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Top-Management Compensation and Capital Structure

TERESA A. JOHN and KOSE JOHN*

ABSTRACT

The interrelationship between top-management compensation and the design and mix of external claims issued by a firm is studied. The optimal managerial compensation structures depend on not only the agency relationship between shareholders and management, but also the conflicts of interests which arise in the other contracting relationships for which the firm serves as a nexus. We analyze in detail the optimal management compensation for the cases when the external claims are (1) equity and risky debt, and (2) equity and convertible debt. In addition to the role of aligning managerial incentives with shareholder interests, managerial compensation in a *levered* firm also serves as a precommitment device to minimize the agency costs of debt. The optimal management compensation derived has *low* pay-performance sensitivity. With convertible debt, instead of straight debt, the corresponding optimal managerial compensation has high pay-to-performance sensitivity. A *negative* relationship between pay-performance sensitivity and leverage is derived. Our results provide a reconciliation of the puzzling evidence of Jensen and Murphy (1990) with agency theory. Other testable implications include (1) a relationship between the risk premium in corporate bond yields and top-management compensation structures, and (2) the announcement effect of adoption of executive stock option plans on bond prices. The model yields implications for management compensation in banks and Federal Deposit Insurance reform. Our results explain the dynamics of top-management compensation in firms going through financial distress and reorganization.

INTERNAL INCENTIVE STRUCTURES DETERMINE how individuals behave in organizations and their role is critical to developing a viable theory of the firm. Although the economic theories of agency and optimal contracts have provided some framework to think about the structure of management compensation, our understanding of compensation arrangements in large organi-

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zations is still primitive. Many common features of organizational incentive systems such as pay systems with extremely low response to performance, the extensive use of promotion-based incentive systems, tenure, and up-or-out promotion systems all require more extensive study by economists.

In this paper the design and characteristics of top-management compensation contracts are studied. In particular, we examine how the design and mix of external claims issued by the firm determine the optimal management compensation structure. The agency theory framework employed in most of the prior theoretical studies of the design of top-management compensation emphasizes the conflict of interest between shareholders of a publicly owned corporation and its top management. Since managerial actions and/or the details of the investment opportunities are not perfectly observable by shareholders, there is *incomplete* contracting vis-à-vis managerial choices. In such a situation, agency theory predicts that compensation contracts will be designed to give the manager incentives to choose actions that increase shareholder wealth.

In an important recent paper, Jensen and Murphy (1990) estimate the pay-performance relation (including pay, options, stockholdings, and threat of dismissal) for chief executive officers. They estimate that CEO wealth changes \$3.25 for every \$1,000 change in shareholder wealth. After a detailed analysis of the consistency of their results with agency theory, they argue that "although the estimated pay-performance sensitivity (with respect to compensation, dismissal, and stock ownership) is statistically significant, the magnitude seems small in terms of the implied incentives." After examining the effect of various factors such as executive risk aversion, limited resources of executives, existence of direct measures of performance, and the role of external forces in providing managerial incentives, Jensen and Murphy conclude that "...the small observed pay-performance sensitivity seems inconsistent with the implications of formal principal-agent models."[1]

The perspective of this paper is that the design of managerial compensation structures should take into account not only the agency relationship between shareholders and management, but also the conflicts of interests which arise in the other contracting relationships for which the firm serves as a nexus.[2] The optimal top-management compensation structure will be determined by the design and mix of all external claims issued by the firm, not just equity. In other words, an environment in which there is moral hazard and incomplete contracting between management and shareholders would also be one in which there is moral hazard in the contractual relationship between shareholders and other external claimholders. For concreteness,

[1] See Holmstrom (1979) for pioneering work on the principal agent model. Baker, Jensen, and Murphy (1988) survey issues in management compensation. Scholes (1991) surveys aspects of taxation in management compensation design.

[2] See Jensen and Meckling (1976) for an articulation of the idea that the firm is a nexus for a multitude of contracting relationships.

consider a firm financed with equity and risky debt.[3] Assume that there is incomplete contracting vis-à-vis managerial decisions about consumption of perks and risk choices of projects. It may be possible to fine tune the compensation structure to align managerial incentives with shareholders interest, minimizing agency costs of equity. However, such a compensation structure would induce risk-shifting incentives in the managers (i.e., when risky debt is outstanding, equity has a convex payoff structure such that shareholders gain by shifting into higher risk projects even when the incremental net present value is negative; see Jensen and Meckling (1976)). A management compensation designed carefully to minimize the agency costs of equity may give rise to high agency costs of debt. However, if the management compensation structure is aligned less with the shareholder interests and the rewards are tied to, say, stability and size of the total cash flows, the agency costs of debt would be reduced and rational pricing of their claims by bondholders would incorporate the anticipated superior risk choices by the managers. As residual claimholders, the shareholders gain from the reduced agency costs of debt.

Another way to characterize the perspective of this paper is to view the management compensation as playing the role of a precommitment mechanism in addition to its conventional role of aligning management incentives with shareholder interest. If the management compensation is structured to closely align managerial interests with shareholders' interest (e.g., tying CEO's wealth changes to shareholder wealth changes), the agency costs of *equity* would be low. However, prospective bondholders, observing the management compensation structure (but not detailed risk choices made by managers in their investment decisions), would rationally anticipate that the managers have risk-shifting incentives. Alternatively, shareholders can structure management contracts such that the managers have incentives to take ex post investment decisions that maximize the value of the firm. In this case, the management compensation would not closely align managerial incentives with shareholders interests (e.g., the sensitivity of CEO's wealth changes to shareholder wealth changes is lower than that in the first case). In this case, the management compensation contract plays an important role as a precommitment device. Given the compensation structure is observable, bondholders can infer (compute) the risk choices that management would make *in their own self-interest*. They would price the bonds incorporating their rational expectation of the investment policy.

Given the moral hazard as to future investment policy and resulting incomplete contracting, there is a conflict of interests between shareholders and bondholders. The shareholders are using management compensation

[3] Several authors have pointed out that agency problems can be reduced or eliminated through the use of managerial incentive schemes and more complex financial securities such as convertible debt. See Barnea, Haugen, and Senbet (1985), Green (1984), and Brander and Poitevin (1991). In independent work, Madan, Senbet, and Soubra (1992) also examine the interaction of managerial contracts and the agency costs of debt. For a survey of the modern literature on capital structure including models of agency costs of debt, see Harris and Raviv (1991).

contracts as an *implicit contract* precommitting to value-maximizing investment choices. In this case, the optimal managerial contract may give up a little of its "alignment with shareholders" role to achieve more of a "precommitment" role. The optimal managerial contract thus may have low pay-to-shareholder-wealth sensitivity if the potential agency costs of debt are high.

Although only two moral hazard relationships have been used in the above exposition, the underlying argument is very general. If one views the modern corporation as a "nexus for a set of contracting relationships—in a very real sense only a multitude of complex relationships (i.e., contracts) between the legal fiction (the firm) and the owners of labor, material and capital inputs and the consumers of output" (Jensen and Meckling (1976), p. 88), then the extensive applicability of the above argument becomes clear. In the design of managerial contracts, an optimally structured compensation system depends not only on the agency relationship between shareholders and managers, but also on the other agency relationships that constitute the firm. Contracts with external claimholders, suppliers, employees, and consumers may have a bearing on the structure of optimal managerial contracts. As Jensen and Meckling (1976) argue, "the firm ... serves as a focus for a complex process in which the conflicting objectives of individuals (some of whom may represent other organizations) are brought into equilibrium within a framework of contractual relations." The argument made in this paper is that management contracts cannot be structured to minimize the agency costs of equity alone since there are agency costs resulting from the several contractual relationships (including those with external claimants).

