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Managerial Compensation and the Agency Costs of Debt Finance

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This paper presents a model of the agency costs of debt finance, based on the conflict of interest between shareholders and bondholders. We show how the terms of the compensation contract offered to management by shareholders can reduce these agency costs. We derive a managerial compensation contract that restores the first-best outcome and leads to a local irrelevance result for financial structure. More generally, the model points out that the nature of managerial compensation contracts will affect the firm's optimal financial structure, and offers a reason why managerial compensation is typically not closely correlated with shareholder returns.

INTRODUCTION

Most recent research on the theory of the firm has accepted the view articulated by Jensen and Meckling (1976) that the firm is best viewed as a set of contracts between self-interested parties.[1] Furthermore, as emphasized by Williamson (1975) and many others, these contractual relationships are typically of the 'agency' type: one party can be viewed as acting on behalf of another under conditions of differential information. In the theory of finance, agency relationships have become fundamental to the analysis of financial structure, and, more generally, to the overall understanding of financial contracting.

The agency relationship of most interest in financial economics is that between shareholders and bondholders. Specifically, one can view the bondholders (or, more generally, all creditors) of the firm as 'principals' who delegate authority to the firm's shareholders (their 'agents') to make investments with the bondholders' money. The fact that shareholders cannot normally commit themselves to act in the bondholders' best interests leads to an 'agency cost' of debt, which, if debt markets are competitive, will be borne by shareholders. More concretely, bondholders will anticipate that shareholders will maximize the equity value of the firm without particular concern over the value of the firm's debt. Bondholders will therefore require a sufficiently high interest rate or premium that their expected returns equal the returns on alternative uses of their funds. This agency cost of debt is then compared with the costs of other sources of finance, leading to the determination of the firm's optimal financial structure.

In large publicly held corporations it is rarely the shareholders who make important investment and product-market decisions. These decisions are normally made by senior managers who are themselves agents of the shareholders. The agency relationship between managers and shareholders has been extensively studied. It has not been emphasized, however, that the agency relationship between managers and shareholders can affect that between bondholders and shareholders. In this paper we investigate the interaction between these two agency relationships.

Assuming first that shareholders control the firm, we present a simple representation of the agency costs of debt finance. We then introduce outside management, and show how the terms of the compensation contract offered by shareholders to management can mitigate the agency costs of debt

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finance. We present a managerial contract that, in our simple context, eliminates the agency cost of debt. Finally, we illustrate the importance of the managerial compensation contract for the determination of optimal financial structure.

This approach provides a partial answer to a question raised by Baker *et al.* (1988) concerning why managerial compensation is not more closely related to profit performance. Our basic point is that it is not in the interest of shareholders to make the incentives of managers coincide with their own, for their own incentives create an agency cost of debt. Shareholders are better off overall if they use outside management as a device to commit the firm to strategies that place more weight on the interests of bondholders than would shareholders themselves if they controlled the firm. More specifically, our paper suggests why it might be in the overall interest of shareholders to have management that adopts more conservative strategies than would be implied by always trying to maximize the current equity value of the firm. By inducing more conservative behaviour by managers, the agency costs of debt are reduced.

The idea of solving agency problems by precommitment goes back at least to Schelling (1956), who first described the role of commitment strategies and recognized that commitments can be created by third-party contracts. Our contribution is to draw attention to the importance of third-party contracts between shareholders and managers for financial contracting, and to the feasibility of using such contracts as commitment devices.

There is a very large literature on agency relationships in general, and on applications of agency theory to financial contracts in particular. Standard references include Jensen and Meckling (1976) and Holmstrom (1979). The particular agency problem we consider is similar to the 'investment incentive' problem that has been studied by Myers (1977), Green (1984), John and Nachman (1985), and Darrough and Stoughton (1986), among others. Analysis of agency contracts under limited liability is contained in Sappington (1983) and Brander and Spencer (1989). Fershtman and Judd (1987) examine the role of the managerial contract as a precommitment device in oligopolistic industries, and Katz (1988) offers a general analysis of the use of agency contracts as commitment strategies. One paper with a fairly close relationship to ours is Dybvig and Zender (1990), who make the point that if managerial contracts are chosen optimally, then the financial structure irrelevance results of Modigliani and Miller (1958) can be extended to various model structures incorporating asymmetric information.

The next section presents a simple model of the agency relationship between shareholders and bondholders, assuming that shareholders control the firm. The third section then introduces management as the agent of shareholders and shows how the agency costs of debt finance derived in the next section can be reduced by a very simple contract. The fourth section derives a 'first-best' managerial compensation contract for our structure, and the fifth section illustrates the role of managerial compensation contracts in determining financial structure. The final section contains conclusions.

