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Capital Structure as an Optimal Contract Between Employees and Investors

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ABSTRACT

The ex ante optimal contract between investors and employees is derived endogenously and is interpreted in terms of debt, equity, and employees' compensation. Although public equity financing is feasible in this model through verified accounting income, debt is needed to force value-enhancing restructuring before the income realizes. The optimal debt level, however, is lower than that which maximizes the value of the firm when there is nonmonetary restructuring-related cost to employees. The paper explains how stock prices react to exchange offers, how earnings can be diluted by a decrease in leverage, and why employees' claims are generally senior to those of investors. New testable implications about leverage and compensation levels are derived.

INVESTORS AND EMPLOYEES ARE the most important stakeholders in the firm. The contractual arrangements involving employees and investors should play a major role in the theory of the firm. This paper explicitly analyzes the contracting problem between employees and investors. It shows that the firm's capital structure can be a part of the optimal contract. The extant finance literature has studied the role of capital structure in mitigating the agency problem between employees and investors (see Jensen and Meckling (1976)). Some economists, however, have asked why capital structure, in addition to compensation schemes, has to be used as an incentive device (see Hart and Holmstrom (1987), for example). One cannot answer this question without explicitly analyzing the optimal contracting problem.

The existing economic literature on contracting mainly studies managerial "shirking" problems and "stealing" problems. In the models that deal with the shirking problem, employees have incentives to shirk, and the contract is structured to motivate them to work. The optimal contract derived is inter-

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preted as a compensation contract.[1] Financial contracts can be obtained in the models that deal with the stealing problem. However, the only feasible *external* financing in those models is through debt, because the firm's true income is unverifiable without cost and the employees can steal it for their own consumption.[2] These models can only explain the capital structure of privately held firms.

This paper deals with the firm's restructuring decisions. Restructuring involves asset liquidation, job reassignments and relocation, cost cutting, and so on. For example, it may involve closing down some of the firms' operations or reducing the spending that facilitates employees' job performance, such as canceling purchases of equipment. If future output is expected to be low, restructuring can improve the firm's financial performance by directing resources to alternative uses. The employees, however, will incur nonmonetary losses as a result of restructuring. The losses include, among other things, the time and effort that the relocated employees spend to learn new skills for new job assignments, and the extra effort required of the employees due to a more demanding working environment.

A contract in this setting consists of the firm's restructuring rule and the profit sharing rule. The optimal, or "first-best", contract insures the risk-averse employees against their income risk. When the *expected* output can be observed rather than verified, the restructuring rule cannot be made contingent on the expected output. The employees have no incentive to restructure the firm. Debt can be used to implement the first-best restructuring rule. If the expected output exceeds the debt payment, the debt can be rolled over and restructuring will not occur. Otherwise, the firm will be forced to restructure, because in default the investors are given control of the firm.[3]

The ex ante optimal debt level balances the financial as well as the nonfinancial benefits and costs of restructuring. Interestingly, unlike some tradeoff models (Jensen and Meckling (1976), Harris and Raviv (1990a) or Stulz (1990), for example), we show that the optimal debt level is generally below the level that maximizes the financial value of the firm because the restructuring-related loss to the employees has to be accounted for.[4] The nonmonetary loss in restructuring cannot be compensated for by the investors, because restructuring can take many forms and hence the contract cannot be made contingent on whether restructuring has occurred. The model

[1] See Hart and Holmstrom (1987) for a review of these models.

[2] See Townsend (1979), Diamond (1984), Gale and Hellwig (1985), Hart and Moore (1989), and Chang (1990). See Allen (1990) and Harris and Raviv (1990b) for survey and critique.

[3] Jensen (1986), Harris and Raviv (1990a), and Stulz (1990) also assume that debt can be used to force the firm to liquidate or restructure. Aghion and Bolton (1988) and Zender (1991) view default as a transfer of control. In their models, the control transfer is from owners to creditors rather than from managers to creditors.

[4] Titman (1984) first recognized that investors may have incentives to overliquidate the firm when they ignore nonfinancial stakeholders' benefits from continued operation. He dealt mainly with the effect of liquidation on customers. He did not model explicitly the optimal contracting problem.

thus implies a positive relationship between the value of the firm and leverage. This relationship is one of "the two most striking facts about corporate finance" according to Myers (1990).[5]

Although the optimal debt level does not maximize the firm value, it is the level that gives the investors their required return. In the model, an exchange offer can be viewed as a result of recontracting after the investors' required return subsequently changes. When the investors' required return rises, the leverage of the firm will rise and a debt-for-equity exchange can occur. The opposite is true when the investors' required return falls. The model thus offers a new framework to interpret the empirical results on exchange offers (see Masulis (1980)). In this paper, we also show that a decrease in leverage can dilute earnings. Testable implications are derived jointly for the firm's debt level and the employees' compensation level.