Even though the argument above is applicable to any contracting relationship of the firm, we will focus on the case of a firm with two external claims, outside equity and risky debt (or outside equity and convertible debt). In addition to considerations of simplicity of modeling, our choice is influenced by a wealth of empirical evidence which suggests a link between the debt ratio of a firm and the pay-to-shareholder-wealth sensitivity of its managerial compensation (or managerial ownership of stocks or stock options). Agarwal and Nagarajan (1990) provide evidence that all-equity–financed firms exhibit greater equity ownership by top managers than levered firms. For the group of all directors and officers, the mean (median) of stockholdings of top managers in all-equity firms is 33.14 (32) percent—in levered firms, it is 19.55 (16) percent. (All of the differences are statistically significant at the 1 percent level). Freind and Lang (1988) also document a negative relationship between debt ratio and management's shareholdings. It has also been documented that the pay-performance sensitivity is extremely low in firms with very high leverage. For example, Pi and Timme (1990) document that the compensation structures in banks (with debt-to-asset ratios exceeding 90 percent) display pay-performance sensitivities that are close to zero (see also Kane (1989) and Houston and James (1993)). Similarly, Gilson and Vetsuypens (1993) find that when firms become financially distressed (therefore with very high leverage) the pay-to-shareholder wealth ratio declines dramatically and becomes insignificantly different from zero. For firms that restruc-

ture their debt privately with reductions in leverage, the sensitivity ratio increases after financial distress. Our results will provide an explanation for these findings as well as for the evidence of Jensen and Murphy (1990).

In the model of this paper, the agency relationships between shareholders and managers and between shareholders and debtholders are characterized. Debtholders rationally price bonds in anticipation of incentives induced by the management compensation contract. To provide a benchmark, we characterize the investment policies of an all-equity firm and a levered firm in which the managerial contract provides a perfect alignment of managerial and shareholder interests. As expected, the all-equity firm implements a first-best optimal investment policy and the levered firm's management overinvests in risky projects. Next, the optimal compensation structure of the levered firm is derived and characterized. The implied sensitivity of managerial wealth changes to shareholder wealth changes (i.e., the pay-to-shareholder-wealth sensitivity) is shown to be decreasing in the debt level.

Some interesting additional testable implications follow. The risk premium in the bond yields is shown to be increasing in the pay-to-shareholder-wealth sensitivity parameter of the managerial compensation structure. Since managerial ownership of stock and stock options is a major contributor to the above sensitivity parameter, a related testable implication is the positive relationship between bond yield risk premium and managerial holding of stock and stock options. In general, all-equity firms should have compensation contracts with higher pay-to-shareholder-wealth sensitivity than levered firms. The greater the debt level (say, debt-to-equity ratio), the lower the pay-to-shareholder-wealth sensitivity. For firms in financial distress, the sensitivity is predicted to be close to zero. Larger firms typically have relatively more debt in their capital structures (see Chatterjee and Ramirez (1991) and Titman and Wessels (1988)) than smaller firms and hence smaller firms should have a higher sensitivity parameter than larger firms. Historically, over the last fifty years, the firm capital structures have become more complex and the leverage ratios have increased (see, e.g., Brealey and Myers (1991), p. 331). This would suggest that there should be a weakening of the pay-to-shareholder-wealth sensitivity over the last fifty years.

The perspective of this paper and the predictions of the model help to explain some of the empirical regularities documented in existing work. A number of studies document a positive relation between changes in executive compensation and changes in shareholder wealth, as well as a negative relation between stock price performance and subsequent executive turnover. More interestingly, Jensen and Murphy (1990) find that (1) the pay-to-shareholder-wealth sensitivity is low, (2) it has declined from 1934–1938 to 1974–1986, by a factor of 10, and (3) it is higher for small firms ($8.05 per $1,000) compared to that for large firms ($1.85 per $1,000). Jensen and Murphy (1990) argue that these findings may be consistent with an implicit regulation hypothesis, i.e., strong political forces operate in both the organization and the public sector to effectively constrain contracting between shareholders and managers. Baker, Jensen, and Murphy (1988) find such an

explanation unsatisfactory. Our results provide an alternative explanation for all the three regularities documented, based on the predicted decrease of the sensitivity parameter with level of debt and complexity of capital structure. The increase in leverage over the last fifty years (see Brealey and Myers (1991), p. 331) implies a decline in sensitivity over this period. Similarly, larger firms, which have relatively more leverage and more complex capital structures, are predicted to have less sensitivity according to our model.

The implications of the model are also supported by recent empirical evidence provided by Gilson and Vetsuypens (1993) on CEO compensation structures for firms in financial distress. They find the pay-to-shareholder-wealth ratio declines dramatically when firms become financially distressed and the sensitivity parameter is insignificantly different from zero during financial distress. For firms that privately restructure their debt with reductions in leverage, the sensitivity ratio increases after financial distress. Some preliminary evidence in Milonas, Saunders, Strock, and Travlos (1991) documents an increasing relationship between the fraction of stockholding by managers and the risk premium in corporate bond yields, as predicted by our model. DeFusco, Johnson, and Zorn (1990) document that bond prices fall when executive stock option plans are adopted. Both pieces of the above evidence are consistent with our prediction that increased alignment of management compensation with equity may indicate increased risk-shifting incentives and higher risk premia in bond prices.

The basic model is laid out in Section I. The investment policy induced by the equity-aligned managerial contract is also derived in Section I. The optimal managerial contract is characterized in Section II and its relationships to capital structure and bond yields are derived. Alternative mechanisms for controlling agency costs of debt are discussed in Section III. An optimally designed convertible debt and the corresponding managerial contract are also derived in Section III. Empirical implications are explored in Section IV. Extensions and concluding remarks are in Section V.

I. The Model

A. The Basic Setup

The model is designed to capture the focal issues as simply as possible. The managers act on their own behalf given the incentive contracts in place. These management compensation contracts are optimally designed by the corporate board of directors who are acting on behalf of the shareholders. The shareholders are the residual claimholders and the owners of the firm technology. In structuring the management compensation contracts, the shareholders anticipate the ex post managerial investment choices and their effects on their wealth (which is the sum of the value of the claims they retain and the rational price paid by the external claimants in the firm).

Consider the representative firm and its investment opportunity set. The risk choices made by the manager of the firm are modeled as "private action." That is, there is less than perfect external monitoring of these risk choices by

outsider investors (including prospective bondholders) and consequently there is "incomplete contracting" vis-à-vis those choices. Imperfect observability of private action (and resulting incomplete contracting) is at the heart of the agency problem, and it is crucial for the analysis.

It will be convenient for expositional purposes to lay out the model as a three-date, two-period model. At $t = 0$ the managerial compensation structure is established. This is common knowledge in the market. Then, the external claims are issued and investors pay the appropriate price for these claims. The price of these claims is determined in a rational expectations manner. The only external claims that are explicitly studied are equity and debt (possibly risky). The debt consists of a pure discount bond of face value $F, F > 0$, which matures at date $t = 2$.

