Attracting Attention: Cheap Managerial Talk and Costly Market Monitoring*

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ABSTRACT

Agency conflicts between managers and shareholders can lead to fundamental disagreements about information disclosure. For instance, managers can be reluctant to disclose information about the firm that exposes poor managerial decisions and questions their performance. This paper provides a theory of informal communication between firms and the capital market that incorporates the role of agency conflicts in information disclosure. The analysis suggests that a policy of discretionary and selective disclosure that encourages managers to announce when the firm is substantially undervalued can create shareholder value. The theory also relates the credibility of managerial announcements to the use of stock based compensation, the presence of informed trading, and the liquidity of the stock. Our results are consistent with the presence of positive announcement effects produced by apparently innocuous corporate events (e.g., a stock dividend or a name change).

Recent regulations, such as the Sarbanes-Oxley Act, stress the importance of providing timely and accurate information to investors. In practice, firm information can be concealed and is often difficult to substantiate. Moreover, there is likely to be fundamental disagreements between managers and shareholders about the firm's disclosure policy. Managers can be reluctant to disclose information because, among other things, it may reflect prior poor managerial decisions, and hence question their performance. For this reason, inducing managers to disclose information is an essential component of managerial incentives. As a result, a firm's disclosure and compensation policies are intrinsically related aspects of corporate governance which cannot be considered in isolation.

This paper develops a theory of information disclosure that incorporates the following two elements. First, managers, who become informed through the course of everyday operations, are unwilling to disclose their private information when it reflects poorly on them. In this sense, the theory explores the trade-offs that agency conflicts between managers and shareholders create on information disclosure. Second, apparently innocuous corporate actions such as non-binding managerial announcements have valuation effects.[1] In our theory, these actions can be understood as cheap talk communication between firms and the capital market. This is in contrast to the previous literature which has mainly focused on costly signals as a way of conveying information, e.g., Ross (1977).

Our model considers a firm run by a manager who, after exerting effort, obtains *soft* information about the firm's prospects.[2] The manager can publicly announce this information, however, the manager may not necessarily reveal it truthfully. Hence, when determining the incentive compensation contract, shareholders must simultaneously address managerial moral hazard, and induce the manager to truthfully disclose information.

In the model, managerial announcements provide informal communication –cheap talk– whose credibility depends upon the potential validation provided by the analysis of speculators. Specifically, since it is costly to investigate firms, managerial announcements not only convey information to the market but also attract attention to the firm and guide speculators in their investigation efforts. As a result, information disclosure, by attracting informed trade, makes the firm's stock price more informative and helps to assess the credibility of managerial announcements. In this sense our theory builds on the well-known intuition in agency theory that compensation becomes more efficient when additional relevant information can be incorporated into the incentive contract. Our analysis, however, illustrates that this intuition needs to be reconsidered when the agent himself must volunteer the additional information.

As we show, the optimal disclosure policy depends on the cost of speculative trading, and on the importance of the managerial incentive problem faced by the firm. If the incentive problem is severe, the information disclosed by the manager becomes particularly useful in alleviating managerial moral hazard. Under these circumstances, the optimal incentive contract includes short-term equity-based compensation that induces the manager to disclose information only when the firm's stock is undervalued. This asymmetry in disclosure behavior between undervalued and overvalued firms arises because there is a complementarity between inducing the manager to disclose good news, and resolving managerial moral hazard. Intuitively, rewarding the manager for disclosing bad news, to the extent that such news are the consequence of past managerial actions, would interfere with the provision of managerial incentives.

Our model generates a number of insights related to firms' disclosure and compensation policies. Specifically, the analysis (i) identifies a trade-off faced by firms in their disclosure policy: more disclosure increases price efficiency (and hence ameliorates agency conflicts) but attracts costly speculation to the firm's stock; (ii) shows that a policy of discretionary and selective information disclosure can create shareholder value; (iii) rationalizes the valuation effects of apparently costless corporate actions as a form of cheap talk communication between firms and investors; (iv) predicts positive valuation effects after managerial cheap talk; and (v) suggests a novel role for managerial compensation, that is, to facilitate the transmission of information from firms to the capital market. Empirically, this implies that the use of high-powered equity-based compensation is accompanied by more intense disclosure of information by managers, which contrasts with the widespread view that short-term equity-based compensation reduces firm transparency and generates fraud.[3]

By linking managerial compensation to the firm's disclosure policy, our paper contributes to two strands of literature. First, in the managerial compensation literature, the analysis is related to a number of studies that examine how managerial moral hazard can be alleviated by using information generated in the stock market (Diamond and Verrecchia, 1982, Holmstrom and Tirole, 1993, and Faure-Grimaud and Gromb, 2004). In these papers, however, managers do not have an active role in attracting attention and disclosing information to the market, which is precisely the focus of our paper.

Our paper also contributes to the literature on information disclosure.[4] This literature has typically focused on the use of costly signals (Spence, 1973) or cheap talk (Crawford and Sobel, 1982) as a way of conveying uncertifiable –soft– information.[5] Within this literature, our paper is particularly related to Bhattacharya (1980) which shows that managers can be induced to disclose their private soft information when there is an exogenous verifiable signal correlated with that information.[6] In contrast to Bhattacharya, by recognizing that managers' private information is partially the result of past managerial actions, this paper stresses the agency conflicts between managers and shareholders that arise in public corporations, and examines the implications that these conflicts have on the incentives to disclose information.[7]

The paper is organized as follows. In section I we describe the model. In section II we present the analysis and derive the model's main implications. Section III considers several extensions and robustness issues and section IV concludes. Proofs and other technical derivations are relegated to the appendix.

I. The Model

A. Agents, technology and managerial news

We consider an all-equity public firm that operates in a risk-neutral economy where the market rate of return is normalized to zero. The firm consists of a project that yields a terminal cash-flow $z \in \{R, 0\}$ where $R > 0$. The firm is run by a manager who has no wealth, is protected by limited liability, and has a zero reservation level of utility. The firm's stock trades in a market with three (classes of) participants: liquidity traders, a speculator, and a competitive market maker.

There are four relevant dates, $t = 0, 1, 2, 3$. At $t = 0$, the firm sells a fraction $h \in [0, 1]$ of the shares in the open market and offers a compensation contract to the manager who then makes an effort choice. At $t = 1$, the manager receives private information about the firm and makes a public announcement regarding the content of such information. At $t = 2$, given the announcement, the speculator decides whether or not to investigate and trade on the firm's stock. Finally, at $t = 3$, the firm's cash-flow is realized and the managerial compensation contract is enforced.

Managerial effort $e \in \{0, 1\}$ affects the probability that the project succeeds (i.e., yields R). In particular, there are three states of nature $\omega \in \{b, n, g\}$ with associated probabilities of the project's success s_ω where $s_b < s_n < s_g$. These states, which we refer to as bad, b, neutral, n, and good, g, occur with the following probabilities:

$$\omega = \begin{cases} b & \text{with prob. } \beta - \Delta e \\ n & \text{with prob. } 1 - \beta - \gamma \\ g & \text{with prob. } \gamma + \Delta e, \end{cases} \tag{1}$$

where $\beta \geq \Delta > 0$, $\gamma \geq 0$, and $\beta + \gamma < 1$. That is, high effort $e = 1$, which has a private costs B for the manager, increases by Δ the likelihood of g vis-à-vis b but does not affect the likelihood of n. This implies that the distribution satisfies the monotone likelihood ratio property, i.e., the likelihood ratio that the manager has exerted effort is greater in state g than in n, which in turn, is greater than in b. We also assume that

$$\Delta(s_g - s_b)R > \frac{(\gamma + \Delta)\, s_g + (1 - \beta - \gamma)s_n + (\beta - \Delta)s_b}{\Delta(s_g - s_b)} B, \tag{2}$$

which guarantees not only that high managerial effort is efficient, i.e., $\Delta(s_g - s_b)R > B$, but also that, after considering managerial rents, it is beneficial for shareholders to induce high effort.[8] After exerting effort, the manager privately observes the firm's state ω and makes a public announcement, $f \in \{\hat{b}, \hat{n}, \hat{g}\}$. We refer to these managerial announcements as "flags" and to the action of the announcement as either "raising a flag" or "flagging."

B. Investigation by the speculator and trading

We use a setting similar to Kyle (1985), also considered in Holmstrom and Tirole (1993) and, more recently, in Faure-Grimaud and Gromb (2004). In particular, there are three market participants: (1) liquidity traders who, collectively, are equally likely to buy or sell $\delta(h)$ shares where $\delta(0) = 0$, $\delta(1) = \bar{\delta}$ and $\delta'(h) > 0$, i.e., the volume of trade increases with the shares initially sold in the open market; (2) a speculator who decides on his demand for shares after, possibly, acquiring some private information about the firm; and (3) a competitive market maker who sets the break-even price p for the shares given all publicly available information, i.e., the stock order flow, the flag, and the manager's compensation contract. For simplicity, we assume that the market maker can observe the trade orders but not the identity of the trader passing each order.[9] We normalize the total number of shares to one so that $\delta(h)$ is both the number and the proportion of shares traded by the liquidity traders, and refer directly to δ rather than h as the choice variable for the firm.

Investigating the firm provides the speculator with a private signal $\sigma \in \{\sigma_d, \sigma_u\}$ of the project's probability of success with $0 < \sigma_d < \sigma_u \leq 1$. Specifically, in state ω, σ_u is observed with a frequency of x_ω and σ_d with a frequency of $(1 - x_\omega)$. Consistency requires that for each state ω

$$x_\omega \sigma_u + (1 - x_\omega)\sigma_d = s_\omega, \tag{3}$$

which implies that there is a one-to-one relation between s_ω and x_ω. For convenience, it is easier to think of x_ω rather than s_ω as the primitive parameter, in which case, imposing $x_b < x_n < x_g$ is equivalent to the condition $s_b < s_n < s_g$ stated above (i.e., since s_ω is a convex combination of σ_u and σ_d then, $\sigma_d \leq s_b < s_n < s_g \leq \sigma_u$).

We assume that investigating a firm is costly, and that the cost depends on the state realized at $t = 1$. Specifically, $k > 0$ is the investigation cost in states b and g, and αk, with $\alpha > 1$, is the investigation cost in state n.[10] Furthermore, we also assume that the investigation cost is high enough in state n and low enough in states b and g so that the speculator finds it profitable to investigate only when he can exclude the presence of state n. This assumption is a simple form of capturing the intuition that market scrutiny is relatively more valuable in "news" states, i.e., b and g, than in situations of "business as usual," i.e., n. In general, to the extent that investigating a firm is costly and not equally profitable in all possible states, there is a role for managerial announcements in providing guidance to the investigation efforts of the market participants.[11]

C. Information and contracting

At $t = 0$, shareholders choose the level of liquidity δ, and the managerial compensation contract W that maximize firm value net of speculation and compensation costs. In this setting, which consists of moral hazard on e followed by asymmetric information on ω, W can be contingent on the following observable variables: (i) the managerial announcement f at $t = 1$, (ii) the stock price p at $t = 2$, and (iii) the realized cash-flow z at $t = 3$. The contract, however, cannot be contingent on: (i) managerial effort e at $t = 0$, (ii) managerial information ω at $t = 1$, and (iii) the speculator's assessment σ at $t = 2$. A central issue in the contracting problem is whether the compensation contract can incorporate the successive updates on the project's probability of success (which is updated from the managerial choice at $t = 0$, to the managerial information at $t = 1$, $s_\omega \in \{s_b, s_n, s_g\}$, to the speculator's assessment due to his investigations at $t = 2$, $\sigma \in \{\sigma_u, \sigma_d\}$). As discussed below, incorporating these successive updates requires inducing the manager to follow a specific disclosure policy.

Figure 1 below illustrates the timing of events, and Figure 2 in the appendix illustrates the information structure.

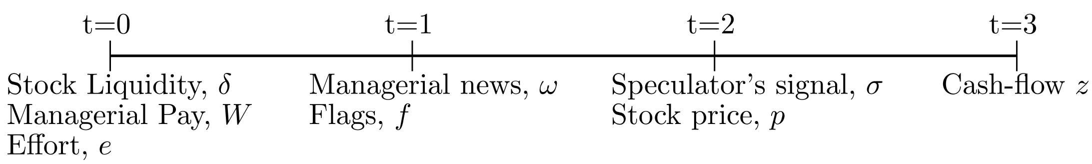

Figure 1: Timing of events.

II. Analysis of the model

In this section, we solve a simplified version of the model which allows us to investigate most of the issues of interest with a considerable reduction in complexity. In particular, we make the following simplifications. First, we impose $\beta = \Delta$ and $\gamma = 0$ which implies that only states n and g are feasible under high managerial effort $e = 1$, i.e., on-the-equilibrium-path. Second, we restrict the analysis to binary flags $f \in \{-1, +1\}$, rather than considering the more general message space $f \in \{\hat{b}, \hat{n}, \hat{g}\}$. The focus on binary flags captures the idea that managers "attract" the market attention to their firms in some states, $f = +1$, but not in others, $f = -1$. Finally, we restrict managerial compensation to contracts that can be contingent on prices p and cash-flows z but not on flags f, and that pay nothing when the cash-flow is zero, i.e., $z = 0$. These restrictions in compensation retain the realistic flavor of stock-based compensation with positive pay for performance sensitivity. In section III, however, we relax these restrictions and examine the robustness of the results under the assumptions of the general model.

Solving the model requires finding the level of liquidity and the compensation contract that maximize shareholder value, namely the firm's expected cash-flow net of compensation and speculation costs. Notice, however, that since managerial compensation affects information disclosure which in turn, affects the speculator's incentives to investigate and trade, there is a feedback effect from compensation to stock prices. For this reason, finding the optimal liquidity and compensation requires the simultaneous consideration of the stock price formation and the manager's incentives to disclose information. More specifically, we solve the model in four steps:

1. We distinguish the cases that can arise in terms of managerial disclosure of information. We refer to each case as a *flagging convention,* and denote it as $F_J \equiv \left\{f_J^b, f_J^n, f_J^g\right\}$ where f_J^ω represents the flag raised under convention F_J in state ω.

