Managerial Compensation and the Market Reaction to Bank Loans

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This article considers why a manager would choose to submit himself to the discipline of bank monitoring. This issue is analyzed within the context of a model where the manager enjoys private benefits, which can be restricted by the monitor, and is optimally compensated by shareholders. Within this setting we find that managers will submit to monitoring when they receive favorable private information. This result is consistent with event study evidence that suggests that the market has a favorable view of financing choices that increase monitoring.

Previous research has analyzed the monitoring role of banks in entrepreneurial models where firms are managed by their owners [see, e.g., Diamond (1984), Rajan (1992), and Holmstrom and Tirole (1997)]. In these models, entrepreneurs relinquish control in favor of a monitor whenever monitoring produces a net gain in firm value.[1] However, in public corporations, where ownership and control are separated, a conflict of interest emerges: the cost of bank monitoring falls largely on management, while the potential gain in value accrues, in principle, to shareholders.

In this article we examine the case in which shareholders cannot directly control a firm's investing and financing decisions but can offer incentive compensation to affect these choices. We characterize the optimal managerial compensation contract and explain why some firms use bank financing while others do not, why the choice of bank financing tends to raise the firm's stock price, and how these price effects can be used by shareholders to induce optimal financing decisions.

The managers in our model have a tendency to extract private benefits that hurt shareholders. This tendency is affected by the manager's compensation contract and can also be imperfectly controlled by bank monitoring. In our

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[1] Say, by inducing more efficient investment and liquidation decisions and/or by increasing the firm's debt capacity.

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setting, banks reduce the size of the manager's private benefits, that is, managers' temptations to misbehave, and so complement the use of incentive compensation by reducing its cost.

The cost of providing a compensation package that induces the manager to take less private benefits also depends on firm profitability, which is not known before the compensation contract is written. We characterize profitability as the firm's probability of success and consider a firm that can turn out to be one of two types, a type with a high probability of success and a type with a low probability of success. If the firm turns out to be the high type, then a lower level of incentive pay can be used to induce the manager to submit to bank monitoring and forsake inefficient private benefits. However, if the firm turns out to be the low type, then a higher level of incentive pay must be used to induce such a desirable behavior.

Because firm type is not initially known, shareholders cannot offer compensation contracts that are contingent on whether or not the firm turns out to be the high or low type; therefore, to induce the manager to behave when the firm turns out to be low, shareholders would have to substantially overpay the manager when the firm turns out to be high. However, as we show, shareholders may be able to induce the high- and low-type firms to separate by making the manager's compensation to depend on whether or not he chooses to be monitored by a bank. In particular, we show that two *regimes* (i.e., combinations of financing and incentive contracts) may emerge depending on parameters. In what we will call the *separating* regime, shareholders offer a contract that induces only high-profitability firms to use bank financing and incentive pay. In the *pooling* regime, all firms are attracted to bank financing. In this regime, a higher level of incentive pay is employed which generates additional rents to the managers of high-profitability firms.

The separating regime can be characterized by an (endogenous) association between the firms' unobservable profitability, bank monitoring, and incentive pay which makes the use of bank financing work as a signal of high profitability. Thus this association provides a theoretical rationale for James' (1987) result that the announcement of a bank loan agreement produces positive abnormal returns on the borrower's stock.[2] We show that the valuation effects that follow the announcement of financing choices allow an intuitive implementation of the optimal contract using market-based compensation.

Our analysis offers predictions both on the size and the direction of the market reaction to the announcement of financing choices as well as on the cross-sectional determinants of these choices. In addition, our results raise novel predictions regarding the links between incentive compensation and

[2] Lummer and McConnell (1989), as well as Best and Zhang (1993), argue that the positive market reaction documented by James (1987) only applies to loan renewals. However, with a revised empirical definition of new loans, Billet, Flannery, and Garfinkel (1995) find no significant differences between initiations and renewals; the same applies to Slovin, Johnson, and Glascock (1992) and Hadlock and James (2000).

financing sources. For instance, it is suggested that firms that use bank financing will tend to be characterized by larger pay-performance sensitivities.

This article combines ingredients from two strands of the banking literature. As in the screening models [e.g., Boyd and Prescott (1986) and Diamond (1991)], a successful credit agreement is good news about the firm's profitability. However, our argument does not rely on banks' advantage in evaluating firms' profitability but on the fact that banks perform a monitoring function that managers dislike. This feature brings us close to the monitoring models [e.g., Rajan (1992), Diamond (1993), and Holmstrom and Tirole (1997)] which emphasize the role of banks in alleviating moral hazard problems through monitoring.[3] Part of our contribution is to show that adding *unobservable* heterogeneity (private information) to models which had reasonably succeeded in identifying the *observable* determinants of the use of bank loans allows them to also accommodate the evidence on bank loan announcements.[4]

Finally, it is worth noting that one can apply the logic of our analysis to other cases where managers voluntarily submit to increased monitoring. Examples include managerial proposals to change governance, accounting, auditing, or internal organization, whose main consequence is a reduction in the private benefits that the managers might obtain by deviating from value maximization.[5] Our results provide insights about the type of managerial compensation contracts that one can use to induce these changes and clarify the circumstances in which their announcement is likely to produce stock price responses.

The article is organized as follows. In Section 1 we describe the model. In Section 2 we analyze the optimal contracting problem. Section 3 describes the two different regimes that may arise and the factors that determine the prevalence of one or the other. In Section 4 we examine the valuation effects of financing choices. Section 5 discusses the implementation of the optimal contract through market-based compensation. We discuss the main implications of our analysis in Section 6. Section 7 concludes the article.

1. The Model

1.1 Agents, technology, and modes of financing

We consider a publicly traded firm that operates in a risk-neutral economy in which the market rate of return is normalized to zero. The firm is owned

[3] A third strand of the literature [e.g., Detragiache (1994) and Gorton and Kahn (2000)] focuses on the role of banks in debt renegotiations and financial restructuring following episodes of financial distress. These articles offer implications consistent with the announcement effects associated with loan renewals among financially troubled firms. Our theory points to a mechanism whereby the announcement effects may also occur following initiations and among financially sound publicly traded firms.

[4] For a recent empirical study on the observable determinants of the choice between market and bank financing, see Cantillo and Wright (2000).

[5] Constraints on managerial behavior commonly associated with leveraged buyouts (LBOs) and venture capìtal financing are also consistent with this description.

by small shareholders and run by a manager. Shareholders and the manager maximize their lifetime pecuniary and nonpecuniary income. The manager has no wealth, is protected by limited liability, and has a zero reservation level of utility.

The firm has a project that requires an initial investment I and yields a terminal cash flow $x = R$ if it succeeds and $x = 0$ otherwise.[6] The probability of success depends partly on the project's type θ, which identifies whether its profitability is high ($\theta = \theta_H$) or low ($\theta = \theta_L$), and partly on the manager's "effort" decision e, which identifies whether the manager is diligent ($e = 1$) or extracts private benefits from the project ($e = 0$). Specifically, the distribution of terminal cash flow is

$$x = \begin{cases} R & \text{with probability } \theta + \Delta e, \\ 0 & \text{with probability } 1 - \theta - \Delta e, \end{cases} \tag{1}$$

where

$$0 < \Delta < 1 - \theta_H < 1 - \theta_L < 1. \tag{2}$$

Thus managerial effort (i.e., choosing $e = 1$ rather than $e = 0$) produces an expected cash flow gain of ΔR.

We assume, however, that the manager's effort choice is subject to a trade-off, since by choosing $e = 0$ he can extract some private benefits C_f from the project, where f identifies whether the project is financed by the market ($f = m$) or by a bank ($f = b$). In this respect, we follow the standard view that banks can exert tighter control and better monitoring of managerial discretion than smaller and more dispersed market investors.[7] Specifically, borrowing from Holmstrom and Tirole (1997), we assume that

$$C_b < C_m, \tag{3}$$

which captures the idea that bank monitoring reduces the ability of the manager to extract private benefits from the firm.

