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In defense of defensive measures

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Abstract

We examine how measures that defend incumbent managers against replacement by rival managers affect the information generated in control contests and how this information is used in subsequent investment decisions. We show that commonly used defensive measures allow shareholders to make better investment decisions than they can make absent these measures. Consequently, the adoption of defensive measures can increase shareholders' wealth. We find that good managers are less defended than poor managers and that managers whose interests are closely aligned with those of shareholders (e.g., via options or bonus plans) are less defended and have more control over firm decisions than managers whose interests are not so well aligned with those of shareholders. We also show that the informational role of defensive measures depends on the relative uncertainty about the quality of both parties to a control contest, and relate the predictions to the empirical evidence in the literature.

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1. Introduction

Shareholders' role in contests between managerial teams for the right to manage their firm — *control contests* — is not limited to the final vote for one of

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the teams. Rather, shareholders set the rules of the game by choosing specific corporate bylaws and selecting the rights attached to securities. Often, these rules give an edge to incumbent managers in control contests. We refer to all such actions as *defensive measures*.

Over the years, shareholders have adopted a variety of defensive measures including *golden parachutes*, *super majority* voting rules, multiple classes of shares, and *staggered boards*. [1] The prevalence of defensive measures suggests that shareholders perceive them to be wealth enhancing. However, the evidence on the effect of defensive measures on shareholders' wealth is mixed and difficult to interpret since the adoption of defensive measures may simultaneously signal that management views the firm as a takeover candidate. [2] In this paper, we show that defensive measures that protect incumbent managers against replacement by only slightly better managers (while still allowing replacement by substantially better managers) can benefit shareholders. This is because defensive measures, by discriminating between competing managers, improve the information revealed in control contests about the ability of the winning manager. Shareholders can use this information to improve subsequent decisions, such as the optimal scale of operations.

Models of control contests generally assume either a complete separation of ownership from control (i.e., a firm managed by professional managers on behalf of a diverse body of shareholders) or a complete congruency of interests (i.e., an owner–manager model). Reality, however, rarely fits either extreme form of relation between ownership and control. Shareholders of publicly traded firms, while not involved in daily management, participate in major corporate decisions, such as mergers and raising new capital (Easterbrook and Fischel (1983)). [3] Recently, several factors caused shareholder involvement in corporate governance to increase. First, the dramatic increase in lawsuits against board members has made directors more aware of their accountability to shareholders. Second, new state and federal legislation encourages shareholder activism and better communication among shareholders on voting matters. Lastly, growing institutional ownership of companies fosters close monitoring and control of managements (see e.g.,

[1] Obviously, some of these measure are not adopted solely to protect incumbent managers in control contests. Their role in such contests, however, is the only aspect considered in this paper.

[2] For example, Lambert and Larcker (1985) find a significant positive market reaction to the adoption of golden parachutes, DeAngelo and Rice (1983) find an insignificant negative reaction to announcements of adoption of 'bundles' of defensive measures, while Linn and McConnell (1983) and Agrawal and Mandelker (1990) report an insignificant positive reaction to such announcements.

[3] Shareholders influence such decisions directly by voting in shareholder meetings, staging proxy fights, and filing suits against managers who take undesired decisions. Moreover, since shareholders *can* fight undesired actions, managers and directors take the desired actions even when the threat may ultimately not materialize.

Smith (1996)). Taking all these factors together, shareholder and board activism has grown immensely in importance in recent years.

Shareholders' partial involvement in firm management affects both corporate decisions and performance. The effect of shareholder activism on corporate performance has been the subject of recent research (e.g., Holderness and Sheehan (1991); Gordon and Pound (1991), Gordon and Pound (1993); Mulherin and Poulsen (1995)). In this paper, we evaluate the *informational* role of defensive measures in light of shareholders' involvement in major corporate decisions. [4] In a nutshell, the our argument is as follows. Shareholders often know little about the ability of potential managers. Discrimination against such managers in control contests provides the shareholders more accurate information about the ability of the *winning* manager, information which can be used to improve shareholders' strategic decisions subsequent to the contest. Thus, optimal defensive measures balance the gain in improved subsequent profitability against the loss resulting from the entrenchment of incumbent management. [5]

Our argument has similar elements, albeit in a different context, to Harris and Raviv (1990) where shareholders can learn managers' ability only when the firm defaults and an audit is performed. Shareholders may use this information for subsequent strategic decisions. A key difference between Harris and Raviv's and our analyses is that in our analysis information is endogenously generated whereas in their model information is provided by an audit.

We also examine the optimality of shareholder retaining control over strategic decisions. Delegation of control to managers exposes shareholders to managerial self-serving behavior, in particular to managerial inclination to control more assets than value maximization justifies. [6] On the other hand, we show that shareholders who retain control optimally adopt defensive measures, which entails management entrenchment. We compare the costs of delegation and retaining control over strategic decisions and can characterize the cases in which it is optimal to retain or to delegate control.

The paper is structured as follows. In Section 2 we describe the model. In Section 3 we characterize commonly used defensive measures and provide a simple representation of defensive measures that captures the nature of actual measures. In Section 4 we show how optimally designed defensive measures can benefit shareholders when shareholders retain control over strategic decisions. The

[4] For other aspects of defensive measures see Bagnoli et al. (1989); Berkovitch et al. (1989); Berkovitch and Khanna (1990); Giammarino and Heinkel (1990); Grossman and Hart (1988); Israel (1991, Israel, 1992; Harris and Raviv (1988); Harris (1990); Shleifer and Vishny (1986); Stulz (1988).

[5] The argument does not apply control contests where the winner becomes the sole shareholder since in this case ownership and control are joint and defensive measures have no informational role of the type we suggest.

[6] See, for example, Baumol (1967) and Jensen and Meckling (1976).

optimal assignment of control over strategic decisions is then considered in Section 5. Section 6 examines the effects of multiple sources of information asymmetry on the design of defensive measures. Section 7 reviews the empirical evidence on the informational role of defensive measures and relates them to the predictions of the model. The last section summarizes the paper.

