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Asymmetric Information, Managerial Opportunism, Financing, and Payout Policies

THOMAS H. NOE and MICHAEL J. REBELLO*

ABSTRACT

We examine corporate issuance and payout policies in the presence of both adverse selection (in capital markets) and managerial opportunism. Our results establish the importance of the locus of decision control in the firm. When shareholders determine policies, debt financing is always optimal in the presence of either adverse selection or managerial opportunism. However, when both of these problems are simultaneously present, equity issuance can become an optimal signaling mechanism. Shareholders' most preferred signaling mechanism is restricting dividends, followed by equity financing, and finally underpricing securities. When managers determine policies, a reversed hierarchy may be obtained.

RESEARCH HAS DOCUMENTED A number of regularities in the average wealth effects of a variety of financial policies.[1] In many cases, considerable cross-sectional variation in these wealth effects is also observed.[2] These variations in the wealth effects of financial policies are puzzling in the light of the unidirectional predictions of asymmetric information-based models of these decisions. These predictions are based on the assumption that corporate policy is controlled by shareholders, abstracting from the effects that conflicts of interest between shareholders and management exert over corporate policies.[3] However, the agency literature shows that managers have the ability to independently influence corporate policy, and this ability of managers has a

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[1] For an overview of the wealth effects of financing and takeover activity, see Harris and Raviv (1991) and Jarrell and Poulsen (1989), respectively.

[2] All studies of public equity issues have documented that the market's reaction to these issues is negative on average. Mikkelson and Partch (1986), for example, have also documented that a large number of equity issues induce positive reactions from investors. Studies of dividend changes have documented that, in general, dividend increases lead to increased stock prices (Aharony and Swary (1980)). However, Woolridge and Ghosh (1992) and John and Lang (1991) provide evidence that smaller dividend increases may generate positive wealth effects.

[3] See Harris and Raviv (1991) for summary and discussion of some of this literature.

profound impact on financial policies.[4] Therefore, models incorporating these conflicts of interest between shareholders and management into the asymmetric-information paradigm of corporate financial policy may better explain the cross-sectional variations in wealth effects of financial policies.

This article is a first attempt in this direction. It explores financing and payout policies when management pursues its own objectives, subject to the constraints imposed by adverse selection in security markets. In our analysis, a firm, initially owned by a large inside shareholder and managed by an incumbent manager, seeks funding for an investment opportunity. The shareholder and the manager have private information regarding the firm's prospects. The manager possesses unique skills that give rise to rents. By opportunistically renegotiating his contract, the manager is able to hold up shareholders and capture a share of these rents.[5] Thus, managerial rents give rise to agency conflicts with shareholders. At the same time, the asymmetry of information in capital markets engenders an adverse selection problem. Within the context of these problems, the firm has to raise capital to fund its investment opportunity. While it has recourse to some internal funds, these funds are not sufficient to meet its investment needs. To obtain outside financing, the firm must issue a mixture of debt and equity.

In the absence of informational asymmetries, the financial policy choice is driven solely by concerns regarding the share of rents garnered by the manager. Debt financing, and the attendant threat of financial distress, improves the bargaining position of shareholders relative to management. However, internal finance limits shareholder bargaining power by increasing solvency and, thus, reducing the effectiveness of debt as a bargaining tool. Thus, when financial decisions are dictated by shareholders, the optimal policy calls for minimizing managerial rent appropriation via a strategy of high dividends and complete reliance on competitively-priced external debt financing. When management determines financial policies, all equity structures that maximize managerial rent appropriation are optimal. The presence of informational asymmetries, however, may force deviations from these policies to reduce adverse selection costs.

Some of the effects of the constraints imposed by adverse selection can be deduced simply by cutting and pasting together the predictions from the agency and adverse selection literature. Consider, for example, the case of dividend payouts in shareholder-controlled firms. Managerial opportunism can be reduced by increasing dividend payouts. On the other hand, under the adverse selection paradigm, firms can minimize mispricing losses by reducing dividend payments. Combining the two theories, then, would indicate that the

[4] See, for example, Jensen (1986), Kaplan (1989), Dann (1981), and DeAngelo and DeAngelo (1989).

[5] These unique skills can take a variety of forms. For example, the success of the project may depend on the manager's personal reputation and his ties with the firm's customers and/or suppliers. Alternatively, the manager may possess detailed knowledge of the structure of interpersonal relationships between the key actors in the firm. Another factor giving rise to rents is that the remainder of the management team may have adapted to the manager's operational style.

presence of adverse selection should lead even shareholder-controlled firms concerned with managerial opportunism to reduce dividend payments. Our analysis indicates this is indeed the case, with the reduction in dividend payments determined by the relative importance of the two problems. Similar results are obtained in the case of debt financing by manager-controlled firms. Under management control, the firm attempts to minimize reliance on debt financing. However, the costs of adverse selection associated with equity issuance may force increased reliance on debt financing.

A number of the predictions of our analysis, however, are not simple artifacts of cut-and-paste logic. For example, when shareholders determine policies, debt financing is always optimal in the presence of either pure adverse selection (e.g., Myers and Majluf (1984)) or pure managerial opportunism (e.g., Perotti and Spier (1993) and Jensen (1986)). However, when both of these problems are simultaneously present, equity issuance, because it permits signaling of favorable information, may become an optimal financial policy.[6] A similar reversal in predictions arises when managers determine financial policies. In this case, dividend payouts are suboptimal in the presence of either pure adverse selection or pure managerial opportunism. When these problems are combined, however, the requirement to signal may render high dividend payouts optimal.

Our analysis also points to the existence of a hierarchy in financial signals. When shareholders control financial policies, their tradeoffs between the costs of increased rent concessions and the adverse selection costs induce a signaling hierarchy. Shareholders' most preferred signaling mechanism is restricting dividends, followed by equity financing, and finally underpricing securities. Managers, when in control, face a different set of tradeoffs. They trade off the benefits of increased rents against the costs of adverse selection. As a result, the signaling hierarchy may be inverted.

The remainder of the article is organized as follows. Section I contains the basic model set-up. Section II focuses on optimal financial policies of shareholder-controlled firms in the absence of asymmetric information. Section III contains an analysis of these policies in the presence of asymmetric information. Section IV analyzes the effect of management control on financial policies. The robustness of our analysis to alternative specifications is considered in Section V. Testable implications of our analysis are sketched in Section VI. Concluding remarks are presented in Section VII. Proofs of all results are presented in the Appendix.

I. The Model

Consider a three-date economy. The risk-free rate of return is 0 and all agents are risk-neutral, expected-value maximizers. Financial markets are competitive. At time 0, an inside shareholder and an incumbent manager have private

[6] In a model with managerial discretion and asymmetric information, Stulz (1990) provides conditions under which equity issuance is optimal.

information about a firm's future investment prospect, a positive NPV project that will become available at time 1. This information enables them to identify the firm's type: either bad (B) or good (G). The remaining agents in the economy only know that the firm is type G with probability ϕ. The investment generates a cash flow of X dollars at time 2. For simplicity, we assume that this cash flow takes values 0 or H. Making this assumption allows us to abstract from technical considerations relating to the functional form of the claim issued to finance the project.[7] The firm has financial slack of S dollars, available either for financing or distribution in the form of dividends. Let the dividend payout, which is made at time 0, be represented by D. This payment cannot exceed the financial slack.[8] Apart from its financial slack, the firm has no assets-in-place.[9] Thus, apart from the retained slack, it is worthless if it rejects the investment. If it invests, it is able to capture some of the project's NPV, ensuring that it will choose to invest.