1.2 Efficiency and viability

We assume that, under any of the available modes of finance, the effort decision that maximizes the project's total return (expected cash flow plus

[6] Assuming that the project yields no cash flow in case of failure implies no loss of generality. We could have assumed instead a cash flow $k + R$ if it succeeds and k otherwise.

[7] This view is consistent with the evidence that covenants in private financing arrangements, especially bank loans, are typically more abundant and restrictive than in public security issues [see Smith and Warner (1979) and Gilson and Warner (1997)]. It is also consistent with the wisdom that some features of bank financing, such as the explicit or implicit conditions governing the renewal of revolving loans and credit lines, impose effective discipline on managerial behavior [see Repullo and Suarez (1998)].

private benefits) is $e = 1$, that is,

$$\Delta R > C_m. \tag{4}$$

We also assume that, even with the lowest-profitability type and the least favorable effort decision, the project is viable, that is,

$$\theta_L R > I. \tag{5}$$

1.3 Information and contracting

The project's profitability type θ is θ_L with probability μ and θ_H with probability $1 - \mu$. When the manager is hired, θ is still uncertain. Once in charge, he privately observes θ. Afterwards he decides on both the financing mode f, which is publicly observable, and the effort e, which is not. The cash flow x, once it realizes, is also publicly observable. Hence the model features an asymmetry of information related to θ and an incentive problem related to f and e. To cope with these problems, shareholders offer the manager a contract that maximizes their expected income subject to the relevant participation and incentive compatibility constraints. This contract may make the manager's compensation contingent on the observable variables f and x.[8]

Notice that, consistent with the discretion that managers enjoy in most publicly traded companies, we have assumed that the manager cannot be obliged to use a particular mode of financing. Once in charge, the manager will choose f in order to maximize his own expected income (monetary rewards plus private benefits).[9] Yet, if feasible, shareholders would surely benefit from abolishing the manager's discretion on f and imposing the use of bank financing, since this would reduce the manager's temptation to extract private benefits from the firm.[10]

To sum up, Figure 1 briefly reviews the timing of events in the model.

2. The Manager's Contract

In this section we characterize the optimal managerial contract. We show that such a contract may correspond to different financial regimes, that is, different associations between project types, modes of financing, and compensation

[8] There is no theoretical reason to rule out the contingency on f. Nevertheless, since it may seem somewhat counterfactual, we will show in Section 5 that the optimal contract can be implemented using a compensation scheme based exclusively on stock market performance.

[9] Technically the model is related to Sappington (1983) who analyzes a principal-agent problem in which there are ex post limits to the maximum penalty that can be imposed on a risk-neutral agent.

[10] Zwiebel (1996) and Novaes and Zingales (1995) are other examples in the literature where managerial discretion over capital structure decisions can be harmful to shareholders. One could think in modifications of our model in which, in some states of the world, both shareholders and the manager prefer market financing to bank financing. In such a case it could be suboptimal to force the manager to always use bank financing. Aghion and Tirole (1997) present a model of managerial delegation along these lines.

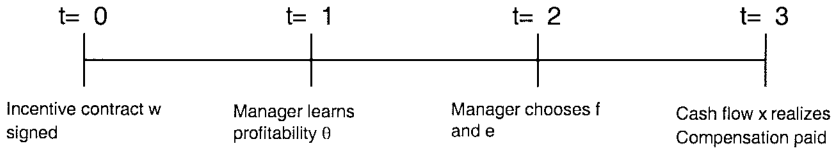

Figure 1
The sequence of events
At $t=0$ the shareholders offer an incentive contract to the manager. At $t=1$ the manager privately learns the profitability type θ. At $t=2$ the manager chooses the mode of finance f and his effort e. At $t=3$ the project's cash flow x realizes and the incentive contract payments are enforced.

schemes. Later sections will examine the determinants of the occurrence of each equilibrium regime, the associated valuation effects, and the possibility of using market-based compensation to implement the optimal contract.

2.1 The problem

Shareholders offer the manager a contract that maximizes the ex ante value of the firm net the cost of managerial compensation. By virtue of the revelation principle [Myerson (1979)], we can characterize such a contract, restricting our attention to direct mechanisms whereby the manager, after observing the project's type θ, is induced to truthfully reveal it through an *announcement* $z \in \{\theta_L, \theta_H\}$. Formally this announcement appears, together with the financing mode f and the effort e, in the triplet (z, f, e) that describes the manager's action. Accordingly, a contract consists of an *intended action* $a(\theta) = (\theta, f(\theta), e(\theta))$ for each type θ and a *compensation scheme*

$$w = \{(w_0(z,f), w_R(z,f)),\ \text{for } z = \theta_L, \theta_H \text{ and } f = m, b\}$$

that specifies some nonnegative rewards $w_x(z,f)$ contingent on the announced type z, the chosen financing mode f, and the realization of x.[11]

The optimal contract solves

$$\begin{aligned}
&\max_{\substack{\{a(\theta_j)\}_{j=L,H}\\ w \in \mathbb{R}^8_+}} && \mu V(a(\theta_L), w; \theta_L) + (1-\mu) V(a(\theta_H), w; \theta_H) \\
&s.t. && U(a(\theta_L), w; \theta_L) \geq U(a, w; \theta_L) \text{ for all } a \\
& && U(a(\theta_H), w; \theta_H) \geq U(a, w; \theta_H) \text{ for all } a,
\end{aligned} \tag{6}$$

where

$$V(a, w; \theta) \equiv (\theta + \Delta e)(R - w_R(z,f)) - (1 - \theta - \Delta e) w_0(z,f) \tag{7}$$

[11] We assume that even with $x = 0$ the manager can receive positive compensation. The firm could fulfill that commitment by "saving funds" before the realization of x occurs.

Table 1
Possible allocations

	$(f(\theta_H), e(\theta_H))$			
$(f(\theta_L), e(\theta_L))$	$(m, 0)$	$(m, 1)$	$(b, 0)$	$(b, 1)$
$(m, 0)$	A1	A2	A3	A4
$(m, 1)$	A5	A6	A7	A8
$(b, 0)$	A9	A10	A11	A12
$(b, 1)$	A13	A14	A15	A16

is the value of type-θ firm to its shareholders under action a and the compensation scheme w, and

$$U(a, w; \theta) \equiv (\theta + \Delta e) w_R(z, f) + (1 - \theta - \Delta e) w_0(z, f) + (1 - e) C_f \qquad (8)$$

is the manager's expected utility (monetary rewards plus private benefits) in a type-θ firm under action a and the compensation scheme w. The constraints of this problem are the self-selection or incentive compatibility conditions required to induce the manager to follow $a(\theta)$ under each θ.

Note that the manager's participation constraints have been ignored since they are trivially satisfied. In particular, the manager's reservation utility is zero, but given the nonnegativity of w, he can always guarantee himself an expected utility (in private benefits) of at least $C_m > 0$ by just choosing $(f, e) = (m, 0)$.

2.2 The solution

Conditional on self-selection, each type has four possible pairs of actions $(f, e) \in \{m, b\} \times \{0, 1\}$. Hence the two types produce $4^2 = 16$ possible combinations of actions, $\{(f(\theta_L), e(\theta_L)), (f(\theta_H), e(\theta_H))\}$. Each of these combinations will be called an *allocation* in order to signify that, once such a combination is fixed, the firm's surplus under each θ is also fixed, so the compensation scheme w only affects the distribution of such a surplus between shareholders and the manager.[12] For future reference, Table 1 enumerates all possible allocations.

