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Resolution Preference and Project Choice

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Abstract

Resolution Preference and Project Choice

A manager who is concerned with outsider's perceptions of himself or his firm will be sensitive to the timing of resolution of uncertainty about the firm's projects. While a high ability manager tries to advance resolution of a likely-favorable outcome, a low manager may defer resolution, hoping to be mistaken for a high ability manager forced into late resolution by external circumstances. This suggests that managers who demand protection from takeovers to focus on long-term goals are frequently incompetent.

In contrast with previous models, we show that resolution preference can cause a bias toward late cash flows ("hyperopia") as well as early cash flows ("myopia"). A high ability manager may accelerate resolution through R&D, even if this reduces net present value. Nevertheless, since early resolution is preferred by high quality managers or firms, higher R&D can be good news for investors. Thus, reputational concerns will sometimes cause *excessive* innovative expenditures. Resolution-advancing decisions are more favored when they are visible to outsiders. The model provides some new empirical predictions, and offers an explanation for some evidence that is inconsistent with previous models of managerial time horizons. It also suggests that in general there may be a bias toward direct product development over basic research activity. Perhaps more importantly, there is a perverse sorting of high ability managers to conventional R&D projects and low ability managers to more visionary projects.

"Even a fool, when he holdeth his peace, is counted wise."
—*Proverbs* 17:28

1 Introduction

The quotation prefacing this text can be regarded as a biblical directive for managerial policy. A wise manager, one whose investments are usually successful, can afford an early public resolution of the outcome of his decisions; a foolish manager, one whose projects frequently fail, is better advised to "hold his peace" by choosing projects whose outcome will remain in doubt for a longer period.

There is a problem with this directive, however. A more sophisticated analysis suggests that a manager's choice of a late-resolving project will itself be taken as an adverse signal of quality. However, so long as there is some noise in the timing of information arrival, we will show that the naive view retains a degree of validity. There will thus be a balance between the incentives of good and bad managers to seek early or late resolution. Since advancing or deferring resolution will affect the timing of cash flows, a bias toward early or late public revelation (resolution preference) indirectly leads to a bias toward early or late cash flows— "myopia" or "hyperopia". This paper examines the conditions determining the equilibrium balance between early and late resolution, and its consequences for myopia and hyperopia.

Allegations of management shortsightedness have played a large role in the debate over the boom in takeovers and restructuring of the 1980's. Numerous popular writers have argued that a fear of corporate "raiders" pushes managers toward short-sighted decisions; and that short-sighted behavior of U.S. management has led to a decline in competitiveness. Corporate managers subjected to takeover threats frequently justify their records by arguing that they are following long-term strategies whose value has not been recognized by the stock market.[1] Such arguments have been used to justify state anti-takeover statutes such as recent Pennsylvania legislation (*Wall Street Journal*, 4/3/90, editorial page.)

Managerial "shortsightedness" could refer to two related but potentially different phenomena: (1) an excessive focus on short-run *reputation*, as reflected in the man-

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[1] During the Time-Warner-Paramount takeover battle (see *Fortune*, 11/20/89, p. 164-210), Time's board of directors rejected a $200 per share offer (compared to a price of $135 per share a week prior to Paramount's initial bid of $175 per share), purportedly in the long-term interest of the shareholders; on 10/15/91, the renamed Times-Warner stock closed at $83.63.

ager's pay or in the current stock price, and (2) an excessive preference for current rather than future *cash flows*. Numerous recent papers provide efficient market settings in both (1) and (2) occur: the manager or firm's efforts to improve short-term reputation lead to *myopia*, defined as excessive preference for early *cash flows*.[2] Brennan (1990), in his presidential address to the American Finance Association, uses the term *latent assets* to describe the component of the firm's value known to the manager that is not reflected in share price. He argues that firms will convert positive latent assets into cash, whose value is universally observable, earlier than would be optimal for shareholders.

In these studies a manager's forward time preference, *i.e.*, a bias in favor of early over late cash flows, derives from his concern with his own or his firm's short-term reputation (as reflected in stock prices or managerial wages). Even setting aside a direct preference for prestige, there are pecuniary reasons for preferring a high early reputation. The manager may expect to change jobs, or may want to have a potent threat of quitting in order to negotiate higher pay.[3] He may also own shares of the firm that he would rather sell at a higher price.

The general thrust of this argument might seem to lend support to those critics of hostile corporate control mechanisms (tender offers and proxy fights) who emphasize

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[2] Narayanan (1985ab, 1987) shows that if project choice is unobservable to outsiders, then a manager will favor early payoff projects in order to enhance perceptions of his abilities early in his career (see also Darrough [1987], and Campbell and Marino [1989]). Stein (1988, 1989) shows that a manager who plans to sell stock early will also try to raise short-term earnings, and that managers with private information may act to raise share value to prevent "raiders" from acquiring the firm when there is transient undervaluation. Laffont and Tirole (1988) observe that incentive contracts should tie manager's incentives to long-run firm performance, in order to mitigate such incentives. Hagerty, Ofer and Siegel (1990) show that option compensation is an effective way to motivate risk averse managers to focus on the long term. Thakor (1990ab) shows that a superior firm may favor early-cash-flow projects in order to signal high quality and economize on external financing. Extending a model of Bresnahan, Milgrom and Paul (1991), Paul (1991) shows that firms will favor early cash flows if short-term cash flows predict total firm payoffs better than long-term cash flows. Brennan (1990), Shleifer and Vishny (1990), and Froot, Scharfstein and Stein (forthcoming) make the distinct point that the stock market may price assets based on a short-term horizon because exploitation of long-term profit opportunities is risky and costly.

[3] Ideally, a manager could be paid based only on long term performance, not short term reputation (see Dybvig and Zender [1990]), rendering the manager indifferent with respect to resolution timing. However, there are constraints on contracting which may give managers an incentive to try to seem good early. Narayanan (1985b) and Holmstrom and Ricart i Costa (1986) show that the ability of a manager to quit constrains the feasible compensation contract. The optimal compensation contract does not fully offset the manager's incentive to manipulate his project decision in order to build a favorable reputation.

that these deter innovation and adequate investment. To the extent that myopia is a systematic problem, several authors have suggested that it may be appropriate to regulate takeovers or to encourage managers to take defensive actions against bidders, (see Laffont and Tirole (1988) and Stein (1988)).

For two reasons, we believe that it would be premature to establish policies to combat the problem of cash flow myopia as identified by recent studies. First, we are not aware of any persuasive empirical evidence that managers behave myopically, or that takeover threats lead to myopia.[4,5] Indeed, McConnell and Muscarella's (1985) finding that stock prices generally react positively to the announcement of investment projects suggests that managers who are concerned with their short-run reputations have an incentive to sacrifice early cash flows in favor of later ones.

Second, whatever the source of a manager's concern for reputation, he is biased in favor of early cash flows in the above-mentioned models only because high early cash flows bring about favorable resolution of uncertainty. These are therefore models of resolution preference: an excessive desire for early versus late resolution of outsiders' uncertainty as a function of whether the manager expects the news to be revealed will be favorable or adverse. The problem of forward-biased time preference (cash flow myopia, or the latent assets problem) is a side-effect of biased resolution preference.

Like these papers, we also assume a managerial concern for short-run reputation. However, unlike these papers, we show that this concern does not imply *cash flow myopia*. We will show that when some special assumptions are relaxed, managers' resolution preference sometimes leads to forward time preference, and sometimes to deferred time preference. For example, these models assume that high or low cash flows are associated perfectly with favorable or unfavorable resolution of uncertainty. In reality, the market makes use of a wide variety of information sources that are not subsumed by the information contained in cash flows. Furthermore, an investment decision such as increasing R&D activity may reduce short-run cash flows and yet convey favorable information about the firm's long-run prospects. Thus, a manager's

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[4]Meulbroek *et al* (1990) find that after adopting anti-takeover amendments ("shark repellents") firms decrease R&D spending, suggesting that takeover threats do not cause myopia. It is hard to estimate a pure effect of shark repellents, as these may be proposed in response to takeover threats; they do, however, perform some robustness checks. Furthermore, Pound (1987) found that firms that adopted shark repellents were indeed acquired with lower frequency than those that did not.

[5]Brennan (1990) points out that large takeover premia are *prima facie* evidence of large latent assets (hidden value). This suggests that managers of target firms with positive latent assets are often either unable or unwilling to take immediate steps to demonstrate high value.

reputational preference to advance or defer project resolution is not equivalent to a preference to advance or defer cash flows.

The above-mentioned models also assume that the manager has perfect control over the date of information arrival; and that investors know just as well as the manager whether the action (project choice, or decision to realize a latent asset) increases or decreases the firm's risk-adjusted net present value. These conditions seem unlikely to hold when the firm is contemplating innovative projects. When either of these conditions fail, information will sometimes arrive late about a high quality manager or firm, so that late resolution does not in itself stigmatize the manager or firm. A low quality manager or firm will then be tempted to follow the biblical directive given at the start of this text by deferring instead of advancing resolution.

This discussion implies that some of the CEO's who present themselves as visionaries leading the way to a grandiose future may actually be washouts who deserve the sack. And even a manager who prefers early resolution over late may be *hyper*opic rather than myopic, in the sense of investing too much in projects with long-term payoffs. Our analysis therefore suggests that the social costs of resolution preference in general take a subtler form than a bias toward projects with high early cash flows. One such cost may be a bias toward direct product development over basic research activity. Perhaps more importantly, resolution preference may lead to a perverse sorting of high ability managers or organizationally superior firms to conventional projects, and inefficient managers and firms to visionary projects.

The remainder of the paper is structured as follows. The next section gives the economic setting. Section 3 then presents the model when the manager's resolution choice is invisible to the public. In Section 4 we examine the opposite extreme in which the manager's decision is perfectly visible. Section 5 discusses the relationship between resolution preference and a preference with regard to the timing of cash flows ("myopia" or "hyperopia"). Section 6 concludes the paper. Except as otherwise noted, proofs are given in the Appendix.

2   The Economic Setting

We consider a four date model. At date 0, the manager takes an action M by means of which he can attempt to influence the date ($s = 1$ or 2) at which uncertainty is resolved about project success. His choice to *advance* or *defer* resolution is denoted

by M = A or M = D. At date 1, uncertainty about the success of the project (good news, G or bad news, B) may or may not be resolved. The public arrival of news at date 1 is referred to as early resolution, and non-arrival as late resolution. At date 2, conclusive information about not only the project outcome, but also the manager's type (H or L) becomes know to the market. At date 3 a cash flow C arrives.[6]

The manager may be one of two types, high ability ($\Theta = H$) and low ability ($\Theta = L$). Outsiders initially assess a probability λ that the manager has high ability. The manager seeks to maximize the weighted sum of the expected date 1 and the date 2 stock prices of the firm, V_1 and V_2,

$$U^{\Theta} \equiv E_0[V_1 + \delta V_2 | \Theta], \tag{1}$$

where δ is a discount factor.[7] The assumed objective function implies that a high ability manager would like to communicate his ability to the market, while a low manager would rather conceal it. (Alternatively, the *firm* may have either high or low productivity, and the manager seeks to raise investors' perception of firm value.) We assume that the manager learns his type only after being hired, ruling out the offer of a menu of compensation contracts designed to induce him to self-select according to his ability.[8]

The outcome (ϕ) of the project is good (G) with probability $\gamma_H \equiv Pr(\text{G}|\text{H})$ or $\gamma_L \equiv Pr(\text{G}|\text{L})$ and bad (B) with probability $1 - \gamma_H = Pr(\text{B}|\text{H})$ or $1 - \gamma_L = Pr(\text{B}|\text{L})$. We assume that a high manager has a higher probability of obtaining a good outcome than a low manager, *i.e.*, $\gamma_H > \gamma_L$. The manager and outsiders both know these conditional probabilities, but the manager knows more about the likelihood of a good

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[6] In a previous version of the paper, we have derived similar results when cash flows arrive at all dates.

[7] A similar objective function has been used in many financial signaling models (e.g., Harris and Raviv [1985]). The assumption that the manager is concerned with the stock price in the short term (date 1) reflects the possibility that the manager or old shareholders may sell shares (*e.g.*, when the firm receives a takeover bid). Alternatively, the manager's freedom to switch jobs may provide him an incentive to build a good reputation early. In a previous version of the paper, we have derived similar results under an objective function in which the manager is compensated based on his current and future reputation (the posterior probability assessed by outsiders that his ability is high) instead of the firm's cash flows. Such reputational considerations are indirectly captured by the stock price objective function, as the stock price reflects both cash flows and the market's assessment of the manager's ability.