At time 1, the firm has to decide how to finance its project. Outside financing takes the form of a mixture of debt and equity. Debt financing takes the form of zero-coupon debt with a face value of $F \in [0, H]$, maturing at time 2. Before financing, the firm has N shares outstanding, with the inside shareholder owning n_I shares. The incumbent manager holds the remaining $n_M = N - n_I$ shares. Equity represents the sale of n_N new shares to outside investors. Let α and β represent proportions of equity owned by the new investors and the proportion of the remaining equity owned by the manager, where

$$\alpha \equiv \frac{n_N}{n_N + n_M + n_I},$$

and

$$\beta \equiv \frac{n_M}{n_M + n_I}.$$

The proceeds of the new security issue (Π), plus retained slack, must equal the funds required for investment (I), that is $S - D + \Pi = I$.[10] This implies that the firm does not retain any cash flows after time 1.

[7] In Section V, we consider the effect of replacing this assumption with more general distributional assumptions.

[8] This assumption ensures that the firm cannot borrow to finance dividend payments. Such borrowing would violate almost all the statutory tests that are used to determine the permissibility of dividend payments. Further, in reality, firms are often restricted from paying increased dividends because of explicit bond covenants and, even when higher dividends may be feasible, debt financing for these dividends may be restricted by bond indentures (see, e.g., Rao (1992)).

[9] This assumption is made to focus attention on financing policies. The impact of relaxing this assumption is considered in Section V.

[10] This assumption is innocuous but greatly simplifies our presentation. As will become apparent later, the firm never has any incentive to raise cash in excess of the amount needed to fund the project.

At time 1, the inside owner can choose between the incumbent manager and a "replacement," r. The replacement is chosen from a pool of identical managers in a competitive labor market. Assume for simplicity that the second period reservation wage for both the incumbent manager as well as the replacement manager is 0. If the replacement manager is chosen to run the firm, he too acquires private information regarding the firm's time 2 cash flow. This private information is identical to that of the inside owner.

If the incumbent manager is retained and the firm is type $t \in \{B, G\}$, the probability of realizing the cash flow H is given by $P_t(i)$ and the probability of realizing cash flow 0 is given by $1 - P_t(i)$. On the other hand, if the firm is type t and a replacement manager is hired, the probability of realizing cash flow H is given by $P_t(r)$ and the probability of realizing cash flow 0 is given by $1 - P_t(r)$. Thus, if the firm is type t, the expected value of the cash flow is $V_t(i) = P_t(i)\ H$ if the incumbent manager is retained and $V_t(r) = P_t(r)\ H$ if he is replaced. It follows that the rent generated by the incumbent manager can be represented by $\Delta V_t = V_t(i) - V_t(r)$ if the firm is type t. We assume that this rent is positive, i.e., $\Delta V_t \geq 0$ for all t. We also assume that $P_G(i) > P_B(i)$ and $P_G(r) > P_B(r)$. This ensures that type G's cash flows are higher than those of type B both under the replacement and incumbent managers. Thus, the value of any claim is higher if it is issued by type G.

Given that the manager generates rents if he is retained by the firm, and he cannot be forced to work for the firm, the opportunity for contractual opportunism effectively prevents either party from precommitting ex ante to a division of the rents. The allocation of these rents is arrived at through negotiations between the firm's claimants. Negotiations occur at time 1, after the financing decision has been made. Bondholders have the highest priority claims. Thus, their claims are satisfied prior to those of the shareholders and manager, leaving the inside stockholder and the manager to participate in the negotiations over cash flows in excess of bondholder payments.[11] The value of these cash flows is given by

$$E_t(h, F) = P_t(h)\ (H - F),$$

where $h = i, r$, and the firm is type $t \in \{B, G\}$. It follows that negotiations between the stockholders and the manager focus on the division of the fraction of the total rent $E_t(i, F) - E_t(r, F)$.

We model these negotiations using a structure similar to that of Hart and Moore (1994). The negotiations begin with the manager making an offer. If the offer is accepted, negotiations end with the two claimants sharing the rents in accordance with the manager's proposal. If the offer is rejected, the inside shareholder and the manager have some probability of making a last and final offer. If this offer is rejected, a replacement manager must be hired. The

[11] In the context of our model, the interests of all shareholders are aligned with respect to negotiations with the manager. Further, all shareholders, with the exception of the inside stockholder, are at an informational disadvantage with respect to the manager. Thus, it is in their interests to let the inside shareholder negotiate with the manager.

probability that the insider makes the last offer is given by γ and the probability that the manager makes the last offer is given by $1 - \gamma$.

If the final offer is rejected, shareholders obtain a payoff of $E_t(r, F)$. When he makes the last offer, in the unique sub-game perfect Nash equilibrium, the inside shareholder makes an offer that appropriates the entire rent for shareholders. The manager accepts this offer, yielding a payoff of $E_t(i, F)$ to be shared between all shareholders. Thus, in the unique sub-game perfect Nash equilibrium, when the inside shareholder makes the last offer, the outside owners receive $\alpha E_t(i, F)$, the manager receives $\beta(1 - \alpha)E_t(i, F)$, and the inside shareholder receives $(1 - \beta)(1 - \alpha)E_t(i, F)$. On the other hand, if the manager makes the final offer, he proposes $E_t(r, F)$ to be shared among all shareholders. This offer is accepted and the manager receives $E_t(i, F) - E_t(r, F) + \beta(1 - \alpha)E_t(r, F)$, the outside owners receive $\alpha E_t(r, F)$, and the inside owner receives $(1 - \beta)(1 - \alpha)E_t(r, F)$. Given these payoffs to the claimants, when the manager makes the initial offer, he proposes that shareholders receive $(1 - \gamma)E_t(r, F) + \gamma E_t(i, F)$ and this offer is accepted. Let $P_t(\gamma)$ be defined as follows: $P_t(\gamma) \equiv P_t(r) + \gamma(P_t(i) - P_t(r))$. Then, in equilibrium, the outside shareholders receive $\alpha P_t(\gamma)(H - F)$, the inside shareholder receives $(1 - \beta)(1 - \alpha)P_t(\gamma)(H - F)$, and the manager receives $(P_t(i) - P_t(\gamma))(H - F) + \beta(1 - \alpha)P_t(\gamma)(H - F)$.

Given the equilibrium division of rents, the total payoff to the inside shareholder, which includes the date 0 dividend, can be represented by $U_t(\alpha, F, D)$, where

$$U_t(\alpha, F, D) \equiv (1 - \beta)[D + (1 - \alpha)P_t(\gamma)(H - F)].$$

Similarly, the intrinsic value of equity issued to outside investors by type t can be represented by $\alpha P_t(\gamma)(H - F)$, and the intrinsic value of debt claims issued to outsiders can be represented by $P_t(i)F$. Thus, the intrinsic value of any combination of debt and equity claims issued to outsiders can be represented by $W_t(\alpha, F)$, where

$$W_t(\alpha, F) \equiv \alpha P_t(\gamma)(H - F) + P_t(i)F.$$

In the following sections, we examine the tradeoff inherent in these payoff structures.