2. The model

We analyze a four-date model of assignment of control over strategic decisions and of selection of defensive measures. We abstract from the specific mechanism by which a winner is determined, an issue already analyzed in other studies. Our analysis, however, is consistent with any protocol in which information about the winner's type is revealed during the contest and the winner cannot completely disregard the shareholders when making future strategic decisions. [7]

We assume that competing managers are characterized by their type, denoted by ϕ. At date 1 the firm is managed by an incumbent manager of known quality, ϕ_i. [8] At date 2, shareholders choose either to delegate to management the choice of investment scale, denoted by I, or to retain control over the scale decision. In both cases management controls the daily operations generating profits that depend on its type. At time 2 shareholders may also adopt a set of defensive measures. At date 3, a rival manager appears whose quality, denoted by ϕ_r, is known only to the rival. Shareholders' prior information about the rival's quality is that it is drawn according to an exponential distribution function with parameter τ. The density function of the rival types is:

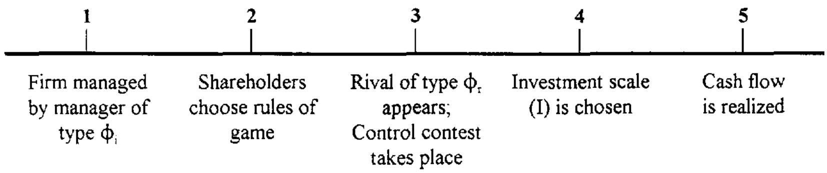
$$f(\phi_r) = \tau e^{-\tau\phi_r}. \tag{1}$$

The ensuing control contest, regardless of its form and protocol, is summarized in our setting by its results: the chosen manager and the information shareholders infer in the process. At date 4 shareholders decide the investment scale of the firm (I) using information revealed in the contest about the winner's quality. Investment profits (π) are realized at date 5. For sake of simplicity, we assume that there is no residual uncertainty between dates 4 and 5 and that the discount rate is zero.

[7] Note that the latter condition is virtually guaranteed whenever the winning manager has less than 100% of the shares by the minority shareholders' ability to sue managers who take unwarranted actions.

[8] Assuming that incumbent quality is known captures the idea that shareholders know more about the incumbent's ability than they know about the ability of the rival. We relax this assumption in Section 6.

The following time line delineates the structure of the model:



We assume that the production function of the firm is of the Cobb–Douglas type

$$Q = I^{1/2}\phi, \tag{2}$$

where Q denotes the quantity produced. Profits equal revenues minus investments:

$$\pi = PI^{1/2}\phi - I, \tag{3}$$

where P denotes the price of a unit output net of marginal production costs. [9]

Shareholders are assumed to be expected profit maximizers. [10] Managers, however, also care about the size of the assets under their control (Baumol (1967); Stulz (1990)). We model the managers' utility as a weighted sum of the firm's profits and the firm's investment:

$$U_j = \pi + \lambda I, \tag{4}$$

where $j = I$, r denotes the manager's identity and $\lambda > 0$ denotes the weight of size relative to profits in the manager's utility. When $\lambda = 0$ the interests of management and shareholders coincide while $\lambda > 0$ represents divergent interests. The size of λ depends on the form of the manager's compensation contract: The more a manager is compensated like a shareholder (e.g., with options or bonus plans) the smaller will λ be.

The inclusion of firm size in the manager's utility means that, under managerial control over investment decisions, managers invest beyond the level justified by profit maximization only. Specifically, the investment level that maximizes profit solves the first-order condition:

$$\pi_I = \tfrac{1}{2}PI^{-1/2}\phi - 1 = 0, \tag{5}$$

$$\Rightarrow \; I_S^* = \tfrac{1}{4}P^2\phi^2. \tag{6}$$

[9] Profits are taken to be net of the manager's compensation. The particular form of managerial compensation is not crucial for our results to follow so long as managers do not receive the entire surplus of their firms.

[10] If managers are risk averse, compensating them with bonuses and options to exert more effort will entail suboptimal risk sharing, an issue we abstract from in the analysis.

On the other hand, if the manager maximizes her own expected utility in selecting the investment level, the first-order condition and its solution will be: [11]

$$U_I = \tfrac{1}{2} P I^{-1/2} \phi - (1-\lambda) = 0. \tag{7}$$

$$\Rightarrow I_M^* = \tfrac{1}{4} P^2 \phi^2 \frac{1}{(1-\lambda)^2} > I_S^*. \tag{8}$$

Instead of delegating control over all investment decisions to managers (and incurring the associated cost of excess investments), shareholders may retain control over the strategic decisions. When shareholders retain control, they base their investment decisions on imprecise information about the manager's ability. Thus, when shareholders retain control, they may use defensive measures to gain additional information before selecting the investment scale.

We proceed by first analyzing optimal defensive plans, investments, and profits when shareholders retain control over the scale decision. In the second stage we analyze the question of assignment of control over the scale decision.

3. A simple representation of common defensive measures

We consider defensive measures that allow rival managers to gain control only if they offer a substantial improvement over incumbent management (e.g., golden parachutes, discount bonds that become due upon a control change, super-majority voting rules). Typically, such measures impose a cost on shareholders when incumbent management is replaced. Clearly, shareholders will replace incumbent management only if they believe that the new management will increase the value of the firm by more than this cost. These measures, therefore, protect incumbent management against replacement by managers that can increase firm value by less than the cost of the defense.

Each of the defensive measures we consider entails a minimal-quality requirement of rival managers who seek to replace incumbent managers. Firms, however, typically adopt several defensive measures rather than a single measure. In such cases, what is relevant for our analysis is the *aggregate* requirement that a package of defensive measures imposes on rival quality, rather than the particular configuration of measures generating this aggregate requirement. This is modeled by partitioning the set of rival types, Φ, into two subsets, Φ_r and Φ_i., where Φ_r is the set of rival types that win and Φ_i is the set of rival types that lose to the incumbent. We call the partition of Φ induced by a set of defensive measures a *defensive plan*. Since a defensive plan determines the winner of the contest as well

[11] Note that, under delegation of control over investments to managers, if $\lambda \geq \frac{1}{2}$ profits will be negative and shareholders will not delegate control. Thus, we analyze delegation only for $\frac{1}{2}\lambda$.

as the information revealed by the contest, different configurations of defensive measures inducing the same defensive plans are, for our purposes, indistinguishable.

