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Reputation management and the disclosure of earnings forecasts

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Abstract In this paper, managers differ from each other in terms of the probability that they are "forthcoming" (and disclose all the earnings forecasts they receive) or "strategic" (and disclose the earnings forecasts they receive only when it is in their self-interest to do so). Strategic managers choose whether to disclose their forecasts based on both the disclosure's effects on their firms' stock price and on their reputation among investors for being forthcoming. Our findings include: strategic managers can build a reputation for being forthcoming by disclosing unfavorable forecasts; managers' incentive to build a reputation for being forthcoming may be so strong that they disclose even the most negative forecasts; as managers become more concerned about their reputation: (a) the current price of the firm in the event the manager makes no forecast increases; (b) managers who have a high probability of behaving strategically (as forthcoming) in the future issue forecasts more (less) often in the present.

Keywords Reputation · Forecasts · Voluntary disclosure · Valuation

JEL Classification D82 · M41

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1 Introduction

We construct a model that examines how managers' propensity to issue earnings forecasts affects and is affected by their concern for developing a reputation for disclosing value-relevant information in a timely manner and, more generally, for being known as "forthcoming." This paper is motivated by survey and anecdotal evidence suggesting that managers believe making voluntary disclosures enhances their reputations with investors. For example, Graham et al. (2005)'s survey of financial reporting finds that more than 90% of the managers surveyed agreed with the statement that:

> "Voluntarily communicating financial information ... promotes a reputation for transparent/accurate reporting."

As another example, Miller and Bahnson (2002) state that:

> "We think that establishing a pattern and reputation for being forthcoming, honest, and timely will boost stock prices and cut capital costs ...."

The model we construct contains the minimal ingredients for such a study: it is a two-period model (today/the future) where, in each period, every firm's manager probabilistically learns a forecast of his firm's earnings for the period, which the manager can either disclose or withhold. Managers differ from each other in the probability that they behave either as "forthcoming" or "strategic" in each period, where a forthcoming manager discloses his earnings forecast whenever he receives it, and a strategic manager discloses his forecast only if it is in his self-interest to do so. Strategic managers are concerned about maximizing a weighted average of their firms' current and future market prices. While each manager knows his own "type" (that is, his probability of behaving strategically in a period), investors do not. A manager's reputation is defined by investors' perceptions of the manager's type. Investors revise their assessments of a manager's reputation depending on which forecast, if any, they observe the manager issue. Strategic managers anticipate how their disclosures influence their reputations, and the reputations strategic managers develop in turn affect their incentives to disclose forecasts.

A key to many of the model's predictions is that a manager can improve his reputation for being forthcoming by disclosing an unfavorable earnings forecast. While the immediate effect of disclosing an unfavorable forecast is to reduce the firm's current market value, such a disclosure increases the future expected market price of the firm. The latter effect obtains because, when observing an unfavorable forecast, investors revise upwards their perceptions of the probability the manager is forthcoming. This in turn leads investors to conclude that, if the manager makes no disclosure in the future, that nondisclosure is more likely attributable to the manager not having received a forecast rather than to the manager having deliberately withheld a negative forecast. Hence, investors assign a higher value to the firm when it makes no disclosure in the future.

We show that managers who are more likely to behave strategically in the future have a greater incentive to issue a forecast today (than do managers who are less likely to behave strategically in the future) because such managers obtain greater expected benefits from being perceived as forthcoming. This reputational effect can be so strong that some strategic managers may disclose today the very worst earnings forecast they could receive. This prediction stands in contrast to the predictions of one-period models of voluntary disclosure in the literature, where managers never disclose the worst information they could possibly receive.[1]

Notwithstanding this prediction—that reputational forces can be so strong as to induce some managers to disclose the worst information they could receive—we show that, in equilibrium, for all unfavorable (price-reducing) forecasts there must always be some strategic managers who are not inclined to engage in "reputation management," that is, some strategic managers who decide whether to disclose or withhold unfavorable forecasts solely based on the forecasts' disclosures' effect on the firms' current market value.[2] The intuition for this result is as follows: were investors to conjecture that *all* strategic managers invest in building their reputations by disclosing some (specific) unfavorable forecast today, then investors would not revise their perceptions of any manager's type upon observing the manager issue this forecast. As a result, the downside to a manager from issuing the forecast (a reduction in the firm's stock price) would not be compensated by an upside (an improvement in the manager's reputation), so no strategic manager would act in accordance with investors' beliefs, that is, the unfavorable forecast would not be issued. Therefore, in equilibrium, for any unfavorable forecast, there must be some managers whose disclosure decisions are not driven by "reputation management" considerations.

We also show that, if strategic managers' incentives for developing a reputation increase, then their firms' current prices in the event they issue no forecasts today increase. This follows because nondisclosure today is less likely to be due to the firms' managers having withheld information and more likely due to the managers not having received information, as the importance managers attach to acquiring a reputation increases. We further show that not all managers change their preferred disclosure policies in the same way as their concern for developing a reputation increases: as reputational considerations become more important, managers who have a high probability of being strategic in the future issue forecasts more often today, whereas managers who have a low probability of being strategic in the future issue forecasts less often today.

We also generate predictions about how the persistence of a firm's earnings affects its manager's propensity to issue earnings forecasts. Among other things, we show that, when a firm is run by a strategic manager, increasing the persistence of the firm's earnings has the same qualitative effect on its manager's disclosure policy as reducing the manager's concern for developing his reputation for being forthcoming. This result is intuitive: as the persistence of a firm's earnings increases, its current earnings forecast has more "value relevance" for the firm's future market price, which diminishes the impact of future earnings' forecasts on the firm's future market price, which in turn reduces the importance a manager attaches

[1] When there is a positive probability that the firm does not receive information during the period.

[2] In fact, we will show that, in our model, at least 50% of all managers do not engage in "reputation management."

to developing a reputation for being forthcoming in the future. In addition, we show that increasing the volatility of the firm's future earnings has the opposite effect: it increases the value relevance of future earnings forecasts for the firm's future market value (relative to the current earnings forecast), which amplifies the importance the firm's manager attaches to developing a reputation for being forthcoming.

Additional predictions of the model are deferred to the body of the paper.