Much of the existing literature on the firm's capital structure has taken the *forms* of financial instruments as exogenous and assumes that the firm can issue only debt and equity. In this model, the form of the firm's capital structure is *endogenous*. By endogenizing the forms of financial instruments, we can better understand the conditions under which debt-equity combination becomes optimal as well as the determinants of capital structure.[6]

In the model, the payoff to the investors comes from the firm's profit that is verified through accounting and auditing mechanisms. The presence of rigorous accounting procedures is one feature that distinguishes widely held public corporations from small, privately held firms. Although public equity financing is feasible in this model through verified accounting income, debt is needed to force value-enhancing restructuring before the income realizes.[7]

This paper proceeds as follows. The first section describes the model. The optimal contract between the investors and the employees is characterized in Section II. In Section III, it is shown that the optimal contract can be achieved by capital structure consisting of debt and equity. Comparative static results are derived in Section IV. In Section V, we discuss implications of the model for exchange offers. Some extensions of the model are discussed in Section VI. Section VII concludes the paper. All proofs are in the Appendix.

I. The Model

The model has three dates: 0, 1, and 2. At date 0, the contract between the firm's employees and investors is signed subject to the capital market con-

[5] Myers (1990) has sketched "an organizational theory of capital structure" which in some regards is similar to the theory developed here. He does not, however, develop a formal model.

[6] Some economists have advocated such an approach. See Jensen and Meckling (1976, p. 332), Ross (1987, p. 29), Holmstrom and Tirole (1989), and Dybvig and Zender (1991).

[7] When earnings are retained partially, one may question the effectiveness of accounting mechanisms. Investors, however, seem to pay a lot of attention to accounting returns. Thus retained earnings may not be wasted for very long.

straint that the expected payoff to the investors is at least v.[8] One can view v as the initial investment times the interest rate or as the value of the firm below which a takeover will occur (see more discussion on the latter interpretation in Section IV). v will be referred to as the investors' required return.

To focus our attention on the conflict of interest between employees and investors, we will ignore possible conflicts of interest among employees. In this model, the term employees refers to the firm's managers and other key employees. Initially, we will not divide the investors into shareholders and bondholders. That distinction will be made after we derive the optimal contract.

The firm produces a single random output y at date 2. y is the difference between the firm's revenue and operating costs except the employees' compensation. y is verified through accounting and auditing mechanisms. In accounting terms, y is the firm's income before wages and debt payments. Henceforth, y will be referred to as the output. y net of the employees' compensation will be referred to as the operating income.

The value of y at date 2 will depend on whether the firm's operation is restructured at date 1. Restructuring refers to a major change in the firm's operation. It may involve asset sell-off, plant closing, job reassignment, cost cutting, and so on. Restructuring can increase the firm's output when the expected output from current operation is not good and the firm's resources can be put in alternative uses.

If the firm is not restructured at date 1, the date 2 output can be written as $y = x + \varepsilon$, where both x and ε are random variables. x is realized at date 1 and ε at date 2. ε has zero mean and is uncorrelated with other random variables in the model. x will be referred to as the date 1 expected y without restructuring. If the firm is restructured, the date 1 expected y is $T(x)$ and the date 2 output is $y = T(x) + \delta$, where δ is a zero-mean random variable uncorrelated with other random variables in the model.

We make two assumptions about restructuring. First, the employees will incur a nonmonetary loss as a result of restructuring (the loss may also be interpreted as the loss of future monetary benefits that cannot be contracted on ex ante due to contract incompleteness. See Footnote 19). Restructuring may reassign or relocate the employees to new jobs. The employees may have to spend time and effort to learn new skills. Cost cutting associated with restructuring can require more effort on the part of the employees to perform their jobs.

Second, it is assumed that ex ante contract cannot be made contingent on whether restructuring has occurred or not. Restructuring can take many forms. It may be very difficult to distinguish restructuring decisions from many normal business decisions. This assumption in fact is not crucial (see Section VI).

[8] For large, widely held corporations, the assumption that the investors behave competitively is not implausible. In any event, this assumption is not crucial. The major results would be preserved if the employees behaved competitively. See Section VI for more discussion.

Let P be the date 2 payment to the investors. P can be made contingent on the verifiable variables in the model. The employees' aggregate utility is $U(y - P) + V(z)$ if the firm is not restructured and is $U(y - P) + V(0)$ if the firm is restructured. $V(z) - V(0) > 0$ represents restructuring-related nonmonetary loss to the employees. To simplify the notation, $V(z) - V(0)$ will be denoted by Q.

The specification of the employees' preferences is similar to that of Jensen and Meckling (1976) and to that in the principal-agent models (see Hart and Holmstrom (1987) for a survey). In the principal-agent models, the employees privately choose the level of effort. In this model, the firm's restructuring decisions will affect the effort level (or nonpecuniary benefits).

The employees maximize their expected utility. The function $U(\ )$ is strictly increasing and strictly concave. The investors are assumed to be risk neutral and to maximize their expected payoff. The risk neutrality assumption can be justified by the fact that investors can diversify their portfolio risk in capital market. As noted earlier, the investors behave competitively and require an expected payoff of v at date 0.

It is assumed that x, the date 1 expected value of the date 2 output without restructuring, is observable but not verifiable at date 1.[9] Expectations about output are more costly to verify than tangible output. The distribution function of x, $F(x)$, is differentiable, and the density function for x is strictly positive on its support $[L, H]$. We will ignore taxes.