A SIMPLE MODEL OF THE AGENCY COST OF DEBT

In this section we develop a simple model of the agency costs of debt. We abstract from many important influences on financial decisions, such as risk aversion and taxes, but the model does allow the central conflict of interest between shareholders and bondholders to be clearly demonstrated. We assume that shareholders control the firm and have access to a new investment opportunity requiring an *ex ante* payment, K. Shareholders must also incur a cost, M_0, which is their personal opportunity cost of managing the firm. Investment K must be financed at least partially by borrowing, B. In order to borrow amount B, shareholders must promise to pay back D, which will normally exceed B.

Returns to the investment depend in part on some action variable, a, chosen by shareholders, and in part on a random variable, s, representing the state of nature. Random variable s is normalized to be in the interval $[0, 1]$, and is distributed according to probability density function $f(s)$, with cumulative distribution function $F(s)$. The return to the firm given state s and action a is denoted $R = R(a, s)$. Higher values of s represent better states of nature. Using subscripts to denote derivatives, this means $R_s(a, s) > 0$.

It is useful to distinguish between two types of actions that an agent might undertake, i.e. 'personal' and 'impersonal'. Personal actions are those that impose direct personal costs (or benefits) on the agent, and therefore enter the agent's utility function directly. Impersonal actions do not directly enter the agent's utility, but may enter indirectly through their effects on the agent's financial returns. For example, the provision of 'effort' is a personal action, whereas choosing between two investments (or choosing whether the firm's output should be red or blue) is an impersonal action.

In general, a might be a vector including both types of action. We simplify the analysis, however, by assuming that a is a scalar variable representing an 'impersonal' action. We focus on impersonal actions because they are algebraically clearer and probably more empirically relevant than personal actions, especially in medium-sized and large corporations, where the effort of a senior manager is only a very small part of total factor input but where the 'quality' of decision making is very important. The basic ideas can, moreover, be extended fairly readily to the case of personal actions.

We assume that higher values of a represent 'more aggressive' strategies in the sense that higher values of a have higher marginal returns in good states of nature:

$$R_{as}>0 \tag{1}$$

Expression (1) implies that the return-maximizing value of a is increasing in s, so choosing high values of a represents 'optimistic' strategies. For the various second-order conditions it is important that R be concave in a: $R_{aa}<0$.

If returns are insufficient to cover debt, the firm is bankrupt and bondholders become the residual claimants. The 'breakeven' state of nature, in which the firm is just able to remain solvent, is denoted s^* and defined by

$$R(a, s^*)-D=0 \tag{2}$$

States of nature above s^* are solvent states, and those below s^* are bankrupt states. The probability of bankruptcy is $F(s^*)$ and the probability of solvency is $1-F(s^*)$.

The model comprises several stages. In stage 1, shareholders decide on the amount of borrowing, B. In stage 2, money is raised in bond markets, debt D is determined, and investment cost K is paid. In stage 3, shareholders decide on a, taking D as given. Finally, uncertainty is resolved and payoffs are made.

The stage-3 value of the firm to shareholders, denoted V^{E}, is given by

$$V^{\mathrm{E}}=\int_{s^*}^{1}(R(a, s)-D)f(s)\,\mathrm{d}s-M_0 \tag{3}$$

Maximization of the above yields first-order condition

$$V_a^{\mathrm{E}}=0 \Rightarrow \int_{s^*}^{1} R_a(a^{\mathrm{E}}, s)f(s)\,\mathrm{d}s=0 \tag{4}$$

where a^{E} represents the shareholders' preferred action. (In the derivation of Eqn (4) there is a second term, $(R(a, s^*)-D)\,\mathrm{d}s^*/\mathrm{d}a$, which is equal to 0 from Eqn (2).) The second-order condition is $V_{aa}^{\mathrm{E}}<0$.