[8] If managers learn their types before contracting, it might be profitable to separate the types by offering the manager a choice of contracts with different weights (δ) on the future. However, such separation will be imperfect if managers also have private knowledge of their personal time preferences (with borrowing constrained).

outcome than do outsiders by virtue of knowing his own type (H or L). For simplicity, we assume that the probability of good news for a manager of given type is independent of his decision to advance or defer, and of the resolution date.

The model describes some basic consequences of resolution preference that will apply in a variety of investment settings. It is therefore consistent with a variety of interpretations of the manager's decision to advance or defer resolution. One is of a choice between distinct projects that have different tendencies toward early versus late resolution, *e.g.*, designing a new product (which will take time to bring to the market) versus modifying slightly an old one. Another interpretation is of a choice of expenditure on a given project that advances resolution (by speeding up product development) or defers it (by slowing development or concealing adverse outcomes). For example, to advance resolution, a pharmaceutical firm might spend heavily on R&D to obtain approval for a medication sooner. For a new product design, parallel rather than sequential examination of alternatives will require more intense expenditure, but will hasten resolution. Alternatively, to defer resolution, a manufacturer might build factories for a consumer appliance to avoid admitting that his new product is a dud.[9] Thus, advancing resolution might correspond to undertaking a project, and defer to avoiding it; while in another application, it may be deferring resolution that corresponds to undertaking the project. Depending on the context, the decision either to advance or to defer resolution may increase cash flows.

Given the manager's decision, Nature may intervene to delay or advance the date of the resolution. For example, the success of a high-technology project may depend on a key technical problem, the outcome of which could be resolved early or late. Alternatively, approval of a new medicine may depend on the speed of regulatory evaluation. The timing of these processes in general will be only partly under the manager's control. Clearly, the manager cannot force early resolution if conclusive information is unavailable. Conversely, he may not be able to force late resolution, either because conclusive information arrives publicly, or because it is impossible to suppress leaks from within the firm.[10] We will allow for either mixed or pure strategies

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[9] Boot (forthcoming) analyzes managerial incentives to terminate projects and sell divisions.

[10] Instead of allowing Nature to overrule the manager's resolution choice, a reasonable assumption would be that Nature chooses the expected returns on an early- and on a late-resolving project (see Thakor 1990b). If the manager cares about underlying firm value, this would still in effect "force" him sometimes to advance or defer resolution despite his other reasons for preferring early or late resolution. The "invisible" resolution choice regime would then correspond to the case in which the manager

by letting h denote the probability that a high ability manager advances resolution (M = A), and $1 - h$ the probability that he defers resolution (M = D). A low ability manager chooses A and D with probabilities l and $1 - l$.

When a manager advances resolution, Nature's intervention causes resolution at date 1 $(s = 1)$ with probability r_A and at date 2 $(s = 2)$ with probability $1 - r_A$. When a manager defers resolution, Nature's intervention causes $s = 1$ or $s = 2$ to occur with probabilities r_D and $1 - r_D$. We assume that $r_A > r_D$, *i.e.*, early resolution is more likely when a manager attempts to advance resolution than when he tries to defer. Figure 1 describes the sequence of moves in a game tree. (The q functions in Figure 1 are defined later.)

Realization of a latent asset (as with extracting and selling gold) is a special case of our analysis in three respects. First, a high manager or firm is sure of success (he *knows* it has low extraction cost), while a low manager or firm is sure of failure (he knows it has high extraction cost). Second, Nature is fully compliant with the manager's decision to advance or defer resolution. Third, favorable resolution always coincides with the arrival of a high cash flow.

Nature probably interferes relatively little with the timing of natural resource extraction, which is often a standard engineering problem. A manager has a much looser grip on resolution timing in an innovative context. Much of the policy debate on takeovers and restructuring has been concerned with the need for managers to be free to take a long view in order for innovation to occur. It is therefore important to analyze an innovative context in which resolution timing cannot be perfectly controlled.

The project will pay a cash flow at date 3 of $C(\Theta, M)$ if the manager is type Θ (high or low) and his choice M was to advance or defer resolution (A or D). The attempt to advance or defer resolution may affect profitability. For example, a manager's decision to introduce a superior new product prematurely may reduce net present expected value, as may a decision to prolong a project to conceal its failure. Specifically, the firm's cash flow is assumed to be

$$C(\Theta, M) \;=\; dI(\text{H}) - cI(\text{A}), \tag{2}$$

where $I(\text{H})$ is an indicator function for a high manager and $I(\text{A})$ is an indicator for advancing resolution. Thus, high ability raises profitability; and when a manager

privately observes the expected payoffs from alternative projects; the "visible" regime to the case in which everyone knows expected payoffs. A model essentially equivalent to the one we present could be derived based on this approach.

FIGURE 1

t=1

q (G,1)

Pr(G|θ)

good outcome

bad outcome

Pr(B|θ)

q (B,1)

r_A

Nature chooses early
resolution

θ = h or l

Nature chooses late
resolution

$1-r_A$

q (2)

Pr(G|θ)

good outcome

bad outcome

Pr(B|θ)

q (2)

Advance

Defer

q (G,1)

Pr(G|θ)

good outcome

bad outcome

Pr(B|θ)

q (B,1)

r_D

$1-θ = 1-h$ or $1-l$

Nature chooses early
resolution

Nature chooses late
resolution

q (2)

Pr(G|θ)

good outcome

$1-r_D$

bad outcome

Pr(B|θ)

q (2)
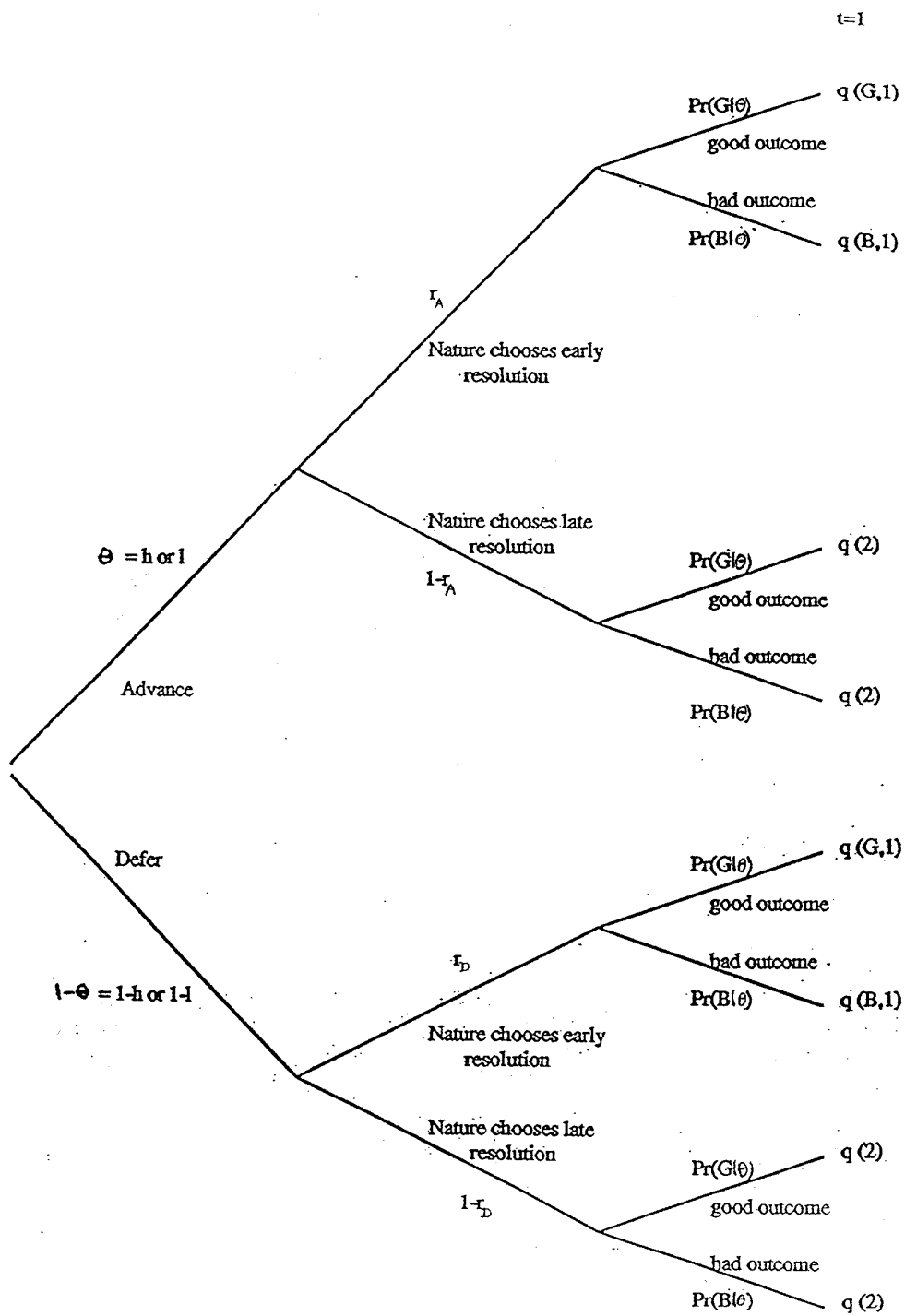
advances resolution the firm incurs a positive or negative cost at date 3 of c.[11] Given
(2), the stock price at dates 1 depends upon the resolution date (1 or 2), the outcome
(G or B) if public resolution has occurred, and the manager's action (A or D) if the
action choice is visible. The date 2 stock price depends upon the resolution date (which
may be informative about the manager's action), and the manager's type, but not on
the outcome.

3 Invisible Resolution Choice

In some cases, the manager's decision to advance or defer resolution will be hard
for outsiders to detect. For example, a manager might defer resolution by failing to
perform an informative experiment, or by suppressing the outcome of an experiment.[12]
Alternatively, he can advance resolution secretly by neglecting equipment and customer
service while completing a new product. Or, he may substitute executive time toward
product development from other activities.

We therefore assume in this section that the decision to advance or defer resolution
is entirely invisible to outsiders at dates 0, 1, and 2, though it may become visible
at date 3. At dates $t = 1$ and $t = 2$ outsiders update their prior beliefs about the
manager depending on whether the resolution occurred at date 1 or 2, and, if resolution
has occurred, whether the outcome (ϕ) was good or bad. Let the manager's date 1
reputation q be the posterior probability at date 1 that the manager is H conditional
on available information. Thus, if the outcome is ϕ, then

$$
\begin{aligned}
q(\phi, s) &\equiv Pr(\text{H}|\phi, s) \quad \text{if } s = 1 \\
q(s) &\equiv Pr(\text{H}|s) \quad \text{if } s = 2.
\end{aligned}
\tag{3}
$$

In the second equality q does not depend on the outcome $\phi = $ G or B, which has not

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[11]For algebraic simplicity, we make the artificial assumption that the cash flow does not depend on
the good or bad news. This does not affect the nature of the results, because good news still leads
investors to value the firm more highly based on a more favorable assessment of the manager's ability,
which is related to the cash flow. The cash flow also does not depend on the resolution date. Since
the resolution date is (stochastically) advanced or deferred by the manager's decision A or D, such
an effect is implicitly reflected in the cost of advancing c. In a previous version of the paper, we have
derived similar results in a model in which cash flows are higher with good news than with bad news,
can depend on the resolution date, and can arrive at all four dates.

[12]NASA was reproached by Sen. Albert Gore for failing to perform an advance test of the mirror
before launching the $ 2.5 billion Hubble Space Telescope, which was crippled by an inability to focus
properly; see *Wall Street Journal* 5/21/90 p. B8B, and *New York Times* 7/11/90 p. B6.

yet been resolved publicly. We illustrate the calculation of probabilities in (3) with a single case.

$$q(G, s = 1) \equiv Pr(H|G, s = 1) = \frac{Pr(G, s = 1|H)\lambda}{Pr(G, s = 1|H)\lambda + Pr(G, s = 1|L)(1 - \lambda)}. \quad (4)$$

Since the project outcome (ϕ) and the date of resolution (s) are independent, we can write $Pr(G, s = 1|H)$ and $Pr(G, s = 1|L)$ in (4) as

$$
\begin{aligned}
Pr(G, s = 1|H) &= Pr(G|H)Pr(s = 1|H) = \gamma_H[h(r_A - r_D) + r_D], \\
Pr(G, s = 1|L) &= \gamma_L[l(r_A - r_D) + r_D].
\end{aligned}
$$

Letting $\theta = h$ or l for a manager of type H or L, by inspection of Figure 1 the expected values of the date 1 and 2 stock prices V_1 and V_2 in (1) are

$$
\begin{aligned}
E_0[V_1|\Theta] &= [\theta r_A + (1 - \theta)r_D][\gamma_\Theta V_1(G, s = 1) + (1 - \gamma_\Theta)V_1(B, s = 1)] \\
&\quad + [\theta(1 - r_A) + (1 - \theta)(1 - r_D)]V_1(s = 2) \\
E_0[V_2|\Theta] &= [\theta r_A + (1 - \theta)r_D][\gamma_\Theta V_2(G, s = 1) + (1 - \gamma_\Theta)V_2(B, s = 1)] \\
&\quad + [\theta(1 - r_A) + (1 - \theta)(1 - r_D)][\gamma_\Theta V_2(G, s = 2) + (1 - \gamma_\Theta)V_2(B, s = 2)]. \quad (5)
\end{aligned}
$$

The various stock prices in (5) and (1) are calculated in the Appendix.