II. Financial Policies and Opportunism

In the absence of asymmetric information, the value of claims issued to investors exactly equals the proceeds from their sale. Thus, in this case, the insider's payoff is determined by the share of the rent obtained by the manager. Because the manager's equilibrium payoff $\beta(1 - \alpha)(P(i) - P_t(\gamma))(H - F)$ is strictly decreasing in F, the insider's payoff can be maximized by opting for all-debt financing. Further, by increasing dividend payments, the firm decreases its reliance on internal funds. This requires it to raise more financing from outsiders, enabling it to increase its reliance on debt financing. Thus,

the insider will choose to pay out all the slack as a dividend and finance exclusively through external capital. For convenience, hereafter, this policy is referred to as the "first-best policy."

LEMMA 1: *In the absence of informational asymmetries, the insider's optimal policy is to rely entirely on correctly-priced external debt finance.*[12]

As is apparent from Lemma 1, in the absence of informational asymmetries, the firm's dividend and financing decisions are driven primarily by the motive to maximize managerial rent concessions. These concessions are maximized by following a policy of eliminating financial slack through a dividend of S at time 0 and financing the investment solely with bonds. The use of debt to extract rent concessions is a common theme in the literature. Israel (1991) shows that debt finance can be used by target firms to extract the economic rents generated by a change in corporate ownership from acquirers. Perotti and Spier (1993) show that debt financing can be used to extract economic rents from employees. Our policy prescription in the absence of informational asymmetry also resembles the policy prescriptions of Easterbrook (1984), Jensen (1986), and Rozeff (1982) in that it calls for the firm to maximize its reliance on external capital in the form of debt finance.

III. Asymmetric Information and Management Opportunism

The introduction of an informational asymmetry between the firm and capital markets fundamentally alters the strategic incentives analyzed above. The financing policy now has both a direct effect on the division of rents between shareholders and managers as well as an indirect effect through its impact on the perceptions of outside investors regarding firm quality. To better understand the effect of informational asymmetry on the firm's financial policy, note that the insider's payoff can be represented as

$$U_t(\alpha, F, D) = (1 - \beta)[S + P_t(i)\, H - I - ((P_t(i) - P_t(\gamma))(H - F)) - (W_t(\alpha, F) - I - D + S)].$$

From the above expression it follows that the insider shareholder's payoff is proportional to the NPV under the incumbent manager, less both the manager's share of the rents and the mispricing of the firm's financial claims.

To characterize the firm's optimal financial policies under asymmetric information, we focus exclusively on the "efficient" signaling equilibria. In these equilibria, if the firm is type B, it chooses the first-best policy f_B^{FB}, while if the firm is type G, it chooses a policy that will make it incentive compatible for each type not to mimic the other.[13] In these equilibria, the total ex ante value

[12] Henceforth, we identify the firm with its inside owner.

[13] There exists a long tradition in the finance literature that, when dealing with a multiple signal context, attention is focused on efficient separating equilibria (see, for example, Ambarish,

of type G is maximized subject to non-mimicry constraints. Thus, if the firm is type G, its optimal financial policy solves

$$\underset{(\alpha, F, D)\in\mathcal{F}}{\text{Max}} \quad U_G(\alpha, F, D) \tag{1}$$

s.t.

$$U_G(\alpha, F, D) \geq U_G(f_B^{FB}) \tag{2}$$

$$U_B(f_B^{FB}) \geq U_B(\alpha, F, D) \tag{3}$$

$$W_G(\alpha, F) \geq I + D - S, \tag{4}$$

where $\mathcal{F} \equiv [0, 1] \times [0, H] \times [0, S]$. The inequality (2) is the non-mimicry constraint for type G. It ensures that, if it is type G, the firm will not have an incentive to mimic type B. The inequality (3) is the corresponding non-mimicry constraint for the firm if it is type B. The last inequality, equation (4) is the capital market rationality constraint. It ensures that the value of claims issued to outside investors is no lower than the proceeds of the issue.

The costs of adverse selection force the firm away from a policy of complete reliance on external debt financing. The firm can either reduce its reliance on external finance by reducing dividend payouts or increase its reliance on equity finance. It faces a tradeoff between the effects these two policy alternatives have on constraining managerial opportunism and controlling adverse selection costs. Lower dividends decrease the firm's reliance on external capital, thereby restricting its ability to obtain rent concessions from the manager. Because decreased dividends reduce the firm's reliance on external capital, the decrease in managerial rent concessions is partially offset by a decrease in the magnitude of mispricing on security issues. Equity issuance, which also results in decreased managerial rent concessions, however, does not reduce mispricing. Thus, it is a more costly signal than reduced dividend payouts. It follows that the firm will first use dividend reductions to the maximal extent before resorting to equity financing.

LEMMA 2: *If the firm has favorable information (type G) and issues equity, it will not pay out any dividends.*

As one can see from Lemma 2, the firm will prefer to signal its information solely through dividend reductions whenever possible. As the following proposition demonstrates, this is feasible when the adverse selection costs are relatively small.

John, and Williams (1987)). Further, Cho and Sobel (1990) have derived general conditions under which only these equilibria survive the D_1 refinement.

PROPOSITION 3: *If the adverse selection costs are relatively small, i.e.,*

$$\frac{P_B(i) - P_B(\gamma)}{P_B(\gamma)} \Big/ \frac{P_G(i) - P_B(i)}{P_G(i)} > \frac{I - S}{S}, \tag{5}$$

then the firm will finance with debt and will pay some dividends if it has favorable information.

The right-hand side of equation (5) is simply the ratio of external financing needs to internal funds. The numerator of the left-hand-side ratio is proportional to the rent concessions extracted from the manager per dollar of debt financing if the firm is type B, while the denominator is proportional to the adverse selection costs of debt finance. Thus, the condition is likely to be satisfied when adverse selection costs are small.

When the adverse selection problem is more severe, the firm is forced to use more costly signals. Two avenues are open: equity issuance or underpricing through the issuance of securities at prices below their intrinsic value. While the substitution of equity for debt finance increases concessions to managers, this effect is never severe enough to induce a preference on the part of the inside owners to "give away" some of the cash flows to outside investors by underpricing.[14] Thus, when reliance on equity financing alone is sufficient to signal its information, the firm need not underprice. In this case, a mixture of debt and equity financing ($\alpha^* > 0, F^* > 0$), combined with a zero dividend, is the firm's optimal policy.

PROPOSITION 4: *If the firm is faced with an intermediate level of adverse selection costs, i.e.,*

$$\frac{P_B(i) - P_B(\gamma)}{P_B(\gamma)} \Big/ \frac{P_G(i) - P_B(i)}{P_G(i)} < \frac{I - S}{S}, \tag{6}$$

and either $P_G(\gamma) - P_B(i) < 0$ *or*

$$\frac{P_B(i) - P_B(\gamma)}{P_B(\gamma)} \Big/ \frac{P_G(\gamma) - P_B(i)}{P_G(\gamma)} > \frac{I - S}{S}, \tag{7}$$

then mixtures of correctly priced debt and equity are optimal policies if the firm receives favorable information.