The value of bondholders' claim on the firm, denoted V^{B}, is given by

$$V^{\mathrm{B}}=(1-F(s^*))D+\int_{0}^{s^*} R(a, s)f(s)\,\mathrm{d}s \tag{5}$$

The first term represents the expected return to bondholders over solvent states and the second denotes the expected value of residual returns over bankrupt states. Maximization of Eqn (5) implies the following first-order condition, where the bondholders' preferred solution for a is represented by a^{B}:

$$V_a^{\mathrm{B}}=0 \Rightarrow \int_{0}^{s^*} R_a(a^{\mathrm{B}}, s)f(s)\,\mathrm{d}s=0 \tag{6}$$

The 'first-best' outcome would involve maximizing the sum of the equity value, V^{E}, and the debt value, V^{B}, denoted V:

$$V\equiv V^{\mathrm{E}}+V^{\mathrm{B}}=\int_{0}^{1} R(a, s)f(s)\,\mathrm{d}s-M_0 \tag{7}$$

The first-best level of action, denoted a^1, solves the following first-order condition:

$$V_a\equiv\int_{0}^{1} R_a(a^1, s)f(s)\,\mathrm{d}s=0 \tag{8}$$

Proposition 1

The level of action a favored by shareholders exceeds the first-best level, while the level of action favored by bondholders falls short of the first-best level:

$$a^{\mathrm{E}}>a^1>a^{\mathrm{B}} \tag{9}$$

Proof: The result follows from the three first-order conditions (4), (6), and (8) and condition (1). The basic structure of the result is that first-order condition (4), which determines a^{E}, sets the expected value of R_a over the range $[s^*, 1]$ equal to zero. First-order condition (8), which characterizes a^1, sets the expected value of R_a over the range $[0, 1]$ equal to zero. This includes the range used to define a^{E} and additional values of s over which R_a is strictly less than in the range $[s^*, 1]$, implying that $a^1 < a^E$. Parallel reasoning implies $a^B < a^1$. □

The intuition of Proposition 1 is that shareholders place emphasis only on states of nature that are solvent, i.e. on states in which the marginal value of a is high. In bankrupt states, shareholders' losses are truncated at zero, due to limited liability, so they are unaffected by the size of shortfalls. This leads shareholders to favor excessively aggressive actions (relative to the first-best). Bondholders, however, place emphasis only on bankrupt states, which leads them to favor excessively conservative actions. The difference between a^1 and a^E generates the agency costs of debt, leading to losses in shareholders' stage-1 net value.

Assuming bondholders are risk neutral, and letting the risk-free rate be zero for algebraic convenience, we obtain the following bond-market condition linking B, the amount borrowed, and D, the face value of the debt:

$$B = V^B = (1 - F(s^*))D + \int_0^{s^*} R(a^E, s) f(s)\, ds \qquad (10)$$

It follows from Eqn (10) that D must exceed B. Thus, shareholders bear the full cost of their excess aggressiveness, as can be seen formally by considering their stage-1 problem. Their stage-1 expected return, denoted V^{E1}, can be written:

$$V^{E1} = V^E - K + B = V - K \qquad (11)$$

Amount K is just an exogenous constant, so the stage-1 problem facing shareholders is simply to maximize the value of the firm. If a were observable to bondholders, it would be in the shareholders' interest to choose the first-best level of a. We assume, however, that a is unobservable to bondholders, so shareholders can credibly promise only to act in their own interests, taking as given whatever debt contract they have. This implies a choice of a^E rather than a^1.

THE ROLE OF OUTSIDE MANAGEMENT

We now introduce outside management that receives benefits according to some managerial contract set by shareholders. The manager rather than shareholders now sets a. Shareholders no longer incur personal costs of managing the firm, but pay the management instead. Our main point is that the managerial contract can be used to induce management to prefer a level of a that raises the overall value of the firm.

Consider first the simple 'penalty' contract. The manager receives a fixed salary, M, provided the firm remains solvent, but receives $M - T$ if the firm is bankrupt, where T is a personal transaction cost borne by the manager if bankruptcy occurs. (This might be the cost associated with looking for a new job.) Salary M might not be the same as the cost to shareholders of managing the firm themselves, but must be sufficiently high to attract management to the firm.

If the firm is solvent, shareholders pay the manager M, pay bondholders debt, D, and claim the residual returns. The breakeven state of nature, s^*, occurs when residual returns are marginally nonnegative, as defined by

$$R(a, s^*) - D - M = 0 \qquad (2a)$$

Assuming that even the worst state of nature generates enough revenue to pay the manager's salary, M, the expected return to the manager is given by

$$V^M = (1 - F(s^*))M + F(s^*)\,(M - T) \qquad (12)$$

The manager's value-maximizing action, a^M, given payoff function (12), requires minimizing the probability of bankruptcy, as implied by the following first-order condition:

$$V^M_a = 0 \Rightarrow R_a(a^M, s^*) = 0 \qquad (13)$$

It is as if the manager cares only about this critical state, and wants to choose a so as to make expected revenue in this state as high as possible. This may or may not coincide with the first-best choice of a.