Commonly used defensive measures allow shareholders to learn that the winning rival can increase firm value by at least the extent of the defense but they do not learn the exact increase in firm value the new manager offers. In our notation, common defensive measures imply:

$$\Phi_r = \{\phi | \phi \geq K\} \tag{9}$$

for some K, and the set Φ_i is defined as $\Phi - \Phi_r$. While defensive plans may partition Φ into any two arbitrary subsets Φ_i and Φ_r, we can show that:

Proposition 1. An optimal defensive plan is given by some K and:

$$\Phi_r = \{\phi | \phi \geq K\} \tag{10}$$

$$\Phi_i = \{\phi | \phi < K\} \tag{11}$$

For proof: see Appendix A.

The proof shows that any defensive plan not satisfying Eqs. (10) and (11) is first-order stochastically dominated by an alternative defensive plan. Consequently, we consider only defensive plans of this form, which is the form of actual defensive measures. Such defensive plans are equivalent to advantage rules whereby rivals win only if their type exceeds the incumbent type by at least $\beta \equiv K - \phi_i$. β may be negative (i.e., shareholders favor rivals), zero (i.e., shareholders use no defensive measures), or positive. The optimality of a strictly positive β is proven in the next section, where we analyze the role defensive measures play in improving subsequent strategic decisions.

To facilitate an intuitive interpretation of our representation of defensive plans, we illustrate it for supermajority defensive measures. We assume that both the incumbent and rival obtain private benefits of control worth B dollars and that rivals need a fraction $\gamma > \frac{1}{2}$ of the shares to gain control.

Under the incumbent's management, shareholders choose investment level $I(\phi_i)$ and expect profits of $\pi(\phi_i, I(\phi_i))$. Given the incumbent's private benefits of control, the incumbent can offer to pay $(1-\gamma)\pi + B$ for a $(1-\gamma)$ fraction of the firm. This is equivalent to a price per 100% of the firm of:

$$S(\phi_i) \equiv \pi(\cdot) + \frac{B}{1-\gamma} \tag{12}$$

To win, a rival must offer this price (plus a penny). Let K denote the lowest quality rival who can profitably bid $S(\phi_i)$. Hence, when a rival wins, shareholders learn that $\phi_r \geq K$ and choose an investment level, denoted by I_K, that maximizes the expected profits conditional on $\phi_r \geq K$. The posterior probability of the rival's type conditional on it being at least K is:

$$f(\phi_r | \phi_r \geq K) = \tau e^{-\tau(\phi_r - K)}. \tag{13}$$

and the expected profits, $E(\pi_r | \phi_r \geq K)$, are given by:

$$E(\pi | \phi_r \geq K) = \int_K^{\infty} P I^{1/2} \phi_r \tau e^{-\tau(\phi_r - K)} \, d\phi_r - I = P I^{1/2} (K + 1/\tau) - I. \tag{14}$$

The optimal investment is determined by the maximization of $E(\pi | \phi_r \geq K)$ with respect to I:

$$I_K = \tfrac{1}{4} P^2 (K + 1/\tau)^2. \tag{15}$$

Given I_K, a rival of type ϕ_r can profitably bid $S(\phi_i)$ for the firm only if:

$$\gamma \pi(\phi_r, I_K) + B \geq \gamma S(\phi_i). \tag{16}$$

Substituting for I_k we get that $\pi(\phi_r, I_K)$ equals

$$\pi(\phi_r, I_K) = P I_K^{1/2} \phi_r - I_K = \tfrac{1}{2} P^2 (K + 1/\tau) \phi_r - \tfrac{1}{4} P^2 (K + 1/\tau)^2. \tag{17}$$

Substituting for $S(\phi_i)$ and simplifying we obtain:

$$\pi(\phi_r, I_K) - \pi(\phi_i, I_i) \geq B \left[\frac{1}{1-\gamma} - \frac{1}{\gamma} \right]. \tag{18}$$

Rationality of expectation implies that Eq. (18) holds as an equality for a rival of type $\phi_r = K$. Substituting for $\pi(\phi_r, I_K | \phi_r = K)$ yields an equation that translates selections of γ's to equivalent K's:

$$\tfrac{1}{4} P^2 \left(K^2 - \frac{1}{\tau^2} \right) = B \left(\frac{1}{1-\gamma} - \frac{1}{\gamma} \right) + \pi(\phi_i, I_i), \tag{19}$$

which implies the monotone mapping of γ's to K's:

$$\frac{\partial K}{\partial \gamma} = \frac{2B}{P^2 K} \left[\frac{1}{(1-\gamma)^2} + \frac{1}{\gamma^2} \right] > 0. \tag{20}$$

Similar monotone representations can be obtained for other defensive measures and for other control contest protocols. K is, therefore, a generic representation of various defensive measures. The example demonstrates the great simplification obtained by summarizing control contest protocols and defensive measures by the partition of the set of rival types they entail while preserving the nature of actual defensive measures.

4. Optimal defensive plans

We approach the shareholder optimization problem recursively. We begin by assuming that at time 2 shareholders chose to retain control over the investment decision and consider the optimal defensive measures to adopt in this case. In the next section we examine whether delegation of control over the investment decision dominates the retention of control, or vice versa.