The investment opportunities of the firm materialize at $t = 1$. For simplicity, assume that the investment opportunity set available to the firm consists of two types of projects. (1) There is a safe project with zero risk and zero net present value (e.g., U.S. Treasury bills). An investment of I dollars made at $t = 1$ results in a return of I dollars at $t = 2$ (a zero risk-free rate of interest is assumed). (2) The second project is a risky project indexed by a parameter q. This project requires an investment I to be made at $t = 1$ and the resulting returns are high or low (H dollars or L dollars respectively) with $H > I > L > 0$, and where q is the probability of the high outcome H and $(1 - q)$ is the probability of the low outcome, L. A key point is that only the manager observes the quality of the project (i.e., the parameter q) at $t = 1$ before he makes the investment decision (i.e., whether to invest I in the riskless project or the risky project). The value of the parameter q is not observed by the shareholders or the prospective bondholders in the market. This precludes any contracting (either managerial contracts or debt covenants) contingent on the value of the parameter q. However, all the relevant parties know that q is distributed uniformly over the interval [0, 1]. This modeling device captures the intuition that, given the level of monitoring undertaken by shareholders and outside investors in a cost-effective manner, the manager has additional information about the details of the technology and its risk through his knowledge of the parameter q. In the exposition that follows, it will be clear that the manager makes the investment risk choice privately. That is, the manager decides between the risky project and the riskless project based on his private observation of q at $t = 1$.

At $t = 2$ the cash flows are realized from the investments made at $t = 1$. Let p denote this terminal cash flow which is equal to I if the riskless investment was chosen at $t = 1$, or equal to H or L depending on the outcome from the risky investment if that choice was made at $t = 1$. Payments are made to the manager according to the terms of his contract. Payment are made to debtholders to settle their claims. The residual amount is paid to the equityholders. The sequence of events described above is depicted in the time line in Figure 1.

For simplicity we will assume that the shareholders, bondholders, and the manager will use risk-neutral valuation of the terminal cash flows accruing

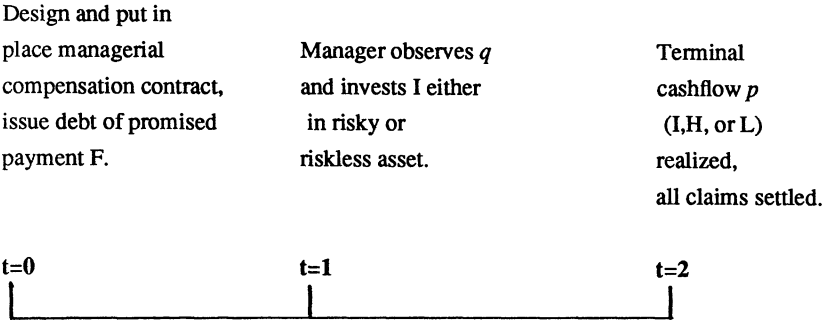

Figure 1. Time line of events.

to their respective claims to value their contracts. However, the valuation will rationally incorporate the investment policy which is endogenously determined given the managerial contracts in place. The managerial compensation structure is, of course, optimally determined. Risk-neutral valuation by diversified investors does not involve loss of generality in reasonably "complete markets" since the conditional expectation of cash flows can be taken with respect to the equivalent martingale measure (see, e.g., Ross (1978)). However, in the case of the manager the assumption is somewhat restrictive. Managerial contracts which are concave, linear and convex in the cash flows of the firm (and cash flows to equityholders) are considered. If the managers are risk averse, it would make their incentives under the different contracts "more concave" than are characterized. However, the general spirit of the results would go through.

Two remarks should be made. In this model when debt of face value $F, F \geq 0$ is issued, the price paid by bondholders, denoted $B(F, \mu)$, is computed in a rational expectations manner taking into account the managerial contract μ and the investment policy it will induce. For any given $F \geq 0$, the shortfall in required financing (i.e., $I - B(F, \mu)$) is supplied by the shareholders. This enables an exogenous determination of F based on other debt-related benefits (such as taxes, signaling value, etc.) and costs (costs of financial distress). Endogenizing F is not essential to the model. For any given value of F, however, endogenous determination of $B(F, \mu)$ is essential since it ensures that shareholders bear the agency costs of debt for a given managerial compensation structure μ in place. Moreover, for any exogenous specification of F, the required funds I for investment is raised as follows: $B(F, \mu)$ from bondholders and the residual $I - B(F, \mu)$ from stockholders. Although this resource balance condition is kept in the background and not explicitly characterized in the specification of the problem, it is always satisfied. This is done for expositional convenience only and nothing of essence is left out.

Assume that managers require a present value of compensation W, where W is determined by competitive forces in the managerial labor market. Therefore only such contracts μ will be considered which have the property

that the present value of terminal compensation payoffs under the investment policy implemented (given the contract μ) equals W. By choosing different contracts μ, shareholders are simply controlling managerial incentives and thereby the investment policy that would be implemented under those incentives. Since at $t = 0$ bondholders pay $B(F, \mu)$, an amount exactly equal to the present value of their payoffs (given managerial contract μ), the shareholders problem at $t = 0$ is to design a managerial contract μ^* such that the total value of the firm (minus a constant value W) is maximized.

B. Investment Policy of an All-Equity Firm

In this section the investment policy of the firm in a scenario with complete contracting is characterized. This is equivalent to the investment policy of the all-equity firm with a managerial contract that perfectly aligns managerial incentives with shareholder interests. Since the goal is only to derive the ideal benchmark, the specifics of the managerial contract will not be delineated.[4]

Under a contract in which managerial and shareholder interests are perfectly aligned, the manager's investment choice at $t = 1$, after observing q, is as follows. Invest in the risky project only if

$$qH + (1 - q)L \geq I \tag{1}$$

That is, the manager invests in the risky project only if it yields a higher present value than investing in the riskless project, which yields a zero net present value. Denote as $\hat{q}$ the lowest (cutoff) value of q which satisfies (1) such that the risky investment dominates the riskless one. That is,

$$\hat{q} = \frac{I - L}{H - L}. \tag{2}$$

The investment policy in (1) is equivalent to investing in the risky project for all values of q such that $q \geq \hat{q}$. The above investment policy is the one that could have been achieved if q were perfectly observed by all parties (including shareholders and investors in the market) and if a complete set of enforceable contracts specifying any investment policy could have been written.

The following definition facilitates a discussion and comparison of various investment policies:

Definition 1: An investment policy of investing in the risky project for all $q \geq \tilde{q}$ will be denoted as investment policy $[\tilde{q}]$.

[4] A contract which gives the manager a proportion $\alpha, 0 < \alpha < 1$ of the total cash flows (such that $\alpha V(q) = W$) will perfectly align managerial incentives to shareholder interests. In a somewhat related analysis of venture capital financing, Admati and Pfleiderer (1991) obtain such a contract (called a fixed fraction equity contract) to be the optimal one for the venture capitalist. However, in our context, when outstanding risky debt has priority over the equity component of management compensation, this contract will not be optimal, as shown in Section II.

An investment policy $[\tilde{q}]$ produces the distribution of terminal cash flows displayed in Figure 2 (given that q is uniformly distributed on $[0, 1]$.) Based on Figure 2, and given risk-neutral pricing of terminal cash flows, the net present value of an investment policy $[\tilde{q}]$, denoted $V(\tilde{q})$, can be easily specified:

$$V(\tilde{q}) = -I + \tilde{q}I + \frac{L}{2}[1 - \tilde{q}]^2 + \frac{H}{2}[1 - \tilde{q}^2] \tag{3}$$

Using equation (3) and the Pareto-optimal investment policy $[\hat{q}]$ characterized in (1), the best net present value $V(\hat{q})$ achievable from the firm's technology can be specified as follows:

$$V(\hat{q}) = -I + \hat{q}I + \frac{L}{2}[1 - \hat{q}]^2 + \frac{H}{2}[1 - \hat{q}^2] \tag{4}$$

Clearly the investment policy $[\hat{q}]$, where $\hat{q}$ is given in (1) and the resulting value $V(\hat{q})$ is specified in (4), forms a useful benchmark to measure the distortions caused by suboptimal managerial contracts and the conflict of interests between shareholders and debtholders. In the above case, the equityholders achieve a value $V(\hat{q}) - W$, which is the maximum possible after paying the manager his competitive compensation of present value W.

