$$

and

$$K=D+M, \qquad K\geq 0,\ M\geq 0.$$

In Eq. (3), the firm is maximizing the expected value of profit after debt service, less the opportunity cost of the stockholders' capital. This equation has an important potential corner solution. If D is equal to zero, then the constraint imposed by creditors from Eq. (2) is not binding. Thus, some firms may not be able to obtain debt financing, and Eq. (2) will have no solution for i. In this case, the problem simplifies and the firm maximizes over M.

Eq. (3) may be rewritten as an unconstrained optimization. Using Eq. (2) and substituting $K=D+M$ yields

$$\max_{D,M}(1-\tau_{co})\left\{\int_0^{\infty}RF_R(R,D+M)\,\mathrm{d}R-D(1+r_d)-BF(D(1+i),D+M)-M(1+r_s)\right\} \quad (4)$$

subject to $K\geq 0,\ M\geq 0$.

The first-order condition with respect to D is

$$(1+r_{\mathrm{d}}) = \int_0^{\infty} RF_{RK}(R, D+M)\,\mathrm{d}R - B\Big\{F_R(D(1+i), D+M) \times \Big[(1+i) + D\frac{\mathrm{d}i}{\mathrm{d}D}\Big] + F_K(D(1+i), D+M)\Big\} \tag{5}$$

and with respect to M:

$$(1+r_{\mathrm{s}}) = \int_0^{\infty} RF_{RK}(R, D+M)\,\mathrm{d}R - B\Big\{F_R(D(1+i), D+M)\,D\frac{\mathrm{d}i}{\mathrm{d}M} + F_K(D(1+i), D+M)\Big\}. \tag{6}$$

For reasonable values, $\mathrm{d}i/\mathrm{d}D > 0$, and $\mathrm{d}i/\mathrm{d}M < 0$.

Expanding this model to include tax shelters is relatively straightforward. Following DeAngelo and Masulis (1980), Eq. (4) can be changed to include tax-exempt income due to tax-credits and non-debt deductions.

3.3. Implications for capital structure

The model presented above provides realistic implications about capital structure. Even without bankruptcy costs, firms will be financed by both debt and stock. In contrast prior classical models of the firm generally assume an optimal capital input, then maximize the financial structure using the objective function: $V = D + E$, where V is firm value, the sum of outstanding debt and stock. When a firm's maximization is constrained so that real investments and financial decisions are not separable, maximizing firm value is not generally equivalent to maximizing shareholder wealth.

The reason for the non-zero equity implications of the model presented here lie in the constraints placed on debt and equity investments. D, debt, always enters the investment decision, whereas in classical models debt and equity are decided for a given level of investment. Additional debt financing in a classical model goes directly to payments to shareholders. By limiting dividend payments, an increase in debt must increase the capital used by the firm. Shareholders then face a more complex problem which is most appropriately modeled by the constrained maximization above.

To further explore the implications of the model introduced above, consider first the case where $B = 0$. The first-order condition for debt (assuming there exists an interest rate which makes creditors participate) is

$$(1+r_{\mathrm{d}}) = \int_0^{\infty} RF_{RK}(R, D+M)\,\mathrm{d}R, \tag{7}$$

and the first-order condition for equity investments is

$$(1+r_s) = \int_0^\infty R F_{RK}(R, D+M)\,\mathrm{d}R. \qquad (8)$$

If $r_d < r_s$, then debt financing is cheaper than equity financing. As long as there exists an interest rate which makes creditors participate, firms will issue only debt and set $M=0$. But this does not imply that the equity value of the firm is equal to zero. Instead, the equity value is the expected discounted residual after debt service. Firms for which $r_d < r_s$ and $B=0$ will thus use debt financing repeatedly, but sell stock at most once. They will not want new equity financing, but if the original owners decide to cash-out, they will take the firm public and sell stock. Moreover, if the firm on average generates higher cash flows with a given amount of capital, it will have a larger equity value. That is, while all firms will have the same condition on the marginal product of capital, those with higher average product of capital will have higher equity values. This aspect of the model is demonstrated in the simulations below.

Next, consider if marginal tax rates cause $r_s < r_d$. Firms will set $D=0$, and only use equity for capital. However, firms may also be constrained to only equity financing if there is no interest rate i satisfying Eq. (1), the creditor's break-even equation.

Lastly, consider the case described by Miller (1977), where market forces cause r_s to equal r_d at the margin. Firms are now indifferent between equity and debt financing. Investors' profits as well as the market value of the firm are independent of capital structure as Modigliani and Miller (1958) showed, but the limitation on dividend payments makes the value of equity strictly positive.