In Proposition 4, the condition (6) ensures that dividend restrictions alone are not sufficient to signal information. Condition (7), whose denominator is proportional to the adverse selection costs associated with equity finance, ensures that equity issuance is sufficient to reveal the firm's information when

[14] In contrast to our other results, this one depends to some extent on our cash flow distribution assumptions. In general, distributions of cash flows exist for which the increased mispricing associated with equity financing leads to underpricing dominating equity issuance. However, there also exist many other distributions of cash flows for which our result remains valid. See Section V for a detailed discussion.

combined with dividend restrictions. These conditions are likely to be satisfied when the rent losses from decreased debt financing are large relative to the mispricing gain induced by informational asymmetry. If this is not the case, then even equity issuance is insufficient to signal information, forcing the firm to use the last signal at its disposal: selling underpriced securities. Because of our simplifying distributional assumptions, the firm is indifferent between issuing equity and debt if it is forced to issue underpriced securities.

PROPOSITION 5: *Suppose that the adverse selection problem is severe, i.e.,*

$$\frac{P_B(i) - P_B(\gamma)}{P_B(\gamma)} \Big/ \frac{P_G(\gamma) - P_B(i)}{P_G(\gamma)} < \frac{I - S}{S}, \tag{8}$$

then the firm will underprice its claims if it has favorable information.

In summary, the above results characterize the financing hierarchy in shareholder controlled firms: using internal funds, using equity finance, and finally selling underpriced claims. The degree to which shareholder controlled firms are forced to "move down" this financing hierarchy depends on the ability of managers to extract rents, the degree of informational asymmetry, and the firm's internal financing capability. This financing hierarchy has some features that are similar to those of the pecking order postulated by Myers and Majluf (1984). For example, debt financing is preferred to equity financing under both hierarchies. Differences in the two orderings of financial policies arise in the hierarchical position of internal finance. In the pecking order theory, *internal* finance is placed at the top of the pecking order. On the other hand, in our analysis, *external* finance is placed at the top of the financing hierarchy, and internal finance is utilized only when adverse selection forces its use.

IV. Manager Control

In this section, we characterize separating equilibria when dividend and financing decisions are controlled by the manager. We demonstrate that management's preferred policies offer a stark contrast to those preferred by owners. This contrast is present both when there is information asymmetry regarding cash flows, as well as when these asymmetries are absent.

First, we examine the policies preferred by the manager in the absence of information asymmetries. To do so we construct an objective function for the manager. The manager owns β percent of the shares owned by all insiders. Thus, the manager's payoff arises from two sources: the rents he can extract as well as his personal equity stake. It follows that his payoff, given financial policy (α, F, D), can be represented by $\mathcal{V}(\alpha, F, D)$, where

$$\mathcal{V}_t(\alpha, F, D) = \beta[D + (1 - \alpha)P_t(\gamma)(H - F)] + [P_t(i) - P_t(\gamma)](H - F).$$

The first set of terms in the above expression represents the manager's payoff resulting from his equity stake in the firm. The second set of terms represents his share of the rents.

In the absence of informational asymmetries, the manager's optimal policy solves

$$\underset{(\alpha, F, D)\in\mathcal{F}}{\text{Max}} \; \mathcal{V}_t(\alpha, F, D) \tag{9}$$

s.t.

$$W_t(\alpha, F) \geq I + D - S.$$

The solution to this problem is transparent. Debt financing induces rent concessions by the manager. Because his equity stake only allows him to recoup a fraction of these rent concessions in the form of higher equity values, fractional equity ownership does not eliminate this bias towards equity finance. Thus, the manager is averse to debt-financing. Absent debt financing, dividend payments have no effect on either the manager's share of the rents or the value of his equity stake. Thus, the dividend decision is irrelevant.

LEMMA 6: *In the absence of informational asymmetries, the manager's first-best policy,* f_t^{MFB}*, is all-equity finance.*

This result demonstrates that, in the absence of informational asymmetries, both financing and dividend policies vary with control. It indicates that management controlled firms rely more heavily on equity financing and need not follow a residual dividend policy.

Control-induced differences persist even in the presence of informational asymmetries. As is the case under shareholder control, the introduction of informational asymmetries complicates the characterization of the optimal policies. These policies have to trade off the benefits from reduced rent concessions against adverse selection costs. More formally, under management control, the optimal policy solves the following problem:

$$\underset{(\alpha, F, D)\in\mathcal{F}}{\text{Max}} \; \mathcal{V}_t(\alpha, F, D) \tag{10}$$

s.t.

$$\mathcal{V}_G(\alpha, F, D) \geq \mathcal{V}_G(f_B^{MFB})$$

$$\mathcal{V}_B(f_B^{MFB}) \geq \mathcal{V}_B(\alpha, F, D)$$

$$W_t(\alpha, F) \geq I + D - S.$$

In expression (10) the first two constraints are incentive compatibility constraints, ensuring that type G has no incentive to mimic type B, and type B has no incentive to mimic type G. The last constraint is the market rationality

constraint, ensuring that the value of outsiders' claims is at least as large as the injection of funds they provide the firm.

The following result demonstrates that changes in control can lead to a complete reversal of the informational effect of financial policies. In direct contrast to the shareholder-control case, to signal information, financial policies have to impose costs on the manager rather than the shareholders. These costs take the form of increased rent concessions to shareholders. Thus, debt financing is crucial to signaling favorable information. Increased debt financing results in forcing managerial rent-concessions and increasing mimicry costs. Sufficiently high levels of debt financing eliminate all mimicry incentives. Dividend payments may be necessary to support a mimicry-deterring level of debt and, thus, high dividends may be an integral part of the optimal policy.

PROPOSITION 7: *(i) Favorable information is signaled either by underpricing securities or including debt in the financing mix. (ii) High dividends and complete reliance on external debt financing can signal favorable information while low dividends, internal financing, and complete reliance on equity financing can convey less favorable information.*

In some ways, the results of Proposition 7 are consistent with the standard "pecking order" model. Firms prefer internal to external financial sources as external finance brings with it the possibility of increased managerial rent concessions. In other ways, our results for the management-controlled firm contrast sharply with the predictions of the pecking order theory, which predicts that firms will prefer debt to equity securities. In our analysis, debt is indeed sometimes issued by the management-controlled firm, but only when it is forced to do so by the presence of severe adverse selection costs. The natural preference of such firms is equity finance. Since adverse selection costs will only be high when the firm has favorable information regarding its future, prospects, equity issues will tend to convey negative information.

V. Extensions

In this section, we examine the sensitivity of our results to changes in the assumptions underlying our analysis. We begin by demonstrating that our results are robust to alternate distributional parameterizations. Then we demonstrate that our results are also robust to the inclusion of investment discretion into the analysis. Because considerations regarding the robustness of our results are similar under both manager control and shareholder control, for brevity, we focus on the robustness of our results under shareholder-control.