It should be apparent to the reader that the cutoff level of q, say $\tilde{q}$ that determines the investment policy $[\tilde{q}]$, determines the riskiness of the distribution of terminal cash flows realized at $t = 2$ (shown in Figure 1). The lower the cutoff used, the more likely it is that the risky investment is undertaken and the riskier the distribution of terminal cash flow. It would be useful to formalize the above intuition in Lemma 1.

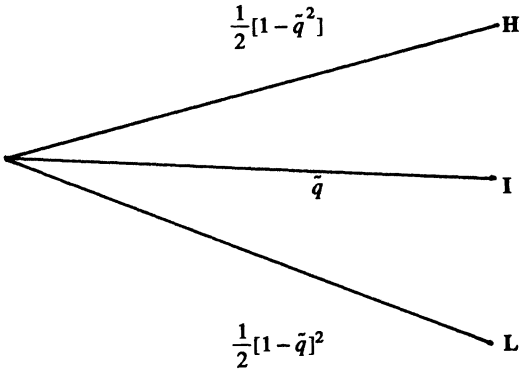

Figure 2. Distribution of terminal cash flows resulting from an investment policy $[\tilde{q}]$. If the manager pursues an investment policy $[\tilde{q}]$, i.e., invests in the risky project for $q \geq \tilde{q}$, since q is uniformly distributed on $[0, 1]$, the probabilities of obtaining the final outcome of H, I and L are as shown above.

LEMMA 1: *For $q_1 < q_2$, the investment policy $[q_1]$ gives rise to a cash flow distribution that is riskier (in the sense of Rothschild and Stiglitz* (1970, 1971)*) than that from the investment policy $[q_2]$. The investment policy $[q_1]$ is thus described as being "riskier" than investment policy $[q_2]$.*

Proof: Use $q_1 < q_2$, in the terminal cash flow distributions (in Figure 2). Q.E.D.

C. Risk-Shifting Incentives of an Equity-Aligned Manager

In this subsection, the investment choices of a manager whose compensation structure is perfectly aligned with equity is characterized. Assume that debt of face value $F \geq 0$ is outstanding in the form of pure discount bonds maturing at $t = 2$. Again assume the managerial compensation contract accomplishes a full alignment of managerial incentives with shareholder interests. The investment policy implemented by the manager under the compensation structure specified above is characterized in Proposition 1.

PROPOSITION 1: (a) *With debt of promised payment $F \geq 0$, the manager will implement an investment policy $[q(F)]$ where $q(F)$ is given in equation* (5):

$$\begin{aligned} q(F) &= \hat{q} \quad \text{when } F \leq L \\ &= \frac{I - F}{H - F} \quad \text{when } L < F < I \\ &= 0 \quad \text{when } F \geq I \end{aligned} \tag{5}$$

(b) *When the debt is risky i.e., $F > L$ the manager implements an investment policy that is suboptimal and riskier than the Pareto-optimal one, $[\hat{q}]$.*

(c) *In the range of F, $L < F < I$ the terminal cash flow distribution resulting from the investment policy $[q[F])$, implemented by the manager is strictly increasing in risk for increasing F.*

Proof: (a) With a promised payment $F > 0$ outstanding to debtholders, the manager (given his full alignment with equity compensation structure) implements an investment policy of choosing the risky project if and only if q is such that the residual payoffs to equityholders are higher than those achieved with the riskless project, i.e.

$$q\{H - F\}^+ + (1 - q)\{L - F\}^+ \geq \{I - F\}^+ \tag{6}$$

where quantity $\{\phi\}^+ \equiv \max\{0, \phi\}$. Now the cutoff probability $q(F)$ is the lowest value of q that satisfies (6). $q(F)$ satisfies (6) as an equality, which implies (5).

(b) For $F \in (L, I)$, equation (5) implies $q(F) = I - F/H - F$, which is strictly less than $\hat{q} = I - L/H - L$. Now the result follows from Lemma 1.

(c) Again, for $I \geq F_1 > F_2 > L$, (5) implies $q(F_2) > q(F_1)$ and the result follows from Lemma 1. Q.E.D.

A managerial compensation structure that aligns totally the managerial interests with those of equityholders gives rise to risk-shifting incentives characterized in Proposition 1. The net present value of the investment policy $[q(F)]$ can be computed from equation (3), and denoted as $V(q(F))$. The loss in value

$$A(F) = V(\hat{q}) - V(q(F)) \tag{7}$$

is fully borne by the equityholders and represents the agency costs of debt of face value F given the managerial compensation that achieves full alignment of managerial incentives with equity interest. It will be shown that managerial compensation structures that reduce managerial pay sensitivity to shareholders' wealth induce investment policies with lower agency costs of debt. In fact, the sensitivity of the optimal compensation contract to shareholder wealth will be shown to be decreasing in F.

II. Optimal Management Compensation

A. A Simple Contract

Before considering the optimal management compensation contracts, it will be useful to define a simple compensation structure consisting of a fixed salary $S \geq 0$ if the returns to equityholders are above a target level T; otherwise, salary $S - \phi$ is paid. In other words, the manager only receives $S - \phi$ if the returns to equityholders are below the target level. In the case of a firm with risky debt outstanding (say, of promised payment $F, L < F < I$) it is natural to set T equal to zero. Then the compensation contract penalizes the manager for insolvency. Here the cost ϕ to the manager can be interpreted as a large salary reduction in a period of financial distress. It can also be seen as the costs of managerial turnover in bankruptcy or the costs of the threat of dismissal for poor performance.[5]

For convenience of reference, denote the simple contract as contract $\{S, \phi\}$. The shape of this compensation structure is concave (see Figure 3).[6] The investment policy undertaken by the manager under this compensation contract $\{S, \phi\}$ can be derived as follows:

The manager would invest in the risky project for all values of q such that

$$qS + (1 - q)(S - \phi) \geq S \tag{8}$$

[5] A number of recent studies document the increased likelihood of management turnover and large salary reductions in financial distress (Gilson (1989) and Gilson and Vetsuypens (1993)) and in response to poor performance (Warner, Watts, and Wruck (1988) and Weisbach (1988)). Therefore ϕ can also be interpreted as expected reductions in salary due to financial distress, or due to a threat of management dismissal for poor performance, to the extent that managers are earning more than their opportunity cost. Gilson and Vetsuypens (1993) document that when firms default on their debt, CEOs experience large reductions in their real salaries and bonuses.

[6] For simplicity, it is assumed that the fixed salary S in the manager's compensation is paid from the gross operating cash flows such that the terminal cash flows, L, I, or H are available for distribution to debtholders and equity holders.