Proposition 2

Under a simple penalty contract, the manager's choice of action, a^M, will exceed the action preferred by bondholders, a^B.

Proof: The results follows from a comparison of first-order condition (6) and (13), and by using Eqn (1). Specifically, the value a^B is calculated by setting the expected value of R_a over the range $[0, s^*]$ to zero. The largest value of R_a in this range occurs at s^*, from Eqn (1), and is positive by Eqn (6). When a manager is hired, and the manager's salary becomes a claim on the firm, s^* rises: the critical state of the world in higher for a given D. It follows that the action implied by setting $R_a(a, s^*)$ to zero is greater than a^B, by Eqn (1) □

The manager's action will be less than the action preferred by shareholders if $R_a(a^E, s^*)$ is negative at the breakeven state defined in Eqn (2a). By Eqn (13) and the concavity of R, this would imply that $a^M < a^E$. This will occur unless managerial salary is very large compared to the overall expected value of the firm's residual returns. Thus the normal case is that this simple penalty contract induces action closer to the bondholders' preferred action that the shareholders would choose if they managed the firm directly.

Even if shareholders could align managerial incentives strictly with their own, they might prefer not to do so. Because shareholders bear the agency costs associated with raising debt, they will be better off if they can commit the firm to an action closer to the first-best than they themselves would subsequently choose. This commitment would allow shareholders to borrow money on more favorable terms and increase the stage-1 value of their investment opportunity.

EFFICIENT MANAGERIAL COMPENSATION

In this section we set out the managerial compensation problem more formally and consider a (slightly) more sophisticated contract, which we refer to as a bonus contract. The contract involves no exogenous personal bankruptcy cost to the manager. Instead, the manager receives a bonus, M, if the firm reaches some revenue target, $\hat{R}$, and receives some straight *ex ante* salary, I, that is paid before action a is chosen. The combined expected value of the managerial contract must be at least equal to the manager's opportunity cost, M_0.

The sequential structure of the model is as follows. In stage 1, shareholders decide how much of investment cost, K, to finance with debt and how much with equity. In stage 2, shareholders select a managerial compensation contract, including a target revenue level, $\hat{R}$, a bonus payment, M, and an 'up-front' salary, I, that is paid in stage 2 out of new equity. In stage 3, the value of the firm's debt is determined in a competitive credit market, and investment K is made. In stage 4, the manager selects action a^M. Finally, uncertainty is resolved and payoffs are made. The sequential structure is as described in the second section of this paper, except that a managerial compensation contract stage is introduced before the terms of the firm's borrowing are determined in debt markets. We assume that the actual selection of a^M and the state of nature s are observed only by the manager. Thus contracts cannot be written directly on a^M, since neither shareholders nor bondholders can verify the actual level of a^M chosen.

The method of analysis involves starting with stage 4 then working backwards, ensuring that the solution is sequentially rational. The revenue target, $\hat{R}$, determines a critical state, $\hat{s}$, below which the bonus will not be paid. This critical state is defined by

$$R(a, \hat{s}) = \hat{R} \qquad (14)$$

The target return level, $\hat{R}$, must be high enough that the firm has sufficient funds to pay back the debt and pay bonus M. Therefore, $\hat{s} > s^*$, where s^* is defined in Eqn (2a). Total differentiation of Eqn (14) establishes

$$d\hat{s}/da = -R_a(a, \hat{s})/R_s; \; d\hat{s}/d\hat{R} = 1/R_s > 0 \qquad (15)$$

The payoff to the manager is

$$V^M = M(1 - F(\hat{s})) + I \qquad (16)$$

The first-order condition associated with maximization of Eqn (16) is

$$V_a^M = 0 \Rightarrow -Mf(\hat{s})\, d\hat{s}/da = 0 \Rightarrow R_a(a^M, \hat{s}) = 0 \qquad (17)$$

with second-order condition $V_{aa}^M < 0$. Equation (17) implies that, at the solution, the manager sets $d\hat{s}/da = 0$: action a^M is chosen so as to minimize $\hat{s}$, in effect maximizing the probability that the manager receives bonus M. In order to understand the optimal bonus contract it is useful to determine the comparative-static response of the manager to changes in the contract parameters M and $\hat{R}$. These comparative-static effects are obtained by total differentiation of first-order condition (17), yielding

$$da^M/dM = -V_{aM}^M/V_{aa}^M = f(\hat{s})\,(d\hat{s}/da)/V_{aa}^M = 0 \qquad (18)$$

$$da^M/d\hat{R} = -Mf(\hat{s})R_{as}(d\hat{s}/d\hat{R})/R_s V_{aa}^M > 0 \qquad (19)$$