2.2.1 Candidate allocations. Instead of exploring the implementation and the ex ante shareholder value of each allocation, we provide some results that reduce the number of potentially optimal allocations to just three. The first result refers to the requirements of incentive compatibility under a given financing mode. All proofs are in the appendix.

Proposition 1. *If a compensation scheme induces the financing choice $f(\theta)$ under project type θ, then a necessary and sufficient condition for inducing*

[12] Note that $V(a, w; \theta) + U(a, w; \theta) = (\theta + \Delta e) R + (1 - e) C_f$.

$e(\theta) = 1$ *is*

$$w_R(\theta, f(\theta)) - w_0(\theta, f(\theta)) \geq \frac{C_{f(\theta)}}{\Delta}. \tag{9}$$

To explain this result, think of the left-hand side of Inequality (9) as the bonus that the manager of a project of type θ under the mode of finance $f(\theta)$ receives when the project succeeds. Then Inequality (9) simply says that the bonus should be high enough to guarantee that the increase in the manager's compensation due to choosing $e = 1$ rather than $e = 0$ exceeds the private benefits that the manager could have extracted by choosing $e = 0$.

Proposition 2. *Allocations in which bank financing is associated with low-powered incentives (i.e., $(f(\theta), e(\theta)) = (b, 0)$ for some θ) or market financing with high-powered incentives (i.e., $(f(\theta), e(\theta)) = (m, 1)$ for some θ) are suboptimal.*

This result excludes all allocations in rows 2 and 3 and columns 2 and 3 of Table 1 (namely, A2, A3, A5–A8, A9–A12, A14, and A15). It establishes the association of bank financing with high-powered incentives and of market financing with low-powered incentives. These associations reflect that the reduction in private benefits brought about by bank monitoring is worthy if the manager is to be induced to exert his effort (since lower private benefits make him less resistant to do so), but it is worthless otherwise. Actually, given that the manager can always get C_m with $(f, e) = (m, 0)$, implementing $(f, e) = (b, 0)$ would be wasteful since it would oblige shareholders to pecuniarily compensate the manager (out of a non-larger expected cash flow) for the dissipated private benefits $C_m - C_b$.

Proposition 3. *Allocations in which low-profitability projects receive high-powered incentives, $e(\theta_L) = 1$, while high-profitability projects receive low-powered incentives, $e(\theta_H) = 0$, are suboptimal.*

This result excludes A13 as well as A5, A7, and A15 (which were already excluded by Proposition 2) and establishes that it is never optimal to provide higher-powered incentives to a low-profitability firm than to a high-profitability one. To explain this, notice that, for a given effort choice, a θ_H project is always more likely to succeed than a θ_L project. So a bonus that convinces the manager of a θ_L project to contribute his effort can also convince, at no extra cost, the manager of a θ_H project to do so, which would certainly increase shareholder value.

The joint consideration of Propositions 2 and 3 reveals an association between incentive pay, bank monitoring, and high-profitability projects. Of importance is that this association does not come from any assumed technological complementarity between bank financing and the high-profitability project, since as is clear from Expressions (1) and (3), neither the marginal effect of e on cash flows nor the effects of f on the manager's potential private benefits depend on θ. The association comes from the interactions between the private information problem and the moral hazard problem that emerge in the design of the optimal contract. Therefore we are left with three possibly optimal allocations: the *market-market* allocation or *mm* (A1), the *market-bank* allocation or *mb* (A4), and the *bank-bank* allocation or *bb* (A16).

2.2.2 Implementing the candidate allocations. To simplify the presentation we will focus on the case in which, even with a high profitability project, inducing the manager to choose bank financing entails some extra compensation cost (beyond what would be required to implement $e = 1$ under a nondiscretionary f). This case occurs when C_m is sufficiently larger than C_b, specifically when

$$C_m > (\theta_H + \Delta)\frac{C_b}{\Delta}, \tag{10}$$

which strengthens Inequality (3).[13]

Assuming Inequality (10), we will first characterize the minimum cost compensation schemes w^{mb} and w^{bb} that implement *mb* and *bb*, respectively, and then establish the dominance of *mb* over *mm*.[14] The characterized schemes share three features. First, their rewards $w_x(z, f)$ do not vary with z, that is, the implementation of *mb* and *bb* does not require compensation that explicitly depends on the announcement of the project's type.[15] Type separation in *mb* is attained by making rewards differ across financing choices. Second, when $f(\theta) = b$, the proposed schemes leave the manager an expected pecuniary reward of at least C_m, the value of the private benefits which he sacrifices by not choosing $e = 0$. Third, the rewards that follow the choice of $f = m$ are always zero for at least one of the following reasons: because otherwise the choice of market financing becomes unnecessarily more expensive to the shareholders and because, by making market financing more attractive to managers, the cost of inducing the choice of bank financing increases.

[13] To obtain Inequality (10), suppose that $f(\theta_H) = b$ could be guaranteed at no cost. The cheapest contract that implements $e(\theta_H) = 1$ would then set, by Proposition 1, $w_0(\theta_H, b) = 0$ and $w_R(\theta_H, b) = \frac{C_b}{\Delta}$, and the expected utility of a manager with a θ_H project who chooses $(f, e) = (b, 1)$ would then be $(\theta_H + \Delta)\frac{C_b}{\Delta}$. However, if Inequality (10) holds, such a utility would be lower than the private benefits obtainable with $(f, e) = (0, m)$. But then implementing $f(\theta_H) = b$ will indeed require some additional compensation.

[14] Covering the case in which Inequality (10) does not hold would require a slight generalization of Propositions 4 and 5 below. Qualitatively the solution to the optimal contract problem does not change, except that if C_m is close to ΔR, there may be cases in which the second-best choice of e becomes trivially zero for both types. In such cases, the dominance of *mb* over *mm* does not follow.

[15] The compensation schemes w^{mb} and w^{bb} are the unique minimum-cost schemes among the class of z-invariant schemes that implement *mb* and *bb*, respectively. For each of these allocations, however, there is a continuum of alternative minimum-cost compensation schemes in which rewards vary with z. For simplicity, but without loss of generality, the analysis below focuses on w^{mb} and w^{bb}.

The scheme w^{mb} implements a separating regime in which shareholders keep the θ_L project in market financing at a zero compensation cost and attract the θ_H project to bank financing at a cost of just C_m:

Proposition 4. *The compensation scheme w^{mb} with*

$$w_0(z,b) = C_m - (\theta_H + \Delta)\frac{C_b}{\Delta}, \;\; w_R(z,b) = C_m + (1 - \theta_H - \Delta)\frac{C_b}{\Delta},$$

and $w_0(z,m) = w_R(z,m) = 0$, for $z = \theta_L, \theta_H$, implements the market-bank allocation at the minimum cost.

The scheme w^{bb} corresponds to a pooling regime in which the managers of both types of projects are attracted to bank financing, but those with a θ_L project receive expected rewards of just C_m, while those with a θ_H project receive $C_m + (\theta_H - \theta_L)\frac{C_b}{\Delta}$:

Proposition 5. *The compensation scheme w^{bb} with*

$$w_0(z,b) = C_m - (\theta_L + \Delta)\frac{C_b}{\Delta}, \quad w_R(z,b) = C_m + (1 - \theta_L - \Delta)\frac{C_b}{\Delta},$$

and $w_0(z,m) = w_R(z,m) = 0$, for $z = \theta_L, \theta_H$, implements the bank-bank allocation at the minimum cost.