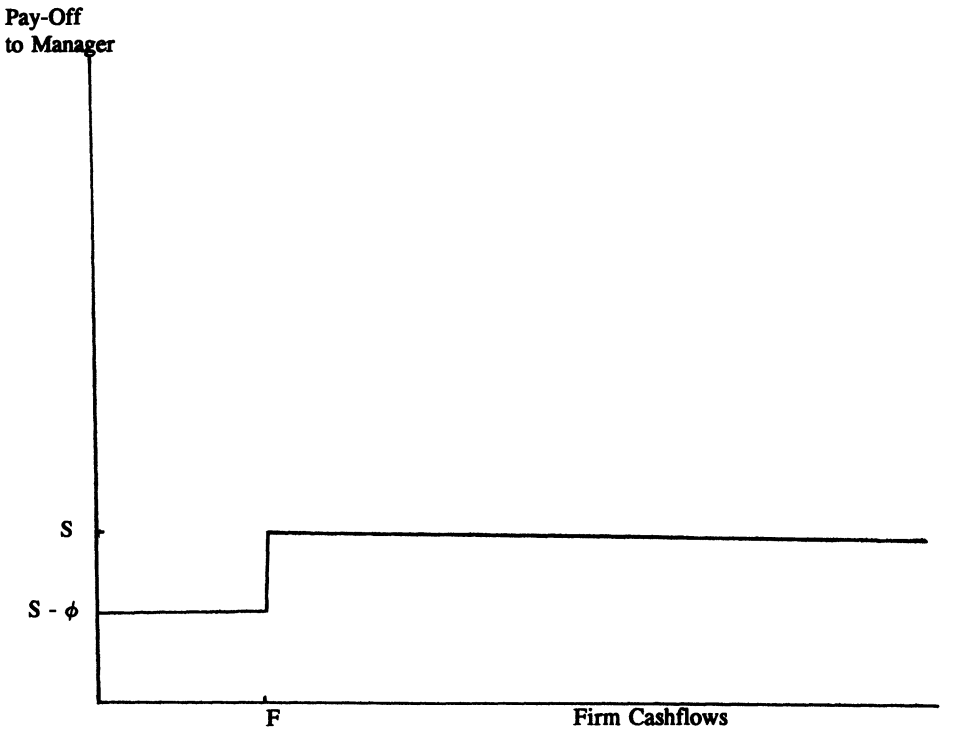

Figure 3. A simple contract $\{S, \phi\}$. S denotes the salary of the manager in solvent states, and ϕ denotes the salary reduction for the manager in default states.

The left-hand side denotes the manager's compensation from undertaking the risky project and the right-hand side the compensation from the riskless project for the realized value of q. $q = 1$ is the only value of q that satisfies (8), i.e., the manager would always invest in the riskless project. Such an investment policy is optimal for the bondholders given $I > F > L$. The bonds are riskless given the investment policy [1]. The following proposition has been established:

PROPOSITION 2: *Under the simple contract* $\{S, \phi\}$ (*fixed salary and threat of salary reductions or dismissal for low performance*), *the manager implements a conservative investment policy* [1] *i.e., he invests in the riskless project for all* $q \in [0, 1]$. *The resulting net present value,* $V(1) = 0$.

The nature of the contract elicits a risk-averse behavior from the manager. Such a scenario is consistent with the behavior of a manager who takes overly conservative investment decisions motivated by human capital concerns, risk aversion, or personal bankruptcy costs (e.g., loss of reputation in the managerial labor market). The contract $\{S, \phi\}$ is suboptimal and entails agency costs of $V(\hat{q}) - 0 = V(\hat{q})$. In the next section the above contract is augmented with incentive features.

B. Simple Contract with Incentive Features

In this subsection, the simple managerial contract is augmented by the addition of a proportion α equity payoff in the solvent states. Under this compensation structure, the manager gets a fixed salary $S \geq 0$, a penalty ϕ (i.e., a compensation $S - \phi$) in the insolvent states, and a compensation of $S + \alpha \times$ {shareholders' payoffs} in the solvent states. This contract is referred to as the incentive contract $\{S, \phi, \alpha\}$. The shape of the contract is graphed in Figure 4.[7] The contract now also has a convex region inherited from the convex payoff of levered equity. First, the investment policy chosen by a manager compensated by an incentive contract $\{S, \phi, \alpha\}$ is characterized. In general, such an investment policy will deviate from the Pareto-optimal one $[\hat{q}]$. Then the incentive parameter α for the optimal contract will be specified.

The manager will invest in the risky project for all values of q such that:

$$(1 - q)(S - \phi) + q\{S + \alpha(H - F)\} \geq S + \alpha(I - F)$$

Equivalently, for $\phi > 0$;

$$q\{\alpha(H - F) + \phi\} \geq \alpha(I - F) + \phi \tag{9}$$

The lowest value of q that satisfies (9) will be denoted as q^m, where

$$q^m = \frac{I - F + \phi/\alpha}{H - F + \phi/\alpha} \tag{10}$$

The manager invests in the risky project for all $q \geq q^m$, i.e., he implements an investment policy $[q^m]$. These arguments imply Proposition 3 below:

PROPOSITION 3: *Under the incentive compensation structure* $\{S, \phi, \alpha\}$ *the manager implements an investment policy* $[q^m]$ *where* q^m *is given in* (10). *For* $\alpha > \phi/(F - L)$ *there is overinvestment in the risky project.*

Proof: For $\alpha > \phi/(F - L)$ it follows that $q^m < \hat{q}$ by comparing equations (10) and (2). Then investment policy $[q^m]$ is riskier than $[\hat{q}]$, by Lemma 1. Q.E.D.

The investment policy induced by an incentive contract may involve overinvestment in risky projects if α, the pay-to-shareholder-wealth sensitivity, is too high.

[7] Again, in the simple exposition presented below, it is assumed that S (or $S - \phi$) in the manager's compensation is paid from gross operating cash flows such that the terminal cash flows, L, I, or H are available to debtholders and stockholders. We have completely characterized the incentive effects and the optimal contract for two alternative specifications in which S (or $S - \phi$) is paid out of terminal cash flows and where (1) managerial salary has higher priority than promised payments to debtholders, and (2) managerial salary has lower priority than payments to debtholders. In specification (2), the costs of insolvency and distress to the manager are endogenously determined, making its exogenous specification (as ϕ) unnecessary. For both specifications (1) and (2) above, all the results continue to hold. Details are available from the authors.

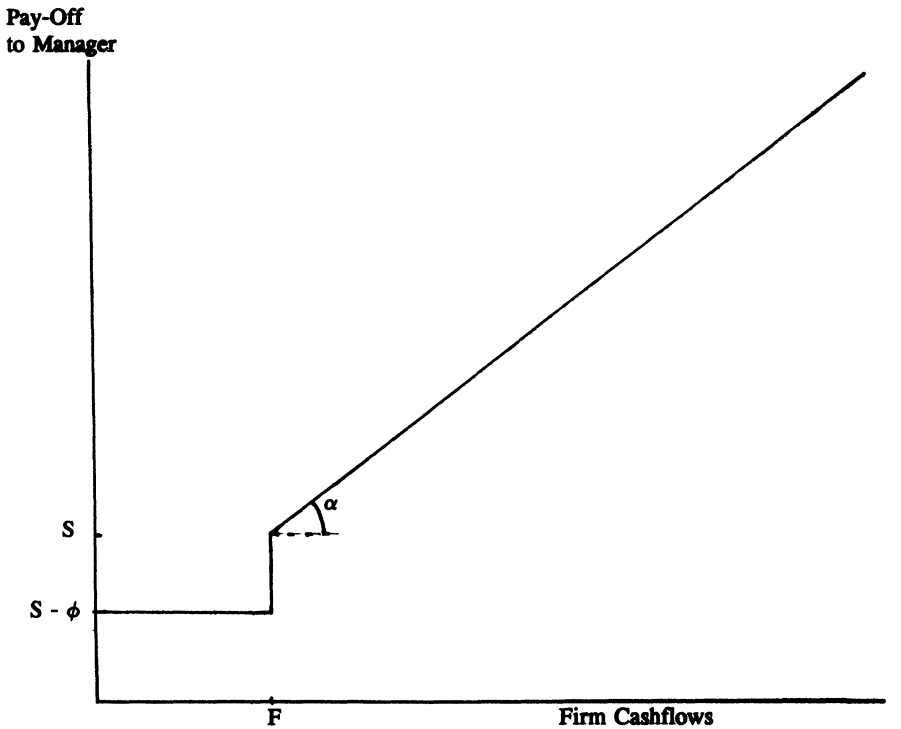

Figure 4. An incentive contract $\{S, \phi, \alpha\}$. S denotes the salary of the manager in solvent states, ϕ denotes the salary reduction for the manager in default states, and α denotes the pay-to-shareholder-wealth sensitivity of the management compensation contract.