2. For each F_J, we derive the distribution of stock prices at $t = 2$, P_J, taking into account the speculator's incentives to investigate and trade.

3. Having derived P_J, we solve for the contract W_J^* and the level of liquidity δ_J^* that minimizes the sum of compensation, C_J^*, and speculation costs, S_J^*, under convention F_J. Notice that the optimal contract W_J^* must simultaneously induce high managerial effort $e = 1$ (see assumption 2) as well as the desired information disclosure behavior under the convention.

4. Finally, we find the optimal convention, i.e., the convention that minimizes the sum of compensation and speculation costs, $C_J^* + S_J^*$.

A. Flagging conventions

Flagging is a costless managerial action that conveys information only when it is accepted and understood by the market, i.e., cheap talk. With the proper understanding by the market, a convention conveys the same information as its reciprocal. For instance, convention $\{+1, +1, -1\}$ where the flag is raised only in states b and n conveys the same information as convention $\{-1, -1, +1\}$ where the flag is raised only in state g. Therefore, with $f \in \{-1, +1\}$ there are four essentially different conventions, i.e., attracting attention when b, n, or g occur, or never attracting attention. However, in this section, we focus the analysis exclusively on the following two conventions:

1. $F_0 = \{-1, -1, -1\}$: "no-flag" convention in which the manager never raises the flag;
2. $F_g = \{-1, -1, +1\}$: "g-flag" convention in which the manager only flags state g.

Conventions, F_0 and F_g, correspond, respectively, to a situation of no information disclosure and of full information disclosure on-the-equilibrium path.[12]

B. No information disclosure: F_0

Under convention F_0 the speculator does not investigate or trade because, without the guidance that managerial flagging provides, the expected benefits from trading would not cover the investigation cost. Formally, the following condition ensures that speculation does not occur unless managerial flagging allows the speculator to exclude state n:

$$k > \underline{k} \equiv \frac{(\sigma_u - \sigma_d)R\bar{\delta}}{4\left[\Delta + \alpha(1-\Delta)\right]}. \tag{4}$$

To understand why condition (4) is a sufficient condition to preclude speculation, notice that the speculator obtains positive (expected) profits only when the market maker cannot deduce the speculator's private information from the order flow. Specifically, this occurs when after investigating, either the speculator obtains signal σ_u and demands δ shares while liquidity traders demand $-\delta$ shares, or alternatively, the speculator obtains signal σ_d, and demands $-\delta$ shares while the liquidity traders demand δ shares. In both cases the order flow is $\{-\delta, \delta\}$, and the market maker is unable to sort out the speculator's from the liquidity traders' demand for shares. Since liquidity traders are equally likely to buy or sell shares, if the speculators were to trade under F_0, the stock price under the medium order flow, $\{-\delta, \delta\}$, would be:[13]

$$p_0^M = P_u \sigma_u (R - w_0) + (1 - P_u) \sigma_d (R - w_0) \tag{5}$$

where $P_u = \Delta x_g + (1 - \Delta) x_n$ is the probability that the speculator's investigation results in signal σ_u and $w_0 \geq 0$ is the wage paid to the manager contingent on the high cash-flow $z = R$ being realized at $t = 3$. In that case the expected profits from speculation under F_0 are:

$$\pi_0^S = \delta \left\{ \frac{1}{2} P_u \left[\sigma_u (R - w_0) - p_0^M \right] + \frac{1}{2} (1 - P_u) \left[p_0^M - \sigma_d (R - w_0) \right] \right\} \tag{6}$$

which, considering equation (5), simplify to:

$$\pi_0^S = P_u \left(1 - P_u\right) \left(\sigma_u - \sigma_d\right) \left(R - w_0\right) \delta. \tag{7}$$

Notice that π_0^S is maximized for $P_u = 1/2$, $w_0 = 0$ and $\delta = \bar{\delta}$, and therefore, when $k > \underline{k}$, the expected profits from speculation are lower than the expected investigation costs, i.e., $k[\Delta + \alpha(1 - \Delta)]$. We summarize this discussion in the following lemma:

Lemma 1 *If $k > \underline{k}$, the speculator does not investigate when the manager does not disclose any information.*

Therefore, without flagging or speculation, the stock price at $t = 2$ contains no information about the state reached at $t = 1$, and, as a result, managerial compensation is independent of the stock price. In this case, the shareholders' problem is to minimize compensation costs while inducing the manager to exert high effort:

$$\min_{w_0 \geq 0} \; \left(\Delta s_g + (1 - \Delta) s_n\right) w_0 \tag{8}$$

s.t. $$\left(\Delta s_g + (1-\Delta)s_n\right) w_0 \geq \left(\Delta s_b + (1-\Delta)s_n\right) w_0 + B, \tag{9}$$

where, as mentioned above, w_0 is the wage paid to the manager if $z = R$. We state the solution to this problem in the following proposition:

Proposition 1 *The optimal compensation contract under F_0, W_0^*, consists of a wage contingent on the project's success, $w_0^* = \frac{B}{\Delta(s_g - s_b)}$. The compensation costs associated with W_0^* are:*

$$C_0^* = \frac{\Delta s_g + (1-\Delta)s_n}{\Delta(s_g - s_b)} B.$$

The compensation costs, C_0^*, correspond to the value of the objective function (8) under the optimal compensation contract, W_0^*. Finally, since under F_0 there are no speculation costs, i.e., $S_0^* = 0$, shareholders are indifferent to the choice of liquidity, i.e., $\delta_0^* = [0, \bar{\delta}]$, and firm value is simply the project's expected cash-flow minus the expected compensation costs:

$$V_0^* = \left(\Delta s_g + (1-\Delta)s_n\right) R - C_0^*. \tag{10}$$

C. Flagging good news: F_g

Under convention F_g, the manager behaves differently in states g and n. Consider first state g. Under F_g the manager raises the flag in state g which triggers investigation and trading by the speculator. In particular, after the flag is raised, the speculator demands δ shares if the investigation results in σ_u, and $-\delta$ if, instead, it results in σ_d. Therefore, three stock prices can emerge as a function of the order flow in state g:

1. With probability $\frac{x_g}{2}$, the order flow is (δ, δ) and the price is $p_g^H = \sigma_u \left(R - w_g^H\right)$;
2. With probability $\frac{1}{2}$, the order flow is $(-\delta, \delta)$ and the price is $p_g^M = s_g \left(R - w_g^M\right)$;
3. With probability $\frac{(1-x_g)}{2}$, the order flow is $(-\delta, -\delta)$ and the price is $p_g^L = \sigma_d \left(R - w_g^L\right)$,

where $\{w_g^H, w_g^M, w_g^L\}$ are, respectively, the wages associated to $\{p_g^H, p_g^M, p_g^L\}$ and contingent on a high cash-flow $z = R$ being realized at $t = 3$. The speculator's trades are profitable when the investigation results in σ_u and liquidity traders sell (which occurs with probability $\frac{x_g}{2}$), and when the investigation results in σ_d and liquidity traders buy (which occurs with probability $\frac{1-x_g}{2}$). In both cases the order flow is $(-\delta, \delta)$ and the market maker cannot infer the speculator's demand with certainty. Therefore, the expected profits from speculation in state g are:

$$\pi_g^S = \left([\sigma_u \left(R - w_g^M\right) - p_g^M] \frac{x_g}{2} + [p_g^M - \sigma_d \left(R - w_g^M\right)] \frac{1 - x_g}{2} \right) \delta. \tag{11}$$

Now consider state n. Under F_g the manager does not raise the flag in state n, and the speculator does not investigate or trade. In such a case, the stock price, which is independent of the order flow, is given by $p_g^N = s_n(R - w_g^N)$ where w_g^N is the wage associated to p_g^N.

Shareholders choose managerial compensation $W_g = \{w_g^H, w_g^M, w_g^L, w_g^N\}$, and stock liquidity δ, to maximize the expected value of the project minus the sum of the expected compensation and speculation costs, $C_g + S_g$. To calculate the speculation costs under F_g, we compute the expectation of the speculator's profits from trading: $S_g = \Delta \pi_g^S$ (i.e., state g occurs with probability Δ, and the expected profits from speculation in state g are π_g^S). Notice that while speculation profits reduce shareholder value, such profits are required to induce the speculator to investigate and trade. Specifically, unless $\pi_g^S \geq k$, the speculator would find it unprofitable to investigate the firm. In this setting, since $\delta(0) = 0$ and $\delta'(h) > 0$, shareholders can set the stock's liquidity δ at a level δ_g^* such that trading profits exactly offset the investigation cost, i.e., $\pi_g^S(\delta_g^*) = k$.

Since the stock's liquidity, except for its effect on the speculator's incentives to trade, does not affect compensation costs, the previous discussion implies that we can separate the compensation and liquidity choices and solve the problem sequentially. We establish this separation result in the following lemma:

Lemma 2 *The following sequential procedure maximizes shareholder value: First, find the* *managerial contract that minimizes compensation costs, and then, taking the optimal compensation as given, choose the level of liquidity such that $\pi_g^S(\delta_g^*) = k$.*

Consequently, we start by finding the optimal compensation contract, which is the solution to the following problem:

$$\min_{W_g \in \mathbb{R}_+^4} \frac{\Delta}{2}\left[x_g \sigma_u w_g^H + (1-x_g)\sigma_d w_g^L + s_g w_g^M\right] + (1-\Delta)s_n w_g^N \tag{12}$$

s.t.

$$x_g \sigma_u w_g^H + (1-x_g)\sigma_d w_g^L + s_g w_g^M \geq 2 s_b w_g^N + \frac{2B}{\Delta} \tag{13}$$

$$x_g \sigma_u w_g^H + (1-x_g)\sigma_d w_g^L + s_g w_g^M \geq 2 s_g w_g^N \tag{14}$$

$$x_n \sigma_u w_g^H + (1-x_n)\sigma_d w_g^L + s_n w_g^M \leq 2 s_n w_g^N \tag{15}$$

$$x_b \sigma_u w_g^H + (1-x_b)\sigma_d w_g^L + s_b w_g^M \leq 2 s_b w_g^N \tag{16}$$

where (12) measures compensation costs, C_g, (13) induces high managerial effort, and (14), (15) and (16) ensure that managerial announcements at $t = 1$ are truthful (i.e., that the manager only flags g).[14] Notice that, as reflected in (13) and (16), we solve the problem by requiring the manager not to flag b. While state b is off-equilibrium-path, the incentives to disclose information in b affect the optimal contract by influencing the opportunity costs of exerting effort.[15]

The next proposition states the solution to the previous optimization problem:

Proposition 2 *The optimal compensation contract under F_g is*

$$W_g^* = (w_g^{L*}, w_g^{M*}, w_g^{H*}, w_g^{N*}) = \left(0, 0, \frac{2 s_n B}{\Delta(x_g s_n - x_n s_b)\sigma_u}, \frac{x_n B}{\Delta(x_g s_n - x_n s_b)}\right),$$

and the compensation costs associated with W_g^* are:

$$C_g^* = \frac{s_n\left[\Delta x_g + (1-\Delta)x_n\right]}{\Delta(x_g s_n - x_n s_b)} B.$$

As Proposition 2 shows, the optimal compensation contract W_g^* consists of (i) a positive wage when the flag is not raised, $w_g^{N*} > 0$, (ii) a bonus when a raised flag is followed by a high stock price, $w_g^{H*} > w_g^{N*}$, and (iii) a zero wage when a raised flag is not followed by a high stock price, $w_g^{L*} = w_g^{M*} = 0$. This compensation scheme simultaneously induces high managerial effort, and the desired managerial disclosure behavior under F_g, i.e., flagging exclusively in state g. More generally, to encourage managers to attract attention in the presence of good news, managers should be compensated when upon attracting attention the market confirms the presence of such good news. In this stylized model, in which prices fully reveal whether or not the manager has attracted attention, this disclosure behavior is achieved by paying a zero wage after attracting attention unless the highest stock price is realized.

Having obtained the optimal compensation contract W_g^*, we now proceed to solve for the optimal level of liquidity. Since $w_g^{M*} = 0$, equation (11), which corresponds to expected profits from speculation in state g, can be expressed as

$$\pi_g^S = (\sigma_u - \sigma_d)\, x_g\, (1 - x_g)\, R\delta. \tag{17}$$

Therefore, setting $\delta_g^* = \frac{k}{(\sigma_u - \sigma_d) x_g (1-x_g) R}$ allows the speculator to exactly recover his investigation cost k. This liquidity minimizes the firm's speculation costs, i.e., $S_g^* = \Delta \pi_g^S(\delta_g^*) = \Delta k$, while inducing the speculator to investigate and trade. Notice, however, that a level of liquidity like δ_g^* would be feasible, i.e., $\delta_g^* \leq \bar{\delta}$, only when the investigation cost k is sufficiently low. We assume the following condition which ensures that this is indeed the case:

$$k < \bar{k} \equiv x_g(1 - x_g)(\sigma_u - \sigma_d)\, R\, \bar{\delta}. \tag{18}$$

Condition (18) in conjunction with condition (4), which implies that the speculator does not investigate unless n is excluded, define the two bounds for the investigation cost required for our analysis.[16] We summarize the previous discussion in the following lemma:

Lemma 3 *If* $\underline{k} < k < \bar{k}$*, then: (i) it is feasible to induce the speculator to investigate only in* g*, and (ii) setting* $\delta_g^* = \frac{k}{(\sigma_u - \sigma_d) x_g (1 - x_g) R}$ *minimizes speculation costs, i.e.,* $S_g^* = \Delta k$*.*

Having found W_g^* and δ_g^*, we finally calculate shareholder value under F_g, which is simply the project's expected cash-flow minus the compensation and speculation costs:

$$V_g^* = (\Delta s_g + (1 - \Delta) s_n) R - C_g^* - S_g^*. \tag{19}$$

D. The optimal convention

The comparison between V_0^* and V_g^* determines the optimal convention for shareholders. This comparison boils down to a trade-off between the smaller speculation costs associated to F_0, i.e., $S_0^* < S_g^*$, and, as the next proposition states, the smaller compensation costs associated to F_g, i.e., $C_g^* < C_0^*$:

Proposition 3 *Compensation costs under* F_g *are smaller than those under* F_0*.*

As stated in Proposition 3 inducing managers to attract attention to their firms when they have good news, i.e., in state g, allows the firm to save on compensation costs. Intuitively, by flagging the presence of g and attracting speculation, the information is incorporated into the stock price and can be used to compensate the manager. Since state g (and hence, a high stock price) is a strong indication of high managerial effort, the firm is able to induce high effort at a lower cost.