When the incumbent wins the contest, the manager's quality is known to be ϕ_i and the shareholders invest I_i to maximizes $\pi(\phi_i, I)$. When the rival wins, shareholders know only that

$$\phi_r \geq K = \phi_i + \beta. \tag{21}$$

Given β, the shareholders choose an investment level to maximize expected profits:

$$\max_I E[\pi(\phi_r, I)|\phi_r \geq \phi_i + \beta] = \int_{\phi_i+\beta}^{\infty} \pi(\phi, I) f(\phi)\,\mathrm{d}\phi. \tag{22}$$

The optimal investment conditional on $\phi_r \geq K$, denoted I_K, uniquely solves the first-order condition:

$$\frac{\partial E[\pi(\cdot)|\phi_r \geq \phi_i + \beta]}{\partial I} = \int_{\phi_i+\beta}^{\infty} \pi_I(\phi, I_K) f(\phi)\,\mathrm{d}\phi = 0, \tag{23}$$

where $\pi_I(\cdot)$ is the partial derivative of the profit function with respect to the investment level.

Given a defensive plan of level β, there is a time-3 probability of $[1 - F(\phi_i + \beta)]$ that a rival of quality of at least $(\phi_i + \beta)$ will appear and replace the incumbent and a probability of $F(\phi_i + \beta)$ that the incumbent will not be replaced. Based on these probabilities and the optimal respective investments, the shareholders choose at time 2 a defensive plan to maximize expected (time-5) profits:

$$\max_\beta E(\pi) = \pi(\phi_i, I_i) F(\phi_i + \beta) + \int_{\phi_i+\beta}^{\infty} \pi(\phi, I_K) f(\phi)\,\mathrm{d}\phi. \tag{24}$$

We now can prove our main result:

Proposition 2. When shareholders retain control over the investment decision, the optimal protection of incumbent managers, β, is strictly positive.

For proof: see Appendix A.

Proposition 2 shows that by protecting some incumbent managers shareholders increase their wealth relative to using no defensive measures. Intuitively, defending incumbent managers entails a cost that is incurred with a small probability but improves investments for a lot of rivals. The optimal defense balances the gain resulting from improved subsequent investment decisions and the loss due to the entrenchment of some incumbent managers.

In Appendix A we prove proposition 2 for general production and distribution functions. For the production and distribution functions given in Eqs. (1) and (2), the optimal β can be derived as follows. Expected date-3 profits are derived by integrating conditional profits over possible rival types when the incumbent wins and when the rival wins. Simplifying, we get

$$E(\pi) = \tfrac{1}{4}P^2\phi_i^2 + \tfrac{1}{4}P^2\left[\beta^2 + \frac{1}{\tau^2} + 2\phi_i\beta + 2(\phi_i + \beta)\frac{1}{\tau}\right]e^{-\tau(\phi_i+\beta)}. \tag{25}$$

The first-order condition for the date-2 maximization of $E(\pi)$ with respect to β is

$$\tau\beta^2 + 2\phi_i\beta\tau - \frac{1}{\tau} = 0. \tag{26}$$

Using the second-order condition, it can be easily verified that the positive root of this quadratic equation is the maximum while the negative root is the minimum, for any $\phi_i \geq 0$, $\tau > 0$. Hence:

$$\beta^* = \sqrt{\phi_i^2 + \frac{1}{\tau^2}} - \phi_i > 0. \tag{27}$$

Differentiating the closed-form solution for the optimal β we can show that:

Proposition 3. The degree of optimal defense is diminishing in the incumbent quality.

Intuitively, as the type of the incumbent increases, additional information on the type of the winner becomes less valuable to warrant as much protection as when the incumbent's quality is low. Thus, we expect that, ceteris paribus, good managers (manifested by better-than-average profit margins, returns on assets, etc.) will be less defended than poor managers.

5. Delegation versus retention of control over investment decisions

In this section we compare the cost of shareholders retaining control over investment decisions despite having imperfect information about manager types to the cost of delegating control to managers who prefer too large investments. In the previous section we showed that when shareholders retain control defensive measures improve subsequent investment decisions. When investment decisions are delegated to management, shareholders have no use for the additional information obtained by defending incumbent managers, and so they set $\beta^* = 0$.

The profits of the firm under delegation, denoted by π_D, are obtained by substituting the optimal investment level under delegation from Eq. (8) into the profit function: [12]

$$\pi_D(\phi_j) = \frac{1}{4}\left[1 - \frac{\lambda^2}{(1-\lambda)^2}\right]P^2\phi_j^2 \quad j = \{i, r\}. \tag{28}$$

[12] Again, note that $\pi_D(\phi) > 0$ iff $0 < \lambda < \frac{1}{2}$.

Under delegation of control over the investment decision to management, shareholders set $\beta = 0$ and, parallel to Eq. (24), expected profits are

$$E(\pi_D) = \pi_D(\phi_i, I_M)F(\phi_i) + \int_{\phi_i}^{\infty} \pi_D(\phi, I_M)f(\phi)\,d\phi \tag{29}$$

where the investment selected by the manager, I_M, replaces I_K inside the integration operator. Let

$$\Lambda \equiv 1 - \frac{\lambda^2}{(1-\lambda)^2}. \tag{30}$$

Then, Eq. (29) becomes

$$E(\pi_D) = \frac{1}{4}\Lambda P^2\phi_i^2 + \frac{1}{2\tau}\Lambda P^2\left(\phi_i + \frac{1}{\tau}\right)e^{-\tau\phi_i}. \tag{31}$$

On the other hand, if the shareholders retain control over the scale decision, the expected profits, denoted by $E(\pi_R)$, are obtained by substituting the β from Eq. (27) into Eq. (25):

$$E(\pi_R) = \frac{1}{4}P^2\phi_i^2 + \frac{1}{2\tau}P^2\left[\frac{1}{\tau} + \left(\phi_i^2 + \frac{1}{\tau^2}\right)^{1/2}\right]e^{-\tau(\phi_i^2 + 1/\tau^2)^{1/2}}. \tag{32}$$

Shareholders choose to retain control over the investment decision if $E(\pi_R) > E(\pi_D)$ and to delegate control otherwise. Comparing Eqs. (31) and (32), we find that whether retaining control (and using defensive measures) or delegating control is optimal depends on the values of λ and ϕ_i:

Proposition 4. There is a cutoff value of λ, denoted by λ^* $(0 < \lambda^* < \frac{1}{2})$, such that it is optimal to retain control for all $\lambda > \lambda^*$ and to delegate control otherwise.