Expression (18) equals zero from first-order condition (17) and indicates that the manager's action is not affected by the magnitude of the bonus (as long as it is positive). As in the second section, as long as the bonus is available, the manager wants to maximize the probability of getting it. Raising the target revenue level, however, does influence the manager's behaviour: specifically, increases in the target revenue make the manager more aggressive. In effect, increases in target revenue force the manager to focus on a critical state of nature, $\hat{s}$, that is higher than before, in which the marginal returns to a are higher than previously. This induces the manager to choose a higher level of a. Increases in debt, D, have no effect on managerial action as long as the breakeven state, s^*, remains below the critical state, $\hat{s}$, in which the revenue target is just met.

We now consider stage 3, the debt-market stage, in which the firm's debt is priced in competitive debt markets. At this stage, the debt market takes the terms of the managerial contract as predetermined and sets an actuarially fair price for the debt. The face value of debt, D, for any given level of desired borrowing, B, is affected by the terms of the managerial compensation contract, and, in particular, by the target revenue level, $\hat{R}$. The debt-market condition equating the value of the firm's debt to the amount of money loaned by bondholders is:

$$B = V^{\mathrm{B}} = (1 - F(s^*))D + \int_0^{s^*} R(a^{\mathrm{M}}, s) f(s)\,\mathrm{d}s \quad (20)$$

Equation (20) is the same as Eqn (10) except that the value of the action variable anticipated by bondholders is now a^{M}. This condition can be viewed as determining D for any given B. It is affected by $\hat{R}$ because $\hat{R}$ influences a^{M}, by Eqn (19), which, in turn, influences the bondholders' return in bankrupt states, and therefore affects the value of the firm's debt. Specifically, if $\hat{R}$ is reduced, this reduces a^{M} which raises $R(a^{\mathrm{M}}, s)$ in bankrupt states, and therefore lowers the required premium of D over B. Algebraically, we have

$$\mathrm{d}D/\mathrm{d}\hat{R} = -V^{\mathrm{B}}_{\hat{R}}/V^{\mathrm{B}}_{D}$$
$$= -\int_0^{s^*} R_a(a^{\mathrm{M}}, s)(\mathrm{d}a^{\mathrm{M}}/\mathrm{d}\hat{R}) f(s)\mathrm{d}s/(1 - F(s^*)) \quad (21)$$

which can be used to demonstrate Proposition 3.

Proposition 3
An increase in the target revenue level raises the premium of D over B paid by the firm in debt markets.

Proof: The proof requires observing that expression (21) is positive. First, $R_a(a^{\mathrm{M}}, \hat{s}) = 0$ from Eqn (17). Recalling that $\hat{s}$ must exceed s^*, this implies, from Eqn (1), that $R_a(a^{\mathrm{M}}, s)$ is negative over the range $[0, \hat{s})$. Since $\mathrm{d}a^{\mathrm{M}}/\mathrm{d}\hat{R} > 0$, it follows that $\mathrm{d}D/\mathrm{d}\hat{R} > 0$. □

The next step is to consider stage 2, when shareholders choose the optimal managerial compensation contract. In stage 2, shareholders have already decided how much they want to borrow, B. They wish to set the terms of the managerial contract so as to keep the required premium of D over B low, and to induce managerial action a^{M} that produces large expected residual returns. Shareholders could minimize the premium of debt over borrowing by inducing the manager to be very conservative in choosing a^{M}, in effect aligning management's incentives with the preferences of bondholders. This would, however, involve a large sacrifice of returns in good states of the world. The solution will involve a tradeoff of these two effects and will, in fact, require a contract that will induce the first-best action level. To see this formally, the stage 2 return to shareholders, denoted V^{E2}, is given by

$$V^{\mathrm{E2}} = \int_{\hat{s}}^{1} (R(a^{\mathrm{M}}, s) - M - D) f(s)\,\mathrm{d}s + \int_{s^*}^{\hat{s}} (R(a^{\mathrm{M}}, s) - D) f(s)\,\mathrm{d}s - I \quad (22)$$

subject to constraint (20) given by the bond market, which can be rewritten as:

$$(1 - F(s^*))D = B - \int_0^{s^*} R(a^{\mathrm{M}}, s) f(s)\,\mathrm{d}s \quad (23)$$

and subject to the managerial participation constraint that the expected value of managerial income be equal to M_0. This constraint is expressed as

$$(1 - F(\hat{s}))M + I = M_0 \quad (24)$$

The problem is also constrained by the fact that $\hat{s}$ must exceed s^*. Rearranging Eqn (22) yields

$$V^{\mathrm{E2}} = \int_{s^*}^{1} R(a^{\mathrm{M}}, s) f(s)\,\mathrm{d}s - (1 - F(s^*))D - (1 - F(\hat{s}))M - I \quad (25)$$