Notice that, in contrast to Holmstrom and Tirole (1993), the role of the information generated by the speculator is not to provide additional information about effort but to help induce managerial truthtelling. In our model, by construction, since the state reached at $t = 1$ is a sufficient statistic of managerial effort, once flagging has conveyed the presence of state g, the speculator's research does not provide any additional information about effort. Nonetheless, inducing managers to disclose information, and making their compensation contingent on the disclosed information would be susceptible to opportunistic behavior by managers, i.e., false announcements. In our setting, the trading activity of the speculator informs the stock price and allows to indirectly verify the truthfulness of the managerial announcements.

An interesting aspect of the analysis is that, even though speculation would not take place in the absence of guidance by the manager, shareholders can induce managers to disclose information and guide speculation, while using the information generated by the speculator to reduce managerial rents. In particular, we find that shareholders foster information disclosure from managers, who will ex-post voluntarily disclose information, even though ex-ante managers end up receiving lower rents.

Next, we state Proposition 4 which considers the factors that make F_0 or F_g more likely to be the optimal convention:

Proposition 4 *F_g is more likely to be the optimal convention vis-à-vis F_0 when: (i) the investigation cost is small (i.e., low, k); and (ii) the incentive problem in the firm is severe (i.e., high B, low $\frac{\sigma_u}{\sigma_d}$, high x_b, and low Δ).*

The effect of the investigation cost k is straightforward. Under F_g the speculator must be induced to investigate in state g. Therefore, the larger the investigation cost, the more liquid the equity needs to be, i.e., the more equity the firm needs to sell, in order to allow the speculator to recover the investigation cost through trading. Since equity must be sold at a discount to compensate liquidity traders for their expected future losses (which occur when they trade against the speculator), a higher k amounts to larger speculation costs that are borne ex-ante by the firm.

The choice of convention also depends on the nature of the incentive problem faced by the firm. Specifically, if the firm faces a severe incentive problem the additional information disclosed under convention F_g becomes especially useful in alleviating managerial moral hazard.

The incentive problem is particularly severe, and hence, F_g is more likely to be the optimal convention vis-à-vis F_0, when (i) the opportunity costs of exerting effort B is large, and (ii) the final cash-flow is not very informative about effort (i.e., low $\frac{\sigma_u}{\sigma_d}$, low Δ, and high x_b).[17]

Notice, however, that the parameters in Proposition 4 are restricted by the bounds in Lemma 3, i.e., $\underline{k} < k < \bar{k}$, and by condition 2 (which guarantees that shareholders find optimal to induce high managerial effort). Therefore, to better illustrate these effects, we consider the following numerical example which shows how, depending on the severity of the moral hazard problem (as captured by B), either convention F_0 or F_g may emerge as optimal.

Example 1 *Let* $R = 2200$, $\Delta = \beta = \frac{1}{2}$, $\gamma = 0$, $\sigma_u = 1$, $\sigma_d = \frac{1}{2}$, $x_g = \frac{4}{5}$, $x_n = \frac{1}{2}$, $x_b = \frac{1}{5}$, $k = \alpha = 20$ *and* $\bar{\delta} = \frac{3}{20}$. *Then when* $B \in (0, \frac{40}{9})$ *convention* F_0 *is optimal, while when* $B \in (\frac{40}{9}, 60)$ *convention* F_g *is optimal instead.*

In the previous example, the speculator finds unprofitable to investigate the firm unless he can exclude state n (i.e., $\frac{55}{14} = \underline{k} < k = 20 < \bar{k} = \frac{132}{5}$), and shareholders induce high managerial effort (i.e., condition (2) is satisfied). Therefore, by ensuring the compatibility of the parametric restrictions considered in the model, this example, for which further details are provided in the appendix, confirms that both conventions can be optimal.

E. Discussion and empirical implications

The previous analysis generates a number of implications. First, the analysis shows that managers who receive stock-based compensation will voluntarily disclose more information. Consistent with this implication, Nagar, Nanda and Wysocki (2003) documents that firms' disclosures are positively related to the value of the shares held by the CEO, and to the proportion of CEO compensation affected by the stock price. In addition, Miller and Piotroski (2000) provides evidence that managers of firms in turnaround situations are more likely to provide earnings forecasts if they have higher stock option compensation at risk.

Second, the analysis shows that valuation effects can be generated by attention grabbing events that do not have associated any obvious signalling costs. In line with this implication, there is evidence that stock prices react to dividend and stock split announcements (Grinblatt, Masulis and Titman 1984), to the announcement of corporate name changes (Cooper, Dimitrov and Rau 2001), to corporate presentations to securities analysts (Francis, Hanna and Philbrick 1998), and to non-binding announcements of share repurchase programs (Ikenberry, Lakonishok and Vermaelen 1995).

Third, the model illustrates that corporations face the following trade-off when they disclose information to the market: on the one hand the stock price becomes more informative but on the other hand, speculators find it easier to investigate the firm. Under such a trade-off, managerial disclosure of information, even though hampered by agency conflicts, plays a role in attracting attention and directing market research.[18] This is consistent with available empirical evidence, reviewed in Healy and Palepu (2001), which shows that voluntary disclosure of information increases analysts' coverage and the speed with which information gets incorporated into prices.[19]

Finally, the model's result that short-term equity-based compensation (i.e., compensation based on prices at $t = 2$ rather than just on realized earnings at $t = 3$) can foster voluntary disclosure of information and improve transparency has important policy implications. Some authors have argued that many of the recent corporate scandals (e.g., Enron) can be understood in the light of the pressures faced by managers to deliver results consistent with their firms overvalued equity (see Jensen, 2004). According to such arguments, short-term equity-based compensation aggravates the costs associated to the overvalued equity (among others, the lack of transparency and the use of fraudulent accounting practices). Our analysis, however, shows that short-term stock compensation is associated to more voluntary information disclosure whenever the stock is undervalued.[20] Therefore, our analysis provides a contrasting view to the notion that short-term equity-based compensation leads to a lack of transparency.

III. Robustness and extensions

In this section we examine the robustness of the results by first removing the simplifying assumptions made in section II and then, considering a number of extensions to the model.

A. *The general model*

In section II we made three simplifying assumptions. Specifically, we imposed (i) the parametric restrictions $\beta = \Delta$ and $\gamma = 0$, (ii) a binary message space $f \in \{-1, +1\}$, and (iii) compensation contracts that could not be contingent on the managerial announcement or reward managers after a low cash-flow. In this section, in order to facilitate the presentation, we first relax assumptions (i) and (ii) by allowing for the possibility that $\beta \neq \Delta$ and $\gamma \geq 0$, and for a three-dimensional message space $f \in \{\hat{b}, \hat{n}, \hat{g}\}$.[21] Then, at the end of the section, we also relax restriction (iii) on the compensation contracts.

Since managerial announcements are cheap talk, those conventions which, with the proper market understanding, convey the same information are equivalent. For instance, $\{\hat{b}, \hat{g}, \hat{n}\}$, $\{\hat{g}, \hat{b}, \hat{n}\}$, $\{\hat{g}, \hat{n}, \hat{b}\}$, $\{\hat{n}, \hat{g}, \hat{b}\}$, $\{\hat{n}, \hat{b}, \hat{g}\}$ and $\{\hat{b}, \hat{n}, \hat{g}\}$ all would allow to completely sort out the state reached at $t = 1$. Therefore, with a three-dimensional message space, $f \in \{\hat{b}, \hat{n}, \hat{g}\}$, there are five essentially different conventions:

1. $F_0 = \{\hat{n}, \hat{n}, \hat{n}\}$: "no-flag" convention in which the manager discloses no information;

2. $F_g = \{\hat{n}, \hat{n}, \hat{g}\}$: "g-flag" convention in which the manager flags state g;

3. $F_b = \{\hat{b}, \hat{n}, \hat{n}\}$: "b-flag" convention in which the manager flags state b;

4. $F_n = \{\hat{b}, \hat{n}, \hat{b}\}$: "n-flag" convention in which the manager flags state n;

5. $F_\omega = \{\hat{b}, \hat{n}, \hat{g}\}$: "full-disclosure" convention in which the manager discloses all information.

Even though there are five possible conventions, the following proposition, which compares the compensation costs associated with the different conventions, allows us to considerably simplify the analysis.[22]

Proposition 5 *Conventions F_b and F_n have the same compensation costs as F_0, i.e., C_0^*. Likewise, convention F_ω has the same compensation costs as F_g, i.e., C_g^*. Furthermore, the compensation costs under F_g are lower than the compensation costs under F_0, i.e., $C_g^* < C_0^*$.*

Consider first conventions F_b and F_n. The information disclosed by the manager under these conventions does not allow the firm to save on compensation costs with respect to convention F_0, in which no information is disclosed. Intuitively, this occurs because inducing the manager to disclose information under F_b and F_n interferes with the provision of incentives to exert effort. Specifically, since low effort increases the probability of state b, rewarding the manager for flagging state b under F_b or preventing the manager from flagging state b under F_n increases the opportunity cost of exerting managerial effort. A similar reasoning explains why conventions F_g and F_ω have the same associated compensation costs. While under F_ω the manager is induced to disclose which state b or n has been reached, the combination of the moral hazard and truthtelling constraints prevents shareholders from using this information to lower compensation costs. As a result, F_ω has the same compensation costs as F_g where states n and b are not individually sorted out.

Finally, to explain the savings in compensation costs associated to F_g relative to F_0 notice that, because high managerial effort increases the probability of state g, there is a complementarity between providing managers with incentives to exert effort, and inducing them to disclose state g. This complementarity between high effort and good news (i.e., state g)

enables shareholders using the disclosed information to design a more efficient compensation contract. In this contract, the manager is rewarded when flagging is followed by a high stock price, which is a strong indicator of high managerial effort.

Having ranked the conventions in terms of their compensation costs, next we narrow the set of optimal conventions by focusing on their associated speculation costs. To do so, we state the following proposition.

Proposition 6 *Conventions F_b and F_n have higher associated speculation costs than F_0. Likewise, convention F_ω has higher associated speculation costs than F_g. Therefore, only conventions F_0 and F_g can be optimal.*

Since speculation is profitable if and only if state n is excluded, the speculator investigates in state g under F_g, in state b under F_b, and in states b and g under F_n and F_ω, and hence, the above proposition follows.[23] Therefore, as in the simplified model of section II, the choice of the optimal convention amounts to comparing conventions F_0 and F_g. Specifically, inducing the manager to attract attention when the firm is undervalued by the market, i.e., in state g under F_g, allows shareholders to save on compensation costs but also attracts costly speculation to the firm. Also as in section II (see Proposition 4) convention F_g is more likely to be optimal vis-a-vis F_0 when the investigations costs are low and when the incentive problem for the firm is more severe.

To sum up: the analysis in this more general model confirms the robustness of the results from the previous section, and allows us to gain some additional insights. Specifically, the analysis shows that firms can find it optimal to have a policy of partial disclosure of information in which the optimal level of disclosure depends on the state reached at $t = 1$. That is, under F_g, the manager sorts out state g but does not distinguish between states b and n. Since all three states (b, n, and g) are feasible under high managerial effort $e = 1$, and since the state reached at $t = 1$ is private information of the manager, implementing such a policy requires that the manager is provided with discretion over the information disclosure decisions.

The analysis also shows that managers of undervalued firms are the ones that attract market attention, i.e., under F_g the manager only discloses the presence of state g. Notice that this result holds even though the presence of good or bad news does not have any additional effect on the firm's activities, and although, by design, the speculator is equally effective in scrutinizing overvalued and undervalued firms, i.e., the speculator can profit from buying undervalued stock as well as from selling overvalued stock. In the analysis, the asymmetry in information disclosure arises endogenously from the complementarity between the optimal resolution of the managerial moral hazard problem, and inducing the disclosure of good news by the manager. Consistent with this implication, there is evidence that stock prices, on average, react positively to corporate name changes, corporate presentations to securities analysts, non-binding announcements of share repurchase programs, and to stock dividend and stock split announcements.[24]

We finish this section by removing restriction (iii) on the compensation contracts. As the next proposition shows allowing for a richer set of contracts does not affect our results.

Proposition 7 *Allowing for contracts that can pay a positive wage after a low cash-flow and/or that can be contingent on flags does not reduce compensation costs under any convention.*

This proposition implies that we have not lost generality by focusing on contracts that pay a zero wage after a low cash-flow. Roughly speaking, although paying a positive wage after a low cash-flow could conceivably facilitate inducing the manager to disclosure information (particularly in state b), rewarding the manager for a low cash-flow increases the opportunity cost of exerting effort and hence, the overall compensation costs.

In addition, Proposition 7 states that focusing on contracts that cannot be directly contingent on managerial announcements (i.e., flags f) is also without loss of generality. Since the distribution of stock prices depends on whether or not a flag has been raised, contracts based solely on stock prices can incorporate any information contained in the flag, and hence flags become redundant as contracting devices in our model. Verifiability problems aside (e.g., a court may not be able to verify whether a manager is or is not attracting attention to the firm), contracting simultaneously on flags and prices could be useful to reduce compensation costs in alternative settings in which stock prices do not fully reveal the content of the flag. Nevertheless, even in those alternative settings, the central message of the current analysis remains valid: managerial cheap talk, i.e., flagging, is a valuable device to reduce compensation costs.[25]

B. Further extensions

In this section, with the purpose of developing a better understanding of the economic forces driving the results, we briefly discuss the role that speculation has on the analysis, as well as the issue of equilibrium selection.