1.1 Related literature

The foundational models of voluntary disclosure of Grossman (1981) and Milgrom (1981) demonstrate that, in a market where (1) sellers know the attributes of the product they are selling; (2) buyers know that all sellers select their disclosure policies so as to maximize their firm's expected market value;[3] (3) buyers know the range of potential attributes of the sellers' products; (4) all buyers evaluate products in the same way; (5) antifraud rules prevent sellers from making false claims about their products; and (6) the attributes of the product being sold can be ordered in terms of the product's quality or value, then the market "unravels" in equilibrium in the sense that every seller will fully disclose the attributes of the product he sells so as to distinguish his product from other lower quality products. Grossman and Milgrom's "full disclosure" result generated many extensions and modifications, including the observation that unravelling would not obtain in equilibrium under conditions 2 through 6 above if condition 1 were replaced by (7) sellers occasionally are uninformed about the value of their products, and (8) when a seller makes no disclosure, buyers cannot discern whether the reason the seller made no disclosure was that he did not have information or was withholding information (cf., Dye 1985; Jung and Kwon 1988). The model in this paper can be viewed as extending Dye (1985) and Jung and Kwon (1988) to a multi-period context where conditions 3 through 8 above hold and condition 2 is replaced by the assumption that managers' objective functions are not perfectly known to investors. (In particular, investors do not know with certainty whether any given manager is strategic or forthcoming.)

The present paper shares two features common to many economic models of reputation (for example, Kreps and Wilson 1982; Milgrom and Roberts 1982; Kreps et al. 1982; Fudenberg and Kreps 1987). First, often the most obvious formulation of the model does not possess an equilibrium in pure strategies. This is true of the version of our model that contains only two types of managers-managers who are always "forthcoming" and disclose any information they receive and managers who are always "strategic" and disclose their private information only if it is in their self-interest to do so.[4] This lack of an equilibrium is both a substantive problem and

[3] This is the adaptation of the objective function of the Grossman and Milgrom models to a capital market context; in a product market context, the objective function Grossman and Milgrom adopt is slightly different from this description.

[4] The intuition is as follows. If an equilibrium did exist with deterministic disclosure policies when the private information a manager receives is continuously distributed, then a strategic manager's optimal disclosure strategy in each period is necessarily described by a cutoff, with the manager preferring to disclose or withhold the private information he receives depending on whether that information is above

a technical problem. It is a substantive problem insofar the nonexistence of an equilibrium thwarts our goal of developing a model that generates predictions—as a model without an equilibrium has no predictions. But it is also merely a technical problem insofar as the nonexistence problem arises principally because, in the most obvious formulation of the problem, the information content of minute changes in forecasted earnings is artificially exaggerated (for reasons discussed in the preceding footnote). We show that this nonexistence problem can be resolved in a natural way by redefining a manager's "type" as the *probability* that the manager behaves strategically in a period.

Second, multi-period considerations alone are not sufficient for reputation formation: reputations can form and evolve only when players differ in some relevant unobservable exogenous characteristics. In our model, the exogenous characteristic is the probability that managers are strategic or forthcoming. In other settings, the exogenous characteristic has been modeled as, for example, the propensity of incumbent firms in an industry to respond aggressively to market entry by rival firms (Milgrom and Roberts 1982), the propensity of government leaders to be committed to low inflation (Barro 1986), etc.

The present paper differs from the existing models of disclosure that address reputation-related concerns, almost all of which involve "cheap talk" (for example, Sobel 1985; Benabou and Laroque 1992; Stocken 2000; Morris 2001) in three ways. First, the cheap talk models of voluntary disclosure address the issue of building a reputation for making truthful disclosures, whereas our model addresses the issue of building a reputation for being forthcoming and disclosing private information in a timely manner. Second, in cheap talk models, by definition, there need be no connection between what managers say and what they know to be true. Unlike cheap talk models, our model assumes that any disclosure must be truthful, reflecting the sizeable civil or criminal penalties that can be imposed on managers and/or their firms when they are caught making false statements to financial markets. Third, the cheap talk models all involve reports about the realization of binary-valued random variables. In contrast, our paper models the disclosure of a continuous random variable in order to capture some of the richness of firms' actual disclosure policies.

In the accounting literature, the paper most closely related to the present paper is a recent paper by Einhorn and Ziv (2008). Einhorn and Ziv study a model in which investors don't know whether a firm receives information in a period unless the firm discloses it, as in our model, but unlike our model, the probability a firm receives information in a period is higher when it received information in the previous period

Footnote 4 continued
or below the cutoff. Notice that were a strategic manager who received information just below the hypothesized first period cutoff to disclose his information-contrary to his expected equilibrium behavior—then the manager would obtain a discrete increase in his expected utility since (a) investors expect only forthcoming managers to disclose information below the cutoff, so investors would (incorrectly) infer that the manager was forthcoming with certainty and (b) other things equal, a strategic manager is always strictly better off by raising investors' perceptions of the probability that he is forthcoming. Since this inconsistency between managers' conjectured and actual behavior occurs no matter where the equilibrium cutoff is posited to be located, it follows that no equilibrium in deterministic disclosure strategies can exist. A formal proof is available from the authors.

than when it received no information in the previous period. Since firms are presumed to bear some exogenous fixed cost every time they make a disclosure, firms' stock prices rise when investors perceive the probability firms will be informed (and hence the probability they will make a disclosure) drops. This provides incentives for managers to withhold information in order to build the firm's reputation for being uninformed. In contrast, in our model, managers have incentives to disclose information in order to establish a reputation for being forthcoming. Because the managers in our model have incentives that are so starkly different from the managers in Einhorn and Ziv's model, many of our results are "orthogonal" to the results in Einhorn and Ziv.[5]

The paper proceeds as follows. Section 2 introduces the model. Section 3 defines the equilibrium of the model, and Sect. 4 characterizes the equilibrium of the model. Section 5 contains the main results of the paper. Section 6 concludes the paper. The appendix contains the proofs of the main results.

2 Model setup

In each of two periods, a firm's manager occasionally privately receives advanced information about the firm's forecasted earnings for that period, which the manager may disclose or withhold before a market for the firm's shares opens. The event that the manager receives a forecast in a period occurs with (constant) probability p over time and is independent from one period to the next. In conformity with the existing disclosure literature, we assume that (1) if the manager does not receive a forecast during a period, the manager necessarily makes no disclosure, and (2) if the manager receives a forecast, he can either issue the forecast or disclose nothing.