For proof: see Appendix A.

Proposition 4 establishes that for relatively low values of λ shareholders should delegate control to managers. This is because for small λ's the interests of shareholders and managers are almost aligned. For high λ's the interests of shareholders and management diverge so much that it is optimal for shareholders to retain control over strategic decisions and employ defensive measures.

Next we relate the quality of present management to the use of defensive measures:

Proposition 5. There is a cut-off value ϕ such that shareholders optimally retain control (and install defensive measures) for all $\phi_i < \phi$ and delegate control to managers otherwise.

For proof: see Appendix A.

The intuition for this result is as follows. Inferior incumbents can be replaced by many rivals. Hence, shareholders have less accurate information about rivals who replace inferior incumbents making the information generated by defensive measures valuable. Thus, shareholders prefer to retain control and use defensive measures when incumbent quality is low. Proposition 5 implies an inverse relation between management quality, as proxied for example by return on assets or gross margins (relative to other firms in the industry), and observed use of defensive measures: good incumbent managers should be less protected by defensive measures than poor incumbent managers.

6. Dual informational asymmetry

In this section we relax the assumption that the incumbent type, ϕ_i, is known and allow the types of both the incumbent and the rival to be unknown. Specifically, we assume that both types are exponentially distributed with parameters τ_i and τ_r, respectively, and that the incumbent is known to be of at least type $L \geq 0$ (i.e., L is a lower bound on the possible values of ϕ_i). [13]

We examine defensive plans optimally used by shareholders assuming they opt to retain control over strategic decisions (i.e., assuming that λ is large). Consider first the investment decision at date 4. For a manager's type that is exponentially distributed with a parameter τ_j and some lower bound, denoted by M, the expected profit for manager of type $j =$ i, r is:

$$E\left[\pi_j(M, \phi_j)\right] = \int_M^{\infty} PI^{1/2}\phi\tau_j e^{-\tau_j(\phi - M)}\, d\phi - I = PI^{1/2}\left(M + \frac{1}{\tau_j}\right) - I \tag{33}$$

Note that M and τ_j depend on who wins the control contest and on the information about the winner revealed in the bidding process. Therefore, in taking expectations of the conditional profits we distinguish three cases. In the first, the rival wins the contest, which happens if $\phi_r > \phi_i + \beta$. In the second, the incumbent wins: $L + \beta \leq \phi_r \leq \phi_i + \beta$. The third case is one of no contest at all: $\phi_r < L + \beta$. In the last case there is no informational gain to shareholders. In contrast, when a control contest takes place (i.e., in the first two cases) investors learn the *exact* quality of the *losing* contestant. Using the information revealed about the *loser's* type they update their beliefs about the distribution of the *winner's* type. For example, in the second case, even though the takeover attempt fails, shareholders generate new information pertaining to the quality of the incumbent (i.e., $\phi_i > \phi_r - \beta > L$).

[13] We retain the simple structure afforded by a fixed β. Under dual information asymmetry certain defensive measures (e.g., super-majority voting rules) imply β's that increase in incumbent quality. We abstract from this added complexity since it does not affect the intuition of our results.

The expected profit of the firm prior to the control contest is the double integral over all incumbent and rival types. Using Eq. (33) we get:

$$E[\pi(\phi_i)] = \int_{\phi_i+\beta}^{\infty} \pi_r(M=\phi_i+\beta,\ \phi_r) f(\phi_r)\,d\phi_r + \int_{L+\beta}^{\phi_i+\beta} \pi_i(M=\phi_r-\beta,\ \phi_i) f(\phi_r)\,d\phi_r + \int_{0}^{L+\beta} \pi_i(M=L,\ \phi_i) f(\phi_r)\,d\phi_r. \tag{34}$$

In Appendix A we prove that Eq. (34) becomes:

$$E[\pi(\phi_i)] = \tfrac{1}{2}P^2\frac{1}{\tau_r}\left[\phi_i - \left(\frac{1}{\tau_i}+\frac{1}{\tau_r}\right) - L\right]e^{-\tau_r(\beta+L)} + \frac{1}{4}P^2\left[\beta^2 + 2\phi_i\beta + 3\frac{1}{\tau_r^2} + 2\phi_i\frac{1}{\tau_r} + 2\beta\frac{1}{\tau_r} + \frac{1}{\tau_i^2} + 2\frac{1}{\tau_i}\frac{1}{\tau_r}\right] \times e^{-\tau_r(\phi_i+\beta)} + \frac{1}{4}P^2\left(L+\frac{1}{\tau_i}\right)\left[2\phi_i - L - \frac{1}{\tau_i}\right]. \tag{35}$$

Integrating Eq. (35) over ϕ_i we get the expected profit of the firm prior to the contest:

$$E(\pi) = \frac{1}{4}P^2 e^{-\tau_r(\beta+L)}\left\langle -2\frac{1}{\tau_r^2} + \frac{\tau_i}{(\tau_i+\tau_r)}\left[\beta^2 + 3\frac{1}{\tau_r^2} + 2\beta\frac{1}{\tau_r} + \frac{1}{\tau_i^2} + 2\frac{1}{\tau_i}\frac{1}{\tau_r} + 2\left(\beta+\frac{1}{\tau_r}\right)\left(L+\frac{1}{(\tau_i+\tau_r)}\right)\right]\right\rangle + \frac{1}{4}P^2\left(L+\frac{1}{\tau_i}\right)^2. \tag{36}$$

The profit-maximizing β satisfies the following first-order condition:

$$2\frac{(\tau_i+\tau_r)}{\tau_i\tau_r} = \beta^2\tau_r + \frac{1}{\tau_r} + \frac{\tau_r}{\tau_i^2} + 2\frac{1}{\tau_i} + 2\beta\tau_r L + 2\beta\tau_r\frac{1}{(\tau_i+\tau_r)}. \tag{37}$$