In this setting the equilibria are as follows.

Proposition 1 *In the invisible resolution setting, the Perfect Bayesian Equilibrium is unique and is one of three types depending on the cost of advancing resolution c:*
(1a) c < d. A high manager always advances ($h^* = 1$) and a low manager randomizes between advancing and deferring resolution ($0 < l^* < 1$)
(1b) c < d. A high manager always advances ($h^* = 1$) and a low manager always defers ($l^* = 0$)
(2) c > d. A high manager randomizes between advancing and deferring resolution ($0 < h^* < 1$); a low manager always defers ($l^* = 0$).
When c < d, the equilibrium (1a) versus (1b) is determined by the other parameter values. Since d > 0, if the cost of advancing resolution is negative (c < 0), then (2) never obtains, so a high manager always advances resolution.

These equilibria reflect the intuition that the benefit to advancing resolution is greater for a high than a low ability manager. An informative benchmark case occurs when

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the cost of advancing resolution c is zero, so that a manager's decision to advance or defer is solely due to reputational considerations. Equilibria (1a) and (1b), but not (2) are possible in this case. Thus, a high manager is always biased in favor of advancing resolution. The pure strategy equilibrium (1b) shows unequivocally that a manager who wants to conceal his low ability may be biased in favor of deferring resolution.

The two mixed strategy equilibria are similar. In one, the cost of advancing resolution is so high that that a low manager is forced to a corner solution (never advance); in the other advancing resolution is so cheap that a high manager always advances. To avoid repeating parallel arguments, we will focus on the lower-cost equilibrium (1a) in which a low manager randomizes. In this equilibrium, the benefit to a low manager of deferring what is likely to be an adverse resolution is balanced against the adverse inference about the manager drawn from late resolution *per se*.

Continuing with the benchmark case $c = 0$, further insight is gained by discussing an illustrative comparative statics of the low-cost mixed strategy equilibrium. (Comparative statics for r_D, γ_H, γ_L, and λ are available in a previous version of this paper.) The probability that a low manager advances resolution, l^*, is increasing with the probability that Nature selects early resolution when the manager advances resolution, r_A. (The proof is contained in the Appendix.) This can be explained as follows. An increase in r_A implies greater compliance by Nature with a manager's attempt to advance resolution. Thus, a manager who defers resolution is more reliably inferred to be low. A low manager will therefore be more inclined to advance resolution.

A pure strategy equilibrium in which a low manager always defers ($l^* = 0$) rather than randomizing will obtain when the various parameters are shifted in those directions that encourage the manager to defer resolution. (Further details are available in a previous version of the paper.)

The comparative statics with respect to δ, the relative weight placed on the later stock price, is of particular interest, because it can be interpreted as an inverse measure of the threat of a hostile takeover.[13] We show in the appendix that if deferral is costly ($c < 0$,   ), then a greater likelihood of a takeover bidder arriving (lower δ) pressures a low ability manager toward deferred resolution. Thus, takeover threats can lead to a shift from conventional, early-resolving projects toward more

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[13]This can be viewed in two ways. First, a hostile takeover market makes it is more important for the manager to maintain a high personal reputation in the short run, to reduce the chance of being fired. Second, as shown by Stein (1988), a manager acting in the interests of shareholders will wish to maintain a high stock price, to reduce the chance of having to sell the firm cheaply.

visionary, late-resolving projects. If advancing is costly ($c > 0$), then takeover threats pressure a low ability manager toward advanced resolution.

The intuition for the case $c < 0$ is as follows. Advancing resolution on average increases the date 2 stock price, because it brings about early resolution which tends to cause investors to infer that the benefit $-c$ will be received. This is offset by the fact that advancing resolution on average decreases the date 1 stock price. A decrease in δ therefore reduces the weight on the benefit of advancing, so in equilibrium a low quality manager advances less often. The reverse applies when $c > 0$.[14]

The analysis of invisible resolution choice shows that firms will sometimes make too great and sometimes too little innovative expenditure. To the extent that intense R&D activity is a costly way of accelerating resolution of uncertainty about a new product, high quality managers or firms overinvest in R&D, while low quality ones may either overinvest or underinvest. On balance, because of the need for low types to mimic high types, the mixed strategy equilibrium suggests that investment on new product development will tend to be too intense.

On the other hand, if A and D refers to an overall strategic decision of whether to aim for conventional and early-resolving projects, or toward visionary and late-resolving projects, then it is *deferral* that is associated with high innovative activity.[15] The overall tendency is then for too little innovative expenditure. However, a low ability manager may do too much.

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[14]In a previous version of the paper, the model is modified so that at date 2 information G or B arrives, rather than conclusive information about H or L. Thus, the action choice affects the date 2 as well as the date 1 reputation. In such a setting, even if $c = 0$, a greater takeover threat (lower δ) pressures a low ability manager toward deferred resolution.

[15]We can reinterpret the model with invisible resolution choice as one in which the choice to advance or defer is visible, but outsiders don't know which alternative is *justified* based on expected net present value (see Note 9). If the value of the visionary project is sufficiently higher than the value to the early-resolving conventional one, even a high manager will defer. This possibility would allow a low manager to defer, pretending to be a high manager with a superb late-resolving project. GM's development of new technology for the Saturn model, billed as the car of the 21st century, under Chairman and CEO Roger Smith has been widely cited as an example of wasteful expenditure on innovation (See *Business Week*, 5/18/87, on "GM's meager profits, its falling market share, and its poor productivity despite $40 billion in new equipment since 1979.") Smith is quoted as saying, "Don't write the book on me until I've been gone at least ten years. It's too early. You've got to wait and see," in Lee (1988, p. 1).

4 Visible Resolution Choice

In this section we assume that a manager's attempt to advance or defer resolution is immediately visible to the public. At least some degree of visibility is reasonable, in that R&D expenditures may be inferred from the firm's accounting statements, and some product development activities (such as hiring a research team and buying equipment) are hard to disguise. For our purposes, it is not important whether resolution choice is directly observed, or inferred from the current cash flow (see Note 6).

Proposition 2 *With visible resolution choice, if $d \neq |c|(1 + \delta)$ there are four possible Perfect Bayesian Equilibria:*[16]
1. Both high and low ability managers advance resolution.
2. Both high and low ability managers defer resolution.
3. A high ability manager advances resolution and a low ability manager randomizes.
4. A high ability manager randomizes and a low ability manager defers resolution.

Intuitively, a high manager has more to gain from resolution than a low manager. So in any equilibrium in which a low manager ever advances, a high manager always does so. Since resolution choice is visible, a manager must either advance resolution or carry the stigma of low ability.[17] If the cost of advancing is sufficiently high, a low manager will nevertheless sometimes defer; for even higher cost both types will defer.[18]

Corollary to Proposition 2 *If advancing resolution is not too costly, i.e., if $c \leq 0$ or if $c > 0$ is sufficiently small, then under the weak Banks and Sobel (1987) refinement criterion both a high and a low ability manager advance resolution.*

Intuitively, a high manager gains more from early resolution and will advance unless there is a cash flow disadvantage ($c > 0$) to doing so; and thus, a low manager is

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[16]If $d = |c|(1 + \delta)$, a perverse special case, then an uninteresting weak equilibrium also exists.

[17]Cold fusion proponents Pons and Fleischman announced that because they had withheld key details of their experimental technique, others would not be able to duplicate their results. This visible deferral of resolution was greeted with great skepticism by other scientists.

[18]Equilibrium 4., in which a high manager sometimes defers, is unreasonable in the sense that there is a tendency for a high manager to shift to a pure strategy. The fragility of this equilibrium is analogous to the fragility of equilibrium in a traffic coordination game in which players randomize between driving on the left side and the right side of the road. The equilibria in which everyone drives on the same side are attractive, in that any small shift in an individual's conjecture about the side chosen by others will cause him to strictly prefer that side. Similarly here, if investors shift their conjecture to a slightly higher (lower) probability of a high manager advancing, then a high manager will strictly prefer to advance (defer).

forced to mimic.[19] In the invisible case, if $c = 0$ it was possible that the low manager deferred resolution. Thus, resolution-advancing decisions are more favored when they are visible to outsiders. This is because visibility eliminates a low manager's ability to hide in the noise.

R&D expenditures have been cited in the takeover debate as a measure of firms' willingness to focus on the long term. If resolution is advanced through innovative expenditure, then the analysis implies that managers, whether able or incompetent, will be too eager to invest in R&D, in order to enhance their reputations in the short-term. A high manager would invest in R&D even if it were moderately unprofitable, because the cash flow loss would be offset by the benefit of separation. A low manager, who has less to gain from early resolution, will thus also be biased in favor of investing in R&D, since not to do so reveals him as low. However, he has less to gain, since A tends to reveal him as low even if he does engage in R&D. So if R&D is sufficiently expensive (c large), he may randomize between A and D, or may always select D.

If A corresponds to undertaking a project, and D to not undertaking it, then the cost of advancing c is the is the negative of the net present value of the project. Conversely, if D corresponds to undertaking a project, and A to not undertaking it, then c is the net present value of undertaking the project. Given this, the next proposition describes the stock price reaction to a firm's visible investment decision, and biases in managers' project choices.

Proposition 3 *In the mixed strategy equilibrium in which a high manager advances resolution and a low manager randomizes, the stock price rises on the announcement of a negative expected NPV project or activity that advances resolution, and falls on the announcement of a positive expected NPV project or activity that defers resolution.*

We have suggested that a possible interpretation of A is accelerating the development of a new product. Thus, the analysis predicts a positive stock price reaction to new product introductions (even if they have negative NPV), which is consistent with the evidence of Woolridge and Snow (1990).

If A corresponds to undertaking an R&D project with negative net expected value ($c > 0$), then R&D spending becomes a costly signal of high managerial ability (or

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[19]Equilibrium 2. can be supported by the belief that a manager who advances resolution must be low. Such an inference is, however, unreasonable in the Banks and Sobel sense because a high manager gains from advancing resolution under a wider range of inferences by outsiders than does a low manager.

firm type).[20] Proposition 3 asserts that so long as a high and a low manager behave differently, this effect outweighs the negative value of investment. Thus, the evidence that increases in R&D expenditures lead to a positive abnormal stock price reaction (Office of the Chief Economist, SEC [1985]; Woolridge [1989]) indicates that if our model is valid, measured R&D expenditures primarily reflect resolution-advancing activity (product development rather than basic research). This evidence is therefore consistent with *over*investment rather than underinvestment in innovation.[21]

The analysis suggests an interesting interpretation of Chan et al's (1990) finding that average abnormal returns are positive when high-technology firms announce increased R&D spending, but are negative when such announcements are made by low-technology firms. This is that expenditures by high-technology firms tend to advance resolution by accelerating the development of new products, while increased R&D expenditures by low-tech firms represent significant strategic shifts to visionary projects that defer resolution of uncertainty.

Jensen (1986) and Stein (1989) offer conflicting interpretations of evidence that stock prices react positively to capital expenditures (McConnell and Muscarella (1985); oil firms were an exception). Jensen maintains that since this indicates that the stock market values investment, managers do not have an incentive to behave myopically (underinvest). Stein disputes this position on the basis that a large positive price reaction indicates that managers use too high a hurdle rate, *i.e.*, they are myopic. Proposition 3 shows that a manager concerned with his own or his firm's short-term reputation should be biased in favor of actions, such as visible R&D expenditures, that raise the stock price. Thus, a reputational argument implies overinvestment.[22]

Although we have developed our argument in a resolution timing model, the prediction that a positive stock price reaction to investment is associated with overinvestment will apply more generally. This conclusion will generally follow so long as high quality

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[20]Such separation based on a visible resolution decision is analogous to Titman and Trueman's (1986) model of auditor quality as a signal of firm value.

[21]More generally, if a high manager has a higher expected NPV from investment than a low manager, then a positive reaction to advancing resolution is consistent with a positive expected NPV for a high manager.