In the next subsection, the optimal incentive contract is specified. The optimal value of the sensitivity parameter and its variation with capital structure are also determined.

C. Optimal Incentive Contracts

Our goal, in this section, is to characterize the optimal contract for all values of F, the exogenously specified promised payment on debt. Although, in general, the class of feasible compensation structures is quite large and the pursuit of an optimal structure difficult, the following lemma will simplify the task.

LEMMA 2: *Any feasible compensation structure that induces the investment policy* $[\hat{q}]$ *is an optimal one.*

Proof: By definition, any feasible compensation structure μ has the property that the present value of terminal compensation payoffs under the investment policy implemented (say $[\tilde{q}]$) equals W. Since, at $t = 0$, bondholders pay $B(F, \mu)$, an amount exactly equal to the present value of their payoffs

(given managerial contract μ and induced investment policy $[\tilde{q}]$), the shareholders problem at $t = 0$ is to design a managerial contract that induces an investment policy $[q]$ that maximizes $V(\tilde{q}) - W$, ($V(\tilde{q})$ as defined in equation (3)). From Section I.*B* we have that $[\hat{q}]$ the Pareto-optimal investment policy in equation (2) maximizes $V(\tilde{q})$ (and therefore $V(\tilde{q}) - W$). Therefore any feasible management compensation μ^* that induces investment policy $[\hat{q}]$ is optimal. Q.E.D.

Since our focal interest is to characterize the incentive features and pay-to-shareholder-wealth sensitivity of the optimal compensation structures and relate it to the capital structure of the firm, it would be convenient if we could find a globally optimal contract among the class of incentive compensation structures of Section II.*B*. Proposition 4 characterizes such an optimal contract, using Proposition 3. It should be noted that since we are able to locate a globally optimal contract, our approach entails no loss in generality.

PROPOSITION 4: *The incentive contract* $\{S, \phi, \hat{\alpha}\}$ *where* $\hat{\alpha} = \phi/(F - L)$ *is an optimal compensation structure.*

Proof: For any α, $0 < \alpha < 1$, the incentive contract induces an investment policy $[q^m]$ where q^m is given in (10). Substitute $\hat{\alpha} = \phi/(F - L)$ in (10) and it reduces to $I - L/H - L$ which equals $\hat{q}$ by (2). The investment policy $[\hat{q}]$ is Pareto optimal, and generates the highest value that can be attained by the technology of the firm. By Lemma 2, $\{S, \phi, \hat{\alpha}\}$ is an optimal compensation structure. Q.E.D.

PROPOSITION 5: $\hat{\alpha}$, *the optimal pay-to-shareholder-wealth sensitivity parameter, is decreasing in the level of debt of the firm,* F *i.e.,* $\partial\hat{\alpha}/\partial F < 0$.

Proof: Given $\hat{\alpha} = \phi/(F - L)$, it follows that

$$\frac{\partial\hat{\alpha}}{\partial F} = -\frac{\phi}{(F - L)^2} < 0. \qquad \text{Q.E.D.}$$

As debt increases, the pay-to-shareholder-wealth sensitivity should optimally decline. The intuition is that with larger debt and increased risk-shifting incentives, the management compensation structure has to play a larger "precommitment role" and a smaller "alignment with shareholders" role. In Section IV, it will be shown that the evidence of Jensen and Murphy (1990) regarding historical decline of the sensitivity parameter and its decline with firm size is consistent with Proposition 5 above.

Now the detailed specification of the optimal contract $\{S, \phi, \hat{\alpha}\}$ can be completed. Take ϕ as a given parametric specification of the losses from dismissal or the costs imposed on the manager from financial distress and bankruptcy. Recall that F, $L < F < I$ is also exogenous in the model. Given ϕ and F, $\hat{\alpha}$ is determined as in Proposition 4, and the investment policy induced is simply $[\hat{q}]$, the Pareto-optimal one. The manager's compensation from the contract can be calculated to be the sum of the fixed salary S, and the fraction $\hat{\alpha}$ of returns to equityholders minus the expected value of the

penalty. Denote it as $M(S, \phi, \hat{\alpha})$:

$$M(S, \phi, \hat{\alpha}) \equiv S + \hat{\alpha}\left[\hat{q}(I - F) + \frac{1}{2}(1 - \hat{q}^2)(H - F)\right] - \frac{1}{2}(1 - \hat{q})^2\phi \quad (11)$$

The second term on the right-hand side follows from Figure 1, given investment policy $[\hat{q}]$. Now S is the only term unspecified in the contract. Choose $\hat{S}$ such that

$$M(\hat{S}, \phi, \hat{\alpha}) = W, \quad (12)$$

which can be done. The incentive contract $\{\hat{S}, \phi, \hat{\alpha}\}$ is now completely specified. It induces the Pareto-optimal investment policy $[\hat{q}]$ and is competitive vis-à-vis the labor market for managers.

In the next subsection, the relationship between the risk premium in bond yields and the sensitivity parameter in the compensation contract or managerial stock holdings is examined. We will focus on changes in $\hat{\alpha}$ due to changes in ϕ.

D. Bond Yields and Pay-Performance Sensitivity

Changes in ϕ can cause changes in $\hat{\alpha}$. Changes in pay-performance sensitivity $\hat{\alpha}$ will change the risk-shifting incentives of the manager, which in turn will affect bond prices and the risk premium in bond yields. It would be instructive to specify the relationship.

PROPOSITION 6: (a) *Increases in ϕ will increase $\hat{\alpha}$.*

(b) *The riskiness of the investment policy implemented by a manager is increasing in the pay-to-shareholder-wealth parameter $\hat{\alpha}$ as well as the managerial stock holding.*

(c) *Bond prices decrease and the risk premium in bond yields increase with increases in the pay-to-shareholder-wealth parameter $\hat{\alpha}$ caused by increases in ϕ.*

Proof: $\partial\hat{\alpha}/\partial\phi > 0$ follows from Proposition 4.

Equation (10) implies that a $\partial q^m/\partial\alpha < 0$. The lower the value of q^m, the riskier the investment policy $[q^m]$. The current price $B(F)$ of the bond of face value F, $L < F < I$ given investment policy $[q^m]$ is given by:

$$B(F) = q^m F + \frac{1}{2}\left[1 - (q^m)^2\right]F + \frac{1}{2}[1 - q^m]^2 L \quad (13)$$

$$\frac{\partial B(F)}{\partial q^m} = (1 - q^m)(F - L) > 0. \quad (14)$$

As $\hat{\alpha}$ increases, q^m decreases, $B(F)$ decreases, causing $F/B(F)$ to be higher. $F/B(F)$ is the yield on the pure discount bond, which is entirely the risk premium given that the risk-free rate is zero. Therefore the bond risk

premium is an increasing function of $\hat{\alpha}$. For a given face value F, bond prices are decreasing in $\hat{\alpha}$. Q.E.D.

The intuition of Proposition 6 is straightforward. The larger the sensitivity parameter, the more the risk-shifting incentives and higher the risk premium required by the bondholders.