Substituting Eqns (23) and (24) into (25) then yields.

$$V^{\mathrm{E2}} = \int_0^1 R(a^{\mathrm{M}}, s) f(s)\,\mathrm{d}s - M_0 - B \quad (26)$$

Since B is predetermined and M_0 is exogenous, maximizing Eqn (26) (through the choice of the managerial compensation contract) is equivalent to maximizing the value of all returns to the firm. This is also equivalent to maximizing the sum of equity value and debt value. Hence, shareholders want to choose a managerial compensation contract for which $a^{\mathrm{M}} = a^1$.

In deriving Eqn (26) we have, however, assumed that shareholders provide the manager with a compensation contract that is just equal to his or her opportunity cost. It is not obvious that such a package is consistent with inducing the first-best action. Our next proposition proves that such a contract does exist, but it requires one further assumption, given by

$$R_a(a^1, s^*) < 0 \tag{27}$$

Condition (27) means that the model parameters must be such that the marginal return to effort beyond the first-best level in breakeven state s^* is negative. This implies that the state for which the first-best level of effort maximizes marginal returns must be in the range where shareholders are residual claimants. This can always be achieved by an appropriate choice of B in the first stage, so it is not highly restrictive, but it does place an upper bound on the debt-equity ratio that is consistent with inducing the first-best action. We discuss this further in the next section. We now state the main result of this section.

Proposition 4
There exists a managerial compensation contract that induces the first-best action, a^1. This contract maximizes shareholders' stage-2 wealth.

Proof: The proof is by construction; i.e. we show how to construct a contract that induces the first-best action. The fact that this contract maximizes shareholders' stage-2 wealth follows immediately from Eqn (26). The steps in the construction of the contract are as follows:

(1) Find $\hat{s}$ such that $R_a(a^1, \hat{s}) = 0$. By Eqns (27) and (1), it follows that $\hat{s} > s^*$;
(2) Set $\hat{R} = R(a^1, \hat{s})$;
(3) Choose M such that $0 < M < \hat{R} - D$ and $(1 - F(\hat{s}))M \leqslant M_0$;
(4) Set $I = M_0 - (1 - F(\hat{s}))M$.

That this contract induces the first-best action level, a^1, can be seen from Eqn (17), the manager's first-order condition. Step 1 above ensures that the manager's chosen action, a^M, coincides with the first-best action, a^1, because the manager chooses precisely to set $R_a(a^M, \hat{s}) = 0$. (Given the assumed concavity of R in a, it is easy to show that there is a unique solution to this first-order condition.) Step 2 then determines the target revenue that is necessary to induce the required level of $\hat{s}$ for step 1. Condition (27) ensures that $\hat{s}$ is large enough that M and D can be paid. Step 3 indicates that the bonus for reaching the target return can be anything strictly positive and sufficiently small that it can be paid without bankrupting the firm in states above $\hat{s}$, and provided that it does not exceed the manager's opportunity cost in expected value. Finally, step 4 sets the manager's salary at just the right level so that the manager's expected return is equal to his or her opportunity income. Since M can be arbitrarily small, it follows that I can always be made strictly positive. □

Proposition 4 implies that choosing an appropriate managerial contract can, in our framework, eliminate the agency cost of debt, at least up to some maximum debt level. We have focused on only one source of the agency cost of debt: the incentive for excessive aggressiveness by shareholders. In addition to this source of agency cost, the literature has also focused on agency costs caused by the possibility that managers may consume perquisites (e.g. Williams, 1987), increasing their own welfare, but reducing the value of the firm, or that they may economize on their own effort, once again raising their own welfare at the cost of other claimants on the firm. Introducing additional sources of agency costs will make it harder (and perhaps impossible) for shareholders to completely eliminate the agency costs of debt. The main point of this section, however, is not that agency costs can be completely eliminated (although they can in our model), but that the terms of managerial compensation can, in general, have an important effect on the agency cost of debt. We complete the analysis of our model by examining the shareholder's stage-1 decision concerning financial structure.