A. Generalizing the Distributional Assumptions of the Model

The above analysis assumes that firm cash flows could take only two values, 0 and H. To consider the impact of loosening this assumption on our results, we

now consider a more general distributional specification of cash flows. In this setup, the firm's cash flow under the replacement manager is given by the non-negative random variable X_t. Similarly, the cash flow of the firm under the incumbent manager is given by the non-negative random variable X_t^+. *Let* $\mathcal{H}_t(\mathcal{H}_t^+)$ represent the cumulative distribution of $X_t(X_t^+)$, and assume that X_G (X_G^+) dominates X_B (X_B^+) by first order stochastic dominance. Because the only change in our analysis is in the cash flow distributions assumed, the specification of payoffs is unchanged save for the obvious modifications to accommodate the changed cash flow distributions. In this general framework, expected cash flows to stockholders can be represented by $E_t(F)$, where

$$\mathcal{E}_t(F) \equiv \gamma \mathrm{E}\{\mathrm{Max}\{X_t^+ - F,\ 0\}\} + (1 - \gamma)\mathrm{E}\{\mathrm{Max}\{X_t - F,\ 0\}\}.$$

The payoff to the inside shareholder can be represented by $U_t(\alpha, F, D)$, where

$$U_t(\alpha, F, D) \equiv (1 - \beta)[D + (1 - \alpha)E_t(F)].$$

In standard signaling models, the "single-crossing" property of marginal rates of substitution is used to infer the properties of global optima from local characterizations. This allows for tractable, even elegant, analysis through differential calculus. Unfortunately, combining managerial opportunism with the standard security choice problem generally leads to violation of single-crossing conditions. Thus, local analysis cannot be used to characterize global optima. While elegant characterizations are not possible, a solution to the firm's problem can still be obtained using numerical techniques.

For a large set of parameterizations of the model, our basic results remain valid. In shareholder-controlled firms, when restricting dividends alone is not sufficient, equity financing is preferred to underpricing as a signal of favorable information. The key to identifying the parameters over which equity efficiently signals favorable information is to determine when equity has a comparative advantage in helping to deter mimicry. A necessary condition is that, at the optimal financing policy, the marginal rate of substitution between debt and equity finance is flatter when the firm has favorable information. Using the specification of the payoff functions U_t, $t = B, G$, this condition can be expressed as

$$\frac{\int \mathrm{Max}\{x - F^*, 0\}\, \mathrm{d}\mathcal{J}_G}{1 - \mathcal{J}_G(F^*)} \leq \frac{\int \mathrm{Max}\{x - F^*, 0\}\, \mathrm{d}\mathcal{J}_B}{1 - \mathcal{J}_B(F^*)},$$

where $\mathcal{J}_t = \gamma\mathcal{H}_t + (1 - \gamma)\mathcal{H}_t^+$. There exist numerous parametric specifications that satisfy this condition. In these cases, increased equity financing results in a disproportionately large rent loss when the firm has unfavorable information. However, because the marginal condition given above varies with F^*, this necessary condition is not sufficient to ensure the efficiency of the equity financing policy.

We now provide a numerical example in which the use of equity financing is globally efficient. For example, let Z be a random variable uniformly distributed over the interval $[-h, h]$. Suppose that the firm's time 2 cash flow under the replacement manager is given by $r_t + Z$ if the firm is type t, where $r_G > r_B$. To ensure that cashflows always have a nonnegative support, let $r_B \geq h$. To capture the notion that the incumbent manager generates rents, let $r_t + \Delta_t + Z$ represent the date 2 cash flow under the incumbent manager, where $\Delta_t > 0$. To ensure that first order stochastic dominance holds regardless of the identity of the manager, let $r_B + \Delta_B < r_G + \Delta_G$.

Setting $h = 0.25$, $\beta = 0$, $\gamma = 0.1$, $r_G = 0.8$, $r_B = 0.25$, $\Delta_G = 0.49$, $\Delta_B = 0.86$, $S = 0$, and $I = 1$, ensures that the firm is unable to deter mimicry if it chooses to finance solely with correctly priced debt. Note that, under the specified parameters, type B has larger rents. Consequently, increased reliance on equity financing results in a disproportionately large rent loss for type B. For these parameter values, $D_G^* = 0$, $F_G^* = 0.9943$, and $\alpha_G^* = 0.1777$ is the efficient signaling policy for G, and the first-best policy for type B is given by; $D_B^{FB} = 0$, $F_B^{FB} = 1.0283$, and $\alpha_B^{FB} = 0$.[15] In both cases, securities are correctly priced. Since $(\alpha_G^*, F_G^*, D_G^*)$ is strictly optimal and the functions defining the agents' payoffs are continuous, it is easy to see that optimality of correctly-priced equity holds in a neighborhood of these parameter values.[16]

By varying the parameters of the above example, it is also easy to generate examples in which the firm is able to signal even though it relies solely on correctly-priced debt. This is the case when $h = 0.25$, $\beta = 0$, $\gamma = 0.1$, $r_G = 0.8$, $r_B = 0.25$, $\Delta_G = 0.49$, $\Delta_B = 0.86$, $S = 0.4$, and $I = 1$. Because the firm has relatively large amount of slack, rent losses due to reduced dividends are sufficient to signal favorable information. Here, $D_G^* = 0.3979$, $F_G^* = 0.9979$, and $\alpha_G^* = 0$ is the efficient signaling policy for G, and the first-best policy for type B is given by $D_B^* = 0.4$, $F_B^* = 1.0283$, and $\alpha_B^* = 0$. While both types rely only on debt financing, type G finances part of its investment by retaining slack.

The optimality of underpricing as a signal of superior firm quality can also be obtained through similar variations in parameter values. For example, setting $h = 0.25$, $\beta = 0$, $\gamma = 0.1$, $r_G = 0.8$, $r_B = 0.75$, $\Delta_G = 0.49$, $\Delta_B = 0.26$, $S = 0.0$, and $I = 1$, renders $D_G^* = 0$, $F_G^* = 1.5600$, and $\alpha_G^* = 0$ the efficient signaling policy for type G. The first-best policy for type B is $D_B^* = 0$, $F_B^* = 1.16$, and $\alpha_B^* = 0$. Given the absence of any slack, the firm is unable to signal through reduced dividends. Because type G has larger rents in this case, the marginal rate of substitution condition favoring equity issuance is not satisfied. Thus, underpricing is necessary to signal information. Given that correctly-priced

[15] Numerical computations of these optimal solutions were performed using Mathematica™. The program is available from the authors upon request.

[16] Interestingly, the cash flows of type G with the incumbent manager conditionally stochastically dominate the cash flows of type B with the incumbent manager. The same dominance relationship holds with respect to the cash flows under the replacement manager. Nachman and Noe (1994) demonstrate that, in a pure adverse selection setting, conditional stochastic dominance is a necessary and sufficient condition for the optimality of debt financing.

debt is riskless if issued by type G, the promised repayment on correctly priced debt is 1 if the firm is type G. Thus, type G's optimal policy calls for underpricing.

B. Signaling Through Underinvestment

The seminal work of Myers and Majluf (1984) demonstrates the role of underinvestment as a signal of firm quality. Our analysis, however, abstracts from the ability of the firm to manipulate its investment policy to signal its information. By assuming that the firm has no assets-in-place and the project has a positive NPV, we ensure that the failure to take on the project is a dominated alternative. As in Myers and Majluf (1984), to consider the possibility of underinvestment as a signal, we would have to introduce assets-in-place into our analysis. This is a relatively easy task. One particularly transparent way of introducing assets-in-place is to assume that the failure to take on the project leaves the firm with some value. In this modified setting, our earlier analysis provides a solution to the firm's problem conditional on its choosing to invest. However, given that underinvesting leaves the firm with some value, a complete solution to the problem can be obtained by comparing the firm's value under the most efficient signal with its value from underinvesting.