[22]Stein's (1989) model does not allow for a stock price reaction to investment, since it requires that the manager's decision be invisible to outsiders. In models of premature realization of latent assets, the manager's action is visible. However, in these models managers are biased in favor of actions that increase the stock price. These therefore do not lend support to Stein's conclusion, which requires a managerial bias *against* an action that raises the stock price.

managers or firms are more inclined to undertake capital expenditures, as would occur, for example, if such types can achieve higher expected net present value (See Trueman [1986]). A marginal manager who is concerned with the current stock price will be just willing to invest because the signaling benefit offsets the investment's negative present value. Thus, current stock return evidence is consistent with overinvestment in conventional as well as innovative undertakings.

Deferral of resolution can be associated with innovations of a strategic rather than a narrowly technological nature. For example, a large acquisition for purposes of globalization, diversification or the exploitation of far-reaching synergies can make it harder to evaluate a manager's record early (see footnote 1).[23] In contrast, we do not interpret a bust-up takeover as deferring resolution. The greater proneness of low ability managers or firms to defer resolution of uncertainty implies that the stock price will react negatively (Proposition 3) to the announcement of such activities. This is consistent with a large body of evidence of low returns to bidders in takeover contests (for tender offers, approximately zero over several decades, and negative in the 1980's; see Roll [1986] and Bradley, Desai and Kim [1988]). To the extent that a takeover bid signifies a large strategic shift for the firm that makes it harder to evaluate performance in the short term, the bid is bad news for the acquiror's shareholders.

This prediction is also consistent with the evidence of Morck, Shleifer and Vishny (1990) that the returns to bidding shareholders are lower when their firm diversifies and when it buys a rapidly growing target. These actions are likely to be associated with momentous shifts in the bidder's strategy, and thus with deferral of resolution of uncertainty.[24] Consistent with the model, Comment and Jarrell (1991) found that firms that narrowed their focus to fewer lines of business earned positive abnormal returns, and those that diversified had negative abnormal returns. Similarly, Sicherman and Pettway (1987) find that the returns to purchasers of divested assets in 1983-5 was larger for assets in related product lines than for unrelated assets.

One way of deferring resolution is to add noise to the news outcome, i.e., choose a project whose outcome is known to be poorly correlated with managerial ability.[25] In

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[23]Brennan (1990, p. 725) also suggests that multidivisional conglomerates may be hard to evaluate.

[24]Two other studies of mergers also find that bidders in related acquisitions have positive abnormal returns while bidders in unrelated acquisitions have negative abnormal returns (see Eckbo [1985], and Scanlon et al [1989]).

[25]Noise should be distinguished from risk. Evaluation of a manager's performance is not hampered by variability in project outcome that arises from observable state variables. However, invisible state

our model, late resolution is analogous to infinite noise, in the sense that the arrival of no news at date 1 is equivalent to the arrival of a "signal" that is uninformative. In a previous version of this paper, we show that equilibria similar to those of the visible resolution timing model apply in a "noise" model in which the manager can visibly choose projects whose outcomes are correlated strongly or weakly with his ability. Other visible decisions that affect noise and so resolution timing may be bank versus public debt financing (if bank financing maintains greater confidentiality than publicly issued debt), and the choice of accounting methods (*e.g.*, LIFO versus FIFO), which may alter the ease of assessing performance.

Resolution can also be advanced visibly by direct disclosure. In direct disclosure, as with realizing a latent asset, the firm knows with certainty when it advances resolution whether the news it is revealing is good or bad. Thus, consistent with much of the previous literature on disclosure, we predict that if bad news is disclosed then good news is also disclosed.[26]

The interpretation of innovative expenditure as advancing resolution (A) fits most closely with conventional product development. Visibly engaging in basic research on visionary projects corresponds to deferring resolution (D). Thus, for fundamental research, the prediction of Proposition 3 is the reverse of that for conventional product development. The market will view managers engaging in visionary projects skeptically, and hence firms will underinvest in basic research from the viewpoint of shareholders. The fact that most R&D expenditure and activity by large firms is for product development, not basic research (Griliches [1990 p. 1674]) is consistent with this prediction. (The problem of appropriability provides a plausible alternative explanation.)

Perhaps more importantly, the analysis implies a mismatch between managerial talent and projects. Because high ability managers desire early resolution, they seize conventional, early-resolving projects, leaving fundamental innovation for low ability managers. This sorting promotes superb execution of minor improvements, along with monumental blunders in ambitious undertakings. Since we normally expect some complementarity between managerial ability and the novelty of the project, the incentive

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variables introduce noise by making the outcome a less reliable indicator of the manager's ability.

[26]See, *e.g.*, Grossman (1981), Verrecchia (1983), and McNichols (1984). Some more recent papers (Darrough and Stoughton [1990], and Teoh and Hwang [1991]) have shown that sometimes good news will be withheld for proprietary or signalling reasons.

for high ability managers to shun late-resolving projects is from society's viewpoint perverse.

As discussed earlier, an increased threat of takeover can be interpreted as a lower relative weight on the future δ. If managerial decisions are visible, and if advancing resolution is costly, then a greater takeover threat pressures a low manager to advance resolution.[27] As discussed earlier, the model (in combination with stock price evidence) implies that R&D expenditures primarily reflect activities that accelerate resolution. This implies that the stock price reaction to increased R&D expenditures should be more positive for firms that are better insulated from market pressures, such as firms protected by antitakeover amendments, or firms with low institutional share ownership (on the latter, see below). These predictions have not, to our knowledge, been empirically tested.

A manager can advance resolution either through greater product development expenditures, or by avoiding long-term visionary projects. If (as discussed earlier) visible R&D expenditures are identified as primarily for product development, then this prediction is consistent with Meulbroek et al's (1990) empirical result discussed earlier that antitakeover amendments are followed by decreases in R&D expenditures. This evidence is hard to understand based on previous models of managerial myopia, in which a slackening in market pressure should lead to *higher* R&D.

As an alternative interpretation of δ, it has often been argued that institutional investors place strong emphasis on the short run stock price performance of the firm.[28] If so, then firms with high institutional ownership need to place greater weight on the present (lower δ). Inconsistent with most previous theories of short-termism, but consistent with our model, Hansen and Hill (1990) find evidence suggesting that, after controlling for other variables, higher institutional ownership is associated with *greater* R&D expenditures.

Consistent with previous papers, we have identified distortions in investment decisions, and the intensity of these distortions is increasing in the relative weight placed on the short run stock price (decreasing in δ). However, the analysis cannot provide a balanced assessment of the desirability of takeovers, since we focus only on a cost

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[27]The proof is in the Appendix. The intuition is similar to that given in the invisible model. This comparative statics is only relevant when the manager randomizes, which by the Corollary to Proposition 3, requires that $c > 0$.

[28]Lang and McNichols (1991) provide some evidence consistent with this view.

of takeovers, *ex ante* investment distortion, and not the benefits, such as control of agency problems. It does suggest that the distortions associated with takeover threats are much more conditional than has been recognized, and need not be associated with less R&D. Takeover threats can encourage low ability managers to focus on more innovative, late-resolving projects (if this decision is invisible), or on more intense R&D spending to accelerate product development (if this decision is visible).

5 Resolution Preference and the Timing of Cash Flows

The term "myopia" has been taken to refer to an excessive preference for early cash flows over late cash flows, *i.e.*, a time preference stronger than the market rate of discount. We emphasize here the distinct but related concept of *resolution preference*, a desire for uncertainty to be resolved publicly early (forward resolution preference) or late (deferred resolution preference) as a function of the likelihood of different outcomes.[29]

Previous writers have assumed that this association takes a particular form: a high early cash flow resolves uncertainty favorably. Thus, in Narayanan (1985ab), Stein (1988) and Brennan (1990), a manager is led to value an early dollar more than a late dollar (even after allowing for the market rate of discount). Hence, in these models, forward resolution preference induces an excessive preference for early cash flows (myopia).

One qualification we have suggested to this conclusion is that a manager with adverse information may prefer late resolution, to hide the bad news. If actions that lead to later resolution also lead to later cash flows, then this implies that such a manager is biased in favor of actions leading to late cash flows, *i.e.*, hyperopia. For example, a firm might delay the introduction of a new product if the firm is relatively pessimistic about its reception, even if immediate introduction would maximize expected profits. Or, a firm might undertake expensive modernization and global reorientation, in the

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[29]Ross (1989) has described a setting in which changes in the foreseen timing of resolution of uncertainty that leave cash flows unaltered are irrelevant for either the welfare of the investors or current prices. Thus, if there were no agency problem, project selection would also ignore resolution timing.

In contrast with the resolution preference described here, which is induced by managers' desire to be viewed as good early in their careers, it is possible that investors or managers *directly* value early or late resolution, which would imply a violation of von Neumann-Morgenstern preference axioms (see, e.g., Kreps and Porteus [1978]). A seeming bias toward early-resolution projects may also be desirable in order to exploit the option to replace a bad manager (DeMarzo and Duffie [1992]).

hope (to be resolved in the future) of regaining future competitiveness. In other words, the firm will sometimes act as if it valued a late (expected) dollar too heavily compared to an early (expected) dollar. This is not because the manager values lateness of cash flows *per se*. Rather, the late realization of cash flows is associated with late resolution, and a low manager values late resolution because this delays the arrival of news that will reflect adversely on him or his firm.

More fundamentally, the linkage between early cash flows and early resolution is more conditional than the impression conveyed by recent research on latent assets and myopia. For example, a manager may simply make or withhold a direct disclosure without affecting cash flows; or, he may secretly delay the completion of a product. A firm may accelerate the development of a new product (such as Apple with a new PC, or Microsoft with a new software package) by spending more rapidly on development now. This will lead to *lower* cash flows in the short run, but earlier resolution. Similarly, having succeeded in developing a superb new product, a firm can accelerate investments in equipment and marketing, which reduce cash flows in the short run, so that the favorable consumer response to the product becomes visible sooner.[30]

The importance of R&D expenditure in accelerating resolution is illustrated by the pharmaceutical industry, in which there is often uncertainty both about whether and when the Food & Drug Administration will approve a new medication. American Home Products Corp., a major U.S. drug company, was criticized in *Business Week* (6/11/90) for a "tightfisted," "anemic" R&D budget, which has, according to industry experts, led to delays in getting new drugs approved by the FDA. For example, the "potential blockbuster" Alredase, a diabetes medication, "was rejected by the FDA in 1986 because AHP's clinical trials failed to prove that it worked." The article described the drug as up to three years away from FDA approval.[31]

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[30]This may also accelerate the arrival of sales revenues. However, allegations of myopia have usually been based on claims that managers wish to boost cash flows in the very short run (quarterly earnings figures). In this example, the manager's effort to accelerate resolution reduces cash flows in the short run, though it may hasten the arrival of later cash flows (when the product comes to market). Similarly, a high-ability manager who is excessively concerned with a 5 year instead of a 10 year horizon may intensify R&D to accelerate the outcome, rather than secretly cutting R&D to increase next quarter's earnings report.

[31]Similarly, *Business Week* (pp. 66-8, 9/24/90) reports that "Over 20 years, Warner-Lambert's record of getting new drugs from patent to FDA filing ranged from five years ... to 14 years ... Merck's range over the same period was three to eight years," and the Warner-Lambert's CEO "Williams is attacking the problem with new recruits and more money," and reports an increase in Warner-Lambert's R&D expenditures relative to drug sales of slightly under 20 %.

High R&D expenditures can also be associated with an effort to defer resolution, as with a low ability manager who claims he is sacrificing current gain for long-range goals. Alternatively, a manager of an unsuccessful innovative project may have an incentive to continue fruitless visible R&D expenditures, because cutting the expenditure would reveal failure.

To the extent that a manager is concerned with persuading shareholders that he (or his firm) is of high quality (or value), it is resolution timing, not cash flow timing that matters.[32] To put this differently, cash flow timing is important only to the extent that it provides information about the firm or its manager.

There is a second important respect in which the linkage between forward resolution preference and reduced R&D spending is tenuous. R&D spending is to a large extent visible to outsiders, both through accounting statements and other means. When innovative spending is visible, outsiders obviously need not attribute a low early net cash flow to bad luck or incompetence. Thus, our analysis does not lend support to the view that managers will cut desirable R&D in egregious, visible ways. To the contrary, resolution preference can just as easily promote an *excess* of visible R&D spending to accelerate resolution by managers who wish to be viewed as having high ability.

The hidden-action rationale for myopia would seem to be most appropriately applied to maintenance or customer service expenditures that have little effect on the timing of future news arrival (except to the extent that immediate costs are reflected visibly in cash flows). If maintenance expenditures were entirely invisible (*i.e.*, the manager could cover up current costs by manipulating accounting figures), then the manager would have no reason to deviate from maximizing expected net present value. If the maintenance decision were perfectly visible, the same conclusion would hold. However, in a partially observable setting in which cash flows are noisy and in which maintenance reduces early cash flows and raises the date 3 cash flow, there would seem to be a legitimate concern about the adequacy of maintenance expenditures.