The firm's period i forecast, denoted by x_i, is the realization of the random variable $\tilde{x}_i$. $\tilde{x}_1$ is taken to be uniformly distributed on $[-1, 1]$, while $\tilde{x}_2$ conditional on x_1 is taken to be uniformly distributed on $[-k_0 + k_1 x_1, k_0 + k_1 x_1]$ where $k_0 > 0$ and $k_1 > -1$. The density and distribution function of $\tilde{x}_1$ (resp., $\tilde{x}_2$ given x_1) are denoted by $f_1(x_1)$ and $F_1(x_1)$ (resp., $f_2(x_2|x_1)$ and $F_2(x_2|x_1)$). This formulation encompasses cases in which earnings are iid across periods ($k_0 = 1$, $k_1 = 0$), follow a random walk ($k_1 = 1$), or exhibit negative auto-correlation ($k_1 < 0$).

At the end of each period, the firm's earnings are distributed to shareholders as a dividend.[6] Firms are priced at the expected value of their future earnings, where the future is, for convenience, not discounted. These assumptions ensure that the expected price of the firm at the start of the first period is $E[\tilde{x}_1 + \tilde{x}_2] = E[\tilde{x}_1 + E[\tilde{x}_2|\tilde{x}_1]] = E[(1 + k_1)\tilde{x}_1] = 0$, and the expected price of the firm at the start of the second period, after x_1 becomes known, is $E[\tilde{x}_2|\tilde{x}_1 = x_1] = k_1 x_1$.

[5] As examples: we predict that managers with longer time horizons will disclose information more often than will managers with short time horizons; Einhorn and Ziv (2008) predict the opposite. We predict that, as a firm's operating environment becomes more stable, managers who are strategic with high probability are more likely to disclose their information currently; Einhorn and Ziv predict the opposite. We predict that, if a manager made a disclosure in one period, the manager is less likely to disclose information in the next period. Einhorn and Ziv predict the opposite.

[6] This assumption can be dropped without affecting the substance of any results that follow.

The manager's disclosure decision may be constrained, insofar as in some periods the manager may be obliged to disclose whatever information he receives, whereas in other periods he may be unconstrained, in which case his disclosure decision is determined by whether the disclosure maximizes the expected value of the weighted average of the firm's stock price:

$$E[\alpha\widetilde{P}_1 + (1-\alpha)\widetilde{P}_2], \tag{1}$$

where $\tilde{P}_i$ is the firm's stock price in period i, and $\alpha \in (0,1)$ is some exogenous constant determining the relative weight the manager places on the firm's first and second period prices.[7] Situations in which the manager is (resp., is not) constrained are described by saying that the manager "behaves as forthcoming" ("behaves strategically").

The potential fluctuations in the manager's behavior described above-from constrained (behaving as forthcoming) in one period to possibly unconstrained (behaving strategically) in another period or vice versa-might be due to situational factors that affect a manager's decision to withhold information in some periods but not others.[8] Alternatively, even if all managers are inherently opportunistic and bent on disclosing information only when they obtain an advantage by doing so, an opportunistic manager may perceive period-specific factors, which are unobservable to investors, as constraints on his disclosure behavior. As examples, in some periods, the manager may recognize that the effectiveness of the firm's internal controls, or the scrutiny by the firm's auditors, or by outside news organizations is so great that he responds by behaving as forthcoming and issues a timely forecast that, barring these constraints on his behavior, he would not disclose.[9]

[7] Similar objective functions have been used by, for example, Miller and Rock (1985) and Harris and Raviv (1985). Note that this objective function could be replaced by the manager maximizing the expected value of a weighted average of not only $P_1(d_1)$ and $P_2(d_2, x_1, d_1)$ but also of prices at other points in time: P_0, $P_{1Expost}(d_1, x_1)$ and $P_{2Expost}(d_2, x_1, d_1, x_2)$, where P_0 is the price of the firm at the start of the model, $P_1(d_1)$ is the price of the firm after a disclosure (or nondisclosure) is made in period 1, $P_{1Expost}(d_1,x_1)$ is the price of the firm at the end of period 1 after x_1 is disclosed (whether or not x_1 was disclosed previously), and similarly for $P_2(d_2, x_1, d_1)$ and $P_{2Expost}(d_2, x_1, d_1, x_2)$. The two objective functions are equivalent because $P_0 \equiv 0$, $P_{1Expost}(d_1, x_1) \equiv (1 + k_1)x_1$ and $P_{2Expost}(d_2, x_1, d_1, x_2) \equiv x_2$ regardless of what disclosure policy the manager adopts, and so all that matters as far as characterizing the manager's preferred disclosure policy is concerned is the weight the manager places on the first period price $P_1(d_1)$ relative to the weight he places on the second period price $P_2(d_2, x_1, d_1)$.

[8] The effect of situational factors such as peer influence on ethical behavior has long been established in the business ethics literature (for example, Jones and Kavanagh 1996). More recently, it has been shown that even simple reminders of moral codes such as the Ten Commandments reduce people's tendency to cheat (Mazar et al. 2008).

[9] The model implicitly depends on investors being unable to discern whether a manager's disclosure in a period was due to the manager being constrained to disclose his forecast in a period or was due to the manager voluntarily disclosing his forecast in a period. If the model were modified so as to allow investors to observe whether a constraint prompted the manager to make a disclosure in a period, the manager could not improve his reputation for being forthcoming by disclosing his forecast in that period. The model, as presented, applies as long as investors do not learn all possible constraints or all possible situational factors that affect the manager's disclosure decision in a period, that is, as long as the investors cannot perfectly determine the manager's motivation for making a disclosure simply by observing the disclosure. Since, generally, it is difficult to impute perfectly an agent's motives for undertaking an action from observing just the action itself (as there is an extreme identification problem here: many different

To represent formally a manager's (potentially) fluctuating disclosure behavior over time, we introduce the uniformly distributed random variable $\tilde{t} \in [\mu - \delta, \mu + \delta] \subseteq [0, 1]$ and the two binary random variables $\tilde{s}_i \in \{0, 1\}, i = 1, 2$. The realization t of $\tilde{t}$ is the manager's "type"; it indicates the probability a manager behaves strategically in each period. The realization s_i of $\tilde{s}_i$ indicates whether the manager is constrained to be forthcoming ($s_i = 0$) or not ($s_i = 1$) in period i.[10] Conditional on $\tilde{t} = t, \tilde{s}_1$ and $\tilde{s}_2$ are *iid* with $\Pr(\tilde{s}_i = 1|t) = t$ for $i = 1,2$.