III. Alternative Mechanisms

In the previous sections we have examined the role of managerial compensation structures in bringing into balance the agency costs arising from a multitude of contracting relationships in the firm, in addition to reducing the agency cost of equity. For modeling convenience we have focused on risky debt as the second external claim, and examined the investment distortions arising from risk-shifting incentives as the only agency cost of debt. Moreover, the only mechanism we have relied on for controlling the incentives of managers, and thereby the agency costs, is the management compensation contract. In general, several alternative mechanisms will play a role in controlling the agency costs of different external claims. Direct monitoring by external claimants (e.g., banks and other creditors may play some role in government), detailed constraints restricting managerial choices (e.g., in debt covenants), regulatory supervision (e.g., by bank examiners in savings and loans and commercial banks), the use of fancy securities (e.g., convertible debt and strip finance), and reputation effects are some alternative mechanisms that curtail agency costs. To the extent these mechanisms are effective, the reliance on managerial compensation is reduced. Multiple mechanisms will also be useful when there are different types of agency costs arising from the same or different external claims of the firm. For example, if the underinvestment incentives as well as the risk-shifting incentives are present, an optimally designed set of dividend constraints included in the debt covenants (see John and Kalay (1982)) as well as an optimal managerial contract may be appropriate mechanisms.

In general, the design and use of alternative mechanisms will affect the nature of the optimal management compensation. In particular, the design of securities and the design of managerial compensation should be jointly done.

A. Convertible Debt

As an example of the use of fancy securities for controlling agency problems and how it affects the nature of the optimal managerial compensation, we will examine the case of convertible debt. Let us consider a convertible debt of face value F and a conversion ratio r, instead of the straight debt that we considered in Sections I and II. A compensation contract that is fully aligned with equity will be optimal when used with an appropriately designed convertible debt.

PROPOSITION 7: *Let the debt security outstanding be a convertible debt of face value* F, $L < F < I$, *and conversion ratio* r^*,

$$r^* = \frac{[L(I - F) + H(F - L)]}{H(I - L)} < 1. \tag{15}$$

The optimal management compensation contract is one that is fully aligned with equity.

Proof: Given a management compensation contract fully aligned with equity, the investment policy implemented will be $[q(r^*)]$, where:

$$q(r^*) = \frac{(I - F)}{(1 - r^*)H} \tag{16}$$

Substituting (15) in (16), $q(r^*)$ reduces to $\hat{q}$ in equation (2), i.e., the Pareto-optimal investment policy is implemented. A managerial contract that is not fully aligned with equity will lead to an investment policy different from $[\hat{q}]$, and hence, suboptimal. Q.E.D.

The intuition of Proposition 7 is straightforward. Since the convertible debt is designed to deal with the agency costs of debt, the management contract can be designed to focus on the agency costs of equity. The pay-to-shareholder-wealth sensitivity of the management compensation contract here is larger than that in the case of straight debt. In the case of straight debt, close alignment of management incentives with equity aggravated the agency costs of debt. With convertible debt outstanding, the payoff to equity contains a concave region that plays a role in ameliorating risk-shifting incentives (see Green (1984)). Alignment of management compensation with equity interests does not lead to an aggravation of the agency costs of debt.

Proposition 7 also demonstrates that optimal design of management compensation is intertwined with optimal design of securities. If the conversion ratio of the convertible debt is lower than r^*, the concave portion of the equity payoff would be "less concave" and the pay-to-shareholder-wealth sensitivity of the corresponding management compensation would be less than that in Proposition 7. In general, the optimal design of external claims and managerial compensation contracts have to be done jointly.

The above proposition also provides some insights on the changes in managerial contracts when the debt of a firm in financial distress is restructured. When a firm is in financial distress, the situation is that of a firm with exceedingly high leverage (say, straight debt). The corresponding pay-performance sensitivity should be low. When the debt is restructured, often increasing the equity and convertible components of it, Proposition 7 tells us that the managerial compensation should also be restructured, increasing its alignment with equity. Gilson and Vetsuypens (1993) document that the renegotiated management contracts have significantly larger stock and option components.

B. Leveraged Buyouts

Leveraged buyouts (LBOs) and management buyouts (MBOs) are transactions characterized by very high leverage, and managements are often large shareholders in the post-buyout company. Although, at first glance, they do not seem to conform to the configuration of Proposition 5 (with low pay-to-shareholder-wealth sensitivity), these transactions make use of several strategies and mechanisms to reduce the agency costs of high leverage. Kaplan (1989), Baker and Wruck (1989), and Opler (1993) describe many of the innovative financing methods and detailed stringent loan covenants used in LBOs to combat agency costs of debt. Reputation effects of LBO sponsors may be one of the important mechanisms that ameliorate agency costs of debt. LBO sponsors adopt a number of measures to ensure that debtholders' interests are protected. They also build a track record of not expropriating debtholders (see John and Nachman (1985) for a model of reputation formation in debt markets and its role in ameliorating agency costs of debt).

Another mechanism for directly mitigating conflict between debtholders and equity holders is to give each some of both securities in a strip financing arrangement (Jensen (1989)). Strip financing is an institutional feature of LBOs which acts like the convertible debt of Proposition 7. Proposition 7 suggests that in this case a high degree of alignment of managerial compensation with equity does not aggravate the agency costs of debt—in fact, it reduces the agency cost of equity. This helps to explain how LBOs and MBOs can handle high levels of managerial ownership along with high degrees of leverage. For details of a variety of mechanisms that reduce the agency cost of debt in LBOs, see Opler (1993).

C. Renegotiation

The role of management compensation in our framework in reducing agency costs of debt depends on its use by the equityholders to "reassure" the debtholders that they are precommitted to value-maximizing investment policy by making such a policy in the interests of the management. The effectiveness of this "precommitment role" of the management compensation contract will be reduced, if the contract can be renegotiated and changed easily, altering its pay-performance sensitivity and the resulting managerial incentives. If the management contract is altered (independently of the bond contract), increasing the pay-performance sensitivity significantly, Proposition 6 tells us that bond prices will drop materially. In such a case the bondholders should sue the firm for damages. The empirical finding by DeFusco, Johnson, and Zorn (1990), that bond prices decline when firms adopt executive option plans, suggests that such a mechanism may be implementable.[8]

[8] Additional mechanisms to increase the precommitment role of management compensation contracts may be (1) to include a dominant debtholder in the board of directors, and (2) to disclose publicly the details of the management compensation structure. (New SEC regulation mandates such disclosures.)

Proposition 7 tells us that the renegotiation of the management compensation structure, when done jointly with the terms and features of the debt contract, can be fair and proper. In this case, if the incentive features of the management compensation are altered such that the resulting investment policy is riskier, the terms of the bond contract can be altered correspondingly such that the bondholders are equally well off. The above discussion also suggests that a comprehensive debt workout should also include restructuring of the management compensation structure.[9]

IV. Empirical Implications

The basic proposition developed in this paper is that managerial compensation should be structured to consider the agency costs of debt in addition to the agency costs of equity. In general, design of securities and design of management compensation are interrelated. Although the model used to develop this idea is a simple one with two agency relationships, it yields several new testable implications. Some of these implications help to explain existing findings; others provide opportunities for further empirical work. The implications are grouped in three categories as follows.

A. Capital Structure

The first group of testable implications relates the pay-to-shareholder-wealth sensitivity in top-management compensation to the firm's capital structure. Strict alignment of management compensation with shareholder interest is shown to be optimal only for all-equity firms. For firms with risky debt, the pay-performance ratio should be smaller. In fact, Proposition 5 implies that the larger the leverage, the smaller the pay-performance ratio of the top-management compensation. This is directly testable.[10]

Even for firms with little long-term debt, there may be debt-like contractual agreements with fixed claimants such as workers, suppliers, and customers. Fama (1990) has argued that such claims be considered along with

[9] Myers and Majluf (1984) show that in the presence of asymmetric information about the firm's cash flows, managers acting in the interest of shareholders may choose to pass up investments that have positive net present value. When the firm's shares are underpriced by the market, issuing new shares to fund a positive net present value investment can harm current shareholders because the issue price is too low. Dybvig and Zender (1991) argue that this underinvestment problem, if it exists, results from the firm offering the manager a suboptimal contract. Using a framework quite close to that of Myers and Majluf, they present a simple profit-sharing contract that provides the manager with incentives to take all and only positive net present value projects. However, Persons (1992) shows that if renegotiation is allowed, the compensation contract of Dybvig and Zender will be renegotiated, and investment will be suboptimal.