The extra rent of $(\theta_H - \theta_L)\frac{C_b}{\Delta}$ received by the manager of the θ_H project is due to the need of inducing $(f, e) = (b, 1)$ in the θ_L project. Notice that inducing $f(\theta_L) = b$ requires, at least,

$$(\theta_L + \Delta)w_R(\theta_L, b) + (1 - \theta_L - \Delta)w_0(\theta_L, b) \geq C_m, \tag{11}$$

since the manager can obtain C_m by choosing $(f, e) = (m, 0)$. Further, inducing $e(\theta_L) = 1$ when $f(\theta_L) = b$ requires, by Proposition 1, a bonus on success such that

$$w_R(\theta_L, b) - w_0(\theta_L, b) \geq \frac{C_b}{\Delta}. \tag{12}$$

Now, suppose the manager of a θ_H project announces θ_L and chooses $(f, e) = (b, 1)$. Then, Expressions (11) and (12) imply that his expected payoff will amount to at least $C_m + (\theta_H - \theta_L)\frac{C_b}{\Delta}$, given the greater chances of success of his project and the presence of a positive bonus. The extra rent can be reduced to its minimum by making Expressions (11) and (12) hold with equality, as with w^{bb}.

Finally, we show that the mm allocation is dominated by the mb allocation. Indeed, notice that mm can be implemented at a zero compensation cost by setting $w_x(z, f) = 0$ for all x, z, and f. So it can generate an ex ante value of $[\mu\theta_L + (1-\mu)\theta_H]R$. However, w^{mb} implements $e = 1$ with the θ_H project at a compensation cost of just C_m, so mb generates an additional positive value for shareholders of $(1-\mu)(\Delta R - C_m)$.

3. Equilibrium Regimes

We now discuss the choice between the two potentially optimal financial regimes identified in the previous section: the *market-bank regime* (associated with the *mb* allocation and the w^{mb} scheme) and the *bank-bank regime* (associated with the *bb* allocation and the w^{bb} scheme).

3.1 The market-bank regime

In the *mb* regime, the manager of a low-profitability project resorts to market financing, is not subject to monitoring, receives a flat reward profile, and extracts private benefits at the cost of the project's probability of success. In contrast, the manager of a high-profitability project resorts to bank financing, is monitored by the bank, receives incentive pay, and refrains from extracting private benefits at the cost of the project's probability of success. As a consequence, a low-profitability project succeeds with probability θ_L, whereas a high-profitability project succeeds with probability $\theta_H + \Delta$. The cost of the manager's compensation is zero with θ_L and C_m with θ_H. The resulting ex ante value of the firm to shareholders is

$$V_0^{mb} = [\mu\theta_L + (1-\mu)\theta_H]R + (1-\mu)(\Delta R - C_m), \tag{13}$$

where the first term is the expected cash flow obtainable without managerial effort and the second is the expected cash flow (net of compensation costs) due to inducing $e(\theta_H) = 1$.

3.2 The bank-bank regime

In the *bb* regime, the manager resorts to bank financing irrespective of his project's type, receives incentive pay, and refrains from extracting private benefits at the cost of the project's probability of success. As a result, low- and high-profitability projects succeed with probability $\theta_L + \Delta$ and $\theta_H + \Delta$, respectively. The cost of the manager's compensation is C_m with θ_L and $C_m + (\theta_H - \theta_L)\frac{C_b}{\Delta}$ with θ_H. Hence the ex ante value of the firm to shareholders is

$$V_0^{bb} = \left[\mu\theta_L + (1-\mu)\theta_H\right]R + \left[\Delta R - C_m - (1-\mu)(\theta_H - \theta_L)\frac{C_b}{\Delta}\right], \tag{14}$$

which adds up the expected cash flow without managerial effort and the expected cash flow (net of compensation costs) due to now inducing $e(\theta_L) = e(\theta_H) = 1$.

3.3 Comparison of regimes

A glance at the expressions for V_0^{mb} and V_0^{bb} makes it clear that the *bb* regime produces a larger gross expected cash flow than the *mb* regime, but at the cost of a higher compensation to the manager. Producing an extra ΔR under θ_L (i.e., with probability μ) implies not only paying an extra C_m to the manager in that case (which, absent other costs, would always be worthy), but also paying him an extra $(\theta_H - \theta_L)\frac{C_b}{\Delta}$ under θ_H (i.e., with probability $1-\mu$). Hence the difference

$$V_0^{bb} - V_0^{mb} = \mu(\Delta R - C_m) - (1-\mu)(\theta_H - \theta_L)\frac{C_b}{\Delta} \tag{15}$$

may be positive or negative. In particular, it becomes negative when $\mu \to 0$ and positive when $\mu \to 1$. Moreover, since $V_0^{bb} - V_0^{mb}$ is monotonically increasing in μ, we obtain the following result:

Proposition 6. *If the probability of holding a low-profitability project,* μ, *is below a critical level* $\mu_c \in (0, 1)$, *the market-bank regime is optimal*; *otherwise, the bank-bank regime is optimal.*

Intuitively shareholders' choice between the *mb* regime and the *bb* regime is driven by the underlying private information problem. When shareholders opt for the separation of types, they lose on production efficiency if the project's profitability is low, but save on compensation costs if it is high. So the *mb* regime is worthy insofar as the probability of holding a low-profitability project is below the threshold μ_c.

The comparative statics of the threshold μ_c is as follows. On the one hand, μ_c is reduced by factors that increase the direct surplus associated with using bank financing in the low-profitability project. These include increases in the efficiency gains associated with the managerial effort, Δ and R, and decreases in the incremental private benefits obtainable under market financing, C_m (which makes the manager less reluctant to submit himself to bank monitoring). On the other hand, μ_c is raised by factors that exacerbate the asymmetries of information and/or increase the extra rent received by the manager of a high-profitability project in the *bb* regime. These include increases in the private benefits obtainable under bank monitoring, C_b (which increases the leverage required to provide incentives under bank financing), and increases in the difference in profitability across project types, $\theta_H - \theta_L$ (which increases the manager's gain due to such leverage). We postpone to Section 6 further discussion of the empirical implications of these results.

3.4 On the possibility of renegotiation

The financial regimes *mb* and *bb* emerge under the implicit assumption that their supporting compensation schemes w^{mb} and w^{bb}, respectively, will not be renegotiated. However, optimal screening mechanisms frequently require some degree of commitment on the part of the principal. Without such a commitment, if the optimal mechanism produces some ex post inefficiency, both parties can ex post try to renegotiate the inefficiency away.

Here we examine the robustness of *mb* and *bb* to the possibility of renegotiating the manager's compensation scheme once the project's profitability type θ has been truthfully revealed. The analysis of regime bb is straightforward. Under our assumptions, the choice of $(f, e) = (b, 1)$ is ex post efficient irrespective of θ, so we can conclude that bb is renegotiation proof.

The analysis of the mb regime is less straightforward. The rewards in w^{mb} imply that if the project's profitability type is low, the manager chooses $f = m$. However, after observing this choice, shareholders might want to modify the manager's rewards so as to induce $e = 1$. Two different possibilities arise. If the choice of f is reversible, the rewards in w^{bb} would suffice to induce the shift to $(f, e) = (b, 1)$ at the minimum cost to shareholders. However, if this renegotiation is anticipated, the high type will find these renegotiated rewards more desirable than his original ones in w^{mb}, so type separation will not be sustainable.

Alternatively, if the choice of f is not reversible (say, because public securities have been issued and they are costly to retire from the market), shareholders can induce the choice of $e = 1$ at a minimum cost by offering $w_0 = 0$ and $w_R = C_m/\Delta$ to the manager. However, it is possible that the cost of these new rewards outweigh the induced expected cash flow gains, in which case the renegotiation will not go through.[16] If this were not the case, the manager with a high-type project would again find the modified rewards more attractive than those in w^{mb}, so type separation would collapse.

In conclusion, sustaining mb may require the commitment from shareholders not to renegotiate the manager's compensation package. Absent such a commitment, type separation will generally be harder to obtain.