Speculation

Since the speculator plays a central role in the analysis, a natural question is whether similar results could be reached in a model without speculation. In the absence of market speculation, however, it can be shown that inducing the manager to announce his information, and allowing managerial compensation to be contingent on the announcement and the final cash-flow, does not reduce compensation costs with respect to the case in which the manager does not disclose any information, i.e., F_0.[26] This confirms the intuition that the additional information generated by the speculator, by acting as an indirect certification device, helps to induce managerial truthtelling, and facilitates the use of the disclosed information to save on compensation costs.

While we have considered speculation as an indirect certification device of the managerial announcements, an alternative would involve the use of an auditor to certify the private information conveyed by the manager. Previous literature, however, has emphasized the problems that arise when auditors and managers can collude (Tirole 1986, and Kofman and Lawarree 1993).[27] In this sense, our paper contributes to the literature by proposing an alternative mechanism which is free from collusion, i.e., speculation.

Equilibrium selection

In the model the manager and the speculator play a cheap talk game. The manager sends a message, and the speculator chooses an action, i.e. investigate or not investigate, as a function of the message sent by the manager. At $t = 0$ shareholders take the equilibrium in the cheap talk game between the manager and the speculator as a given. Thus, if F_g is expected to be played, shareholders can design a compensation contract that is compatible with F_g being an equilibrium, which minimizes compensation costs. In this cheap talk game, however, even if F_g were the optimal convention for shareholders, a "babbling" equilibrium in which the market believes that flags convey no information, and hence, prices remain uninformative after flagging, is also feasible.

Although shareholders would benefit from influencing the choice of the equilibrium convention, nothing in the formal analysis enables them to do so. However, one may argue that compensation contracts could act as focal points. For instance, when compensation contracts are observable, if shareholders select the optimal contract for convention F_g, both the manager and the speculator may choose to play the equilibrium strategies compatible with convention F_g. In contrast, when compensation contracts are unobservable, shareholders could find it difficult to direct the market to follow a specific convention. The argument above suggests that regulations that foster managerial compensation disclosure, in addition to reducing the managers' ability to extract rents from the firm (e.g., Bebchuk and Fried 2003), can enhance the importance of market scrutiny, and increase the production of information about the firm.

IV. Concluding Remarks

We have developed a theory of informal communication between firms and the capital market in the presence of agency conflicts. The theory is based on three premises: (1) the presence of a managerial agency problem that shareholders must address; (2) the existence of managerial private information that cannot be substantiated with hard evidence; and (3) the ability of market speculators to produce additional information about the firm at a cost. In this setting, firms face a trade-off when they disclose information to the market: prices become more informative but speculators find it easier to investigate the firm. In other words, managerial disclosure of information, even though hampered by agency conflicts, plays a role in attracting attention and directing market research. This trade-off suggests a theory of discretionary disclosure: firms may want to regulate the disclosure of information to attract speculation in certain cases but discourage it in others. The study also explores the interactions between agency conflicts, managerial compensation and information disclosure. In particular, the analysis shows that the presence of strong agency conflicts that require the use of high-powered incentive compensation should be accompanied by a more intense disclosure of information by managers.

Finally, this paper has implications concerning the debate about the effects of regulation on capital markets. For instance, recent regulatory changes in the US have stressed the importance of providing equal information to investors (i.e., regulation FD) and of making managers more responsible for their communications with the market (i.e., the Sarbanes-Oxley Act). These regulations, however, may have the unintended effect of encouraging some forms of informal communications between managers and capital markets. Rather than directly disclosing the information to professional analysts and thus be exposed to future legal action, managers can now be compelled to rely on more subtle mechanisms which attract the attention of sophisticated investors. In this sense, these new regulations may produce, contrary to their intended objective, higher rather than lower information asymmetries among different market participants.

APPENDIX

Proof of Proposition 2 (Contract for F_g)

$$\min_{W_g \in \mathbb{R}^4_+} \Delta \left[\frac{x_g \sigma_u}{2} w_g^H + \frac{(1-x_g)\sigma_d}{2} w_g^L + \frac{s_g}{2} w_g^M \right] + (1-\Delta) s_n w_g^N \tag{A.1}$$

s.t.

$$\frac{x_g \sigma_u}{2} w_g^H + \frac{(1-x_g)\sigma_d}{2} w_g^L + \frac{s_g}{2} w_g^M \geq s_b w_g^N + \frac{B}{\Delta} \tag{A.2}$$

$$\frac{x_g \sigma_u}{2} w_g^H + \frac{(1-x_g)\sigma_d}{2} w_g^L + \frac{s_g}{2} w_g^M \geq s_g w_g^N \tag{A.3}$$

$$\frac{x_n \sigma_u}{2} w_g^H + \frac{(1-x_n)\sigma_d}{2} w_g^L + \frac{s_n}{2} w_g^M \leq s_n w_g^N \tag{A.4}$$

$$\frac{x_b \sigma_u}{2} w_g^H + \frac{(1-x_b)\sigma_d}{2} w_g^L + \frac{s_b}{2} w_g^M \leq s_b w_g^N \tag{A.5}$$

The problem can be simplified by noting that any contract for which w_g^L (or w_g^M) is positive can be replaced by an alternative contract that reduces w_g^L (or w_g^M) by $\varepsilon > 0$ and increases w_g^H by $\varepsilon \frac{(1-x_g)\sigma_d}{x_g \sigma_u}$ (or $\varepsilon \frac{s_g}{x_g \sigma_u}$). The new contract does not affect the value of the objective function or of constraints (A.2) and (A.3), and strictly helps with constraints (A.4) and (A.5). Hence, imposing $w_g^L = w_g^M = 0$, (A.2)-(A.5) boil down to:

$$\frac{\sigma_u}{2} w_g^H \geq \frac{s_b}{x_g} w_g^N + \frac{B}{x_g \Delta} \tag{A.6}$$

$$\frac{\sigma_u}{2} w_g^H \geq \frac{s_g}{x_g} w_g^N \tag{A.7}$$

$$\frac{\sigma_u}{2} w_g^H \leq \frac{s_n}{x_n} w_g^N \tag{A.8}$$

$$\frac{\sigma_u}{2} w_g^H \leq \frac{s_b}{x_b} w_g^N \tag{A.9}$$

Since $\frac{s_g}{x_g} < \frac{s_n}{x_n} < \frac{s_b}{x_b}$ (i.e., $\frac{s_\omega}{x_\omega} = \frac{\sigma_d + x_\omega(\sigma_u - \sigma_d)}{x_\omega}$ for $\omega \in \{b, n, g\}$) constraint (A.8) implies (A.9) so (A.9) can be ignored. Furthermore, (A.8) must be binding (otherwise reducing w_g^N would relax (A.6) and (A.7) and decrease the objective function). If (A.8) is binding, this implies that (A.7) is not ($\frac{s_n}{x_n} < \frac{s_b}{x_b}$). Finally (A.6) must be binding (otherwise reducing w_g^H would relax (A.8) and decrease the objective function). In summary, (A.6) and (A.8) must bind. Solving the linear system formed by them yields the optimal contract, which substituted into the objective function yields C_g^*.

Proof of Proposition 3 (Comparison between C_0^* and C_g^*)

$$\begin{aligned}
C_0^* - C_g^* &= \frac{\Delta s_g + (1-\Delta)s_n}{\Delta(s_g - s_b)}B - \frac{s_n\left[\Delta x_g + (1-\Delta)x_n\right]}{\Delta(x_g s_n - x_n s_b)}B \\
&= \left(1 + \frac{\Delta s_b + (1-\Delta)s_n}{\Delta(s_g - s_b)}\right)B - \left(1 + \frac{\Delta s_b + (1-\Delta)s_n}{\Delta(\frac{x_g s_n}{x_n} - s_b)}\right)B \\
&= \left(\Delta s_b + (1-\Delta)s_n\right)B - \left(\frac{1}{\Delta(s_g - s_b)} - \frac{1}{\Delta(\frac{x_g s_n}{x_n} - s_b)}\right) \\
&= \frac{\Delta s_b + (1-\Delta)s_n}{\left[(\frac{x_g}{x_n}s_n - s_g) + (s_g - s_b)\right]\Delta\left(s_g - s_b\right)}(\frac{x_g}{x_n}s_n - s_g)B > 0 \qquad \text{(A.10)}
\end{aligned}$$

Proof of Proposition 4 (Comparative statics between F_0 and F_g)

The difference in value between conventions F_0 and F_g is

$$\begin{aligned}
C_0^* - \left(C_g^* + S_g^*\right) &= \frac{\Delta s_g + (1-\Delta)s_n}{\Delta(s_g - s_b)}B - \frac{s_n\left[\Delta x_g + (1-\Delta)x_n\right]}{\Delta(x_g s_n - x_n s_b)}B - \Delta k \\
&= \frac{(1-\Delta)s_n\left(x_g s_n - x_n s_g\right) + \Delta\left(s_n x_g - s_g x_n\right)s_b}{\Delta(s_g - s_b)(x_g s_n - x_n s_b)}B - \Delta k \\
&= \frac{(1-\Delta)s_n + \Delta s_b}{(s_g - s_b)(1 + \frac{x_n(s_g - s_b)}{s_n x_g - s_g x_n})}\frac{B}{\Delta} - \Delta k \\
&= \frac{\sigma_d + ((1-\Delta)x_n + \Delta x_b)\left(\sigma_u - \sigma_d\right)}{(x_g - x_b)(\sigma_u - \sigma_d)(1 + \frac{x_n(x_g - x_b)(\sigma_u - \sigma_d)}{(x_g - x_n)\sigma_d})}\frac{B}{\Delta} - \Delta k \\
&= \frac{\left(\frac{\sigma_d}{\sigma_u - \sigma_d} + x_n\right)\frac{1}{\Delta} - (x_n - x_b)}{(x_g - x_b)(1 + x_n\frac{x_g - x_b}{x_g - x_n}\frac{\sigma_u - \sigma_d}{\sigma_d})}B - \Delta k \qquad \text{(A.11)}
\end{aligned}$$

from which the comparative statics in the proposition follow.

Proof of Example 1 (Numerical example)

Under $R = 2200$, $\Delta = \beta = \frac{1}{2}$, $\gamma = 0$, $\sigma_u = 1$, $\sigma_d = \frac{1}{2}$, $x_g = \frac{4}{5}$, $x_n = \frac{1}{2}$, $x_b = \frac{1}{5}$, $k = \alpha = 20$ and $\bar{\delta} = \frac{3}{20}$ it follows that $(s_g, s_n, s_b) = \left(\frac{9}{10}, \frac{3}{4}, \frac{3}{5}\right)$

Optimality of inducing high managerial effort:

$$\Delta(s_g - s_b)R > \frac{(\gamma + \Delta)\,s_g + (1-\beta-\gamma)s_n + (\beta - \Delta)s_b}{\Delta(s_g - s_b)}B \iff B < 60 \qquad \text{(A.12)}$$

Incentives to investigate:

$$(\underline{k}, \overline{k}) = \left(\frac{(\sigma_u - \sigma_d)R\bar{\delta}}{4\left[\Delta + \alpha(1-\Delta)\right]}, x_g(1 - x_g)(\sigma_u - \sigma_d)\,R\,\bar{\delta}\right) = \left(\frac{55}{14}, \frac{132}{5}\right) \qquad \text{(A.13)}$$

and therefore $\underline{k} < k = 20 < \overline{k}$ which implies that the speculator will not investigate under F_0 or under F_g unless the manager flags state g.

Convention F_0:

$$C_0^* = \frac{11}{2}B \;\; ; \;\; V_0^* = 1815 - \frac{11}{2}B \tag{A.14}$$

Convention F_g:

$$\delta_g^* = \frac{5}{44} < \frac{3}{20} = \overline{\delta} \;\; ; \;\; C_g^* = \frac{13}{4}B \;\; ; \;\; S_g^* = 10 \;\; ; \;\; V_g^* = 1805 - \frac{13}{4}B \tag{A.15}$$

Convention F_g is preferred to convention F_0 if $V_g^* > V_0^*$:

$$1805 - \frac{13}{4}B > 1815 - \frac{11}{2}B \Rightarrow B > \frac{40}{9} \tag{A.16}$$

so if $B < \frac{40}{9}$ convention F_0 is preferred and, alternatively, if $\frac{40}{9} < B < 60$ convention F_g is preferred (as shown in A.12, $B < 60$ guarantees that it is optimal for shareholders to induce high managerial effort).

GENERAL MODEL (Proof of Proposition 5)

Next we solve the model without the parametric assumptions that $\beta = \Delta$ and $\gamma = 0$ and with a three-dimensional message space $f \in \{\hat{b}, \hat{n}, \hat{g}\}$. In this setting, there are five (essentially) different conventions: (1) "no-disclosure," $F_0 = \{\hat{n}, \hat{n}, \hat{n}\}$, i.e., the manager does not disclose any information; (2) "g-flag," $F_g = \{\hat{n}, \hat{n}, \hat{g}\}$, i.e., the manager flags state g; (3) "b-flag," $F_b = \{\hat{b}, \hat{n}, \hat{n}\}$, i.e., the manager flags state b; (4) "n-flag" $F_n = \{\hat{b}, \hat{n}, \hat{b}\}$, i.e., the manager flags state n; and (5) "full-disclosure," $F_\omega = \{\hat{b}, \hat{n}, \hat{g}\}$, i.e., the manager discloses all information.