II. The Optimal Contract

At date 0, a contract between the employees and the investors consists of a date 1 restructuring schedule and a date 2 payment schedule to the investors. In this section we assume temporarily that x is verifiable at date 1 and derive in some sense the first-best contract. Contracts can be made contingent on verifiable variables. Thus, the restructuring schedule can be made contingent on x and the payment schedule can be made contingent on both x and y. We denote the restructuring schedule by $s(x)$ and the payment schedule by $P(x, y)$. $s(x)$ is the probability that the firm will be restructured.

The optimal contracting problem at date 0 is as follows.

$$\begin{aligned} \max_{s(x),\, P(x,y)} \quad & E[s(x)[U(y - P(x,y)) + V(0)] \\ & +[1 - s(x)][U(y - P(x,y)) + V(z)]] \qquad (1) \\ \text{s.t.} \quad & E[P(x,y)] \geq v. \end{aligned}$$

The monetary income of the employees is $y - P(x, y)$. Furthermore, when the firm is restructured, $V(z)$ will be reduced to $V(0)$.

[9] The distinction between observability and verifiability has been made by, among others, Grossman and Hart (1986). Only contracts contingent on verifiable variables can be enforced by courts.

Since the employees are risk averse with regard to their monetary income and the investors are risk neutral, the optimal contract should provide the employees with a complete insurance with regard to their monetary income. This is achieved by paying the employees a constant compensation w.

Proposition 1: *For any given restructuring schedule $s(x)$, the optimal compensation to the employees is w. The optimal payment schedule to the investors, $P(x, y)$, is $y - w = x + \varepsilon - w$ if the firm is not restructured and $y - w = T(x) + \delta - w$ otherwise.*

This result shows that the employees' claim should be senior to the investors' claim, a phenomenon we commonly observe. Since the employees are risk-averse and the investors are risk neutral, it is more efficient for the investors to bear the residual risk.

In problem (1), if we substitute the expressions of Proposition 1 and take the expectation of y by first taking x as given, the problem can be rewritten as

$$\max_{s(x),\, w} E[s(x)[U(w) + V(0)] + [1 - s(x)][U(w) + V(z)]] \tag{2}$$

$$\text{s.t.} \quad E[s(x)[T(x) - w] + [1 - s(x)](x - w)] \geq v.$$

We assume that there exists a solution to (2). Denote by λ the multiplier for the capital market constraint in (2), the first-order necessary conditions for the optimal contract are

$$U'(w) = \lambda, \tag{3}$$

and $s(x) = 1$ if

$$T(x) > x + Q/\lambda, \tag{4}$$

and $s(x) = 0$ otherwise, where $Q = V(z) - V(0)$.[10]

Inequality (4) states that restructuring should occur whenever its benefit is higher than its cost. The benefit from restructuring is $T(x)$. The restructuring cost (monetary plus nonmonetary) is $x + Q/\lambda$.

Since (3) implies $\lambda > 0$, the capital market constraint must be binding for the optimal contract. It can be written as

$$E[s(x)(T(x) - w) + [1 - s(x)](x - w)] = v. \tag{5}$$

In order for the optimal contract to exhibit the property of a debt contract, we need the following assumption on the date 1 expected output given restructuring, $T(x)$.

Assumption 1: *$T(x)$ exceeds x if and only if x is less than a constant in (L, H).*

Intuitively, the assumption says that suppose the restructuring decision is made by comparing the financial benefits x with $T(x)$, then it is optimal to restructure the firm if and only if the date 1 value of the firm without restructuring, x, is too low. This assumption seems quite plausible.

[10] Note that when $-Q + \lambda[T(x) - w] = 0$, $s(x)$ could be any number between 0 and 1. We assume that it is 0 for simplicity.

Under Assumption 1, inequality (4) is equivalent to $x < m$, where m is determined by[11]

$$-Q/\lambda + T(m) - m = 0. \tag{6}$$

Since the wage payment w will be made first before the investors are paid, the expected operating income available for the investors without restructuring is $x - w$. By defining $D = m - w$, we can write the optimal restructuring schedule in terms of $x - w$ and D.

Proposition 2: *Under Assumption* 1, *the optimal restructuring schedule is*: $s(x) = 1$ *for* $x - w < D$ *and* $s(x) = 0$ *for* $x - w \geq D$. *That is, restructuring should occur whenever the date* 1 *expected operating income is below D.*

It is instructive to compare the optimal restructuring schedule with the one that maximizes the value of the firm. Given that the investors expect to receive $x - w$ without restructuring and $T(x) - w$ with restructuring, their expected payoff will be maximized when the firm is restructured if and only if $T(x) - w - (x - w) > 0$. Under Assumption 1, this is equivalent to $x < M$, where M is determined by

$$T(M) - M = 0. \tag{7}$$

Define $C = M - w$. Then the restructuring schedule maximizing the firm value becomes: $s(x) = 1$ if and only if the expected operating income, $x - w$, is less than C. It will become clear later that C can be regarded as the firm's debt capacity.