4. The Valuation Effects of the Financing Decision

Private information influences the main results of the model. When the managerial contract is designed, shareholders know that the manager's financing decision f will be based on his observation of project type θ. The regimes mb and bb differ fundamentally in the information revealed to shareholders through f. In bb the financing decision is identical for the two types, hence it does not reveal any information. In contrast, in mb the financing decision varies with project type, so the market value of the firm may change at the announcement of f. Therefore a necessary and sufficient condition to observe valuation effects in equilibrium is the prevalence of the mb regime.[17]

Suppose the mb regime is indeed optimal. Then, when the manager chooses market financing, shareholders learn that the project is of type θ_L whose optimal contract induces $e(\theta_L) = 0$ and specifies zero rewards to the

[16] The new rewards cost, on average, $(\theta_L + \Delta)\frac{C_m}{\Delta}$ under a low-type project, while the induced expected cash flow gain is ΔR. Our assumptions do not imply any ordering between these two quantities.

[17] The conditions under which this regime prevails have been described in Proposition 6.

manager. Hence their valuation of the firm shifts to

$$V_m^{mb} = \theta_L R, \tag{16}$$

where the subscript m identifies the observed financing choice. Alternatively, if the manager chooses bank financing, shareholders learn that the project is of type θ_H whose optimal contract induces $e(\theta_L) = 1$ and specifies rewards to the manager with an expected value of C_m. Hence their valuation of the firm shifts to

$$V_b^{mb} = (\theta_H + \Delta)R - C_m. \tag{17}$$

Note that V_b^{mb} is larger than V_m^{mb} for two reasons. First, because of the difference in the project's intrinsic profitability types, $\theta_H > \theta_L$, and second because of the net value coming from inducing managerial effort, $\Delta R - C_m > 0$.

This last element, in turn, reflects the contribution of bank financing to the value of the firm. Given f, providing the incentives for $e = 1$ in a θ_H project implies an expected reward of at least $(\theta_H + \Delta)\frac{C_f}{\Delta} > C_f$, a quantity that increases with C_f. By reducing C_f, bank monitoring reduces the cost of managerial compensation from $(\theta_H + \Delta)\frac{C_m}{\Delta}$ to $\max\{C_m, (\theta_H + \Delta)\frac{C_b}{\Delta}\} = C_m$.[18] This identifies the channel through which banks contribute to firm value in this model. In addition, banks are endogenously associated with good projects. Therefore:

Proposition 7. *In the market-bank regime, the announcement of the manager's decision to use bank (market) financing produces a positive (negative) variation in the firm's market value.*

These valuation effects can be quantified using Equations (13), (16), and (17):

$$V_b^{mb} - V_0^{mb} = \mu[(\theta_H - \theta_L)R + (\Delta R - C_m)],$$
$$V_0^{mb} - V_m^{mb} = (1-\mu)[(\theta_H - \theta_L)R + (\Delta R - C_m)].$$

Thus the size of the positive (negative) reaction to bank (market) financing is directly proportional to the difference between the net expected cash flow generated by high- and low-profitability types, $V_b^{mb} - V_m^{mb}$ (which is the quantity that appears in square brackets), and to the ex ante probability that the project is of the low- (high-) profitability type.[19] So the positive market response to bank loans becomes quantitatively more significant as $\mu \leq \mu_c$ approaches the critical value μ_c (above which *bb* replaces *mb*). Changes

[18] Recall Inequality (10).

[19] While the positive reaction to bank financing seems consistent with abnormal returns observed at the announcement of bank loans, the negative reaction to market financing has a less obvious empirical counterpart. It is clearly consistent with the well-documented negative response to public equity issuance, as well as with Datta, Iskandar-Datta, and Patel (2000), who document a negative response to initial public debt offerings.

in Δ, R, and the difference $\theta_H - \theta_L$ relate positively with the size of the response, while C_m affects it negatively. We discuss further the empirical implications of these results in Section 6.

5. Another Role for Market-Based Compensation

So far we have assumed that contracts contingent upon the mode of financing chosen by the manager are enforceable. However, in practice, it is unusual to observe managerial contracts with rewards directly dependent on the manager's financing choices. In this section we show that the direct contractibility on f is not necessary for the implementation of the compensation schemes associated with the optimal financial regimes. The market reaction associated with the announcement of f can be used to implement the optimal contracts by means of market-based compensation.

Consider first the market-bank regime. The compensation scheme w^{mb} can be implemented by granting the manager the following compensation package consisting of *stock appreciation rights*:

- If at $t = 2$ the firm's stock price appreciates up to $V_b^{mb} = (\theta_H + \Delta)R - C_m$, the manager receives
  - (a) a reward in cash of $C_m - (\theta_H + \Delta)\frac{C_b}{\Delta} > 0$,
  - (b) a reward in nontransferable shares entitling him to a fraction $s = \frac{C_b}{\Delta R} < 1$ of the cash flow of the firm at $t = 3$.
- In the absence of the required stock price appreciation, the manager receives no reward.

To see how this package works, consider the market reaction to the manager's financing decision as discussed in Section 4 and the possible scenarios faced by a manager who has discovered that the firm's type is $\hat{\theta}$. If he chooses $f = m$, the firm's stock price will go from V_0^{mb} down to V_m^{mb} and the manager will be paid zero irrespective of the success or failure of the project. Consequently he will choose $e = 0$ and obtain an expected utility of C_m coming from private benefits.

Alternatively, if he chooses $f = b$, the firm's stock price will go from V_0^{mb} up to V_b^{mb} and he will receive a safe cash payment of $C_m - (\theta_H + \Delta)\frac{C_b}{\Delta}$ and the possibility of an additional cash payment of $sR = \frac{C_b}{\Delta}$ if the project succeeds. Thus, choosing $e = 0$, his expected utility will be

$$\left[C_m - (\theta_H + \Delta)\frac{C_b}{\Delta}\right] + \hat{\theta}sR + C_b = C_m - (\theta_H - \hat{\theta})\frac{C_b}{\Delta}, \tag{18}$$

while, choosing $e = 1$, it will be

$$\left[C_m - (\theta_H + \Delta)\frac{C_b}{\Delta}\right] + (\hat{\theta} + \Delta)sR + C_b = C_m - (\theta_H - \hat{\theta})\frac{C_b}{\Delta}, \tag{19}$$

which happens to be identical to the previous one. Hence if $\hat{\theta} = \theta_L$, the manager strictly prefers $(f, e) = (m, 0)$ to any other alternative, whereas if $\hat{\theta} = \theta_H$, the manager is indifferent between the choices $(m, 0)$, $(b, 0)$, and $(b, 1)$, which are all preferred to $(m, 1)$.[20] So the intended allocation is implemented with the described compensation package.

To complete the proof that the market-bank regime can be implemented using a compensation package based exclusively on stock market performance, it is immediate to check that such a compensation package has an expected cost identical to the compensation scheme referred in Proposition 4.

Consider next the implementation of the bank-bank regime. In this case the compensation package will establish that

- If at $t = 2$ the firm's stock *does not depreciate*, the manager receives

  (a) a reward in cash of $C_m - (\theta_L + \Delta)\frac{C_b}{\Delta} > 0$,
  (b) a reward in nontransferable shares entitling him to a fraction $s = \frac{C_b}{\Delta R} < 1$ of the cash flow of the firm at $t = 3$.

- If the stock price falls, the manager receives no reward.

The main difference with respect to the *mb* regime is that now using market financing is an *out-of-the-equilibrium* choice for the manager. We can, however, reasonably assume that investors believe that the manager is equally likely to deviate under the two possible values of θ. Clearly, after such a deviation, and because the compensation scheme is either flat (if the value of the firm falls) or not levered enough to provide incentives under market financing (if it remains at V_0^{bb}), the manager's optimal effort choice would be $e = 0$, irrespective of θ. Accordingly, after the deviation, the market value of the company would fall from V_0^{bb} [see Equation (14)] to $[\mu\theta_L + (1-\mu)\theta_H]R < V_0^{bb}$. But this is enough for the manager not to have incentives to deviate from his intended course of action under the proposed market-based compensation package.[21]

The main implication of these decentralization results is that if the complexity of the financing decisions corresponding to our variable f impedes contracting directly on them, contracting on market performance may be a good substitute. In particular, the stock market reaction to bank financing may become the means for providing incentives to the manager and, consequently, attaining the gains in value that the reaction reflects.