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[32]Thakor's (1990b) analysis might seem to suggest otherwise, in that a firm may benefit from receiving cash early in order to finance future projects through internally generated funds. However, once the uncertainty about cash flows of the old project is resolved, the firm could issue debt secured by assets in place, rendering the timing of the actual cash flows irrelevant. (This does not eliminate distortion, but shows that the problem he analyzes is still fundamentally one of resolution timing.)

6 Conclusion

Most significant managerial decisions affect the timing with which uncertainty about the manager and the firm is publicly resolved, either favorably or unfavorably. Previous research has emphasized that if managers are concerned with short-run reputation (as reflected in their wages or in stock prices), then the favorable resolution brought about by high early cash flows. This suggests that managers will take actions, such as realization of latent assets, that are biased toward increasing early cash flows.

This paper also assumes a focus on short-run reputation, but cautions against drawing strong policy conclusions from theoretical arguments for cash flow myopia. We show that high quality managers (or firms) will be biased toward advancing resolution, while low ability managers may favor either advancing or deferring resolution. Because of the desire of the low to mimic the high, there is an overall (but not uniform) tendency for forward resolution preference to prevail. But a preference for early resolution can be associated with *hyperopia*, an excessive preference for long-term cash flows, rather than myopia, because advancing resolution of uncertainty need not increase short run cash flows. For example, increasing R&D expenditures to accelerate development of a new product leads to lower net cash flows in the short run. Furthermore, recent evidence that increases in R&D expenditures lead to positive abnormal stock returns is consistent with *over*investment in R&D.

The analysis provided here offers a possible explanation for evidence that takeover threats and high institutional share ownership are associated with high R&D expenditures (Meulbroek *et al* [1990]; Hansen and Hill [1990]). This evidence is puzzling from the perspective of the previous theoretical literature on myopic managerial behavior. The analysis also leads to untested empirical predictions relating the stock price reaction to advancing resolution (*e.g.*, by increasing R&D expenditures) to the extent that the firm is insulated from market pressure (*e.g.*, through antitakeover amendments or low institutional share ownership).

More generally, the analysis raises doubts about a criticism frequently leveled against particular hostile takeovers, that a poor stock price performance of the target reflects the stock market's failure to comprehend management's vision for the long-term. Utopian futuristic "vision" is the last refuge of incompetence. (This is not to deny that some managers who look toward the long-term are highly able.) High ability tends to induce forward resolution preference, while low ability tends to induce

deferred resolution preference. Therefore, it is valid to be skeptical of managers who have little to show now but promise favorable resolution in the distant future.

It has been argued in the business press that takeovers have caused a failure of U.S. firms to innovate, and the decline of U.S. competitiveness on world markets. Since it is not clear on either theoretical or empirical grounds whether takeovers have a positive or negative effect on innovation, this conclusion is premature. There are, of course, other plausible explanations for the gradual decline in U.S. economic and technological dominance.

Deferral of resolution may be associated not only with innovative expenditure, but with acquisition or other major strategic reorientation of the firm. Also, the choice of projects with noisy outcomes makes it harder to evaluate a manager, deferring resolution about his ability. The analysis suggests that able managers will tend to be too conservative, owing to their desire to obtain favorable resolution; while poor managers may also be conservative, to mimic, or may favor wild, radical changes, to defer resolution.

Since induced resolution preference can lead to excessive R&D expenditures as easily as too little, in some firms it may be desirable for the board of directors to monitor innovative projects and ration capital. And if boards do not perform this job well, it is even possible that regulatory policies less encouraging to innovation might be desirable, such as weaker patent protection. There is potentially a problem of inadequate routine expenditures (such as maintenance), if these are invisible.

An interesting direction for further research is the role of option-based compensation (see Hagerty, Ofer and Siegel [1990]). On the one hand, an option with a short term to expiration encourages a manager to advance resolution of uncertainty, to exploit the option value. However, it also encourages managers to take other risk-increasing actions, which might add noise to the resolution process. Thus, the net effect of option compensation on resolution preference is not obvious.

Resolution preference is also relevant in other labor market settings in which the employee has some discretion over tasks. Young academicians are often told to do conventional research before tenure to prove they are good (obtain early resolution); after tenure, the advice goes, they can sit back, survey the big picture, and attempt major (late-resolving) projects. The introduction of noise to confuse judgement of ability is also relevant in other settings, as with obscurantism in modern music, poetry

and visual arts.[33] Of course, while those with no talent should be obscure, some that are obscure are highly talented.

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[33]Or in the words of W. S. Gilbert, "If this young man expresses himself in terms too deep for me, why what a very singularly deep young man this deep young man must be."

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Appendix

Calculation of stock prices in (5):

$$
\begin{aligned}
V_1(s = 2) &= dq(2) - cPr(\mathrm{A}|s = 2) \\
V_1(\mathrm{G}, s = 1) &= dq(\mathrm{G}, 1) - cPr(\mathrm{A}|\mathrm{G}, s = 1) \\
V_2(\phi, s) &= dI(H) - cPr(\mathrm{A}|\Theta, s).
\end{aligned}
\tag{6}
$$

By (6), (1) can be written as

$$
\begin{aligned}
E_0[V_1 \;+\; \delta V_2|\Theta] ={}& d[\theta r_{\mathrm{A}} + (1 - \theta)r_{\mathrm{D}}][\gamma_\Theta q(\mathrm{G}, 1) + (1 - \gamma_\Theta)q(\mathrm{B}, 1)] \\
&+\; d[\theta(1 - r_{\mathrm{A}}) + (1 - \theta)(1 - r_{\mathrm{D}})]q(2) + d\delta I(H) \\
&-\; c[Pr(\mathrm{A}|s = 2)Pr(s = 2|\Theta) + Pr(\mathrm{A}|\mathrm{G}, s = 1)Pr(\mathrm{G}, s = 1|\Theta) \\
&+\; Pr(\mathrm{A}|\mathrm{B}, s = 1)Pr(\mathrm{B}, s = 1|\Theta)] - c\delta[\theta r_{\mathrm{A}} + (1 - \theta)r_{\mathrm{D}}]Pr(\mathrm{A}|\Theta, s = 1) \\
&-\; c\delta[\theta(1 - r_{\mathrm{A}}) + (1 - \theta)(1 - r_{\mathrm{D}})]Pr(\mathrm{A}|\Theta, s = 2)].
\end{aligned}
\tag{7}
$$

Proof of Proposition 1: In a pure strategy equilibrium, one of the following four outsider beliefs must be confirmed.

1. $h = 0, l = 0$, *i.e.*, a high manager defers resolution and a low manager mimics. Intuitively, this belief is not an equilibrium because a high manager could advance in order to reveal his type without any adverse inference about incurring c.

2. $h = 1, l = 1$, *i.e.*, a high manager advances resolution and a low manager mimics. Intuitively, this is not an equilibrium because a low manager could defer in order to conceal his type without any adverse inference about his type (or about the failure to incur c even if $c < 0$).

3. $h = 0, l = 1$, *i.e.*, a high manager defers resolution and a low manager advances resolution. Intuitively, we do not expect Belief 3 to hold because a low manager prefers late resolution, and will defect if investors believe that a high manager defers resolution.

4. $h = 1, l = 0$, *i.e.*, a high manager advances resolution and a low manager defers resolution. Intuitively, we expect Belief 4 to hold only for some parameter values. For a sufficiently low cost of advancing resolution and a sufficiently low differential in the probability of good outcome, $(\gamma_{\mathrm{H}} - \gamma_{\mathrm{L}})$ a low manager will also advance resolution and the equilibrium breaks down. Similarly, if the cost of advancing resolution is high, a high manager will also defer resolution and once again the equilibrium breaks down.

We now describe parameter values under which Belief 4 is confirmed in equilibrium, and under which a mixed strategy equilibrium applies. Beliefs 1, 2 and 3 are inconsistent with equilibrium.

which the high manager is indifferent between advancing and deferring resolution. By (24), $c^H(1,0) = d$. Thus, $c^H(1,0) = c^L(1,0) > c^L(1,1)$.

If the pure strategy equilibrium of belief (4) does not exist, then for $c \in \left(c^L(1,1), c^L(1,0)\right)$, a high manager advances and a low manager randomizes between advancing and deferring resolution. We will show using a fixed point argument that when there is no pure strategy equilibrium, one or the other of the two mixed strategy equilibria will obtain.

If the pure strategy equilibrium does not exist, Belief 4 ($h = 1, l = 0$) fails because when $h = 1$ and $l = 0$, either a low manager prefers to advance resolution or a high manager prefers to defer resolution. Furthermore, we showed earlier that Belief 2 ($h = 1$, $l = 1$) fails, because when $l = 1$, a low manager prefers late resolution. Thus, when the investors conjecture $l = 0$ a low manager prefers to advance resolution (action $\hat{l} = 1$) and when the investors conjecture $l = 1$ a low manager prefers to defer (action $\hat{l} = 0$). In other words, $U^L(A) - U^L(D) > 0$ when $l = 0$ and $U^L(A) - U^L(D) < 0$ when $l = 1$. Furthermore, direct differentiation of (18) shows that $U^L(A) - U^L(D)$ is continuous and convex in l.

Let $l^* \in (0,1)$ be the candidate equilibrium, defined as the value of l where $U^L(A) - U^L(D) = 0$. A unique l^* exists because $U^L(A) - U^L(D)$ is continuous, convex, positive for $l = 0$ and negative for $l = 1$. By convexity, it follows that $U^L(A) - U^L(D)$ decreases in l at l^*. We shall refer to this fact as the *negative slope condition* (low manager, invisible case).

The pure strategy equilibrium can also fail because under Belief 4 ($h = 1, l = 0$) a high manager defers. Under such parameter values, we now show that a high manager randomizes. By (17) a high manager is indifferent between advancing and deferring resolution if

$$
\begin{aligned}
c^H(h,0) \quad & [\frac{r_A \gamma_H^2 h}{r_A \gamma_H h\lambda + r_D[\gamma_H(1-h)\lambda + \gamma_L(1-\lambda)]} \\
& + \frac{r_A(1-\gamma_H)^2 h}{r_A(1-\gamma_H)h\lambda + r_D[(1-\gamma_H)(1-h)\lambda + (1-\gamma_L)(1-\lambda)]} \\
& - \frac{(1-r_A)h}{(1-r_A)h\lambda + (1-r_D)[(1-h)\lambda + (1-\lambda)]} \\
& - \frac{\delta r_A h}{r_A h + r_D(1-h)} + \frac{\delta(1-r_A)h}{(1-r_A)h + (1-r_D)(1-h)}] \\
= d \quad & [\frac{[h(r_A - r_D) + r_D]\gamma_H^2}{[h(r_A - r_D) + r_D]\gamma_H\lambda + r_D\gamma_L(1-\lambda)} \\
& + \frac{[h(r_A - r_D) + r_D](1-\gamma_H)^2}{[h(r_A - r_D) + r_D](1-\gamma_H)\lambda + r_D(1-\gamma_L)(1-\lambda)} \\
& - \frac{1 - h(r_A - r_D) - r_D}{[1 - h(r_A - r_D) - r_D]\lambda + (1-r_D)(1-\lambda)}].
\end{aligned}
\tag{27}
$$

If $c > c^H(1,0)$, then Belief 4 ($h = 1, l = 0$) does not hold because H wishes to defer. Furthermore, we have shown earlier that Belief 1 ($h = 0, l = 0$) does not hold because H wishes to advance. In other words, $U^H(A) - U^H(D)$ is positive for $h = 0$ and negative for $h = 1$. Also, direct differentiation of (17) shows that $U^H(A) - U^H(D)$ is continuous and convex in h.

Let $h^* \in (0, 1)$ be the candidate equilibrium, defined as the value of h where $U^H(A) - U^H(D) = 0$. A unique h^* exists because $U^H(A) - U^H(D)$ is continuous, convex, positive for $h = 0$ and negative for $h = 1$. For $h > h^*$ a high manager will want to defer resolution and for $h < h^*$ a high manager will want to advance resolution.

Comparative Statics with Respect to r_A: Setting $\partial E_0[V_1 + \delta V_2 | L] / \partial l = 0$ in (7) gives

$$
\begin{aligned}
0 = F(\cdot) &= (r_A - r_D)d[\gamma_L q(G, 1) + (1 - \gamma_L)q(B, 1) - q(2)] \\
&\quad - (r_A - r_D)c[\gamma_L Pr(A|G, s = 1) + (1 - \gamma_L)Pr(A|B, s = 1) - Pr(A|s = 2)] \\
&\quad - (r_A - r_D)c\delta[Pr(A|L, s = 1) - Pr(A|L, s = 2)],
\end{aligned}
\tag{28}
$$

where $F(\cdot)$ is a function of l^*, r_A, r_D, γ_H, γ_L and λ. In a mixed strategy equilibrium with a low manager indifferent, (28) must be zero regardless of l.