Each manager learns the realization of "his" t, as well as whether he will behave strategically in the first period (that is, the realization of $\tilde{s}_1$), before he makes a disclosure decision in the first period. By learning t in the first period, a manager learns the probability he will behave strategically in the second period, but the manager does not learn his actual second period behavior (that is, the realization of $\tilde{s}_2$) until the second period arrives, under the premise that the constraints, if any, on his second period disclosure behavior will become apparent only during the second period. We also posit: the parameters μ and δ defining the distribution of $\tilde{t}$ are common knowledge; $\tilde{t}$ is independent of all other variables in the model; and $h(t)$ denotes the density of $\tilde{t}$.

Other capital market participants know the ex ante distribution of $\tilde{t}$ but not its realization for any manager. The capital market's beliefs about $\tilde{t}$ at a point in time defines the manager's reputation at that time. A manager's reputation will vary over time, depending on whether the manager issues a forecast, and if so, what forecast, during the period. In the following, we simplify the process by which investors update their beliefs about the manager's reputation by postulating that the manager's forecast is accurate, that is, by having the realized value of the firm's earnings coincide with the forecasted value of those earnings. One way of interpreting this simplification is that the model can be viewed as one where the manager develops a reputation for the *timely* disclosure of his forecast (with "untimely" forecasts being made after the market for the firm's shares closes at the end of a period).[11]

Finally, we require that managers with no information make necessarily no disclosure and forthcoming managers disclose what they know. The disclosure

Footnote 9 continued
motivations can give rise to the same action), and in particular, it is difficult to determine why a manager decides to make a disclosure given the multitude of potential constraints or situational factors (as discussed in the previous footnote) that could affect a manager's disclosure decision, this assumption seems descriptive of many corporate voluntary disclosure scenarios.

We wish to thank a referee for asking us to elaborate on this point further.

[10] For a similar distributional assumption, see Milgrom and Roberts (1982).

[11] This situation arises often in accounting: for instance, managers might learn that the firm's assets are impaired early in a period and might either disclose this information voluntarily during the period or wait until it is revealed in the firm's periodic financial statements. As another example, a supplier might learn about the demand by its major customers early in a period but whether it discloses information about customers' demand during a period, the supplier is obliged to report its earnings at the end of the period which naturally include the shipments made to customers. As a third example, a manager who receives private information about the success of certain projects, such as FDA approval for an experimental drug—may choose to disclose or withhold that information during the period but, regardless, this information eventually becomes public.

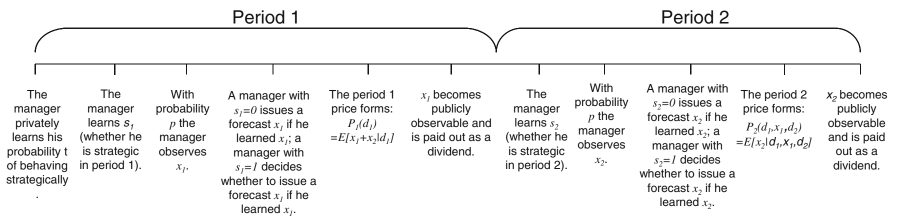

Fig. 1 Timeline

policy of a strategic manager of type t in period 1 (resp., period 2) who received information is described by a function $d_1^t(x_1)$ (resp., $d_2^t(x_2, d_1, x_1)$).

The sequence of events is summarized in Fig. 1.

3 Definition of equilibrium

Based on the preceding setup and notation, the equilibrium of the model is defined formally as follows.

Definition 1 An equilibrium consists of a pair of disclosure policies $d_1^t(\cdot)$ and $d_2^t(\cdot)$ for each $t \in [\mu - \delta, \mu + \delta]$ and pricing functions $P_1(\cdot)$ and $P_2(\cdot)$ such that:

A. for each $t \in [\mu - \delta, \mu + \delta]$:

a1. Managers with no information make necessarily no disclosure, and forthcoming managers disclose what they know.

a2. If a manager of type t behaves strategically and receives information in period 2, he chooses d_2^t s.t.

$$d_2^t(x_2, d_1, x_1) \in \underset{d_2 \in \{x_2, nd\}}{\arg\max} P_2(d_1, x_1, d_2);$$

a3. If a manager of type t behaves strategically and receives information in period 1, he chooses d_1^t s.t.

$$d_1^t(x_1) \in \underset{d_1 \in \{x_1, nd\}}{\arg\max} \alpha P_1(d_1) + (1-\alpha) E\left[P_2\left(d_1, x_1, d_2^t(\tilde{x}_2, d_1, x_1)\right)\middle| x_1, t\right];$$

and

B. for each d_1,$x_1$and d_2:

$$P_1(d_1) = E\left[\tilde{x}_1 + \tilde{x}_2 | d_1(\tilde{x}_1) = d_1\right]$$

$$P_2(d_1, x_1, d_2) = E\left[\tilde{x}_2 | d_1, x_1, d_2^{\tilde{t}}(\tilde{x}_2, d_1, x_1) = d_2\right].$$

The definition is straightforward: (a1) was described previously. (a2) requires that when $\tilde{t} = t$ and a manager is strategic in period 2 and receives information, he issues a forecast in period 2 provided he gets a higher price from issuing the forecast than from withholding it, taking the period 2 pricing function as given. (a3) requires that when $\tilde{t} = t$ and a manager is strategic in period 1 and receives information, he issues a forecast in period 1 provided he gets a higher expected weighted average price over the two periods from issuing the forecast than from withholding it, taking the pricing functions of both periods as given. (B) requires that, taking managers' disclosure policies as given, in each period investors price each firm at the expected value of the firm's future earnings taking into account all current and past forecasts and earnings reports the manager has issued and the information those forecasts and reports reveal about $\tilde{x}_i, \tilde{s}_i$, and $\tilde{t}$.