Prices and Probabilities Under the Different Conventions

Under each convention F_J (where $J \in \{0, g, b, n, \omega\}$) the distribution of stock prices at $t = 2$, P_J, depends on the speculator's incentives to investigate and trade. Given the assumption that the speculator does not find it profitable to investigate unless state n can be excluded (see Lemma A.1 below), the speculator will investigate in state g under F_g, in state b under F_b, and in states b and g under F_n and F_ω.

Let Ω_J^f be the order flow for the firm's stock under convention F_J and flag f. If the speculator does not investigate (or trade), the order flow only contains the liquidity traders' demand, $\Omega_J^f \in \{-\delta, \delta\}$, and therefore, the stock price at $t = 2$, p_J^N, is independent of the order flow. Alternatively, if the speculator investigates, the order flow has two distinct components: (i) the liquidity traders' demand (either $-\delta$

or δ with equal probability), and (ii) the speculator's demand, (either $-\delta$ when the investigation yields σ_d or δ when it instead yields σ_u). Thus $\Omega_J^f \in \{(\delta,\delta), (-\delta,-\delta), (-\delta,\delta)\}$ and three prices can hold: p_J^H for a high order flow (δ,δ), p_J^M for a medium order flow $(-\delta,\delta)$, and p_J^L for a low order flow $(-\delta,-\delta)$. The market maker sets the break even price given the available information (the flag, the order flow and the compensation contract):

$$p_J^i = E_J(z - w(z, p_J^i) \mid f, \Omega_J^f, W_J), \tag{A.17}$$

for $i = N, L, M, H$, where $w(z, p_J^i)$ is the manager's wage under convention F_J (contingent on cash-flow z and price p_J^i) and W_J is the manager's compensation contract (i.e., the set of possible wages $w(z, p_J^i)$ under convention F_J). Next we describe the prices under the different conventions:

$$P_g \begin{cases} p_g^H = \sigma_u\left(R - w_g^H\right) & \text{w.p. } \frac{1}{2}(\gamma+\Delta e)x_g \\ p_g^L = \sigma_d\left(R - w_g^L\right) & \text{w.p. } \frac{1}{2}(\gamma+\Delta e)(1-x_g) \\ p_g^M = s_g\left(R - w_g^M\right) & \text{w.p. } \frac{1}{2}(\gamma+\Delta e) \\ p_g^N = \frac{s_n(1-\gamma-\beta)+s_b(\beta-\Delta e)}{1-\gamma-\Delta e}\left(R - w_g^N\right) & \text{w.p. } 1-\gamma-\Delta e \end{cases}$$

$$P_b \begin{cases} p_b^H = \sigma_u\left(R - w_b^H\right) & \text{w.p. } \frac{1}{2}(\beta-\Delta e)x_b \\ p_b^L = \sigma_d\left(R - w_b^L\right) & \text{w.p. } \frac{1}{2}(\beta-\Delta e)(1-x_b) \\ p_b^M = s_b\left(R - w_b^M\right) & \text{w.p. } \frac{1}{2}(\beta-\Delta e) \\ p_b^N = \frac{s_n(1-\gamma-\beta)+s_g(\gamma+\Delta e)}{1-\beta+\Delta e}\left(R - w_b^N\right) & \text{w.p. } 1-\beta+\Delta e \end{cases}$$

$$P_n \begin{cases} p_n^H = \sigma_u\left(R - w_n^N\right) & \text{w.p. } \frac{1}{2}\left[(\gamma+\Delta e)x_g + (\beta-\Delta e)x_b\right] \\ p_n^L = \sigma_d\left(R - w_n^L\right) & \text{w.p. } \frac{1}{2}\left[(\gamma+\Delta e)(1-x_g) + (\beta-\Delta e)(1-x_b)\right] \\ p_n^M = \frac{(\gamma+\Delta e)s_g+(\beta-\Delta e)s_b}{\gamma+\beta}\left(R - w_n^M\right) & \text{w.p. } \frac{1}{2}\left(\gamma+\beta\right) \\ p_n^N = s_n\left(R - w_n^N\right) & \text{w.p. } 1-\gamma-\beta \end{cases}$$

$$P_\omega \begin{cases} p_\omega^{gH} = \sigma_u(R - w_\omega^{gH}) & \text{w.p. } \frac{1}{2}(\gamma+\Delta e)x_g \\ p_\omega^{gL} = \sigma_d(R - w_\omega^{gL}) & \text{w.p. } \frac{1}{2}(\gamma+\Delta e)(1-x_g) \\ p_\omega^{gM} = s_g(R - w_\omega^{gM}) & \text{w.p. } \frac{1}{2}(\gamma+\Delta e) \\ p_\omega^{bH} = \sigma_u\left(R - w_\omega^{bH}\right) & \text{w.p. } \frac{1}{2}(\beta-\Delta e)x_b \\ p_\omega^{bL} = \sigma_d\left(R - w_\omega^{bL}\right) & \text{w.p. } \frac{1}{2}(\beta-\Delta e)(1-x_b) \\ p_\omega^{bM} = s_b(R - w_\omega^{bM}) & \text{w.p. } \frac{1}{2}(\beta-\Delta e) \\ p_\omega^{nN} = s_n(R - w_\omega^{nN}) & \text{w.p. } 1-\gamma-\beta \end{cases}$$

where $w_J^i \equiv w(R, p_J^i)$.

Note: Under F_ω there are two different flags, i.e., $\hat{g}$ and $\hat{b}$, which lead to investigation and trading, and following each of these two flags there are three possible stock prices, $(p_\omega^{gL}, p_\omega^{gM}, p_\omega^{gH})$ and $(p_\omega^{bL}, p_\omega^{bM}, p_\omega^{bH})$ respectively (and also their corresponding wages $(w_\omega^{gL}, w_\omega^{gM}, w_\omega^{gH})$ and $(w_\omega^{bL}, w_\omega^{bM}, w_\omega^{bH})$).

Speculator's profits from trading and bounds for k

Profits from trading unconditionally (i.e., under F_0)

Probability that the speculator gets a good signal (σ_u) and a bad signal (σ_d):

$$\begin{aligned}\Pr(\sigma_u) &= (\gamma+\Delta)\,x_g + (\beta-\Delta)\,x_b + (1-\beta-\gamma)x_n \equiv P_u && \text{(A.18)}\\ \Pr(\sigma_d) &= (\gamma+\Delta)\,(1-x_g) + (\beta-\Delta)\,(1-x_b) + (1-\beta-\gamma)\,(1-x_n) = 1-P_u && \text{(A.19)}\end{aligned}$$

Firm's value conditioning on speculator's signal:

$$\begin{aligned}V(\sigma_u) &= \sigma_u\,(R-w_0^*) && \text{(A.20)}\\ V(\sigma_d) &= \sigma_d\,(R-w_0^*)\,. && \text{(A.21)}\end{aligned}$$

where $w_0^* = \frac{B}{\Delta(s_g-s_b)}$ (see A.35 below)

Prices if speculators trade under low, high and medium order flow (i.e., p_0^L, p_0^H, p_0^M respectively):

$$\begin{aligned}p_0^L &= p(-\delta,-\delta) = \sigma_d\,(R-w_0^*) && \text{(A.22)}\\ p_0^H &= p(\delta,\delta) = \sigma_u\,(R-w_0^*) && \text{(A.23)}\\ p_0^M &= p(-\delta,\delta) = P_u\sigma_u\,(R-w_0^*) + (1-P_u)\sigma_d\,(R-w_0^*) && \text{(A.24)}\end{aligned}$$

where P_u is defined in (A.18).

Speculator's expected profits from trading would be:

$$\begin{aligned}\pi_0^{S*} &= \frac{\delta}{2}\left(\left[V(\sigma_u)-p_0^M\right]P_u + \left[p_0^M - V(\sigma_d)\right](1-P_u)\right) = \\ &= \delta\,(1-P_u)\,P_u\,(\sigma_u-\sigma_d)\,(R-w_0^*) && \text{(A.25)}\end{aligned}$$

Notice that $\pi_0^{S*} \leq \frac{1}{4}\overline{\delta}(\sigma_u-\sigma_d)R$ (i.e., π_0^{S*} is maximized when $P_u = 1/2$, $w_0^* = 0$, and $\delta = \overline{\delta}$). The speculator will not investigate if the expected profits from trading do not compensate him for the expected investigation cost (i.e., $k(\gamma+\beta) + k_n(1-\gamma-\beta) = k\left[(\gamma+\beta)+\alpha(1-\gamma-\beta)\right]$). Therefore, the following is a sufficient condition for the speculator not to investigate and trade under F_0:

$$\begin{aligned}k\left[(\gamma+\beta)+\alpha(1-\gamma-\beta)\right] &> \frac{1}{4}R\overline{\delta}(\sigma_u-\sigma_d) \Rightarrow \\ &\Rightarrow\; k > \frac{R\overline{\delta}(\sigma_u-\sigma_d)}{4\left[(\gamma+\beta)+\alpha(1-\gamma-\beta)\right]} \equiv \underline{k} && \text{(A.26)}\end{aligned}$$

Note: As already explained in the simplified model, under F_0 investigation and trading by the speculator is an out-of-equilibrium action. In that case, we assume that the market maker believes that trading by the speculator is informed (e.g., if the order flow is $\{\delta,\delta\}$ the market maker believes that the speculator has investigated and obtained a high signal σ_u). Similarly, under F_0 raising the flag is a managerial out-of-equilibrium action, and hence, we will simply assume that the speculator does not change his beliefs after the flag has been raised (i.e., conditional on flagging, the probability of n is still $(1-\Delta)$).

Profits from trading in g (e.g., under F_g)

Firm's value conditioning on speculator's signal, $\sigma \in \{\sigma_d, \sigma_u\}$, state g, and a medium order flow $(-\delta, \delta)$:

$$V(\sigma_u, g, (-\delta,\delta)) = \sigma_u \left(R - w_g^{M*}\right) \tag{A.27}$$

$$V(\sigma_d, g, (-\delta,\delta)) = \sigma_d \left(R - w_g^{M*}\right) \tag{A.28}$$

where $w_g^{M*} = 0$ (see A.42 below). The speculator's expected profits from trading in state g are:

$$\begin{aligned}\pi_g^{S*} &= \frac{\delta}{2}\left(\left[\sigma_u R - p_g^M\right] x_g + \left[p_g^M - \sigma_d R\right](1-x_g)\right) = \\ &= \frac{\delta R}{2}\left(\left[\sigma_u - s_g\right] x_g + \left[s_g - \sigma_d\right](1-x_g)\right) = \delta R\left(\sigma_u - \sigma_d\right) x_g\left(1-x_g\right).\end{aligned} \tag{A.29}$$

The speculator will investigate if the expected profits from trading compensate him for the investigation costs (i.e., if $\pi_g^{S*} \geq k$). When

$$k < R\overline{\delta}(\sigma_u - \sigma_d)\min\left\{x_b(1-x_b), x_g(1-x_g)\right\} \equiv \overline{k} \tag{A.30}$$

shareholders can set the level of liquidity high enough, $\delta_g^* < \overline{\delta}$, to induce the speculator to investigate and trade when state g has been flagged.

Profits from trading in b (e.g., under F_b)

Following similar steps as before, the speculator's expected profits from trading under state b are:

$$\pi_b^{S*} = \frac{\delta}{2}\left(\left[\sigma_u R - p_b^M\right] x_b + \left[p_b^M - \sigma_d R\right](1-x_b)\right) = \delta R\left(\sigma_u - \sigma_d\right) x_b\left(1-x_b\right). \tag{A.31}$$

The speculator will investigate if the expected profits from trading compensate him for the investigation costs (i.e., if $\pi_b^{S*} \geq k$). When $k < \overline{k}$ (see A.30 above for the definition of $\overline{k}$) shareholders can set the level of liquidity high enough, $\delta_b^* < \overline{\delta}$, to induce the speculator to investigate and trade when state b has been flagged.

Profits from trading when n is flagged (e.g., under F_n)

Following similar steps as before, the speculator's expected profits from trading when state n is excluded (i.e., under state b or g) are:

$$\pi_n^{S*} = \frac{\delta}{2}\left(\left[\sigma_u R - p_n^M\right]\varkappa + \left[p_n^M - \sigma_d R\right](1-\varkappa)\right) = \delta R\left(\sigma_u - \sigma_d\right)\varkappa\left(1-\varkappa\right). \tag{A.32}$$

where $\varkappa \equiv \frac{\gamma+\Delta}{\gamma+\beta}x_g + (1-\frac{\gamma+\Delta}{\gamma+\beta})x_b$. The speculator will investigate if the expected profits from trading compensate him for the investigation costs (i.e., if $\pi_n^{S*} \geq k$). When $k < \overline{k}$ (see (A.30) above for the definition of $\overline{k}$) shareholders can set the level of liquidity high enough, $\delta_n^* < \overline{\delta}$, to induce the speculator to investigate (Note: Since $\varkappa$ is a convex combination of $x_g \in (0,1)$ and $x_b \in (0,1)$ then $\min\{x_b(1-x_b), x_g(1-x_g)\} \leq \varkappa(1-\varkappa)$).