[20] To break this indifference in favor of $(b, 1)$ one can simply increase a little bit the award of shares associated with the required stock price appreciation.

[21] In addition, one can immediately check that the proposed package has an expected cost identical to the compensation scheme referred to in Proposition 5.

6. Discussion of the Results

We organize the discussion of our results in two parts. First, we comment on the implications of private information and the effectiveness of bank monitoring for the choice of bank financing and its announcement effects, comparing our model with its main theoretical alternative: a model in which banks play a pure certification role. Second, we comment on the linkages between managerial compensation and financing decisions (and, more generally, between governance and managerial submission to monitoring) that our theory unveils.

6.1 Private information and the role of banks

In our model the problem of inducing managers to submit to bank monitoring is fundamentally affected by private information: it makes it costly to attract the managers of low-profitability firms to the bank. This private information cost may drive shareholders into the separating *mb* regime, where low-profitability firms are kept away from bank financing and the announcement effects of bank loans follow.

The outcome in *mb* resembles that of a model in which banks play a certification role: high-profitability firms are willing to incur the bank certification cost, while low-profitability firms are not. In such a model, as in ours, bank loan announcements would be followed by positive stock market reactions. However, other implications differ substantially across this model and ours. For instance, in a pure certification setting a less severe informational asymmetry (i.e., a lower spread of profitability types, $\theta_H - \theta_L$) would reduce the use of bank financing. In our model, in contrast, having a lower type spread reduces the cost of attracting the managers to banks so it makes bank financing more widespread.

A recent article by Krishnaswami, Spindt, and Subramaniam (1999) that examines the relative use of private and public financing in U.S. corporations offers evidence consistent with our model. In fact, they find no evidence that a higher degree of informational asymmetry (measured either by the standard deviation of the market model residuals or by firm age) is associated with a greater use of private financing. Moreover, they find that, when the private information problem is severe, firms with positive private information about their future (identified as those experiencing positive abnormal earnings after their financing) are more inclined to use bank financing. Notice that their first finding goes against the main prediction of the pure screening model, but it would certainly be consistent with our model if some firms in their sample operate in the *bb* regime and others in the *mb* regime.[22] Their second finding suggests a logic consistent with our *mb* regime: only when the private information problem is severe enough does the use of bank financing become a signal of good future performance.

[22] This is because the degree of asymmetric information is positively correlated with the incidence of *mb* and thereby with a *less frequent* use of private financing.

Another difference between the implications of a pure certification model and of our analysis emerges by examining the effects of the degree of asymmetric information on the average stock price response to bank loans. In our model, larger informational asymmetries make shareholders *less* prone to induce the low-profitability firms to use bank monitoring, thereby making the use of bank loans a stronger signal of high profitability. In the pure certification model, a *composition* effect would work in exactly the opposite direction: larger informational asymmetries would make firms of intermediate profitability also willing to incur the certification cost, and hence could make, on average, the use of bank financing a weaker signal of high profitability. Consistent with our results, the evidence shows a positive relationship between the degree of asymmetric information and the size of the announcement effects. For instance, Best and Zhang (1993) show that firms with a greater dispersion in analysts' earnings forecasts tend to experience larger stock price run-ups at the announcement of a new bank loan. Likewise, Billet, Flannery, and Garfinkel (1995) find that the reaction to new bank loans is positively correlated with the idiosyncratic component of borrowers' stock returns.

Improvements in bank effectiveness will also have different implications in our model than they would in a pure certification model. In the latter, more effective banks would provide a better selection of bank borrowers, thus their loans should be associated with larger positive stock market reactions. In our model, if banks are more effective in ameliorating the moral hazard problem (so that in their presence managers' potential private benefits C_b are lower), the average stock market reaction to bank loans is smaller. In fact, all firms, irrespective of their profitability type, will opt for bank financing, in which case no market reaction to bank loans would be observed. Hence we expect a larger reaction to bank financing among firms for which banks are comparatively less effective monitors.[23]

6.2 Governance and managerial submission to monitoring

The implementation of *mb* and *bb* using stock-based managerial compensation allows us to offer novel predictions relative to the correlation between financing choices and managerial compensation. In particular, our results imply a positive cross-sectional correlation between the responsiveness of the market to financing choices (present in *mb* but not in *bb*) and the sensitivity of managerial pay to performance (larger in *mb* than in *bb*). In addition, pay-performance sensitivity should be larger among firms that rely more on bank

[23] This prediction is consistent with Bayless and Chaplinsky (1991), who find that firms which are ex ante less likely to use bank loans are those receiving a more positive reaction at the announcement, and with Hadlock and James (2000), who find that the reaction is only significant among firms with public debt outstanding, that is, those that found banks less attractive in the past.

financing. These predictions, however, emerge from the contract that maximizes ex ante shareholder value, so they would apply to firms whose governance system works reasonably well. With poor governance we should expect less submission to bank monitoring and lower pay-performance sensitivities.

As far as we know, no empirical study has related bank monitoring with managerial compensation and governance. However, if we accept leverage as a proxy for the intensity of monitoring, the evidence in Berger, Ofek, and Yermack (1997) seems consistent with the predictions of our model. These authors examine the relationship between leverage and some proxies of managerial entrenchment (presumably related to the quality of governance). They report that leverage (in our interpretation, the degree of managers' "submission to monitoring") is positively correlated with pay-performance sensitivity, is lower when CEOs are entrenched, and increases in the aftermath of entrenchment-reducing shocks.[24]

Despite that we emphasize the relationship between governance, compensation, and the managerial submission to monitoring present in the choice of bank loans, the logic of our analysis may extend to other managerial decisions with a similar impact on the subsequent incentive problem. These include any managerial proposal of changes in financing, governance, accounting, auditing or internal organization that reduce the private benefits that managers could obtain by deviating from value maximization. A prominent example of such proposals are LBOs which, in line with our predictions, frequently entail the introduction of both greater discipline through debt and explicit incentive pay for the managers. Our analysis suggests that LBOs would tend to follow the reception by managers of favorable information about their firms and would support the wisdom that part of the LBO cash flow improvement is due to enhanced incentives, but another part is the result of reverse causation [see Grinblatt and Titman (1998, pp. 685–687)].

Another relevant example may be venture capital financing, especially when the presence of sizable private benefits or large financing needs implies that the founder entrepreneur looks more like a manager than like an owner (i.e., holds an important stake in the private benefits associated with poor management but only a small fraction of the residual cash flows produced by good management). Consistent with the logic of our separating regime, entrepreneurs are identified as having relatively better projects as they seek financing from venture capitalists who are able to monitor them.

7. Conclusion

We have examined the determinants of the use of bank financing in a novel setting. In our model there is a separation between ownership and control.

[24] From a monitoring viewpoint, what probably matters is not the payoff structure of the security issued (i.e., debt versus equity), but whether it is held privately or publicly. In this respect, Wruck (1989) shows that, in contrast with the negative market reaction to public equity placements, private equity placements associate with a positive market reaction.

Managers enjoy full discretion on both investment and financing decisions, so inducing managers to submit themselves to the discipline of bank financing requires a proper incentive contract.

The design of the incentive contract that shareholders would wish to offer to managers is fundamentally affected by the existence of private information concerning the firm's profitability. To induce managers of both high- and low-profitability firms to choose bank financing requires the managers of the high-profitability firms to capture additional informational rents. These rents can be reduced by offering separating contracts that induce high-profitability firms to choose bank financing and low-profitability firms to choose market financing. We have shown that when the asymmetries of information are substantial, separating contracts are optimal. We have also provided an intuitive implementation of the optimal separating contract through market-based compensation.