Proposition 6 follows immediately:

Proposition 6. The optimal protection of incumbent managers under dual information asymmetry is:

$$\beta^* = \left[\left(L+\frac{1}{(\tau_i+\tau_r)}\right)^2 + \frac{1}{\tau_r^2} - \frac{1}{\tau_i^2}\right]^{1/2} - \left(L+\frac{1}{(\tau_i+\tau_r)}\right). \tag{38}$$

From which it follows that

Proposition 7.

$$\beta^* \gtreqless 0 \quad \text{iff } \tau_i \gtreqless \tau_r$$

Proof. Let $T \equiv L + 1/(\tau_i + \tau_r)$. Suppose $\tau_i > \tau_r$, then $1/\tau_r^2 - 1/\tau_i^2 > 0$ and so

$$\left[T^2 + \frac{1}{\tau_r^2} - \frac{1}{\tau_i^2}\right]^{1/2} > T,$$

implying $\beta^* > 0$. An opposite result is obtained for $\tau_i < \tau_r$. □

Proposition 7 underscores the model's economic rationale for setting defensive measures. The larger is τ, the tighter is the exponential distribution. For the plausible situation of $\tau_i > \tau_r$, where more information is available on incumbents than on rivals, a positive β^* is optimal. If, on the other hand, information is symmetric (i.e., $\tau_i = \tau_r$), it will be optimal not to tilt the control contest in favor of any party, as there is no informational gain in this case to offset the loss of efficiency. Finally, if shareholders know more about the quality of the rival than about the quality of the incumbent, it will be optimal to favor rival managers by designing 'raiding-inviting' measures.

Lastly, by taking the derivative of β^* with respect to L we get:

Proposition 8. The optimal defense level increases (decreases) with the minimal value of the quality of the incumbent if τ_i is smaller (larger) than τ_r.

Hence, when the incumbent is better known ($\tau_i > \tau_r$), the better is his expected type (captured by a higher L), the *less* protection is optimal to provide him with. This is because the informational gain becomes smaller as L gets larger, causing the loss of efficiency to weigh relatively more.

Propositions 6, 7, and 8 suggest certain dynamic and cross-sectional properties of defensive measures. Specifically, since shareholders' knowledge of their managers increases with the managers' tenure, the propositions imply that the extent to which incumbent managers are defended increases with time. They also imply a positive cross-sectional correlation between management tenure and the extent to which management is defended.

7. Empirical implications

In this section we relate the implications of the model to the empirical evidence on corporate control and defensive measures.

Propositions 1 and 2 suggest that the replacement of incumbent managers by outside managers should be associated with an increase in firm value. This is consistent with findings (e.g., Reinganum, 1985) that replacement of incumbent managers by outside managers results in a higher abnormal returns than replacement by insiders. This is also consistent with the finding that higher premiums are paid in acquisitions of defended firms than in acquisitions of undefended firms. (e.g., Machlin et al. (1993) show that a $1 golden parachute increases acquisition premiums by $10; Comment and Schwert (1995) show that, controlling for other potential determinants of acquisition premiums, firms with poison pills are acquired for larger premiums than undefended firms.) The evidence of premiums of takeovers, besides being consistent with our prediction, is also consistent with the hypothesis that anti-takeover measures improve the bargaining position of target firms. An analysis of the *aggregate* returns to bidders and targets (defended and undefended) can potentially distinguish between these two hypotheses. [14]

Proposition 4 suggests that managers whose interests are well aligned with shareholder interests should be less protected than managers whose objectives are less aligned with shareholders. Singh and Harianto (1989a,Singh and Harianto, 1989b) examine the correlation between the size of golden parachutes awarded to top managers and managerial stock ownership and find ambiguous and insignificant results. However, a more direct test of our model would be to examine whether the use of performance-based compensation is negatively correlated with the degree of defensive measures employed.

While some of our model's predictions may also be consistent with alternative explanations for the use of defensive measures, by focusing on the informational role of defensive measures we derive a unique *information-motivated* prediction. Propositions 7 and 8 show that, *ceteris paribus*, the more shareholders know about the incumbent manager, the more they protect the incumbent with defensive measures. Several empirical studies provide evidence in support of the informational role of defensive measures. Singh and Harianto (1989a,Singh and Harianto, 1989b) examine the determinants of the use of golden parachutes and show that, controlling for other variables, golden parachutes of relatively known managers are larger than those of relatively unknown managers. Specifically, they show that managers with relatively long tenure with the firm (i.e., managers whose ability is better known to shareholders) receive larger golden parachutes than short-tenure managers. More importantly, they show that golden parachutes are more prevalent among firms with higher proportion of outside directors. Thus, managers whose quality is better known to outsiders get larger golden parachutes than relatively unknown managers. In another study, Knoeber (1986) tested the relation between company characteristics and the use of golden parachutes and shark repellents. He reports that stock return variability and advertisement and research expenditures are positively correlated with the incidence of defensive measures. Since high advertisement and research expenditures create company-specific know-how, con-

[14] For related evidence, see Nathan and O'Keefe (1989).

sistent with proposition 7 and 8, Knoeber's findings are consistent with the proposition that defensive measures have a higher informational role in companies with a relatively high level of intangible assets and company-specific knowledge.

8. Concluding remarks

In this paper we examine how measures that defend incumbent managers against replacement by rival managers affect the information generated in control contests and how this information is used in subsequent investment decisions. We show that commonly used defensive measures resemble in their form the optimal design of quality-based defensive measures and allow shareholders to make better subsequent investment decisions. Consequently, adoption of defensive measures can increase shareholders' wealth. The optimal level of defense balances the cost of management entrenchment with the benefit of improved investment decisions, leading to increased expected profit.

Shareholders, rather than taking investment decisions themselves using imperfect information, may delegate control to managers. Such delegation, however, entails agency costs. We show that when shareholder and management interests do not diverge materially, delegation of control is optimal and defensive measures are not needed, whereas when their interests diverge materially, shareholders optimally retain control and employ defensive measures.