It is obvious that, if the value from underinvesting is sufficiently low, our results remain unchanged, as the firm will always prefer to invest and use its financing and payout policies to signal its quality. Thus, the hierarchy of signals will remain unchanged. However, if the firm's value from underinvestment is sufficiently high, implying a low marginal cost from underinvestment, underinvestment may dominate financial policy alternatives such as reduced dividend payouts, equity financing, and underpricing, as a signal of firm quality. From these arguments it is clear that the usefulness of underinvestment as a signal is contingent on the marginal cost of deviating from the first-best investment policy. When the marginal cost is high, firms will prefer to utilize financial policies to signal information, leaving our results unchanged. The role of underinvestment as a signal in the presence of managerial opportunism is even greater in models of managerial opportunism and informational asymmetry such as Hadlock (1994) in which the firm is restricted to equity financing. In this case, the possibly lower cost financing signals analyzed in this article are not available, forcing the firm to rely more heavily on investment distortion to signal.

VI. Empirical Implications

A recent thrust in empirical research is identifying and assessing the relative contribution of competing theoretical paradigms in explaining observed financial policies (see, e.g., Smith and Watts (1992), Barclay and Smith (1995), Hadlock (1994), Helwege and Liang (1994), Opler and Titman (1994), and Jung, Kim, and Stulz (1995)). Our analysis, by demonstrating that the locus of

control is a key determinant of optimal financial policies, produces numerous nonobvious predictions that can further focus research in this area. For example, our analysis provides the following hypotheses regarding the interactive effects of managerial opportunism and adverse selection.

Implications of Shareholder Control

- Shareholders will accept the rent concessions to managers induced by equity finance only when adverse selection costs are high. Thus, higher reliance on debt financing conveys less favorable information while increased equity financing conveys favorable information.
- Shareholders will reduce dividend payouts only if they are forced to do so because of high adverse selection costs. Thus, reduced dividend payouts signal favorable information.
- Shareholder-controlled firms lacking internal sources of funds are unable to cheaply signal favorable information by cutting back on dividend payouts. Thus, they will be forced to rely more heavily on equity financing.

Implications of Manager Control

- Managers will tolerate higher dividends and the attendant increases in rent concessions only when they face high adverse selection costs. Thus, higher dividend payouts convey more favorable information.
- Managers will accept the rent concessions to shareholders accompanying debt finance only if they are forced to do so because of adverse selection costs. Thus, greater reliance on debt financing signals favorable information.
- Manager-controlled firms lacking internal sources of funds are unable to cheaply signal favorable information by increasing dividend payouts. Thus, they will be forced to rely more heavily on debt financing.

General Implications

- Increased informational asymmetry induces increased financial policy distortion by firms with favorable information. Thus, when informational asymmetry is large, greater cross-sectional dispersion in financing policies should be observed.
- Because underpricing is a signal of last resort, underpricing will occur only when informational asymmetries are great.

These hypotheses can be tested employing the standard methodology used in cross-sectional regression analysis. Successful testing is crucially dependent on the availability of good proxies for firm attributes. A number of proxies for the locus of control suggest themselves. We expect that highly dispersed ownership will attenuate both the ability and the incentives of shareholders to set corporate financing policies, thus increasing management control (Slovin and Sushka (1993)). Managerial share ownership would also tend to increase

managerial influence on the decision process as would a board of directors "stacked" in favor of management (Stulz (1988), and Weisbach (1988)). On the other hand, when share ownership is highly concentrated in the hands of a few large shareholders, we would expect these shareholders to take an active role in setting financing and dividend policy. Given the results of Brickley, Lease, and Smith (1988), which show that institutional investors exercise a more active role in corporate governance than individual investors, we expect that higher levels of institutional ownership would also indicate greater shareholder control.

The degree of informational asymmetry regarding a firm may be proxied by its size and age (Barclay and Smith (1995)), with younger and smaller firms being those contending with the largest informational asymmetries. Informational asymmetry should also be negatively related to the number of analysts following the firm's stock (Best and Zhang (1993)). Further, rating of a firm's securities by a rating agency would tend to indicate lower informational asymmetry. Research and Development expenditures (Helwege and Liang (1994)) may serve as an additional proxy for informational asymmetry, with higher levels of R&D spending leading to output which is more difficult for outsiders to evaluate and, thus, to higher levels of informational asymmetry.

The magnitude of managerial rents should be proportional to the manager's unique contributions to the firm. This can be proxied by the manager's tenure with the firm, the length of time other members of top management have been together, and the tangibility of the asset base. The longer the manager's tenure and the time top management has served together, ceteris paribus, the greater the opportunity for developing relationship-specific human capital. If one follows the interpretation in Hart and Moore (1994) of intangible assets as assets that are more difficult to replace, then higher levels of asset intangibility will proxy for the magnitude of managerial rents. In the same spirit, high Tobin's Q ratios can serve as indications that managerial human capital accounts for a significant fraction of firm value. A related concept is the collateralizability of the firm's asset base. Since collateral values are usually based on the extra-firm value of the asset rather than the value of the asset in the hands of current management, low collateral value for a firm's asset base may proxy for significant managerial rents. Depreciation charges may proxy for asset collateralizability (Kale, Noe, and Ramírez (1991)) and, thus, low levels of nondebt tax shields relative to earnings may also serve as a proxy for managerial rents. Managerial rents can also be viewed more generally as the component of firm value which is appropriable by the manager (see, e.g., Bolton and Scharfstein (1990, 1993)). These more general interpretations suggest that greater technical complexity of a firm's operations and the resulting difficulty in valuing it, both of which can be proxied by industry groupings such as Standard Industrial Classification (SIC) codes, would tend to be associated with higher managerial rents.

Not surprisingly, few of the hypotheses discussed above have been tested empirically. However, some supporting evidence for our results can be adduced

from existing studies. For example, our analysis demonstrates that the heterogeneity in announcement effects of equity financing and dividend changes may be explained merely by differences in the locus of control in firms (see, for example, Mikkelson and Partch (1986), Aharony and Swary (1980), and Woolridge and Ghosh (1992)). Because asset intangibility may proxy for managerial rents, the positive relationship between leverage and the tangibility of a firm's asset base documented by Long and Malitz (1992) supports our analysis for shareholder-controlled firms. Smith and Watts' (1992) evidence that leverage is negatively related to the level of managerial compensation and positively related to dividend payouts is also consistent with our analysis.[17] Jung, Kim, and Stulz's (1995) documentation of a positive relationship between Q ratios (and thus managerial rents) and the likelihood of equity issuance provides additional support for our analysis. Finally, Kaplan's (1989) examination of the announcement effects of leveraged buyouts, documenting positive earnings surprises, supports our result that high leverage signals firm quality under management control.

VII. Conclusion

In this article we develop a framework that synthesizes the effects of informational asymmetries and managerial opportunism. Our results predict that financial policies in shareholder-controlled firms differ radically from those in management-controlled firms. The reason for this difference is that these two sets of claimants have diametrically opposing objectives in the context of rents divisions. Because debt financing strengthens the shareholders' negotiating position vis a vis the manager, shareholders display a preference for debt financing while managers display an aversion to it. Informational asymmetries alter both managerial and shareholder incentives. To avoid mispricing losses, shareholder-controlled firms reduce their dependence on both outside capital and debt financing. Manager-controlled firms, on the other hand, can achieve the same objectives by increasing their dependence on both debt financing and outside capital.