Let $c = 0$. Then, (28) can be written as

$$
\gamma_L q(G, 1) + (1 - \gamma_L)q(B, 1) = q(2).
\tag{29}
$$

Fixing l^*, consider the partial derivative of (29) with respect to r_A. The derivative of the LHS of (29) is positive because

$$
\frac{\partial q(G, 1)}{\partial r_A} = \frac{\gamma_H \gamma_L r_D (1 - l^*)\lambda(1 - \lambda)}{\{r_A \gamma_H \lambda + [l^*(r_A - r_D) + r_D]\gamma_L(1 - \lambda)\}^2} > 0,
$$

and

$$
\frac{\partial q(B, 1)}{\partial r_A} = \frac{(1 - \gamma_H)(1 - \gamma_L)r_D(1 - l^*)\lambda(1 - \lambda)}{\{r_A(1 - \gamma_H)\lambda + [l^*(r_A - r_D) + r_D](1 - \gamma_L)(1 - \lambda)\}^2} > 0.
$$

The derivative of the RHS of (29) is negative because

$$
\frac{\partial q(2)}{\partial r_A} = -\frac{(1 - r_D)(1 - l^*)\lambda(1 - \lambda)}{\{(1 - r_A)\lambda + [1 - l^*(r_A - r_D) - r_D](1 - \lambda)\}^2} < 0.
$$

It follows that the derivative of the RHS with respect to r_A is negative, *i.e.*, $\partial \text{LHS}/\partial r_A > \partial \text{RHS}/\partial r_A$ if l^* is kept fixed. Thus, by the negative slope condition (low manager), an increase in l^* is required to bring about equality between the gain to advancing and the gain to deferring resolution. Thus, the mixed strategy equilibrium requires $\partial l^*/\partial r_A > 0$.

Comparative Statics with Respect to δ:

Since $F(\cdot) \equiv 0$, by the implicit function theorem

$$
\frac{\partial l^*}{\partial \delta} = -\frac{\frac{\partial F(\cdot)}{\partial \delta}}{\frac{\partial F(\cdot)}{\partial l^*}}
$$

By the negative slope condition (low manager, invisible case), $\frac{\partial F(\cdot)}{\partial l}|_{l=l^*} < 0$. Thus, sign $(\partial l^*/\partial \delta) = $ sign $(\partial F(\cdot)/\partial \delta)$. Differentiating (28) with respect to δ gives $\partial F(\cdot)/\partial \delta < 0$ for $c > 0$ which implies that $\partial l^*/\partial \delta < 0$ for $c > 0$.

Proof of Proposition 2 and its Corollary: In the visible case the manager's choice is observed by investors. Since the actual timing of the resolution is no longer informative about the manager's decision, and if both A and D can occur with a positive probability, the probabilities of equations (10) through (11) become

$$q(A) = \frac{h\lambda}{h\lambda + l(1-\lambda)},$$

$$q(D) = \frac{(1-h)\lambda}{(1-h)\lambda + (1-l)(1-\lambda)},$$

$$q(G,A) = \frac{h\gamma_H\lambda}{h\gamma_H\lambda + l\gamma_L(1-\lambda)},$$

$$q(G,D) = \frac{(1-h)\gamma_H\lambda}{(1-h)\gamma_H\lambda + (1-l)\gamma_L(1-\lambda)},$$

$$q(B,A) = \frac{h(1-\gamma_H)\lambda}{h(1-\gamma_H)\lambda + l(1-\gamma_L)(1-\lambda)},$$

$$q(B,D) = \frac{(1-h)(1-\gamma_H)\lambda}{(1-h)(1-\gamma_H)\lambda + (1-l)(1-\gamma_L)(1-\lambda)}. \tag{30}$$

The gain to High of advancing is then

$$
\begin{aligned}
U^H(A) \;-\; U^H(D) =\; & -(1+\delta)c \\
& + dr_A[\gamma_H q(G,A) + (1-\gamma_H)q(B,A)] + d(1-r_A)q(A) \\
& - dr_D[\gamma_H q(G,D) + (1-\gamma_H)q(B,D)] - d(1-r_D)q(D).
\end{aligned} \tag{31}
$$

(18) becomes

$$
\begin{aligned}
U^L(A) \;-\; U^L(D) =\; & -(1+\delta)c \\
& + dr_A[\gamma_L q(G,A) + (1-\gamma_L)q(B,A)] + d(1-r_A)q(A) \\
& - dr_D[\gamma_L q(G,D) + (1-\gamma_L)q(B,D)] - d(1-r_D)q(D).
\end{aligned} \tag{32}
$$

Belief 5 $h = 0, l = 0$ *and a defection to advance is attributed, with probability β_A to a high manager.*

(30) now becomes

$$q(A) = \beta_A, \quad q(D) = \lambda$$

$$q(G,A) = \frac{\gamma_H\beta_A}{\gamma_H\beta_A + \gamma_L(1-\beta_A)}$$

$$q(G,D) = \frac{(1-h)\gamma_H\lambda}{(1-h)\gamma_H\lambda + (1-l)\gamma_L(1-\lambda)}$$

$$q(B,A) = \frac{(1-\gamma_H)\beta_A}{(1-\gamma_H)\beta_A + (1-\gamma_L)(1-\beta_A)}$$

$$q(B,D) = \frac{(1-h)(1-\gamma_H)\lambda}{(1-h)(1-\gamma_H)\lambda + (1-l)(1-\gamma_L)(1-\lambda)}.$$

(31) becomes

$$U^H(A) \quad - \quad U^H(D) = -(1+\delta)c$$
$$+ \quad dr_A\beta_A\left[\frac{\gamma_H^2}{\gamma_H\beta_A + \gamma_L(1-\beta_A)} + \frac{(1-\gamma_H)^2}{(1-\gamma_H)\beta_A + (1-\gamma_L)(1-\beta_A)}\right] + d\beta_A(1-r_A)$$
$$- \quad dr_D\lambda\left[\frac{\gamma_H^2}{\gamma_H\lambda + \gamma_L(1-\lambda)} + \frac{(1-\gamma_H)^2}{(1-\gamma_H)\lambda + (1-\gamma_L)(1-\lambda)}\right] - d\lambda(1-r_D), \quad (33)$$

and (32) becomes

$$U^L(A) \quad - \quad U^L(D) = -(1+\delta)c$$
$$+ \quad dr_A\beta_A\left[\frac{\gamma_H\gamma_L}{\gamma_H\beta_A + \gamma_L(1-\beta_A)} + \frac{(1-\gamma_H)(1-\gamma_L)}{(1-\gamma_H)\beta_A + (1-\gamma_L)(1-\beta_A)}\right] + d\beta_A(1-r_A)$$
$$- \quad dr_D\lambda\left[\frac{\gamma_H\gamma_L}{\gamma_H\lambda + \gamma_L(1-\lambda)} + \frac{(1-\gamma_H)(1-\gamma_L)}{(1-\gamma_H)\lambda + (1-\gamma_L)(1-\lambda)}\right] - d\lambda(1-r_A). \quad (34)$$

For $\beta_A = \lambda$, $U^L(A) - U^L(D) < 0$ by (34). Also, $U^L(A) - U^L(D)$ is increasing in β_A. Thus, if $\beta_A \le \lambda$ a low manager never defects. If $\beta_A \ge \lambda$, then by (33) and (34)

$$[U^H(A) \quad - \quad U^H(D)] - [U^L(A) - U^L(D)]$$
$$= \quad d(\gamma_H - \gamma_L)r_A\beta_A\left[\frac{\gamma_H}{\gamma_H\beta_A + \gamma_L(1-\beta_A)} - \frac{(1-\gamma_H)}{(1-\gamma_H)\beta_A + (1-\gamma_L)(1-\beta_A)}\right]$$
$$- \quad d(\gamma_H - \gamma_L)r_D\lambda\left[\frac{\gamma_H}{\gamma_H\lambda + \gamma_L(1-\lambda)} + \frac{1-\gamma_H}{(1-\gamma_H)\lambda + (1-\gamma_L)(1-\lambda)}\right]$$
$$> \quad 0. \quad (35)$$

(35) shows that a high manager will defect for a strictly larger set of responses by investors than a low manager.[34] Thus, the weak Banks and Sobel (1987) criterion for reasonable beliefs ("Divinity") states that investors must infer $\beta_A \ge \lambda$. $c^H(0,0;\beta_A)$ is that value of c at which a high manager is just indifferent between advancing and deferring resolution. Similarly, $c^L(0,0;\beta_A)$ is that value of c at which a low manager is just indifferent between advancing and deferring resolution. By (33) and (34) it is clear that $c^H(0,0;\beta_A) > c^L(0,0;\beta_A)$. For a sufficiently high c both types defer resolution since advancing resolution is a strongly negative net present value expenditure. As c decreases a high manager will defect first (and then as c decreases further a low manager will also defect to advance resolution) thus breaking the equilibrium. Examination of (33) shows that if $c \le 0$ and $\beta_A \ge \lambda$ then a high manager defects to advance, breaking the equilibrium.

Belief 6 $h = 1, l = 1$ *and a defection to defer is attributed, with probability β_D to a high manager.*

(30) now becomes

$$q(A) \quad = \quad \lambda, \quad q(D) = \beta_D$$

---

[34]The set is strictly larger unless the cost of advancing is so large that neither a high nor a low manager defects regardless of investor beliefs.

$$q(\mathrm{G},\mathrm{A}) = \frac{h\gamma_{\mathrm{H}}\lambda}{h\gamma_{\mathrm{H}}\lambda + l\gamma_{\mathrm{L}}(1-\lambda)},$$

$$q(\mathrm{G},\mathrm{D}) = \frac{\gamma_{\mathrm{H}}\beta_{\mathrm{D}}}{\gamma_{\mathrm{H}}\beta_{\mathrm{D}} + \gamma_{\mathrm{L}}(1-\beta_{\mathrm{D}})},$$

$$q(\mathrm{B},\mathrm{A}) = \frac{h(1-\gamma_{\mathrm{H}})\lambda}{h(1-\gamma_{\mathrm{H}})\lambda + l(1-\gamma_{\mathrm{L}})(1-\lambda)},$$

$$q(\mathrm{B},\mathrm{D}) = \frac{(1-\gamma_{\mathrm{H}})\beta_{\mathrm{D}}}{(1-\gamma_{\mathrm{H}})\beta_{\mathrm{D}} + (1-\gamma_{\mathrm{L}})(1-\beta_{\mathrm{D}})}.$$

(31) now becomes

$$
\begin{aligned}
U^{\mathrm{H}}(\mathrm{A}) \;-\; & U^{\mathrm{H}}(\mathrm{D}) = -(1+\delta)c \\
- \; & dr_{\mathrm{D}}\beta_{\mathrm{D}}\Big[\frac{\gamma_{\mathrm{H}}^2}{\gamma_{\mathrm{H}}\beta_{\mathrm{D}} + \gamma_{\mathrm{L}}(1-\beta_{\mathrm{D}})} + \frac{(1-\gamma_{\mathrm{H}})^2}{(1-\gamma_{\mathrm{H}})\beta_{\mathrm{D}} + (1-\gamma_{\mathrm{L}})(1-\beta_{\mathrm{D}})}\Big] - d\beta_{\mathrm{D}}(1-r_{\mathrm{D}}) \\
+ \; & dr_{\mathrm{A}}\lambda\Big[\frac{\gamma_{\mathrm{H}}^2}{\gamma_{\mathrm{H}}\lambda + \gamma_{\mathrm{L}}(1-\lambda)} + \frac{(1-\gamma_{\mathrm{H}})^2}{(1-\gamma_{\mathrm{H}})\lambda + (1-\gamma_{\mathrm{L}})(1-\lambda)}\Big] + d\lambda(1-r_{\mathrm{A}}). \qquad (36)
\end{aligned}
$$