The following lemma summarizes the above discussion:

Lemma A.1 *If $\underline{k} < k < \overline{k}$, the speculator can be induced to only investigate in state g under F_g, in state b under F_b,and in states b an g under F_n and F_ω.*

Derivation of Optimal Contracts under the different conventions

Next we derive the optimal compensation contracts under the five possible conventions,

1) Optimal contract under F_0:

$$\min_{w_0 \geq 0} \; [(\Delta+\gamma)s_g + (1-\beta-\gamma)s_n + (\beta-\Delta)s_b]\, w_0 \tag{A.33}$$

s.t.

$$[(\Delta+\gamma)s_g + (1-\beta-\gamma)s_n + (\beta-\Delta)s_b]\, w_0 \geq [\gamma s_g + (1-\beta-\gamma)s_n + \beta s_b]\, w_0 + B \tag{A.34}$$

the optimization problem yields

$$w_0^* = \frac{B}{\Delta\,(s_g - s_b)}, \tag{A.35}$$

and substituting the optimal contract into the objective function yields

$$C_0^* = \frac{(\Delta+\gamma)s_g + (1-\beta-\gamma)s_n + (\beta-\Delta)s_b}{\Delta\,(s_g - s_b)} B \tag{A.36}$$

2) Optimal contract under F_g:

$$\min_{W_g \in \mathbb{R}_+^4} (\gamma+\Delta)\left[\frac{x_g\sigma_u}{2}w_g^H + \frac{(1-x_g)\sigma_d}{2}w_g^L + \frac{s_g}{2}w_g^M\right] + [(1-\gamma-\beta)s_n + (\beta-\Delta)s_b]\, w_g^N \tag{A.37}$$

s.t.

$$\frac{x_g\sigma_u}{2}w_g^H + \frac{(1-x_g)\sigma_d}{2}w_g^L + \frac{s_g}{2}w_g^M \geq s_b w_g^N + \frac{B}{\Delta} \tag{A.38}$$

$$\frac{x_g\sigma_u}{2}w_g^H + \frac{(1-x_g)\sigma_d}{2}w_g^L + \frac{s_g}{2}w_g^M \geq s_g w_g^N \tag{A.39}$$

$$\frac{x_n\sigma_u}{2}w_g^H + \frac{(1-x_n)\sigma_d}{2}w_g^L + \frac{s_n}{2}w_g^M \leq s_n w_g^N \tag{A.40}$$

$$\frac{x_b\sigma_u}{2}w_g^H + \frac{(1-x_b)\sigma_d}{2}w_g^L + \frac{s_b}{2}w_g^M \leq s_b w_g^N \tag{A.41}$$

Following an identical reasoning to the one in the proof of Proposition 2 above, we set $w_g^L = w_g^M = 0$ and conclude that (A.38) and (A.40) are the only two binding constraints. Solving the linear system formed by these two constraints yields the optimal contract,

$$W_g^* = (w_g^{L*}, w_g^{M*}, w_g^{H*}, w_g^{N*}) = \left(0, 0, \frac{2s_n B}{\Delta(x_g s_n - x_n s_b)\sigma_u}, \frac{x_n B}{\Delta(x_g s_n - x_n s_b)}\right), \tag{A.42}$$

which substituted into the objective function yields the associated compensation costs

$$C_g^* = \frac{[(\gamma+\Delta)x_g + (1-\gamma-\beta)x_n]s_n + (\beta-\Delta)x_n s_b}{\Delta(x_g s_n - x_n s_b)} B. \tag{A.43}$$

3) Optimal contract under F_b:

$$\min_{W_b \in \mathbb{R}_+^4} (\beta - \Delta)\left[\frac{x_b\sigma_u}{2} w_b^H + \frac{(1-x_b)\sigma_d}{2} w_b^L + \frac{s_b}{2} w_b^M\right] + [(1-\gamma-\beta)s_n + (\gamma+\Delta)s_g]\, w_b^N \tag{A.44}$$

s.t.

$$\frac{x_b\sigma_u}{2} w_b^H + \frac{(1-x_b)\sigma_d}{2} w_b^L + \frac{s_b}{2} w_b^M \le s_g w_b^N - \frac{B}{\Delta} \tag{A.45}$$

$$\frac{x_g\sigma_u}{2} w_b^H + \frac{(1-x_g)\sigma_d}{2} w_b^L + \frac{s_g}{2} w_b^M \le s_g w_b^N \tag{A.46}$$

$$\frac{x_n\sigma_u}{2} w_b^H + \frac{(1-x_n)\sigma_d}{2} w_b^L + \frac{s_n}{2} w_b^M \le s_n w_b^N \tag{A.47}$$

$$\frac{x_b\sigma_u}{2} w_b^H + \frac{(1-x_b)\sigma_d}{2} w_b^L + \frac{s_b}{2} w_b^M \ge s_b w_b^N \tag{A.48}$$

The problem can be simplified by noting that for any contract with strictly positive w_b^H (or w_b^M) we can reduce w_b^H (or w_b^M) by $\varepsilon > 0$ and increase w_b^L by $\varepsilon \frac{x_b}{(1-x_b)} \frac{\sigma_u}{\sigma_d}$ (or $\varepsilon \frac{s_b}{(1-x_b)\sigma_d} > 0$). Such change does not affect the value of the objective function or of constraints (A.45), and (A.48) and strictly relaxes constraints (A.46) and (A.47) (notice that $\frac{x_g\sigma_u}{2} > \frac{(1-x_g)\sigma_d}{2} \frac{x_b}{(1-x_b)} \frac{\sigma_u}{\sigma_d}$ and $\frac{s_g}{2} > \frac{(1-x_g)\sigma_d}{2} \frac{s_b}{(1-x_b)\sigma_d}$ for (A.46) and $\frac{x_n\sigma_u}{2} > \frac{(1-x_n)\sigma_d}{2} \frac{x_b}{(1-x_b)} \frac{\sigma_u}{\sigma_d}$ and $\frac{s_n}{2} > \frac{(1-x_n)\sigma_d}{2} \frac{s_b}{(1-x_b)\sigma_d}$ for (A.47)). Hence, we can impose w.l.o.g. that $w_b^H = w_b^M = 0$ and (A.45)-(A.48) boil down to:

$$\frac{\sigma_d}{2} w_b^L \le \frac{s_g}{1-x_b} w_b^N - \frac{B}{(1-x_b)\Delta} \tag{A.49}$$

$$\frac{\sigma_d}{2} w_b^L \le \frac{s_g}{1-x_g} w_b^N \tag{A.50}$$

$$\frac{\sigma_d}{2} w_b^L \le \frac{s_n}{1-x_n} w_b^N \tag{A.51}$$

$$\frac{\sigma_d}{2} w_b^L \ge \frac{s_b}{1-x_b} w_b^N \tag{A.52}$$

Since $\frac{s_g}{1-x_g} > \frac{s_n}{1-x_n} > \frac{s_b}{1-x_b}$, (A.51) implies (A.50) so (A.50) can be ignored. Furthermore, (A.52) must be binding (otherwise reducing w_b^L relaxes (A.49) and (A.51) and decreases the objective function). If (A.52) is binding implies (A.51) is not ($\frac{s_n}{1-x_n} > \frac{s_b}{1-x_b}$). Finally (A.49) must be binding (otherwise reducing w_b^N relaxes (A.52) and decreases the objective function). In sum, solving the linear system formed by (A.49) and (A.52) gives the optimal contract,

$$W_b^* = (w_b^{L*}, w_b^{M*}, w_b^{H*}, w_b^{N*}) = \left(\frac{2s_b B}{\Delta(s_g - s_b)(1-x_b)\sigma_d}, 0, 0, \frac{B}{\Delta(s_g - s_b)}\right), \tag{A.53}$$

which substituted into the objective function yields C_b^* (which equals C_0^*):

$$C_b^* = \frac{(\Delta+\gamma)s_g + (1-\beta-\gamma)s_n + (\beta-\Delta)s_b}{\Delta\left(s_g - s_b\right)} B = C_0^* \tag{A.54}$$

4) Optimal contract under F_n:

$$\min_{W_n \in \mathbb{R}_+^4} \frac{(\gamma+\Delta)\left[x_g \sigma_u w_n^H + s_g w_n^M + (1-x_g)\sigma_d w_n^L\right]}{2} + \tag{A.55}$$

$$+ \frac{(\beta-\Delta)[x_b \sigma_u w_n^H + s_b w_n^M + (1-x_b)\sigma_d w_n^L]}{2} + (1-\gamma-\beta) s_n w_n^N$$

s.t.

$$\frac{(x_g - x_b)\sigma_u}{2} w_n^H - \frac{(x_g - x_b)\sigma_d}{2} w_n^L + \frac{s_g - s_b}{2} w_n^M \geq \frac{B}{\Delta} \tag{A.56}$$

$$\frac{x_g \sigma_u}{2} w_n^H + \frac{(1-x_g)\sigma_d}{2} w_n^L + \frac{s_g}{2} w_n^M \geq s_g w_n^N \tag{A.57}$$

$$\frac{x_n \sigma_u}{2} w_n^H + \frac{(1-x_n)\sigma_d}{2} w_n^L + \frac{s_n}{2} w_n^M \leq s_n w_n^N \tag{A.58}$$

$$\frac{x_b \sigma_u}{2} w_n^H + \frac{(1-x_b)\sigma_d}{2} w_n^L + \frac{s_b}{2} w_n^M \geq s_b w_n^N \tag{A.59}$$

Define $\alpha(v) \equiv \frac{x_v \sigma_u}{s_v} \in [0,1]$ for $v \in \{b, g, n\}$, and rewrite the constraints as:

$$\frac{(x_g - x_b)\sigma_u}{2} w_n^H - \frac{(x_g - x_b)\sigma_d}{2} w_n^L + \frac{s_g - s_b}{2} w_n^M \geq \frac{B}{\Delta} \tag{A.60}$$

$$\alpha(g) w_n^H + (1-\alpha(g))\, w_n^L + w_n^M \geq 2 w_n^N \tag{A.61}$$

$$\alpha(n) w_n^H + (1-\alpha(n))\, w_n^L + w_n^M \leq 2 w_n^N \tag{A.62}$$

$$\alpha(b) w_n^H + (1-\alpha(b))\, w_n^L + w_n^M \geq 2 w_n^N \tag{A.63}$$

and since $\alpha(b) < \alpha(n) < \alpha(g)$ then $w_n^H = w_n^L \equiv w_n^{HL}$ and constraints (A.61)-(A.63) are binding. Furthermore, (A.60) must be binding (otherwise reducing w_n^{HL} or w_n^M by 2ε and w_n^N by ε would leave constraints (A.61)-(A.63) unaffected and decrease the objective function). In summary, the optimization problem boils down to solving the linear system of the binding constraints:

$$w_n^{HL} + w_n^M = \frac{2B}{\Delta\left(s_g - s_b\right)} \tag{A.64}$$

$$w_n^N = \frac{B}{\Delta\left(s_g - s_b\right)} \tag{A.65}$$

Furthermore, since $w_n^H = w_n^L \equiv w_n^{HL}$ the objective function boils down to:

$$\min_{W_n \in \mathbb{R}_+^4} \frac{(\gamma+\Delta)s_g\left(w_n^{HL} + w_n^M\right) + (\beta-\Delta)s_b\left(w_n^{HL} + w_n^M\right)}{2} + (1-\gamma-\beta)s_n w_n^N, \tag{A.66}$$

and therefore, the system is determined up to $\left(w_n^{HL} + w_n^M\right)$. Imposing w.l.o.g. $w_n^{HL} = 0$ the optimal contract is

$$W_n^* = (w_n^{L*}, w_n^{M*}, w_n^{H*}, w_n^{N*}) = \left(0, \frac{2B}{\Delta(s_g - s_b)}, 0, \frac{B}{\Delta(s_g - s_b)}\right), \tag{A.67}$$

which substituted into the objective function yields C_n^* (which equals C_0^*):

$$C_n^* = \frac{(\Delta+\gamma)s_g + (1-\beta-\gamma)s_n + (\beta-\Delta)s_b}{\Delta\,(s_g - s_b)} B = C_0^* \tag{A.68}$$

5) Optimal contract under F_ω:

Under convention F_ω, flagging good news, $f = \hat{g}$, and bad news, $f = \hat{b}$, both lead to speculation. Therefore, there are three possible stock prices associated with good news ($p_\omega^{gL}, p_\omega^{gM}, p_\omega^{gH}$), and another three stock prices associated with bad news ($p_\omega^{bL}, p_\omega^{bM}, p_\omega^{bH}$). Alternatively, flagging "no news," $f = \hat{n}$, does not induce speculation and leads to a unique stock price, p_ω^{nN}. As a result, a compensation scheme has seven wages, contingent on $z = R$, each associated with one of the possible stock prices at $t = 2$:

$$W_\omega \equiv \left((w_\omega^{bL}, w_\omega^{bM}, w_\omega^{bH}), w_\omega^{nN}, (w_\omega^{gL}, w_\omega^{gM}, w_\omega^{gH})\right). \tag{A.69}$$

$$\begin{aligned} \min_{W_\omega \in \mathbb{R}_+^7} (\gamma+\Delta) &\frac{\left[x_g\sigma_u w_\omega^{gH} + (1-x_g)\sigma_d w_\omega^{gL} + s_g w_\omega^{gM}\right]}{2} + \\ + (\beta-\Delta) &\frac{\left[x_b\sigma_u w_\omega^{bH} + (1-x_b)\sigma_d w_\omega^{bL} + s_b w_\omega^{bM}\right]}{2} + (1-\gamma-\beta)s_n w_\omega^{nN} \end{aligned} \tag{A.70}$$

s.t.

$$x_g\sigma_u w_\omega^{gH} + (1-x_g)\sigma_d w_\omega^{gL} + s_g w_\omega^{gM} \geq \frac{2B}{\Delta} + x_b\sigma_u w_\omega^{bH} + (1-x_b)\sigma_d w_\omega^{bL} + s_b w_\omega^{bM} \tag{A.71}$$

$$\frac{1}{2}[x_g\sigma_u w_\omega^{gH} + (1-x_g)\sigma_d w_\omega^{gL} + s_g w_\omega^{gM}] \geq s_g w_\omega^{nN} \tag{A.72}$$

$$x_g\sigma_u w_\omega^{gH} + (1-x_g)\sigma_d w_\omega^{gL} + s_g w_\omega^{gM} \geq x_g\sigma_u w_\omega^{bH} + (1-x_g)\sigma_d w_\omega^{bL} + s_g w_\omega^{bM} \tag{A.73}$$

$$\frac{1}{2}[x_n\sigma_u w_\omega^{gH} + (1-x_n)\sigma_d w_\omega^{gL} + s_n w_\omega^{gM}] \leq s_n w_\omega^{nN} \tag{A.74}$$

$$\frac{1}{2}[x_n\sigma_u w_\omega^{bH} + (1-x_n)\sigma_d w_\omega^{bL} + s_n w_\omega^{bM}] \leq s_n w_\omega^{nN} \tag{A.75}$$

$$\frac{1}{2}[x_b\sigma_u w_\omega^{bH} + (1-x_b)\sigma_d w_\omega^{bL} + s_b w_\omega^{bM}] \geq s_b w_\omega^{nN} \tag{A.76}$$

$$x_b\sigma_u w_\omega^{bH} + (1-x_b)\sigma_d w_\omega^{bL} + s_b w_\omega^{bM} \geq x_b\sigma_u w_\omega^{gH} + (1-x_b)\sigma_d w_\omega^{gL} + s_b w_\omega^{gM} \tag{A.77}$$