The difference between equation (6) and equation (7) is that (6) contains an extra term $-Q/\lambda$, which represents the expected cost to the employees when the firm is restructured. Thus, it is not surprising that the optimal restructuring schedule that takes into account Q does not maximize the firm value.

Proposition 3: *Suppose* $Q = V(z) - V(0) > 0$. *Then* $m < M$ (*or equivalently*, $D < C$). *That is*, *the optimal restructuring schedule does not maximize the firm's value*.

The restructuring-related loss to the employees, Q, is what is driving the result here. If Q were 0, D would be the same as C. Note that the employees may be risk averse with regard to z (i.e., $V''(z) < 0$). But this risk cannot be insured by the investors because contract cannot be made contingent on whether restructuring has occurred. In fact, even if a contingent contract was possible, the result would hold provided that the loss z cannot be traded (see Section VI).

The expected payoff to the investors is shown in Figure 1.

[11] If for all m in (L, H), $-Q/\lambda + T(m) - m > 0$, then m is defined to be L.

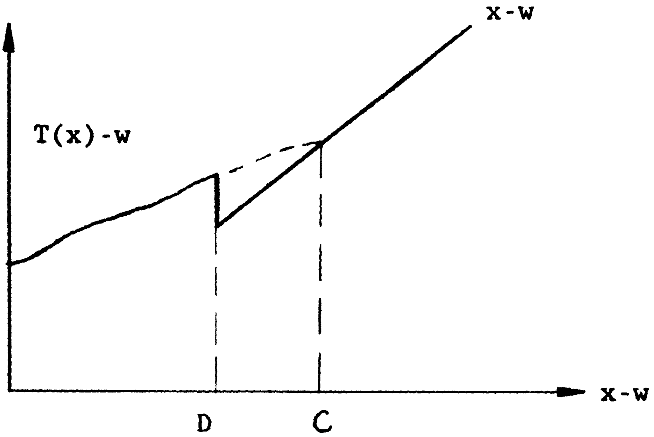

Figure 1. The payoff to the investors.

III. Debt and Equity as Optimal Contract

If the expected output x is verifiable as we have assumed in the previous section, the optimal, or first-best, contract can be achieved by implementing the compensation schedule and the restructuring schedule directly. Since the restructuring schedule depends on x, it cannot be enforced if x is not verifiable. In this section, we show that the optimal restructuring schedule derived above can be achieved by a combination of debt and equity when it is costly to verify x.

A debt contract entitles its holders to a promised payment. If the debtholders fail to receive the promised payment, they will be given control of the firm's restructuring decision.[12] An equity contract entitles its holders to receive whatever is left of the date 2 output y after the employees and the debtholders are paid. The equityholders will not be given the control of the firm's restructuring decision (see more discussion on this point below).

The optimal contract can be achieved by issuing equity and debt with D as the date 1 promised payment on the debt, and by giving the employees the control of the firm's restructuring decisions unless the firm defaults on the debt.

Since the firm has no cash flow at date 1, making the promised payment due at date 1 is intended to induce restructuring. If the expected operating income $x - w$ is above the promised payment D, D can be refinanced at date 1 (note that investors can observe $x - w$). For example, the debt can be rolled over. The firm will not be restructured.[13] If $x - w$ is below the promised

[12] This may be a simplification of the bankruptcy practices in many countries. However, in bankruptcy the firm's major decisions cannot be carried out without the approval of its creditors. Aghion and Bolton (1988), and Zender (1991) also view bankruptcy as a transfer of control.

[13] Since the model is not a dynamic one, we cannot address the role of the new financing in subsequent restructuring decisions. In fact, the form of the new financing is indeterminate as long as its value at date 1 is D.

payment D, D cannot be refinanced without restructuring and the firm will default on D. The debtholders will be given the right to restructure the firm and restructuring will occur. The debtholders' date 1 expected payoff is $\mathrm{Min}(T(x) - w, D)$ and the equityholders' date 1 expected payoff is $\mathrm{Max}(0, T(x) - w - D)$.

To summarize, when the debt payment is D, restructuring will occur at date 1 if and only if $x - w < D$. Thus, the optimal restructuring schedule is achieved by the debt-equity combination.

In Figures 1, 2, and 3, respectively, the expected payoffs to all the investors, to the debtholders, and to the equityholders are illustrated as functions of $x - w$, the date 1 expected operating income without restructuring. Note that the expected payoff to the investors is not continuous at D because $T(x) - w$ is strictly above $x - w$ for $x - w < C$. This is due to the discreteness of the restructuring decision. As a result, even when $x - w$ is slightly less than D, restructuring will enhance the expected income by a lumpy amount so that D will be paid in full and the equityholders will receive something.