OPTIMAL FINANCIAL STRUCTURE

The firm's financial structure decision is determined principally in stage 1, when the firm decides how much to borrow, B, and how much equity to provide, denoted E, to pay the investment cost, K. In stage 2, shareholders add additional equity I, to pay the manager the 'up-front' component of his or her salary. Proposition 4 implies that the agency cost of debt can be reduced to zero, provided condition (27) holds ($R_a(a^1, s^*) < 0$), which says that the marginal return to effort in the breakeven state must be negative at a^1. If no debt is taken on, then $s^* = 0$: even the worst possible state allows the firm to remain solvent. Action a^1 is obtained by setting the average value of R_a over all states in the interval [0, 1] equal to zero. By Eqn (1), all of these states are better than state 0, except for state 0 itself. It follows that Eqn (27) must be satisfied at $s^*=0$.

At the other extreme, if sufficient debt is taken on that bankruptcy is virtually certain, then Eqn (27) cannot be satisfied. In other words, if the breakeven state is very high, then it will not be the case that the marginal value of action beyond the first-best level will be negative in the breakeven state. This is because if the breakeven state is high, marginal returns in that state will be high, and $R_a(a^1, s^*)$ will be positive, since a^1 is obtained by setting the average of R_a over all states to zero.

In general, there is a critical value of B, denoted $\bar{B}$, below which the agency cost of debt is zero (because Eqn (27) is satisfied), and above which the agency cost of debt is increasing. The problem with high debt levels is that shareholders cannot find a target revenue level, $\hat{R}$, that is low enough to induce management to choose action level a^1 while still having enough residual returns to pay the promised bonus, M. At the extreme, if shareholders are extremely unlikely to be able to pay a bonus then the bonus contract cannot affect the manager's action. Condition (27) is equivalent to the idea that shareholders must earn enough residual returns to pay management the bonus in all states of nature in which it is promised.

More formally, the shareholders' stage-1 objective function, denoted V^{E1}, can be written as follows (using Eqn (26)):

$$V^{E1}=\int_0^1 R(a(B,E),s)-B-E-M_0 \qquad (28)$$

where $B+E=K$, assuming that shareholders have a perfectly elastic supply of equity available at the risk-free rate of return, which has been normalized to be 1. In the range of B over which the first-best contract is available, action a will be locally insensitive to changes in B, and maximization of Eqn (28) will not yield a determinate solution. In other words, assuming there are no agency costs of equity, we have an irrelevance result over the range of borrowing $[0, \bar{B})$. In this range, shareholders are indifferent about changing the level of borrowing. They are, however, not indifferent about levels of B beyond $\bar{B}$. Thus, while there is no determinate debt-to-equity or debt-to-asset ratio, there is a maximum debt-asset ratio given by $\bar{B}/(K+I)$.

If, furthermore, there were some other advantage to debt, such as a tax advantage, then shareholders would find it in their interest to borrow slightly beyond $\bar{B}$, up to the point where the marginal agency cost of additional debt just offset the marginal tax advantage of debt. In addition, we expect that the marginal cost of equity finance is increasing, rather than constant, presumably because of (unmodelled) agency costs of outside equity, creating a determinate solution for the debt–equity ratio even in the absence of a tax advantage to debt.

Assuming that the marginal cost of the first dollar of equity finance and the first dollar of debt finance are equal, Proposition 5 characterizes the different possibilities.

Proposition 5

(1) If, at the solution, $da/dE=0$ and $da/dB=0$, the debt–equity ratio is locally indeterminate, and $a^M=a^1$.
(2) If, at the solution, $da/dE=0$ and $da/dB\neq 0$, the firm will be all equity, and $a^M=a^1$.
(3) If, at the solution, $da/dE\neq 0$ and $da/dB\neq 0$, the solution requires $da/dE=da/dB$, there will be a unique solution for the debt–equity ratio (assuming second-order conditions are globally satisfied), and $a^M\neq a^1$. □

CONCLUSIONS

Our main objective in this paper is to point out that managerial compensation contracts are a potentially important method for mitigating the conflict of interest between a firm's shareholders and bondholders. The illustrative model we use is very stylized, and we are able to find a relatively simple contract that eliminates the agency cost of debt entirely, at least for some range of borrowing. More generally, one would not expect the agency costs of debt to be eliminated, but the idea that third-party managerial compensation contracts affect agency costs is certainly robust. This leads to another point of emphasis in the paper: that managerial compensation contracts can be advanced as an important determinant of financial structure.