This similarity to Modigliani and Miller's classical result begs the question: does maximizing equity value also maximize firm value? The answer to this question depends on the assumption one makes about the tax equilibrium. If r_s is equal to r_d, then maximizing equity value is equivalent to maximizing firm value, although the capital structure with dividend restrictions will generally have to include equity. Whenever r_d is less than r_s, the firm could add debt and thus increase total firm value while decreasing the value of equity. [7]

4. Simulation

To simulate this model, I set r_s equal to 0.05 and r_d to 0.03. Thus I assume the marginal tax rates given by Eq. (1) favor debt financing. I ignore the effect of non-debt tax shields for this simulation. I next choose $F(R,K)$ distributed

[7] For $B=0$ and holding $M=0$, add D to the firm's maximand and discount the equity value by $(1+r_s)$ so as to put all terms in first-period dollars. The firm then sets: E[marginal revenue] $= r_s - r_d$.

normally with mean $\alpha + 1.5K - 0.1K^2$ and variance σ^2. This quadratic specification has diminishing returns to capital investment as required to match assumptions A2 and A3. Without actual estimates of a production function, I choose one that produces a simple first order condition, but where the average product of capital varies. The average product of capital (not including bankruptcy costs) is given by

$$\mathrm{APK} = \frac{\alpha + 1.5K - 0.1K^2}{K}. \tag{9}$$

I vary α over a range from 0 to 3 to provide a variety of debt/equity ratios and illustrate how changing these inputs affects capital structure. I vary σ, the standard deviation of earnings from 0.2 to 1.2.

To demonstrate how the constraint on stock payments ($M \geq 0$) affects capital structure, I begin by simulating debt/equity levels in the case where $B = 0$. Note that the definition of equity is not M, the investment made by firm owners, but the value of stock (see Eq. (3)). That is, equity value is defined as the present discounted value of the expected net earnings at the second date. Fig. 1 offers a set of debt/equity ratios without bankruptcy costs. As firms no longer face a penalty for going bankrupt, debt/equity ratios do not vary with changes in the standard deviation of firm earnings.

While the theoretical section above developed results using the simpler assumption of a constant B, the numerical simulation methods allow me to make the more realistic assumption of variable bankruptcy costs. I assume $B = 0.1K$, which

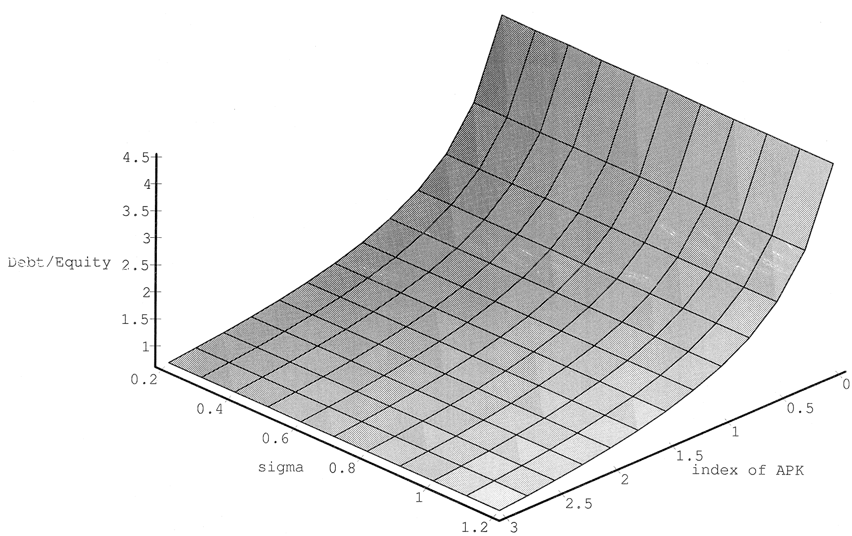

Fig. 1. Debt/equity ratio, no bankruptcy costs.