In the above discussion, we have not required that a court be able to verify x. In fact, all the court needs to verify is whether the payment D is made to the debtholders at date 1. If D is not paid, the debtholders will be given the

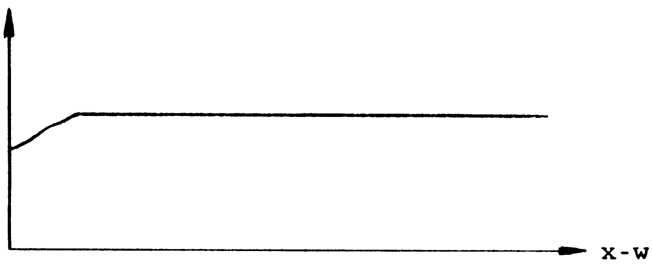

Figure 2. The payoff to the debtholders.

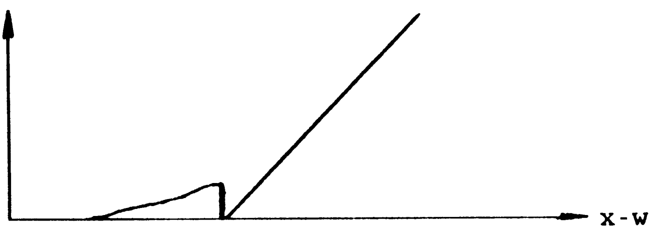

Figure 3. The payoff to the equityholders. The discontinuity of the payoff function at D is due to the discreteness of the restructuring decision. Restructuring will occur even when $x - w$ is slightly below D. This will enhance the expected income by a lumpy amount and D will be paid in full and the equityholders will receive something.

control of the firm. The existence of a competitive capital market and the observability of x by the investors insure that restructuring occurs when $x - w < D$. Therefore, the optimal contract can be achieved by the debt-equity combination when x is merely observable at date 1. In fact, by using the debt-equity combination, x need not be verified even if it can be verified. This reduces the amount of information required to implement the optimal contract.

It is important to note that if the equityholders had the control of the firm's restructuring decision at date 1, they would restructure the firm whenever $x - w$ is below C. Thus, some degree of separation of ownership and control is necessary for the debt-equity combination to achieve the optimum. When the investors have to bear a cost to force the firm into restructuring, the optimum can be achieved by making equity ownership diffuse enough and debt ownership concentrated enough so that no equityholder and some debtholders expect to gain by forcing the firm into restructuring. Casual observation suggests that equity ownership in many large corporations is very diffuse. However, these firms generally have large creditors such as banks.

More importantly, the legal environment is largely consistent with the view that employees/managers have the control of the firm's restructuring decisions unless the firm is in bankruptcy. Under current corporate laws, equityholders generally have no *direct* control of what we call the restructuring decisions. Moreover, the problem here is one of inaction rather than one of action. In the absence of fraud, the "business judgement rule" makes it difficult for equityholders to force the firm into restructuring by proving to a court that undertaking some kind of restructuring actions is beneficial. On the other hand, the bankruptcy laws usually give investors much more control over the firm's decisions. In bankruptcy, all major decisions require creditors' approval and it is understood that some actions are needed to satisfy their claims.

As discussed earlier, if the restructuring-related loss to the employees were 0, D would be the same as C, the debt capacity level. There would be no disagreement ex post between the employees and the investors on when to restructure the firm. The optimal restructuring schedule would be carried out regardless of the debt level. Thus, capital structure would be irrelevant to the value of the firm as described in Modigliani and Miller (1958).

IV. Comparative Statics

In this section, we derive predictions about the firm's capital structure as underlying variables change. It should be emphasized that all the results in this section are under the condition of "everything else being equal."

In this model, the required return to the investors, v, can be interpreted in two ways (Propositions 5 and 6 may not apply to the second interpretation). v can be taken as the investors' initial investment times the interest rate. As such, it increases with the interest rate. v can also be viewed as the maximal price raiders (rival employees/managers) are willing to pay for the firm. That is, v is the solution of the following problem: maximize the firm's value less the takeover cost subject to the constraint that the raiders receive their competitive compensation. As such, v decreases with the takeover cost. The takeover cost depends on the firm's governance structure and specificity of the incumbent employees. The following proposition shows that the optimal debt level D is increasing in v.

Proposition 4: *As the required return to the investors, v, increases, the amount of debt D increases, and the employees' compensation w decreases.*

As the investors' required return increases, two adjustments can be made. First, a higher D can induce more restructuring and more operating income. Second, a reduction in the compensation w can also increase the operating income. If only one adjustment is made, the optimality of the restructuring rule will be disturbed (note that restructuring occurs when $x < D + w$). Both adjustments will be made to preserve the optimality of the restructuring schedule.

One of the most striking empirical facts about capital structure is that more profitable firms borrow less (see, for example, Kester (1986)). In the empirical literature, profitability is usually measured by return on assets (operating income divided by the value of assets). In this model, operating income is endogenous. We can only derive the relationship between leverage and the firm's expected operating income before wages, x. Since the operating income before wages is a random variable, a change in its magnitude can be measured by a change in the sense of first-order stochastic dominance.

Since there is a drop in the investors' payoff at D (see Figure 1), it is not generally true that an increase in x in the sense of first-order stochastic dominance will lower D. We will consider changes in x that will result in an increase in the value of the firm for any given D. This type of change is more restrictive than the usual definition of increase in the sense of first-order stochastic dominance. However, we believe that many cases do fit into this category. For example, if a change in the distribution of x involves shifting the probability rightward within the interval $[C, H]$, it will always raise the value of the firm because the payoff to the investors is increasing for $x > C$.