Assume that (A.72)-(A.73)-(A.75)-(A.77) are not binding. In other words, assume that the only possibly binding constraints are (A.71) (the moral hazard constraint), (A.74) (the IC constraint that prevents the no-news, state n, from imitating the good-news, state g), and (A.76) (the IC constraint that prevents the bad-news, state b, from imitating the no-news, state n). Then:

$$\begin{aligned} \min_{W_\omega \in \mathbb{R}_+^7} (\gamma+\Delta) &\frac{\left[x_g\sigma_u w_\omega^{gH} + (1-x_g)\sigma_d w_\omega^{gL} + s_g w_\omega^{gM}\right]}{2} + \\ + (\beta-\Delta) &\frac{\left[x_b\sigma_u w_\omega^{bH} + (1-x_b)\sigma_d w_\omega^{bL} + s_b w_\omega^{bM}\right]}{2} + (1-\gamma-\beta)s_n w_\omega^{nN} \end{aligned} \tag{A.78}$$

s.t.

$$\frac{2B}{\Delta} + x_b\sigma_u w_\omega^{bH} + (1-x_b)\sigma_d w_\omega^{bL} + s_b w_\omega^{bM} \leq x_g\sigma_u w_\omega^{gH} + (1-x_g)\sigma_d w_\omega^{gL} + s_g w_\omega^{gM} \quad (A.79)$$
$$\frac{1}{2}[x_n\sigma_u w_\omega^{gH} + (1-x_n)\sigma_d w_\omega^{gL} + s_n w_\omega^{gM}] \leq s_n w_\omega^{nN} \quad (A.80)$$
$$\frac{1}{2}[x_b\sigma_u w_\omega^{bH} + (1-x_b)\sigma_d w_\omega^{bL} + s_b w_\omega^{bM}] \geq s_n w_\omega^{nN} \quad (A.81)$$

In the above problem: (1) $\left(w_\omega^{bL}, w_\omega^{bM}, w_\omega^{bH}\right)$ is only determined up to $[x_b\sigma_u w_\omega^{bH}+(1-x_b)\sigma_d w_\omega^{bL}+s_b w_\omega^{bM}]$ and therefore, we can assume w.l.o.g. that $w_\omega^{bL} = w_\omega^{bM} = w_\omega^{bH} \equiv w_\omega^{b}$; (2) w_ω^{gL}(and w_ω^{gM}) can be set equal to zero or otherwise one can reduce w_ω^{gL} (w_ω^{gM}) by ε and increase w_ω^{gH} by $\frac{(1-x_g)\sigma_d}{x_g\sigma_u}\varepsilon$ ($\frac{s_g}{x_g\sigma_u}\varepsilon$) which does not alter the objective function, (A.79) or (A.81) and relaxes (A.80). Therefore the relaxed problem boils down to:

$$\min_{W_\omega \in \mathbb{R}_+^7} (\gamma+\Delta)\frac{x_g\sigma_u w_\omega^{gH}}{2} + (1-\gamma-\beta)s_n w_\omega^{nN} + (\beta-\Delta)s_b w_\omega^{b} \quad (A.82)$$

s.t.

$$x_g\sigma_u w_\omega^{gH} \geq \frac{2B}{\Delta} + 2s_b w_\omega^{b} \quad (A.83)$$
$$\frac{1}{2}x_n\sigma_u w_\omega^{gH} \leq s_n w_\omega^{nN} \quad (A.84)$$
$$s_b w_\omega^{b} \geq s_b w_\omega^{nN} \quad (A.85)$$

Notice that: (A.83) must be binding, otherwise we could reduce w_ω^{gH} ; (A.84) must be binding, otherwise reduce w_ω^{nN}; and (A.85) must be binding, otherwise reduce w_ω^{b}. Solving the linear system we get $w_\omega^{nN*} = w_\omega^{b*} = \frac{B}{\Delta(\frac{x_g}{x_n}s_n - s_b)}$ and $w_\omega^{gH*} = \frac{2Bs_n}{\Delta(\frac{x_g}{x_n}s_n - s_b)x_n\sigma_H}$, which substituted in the objective function gives the expected compensation costs:

$$C_\omega^* = \frac{[(\gamma+\Delta)x_g + (1-\gamma-\beta)x_n]s_n + (\beta-\Delta)x_n s_b}{\Delta(x_g s_n - x_n s_b)}B = C_g^* \quad (A.86)$$

Finally, we must check that indeed satisfies restrictions (A.72)-(A.73)-(A.75)-(A.77):

$$\text{(A.72): } w_\omega^{gH} \geq \frac{2s_g}{x_g\sigma_u}w_\omega^{nN} \overset{\text{Using (A.84)}}{=} \frac{s_g x_n}{x_g s_n}w_\omega^{gH} < w_\omega^{gH}$$
$$\text{(A.73): } w_\omega^{gH} \geq \frac{2s_g}{x_g\sigma_u}w_\omega^{b} \overset{\text{Using (A.84) and (A.85)}}{=} \frac{s_g x_n}{x_g s_n}w_\omega^{gH} < w_\omega^{gH}$$
$$\text{(A.75): } w_\omega^{b} \leq \frac{2s_n}{2s_n}w_\omega^{nN} \overset{\text{Using (A.85)}}{=} w_\omega^{b}$$
$$\text{(A.77): } w_\omega^{b} \geq \frac{x_b\sigma_u}{2s_b}w_\omega^{gH} \overset{\text{Using (A.84) and (A.85)}}{=} \frac{s_n x_b}{x_n s_b}w_\omega^{b} < w_\omega^{b}$$

Proof of Propositions 5

Conventions F_b and F_n have the same compensation costs as F_0: It follows from equations A.36, A.54, and A.68.

Convention F_ω has the same compensation costs as F_g: It follows from equations A.43 and A.86.

Compensation costs under F_g are smaller than those under F_0: From equations A.36 and A.43, and after some calculations:

$$C_0^* - C_g^* = \frac{(1-\gamma-\beta)s_n + (\beta+\gamma)\, s_b}{\left[(\frac{x_g}{x_n}s_n - s_g) + (s_g - s_b)\right]\Delta\,(s_g - s_b)}(\frac{x_g}{x_n}s_n - s_g)B > 0$$

Richer Compensation Contracts (Proposition 7)

Proof of Proposition 7 (Limited Liability)

Next we prove that allowing for contracts that pay a positive wage after a low cash-flow does not reduce speculation costs. To save space, below we provide the proofs for conventions F_0 and F_g (i.e., the two possible optimal conventions). The proofs for F_b, F_n and F_ω follow a similar logic but they are omitted to save space.

a) *Under convention* F_0, paying a positive wage after $z = 0$, $w_0^0 > 0$, strictly increases compensation costs because it increases the value of the objective function and makes the incentive constraint harder to satisfy. (See footnote 8 for details.) In fact we can express the compensation costs as $C_0(w_0^0) = w_0^0 + \frac{B}{\Delta(s_g - s_b)}$; an expression that it is minimized when $w_0^0 = 0$.

In what follows, we use the notation $w_J^{0,i} \equiv w(0, p_J^i)$ and $w_J^{R,i} \equiv w(R, p_J^i)$ for the wage paid, respectively, after a low and high cash-flow.

b) *Convention F_g*. If contracts that pay a positive wage after a low cash-flow are allowed, shareholders solve the following problem:

$$\begin{aligned}
\min_{W_g \in \mathbb{R}_+^8} (\gamma+\Delta) & \left[\begin{array}{c} \frac{x_g \sigma_u}{2} w_g^{R,H} + \frac{x_g(1-\sigma_u)}{2} w_g^{0,H} + \frac{(1-x_g)\sigma_d}{2} w_g^{R,L} + \\ + \frac{(1-x_g)(1-\sigma_d)}{2} w_g^{0,L} + \frac{s_g}{2} w_g^{R,M} + \frac{(1-s_g)}{2} w_g^{0,M} \end{array} \right] + \\
& + \left[(1-\gamma-\beta)s_n + (\beta-\Delta)s_b\right] w_g^{R,N} + \\
& + \left[(1-\gamma-\beta)(1-s_n) + (\beta-\Delta)(1-s_b)\right] w_g^{0,N} \qquad \text{(A.87)}
\end{aligned}$$

s.t.

$$\begin{bmatrix} \frac{x_g\sigma_u}{2}w_g^{R,H}+\frac{x_g(1-\sigma_u)}{2}w_g^{0,H}+\frac{(1-x_g)\sigma_d}{2}w_g^{R,L}+ \\ \frac{(1-x_g)(1-\sigma_d)}{2}w_g^{0,L}+\frac{s_g}{2}w_g^{R,M}+\frac{(1-s_g)}{2}w_g^{0,M} \end{bmatrix} \geq s_b w_g^{R,N}+(1-s_b)w_g^{0,N}+\frac{B}{\Delta} \tag{A.88}$$

$$\begin{bmatrix} \frac{x_g\sigma_u}{2}w_g^{R,H}+\frac{x_g(1-\sigma_u)}{2}w_g^{0,H}+\frac{(1-x_g)\sigma_d}{2}w_g^{R,L}+ \\ \frac{(1-x_g)(1-\sigma_d)}{2}w_g^{0,L}+\frac{s_g}{2}w_g^{R,M}+\frac{(1-s_g)}{2}w_g^{0,M} \end{bmatrix} \geq s_g w_g^{R,N}+(1-s_g)w_g^{0,N} \tag{A.89}$$

$$\begin{bmatrix} \frac{x_n\sigma_u}{2}w_g^{R,H}+\frac{x_n(1-\sigma_u)}{2}w_g^{0,H}+\frac{(1-x_n)\sigma_d}{2}w_g^{R,L}+ \\ \frac{(1-x_n)(1-\sigma_d)}{2}w_g^{0,L}+\frac{s_n}{2}w_g^{R,M}+\frac{(1-s_n)}{2}w_g^{0,M} \end{bmatrix} \leq s_n w_g^{R,N}+(1-s_n)w_g^{0,N} \tag{A.90}$$

$$\begin{bmatrix} \frac{x_b\sigma_u}{2}w_g^{R,H}+\frac{x_b(1-\sigma_u)}{2}w_g^{0,H}+\frac{(1-x_b)\sigma_d}{2}w_g^{R,L}+ \\ \frac{(1-x_b)(1-\sigma_d)}{2}w_g^{0,L}+\frac{s_b}{2}w_g^{R,M}+\frac{(1-s_b)}{2}w_g^{0,M} \end{bmatrix} \leq s_b w_g^{R,N}+(1-s_b)w_g^{0,N} \tag{A.91}$$

To prove that contracts that limit payments to positive cash flows are without loss of generality, we can proceed as follows: **(1)** Any contract for which $w_g^{0,H}$ (or $w_g^{0,L}$) is greater than zero can be replaced with an "alternative" contract that reduces $w_g^{0,H}$ (or $w_g^{0,L}$) by $\varepsilon > 0$ and increases $w_g^{R,H}$ (or $w_g^{R,L}$) by $\frac{1-\sigma_u}{\sigma_u}\varepsilon$ (or $\frac{1-\sigma_d}{\sigma_d}\varepsilon$). These alternative contracts do not change the value of the objective function or any of the constraints, and therefore, in the above optimization problem we can impose $w_g^{0,H} = w_g^{0,L} = 0$. **(2)** Any contract for which $w_g^{0,M}$ is greater than zero can be replaced with an "alternative" contract that reduces $w_g^{0,M}$ by $\varepsilon > 0$ and increases $w_g^{R,M}$ by $\frac{1-s_g}{s_g}\varepsilon$. This alternative contract does not change the value of the objective function or constraints (A.88) and (A.89), and relaxes (A.90) and (A.91); therefore, in the above optimization problem we can impose $w_g^{0,M} = 0$. **(3)** Any contract for which $w_g^{R,L}$ (or $w_g^{R,M}$) is positive can be replaced by an alternative contract that reduces w_g^{RL} (or w_g^{RM}) by $\varepsilon > 0$ and increases $w_2^{R,H}$ by $\varepsilon\frac{(1-x_g)\sigma_d}{x_g\sigma_u}$ (or $\varepsilon\frac{s_g}{x_g\sigma_u} > 0$). This alternative contract does not change the value of the objective function or constraints (A.88) and (A.89), and relaxes constraints (A.90) and (A.91), and therefore, in the above optimization problem we can impose $w_g^{R,L} = w_g^{R,M} = 0$. **(4)** Imposing $w_g^{0,H} = w_g^{0,L} = w_g^{0,M} = w_g^{R,L} = w_g^{R,M} = 0$, and solving the problem by ignoring by now constraints (A.89) and (A.91), it can be immediately seen that, in this relaxed problem, any contract that pays $w_g^{0,N} > 0$ can be replaced by an alternative contract that reduces $w_g^{0,N}$ by $\varepsilon > 0$ and increases $w_g^{R,N}$ by $\frac{1-s_n}{s_n}\varepsilon$. The new contract does not affect the value of the objective function, relaxes (A.88), and does not affect constraint (A.90). **(5)** Notice that after imposing $w_g^{0,N} = 0$, this relaxed problem has the same solution as the one previously solved for convention F_g (i.e., see equation A.42). As W_g^* verifies constraints (A.89) and (A.91) the solution is optimal.