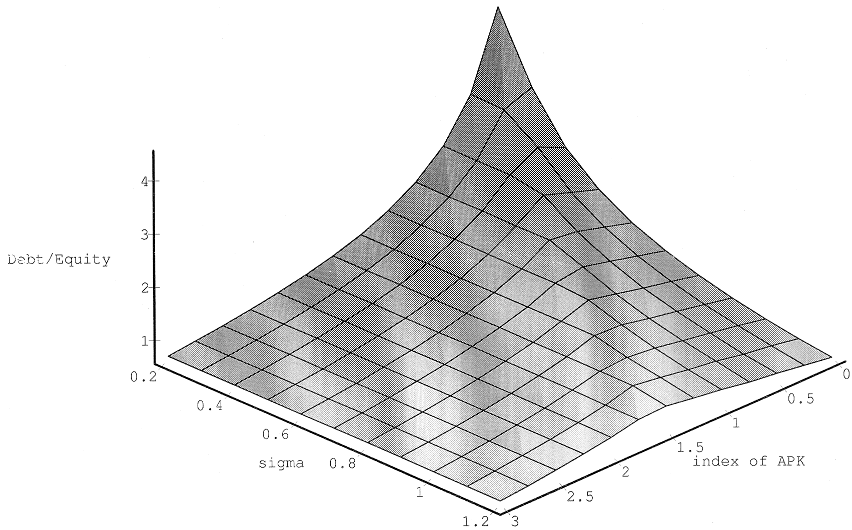

Fig. 2. Debt/equity ratio, $B = 0.1 * \text{debt}$.

is larger than the administrative costs found by Warner (1977) in railroad bankruptcies, but smaller than the costs calculated by Altman (1984).

Fig. 2 graphs debt/equity ratios for $B = 0.1K$. Notice that a higher variance decreases the debt/equity ratio as debt becomes more risky and expensive. If one extends the graph toward higher variances, no debt would be issued.

Fig. 3 shows the interest rates required to meet the creditors' participation constraint. As expected, higher variances lead to higher interest rates, and less debt issued. Because this is a simple one-period model, no attempt is made to scale

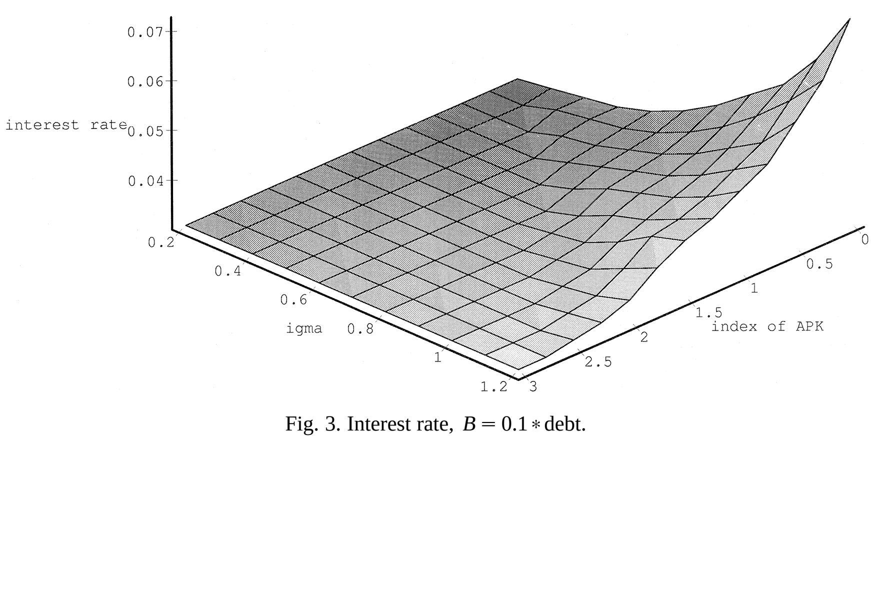

Fig. 3. Interest rate, $B = 0.1 * \text{debt}$.

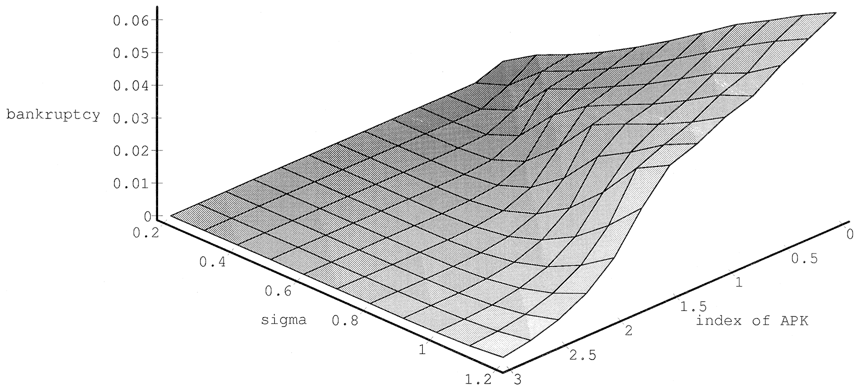

Fig. 4. Probability of bankruptcy, $B = 0.1 * \text{debt}$.

these numbers toward more realistic interest rates. Fig. 4 plots the probability of bankruptcy for the firm. As expected, this closely follows the interest rate graph.