By (36) if $\beta_{\mathrm{D}} = \lambda$ and $c \le 0$ then $U^{\mathrm{H}}(\mathrm{D}) - U^{\mathrm{H}}(\mathrm{A}) < 0$. Also, $U^{\mathrm{H}}(\mathrm{D}) - U^{\mathrm{H}}(\mathrm{A})$ is increasing in β_{D}. Thus, if $\beta_{\mathrm{D}} > \lambda$ a high manager may defect to defer resolution but if $\beta_{\mathrm{D}} \le \lambda$ a high manager will not defect. (32) now becomes

$$
\begin{aligned}
U^{\mathrm{L}}(\mathrm{A}) \;-\; & U^{\mathrm{L}}(\mathrm{D}) = -(1+\delta)c \\
- \; & dr_{\mathrm{D}}\beta_{\mathrm{D}}\Big[\frac{\gamma_{\mathrm{H}}\gamma_{\mathrm{L}}}{\gamma_{\mathrm{H}}\beta_{\mathrm{D}} + \gamma_{\mathrm{L}}(1-\beta_{\mathrm{D}})} + \frac{(1-\gamma_{\mathrm{H}})(1-\gamma_{\mathrm{L}})}{(1-\gamma_{\mathrm{H}})\beta_{\mathrm{D}} + (1-\gamma_{\mathrm{L}})(1-\beta_{\mathrm{D}})}\Big] - d\beta_{\mathrm{D}}(1-r_{\mathrm{D}}) \\
+ \; & dr_{\mathrm{A}}\lambda\Big[\frac{\gamma_{\mathrm{H}}\gamma_{\mathrm{L}}}{\gamma_{\mathrm{H}}\lambda + \gamma_{\mathrm{L}}(1-\lambda)} + \frac{(1-\gamma_{\mathrm{H}})(1-\gamma_{\mathrm{L}})}{(1-\gamma_{\mathrm{H}})\lambda + (1-\gamma_{\mathrm{L}})(1-\lambda)}\Big] + d\lambda(1-r_{\mathrm{A}}). \qquad (37)
\end{aligned}
$$

By (37), if $\beta_{\mathrm{D}} = \lambda$ then, $U^{\mathrm{L}}(\mathrm{D}) - U^{\mathrm{L}}(\mathrm{A}) > 0$. Also, $U^{\mathrm{L}}(\mathrm{D}) - U^{\mathrm{L}}(\mathrm{A})$ is increasing in β_{D} and a low manager defects if $\beta_{\mathrm{D}} \ge \lambda$. If $\beta_{\mathrm{D}} \le \lambda$ and by (36) and (37)

$$
\begin{aligned}
[U^{\mathrm{L}}(\mathrm{D}) \;-\; & U^{\mathrm{L}}(\mathrm{A})] - [U^{\mathrm{H}}(\mathrm{D}) - U^{\mathrm{H}}(\mathrm{A})] \\
= \; & -d(\gamma_{\mathrm{H}} - \gamma_{\mathrm{L}})r_{\mathrm{D}}\beta_{\mathrm{D}}\Big[\frac{\gamma_{\mathrm{H}}}{\gamma_{\mathrm{H}}\beta_{\mathrm{D}} + \gamma_{\mathrm{L}}(1-\beta_{\mathrm{D}})} - \frac{(1-\gamma_{\mathrm{H}})}{(1-\gamma_{\mathrm{H}})\beta_{\mathrm{D}} + (1-\gamma_{\mathrm{L}})(1-\beta_{\mathrm{D}})}\Big] \\
+ \; & d(\gamma_{\mathrm{H}} - \gamma_{\mathrm{L}})r_{\mathrm{A}}\lambda\Big[\frac{\gamma_{\mathrm{H}}}{\gamma_{\mathrm{H}}\lambda + \gamma_{\mathrm{L}}(1-\lambda)} - \frac{1-\gamma_{\mathrm{H}}}{(1-\gamma_{\mathrm{H}})\lambda + (1-\gamma_{\mathrm{L}})(1-\lambda)}\Big] \\
> \; & 0. \qquad (38)
\end{aligned}
$$

Equation (38) shows that a low manager will defect for a strictly larger set of investor responses than a high manager. Thus, the weak Banks and Sobel (1987) criterion for reasonable beliefs states that $\beta_{\mathrm{D}} \le \lambda$. From (38), $c^{\mathrm{H}}(1,1;\beta_{\mathrm{D}}) > c^{\mathrm{L}}(1,1;\beta_{\mathrm{D}})$. For a sufficiently low c neither a high nor a low manager defects since the direct benefit of early resolution exceeds the slightly negative net present value. As c increases, a low manager will be the first to defect (and then as c rises further a high manager will also defect to defer resolution) thus breaking the equilibrium. If $c \le 0$ and $\beta_{\mathrm{D}} \le \lambda$ a high manager will not defect to defer resolution.

Belief 7 $h = 0, l = 1$

(31) and (32) now become

$$U^H(A) - U^H(D) = U^L(A) - U^L(D) = -d - (1+\delta)c. \tag{39}$$

Thus, high and low types will either both advance or both defer, implying that the conjectured equilibrium does not hold (unless $c = -d/(1+\delta)$, in which case it holds weakly).

Belief 8 $h = 1, l = 0$

(31) and (32) now become

$$U^H(A) - U^H(D) = U^L(A) - U^L(D) = d - (1+\delta)c, \tag{40}$$

so high and low types will either both advance or both defer, implying that the conjectured Belief 8 equilibrium does not hold (unless $c = d/(1+\delta)$, in which case it holds weakly).

Pure Strategy and Mixed Strategy Equilibria: We now analyze the incentives for a high and a low manager to randomize. We first dispose of an unreasonable equilibrium in which a high manager randomizes. A high manager is indifferent between advancing and deferring resolution if

$$
\begin{aligned}
U^H(A) \quad - \quad & U^H(D) = d - (1+\delta)c \\
- \quad & dr_D\lambda\left[\frac{(1-h)\gamma_H^2}{(1-h)\gamma_H\lambda + \gamma_L(1-\lambda)} + \frac{(1-h)(1-\gamma_H)^2}{(1-h)(1-\gamma_H)\lambda + (1-\gamma_L)(1-\lambda)}\right] \\
- \quad & d(1 - r_D)\lambda\left[\frac{1-h}{1-h\lambda}\right].
\end{aligned}
\tag{41}
$$

If in (41) $c \leq 0$, a high manager will advance resolution, breaking this equilibrium. For all c, by (41), the higher is h the greater is the benefit to advancing resolution, which we will refer to as the *increasing monotonicity condition* (high manager).

If investors believe that $h = 1$, then the indifference condition derived from (41) becomes $c^H(1,0) = d/(1+\delta)$. If investors believe that $h = 0$, then the indifference condition becomes

$$
\begin{aligned}
(1+\delta)c \quad = \quad & (1+\delta)c^H(0,0) = d \\
- \quad & dr_D\lambda\left[\frac{\gamma_H^2}{\gamma_H\lambda + \gamma_L(1-\lambda)} + \frac{(1-\gamma_H)^2}{(1-\gamma_H)\lambda + (1-\gamma_L)(1-\lambda)}\right] - d\lambda(1 - r_D).
\end{aligned}
\tag{42}
$$

By (42), $c^H(1,0) > c^H(0,0)$. For $c > c^H(1,0)$ a high manager will defer resolution and for $c < c^H(1,0)$ he advances resolution. If $c \in (c^H(0,0), c^H(1,0))$, then if $h = 1$, by (41) H advances, and if $h = 0$ he defers. Thus, by the increasing monotonicity condition on h, there exists a value $h(c)$ such that, a high manager will be indifferent between advancing and deferring resolution. However, by the increasing monotonicity condition this is an unreasonable equilibrium because if investors belief h is slightly higher than $h(c)$, the high manager will want

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to advance resolution, and if the investors belief h is slightly lower than $h(c)$, a high manager will want to defer resolution.

We now turn to a reasonable equilibrium in which a high manager advances and a low manager randomizes. A low manager will randomize between advancing and deferring if

$$
\begin{aligned}
U^{\mathrm{L}}(\mathrm{A}) \quad - \quad U^{\mathrm{L}}(\mathrm{D}) = &-(1+\delta)c \\
&+ \ dr_{\mathrm{A}}\Big[\frac{\gamma_{\mathrm{H}}\gamma_{\mathrm{L}}\lambda}{\gamma_{\mathrm{H}}\lambda + l\gamma_{\mathrm{L}}(1-\lambda)} + \frac{(1-\gamma_{\mathrm{H}})(1-\gamma_{\mathrm{L}})\lambda}{(1-\gamma_{\mathrm{H}})\lambda + l(1-\gamma_{\mathrm{L}})(1-\lambda)}\Big] + \frac{d(1-r_{\mathrm{A}})\lambda}{\lambda + l(1-\lambda)}. \quad (43)
\end{aligned}
$$

If in (43) $c \leq 0$, a low manager will advance resolution, breaking this equilibrium. For all c, if $l = 0$, (43) becomes $c^{\mathrm{L}}(1,0) = d\,(1+\delta)$. For $l = 1$, (43) becomes

$$
\begin{aligned}
(1+\delta)c \quad = \quad (1+&\delta)c^{\mathrm{L}}(1,1) = \\
&+ \ dr_{\mathrm{A}}\Big[\frac{\gamma_{\mathrm{H}}\gamma_{\mathrm{L}}\lambda}{\gamma_{\mathrm{H}}\lambda + \gamma_{\mathrm{L}}(1-\lambda)} + \frac{(1-\gamma_{\mathrm{H}})(1-\gamma_{\mathrm{L}})\lambda}{(1-\gamma_{\mathrm{H}})\lambda + (1-\gamma_{\mathrm{L}})(1-\lambda)}\Big] + d(1-r_{\mathrm{A}})\lambda. \quad (44)
\end{aligned}
$$

When $c \in (c^{\mathrm{L}}(1,1), c^{\mathrm{L}}(1,0))$, a high manager advances and a low manager randomizes between advancing and deferring resolution, thus, giving us the mixed strategy equilibrium. By (43) $U^{\mathrm{L}}(\mathrm{A}) - U^{\mathrm{L}}(\mathrm{D})$ decreases monotonically in the outsider's conjectured l. We shall refer to this as the *decreasing monotonicity condition* (low manager). Belief 8 does not hold as a pure strategy equilibrium when $c < c^{\mathrm{L}}(1,0)$ because a low manager profits from advancing resolution. Belief 6 $(h = 1, l = 1)$ does not hold when $c > c^{\mathrm{L}}(1,1)$, because when $l = 1$ a low manager prefers to defer resolution. It follows by the decreasing monotonicity condition that there exists an intermediate belief l between zero and one where the payoffs to a low manager is equal from advancing or deferring resolution, consistent with his randomizing.

$c^{\mathrm{H}}(1,0) > c^{\mathrm{L}}(1,0) > c^{\mathrm{L}}(1,1)$. If $c > c^{\mathrm{H}}(1,0)$ a high manager will defer resolution because advancing involves a large negative net present value expenditure. If $c < c^{\mathrm{L}}(1,1)$ a low manager will advance resolution because advancing no longer involves a large negative net present value expenditure and also because advancing provides a favorable signal that the manager is high.

Comparative Statics with Respect to δ:

By (43) a low manager is indifferent between advancing and deferring resolution if

$$
\begin{aligned}
(1+\delta)c \quad = \quad (1 - r_{\mathrm{A}})d\frac{\lambda}{\lambda + l(1-\lambda)} \\
+ \ dr_{\mathrm{A}}\Big[\frac{\gamma_{\mathrm{H}}\gamma_{\mathrm{L}}\lambda}{\gamma_{\mathrm{H}}\lambda + l\gamma_{\mathrm{L}}(1-\lambda)} + \frac{(1-\gamma_{\mathrm{H}})(1-\gamma_{\mathrm{L}})\lambda}{(1-\gamma_{\mathrm{H}})\lambda + l(1-\gamma_{\mathrm{L}})(1-\lambda)}\Big]. \quad (45)
\end{aligned}
$$

By differentiating (45) with respect to δ, it can be shown that $\partial l / \partial \delta < 0$ for $c > 0$.