Appendix

Proof of Lemma 1: Note that in the absence of informational asymmetries, the firm's dividend and financing policies solve the following problem:

$$\underset{(\alpha, F, D)\in\mathcal{F}}{\text{Max}} \quad U_t(\alpha, F, D) \tag{A1}$$

s.t.

$$W_t(\alpha, F) \geq I + D - S.$$

[17] Jung, Kim, and Stulz (1995) obtain similar results on debt ratios and dividend payouts.

The Lagrange associated with the problem (A1) can be expressed as follows:

$$\underset{(\alpha, F, D)\in\mathcal{F}}{\text{Max}} \quad L(\alpha, F, D) \tag{A2}$$

$$= U_t(\alpha, F, D) + \lambda\{W_t(\alpha, F) - I - D + S\}.$$

The partial derivatives for the Lagrange are

$$\frac{\partial L}{\partial D} = (1 - \beta) - \lambda,$$

$$\frac{\partial L}{\partial \alpha} = -[(1 - \beta) - \lambda]P_t(\gamma)(H - F),$$

$$\frac{\partial L}{\partial F} = \lambda P_t(i) - [(1 - \beta)(1 - \alpha) + \lambda\alpha]\, P_t(\gamma).$$

Suppose that there exists a solution to (A2), $(\lambda_t^{FB}, \alpha_t^{FB}, F_t^{FB}, D_t^{FB})$, such that $(1 - \beta) - \lambda_t^{FB} \leq 0$. Note that, if $\lambda_t^{FB} = (1 - \beta)$, then $\partial L/\partial F > 0$. Further, $\partial L/\partial F$ is increasing in λ. Thus, it follows that $F_t^{FB} = H$ whenever $(1 - \beta) - \lambda_t^{FB} \leq 0$. However, this provides the insiders with a payoff of at most $(1 - \beta)S$, contradicting the optimality of $(\lambda_t^{FB}, \alpha_t^{FB}, F_t^{FB}, D_t^{FB})$. Next, consider the case where $(1 - \beta) - \lambda_t^{FB} > 0$. In this instance, from the first order conditions, it follows that $D_t^{FB} = S$, $\alpha_t^{FB} = 0$, and λ_t^{FB} solves

$$\lambda_t^{FB} P_t(i) - [(1 - \beta)(1 - \alpha) + \lambda_t^{FB}\alpha]\, P_t(\gamma) = 0.$$

This, in turn, implies that the capital raising constraint is satisfied with equality, giving us $F_t^{FB} = I/P_t(i)$. Q.E.D.

LEMMA A1: *In any solution to (1), (2) does not bind but (3) must bind.*

Proof of Lemma A1: Consider a problem which is identical to equation (1) except that the type G's nonmimicry constraint (2) is not imposed. For convenience, call this problem (1″). We first show that in any solution of (1″), (3) binds. Then we show that when equation (3) binds, (2) is satisfied. Thus, the solution to (1″) is feasible for (1). As the imposition of an extra constraint can never increase the value of the objective function, this implies that the solution of (1″) always solves (1), i.e., that (2) does not bind.

We show, by means of a contradiction, that equation (3) must bind in any solution to (1″). To see this, suppose that (3) does not bind. Then it must be the case that equation (4) must bind. Thus, $F < H$. Further, because equation (3) is satisfied, it must either be the case that $D < S$ or $\alpha > 0$. Note that, in this case, the first order optimality conditions are the same as that for (A2) (in the proof of Lemma 1). The contradiction follows.

To conclude the proof we show that equation (2) is satisfied whenever (3) binds. To see this, note that because (3) binds,

$$(S - D) + P_B(\gamma)(H - F_B^{FB}) = (1 - \alpha)P_B(\gamma)(H - F).$$

It follows that

$$\begin{aligned}(1 - \alpha)\, P_G(\gamma)(H - F) &= (1 - \alpha)\, P_B(\gamma)(H - F)\frac{P_G(\gamma)}{P_B(\gamma)} \\ &= [(S - D) + P_B(\gamma)(H - F_B^{FB})]\, \frac{P_G(\gamma)}{P_B(\gamma)} \\ &\geq (S - D) + P_B(\gamma)(H - F_B^{FB})\, \frac{P_G(\gamma)}{P_B(\gamma)} \\ &= (S - D) + P_G(\gamma)(H - F_B^{FB}).\end{aligned}$$

Q.E.D.

Lemma A2: Let $NM \equiv \{(\alpha, F, D) | U_B(f_B^{FB}) = U_B(\alpha, F, D)$ *and* $W_G(\alpha, F) \geq I + D - S\}$. *Then* (α^*, F^*, D^*) *is an optimal policy if and only if* $(\alpha^*, F^*, D^*) \in NM$ *and* $D^* = Min\ \{D |\ \exists(\alpha, F)$ *such that* $(\alpha, F, D) \in NM\}$.

Proof of Lemma A2: First, note that from Lemma A1 it follows that equation (3) must bind in any solution to (1). Next note that, $\{D |\ \exists(\alpha, F)$ where $(\alpha, F, D) \in NM\}$ is a compact set, being the projection of the compact set NM onto the D-axis. Thus, the Min $\{D |\ \exists(\alpha, F)$ where $(\alpha, F, D) \in NM\}$ is well defined. First, we show ($\Rightarrow$). Note that, from Lemma A1, for (α^*, F^*, D^*) to solve (1), it must be the case that $(\alpha^*, F^*, D^*) \in NM$. Next, note that, for $(\alpha, F, D) \in NM$, $U_B^{FB} \equiv UB(f_B^{FB}) = U_B(\alpha, F, D) = (1 - \beta)[D + (1 - \alpha)P_B(\gamma)(H - F)]$. This implies that

$$U_G(\alpha, F, D) = (1 - \beta)[D + (1 - \alpha)P_G(\gamma)(H - F)] \tag{A3}$$

$$= (1 - \beta)\left[\frac{P_G(\gamma)}{P_B(\gamma)}\, U_B^{FB} - D\left(\frac{P_G(\gamma)}{P_B(\gamma)} - 1\right)\right].$$

Thus, for (α', F', D') and $(\alpha'', F'', D'') \in NM$, $U_G(\alpha', F', D') > (<)\ U_G(\alpha'', F'', D'')$ if and only if $D' > (<)\ D''$. Next, suppose that $(\alpha^*, F^*, D^*) \in NM$ and $D^* = \text{Min}\ \{D |\ \exists(\alpha, F)$ such that $(\alpha, F, D) \in NM\}$. Then (A3) implies that for all $(\alpha, F, D) \in NM$, $U_G(\alpha^*, F^*, D^*) \geq U_G(\alpha, F, D)$. Again, by Lemma A1, $(\alpha, F, D) \in NM$ if it is optimal. Thus (α^*, F^*, D^*) solves (1). Q.E.D.