Here, as in any paper focusing on one specific mechanism for dealing with agency problems, we abstract from other mechanisms. One might ask why risky debt would be used at all rather than financing the firm completely with equity or with an alternative instrument like convertible debt (as analyzed in Green, 1984). In our paper, the agency cost of debt can be entirely eliminated using managerial contracts (at least up to some level of debt), so there is little reason to search for alternative instruments, but in a more general setting, where agency costs cannot be entirely eliminated, one would expect a variety of financing mechanisms to be used. Each would be used up to the point where its marginal agency (or other) cost equalled the marginal cost of alternative mechanisms. One interesting possibility would be to use managerial contracts to deal with moral hazard, and to target the financial mix to other important considerations that are not modelled here, such as taxes and bankruptcy costs.

Incentive problems associated with debt might be reduced or eliminated by using debt covenants, as pointed out in Smith and Warner (1979) and in John and Kalay (1982), who analyze the related problem of using dividend payout restrictions to reduce the agency cost of shareholder–bondholder conflicts. A restriction that only certain projects must be chosen or certain output strategies adopted could be imposed on corporate insiders.[2] The extent to which debt convenants can be used to mitigate incentive problems depends on whether relevant managerial decisions can be anticipated, monitored, and contractually specified. In situations where it is important that corporate insiders be given considerable discretionary power to deal with unforseen contingencies, debt covenants would be less useful. We expect that some potential incentive problems can be handled by debt covenants, but that there are still many unsolved incentive problems left over. The kind of managerial contract we describe is an additional tool for dealing with such problems.

As this discussion suggests, there are many types of agency-based incentive problems and many responses to them. At the empirical level we would like to know which types of agency problems (if any) are important in influencing corporate decisions. We would also like to know which responses are most effective in mitigating these problems and whether, as suggested by this paper, managerial contracts are a useful way of reducing the cost of shareholder–bondholder conflicts of interest. One way to shed light on the relevance of managerial contracts would be to relate features of managerial contracts to industry type, firm size, and other firm characteristics. If the features captured in our model are important then one would expect bonus contracts to be observed in situations of high leverage and in industries where monitoring corporate insiders is particularly difficult. We might also expect that bonus contracts would be a substitute for debt convenants, and that bonus contracts would be used in larger firms, where impersonal rather than personal moral hazard is important.

The use of managerial contracts as commitment devices can be offered as an explanation for the observation that managerial contracts rarely align manager's rewards with shareholder interests, and for the related observation that managers are often alleged to be more conservative than maximization of shareholder wealth would imply. Indeed, managers will frequently say that they have an 'obligation' to a firm's bondholders as well as to its shareholders. We make the point that managerial contracts that induce such 'obligations' are natural market reactions to an important class of agency problems.

Because we sought to focus on the use of managerial contracts to mitigate agency problems between shareholders and bondholders, we abstracted from the agency problems that arise between shareholders and managers as a result of managerial disutility from effort. It is, however, relatively straightforward to generalize the model in this direction by putting in an additional variable (effort) that has positive effects on the revenue of the firm but negative direct ones on the utility of the manager. We also abstracted from managerial risk aversion and the implied risk-sharing considerations. If managerial effort or risk aversion were important, then we would expect the form of managerial compensation contracts to take these concerns into account. As indicated by the literature on optimal risk-sharing incentive contracts, it is hard to derive general characteristics of optimal contracts for such circumstances, and it is not normally possible to restore the first-best. While such analysis is beyond the scope of the present paper it would not undercut the basic insight that managerial contracts can reduce agency problems arising between shareholders and bondholders.

Finally, we would emphasize that our model is an example of what might be called 'hierarchical agency'. We could imagine a hierarchy of actors in which any given actor is an agent for the actor immediately above him or her in the hierarchy and a principal for the actor immediately below. Many institutions, including private-sector management structures, public-sector bureaucracies, unions, the criminal justice system, etc., have elements of this structure. We hope our paper demonstrates that hierarchical agency adds interesting new considerations to agency problems, and is not simply a matter of applying the basic agency model independently at each level. Agency contracts at one level can be expected to interact in important ways with contracts at other levels.

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NOTES

1. The corporation then differs from other contractual networks principally because of a set of legal conventions that allow the corporation to be treated as an 'individual' for the purposes of taxation and commercial law.
2. Another interesting analysis of debt covenants is John (1987), where debt convenants that commit corporate insiders to particular investment strategies arise as part of a signalling equilibrium.

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