To characterize the equilibrium, we proceed "backwards in time." Since period 2 is the last period in the model, the manager faces no further reputational concerns then, so—similar to Dye (1985) and Jung and Kwon (1988)—a strategic manager's disclosure policy is a "cutoff" policy in which the manager discloses the forecast x_2 (when received) if and only if

$$x_2 = P_2(d_1, x_1, d_2 = x_2) \geq P_2(d_1, x_1, d_2 = nd) \equiv P_2^{nd}(d_1, x_1). \tag{2}$$

Consequently, if $\bar{t}_{d_1}$ denotes investors' assessment of the probability that the manager is strategic as of the start of the second period given his disclosure of d_1 in the first period,[12] then investors' assessment of the probability that a manager will not issue a forecast in the second period is $1 - p + p\bar{t}_{d_1} F_2(P_2^{nd}|x_1)$. By applying Bayes' rule, investors can assess the firm's expected second period earnings, given that the manager does not issue a second period forecast, to be

$$\frac{(1-p)E[\tilde{x}_2|x_1] + p\bar{t}_{d_1} F_2(P_2^{nd}|x_1) E[\tilde{x}_2|\tilde{x}_2 < P_2^{nd}, x_1]}{1 - p + p\bar{t}_{d_1} F_2(P_2^{nd}|x_1)}, \tag{3}$$

which is a weighted average of (1) the unconditional expected value of the firm's earnings, $E[\tilde{x}_2|x_1]$ (applicable when the reason the manager did not issue a second period forecast is that he did not receive information) and (2) the conditional expected value of the firm's earnings, $E[\tilde{x}_2|\tilde{x}_2 < P_2^{nd}, x_1]$ (applicable when the manager received a forecast, was strategic, and deliberately withheld his information). In equilibrium, P_2^{nd} equals (3). Solving the quadratic equation yields

$$P_2^{nd} = x_2^c(\bar{t}_{d_1}, x_1) = k_1 x_1 - \frac{k_0}{p\bar{t}_{d_1}} \left(2(1-p) + p\bar{t}_{d_1} - 2\sqrt{(1-p)(1-p+p\bar{t}_{d_1})}\right). \tag{4}$$

In the next section, we characterize the firm's equilibrium first period disclosure policy along with $\bar{t}_{d_1}$. There, among other things, we show that the equilibrium first period disclosure policy can be usefully described in two alternate but mathematically equivalent ways: first as a disclosure cutoff policy (x_1 is disclosed by a manager of type t if and only if $x_1 \geq x_1^c(t)$ for some function $x_1^c(t)$) and second as a

[12] This is explained by the fact that $\tilde{s}_2 = 1$ (resp., $\tilde{s}_2 = 0$) when the manager is strategic (resp., forthcoming) and $E[\tilde{s}_2|t] = t$, so investors' perceptions of the probability that a manager will behave strategically in period 2, given d_1 and x_1, is simply

$$E[\tilde{s}_2|d_1, x_1] = E[E[\tilde{s}_2|\tilde{t}]|d_1, x_1] = E[\tilde{t}|d_1, x_1] \equiv \bar{t}_{d_1}.$$

"right-tailed" policy (x_1 is disclosed by a manager of type t if and only if $t \geq t^*(x_1)$ for some function $t^*(x_1)$).

4 Characterization of the equilibrium

In the first period, a manager faces a disclosure decision only if he receives an earnings forecast and behaves strategically then. When the manager learns $\tilde{x}_1 = x_1$, he must make conjectures about both the firm's first period price $P_1(d_1)$ and its second period expected price $E[P_2(d_1, x_1, \tilde{d}_2)|x_1, t]$ were he to issue a forecast ($d_1 = x_1$) or not issue a forecast ($d_1 = nd$), respectively, in the first period. Here $\tilde{d}_2$ is shorthand for the second period disclosure being a function of three random variables: whether the manager behaves strategically, whether he receives information and second period earnings $\tilde{x}_2$.

A manager's preference for issuing a forecast in the first period varies cross-sectionally with the probability t the manager will be able to exploit his reputation (that is, the probability he will be strategic) in the second period. Understanding this cross-sectional variation is key to identifying and characterizing the equilibrium of the model and is facilitated by calculating the amount the firm's second period price is expected to change depending on whether the manager discloses a forecast in the first period. The function

$$z(t) \equiv E\left[P_2\left(nd_1, x_1, \tilde{d}_2\right)\middle|t^*(x_1) = t\right] - E\left[P_2\left(d_1 = x_1, \tilde{d}_2\right)\middle|t^*(x_1) = t\right] \tag{5}$$

identifies this expected price change, given a right-tailed disclosure policy $t^*(x_1)$.[13] Lemma 4 in the appendix shows that the function $z(t)$ is nonpositive and decreasing in t.[14] Thus, the firm's expected second period price (calculated at the end of the first period) is always at least weakly higher when the manager discloses his first period forecast than when he makes no disclosure in the first period, and this expected benefit of disclosing his first period forecast grows with the probability the manager will be strategic.

The following proposition describes an equilibrium of this model.

Proposition 1 *There is an equilibrium in which both the first and second period disclosure policies are cutoff policies, with the cutoffs and associated first and second period prices specified as in (1–4) below.*

(1) *The first period cutoff* $x_1^c(t)$ *is given by*

$$x_1^c(t) = \begin{cases} \frac{P_1(nd_1)}{1+k_1} & \text{if } \mu - \delta \leq t < \underline{t} \\ \frac{P_1(nd_1) + \frac{1-\alpha}{\alpha} z(t)}{1+k_1} & \text{if } \underline{t} \leq t \leq \hat{t} \\ -1 & \text{if } \hat{t} < t \leq \mu + \delta \end{cases} \tag{6}$$

[13] Even though the notation in (5) might suggest that $z(t)$ depends on both x_1 and t, we show in the appendix that $z(t)$ is in fact independent of x_1 (see proof of Lemma 4).