Proposition 5: *An increase in the expected output that increases the value of the firm will lower D and raise w.*

If we look at the capital market constraint in (5), we can see that the effect of an increase in x that raises the expected payoff to the investors is exactly the same as that of a reduction in v, the required return. As a result, w can be raised and D lowered and the capital market constraint is still met.

The intuition is that when output is abundant, in order to satisfy the investors the employees do not have to promise a high D to induce more restructuring. Thus, the negative relationship between debt and expected output in this model is due to ex ante contracting considerations. By contrast, in the pecking order theory based on Myers and Majluf (1984), a firm that has realized more profit ex post will borrow less to avoid costly external financing due to the existence of asymmetric information.

Proposition 6: *w is decreasing in Q. D is decreasing in Q if and only if* $[T(D + w) - w - D]f(D + w) - 1 < 0$.

When the restructuring-related loss Q increases, w will be reduced in the optimal contract because a reduction in w will raise the operating income and hence reduce the probability of restructuring. $[T(D + w) - w - D]f(D + w) - 1$ is the rate of change in the firm value when w is increased at the margin. The condition $[T(D + w) - w - D]f(D + w) - 1 < 0$ guarantees that the value of the firm will increase when w is reduced at the margin. As a result, D can be reduced and still meet the capital market constraint. A reduction in D will further help to reduce the expected restructuring-related loss. If the inequality is reversed, the firm value will decrease when w is reduced (an odd situation, perhaps). D will have to be raised as a result.

V. Recontracting, Exchange Offers, and Earnings Dilution

We now modify the model slightly. Suppose that the required return v is a random variable as of date 0 with a mean value μ. The realization of v occurs *after* the contract is signed at date 0 and *before* x is realized at date 1. Suppose that the realization v is unverifiable and no one can precommit to a contract signed at date 0. Unverifiability of v will rule out any contract contingent on the realization v. Precommitting to a fixed debt level when v can vary greatly may not be optimal.

Without precommitment, recontracting will occur after v is realized because it is ex post efficient to do so.[14] It is assumed that the contract chosen at date 0 before v realizes is the one that solves the maximization problem (1) with the investors' expected payoff being equal to μ, the mean of v. After v realizes, the new contract is the one that solves (1) with the investors' expected payoff being equal to v.[15] An exchange offer can be viewed as a part of the process of moving from the old contract to the new contract.

When the required return is interpreted as the one below which a takeover will occur, the passing of an antitakeover law can reduce it. By Proposition 4, the optimal debt level should decrease. Thus, an equity-for-debt offer will occur. On the other hand, the creation of a junk bond market that reduces the

[14] Without precommitment, the employees will have to bear income risk because w will depend on v. However, even if precommitment is possible, they may still choose not to precommit to a w because the efficiency gain from recontracting can outweigh the benefit of reduced income risk. Or they may choose to precommit to a compensation level w but not to the debt level D.

[15] If recontracting is costless, how the contract at date 0 is specified is unimportant because recontracting can always occur later. If recontracting is costly, however, it will occur when the gain from it exceeds the cost. At date 0, it is in everyone's interest to reduce the expected recontracting cost. If the realization of v is likely to be concentrated around its mean μ, specifying the date 0 contract as the one that solves (1) with $v = \mu$ can reduce the expected recontracting cost.

raiders' cost of raising capital will increase v. Consequently, a debt-for-equity exchange offer will occur.

Masulis (1980) has documented the stock price changes associated with the announcements of exchange offers. He has found that leverage-increasing exchange offers lead to significant stock price increases while leverage-decreasing offers lead to significant stock price decreases. While Masulis has attributed the stock price changes to wealth transfers between debtholders and shareholders and to tax effects, others have attributed them to the effects of asymmetric information (see Cornett and Travlos (1989)). This model provides a new framework to interpret these results.[16]

We assume that the exchange offer is fair to the investors involved (i.e., the market value of the new security equals that of the retired security). For simplicity, we assume that there is only one class of debt (the bonds) before the exchange offer. Let S be the stock price before the announcement of an exchange offer and S' be that after the announcement, N be the number of shares before the exchange offer, B and B' be the prices of the pre-exchange bonds before and after the announcement, respectively, and n be the number of bonds before the exchange offer.

Proposition 7: *The stock price change due to an exchange offer can be expressed as follows*: $S' - S = [v - \mu + (B - B')n]/N$.