The informational role of defensive measures depends on the relative uncertainty about the quality of both parties to a control contest. We show that shareholders should optimally protect the manager about whose quality they are more informed – typically, the incumbent manager whose performance they have already observed.

Our analysis leads to several testable hypothesis. First, our analysis suggests that the post-control-contest improvement in the performance of the firm (measured, for example, by the change in return on assets) is larger when the incumbent managers were protected by defensive measures than when they were not. Second, our results imply that good managers are optimally delegated more authority over strategic decisions and are less protected by defensive measures than poor managers. Third, the use of defensive measures should be negatively correlated to the extent to which management compensation is tied to firm performance. Lastly, our analysis implies that the more shareholders know about management ability, the more they defend the management against rivals of less known ability. This implies, for example, a positive correlation between managers' tenure and the degree to which they are protected by defensive measures.

In our model, control over strategic issues is allocated either to shareholders or to managers. Further analysis of the allocation of control over strategic issues may examine defensive measures under various degrees of delegation of control or for different types of decisions that differ in the prevalence of information asymmetry.

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Appendix A

Proof of proposition 1. Consider a defensive plan not satisfying Eqs. (10) and (11) Then, there exist intervals

$$T_{\mathrm{h}} \equiv [\phi_1, \phi_2] \subset \Phi_{\mathrm{i}}, \qquad T_{\mathrm{l}} \equiv [\phi_3, \phi_4] \subset \Phi_{\mathrm{r}}$$

such that:

$$\phi_3 < \phi_4 \le \phi_1 < \phi_2$$

Since the density function is continuous on Φ, we can replace either the subset T_{l} or the subset T_{h} (whichever set is of larger probability) by a proper subset of it, to make T_{l} and T_{h} of equal probability. The original defensive plan is first-order stochastically dominates by a plan that switches the sets T_{l} and T_{h}:

$$\hat{\Phi}_{\mathrm{r}} = (\Phi_{\mathrm{r}} - T_{\mathrm{l}}) \cup T_{\mathrm{h}}, \qquad \hat{\Phi}_{\mathrm{i}} = (\Phi_{\mathrm{i}} - T_{\mathrm{h}}) \cup T_{\mathrm{l}}$$

To show first-order stochastic dominance we compare profits under the two defensive plans in four subsets of Φ: $(\Phi_{\mathrm{r}} - T_{\mathrm{l}})$, $(\Phi_{\mathrm{i}} - T_{\mathrm{h}})$, T_{l}, and T_{h}. Suppose first that shareholders choose the same investments under the both plans: I_{r} if the rival wins and I_{i} if the incumbent wins. Then, under both plans there are equal investments and profits for all rival types in $(\Phi_{\mathrm{r}} - T_{\mathrm{l}})$ and $(\Phi_{\mathrm{i}} - T_{\mathrm{h}})$. Under the original plan, rival types in T_{h} lose to the incumbent while under the revised plan this happens in T_{l}. Therefore, investment and profits in T_{h} under the original plan equal investment and profits in T_{l} under the revised plan. Lastly, under the original plan rival types in T_{l} win while under the revised plan rivals in T_{h} win. Hence, profits in the two equally likely subsets are:

$$\pi(\phi_{\mathrm{r}}, I_{\mathrm{r}} | \phi_{\mathrm{r}} \in T_{\mathrm{l}} \subset \Phi_{\mathrm{r}}) < \pi\left(\phi_{\mathrm{r}}, I_{\mathrm{r}} | \phi_{\mathrm{r}} \in T_{\mathrm{h}} \subset \hat{\Phi}_{\mathrm{r}}\right)$$

where the inequality follows from the substitution of a lower quality winning rivals in the original plan by better quality rivals in the modified plan and the fact that profits increase in manager's quality. Since profits under the modified defensive plan first-order stochastically dominate profits under the original plan when investments are not necessarily optimal, the revised plan will dominate the original plan when investments are optimized. □

Proof of proposition 2. From Eq. (24), the first order condition (F.O.C.) for β is:

$$\frac{\partial E(\pi)}{\partial \beta} = \pi(\phi_i, I_i) f(\phi_i + \beta) - \pi(\phi_i + \beta) f(\phi_i + \beta))$$

$$+ \int_{\phi_i + \beta}^{\infty} \pi_I(\phi, I_r) \frac{\partial I_r}{\partial \beta} f(\phi)\, d\phi = 0.$$

Since ϕ_r is unknown at time 2, $\partial I_r / \partial \beta$ is independent of ϕ_r and can be taken out of the integral. Furthermore, the integral term is zero by the F.O.C. for I_r. Hence, the F.O.C. simplifies to:

$$\frac{\partial E(\pi)}{\partial \beta} = \left[\pi(\phi_i, I_i) - \pi(\phi_i + \beta, I_r)\right] f(\phi_i + \beta) = 0.$$

We prove that the optimal β is positive by a contradiction. Given our assumptions that the I that maximizes $\pi(\phi, \cdot)$, denoted by $\hat{I}$, increases with manager quality, it is easy to show that for all β, $I_r > \hat{I}(\phi_i + \beta)$. Therefore, for $\beta = 0$,

$$\left[\pi(\phi_i, I_i) - \pi(\phi_i, I_r)\right] f(\phi_i + \beta) > 0,$$

so that $\beta = 0$ cannot satisfy the F.O.C.. For $\beta < 0$,

$$\pi\left[\phi_i + \beta, \hat{I}(\phi_i + \beta)\right] > \pi(\phi_i + \beta, I_r).$$

Since $\pi_\phi > 0$, using the envelope theorem, we get for a negative β that

$$\pi(\phi_i, I_i) \equiv \pi\left[\phi_i, \hat{I}(\phi_i)\right] > \pi\left[\phi_i + \beta, \hat{I}(\phi_i + \beta)\right].$$

Therefore, for $\beta < 0$,

$$\left[\pi(\phi_i, I_i) - \pi(\phi_i + \beta, I_r)\right] f(\phi_i + \beta) > 0,$$

so the solution to the F.O.C. cannot be negative.