[14] More precisely, Lemma 4 in the appendix shows that $z(t)$ is strictly decreasing in t for all $t \geq \underline{t}$, where $\underline{t}$ is defined in the statement of Proposition 1 below. The specification of $z(t)$ for $t < \underline{t}$ is unnecessary for the characterization of the equilibrium.

where

$$P_1(nd_1) = -(1+k_1) \times \frac{2(1-p) + \bar{s}_1 p - 2\sqrt{(1-p)(1-p+\bar{s}_1 p) + \frac{p^2 \bar{s}_1}{8\delta(1+k_1)^2}\left(\frac{1-\alpha}{\alpha}\right)^2 \int_{\underline{t}}^{\widehat{t}} t \times z(t)^2 dt}}{\bar{s}_1 p}; \tag{7}$$

and $\underline{t}$ *is that unique* $t \in (\mu-\delta, \mu+\delta)$ *that solves the equation* $t^2(2t-3\mu) + (\mu+2\delta)(\mu-\delta)^2 = 0; \widehat{t} \equiv \min\{z^{-1}\left(-\frac{\alpha}{1-\alpha}\left(1+k_1+P_1(nd_1)\right)\right), \mu+\delta\}; \bar{s}_1 \equiv \frac{\widehat{t}^2-(\mu-\delta)^2}{4\delta}$;

(2) *the second period cutoff* $x_2^c(d_1, x_1)$ *is given by*

$$x_2^c(d_1, x_1) \equiv x_2^c(E[\widetilde{t}|d_1, x_1], x_1),$$

where

2a. $x_2^c(\cdot)$ *is defined as in equation* (4) *above;*

2b. *investors' perceptions of the expected value of the manager's type at the end of the first period, after observing the disclosure* d_1, *is given by* $\bar{t}_{d_1} = E[\widetilde{t}|d_1, x_1]$, *where*

$$E[\widetilde{t}|d_1 = x_1, x_1] = \begin{cases} \frac{3\mu - \left(3\mu^2+\delta^2\right)}{3(1-\mu)} & \text{if } x_1 < x_1^c(\mu+\delta) \\ \frac{12\delta\mu - 2\left(t^*(x_1)^3 - (\mu-\delta)^3\right)}{12\delta - 3\left(t^*(x_1)^2 - (\mu-\delta)^2\right)} & \text{if } x_1^c(\mu+\delta) \le x_1 < x_1^c(\underline{t}) = x_1^c(\mu-\delta) \\ \mu & \text{if } x_1^c(\mu-\delta) \le x_1 \end{cases};$$

$$E[\widetilde{t}|d_1 = nd, x_1] = \begin{cases} \frac{3(1-p)\mu + p\left(3\mu^2+\delta^2\right)}{3(1-p)+3\mu p} & \text{if } x_1 < x_1^c(\mu+\delta) \\ \frac{12(1-p)\delta\mu + 2p\left(t^*(x_1)^3 - (\mu-\delta)^3\right)}{12(1-p)\delta + 3p\left(t^*(x_1)^2 - (\mu-\delta)^2\right)} & \text{if } x_1^c(\mu+\delta) \le x_1 < x_1^c(\underline{t}) = x_1^c(\mu-\delta) \\ \mu & \text{if } x_1^c(\mu-\delta) \le x_1 \end{cases};$$

(3) *when the manager issues the forecast* $d_1 = x_1$ *(resp., issues no forecast) in period 1, the first period price of the firm is given by* $P_1(\widetilde{d}_1 = x_1) = (1+k_1)x_1$ *(resp.,* $P_1(nd_1)$*);*

(4) *when the manager issues the forecast* $d_2 = x_2$ *(resp., issues no forecast) in period 2 after having issued the forecast* $d_1 = x_1$ *(or* $d_1 = nd$*) in the first period and* $\tilde{x}_1 = x_1$, *the second period price of the firm is* $P_2(\widetilde{d}_2 = x_2|d_1, x_1) = x_2$ *(resp.,* $P_2(\widetilde{d}_2 = nd|d_1, x_1) = x_2^c(d_1, x_1)$*).*

Some comments regarding Proposition 1 follow.

Part 1 describes the first period disclosure policy of a strategic manager who has probability t of being strategic in the second period: such a manager discloses the earnings forecast x_1 in the first period (when received) if it is above $x_1^c(t)$ in (6). The cutoff $x_1^c(t)$ is weakly decreasing everywhere and strictly so for $t \in (\underline{t}, \widehat{t})$ (since Lemma 4 shows that $z(t)$ is strictly decreasing in t for $t \geq \underline{t}$). Hence, (6) shows that the equilibrium first period disclosure policy is such that, if the earnings forecast x_1 is disclosed (when received) by a strategic manager in the first period who has probability t of being strategic in the second period, then every earnings forecast $x_1' \geq x_1$ is disclosed (when received) by every strategic manager in the first period who has probability $t' \geq t$ of being strategic in the second period. That is, a strategic manager in the first period is more likely to disclose his forecast in the first period the greater the probability he will behave strategically in the second period and also the higher the value of his first period earnings forecast. Both of these results are intuitive.

Part 1 also establishes that the first period no disclosure price $P_1(nd_1)$ is given by equation (7). In many respects, $P_1(nd_1)$ is similar to the second period no disclosure price P_2^{nd} in (4). For example, just as (4) shows the second period no disclosure price depends on both the probability p that the firm receives information during the second period and investors' perceptions of the probability that the manager will behave strategically in the second period, equation (7) shows that the first period no disclosure price also depends on the probability p that the manager receives information during the first period and investors' perceptions of the probability that the manager will behave strategically in the first period. As another example, absent reputational concerns (that is, as $\alpha \to 1$), (4) and (7) show that the first period and second period no disclosure prices are the same when $\bar{s}_1$ is replaced by $\bar{t}_{d_1}$.[15] Discussion of the variables $\underline{t}$ and $\widehat{t}$ is deferred to the next section in reference to Figs. 2 and 3.

Part 2 of the proposition establishes, as was initially discussed at the end of the previous section, that the second period cutoff $x_2^c(E[\widetilde{t}|d_1, x_1])$ is given by (4). The new feature added is part 2b: it provides explicit expressions for investors' perceptions of the probability the manager will behave strategically in the second period, conditional on the manager's first period forecast and on the first period's realized earnings. Part 2a and 2b combined demonstrate that:

$$E[\widetilde{t}|d_1 = x_1] \leq E[\widetilde{t}|d_1 = nd, x_1].$$

That is, a manager can always weakly improve his reputation for being forthcoming by issuing a forecast in the first period rather than by not issuing a forecast then.