Proof of Proposition 3: Under risk neutrality, the stock price just before the manager's decision to advance or defer (V_0^-) is the expected value of the stock price after the decision (V_0^+). We consider values of c such that the mixed strategy equilibrium obtains in which a high manager advances resolution and a low manager randomizes. Then

$$
V_0^- = [\lambda + l^*(1-\lambda)]V_0^+(\mathrm{A}) + (1 - l^*)(1-\lambda)V_0^+(\mathrm{D}). \quad (46)
$$

We will now show that $V_0^+(A) > V_0^+(D)$. Without loss of generality, let the riskfree rate be zero. Then efficient stock prices under risk neutrality follow a martingale, so $(1+\delta)V_0^+(A)$ and $(1+\delta)V_0^+(D)$ can be written as

$$
\begin{aligned}
(1+\delta)V_0^+(A) \;=\; & Pr(H|A)\{E_0^H[V_1(A,\sigma)] + \delta[V_2(A,H)]\} \\
& + Pr(L|A)\{E_0^L[V_1(A,\sigma)] + \delta[V_2(A,L)]\}.
\end{aligned}
\tag{47}
$$

$$
(1+\delta)V_0^+(D) = V_1(D,L) + \delta V_2(D,L) = (1+\delta)V(D,L).
\tag{48}
$$

where σ is a vector that represents all information available to investors at date t, including the resolution date, and if news has arrived by date 1, the outcome G or B. $V(D,L) \equiv V_1(D,L) = V_2(D,L)$. By (47)

$$
\begin{aligned}
(1+\delta)V_0^+(A) \;>\; & Pr(H|A)\{(1+\delta)V(D,L)\} \\
& + Pr(L|A)\{E_0^L[V_1(A,\sigma)] + \delta V_2(A,L)\} \\
=\; & Pr(H|A)(1+\delta)V(D,L) + Pr(L|A)(1+\delta)V(D,L) \\
=\; & (1+\delta)V_0^+(D).
\end{aligned}
\tag{49}
$$

The first inequality of (49) holds because we have shown that a high manager strictly prefers to advance resolution under the mixed strategy equilibrium. The second equality of (49) holds because a low manager is indifferent between advancing and deferring resolution. The third equality holds by (48). Since $V_0^+(A) > V_0^+(D)$, the stock price rises when a decision to advance becomes public, and declines when a decision to defer becomes public.

To derive the various probabilities in (7), note that

$$
\begin{aligned}
Pr(\text{G}, s = 1|\Theta) &= \gamma_\Theta[\theta r_\text{A} + (1 - \theta)r_\text{D}] \\
Pr(\text{B}, s = 1|\Theta) &= (1 - \gamma_\Theta)[\theta r_\text{A} + (1 - \theta)r_\text{D}] \\
Pr(s = 2|\Theta) &= \theta(1 - r_\text{A}) + (1 - \theta)(1 - r_\text{D}).
\end{aligned} \tag{8}
$$

By (4) and (5) in the text,

$$
\begin{aligned}
q(\text{G}, 1) &= Pr(\text{H}|\text{G}, 1) \\
&= \frac{[h(r_\text{A} - r_\text{D}) + r_\text{D}]\gamma_\text{H}\lambda}{[h(r_\text{A} - r_\text{D}) + r_\text{D}]\gamma_\text{H}\lambda + [l(r_\text{A} - r_\text{D}) + r_\text{D}]\gamma_\text{L}(1 - \lambda)}.
\end{aligned} \tag{9}
$$

$$
q(2) = Pr(\text{H}|2) = \frac{Pr(2|\text{H})\lambda}{Pr(2|\text{H})\lambda + Pr(2|\text{L})(1 - \lambda)}.
$$

$$
\begin{aligned}
Pr(2|\text{H}) &= 1 - h(r_\text{A} - r_\text{D}) - r_\text{D}, \\
Pr(2|\text{L}) &= 1 - l(r_\text{A} - r_\text{D}) - r_\text{D}.
\end{aligned}
$$

Thus

$$
q(2) = \frac{[1 - h(r_\text{A} - r_\text{D}) - r_\text{D}]\lambda}{[1 - h(r_\text{A} - r_\text{D}) - r_\text{D}]\lambda + [1 - l(r_\text{A} - r_\text{D}) - r_\text{D}](1 - \lambda)}. \tag{10}
$$

Similarly,

$$
\begin{aligned}
q(\text{B}, 1) &= Pr(\text{H}|\text{B}, 1) \\
&= \frac{[h(r_\text{A} - r_\text{D}) + r_\text{D}](1 - \gamma_\text{H})\lambda}{[h(r_\text{A} - r_\text{D}) + r_\text{D}](1 - \gamma_\text{H})\lambda + [l(r_\text{A} - r_\text{D}) + r_\text{D}](1 - \gamma_\text{L})(1 - \lambda)},
\end{aligned} \tag{11}
$$

$$
\begin{aligned}
Pr(\text{A}|s = 2) &= \frac{Pr(s = 2|\text{A})Pr(\text{A})}{Pr(s = 2|\text{A})Pr(\text{A}) + Pr(s = 2|\text{D})Pr(\text{D})} \\
&= \frac{(1 - r_\text{A})[h\lambda + l(1 - \lambda)]}{(1 - r_\text{A})[h\lambda + l(1 - \lambda)] + (1 - r_\text{D})[(1 - h)\lambda + (1 - l)(1 - \lambda)]}.
\end{aligned} \tag{12}
$$

Similarly,

$$
Pr(\text{A}|\text{G}, s = 1) = \frac{r_\text{A}[h\gamma_\text{H}\lambda + l\gamma_\text{L}(1 - \lambda)]}{r_\text{A}[h\gamma_\text{H}\lambda + l\gamma_\text{L}(1 - \lambda)] + r_\text{D}[(1 - h)\gamma_\text{H}\lambda + (1 - l)\gamma_\text{L}(1 - \lambda)]}. \tag{13}
$$

$$
Pr(\text{A}|\text{B}, s = 1) =
$$
$$
\frac{r_\text{A}[h(1 - \gamma_\text{H})\lambda + l(1 - \gamma_\text{L})(1 - \lambda)]}{r_\text{A}[h(1 - \gamma_\text{H})\lambda + l(1 - \gamma_\text{L})(1 - \lambda)] + r_\text{D}[(1 - h)(1 - \gamma_\text{H})\lambda + (1 - l)(1 - \gamma_\text{L})(1 - \lambda)]} \tag{14}
$$

$$
Pr(\text{A}|\Theta, s = 1) = \frac{r_A\theta}{r_A\theta + r_D(1 - \theta)}. \tag{15}
$$

$$Pr(A|\Theta, s=1) = \frac{(1-r_A)\theta}{(1-r_A)\theta + (1-r_D)(1-\theta)}.$$ (16)

By (7), the gain to a high manager of advancing is

$$\begin{aligned}
U^H(A) \quad - \quad U^H(D) = {} & (r_A - r_D)d[\gamma_H q(G,1) + (1-\gamma_H)q(B,1) - q(2)] \\
& - (r_A - r_D)c[\gamma_H Pr(A|G, s=1) + (1-\gamma_H)Pr(A|B, s=1) - Pr(A|s=2)] \\
& - (r_A - r_D)c\delta[Pr(A|H, s=1) - Pr(A|H, s=2)].
\end{aligned}$$ (17)

Similarly, for a low manager

$$\begin{aligned}
U^L(A) \quad - \quad U^L(D) = {} & (r_A - r_D)d[\gamma_L q(G,1) + (1-\gamma_L)q(B,1) - q(2)] \\
& - (r_A - r_D)c[\gamma_L Pr(A|G, s=1) + (1-\gamma_L)Pr(A|B, s=1) - Pr(A|s=2)] \\
& - (r_A - r_D)c\delta[Pr(A|L, s=1) - Pr(A|L, s=2)].
\end{aligned}$$ (18)

Belief 1 $h=0$, $l=0$:

(17) can be written as

$$U^H(A) \quad - \quad U^H(D) = (r_A - r_D)d[\gamma_H q(G,1) + (1-\gamma_H)q(B,1) - q(2)].$$ (19)

In such a proposed equilibrium, a high manager will defect by advancing resolution if $U^H(A) - U^H(D) > 0$. By (19), it follows that a high manager defects if

$$\gamma_H q(G,1) + (1-\gamma_H)q(B,1) > q(2).$$ (20)

(20) reduces to $(\gamma_H - \gamma_L)^2 > 0$, which holds as a strict inequality because $\gamma_H > \gamma_L$. Thus, a high manager defects and Belief 1 is not a Perfect Bayesian Equilibrium.

Belief 2 $h=1$, $l=1$

(18) can be written as

$$U^L(A) \quad - \quad U^L(D) = (r_A - r_D)d[\gamma_L q(G,1) + (1-\gamma_L)q(B,1) - q(2)].$$ (21)

By (21) a sufficient condition for a low manager to defect is

$$\gamma_L q(G,1) + (1-\gamma_L)q(B,1) < q(2).$$ (22)

(22) reduces to $(\gamma_H - \gamma_L)^2 > 0$, which holds as a strict inequality because $\gamma_H > \gamma_L$. Thus, a low manager defects and Belief 2 is not a Perfect Bayesian Equilibrium.

Belief 3 $h=0$, $l=1$

By (18), a low manager defects if

$$\begin{aligned}
\gamma_L \Big[\frac{dr_D\gamma_H\lambda - cr_A\gamma_L(1-\lambda)}{r_D\gamma_H\lambda + r_A\gamma_L(1-\lambda)} \Big] \quad & + \quad (1-\gamma_L)\Big[\frac{dr_D(1-\gamma_H)\lambda - cr_A(1-\gamma_L)(1-\lambda)}{r_D(1-\gamma_H)\lambda + r_A(1-\gamma_L)(1-\lambda)} \Big] \\
& < \frac{d(1-r_D)\lambda - c(1-r_A)(1-\lambda)}{(1-r_D)\lambda + (1-r_A)(1-\lambda)},
\end{aligned}$$ (23)

(23) holds strictly since $r_A > r_D$ and $\gamma_H > \gamma_L$. Thus, Belief 3 is not an equilibrium.

Belief 4 $h = 1, l = 0$

By (17) a high manager advances resolution if

$$(d-c)[\frac{r_A\gamma_H^2\lambda}{r_A\gamma_H\lambda + r_D\gamma_L(1-\lambda)} + \frac{r_A(1-\gamma_H)^2\lambda}{r_A(1-\gamma_H)\lambda + r_D(1-\gamma_L)(1-\lambda)}$$
$$-\frac{(1-r_A)\lambda}{(1-r_A)\lambda + (1-r_D)(1-\lambda)}] > 0. \tag{24}$$

(24) holds as long as $d > c$. By (18) a low manager defers resolution if

$$(d-c)[\frac{r_A\gamma_H\gamma_L\lambda}{r_A\gamma_H\lambda + r_D\gamma_L(1-\lambda)} + \frac{r_A(1-\gamma_H)(1-\gamma_L)\lambda}{r_A(1-\gamma_H)\lambda + r_D(1-\gamma_L)(1-\lambda)}$$
$$-\frac{(1-r_A)\lambda}{(1-r_A)\lambda + (1-r_D)(1-\lambda)}] < 0. \tag{25}$$

If $d > c$, (25) holds for sufficiently large $\gamma_H - \gamma_L$. If a low manager's probability of receiving G is sufficiently lower than that of a high manager, the low manager will defer resolution resulting in a pure strategy equilibrium. In other words, there exist parameter values for which a high manager advances and the low manager defers resolution. Thus, Belief 4 is a Perfect Bayesian Equilibrium for certain parameter values only.

Mixed Strategy Equilibria: We begin with an equilibrium in which a high manager advances and a low manager randomizes. A low manager is indifferent between A and D if

$$c^L(1,l) \quad [\frac{r_A\gamma_L[\gamma_H\lambda + \gamma_L l(1-\lambda)]}{r_A[\gamma_H\lambda + \gamma_L l(1-\lambda)] + r_D\gamma_L(1-l)(1-\lambda)}$$
$$+ \frac{r_A(1-\gamma_L)[(1-\gamma_H)\lambda + (1-\gamma_L)l(1-\lambda)]}{r_A[(1-\gamma_H)\lambda + (1-\gamma_L)l(1-\lambda)] + r_D(1-\gamma_L)(1-l)(1-\lambda)}$$
$$- \frac{(1-r_A)[\lambda + l(1-\lambda)]}{(1-r_A)[\lambda + l(1-\lambda)] + (1-r_D)(1-l)(1-\lambda)}$$
$$- \frac{\delta r_A l}{r_A l + r_D(1-l)} + \frac{\delta(1-r_A)l}{(1-r_A)l + (1-r_D)(1-l)}]$$
$$= d \quad [\frac{r_A\gamma_H\gamma_L\lambda}{r_A\gamma_H\lambda + [l(r_A - r_D) + r_D]\gamma_L(1-\lambda)}$$
$$+ \frac{r_A(1-\gamma_H)(1-\gamma_L)\lambda}{r_A(1-\gamma_H)\lambda + [l(r_A - r_D) + r_D](1-\gamma_L)(1-\lambda)}$$
$$- \frac{(1-r_A)\lambda}{(1-r_A)\lambda + [1 - l(r_A - r_D) - r_D](1-\lambda)}]. \tag{26}$$

If investors believe $l = 0$, then by (26) $c^L(1,0) = d$. Recall that, if investors believe $l = 1$ then we are in the belief (2) regime and the pure strategy equilibrium does not obtain because a low manager always defects. In other words, $c^L(1,1) = -\infty$. Let $c^H(1,0)$ be the value of c at