[10] A direct test of Proposition 5 is undertaken in John and John (1993). The discussion in Section III highlights the importance of implementing careful controls in the pertinent cross-sectional regressions.

traditional "financial leverage." Similar to the bondholders in the model, these stakeholders will price their claims in anticipation of the investment choices to be made by the management given the compensation contract in place. Even in firms with low financial leverage, the above argument may justify a low pay-performance ratio in the optimal managerial compensation.

It has been documented that leverage in U.S. corporations has increased over the past fifty years (see, e.g., Brealey and Myers (1991)). This would imply that pay-performance ratios should have declined over the last fifty years. Our results also imply that the pay-performance ratios should be lower in larger firms compared to that in smaller firms. The argument is based on the observation that larger firms have more complex capital structures (which involve a multitude of complex agency relationships) and more debt compared to those of smaller firms.

In an important recent paper, Jensen and Murphy (1990) document some interesting evidence consistent with some of the above predictions. These include (1) a low pay-performance ratio of 0.00325, (2) a pay-performance ratio that declined by a factor of 10 over the past 50 years, and (3) pay-performance ratio of 0.00805 in small firms compared to 0.00185 in large firms. Agarwal and Nagarajan (1990) provide evidence that all-equity-financed firms exhibit greater equity ownership by top managers than levered firms. For the group of all directors and officers, the mean (median) of stockholdings of top managers in all-equity firms is 33.14 (32) percent—in levered firms, it is 19.55 (16) percent. (All of the differences are statistically significant at the 1 percent level.) Freind and Lang (1988) also document a negative relationship between debt ratio and management's shareholdings.

The other set of implications of this model comes from our results on the pricing of debt as a function of the sensitivity ratio of the management compensation in place. The more aligned management incentives to shareholder value, the more the risk-shifting incentives and higher the risk-premium required by the bondholders. Several testable implications follow: (i) the larger the pay-performance ratio in the compensation contract, the larger the risk premium in corporate bond yield, (ii) the larger the managerial stock holdings, the larger the risk premium in the bond yield, (iii) a corporate announcement of increases in pay-performance ratio or managerial stock holding will have a negative effect on bond prices, and (iv) when firms adopt executive stock option plans, there should be a negative effect on bond prices. Milonas, Saunders, Strock, and Travlos (1991) find evidence in support of (ii) above in the low and intermediate ranges of managerial stock holdings (less than or equal to 25 percent ownership). DeFusco, Johnson, and Zorn (1990) found that bond prices decline when firms adopt executive stock option plans, which is consistent with (iv) above.

B. Management Compensation in Banks

The risk-shifting incentives in the banking industry (thrifts as well as commercial banks) have been studied extensively. Since the debt-to-equity

ratios in thrifts and banks (where debt includes deposits and other borrowings) can be anywhere from 20:1 to 100:1, these are institutions of extremely high leverage (see Esty (1992) and references therein). Although recent regulatory reform of the Federal Deposit Insurance Corporation has made insurance premia based on measures of risk, its effectiveness in the presence of moral hazard and risk-shifting incentives may be limited. John, John, and Senbet (1991) have argued that risk-based deposit insurance premia may not get at the underlying incentives directly. Our analysis suggests that properly designed managerial compensation structures with low pay-to-shareholder-wealth sensitivity will be able to solve the risk-shifting problem more directly. The policy implication of our result is that direct regulation of managerial compensation in banks may be more effective than risk-based deposit insurance premia. In fact, deposit insurance premia should be tied to the pay-performance sensitivity of the bank management compensation structures.

Another implication of Proposition 5 is that the pay-performance sensitivity in banks (with their extremely high debt ratios) should be extremely low. Pi and Timme (1990) and Houston and James (1993) document that the pay-performance sensitivities in banks are close to zero. In addition, Houston and James (1993) document that CEO compensation in banking is less reliant on stock options and stock ownership than in other industries.

C. Management Compensation in Financial Distress

Our results, Propositions 5 and 7, have direct implications for the pay-to-shareholder-wealth sensitivity of management compensation in financial distress as well as for the changes in the compensation contracts when the firm restructures its debt to resolve financial distress. When the firm is in financial distress, it is insolvent or close to it. It should have extremely high debt ratios, and consequently, extremely low pay-performance ratios. Proposition 7 implies that, while the firm restructures its debt contract, the corresponding optimal management compensation should be closely aligned with equity.

Evidence on CEO compensation structures for firms in financial distress, documented in Gilson and Vetsuypens (1993), is also consistent with the implications of the model. The pay-performance ratio is insignificantly different from zero for firms in financial distress and increases dramatically when the firms successfully restructure their debt. Moreover the option and equity components in the new management compensation contracts also increase significantly when the debt is restructured with increased equity and convertible-to-equity components.

V. Conclusion and Extensions

In an environment of moral hazard vis-à-vis managerial choices regarding project risk, we argue that an optimal managerial compensation has to do

more than align managerial incentives with shareholder interests. It also has to play a role in minimizing the agency costs of debt (or other external claims). These twin roles are modeled in a simple framework with only equity and risky debt (or convertible debt) as the admissible claims and only risk-shifting incentives as the source of agency costs of debt. The amount of debt in the capital structure is shown to be an important determinant of the pay-performance sensitivity of the optimal managerial compensation contract. In fact, the sensitivity parameter is a monotonically decreasing function of debt. Additional testable implications include those for compensation structures in financially distressed firms, banks, and large versus small firms. If alternative mechanisms or fancy securities (such as convertible debt) are used, that can also affect the optimal compensation contract in important ways.

The results also relate bond prices and bond yields to pay-performance sensitivity and managerial stockholdings. Risk premia in bond yields are predicted to be increasing in the sensitivity parameter and managerial stockholding. Other testable predictions include those on the announcement effect of adoption of stock option plans on bond prices.

Because the basic model is simple, several extensions are possible. The menu of securities has been limited to debt, convertible debt, and equity, and the source of agency problems limited to "risk shifting or asset substitution." Allowing for a more extensive menu of external claims or multiple sources of agency problems may change the structure of optimal compensation contracts derived here. For example, when convertible debt was used in the menu of admissible securities, the parameters of the convertible debt can be set to ameliorate the risk-shifting problem (as in Green (1984)) such that the managerial compensation can be optimally aligned closely with shareholder interests. Again, if additional agency problems such as those of managerial perk consumption (see Jensen and Meckling (1976)) or underinvestment (see Myers (1977)) are introduced, then convertible debt ceases to be effective, requiring an increased role for management compensation. Exploring these issues may provide further insights into the structure of management compensation.

In this paper the analysis has been confined to the role of management compensation in environments with problems of moral hazard only. If additional problems of adverse selection also exist (where managers have private information about firm technology which the market does not have), then the managerial compensation in place can affect the incentives of managers to signal. This in turn affects the nature of the optimal compensation contracts.[11] In this paper we took the form of the securities used (debt, equity, or convertible debt) as a given. It would be a challenging and interesting

[11] John (1987) and John and Ronen (1990) analyze optimal financing contracts in environments with both moral hazard and adverse selection problems.

problem to jointly solve the optimal design of the form of securities along with the optimal design of managerial compensation.

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