Parts 3 and 4 provide details about the equilibrium first and second period prices. Part 3 notes that, if the manager discloses x_1 in period 1, then the equilibrium price of the firm is $E[\widetilde{x}_1 + \widetilde{x}_2|x_1] = (1 + k_1)x_1$ and that, if the manager makes no disclosure in period 1, then the period 1 price is $P_1(nd)$. Part 4 establishes that the manager's first period disclosure decision affects the firm's second period price through investors' interpretation of the probability the manager is strategic in the

[15] To see that $\bar{s}_1 = \frac{\widehat{t}^2 - (\mu-\delta)^2}{4\delta}$ reverts to μ as $\alpha \to 1$, note that $\lim_{\alpha \to 1} \widehat{t} = \mu + \delta$. The term $\bar{s}_1$ equals $\int_{\mu-\delta}^{\widehat{t}} th(t)dt$; it is the probability the worst possible first period forecast $x_1 = -1$ is withheld when received.

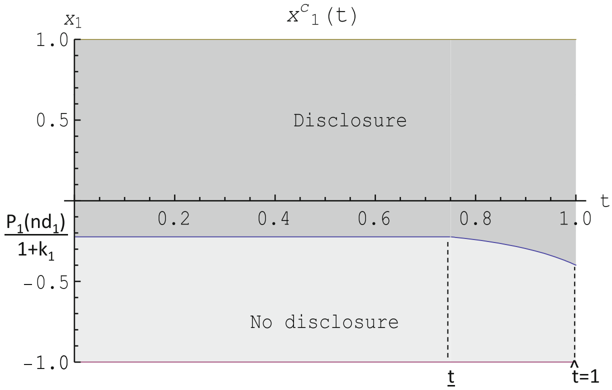

Fig. 2 Partition of the (t, x_1)-space into a no-disclosure and a disclosure region for the parameter values $\alpha = 0.2$, $p = 0.75$

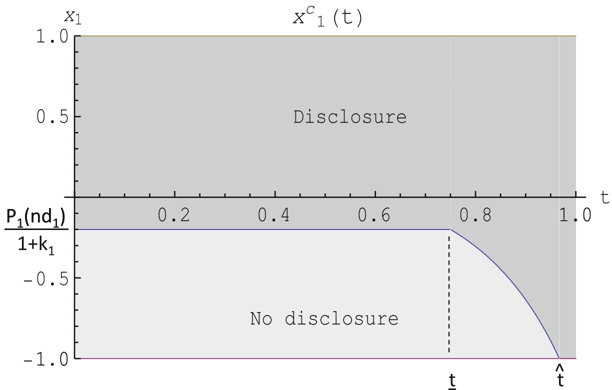

Fig. 3 Partition of the (t, x_1)-space into a no-disclosure and a disclosure region for the parameter values $\alpha = 1/60$, $p = 0.75$

second period. Anticipation of this last effect induces some strategic managers to manage their reputation in the first period.

Moreover, there are no equilibrium "left-tailed" disclosure policies that are not degenerate at x_1 for any $x_1 \in [-1, 1]$.[16] This fact, coupled with Proposition 1 establishes that, within the class of "convex" deterministic disclosure policies, the equilibrium disclosure policy described in Proposition 1 is unique.[17]

[16] Proof available from the authors. A left-tailed disclosure policy is defined analogously to a right-tailed policy: if a manager with probability t of being strategic in period 2 prefers to disclose x_1, then so do all managers whose probability of being strategic in period 2 is $t' < t$. Also, a disclosure policy is said to be nondegenerate at x_1 if there are some managers who prefer to disclose x_1 and some who don't.

[17] "Convex" meaning: disclosure policies for which if strategic managers of type t disclose (resp., don't disclose) the earnings forecast x_1 and also strategic managers of type $t' > t$ disclose (resp., don't disclose) the same earnings forecast x_1, then all strategic managers of type $t'' \in (t, t')$ disclose (resp., don't disclose) x_1 for all x_1.

In the next section, we present a variety of comparative statics results and also some explicit numerical illustrations of the equilibrium for various parameterizations of the model.

5 Features of the equilibrium

Graphs of the equilibrium period 1 disclosure policy are presented in Figs. 2 and 3. In these graphs, we assume $\tilde{t} \sim Uniformly[0, 1]$ and $\tilde{x}_2|x_1 \sim Uniformly[-1, 1]$. The figures partition (t, x_1)-space into "disclosure" and "no disclosure" regions. Consistent with Proposition 1, both figures show that, for each $t \in [0, 1]$, there is a cutoff $x_1^c(t)$ such that a manager who is strategic in the first period and who will behave strategically in the second period with probability t issues a forecast if $x_1 \geq x_1^c(t)$, but not if $x_1 < x_1^c(t)$. The figures also show that the cutoff function $x_1^c(t)$ is weakly decreasing in the probability t, indicating that strategic managers are more likely to issue a forecast in the first period if they are more likely to behave strategically in the second period.

The figures also illustrate that managers with probability $t < \underline{t} = .75$ of being strategic only disclose forecasts that increase their first period price, that is, only when the forecast is such that the disclosure price $P_1(d_1 = x_1) = E[\tilde{x}_1 + \tilde{x}_2|x_1] = (1 + k_1)x_1$ exceeds the no disclosure price $P_1(nd_1)$.

Figure 2 is based on the parameters $\alpha = 0.2$ and $p = 0.75$. For these parameter values, even strategic managers in period 1 who have a high probability of behaving strategically in period 2 do not disclose very low values of x_1. In this example, and consistent with Proposition 1, the first period disclosure threshold is given by $x_1^c(t) = \frac{P_1(nd_1) + \frac{1-\alpha}{\alpha} z(t)}{1+k_1}$ for all $t \geq \underline{t} = 0.75$.

Figure 3 exhibits another partition of (t, x_1)-space into "disclosure" and "no disclosure" regions for $\alpha = 1/60$ and $p = 0.75$. For the latter parameter values, the manager places greater value on developing a reputation than for the parameter values underlying Fig. 2. Also, for the parameter values corresponding to Fig. 3, the number $0 \leq \hat{t} < 1$ described in Proposition 1 is such that all strategic managers in period 1 who anticipate behaving strategically in period 2 with probability $t \geq \hat{t}$ disclose even the worst information $x_1 = -1$ they could possibly receive in the first period.

Corollary 1 combines the results of these figures with the observation that the disclosure of the lowest possible outcome can never happen when managers do not have reputation concerns, as is the case in the second period of this model or in all single period models.