The intuition is as follows. If v is realized with $v > \mu$, the required return has been increased. By Proposition 4, the higher required return can be achieved by making a debt-for-equity offer to increase leverage level and by reducing w. This will increase the total debt payment and increase the firm value from μ to v. Since the exchange is fair to the new debtholders, this gain in the firm value will be shared by the existing investors (shareholders and old bondholders). That is, $(S' - S)N + (B' - B)n = v - \mu$, which is another way to express the formula in Proposition 7. If the price of the pre-exchange bonds does not increase due to added default risk of having new debt ($B \geq B'$), as is likely to be the case, the shareholders' gain will be at least $v - \mu$.[17] This can explain why the announcement effect on stock price is generally positive for a debt-for-equity exchange offer.[18]

The stock price change associated with a debt-for-equity offer discussed here comes from three sources: an increase in the firm value due to more restructuring, an increase in the firm value due to a lower employees' compensation, and a (possible) wealth transfer from the old bondholders. Even if the latter two effects are absent, the gain will still be positive.

[16] There is a large empirical literature on the stock price reactions to new security offerings. See Smith (1986) for a review and references of that literature. Since we have not allowed the firm to raise new capital to take on new projects, strictly speaking our model applies to pure financial transactions such as exchange offers.

[17] It is theoretically possible that the value of the old debt increases after the debt-for-equity exchange because recontracting also reduces w (i.e., increases the operating income $x - w$).

[18] Of course, part of the increase in required return has to be unanticipated or unknown by the public before the announcement to have the announcement effect.

If $v < \mu$, the firm will make an equity-for-debt exchange offer. After the offer, debt payment will be reduced and the firm value will be reduced. If the price of the pre-exchange bonds is not lower after the exchange offer due to added cushion of new equity ($B' \geq B$), the stock price change will be negative.

The exchange offers discussed above represent recontracting in response to a change in the investors' required return. As we have seen, a change in the required return can be the result of ex post opportunism on the part of either the employees or the investors. Shleifer and Summers (1988) have argued that ex post investors' opportunism via hostile takeovers can impair the efficiency of other stakeholders' ex ante decisions. In this paper, we show how the opportunism can be achieved through changes in leverage. In our model, however, the opportunism can go in either direction.

Academics generally dismiss the view held by many practitioners that issuing new equity can dilute the firm's earnings. In this model, an equity-for-debt exchange can indeed dilute earnings even when the exchange is fair. To see this, note that in this model with a single output at date 2, the equity value is in fact the expected value of the firm's net earnings (output net of wages and debt payment). As a result, the stock price S is the expected earnings per share. Proposition 7 implies that the expected earnings per share can be reduced after an equity-for-debt exchange.

VI. Extensions

We have assumed that capital structure is chosen to maximize the employees' welfare subject to the capital market constraint. This assumption is not crucial. If we look at the problem that the contract is chosen to maximize the firm's value ex ante subject to the constraint that the employees have to receive at least their reservation utility at date 0, the first-order conditions are exactly the same except that Q is multiplied rather than divided by the multiplier of the constraint. The forms of the optimal contract will be the same. The optimal debt level will be below the level of debt capacity.

Even if the contract can be made contingent on the occurrence of restructuring, our results will continue to hold if the nonmonetary loss to the employees cannot be traded. In fact, we can show this for a more general form of utility function. Suppose that the employees' utility function takes the following form: $U(c, 0)$ if restructuring occurs and $U(c, z)$ otherwise, where c is the employees' monetary compensation from the firm and z is the time or effort lost in restructuring. Then, due to risk aversion, the employees' consumption without restructuring will be a constant, w_1, and that with restructuring will be a constant, w_0. Now w_0 is allowed to be different from w_1 because contract can be conditioned on restructuring. The first-order condition (4) will become

$$-[U(w_1, z) - U(w_0, 0)] + \lambda[T(x) - x + w_1 - w_0] > 0. \tag{8}$$

When the employees are better off without restructuring, i.e., when $U(w_1, z) - U(w_0, 0) > 0$, (this will be true if consumption and leisure are compliments, i.e., if $\partial^2 U/\partial c \partial z \geq 0$), again the firm value will not be maximized at the optimum. Major results will continue to hold.

When the utility function takes the separable form $U(c) + V(z)$ as in the previous sections, it is easy to see that $w_0 = w_1$ because marginal utility of income does not depend on leisure. Inequality (8) reduces to (4). No results will be changed.

The intuition is that the risk-averse employees prefer stable income. Even if they are offered additional monetary compensation when the firm is restructured, the employees will not be able to use the money to reduce the nonmonetary loss because the loss z cannot be traded.

VII. Conclusions

We have derived endogenously the optimal contract between the investors and the employees and have shown that it can be achieved by a debt-equity combination and a compensation schedule. It is also shown that the optimal debt level is generally lower than the level that maximizes the value of the firm when there is restructuring-related nonmonetary loss to the employees.[19] Leverage can be used as an instrument to transfer wealth between investors and employees. The transfer can go in either direction.

Since the leverage level and the employees' compensation level are jointly determined, the model offers new testable implications. This paper also explains how stock prices react to the announcements of exchanges offers, how earnings per share can be diluted by a decrease in leverage, and why employees' claims are generally senior to those of the investors. The model may be used to explore further the interactions between capital market and labor market.