Proof of Lemma 2: First, suppose that (α^*, F^*, D^*), such that $\alpha^* > 0$ and $D^* > 0$, is an optimal policy. Note that there exists $K \geq 0$ such that $W_G(\alpha^*, F^*) = I + K + D^* - S$. Next define $\Gamma(\alpha, D)$ as follows:

$$\Gamma(\alpha, D) \equiv W_G(\alpha, F^*) - (I + K + D - S).$$

From the implicit function theorem, it follows that, in the neighborhood of α^* there exists $g(\alpha)$ such that $g(\alpha^*) = D^*$, $\Gamma(\alpha, g(\alpha)) = 0$, and

$$g'(\alpha) = P_G(\gamma)(H - F^*).$$

By differentiating $U_t(\alpha, F^*, g(\alpha))$ with respect to α, it follows that for $\alpha' < \alpha^*$ in the neighborhood of α^*, $U_G(\alpha^*, F^*, g(\alpha^*)) = U_G(\alpha', F^*, g(\alpha'))$ and $U_B(\alpha^*, F^*, g(\alpha^*)) < U_B(\alpha', F^*, g(\alpha'))$. This establishes that by reducing α and D simultaneously, it is possible to strictly satisfy equation (3) while leaving the (4) satisfied. Thus, from Lemma 1, it follows that by increasing F while moving along the capital raising constraint (4), $U_G(\cdot)$ can be increased while leaving equation (3) satisfied. This contradiction establishes the desired result. Q.E.D.

Proof of Proposition 3: Let F^0 be defined as follows:

$$W_G(0, F^0) = (I - S).$$

Then, from equation (5), it follows that $U_B^{FB} > U_B(0, F^0, 0)$. Using arguments similar to those in the proof of Lemma 2, it follows that if $D = 0$, and (4) is satisfied as an equality, (3) is satisfied as a strict inequality. Thus, from Lemma A1, it follows that (α, F, D) such that $D = 0$ is not a solution to (1). Because a solution to equation (1) exists and (4) requires that either $\alpha^* > 0$ or $F^* > 0$, from Lemma 2, it follows that $\alpha^* = 0$, $F^* > 0$, and $D^* > 0$. Q.E.D.

Proof of Proposition 4: If (6) is satisfied, it follows that $U_B^{FB} < U_B(0, F^0, 0)$ for F^0 such that $W_G(0, F^0) = (I - S)$. However, from equation (7) it follows that $U_B^{FB} > U_B(\alpha^0, 0, 0)$ for α^0 such that $W_G(\alpha^0, 0) = (I - S)$. Because the pairs (α, F) that satisfy (4) with equality when $D = 0$ is a connected set, and $U_B(\cdot)$ is continuous, there exists (α^*, F^*) such that (3) is satisfied with equality. From Lemma A2, it follows that, because $D^* = 0$, this policy is an optimal policy. Q.E.D.

Proof of Proposition 5: If equation (8) is satisfied, it follows that $U_B^{FB} < U_B(\alpha^0, 0, 0)$ for α^0 such that $W_G(\alpha^0, 0) = (I - S)$. By increasing α, it is possible to satisfy (3) as an equality while leaving (4) strictly satisfied. Because $D = 0$ and (3) is satisfied as an equality, the result follows directly from Lemma A2. Q.E.D.

Proof of Lemma 6: First, we establish that the capital raising constraint has to be satisfied with equality. The proof of this result is straightforward. Suppose that the capital raising constraint is not satisfied with equality. Then it must be the case that either $\alpha > 0$ or $F > 0$. In either case, by reducing the value of the nonzero variable, the manager can increase his payoff without violating the constraint. This establishes the result.

Given that the capital raising constraint is satisfied with equality,

$$\begin{aligned}
\mathcal{V}_t(\alpha, F, D) &= \beta[D + (1 - \alpha)P_t(\gamma)(H - F)] + [P_t(i) - P_t(\gamma)](H - F) \\
&= \beta[D + P_t(\gamma)(H - F)] + [P_t(i) - P_t(\gamma)](H - F) \\
&\qquad - \beta[\alpha P_t(\gamma)(H - F) + P(i)F - P(i)F] \\
&= \beta[D + P_t(\gamma)(H - F)] + [P_t(i) - P_t(\gamma)](H - F) \\
&\qquad - \beta[I + D - S - P(i)\ F] \\
&= \beta[S + P_t(\gamma)H - I + (P_t(i) - P_t(\gamma))F] \\
&\qquad + [P_t(i) - P_t(\gamma)](H - F) \\
&= \beta[S + P_t(\gamma)H - I] + [P_t(i) - P_t(\gamma)]H \\
&\qquad - (1 - \beta)[P_t(i) - P_t(\gamma)]F.
\end{aligned}$$

Because $\beta < 1$ and $[P_t(i) - P_t(\gamma)] > 0$, this expression is decreasing in F. Further, because the above expression is independent of D, the manager's payoff is independent of D as long as the capital raising constraint is satisfied as an equality. Q.E.D.

Proof of Proposition 7: (i) To see this, note that if the capital raising constraint is satisfied as an equality and type G finances solely with equity,

$$\alpha_G^* = \frac{I + D_G^* - S}{P_G(\gamma)\ H}$$

Further, because $\mathcal{V}_B(f_B^{MFB}) = \beta[S + P_B(\gamma)H - I] + [P_B(i) - P_B(\gamma)]H$, it follows that

$$\begin{aligned}
&\mathcal{V}_B(\alpha_B^*, F_B^*, D_B^*) - \mathcal{V}_B(\alpha_G^*, 0, D_G^*) \\
&= \beta[S + P_B(\gamma)H - I] - \beta\left[D_G^* + \left(1 - \frac{I + D_G^* - S}{P_G(\gamma)\ H}\right)P_B(\gamma)H\right] \\
&= \beta[P_B(\gamma)H - (I - S)] - \beta\left[P_B(\gamma)\ H - (I - S)\frac{P_B(\gamma)}{P_G(\gamma)}\right] - D_G^*\frac{P_G(\gamma) - P_B(\gamma)}{P_G(\gamma)}.
\end{aligned}$$

Because $P_G(\gamma) - P_B(\gamma) > 0$ and $P_B(\gamma)/P_G(\gamma) < 1$, it follows that the above expression is negative and type B's nonmimicry constraint cannot be satisfied.

(ii) Suppose that $P_G(i) = P_G(\gamma)$. Then, from the proof of Lemma 6 it follows that, if the capital raising constraint is satisfied,

$$\mathcal{V}_G(\alpha, F, D) = \beta[S + P_G(\gamma)H - I].$$

This implies that the manager will be indifferent to all financing policies that satisfy the capital raising constraint. Further, if $D_B^* = 0$, $\alpha_B^* = (I - S)/P_B(\gamma)$, $F_B^* = 0$, then

$$\mathcal{V}_B(\alpha_B^*, F_B^*, D_B^*) = \beta[S + P_B(\gamma)H - I] + [P_B(i) - P_B(\gamma)]H.$$

Now, note that $(\alpha_G^*, F_G^*, D_G^*)$ satisfies the capital raising constraint and

$$\mathcal{V}_B(\alpha_B^*, F_B^*, D_B^*) - \mathcal{V}_B(\alpha_G^*, F_G^*, D_G^*)$$

$$= \beta I[P_B(\gamma)/P_G(i)) - 1] + [P_B(i) - P_B(\gamma)]I/P_G(i)$$

$$= \frac{1}{P_G(i)}\left[\frac{P_B(i) - P_B(\gamma)}{P_G(i) - P_B(\gamma)} - \beta\right].$$

It follows, then, that for a sufficiently small β, this expression is positive, and the nonmimicry constraint for type B is satisfied. The nonmimicry constraint for type G is also satisfied because the cost of separation is 0 which follows from the assumption that $P_G(i) = P_G(\gamma)$. Q.E.D.

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