Fig. 5 shows the equity investment, M, for various average products of capital and risk. Firms with higher risk and lower average product of capital choose non-zero initial equity investments. In this simple model, this demonstrates which firms would choose covenants further restricting dividends. That is, firms which choose to make an equity investment greater than zero are binding themselves, for this one period game, to a restriction greater than the minimum given by a balance sheet test. Instead of just raising capital through debt, they also make an additional equity investment. In a multiperiod model, these low earnings, high-risk firms would want to bind themselves with additional covenants to greater levels of equity capital.

These results improve on existing simulations in two ways. Other authors, such as Kim (1978), have been criticized for using overly large bankruptcy costs in

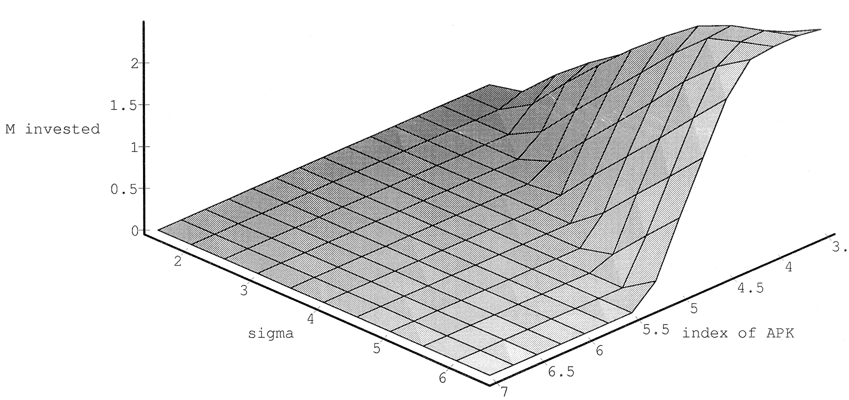

Fig. 5. Equity investment, $B = 0.1 * \text{debt}$.

order to produce reasonable debt/equity ratios. Bradley et al. (1984) are able to produce more reasonable simulations by using high values for non-debt tax shields, but dividend restrictions can also produce lower debt/equity ratios and imply a particular relation between the average product of capital and the firm's financial structure.

5. Empirical implications

The negative correlation between the average product of capital and debt/equity ratios may account for several features of actual capital structures. First, higher levels of physical assets, such as property plant and equipment, are generally correlated with higher levels of debt (Friend and Lang, 1988; MacKie-Mason, 1990). Given the restrictions on equity payments, this correlation can easily be explained within the context of this model as capital is often first funded by debt. Second, profitability is negatively correlated with debt/asset ratios (Kester, 1986; Friend and Lang, 1988) and is among the most important determinants of capital structure. High profitability, usually defined as earnings before interest and taxes (EBIT) divided by book value of assets, may be a good proxy for the firm's average product of capital. If the book values of assets is correlated with capital investment rather than the market value of debt and equity, profitability is highly correlated with the average product of capital.

Whereas Myers and Majluf (1984) explain the negative correlation between profitability and debt/equity ratios using an asymmetric information model, at least part of this relation may be due to the average product of capital effect modeled above. Besides predicting the positive relation between tangible assets and debt, and the negative relation between profitability and debt, this model also suggests that firms with greater monopoly power would have a lower debt/equity ratio. Thus, a negative correlation would exist between debt/equity ratios and Herfindahl–Hirschman indexes across industries. This model would also be consistent with an overall decrease in debt/equity ratios as consolidation occurs in an industry.

The relation between profitability and debt/equity ratios may also be more pronounced for those firms subject to stricter restrictions on dividends. Thus firms in states subject to stricter restrictions would have lower debt/equity ratios. This analysis may also help explain the differences in the impact of profitability across countries. Rajan and Zingales (1995) show that profitability has a larger impact on capital structure in Japan than in the US. This finding may be better explained by differences in monopoly power between Japan and the US, than by greater asymmetric information in Japan. Additionally, an asymmetric information explanation may be less likely given the study by Hoshi et al. (1991), which suggests that Japanese firms have lower asymmetric information costs than similar US firms.

While these facts suggest that the predictions of this model may be visible in empirical data, further studies may be needed to determine the relative importance of the average product of capital relative to asymmetric information on capital structure.

6. Conclusion

This paper explores the consequences for capital structure of dividend restrictions. As dividend restrictions are a relation between a real and a financial variable, maximizing shareholders' equity under dividend restrictions is not equivalent to maximizing the value of the firm. The model presented here produces more realistic implications, including non-zero equity values for all firms even with symmetric information and a tax advantage for debt.

Moreover, a model of bankruptcy costs and dividend restrictions does not require high bankruptcy costs to produce low debt/equity ratios. In this model the average product of capital becomes a primary determinant of the firm's optimal capital structure, and more profitable firms have lower debt/equity ratios. This symmetric information model thus provides an alternative view of firm profitability and capital structure.

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