The optimal separating contract identifies one of the article's main findings: an association between firm profitability, high-powered managerial incentives, and bank financing. While the association between managerial incentives and bank financing is a central theme in the literature on bank monitoring, the association between them and firm profitability relates entirely to the private information effect identified here. The triple-sided association is consistent with the event study evidence on the positive stock market reaction to bank loan announcements and leads to novel empirical predictions about the linkage between financing choices and managerial compensation.

Although the core of our discussion has focused on the case of bank financing, the logic of our theory may help us understand the signaling value of other instances of managerial submission to greater discipline, such as LBOs and venture capital financing. These choices may indeed have a direct impact on cash flows, but our analysis suggests that part of investors' positive reaction to them may be due to the fact that, under the proper compensation scheme, the managers of the firms with the best unobservable profitability prospects are the most willing to be monitored.

Appendix

Proof of Proposition 1. Under a given financing mode $f(\theta)$, inducing $e(\theta)=1$ requires the manager's utility with $e=1$,

$$(1-\theta-\Delta)w_0(\theta,f(\theta))+(\theta+\Delta)w_R(\theta,f(\theta)),$$

to be at least as large as with $e=0$,

$$(1-\theta)w_0(\theta,f(\theta))+\theta w_R(\theta,f(\theta))+C(f(\theta)).$$

Such a condition is equivalent to Inequality (9). ■

Proof of Proposition 2. This proof has two parts. Both are done by contradiction. We start with a proposed allocation which is implemented at a minimum cost by some contract w^0 with components $w_x^0(z, f)$, where $x = 0, R$, $z = \theta_L, \theta_H$, and $f = m, b$. Then we show that it is possible to find some alternative contract, always called w' to save on notation, that leads to a different allocation and provides greater ex ante shareholder value.

Part 1: Suboptimality of $(b, 0)$. Consider an allocation with $(f(\theta_j), e(\theta_j)) = (b, 0)$ for some $j = L, H$ which is implemented at a minimum cost by w^0. Denote by i the type different from j. Then

1. If $e(\theta_i) = 0$, consider the contract w' with components $w'_x(z, f) = 0$ for all x, z, and f. This contract implements $(f, e) = (m, 0)$ for both types, so it generates the same gross value as the original contract. Moreover, it has a zero compensation cost, while inducing $f(\theta_j) = b$ with w^0 implies

$$\theta_j w_R^0(\theta_j, b) + (1 - \theta_j) w_0^0(\theta_j, b) \geq C_m - C_b > 0,$$

where the first inequality follows from the revealed preference for $(b, 0)$ when $(m, 0)$ was available. Hence w' saves on compensation for, at least, type j.

2. If $e(\theta_i) = 1$, there are two subcases:

   (a) If $f(\theta_i) = m$, consider the contract w' with components $w'_0(z, m) = w'_x(z, b) = 0$ for all x and z, and $w'_R(z, m) = \frac{C_m}{\Delta}$ for all z. By Proposition 1, this contract implements $(f, e) = (m, 1)$ for both types at a minimum cost. It does not change the effort decision and minimizes the compensation cost for type i, while it creates additional shareholder value for type j. In particular, for type j it produces extra gross value ΔR at a compensation cost of $(\theta_j + \Delta)\frac{C_m}{\Delta}$. Instead, w^0 implies a compensation cost of at least $(\theta_j + \Delta)\frac{C_m}{\Delta} - C_b$, since the manager could obtain at least $(\theta_j + \Delta)\frac{C_m}{\Delta}$ by announcing θ_i and choosing $(f, e) = (m, 1)$, and C_b is the maximum nonpecuniary income obtainable with $(f, e) = (b, 0)$. So shareholder value increases by, at least, $\Delta R - C_b > 0$.

   (b) If $f(\theta_i) = b$, consider the contract w' with components $w'_x(z, m) = 0$ for all x and z, and $w'_x(z, b) = w_x^0(\theta_i, b)$ for all x and z. This contract does not change the decisions or the compensation cost for i. For type j, it implements either $(f, e) = (b, 1)$ or $(f, e) = (m, 0)$. In the first case, gross value increases by ΔR, while the compensation cost is $(\theta_j + \Delta) w_R^0(\theta_i, b) + (1 - \theta_j - \Delta) w_0^0(\theta_i, b)$. Under w^0, however, the compensation cost is at least $(\theta_j + \Delta) w_R^0(\theta_i, b) + (1 - \theta_j - \Delta) w_0^0(\theta_i, b) - C_b$, since the manager could announce θ_i and choose $(f, e) = (m, 1)$, and C_b is the maximum nonpecuniary income obtainable with $(f, e) = (b, 0)$. So w' increases shareholder value by at least $\Delta R - C_b > 0$. In the second case, gross value does not increase but the compensation cost is zero, so the savings in compensation is $\theta_j w_R^0(\theta_j, b) + (1 - \theta_j) w_0^0(\theta_j, b) \geq C_m - C_b > 0$, where the first inequality follows from the revealed preference for $(b, 0)$ under w^0, when $(m, 0)$ was available.

Part 2: Suboptimality of $(m, 1)$. Consider an allocation with $(f(\theta_j), e(\theta_j)) = (m, 1)$ for some $j = L, H$ which is implemented at a minimum cost by w^0. Consider also the alternative contract w' with components $w'_x(z, m) = 0$ for all x and z, $w'_0(z, b) = w_0^0(\theta_j, m)$ for all z, and $w'_R(z, b) = w_R^0(\theta_j, m) - \varepsilon$ for all z, where ε is a small positive number. Denote by i the type different from j.

Notice first that, by Proposition 1,

$$\lim_{\varepsilon \to 0} [w'_R(z, b) - w'_0(z, b)] = w_R^0(z, m) - w_0^0(z, m) \geq \frac{C_m}{\Delta} > \frac{C_b}{\Delta}$$

so, for any $k = i, j$,

$$\lim_{\varepsilon \to 0} [(\theta_k + \Delta) w'_R(z, b) - (1 - \theta_k - \Delta) w'_0(z, b)] \geq (\theta_k + \Delta) \frac{C_m}{\Delta} > C_m.$$

Thus, for sufficiently small ε, w' implements $(f(\theta_j), e(\theta_j)) = (f(\theta_i), e(\theta_i)) = (b, 1)$. Moreover, relative to w^0, this contract saves an amount $(\theta_k + \Delta)\varepsilon$ on compensation for type j. For type i there are two cases to consider.