Note that the second derivative of $E(\pi)$ with respect to β for a β satisfying the F.O.C. is

$$\frac{\partial^2 E(\pi)}{\partial \beta^2} = -\pi_\phi(\phi_i + \beta, I_r) f(\phi_I + \beta) - \pi_I(\phi_i + \beta, I_r) f(\phi_I + \beta) \frac{\partial I_r}{\partial \beta},$$

which may be positive if $\partial I_r / \partial \beta$ is sufficiently positive. In this case the optimal extent of defense granted to the incumbent is unbounded. □

Proof of proposition 4. Consider first the polar case $\lambda = \frac{1}{2}$. In this case $\Lambda = 0$, which means that $E(\pi_D) = 0$ and that it is optimal to retain the scale decision for any value of ϕ_i. At the other extreme, if $\lambda = 0$ (i.e., $\Lambda = 1$), comparing Eqs. (31) and (32) and using Eq. (27) we obtain that it is optimal to delegate control if

$$\left(\phi_i + \frac{1}{\tau}\right) > \left(\phi_i + \frac{1}{\tau} + \beta_i\right) e^{-\tau \beta_i}.$$

The right side of the inequality has a maximum for $\beta_i = -\phi_i$ and is monotonically decreasing for larger β_i's. Since the two sides of the expression are equal for $\beta = 0$, the inequality holds for all $\beta_i > 0$. Therefore, it is optimal to delegate control when shareholders' and management's interests coincide, i.e., $\lambda = 0$.

Finally, since $E(\pi_D)$ continuously increases in Λ and since

$$E(\pi_D | \Lambda = 1) > E(\pi_R | \Lambda = 1)$$

and

$$E(\pi_D | \Lambda = 0) < E(\pi_R | \Lambda = 0),$$

then there is a value $0 < \Lambda^* < 1$ such that $E(\pi_D | \Lambda = \Lambda^*) = E(\pi_R | \Lambda = \Lambda^*)$. Since Λ is a monotonic transformation of λ, Λ^* corresponds to a unique λ^* in the region $0 < \lambda\frac{1}{2}$. □

Proof of proposition 5. Let

$$A_1 = \phi_i^2 + \frac{2}{\tau}\left(\phi_i + \frac{1}{\tau}\right)e^{-\tau\phi_i},$$

$$A_2 = \phi_i^2 + \frac{2}{\tau}\left[\frac{1}{\tau} + \left(\phi_i^2 + \frac{1}{\tau^2}\right)^{1/2}\right]e^{\tau(\phi_i^2 + 1/\tau^2)^{1/2}}$$

By Eqs. (31) and (32), the interior Λ^* from proposition 4 solves

$$\Lambda^* A_1 = A_2$$

Thus

$$\frac{d\Lambda^*}{d\phi_i} = \left(\frac{\partial A_2}{\partial \phi_i} - \Lambda^* \frac{\partial A_1}{\partial \phi_i}\right) / A_1$$

$$= \frac{2\phi_i}{A_1}\left[\left(1 - e^{-\tau(\phi_i^2 + 1/\tau^2)^{1/2}}\right) - \Lambda^*\left(1 - e^{-\tau\phi_i}\right)\right] > 0.$$

Noticing that Λ^* declines in λ^* completes the proof. □

Derivation of Eq. (35). Taking the partial expectation in the region $\phi_r > \phi_i + \beta$:

$$\pi_1 = \int_{\phi_i + \beta}^{\infty} \pi_r(M = \phi_i + \beta, \phi_r)\tau_r e^{-\tau_r\phi_r} d\phi_r$$

$$= \tfrac{1}{4}P^2\left(\phi_i + \beta + \frac{1}{\tau_r}\right)^2 e^{-\tau_r(\phi_i + \beta)}.$$

The partial expectation in the second region, $L+\beta \leq \phi_r \leq \phi_i + \beta$ is:

$$\pi_2 = \int_{L+\beta}^{\phi_i+\beta} \pi_i(M = \phi_r - \beta,\ \phi_i)\tau_r e^{-\tau_r\phi_r}\,d\phi_r$$

$$= \int_{L+\beta}^{\phi_i+\beta} \tfrac{1}{4}P^2\left(\phi_r - \beta + \frac{1}{\tau_i}\right)\left[2\phi_i - \left(\phi_r - \beta + \frac{1}{\tau_i}\right)\right]\tau_r e^{-\tau_r\phi_r}\,d\phi_r.$$

After tedious algebraic computations π_2 becomes

$$\pi_2 = \frac{1}{4}P^2 e^{\tau_r(\beta+L)}\left[\left(2L + \frac{1}{\tau_r} + \frac{1}{\tau_i}\right)\left(\phi_i - \frac{1}{\tau_r} - \frac{1}{\tau_i} - L^2 - \frac{1}{\tau_r^2}\right.\right.$$

$$\left.\left. + \phi_i\left(\frac{1}{\tau_r} + \frac{1}{\tau_i}\right)\right] + \frac{1}{4}P^2 e^{-\tau_r(\phi_i+\beta)}\left[\left(\frac{1}{\tau_i} + \frac{1}{\tau_r}\right)^2 - \phi_i^2 + \frac{1}{\tau_r^2}\right].$$

For the third region, $\phi_r < L + \beta$:

$$\pi_3 = \int_0^{L+\beta} \pi_i(M = L,\ \phi_i)\tau_r e^{-\tau_r\phi_r}\,d\phi_r$$

$$= \tfrac{1}{4}P^2\left(L + \frac{1}{\tau_i}\right)\left[2\phi_i - L - \frac{1}{\tau_i}\right]\left[1 - e^{-\tau_r(\beta+L)}\right]$$

Summing $\pi_1 + \pi_2 + \pi_3$ and simplifying leads to Eq. (35).

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