The proof that allowing for contracts that can be contingent on flags does not reduce compensation costs (second part of Proposition 8) follows directly from the arguments in the main text (i.e., since the distribution of stock prices depends on the whether the flag has been raised or not, contracts based solely on stock prices can incorporate any information contained in the flag, and hence, flags become redundant as contracting devices in our model). The proof is omitted to save space.

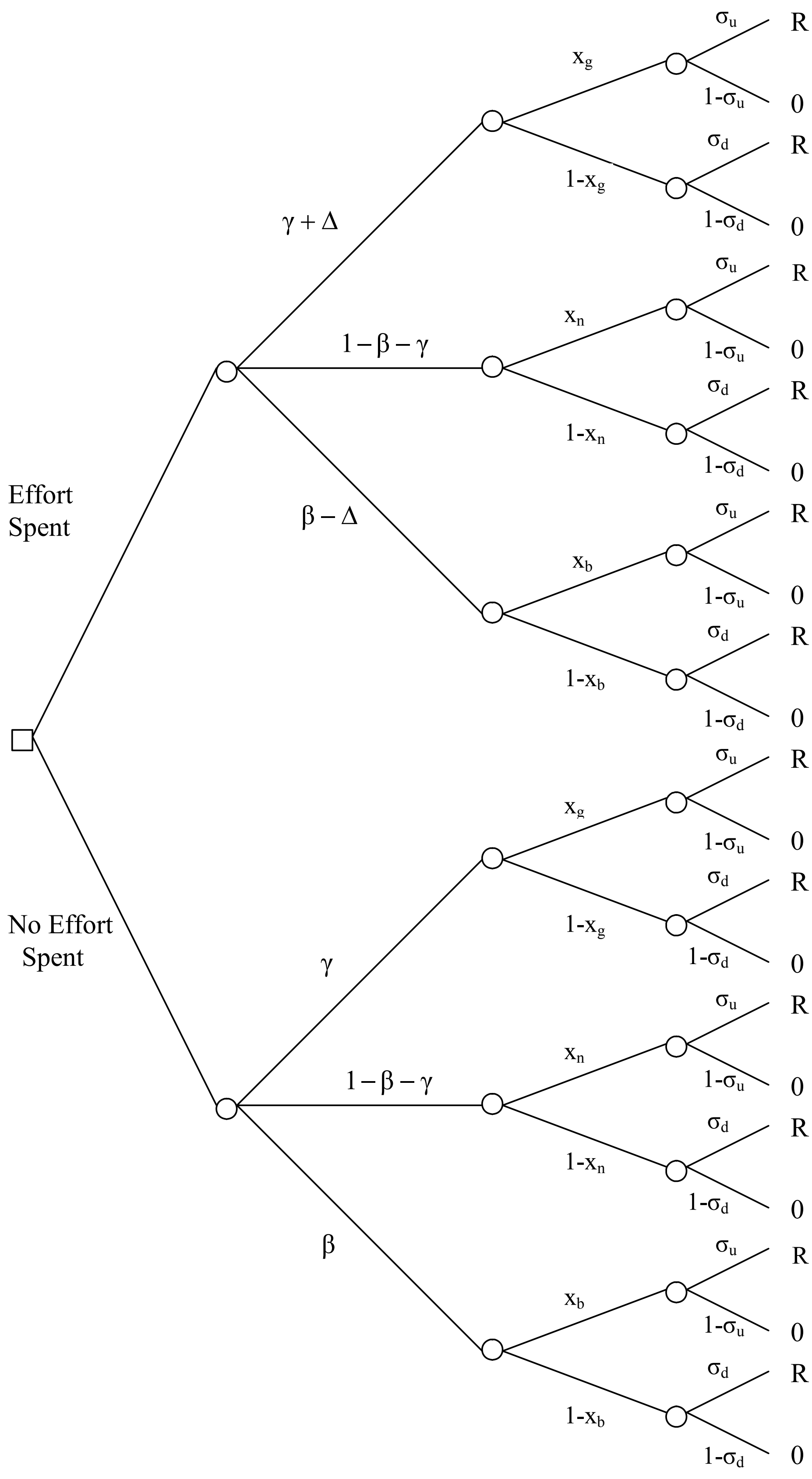

Figure 2: Information Structure

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Notes

[1]For instance, see Ikenberry, Lakonishok and Vermaelen (1995) for the valuation effects of non-binding announcements of share repurchases, Grinblatt, Masulis and Titman (1984) for stock dividend and stock split announcements effects, and Cooper, Dimitrov and Rau (2001) for the effects of corporate name changes.

[2]Soft information precludes a third party from directly looking at the evidence and certifying whether its content has been truthfully disclosed (e.g., Stein, 2002, and Bolton and Dewatripont, 2005).

[3]For instance, Jensen (2004) argues that equity-based compensation exacerbates the agency costs associated with overvalued equity, e.g., earnings manipulation and fraudulent accounting. By contrast, our model shows that, by inducing voluntary disclosure of information, short-term equity-based compensation can actually improve transparency, particularly when the firm's equity is undervalued.

[4]See Verrecchia (2001) for a review of the literature on information disclosure.

[5]In a cheap talk game the message affects the payoff only if agents respond to the messages, e.g., Farrell and Rabin (1996). See Adams and Ferreira (2007), Austen-Smith and Banks (2000), Brennan and Kraus (1987), Franke (1987), Bhattacharya and Dittmar (2003) and Harris and Raviv (2005) for applications of cheap talk and costless signalling to corporate finance.

[6]In a related literature, Stocken (2000) and Fisher and Heinkel (2005) consider reputation-based mechanisms to elicit managerial truthtelling.

[7]There is also a related literature in accounting that studies the role of voluntary disclosure of non-financial and qualitative information. For example: Amir and Lev (1996) and Hirschey et al. (2001) document the value-relevance of non-financial information (e.g., growth potential, market penetration, scientific information on patent quality etc.) in the wireless communication and high-tech industries, respectively. In addition, Bryan (1997) documents the incremental information content of Management Discussion and Analysis (i.e., unaudited , narrative disclosures which augment GAAP mandated disclosures).

[8]In this setting, the manager can be induced to exert high effort with a compensation scheme that pays $\bar{w} = \frac{B}{\Delta(s_g - s_b)}$ in case of success and zero otherwise, i.e., $\Delta\left(s_g - s_b\right)\bar{w} \geq B$. Shareholders benefit from managerial effort if $\left[(\gamma + \Delta)\, s_g + (1 - \beta - \gamma)s_n + (\beta - \Delta)s_b\right](R - \frac{B}{\Delta(s_g - s_b)}) > (\gamma s_g + (1 - \beta - \gamma)s_n + \beta s_b)R$ which is implied by (2). For example, see Holmstrom and Tirole (1997) for a similar setup.

[9]This assumption (also made in Faure-Grimaud and Gromb 2004) simplifies the derivations by

ruling out an equilibrium with trading in mixed strategies. Relaxing this assumption complicates the analysis without qualitatively changing the results.

[10] Alternatively, the investigation cost can be seen as the realization of a random variable whose average is k for states b and g, and αk for state n. Also, notice that the speculator's private signal σ is a sufficient statistic about z and hence, learning about the state ω through the investigation cost does not provide any additional information to the speculator about the firm's cash-flow z.

[11] In section II, we derive the specific bounds for k that make the speculator behavior optimal (i.e., to investigate and trade only when state n can be excluded). In a previous version we also considered two alternative formulations in which either the precision of the speculator's information, or the probability that the speculator finds information about the firm, rather than the investigation cost, differed across states, and obtained similar results.

[12] As we show in section III, focusing on F_0 and F_g is without loss of generality. Notice that in terms of on-the-equilibrium path actions and information disclosure, convention $\{+1, -1, -1\}$ is equivalent to F_0, and convention $\{+1, -1, +1\}$ is equivalent to F_g. These pairs of conventions only differ in state b, which, if $\Delta = \beta$ and $\gamma = 0$, never occurs under high managerial effort $e = 1$.

[13] Under F_0 investigation (and trading) by the speculator is an out-of-equilibrium action. In that case, we assume that the market maker believes that trading by the speculator is informed (e.g., if the order flow is $\{\delta, \delta\}$ the market maker believes that the speculator has investigated and obtained a high signal σ_u). Similarly, under F_0 raising the flag is a managerial out-of-equilibrium action. To complete the description of the equilibrium, we will simply assume that the speculator does not change his beliefs after the flag has been raised (i.e., conditional on flagging, the probability of n is still $(1 - \Delta)$, and hence, the speculator does not investigate the firm).

[14] The manager's participation constraint can be ignored since it is trivially satisfied (i.e., the manager can always obtain a positive expected utility that is above his reservation utility by exerting no effort). Also, notice that since the state ω is a sufficient statistic for effort e, it is unnecessary to condition on the level of effort in the asymmetric information constraints.

[15] Solving the problem under the opposite condition, i.e., inducing the manager to flag b, would reduce shareholder value. Intuitively, this occurs because inducing flagging in b implicitly requires rewarding the manager in b, which aggravates managerial moral hazard. See also section III and the appendix for the solution of the general model in which all states $\{b, n, g\}$ are feasible in equilibrium.

[16]Under F_g, if the speculator were to investigate when the flag is not raised (i.e., in state n), the expected profits for trading would be at most $x_n(1-x_n)(\sigma_u-\sigma_d)\,R\,\bar{\delta}$ (notice the parallelism with equation (17)). Condition (4) implies that $\alpha k > x_n(1-x_n)(\sigma_u-\sigma_d)\,R\,\bar{\delta}$, and hence, the speculator finds unprofitable to investigate in state n.

[17]The ratio $\frac{\Pr(z=R|e=1)}{\Pr(z=R|e=0)} = \frac{\sigma_d+(\Delta x_g+(1-\Delta)x_n)(\sigma_u-\sigma_d)}{\sigma_d+(\Delta x_b+(1-\Delta)x_n)(\sigma_u-\sigma_d)}$ (i.e., the likelihood ratio of obtaining the high cash-flow with and without managerial effort) is decreasing in x_b, and increasing in $\frac{\sigma_u}{\sigma_d}$ and Δ. Notice that a smaller x_g or a larger x_n makes the final cash-flow less informative about effort, but also makes it more difficult to induce managerial truthtelling (because there is a smaller probability under g and a larger probability under n of obtaining a high stock price at $t=2$). For this reason, the effect of changes in x_g and x_n is ambiguous.

[18]Notice that in the model managerial announcements spur speculation and hence, increase trade volume. In practice, however, trade volume would also be affected by the change of behavior of uninformed yet rational traders in an ambiguous way. On the one hand, after an announcement, these traders may find additional motives to trade (e.g., to rebalance their portfolios as a result of the new information). On the other hand, they may also abstain from trading fearing the additional speculation brought by the managerial announcement.

[19]For example, Francis, Hanna and Philbrick (1997) documents that making conference calls increases firms' analysts coverage, and Healy, Hutton and Palepu (1999) shows that firms that expand information disclosure experience contemporaneous increases in stock prices unrelated to current earnings and have an increase in analysts' coverage. In addition, Bushee, Matsumoto and Miller (2003) documents that the provision of unlimited real-time access to corporate conference calls is associated with a greater increase in small trades and a higher price volatility during the call period.

[20]The perception of stock undervaluation can be prevalent among executives. For instance, in a survey conducted in 1999 when the Dow Jones 30 was approaching a new record high, more than two-thirds of Financial Executives Institute executives felt that their common equity was undervalued by the market, and only 3% thought that their stock was overvalued (see Graham 1999).

[21]When $\beta=\Delta$ and $\gamma=0$, only states n and g were feasible on-the-equilibrium path, and hence, a two-dimensional message space $f\in\{-1,1\}$ allowed for full information disclosure. If $\beta\neq\Delta$ and $\gamma\geq 0$, however, all three states $\{b,n,g\}$ can be feasible on-the-equilibrium path, and hence, a three-dimensional message space $f\in\{\hat{b},\hat{n},\hat{g}\}$ is necessary to allow for the possibility of full information disclosure.

[22]Conventions $\{\hat{n},\hat{n},\hat{n}\}$ and $\{\hat{n},\hat{n},\hat{g}\}$ under the three-dimensional message space are equiv-

alent, respectively, to conventions $\{-1,-1,-1\}$ and $\{-1,-1,+1\}$ under the two-dimensional message space. For this reason, in a slight abuse of notation, we refer to them as F_0 and F_g, and to their associated speculation and compensation costs as $\{C_0, S_0\}$ and $\{C_g, S_g\}$ respectively. In fact, imposing $\beta = \Delta$ and $\gamma = 0$ in the general model, yields the corresponding expressions in section II.

[23] This is the optimal behavior by the speculator when the investigation cost is bounded by $k \in (\frac{R\bar{\delta}(\sigma_u - \sigma_d)}{4[(\gamma+\beta)+\alpha(1-\gamma-\beta)]}, R\bar{\delta}(\sigma_u - \sigma_d)\min\{x_b(1-x_b), x_g(1-x_g)\})$. The derivation of these bounds follows similar steps to the derivation of bounds (4) and (18) in section II. See the appendix for details.

[24] See, respectively, Cooper, Dimitrov and Rau (2001), Francis, Hanna and Philbrick (1998), Ikenberry, Lakonishok and Vermaelen (1995), and Grinblatt, Masulis and Titman (1984).

[25] Allowing for contracting on the announcement (i.e., the flag) is akin to a situation in which speculators can collect information only with a lag. In such case, there would be two subsequent stock prices: one right after attracting attention (which would just reflect the fact that the manager has raised the flag) and a second one after speculators collect information and trade.

[26] The formal analysis is omitted to save space but it is available from the authors upon request. Notice also that throughout the analysis we have considered a setting of moral hazard with risk neutrality and limited liability. Managerial risk aversion, however, can also facilitate information disclosure, and lead to additional savings in compensation costs.

[27] Recent corporate scandals (e.g., Enron) also suggest that auditing is far from being a perfect certification mechanism.