We have viewed the changes in leverage as a result of changes in the investors' required return. This is only one possibility. A more interesting direction for future research is to introduce reinvestment opportunities into the model. That will allow us to understand how leverage is changed by subsequent financing decisions. Since the employees and the investors may prefer different ways to finance new projects, the firm's governance and ownership structure may play a role in how financing decisions are made. Currently, the empirical evidence on corporate financial decisions is, to a large extent, interpreted in terms of the information asymmetry model by Myers and Majluf (1984). The extensions of our model have the potential to provide alternative explanations.

[19] In fact, Q in the model could be interpreted more generally than the nonmonetary loss. It could be interpreted as any loss due to restructuring that cannot be contracted ex ante. For example, if a long-term contract cannot be signed due to contract incompleteness, Q could represent the employees' future monetary loss in the form of future wage or benefit reductions.

Appendix

Proof of Proposition 1: The first-order condition for (1) with regard to $P(x, y)$ is

$$-U'(y - P(x, y)) + \lambda = 0.$$

Since $U'(\ )$ is decreasing and λ is a constant, we have $y - P(x, y) = w$. Q.E.D.

Proof of Proposition 2: Under Assumptoin 1, $T(x) > x$ if and only if x is less than a constant in (L, H). This implies that $T(x) - x > Q/\lambda$ if and only if $x < m$, where m is a constant (if $m < L$ it will be defined to be L). Define $D = m - w$. Then inequality (4) holds whenever $x < D$. Q.E.D.

Proof of Propositions 3: Under Assumption 1, $T(x) - x$ intersects x-axis once in (L, H). Thus, $T(M) - M = 0$ has a solution in (L, H). Since $Q/\lambda > 0$, $T(M) - M - Q/\lambda < 0$. The root of $T(x) - x - Q/\lambda = 0$ must be less than M. Q.E.D.

Proof of Proposition 4: For simplicity, the proof of this proposition as well as the proofs of the next two propositions assume that $T(x)$ is a constant T. The proofs will go through as long as Assumption 1 holds.

Substituting $U'(w) = \lambda$ and $m = D + w$ into (6) and totally differentiating it with respect to w, we have

$$\partial D/\partial w = QU''(w)/[U'(w)]^2 - 1. \tag{A1}$$

Totally differentiating (5) with respect to v, we have

$$[f(D + w)(T - D - w)(1 + \partial D/\partial w) - 1]\, \partial w/\partial v = 1. \tag{A2}$$

Substituting (A1) into (A2), we have

$$f(D + w)(T - D - w)QU''(w)/[U'(w)]^2\, \partial w/\partial v = 1. \tag{A3}$$

Since $U'' < 0$ and $T - D - w > 0$ for $D < C$, $\partial w/\partial v < 0$. By using (A1), we have $\partial D/\partial v = (\partial D/\partial w)(\partial w/\partial v) > 0$. The expected operating income is $E[x - w]$. $\partial E[x - w]/\partial v = -\partial w/\partial v > 0$. Q.E.D.

Proof of Proposition 5: The proof is exactly the same as that of Proposition 4 because an increase in x is like a decrease in v. Q.E.D.

Proof of Proposition 6: Totally differentiating (5) with respect to w, we have

$$\partial D/\partial w = [1 - (T - D - w)f(D + w)]/(T - D - w)f(D + w). \tag{A4}$$

Totally differentiating (6) with respect to Q (with $\lambda = U'(w)$ and $m = D + w$), we have

$$(\partial D/\partial w)(\partial w/\partial Q) = -1/U'(w) + \left[QU''(w)/[U'(w)]^2 - 1\right] \omega w/\partial Q. \tag{A5}$$

Substituting (A4) into (A5), we get

$$\left[-QU''(w)/[U'(w)]^2 + 1/(T - D - w)\right] \partial w/\partial Q = -1/U'(w). \tag{A6}$$

Since $U'' < 0$, $U' > 0$ and $T - D - w > 0$, $\partial w/\partial Q < 0$. The expected operating income is $E[x - w]$. $\partial E[x - w]/\partial Q = -\partial w/\partial Q > 0$.

$$\begin{aligned}\partial D/\partial Q &= (\partial D/\partial w)(\partial w/\partial Q)\\ &= \{[1 - (T - D - w)f(D + w)]/(T - D - w)f(D + w)\}\\ &\quad \times(\partial w/\partial Q).\end{aligned} \tag{A7}$$

Since $\partial w/\partial Q < 0$, $\partial D/\partial Q < 0$ if and only if $1 - (T - D - w)f(D + w) > 0$. Q.E.D.

Proof of Proposition 7: In addition to the terms defined in Section V, let β be the value of the new debt issued and K be the number of shares retired in a debt-for-equity exchange (negative β and K represent an equity-for-debt exchange). The firm value identity before and after the exchange announcement are, respectively,

$$Bn + SN = \mu, \tag{A8}$$

$$(B'n + \beta) + S'(N - K) = v. \tag{A9}$$

Remember that B' is the price of the pre-exchange debt after the exchange announcement. Since the exchange must be fair, we have $\beta = S'K$. By substituting this into (A9), we have

$$B'n + S'N = v. \tag{A10}$$

By subtracting (A8) from (A10) and rearranging, we obtain the expression in the Proposition. Q.E.D.

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