1. If $e(\theta_i) = 0$, gross value increases by ΔR while the compensation cost is $(\theta_i + \Delta)[w^0_R(\theta_j, m) - \varepsilon] + (1 - \theta_i - \Delta) w^0_0(\theta_j, m)$. Under w^0, however, the compensation cost is at least $(\theta_i + \Delta) w^0_R(\theta_j, m) + (1 - \theta_i - \Delta) w^0_0(\theta_j, m) - C_m$, since the manager could announce θ_j and choose $(f, e) = (m, 1)$, and C_m is the maximum nonpecuniary income obtainable with $e = 0$. But then w' increases shareholder value by at least $\Delta R + (\theta_i + \Delta)\varepsilon - C_m > 0$.
2. If $e(\theta_i) = 1$, gross value does not change, but the compensation cost is $(\theta_i + \Delta)[w^0_R(\theta_j, m) - \varepsilon] + (1 - \theta_i - \Delta) w^0_0(\theta_j, m)$. Under w^0, however, the compensation cost is at least $(\theta_i + \Delta) w^0_R(\theta_j, m) + (1 - \theta_i - \Delta) w^0_0(\theta_j, m)$, since the manager could announce θ_j and choose $(f, e) = (m, 1)$, and his nonpecuniary income is zero when $e = 1$. But shifting to w' increases shareholder value by at least $(\theta_i + \Delta)\varepsilon > 0$. ■

Proof of Proposition 3. We follow the same logic as in the previous proof. Consider an allocation with $e(\theta_L) = 1$ and $e(\theta_H) = 0$ which is implemented at a minimum cost by the contract w^0. Let $f_L = f(\theta_L)$, then Proposition 1 implies that

$$w^0_R(\theta_L, f_L) - w^0_0(\theta_L, f_L) \geq \frac{C_{f_L}}{\Delta} \tag{20}$$

whereas

$$w^0_R(\theta_H, f(\theta_H)) - w^0_0(\theta_H, f(\theta_H)) < \frac{C_{f(\theta_H)}}{\Delta}.$$

Consider an alternative contract w' with components $w'_x(z, f_L) = w^0_x(\theta_L, f_L)$ for all x and z, and $w'_x(z, f) = 0$ for all x, z, and $f \neq f_L$. Clearly this contract implements $(f, e) = (f_L, 1)$ for type L, but also for type H. To see this, notice that, by Proposition 1, Expression (20) suffices for $e = 1$ if $f(\theta_H) = f_L$, but this is the case since, given Expression (20), the payoff associated with $f = f_L$ is increasing in θ, while that associated with $f \neq f_L$ is flat. Therefore for type H, w' increases gross value by ΔR and has a compensation cost of $Q \equiv (\theta_H + \Delta) w^0_R(\theta_L, f_L) + (1 - \theta_H - \Delta) w^0_0(\theta_L, f_L)$. Notice, however, that w^0 entails a compensation cost of at least $Q - C_m$ for type H, since Q is the utility that the manager could obtain announcing θ_L and choosing $(f, e) = (b, 1)$, and C_m is the maximum nonpecuniary income that he can possibly obtain. But shifting to w' increases shareholder value by at least $\Delta R - C_m > 0$. ■

Proof of Proposition 4. This proof involves two parts. First we prove that w^{mb} implements the *mb* allocation. Then we show that it does so at the minimum cost.

Part 1: Implementation. w^{mb} must satisfy the incentive compatibility conditions

$$U(a(\theta_L), w^{mb}; \theta_L) \geq U(a, w^{mb}; \theta_L) \quad \text{for all } a$$

$$U(a(\theta_H), w^{mb}; \theta_H) \geq U(a, w^{mb}; \theta_H) \quad \text{for all } a,$$

where $a(\theta_L) = (\theta_L, m, 0)$ and $a(\theta_H) = (\theta_H, b, 1)$. Checking that w^{mb} satisfies these conditions is immediate. Notice that the payments in w^{mb} are invariant to z, so the manager does not hesitate about truthfully revealing his project type by choosing $z(\theta) = \theta$ for $\theta = \theta_L, \theta_H$. In addition, by

Proposition 1, the differences $w_R(z,f)-w_0(z,f)$ for $z=\theta_L,\theta_H$ and $f=m,b$ are sufficient for implementing $e(\theta)=0$ insofar as $f(\theta)=m$, and $e(\theta)=1$ insofar as $f(\theta)=b$. But then the choice of action $(\theta_L,m,0)$ under θ_L is guaranteed, since it leads the manager to obtain a utility greater than under the best bank-financing alternatives, $(\theta_L,b,1)$ and $(\theta_H,b,1)$:

$$C_m>(1-\theta_L-\Delta)w_0(z,b)+(\theta_L+\Delta)w_R(z,b),\quad \text{for } z=\theta_L,\theta_H.$$

Similarly the choice of action $(\theta_H,b,1)$ under θ_H is guaranteed by the fact that the manager's utility under such choice is as high as under the best market-financing alternatives, $(\theta_L,m,0)$ and $(\theta_H,m,0)$:

$$(1-\theta_H-\Delta)w_0(\theta_H,b)+(\theta_H+\Delta)w_R(\theta_H,b)=C_m.$$

Hence, w^{mb} definitely implements mb.

Part 2: Minimum cost. Notice first that under θ_L the proposed scheme involves no equilibrium payment to the manager, thereby leaving no room for improvement on this dimension. Notice next that under θ_H there is no room for improvement either, since the expected payment to the manager is just C_m, the minimum pecuniary compensation compatible with the absence of nonpecuniary income under $e(\theta_H)=1$ and the possibility of obtaining C_m by setting $(f,e)=(m,0)$. ■

Proof of Proposition 5. As in the previous proposition we first prove that w^{bb} implements the bb allocation. Then we show that it does so at the minimum cost.

Part 1: Implementation. w^{bb} must satisfy the incentive compatibility conditions

$$U(a(\theta_L),w^{bb};\theta_L)\geq U(a,w^{bb};\theta_L)\quad \text{for all } a$$

$$U(a(\theta_H),w^{bb};\theta_H)\geq U(a,w^{bb};\theta_H)\quad \text{for all } a,$$

where $a(\theta)=(\theta,b,1)$ for $\theta=\theta_L,\theta_H$. Checking that w^{bb} satisfies these conditions is immediate. Again, the payments in w^{bb} are invariant to z, so the manager does not hesitate about truthfully revealing his project type by choosing $z(\theta)=\theta$ for $\theta=\theta_L,\theta_H$. In addition, the differences $w_R(z,f)-w_0(z,f)$ for $z=\theta_L,\theta_H$ and $f=m,b$ are sufficient by Proposition 1 for implementing $e(\theta)=0$ insofar as $f(\theta)=m$, and $e(\theta)=1$ insofar as $f(\theta)=b$. But then the manager's utility following his intended action $(\theta_L,b,1)$ under θ_L is as high as under the best market-financing alternatives, $(\theta_L,m,0)$ and $(\theta_H,m,0)$:

$$(1-\theta_L-\Delta)w_0(z,b)+(\theta_L+\Delta)w_R(z,b)=C_m,$$

so his intended action can be implemented. Similarly the choice of $(\theta_H,b,1)$ under θ_H is guaranteed by the fact that the manager's utility under such choice is greater than under the best market-financing alternatives, $(\theta_L,m,0)$ and $(\theta_H,m,0)$:

$$(1-\theta_H-\Delta)w_0(\theta_H,b)+(\theta_H+\Delta)w_R(\theta_H,b)=C_m+(\theta_H-\theta_L)\frac{C_b}{\Delta}>C_m.$$

Thus w^{bb} definitely implements bb.

Part 2: Minimum cost. Notice first that under θ_L, the proposed scheme involves an equilibrium payment to the manager of just C_m: the minimum amount that, given the absence of private benefits with $e(\theta_L)=1$, is compatible with the possibility of obtaining C_m by just setting $(f,e)=(m,0)$. So there is no room for improvement on this dimension. Note next that, $e(\theta_L)=1$ requires, by Proposition 1, $w_R(\theta_L,b)-w_0(\theta_L,b)\geq\frac{C_b}{\Delta}$. Now suppose that the project has profitability θ_H but the manager mimics the action intended for θ_L. Then his utility will exceed in $(\theta_H-\theta_L)\frac{C_b}{\Delta}$ that attainable under θ_L. Hence the equilibrium utility for the manager under θ_H

cannot be lower than $C_m + (\theta_H - \theta_L)\frac{C_b}{\Delta}$. But then the absence of private benefits when $e(\theta_H) = 1$ implies that the expected payment to the manager under θ_H cannot be lower than $C_m + (\theta_H - \theta_L)\frac{C_b}{\Delta}$. This is precisely the cost of w^{bb} under θ_H, so there is no room for improvement on this dimension either. ■

Proof of Propositions 6 and 7. These propositions are proved by the arguments that precede them in the text.

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