Corollary 1 *A manager who behaves strategically in the first period might optimally disclose the lowest possible outcome, $x_1 = -1$. A manager who behaves strategically in the second period never discloses the lowest possible outcome. That is, for all t, d_1, and x_1,*

$$-1 \leq x_1^c(t) < 0; \tag{8}$$

$$-k_0 + k_1 x_1 < x_2^c(d_1, x_1) < k_1 x_1. \tag{9}$$

The substance of this corollary is that reputation-related concerns in multi-period settings can overturn the reluctance that strategic managers otherwise have in single period settings to issue unfavorable forecasts.[18]

Corollary 2 continues to explore the connections between the incentives of strategic managers to issue a forecast in single period settings to their incentives to issue a forecast in multi-period settings when reputational considerations are present. In this corollary, we say that a manager does, or does not, "manage his reputation" depending on whether the cutoff x_1^c defining his first period disclosure policy is below, or equal to, the scaled first period no disclosure price $\frac{P_1(nd_1)}{1+k_1}$.

Corollary 2

(i) *There are always some strategic managers in period 1 who "manage their reputations." Which managers manage their reputation is determined by the threshold* $\underline{t} < \mu + \delta$ *defined in Proposition 1 part 1:*

  (ia) *all strategic managers with* $t > \underline{t}$ *manage their reputation:* $x_1^c(t) < \frac{P_1(nd_1)}{1+k_1}$ *for all* $t > \underline{t}$;

  (ib) *no strategic manager with* $t \leq \underline{t}$ *manages his reputation:* $x_1^c(t) = \frac{P_1(nd_1)}{1+k_1}$ *for all* $t \leq \underline{t}$;

(ii) *The average manager,* $t = \mu$, *does not manage his reputation, that is,* $\underline{t} > \mu$.

The corollary follows directly from Proposition 1 part 1. $\underline{t}$ determines which managers manage their reputations: the managers who do are the managers who have a sufficiently high probability of being strategic in the future. Managers who have a lower probability of being strategic in the future do not manage their reputations because they don't get a high enough return from doing so. The reduction in the price they receive today as a consequence of disclosing unfavorable information is not offset by the increased price they expect to get in the future in the event they do not issue a forecast in the future.

Part (*i*) of this corollary also establishes the following robustness property of the equilibrium: managers who are strategic in the second period with probability less than or equal to $\underline{t}$ *all* adopt the same first period disclosure policy. Specifically, if they are strategic, they disclose the first period earnings forecast x_1 (when received) if and only if $(1 + k_1)x_1 \geq P_1(nd_1)$. All these managers (with $t \leq \underline{t}$) do not manage their reputation; they choose the same first period disclosure policy they would have chosen had they faced a one-period disclosure problem and reputational considerations were absent. Moreover, since $\underline{t} > \mu$ by part (*ii*) of the corollary, it follows that more than 50% of all managers adopt the same first period disclosure policy. The source of this robustness was mentioned in the introduction: if investors were to believe that all strategic managers will issue a particular low first period forecast,

[18] Other motivations for managers to disclose bad news have been discussed in the literature. For instance, Skinner (1994, 1997) provides evidence that the threat of lawsuits arising from large negative earnings surprises induces managers to pre-announce earnings in order to reduce litigation costs.

investors will not update their beliefs about a given manager's reputation for being forthcoming upon observing a manager disclose that low forecast.[19] That failure of investors to update their beliefs induces strategic managers not to follow through and issue that low forecast when they receive it, which implies that investors cannot hold such beliefs (about what all strategic managers will disclose) in equilibrium. In short, in equilibrium, issuing a particular low forecast can improve a manager's reputation for being forthcoming only when most strategic managers do *not* issue that particular low forecast to manage their reputation. With further parameterization of the model, these last two results can be further sharpened: when $\tilde{t} \sim Uniformly[0,1]$ and $\tilde{x}_2|x_1 \sim Uniformly[-1,1]$, it can be shown that $\underline{t} = 0.75$, that is, 75% of all managers adopt a first period disclosure policy in which the managers do not manage their reputations.

Recalling that the mean probability managers will behave strategically in a period is μ and that the variance in the probability managers will behave strategically is a strictly increasing function of δ (specifically, it is $\frac{\delta^2}{3}$), the next corollary contains comparative statics about how the propensity of managers to manage their reputations changes with μ and δ.

Corollary 3

(a) *Holding δ constant, fewer managers manage their reputation as the average probability they behave strategically increases. That is,* $\frac{\partial \Pr(t > \underline{t})}{\partial \mu} < 0$.

(b) *Holding μ constant, more managers manage their reputation as the variability in the probability they behave strategically increases. That is,* $\frac{\partial \Pr(t > \underline{t})}{\partial \delta} > 0$.

The first part of the corollary asserts that, as the ex ante mean probability that managers behave strategically increases, fewer managers manage their reputation. This is intuitive: as investors think managers are on average more likely to behave strategically, they will assign a lower price to firms whose managers don't issue forecasts in the first period, and this drop in the no disclosure price results in fewer managers being willing to issue forecasts that would result in their firms' first period market values falling below even this lower price. The second part of the corollary states that, as the investors' perception of the dispersion in the probability that managers behave strategically increases, it is more likely that managers will manage their reputations. This too is intuitive: as investors' uncertainty about whether any manager will behave strategically increases, there are greater returns to an individual manager in separating himself from other managers issuing a forecast.

The next corollary studies the effect of the manager's first period disclosure decision on his second period optimal disclosure strategy. It illustrates a form of endogenous hysteresis. Specifically, even though the probability the manager receives a forecast is the same in both periods, Corollary 4 shows that a manager is

[19] If there is any forecast that all (types of) managers issue, then investors will not change their opinion of a manager's type upon observing the manager issue that forecast.

uniformly less likely to issue a forecast in the second period after issuing a forecast in the first period than after not issuing a forecast in the first period.

Corollary 4 *For all* $x_1, x_2^c(d_1 = x_1) \geq x_2^c(nd_1, x_1)$. This inequality is strict if and only if $x_1 < \frac{P_1(nd_1)}{1+k_1}$.[20]

The intuition for the corollary is as follows. As we have noted previously, issuing a forecast in the first period reduces investors' perceptions of the probability that the manager will behave strategically in the second period. Accordingly, investors are more likely to interpret the manager's lack of forecast in the second period as being attributable to the manager not receiving information rather than hiding information, and so they will attach a higher price to the manager's nondisclosure in the second period. Since the disclosure threshold determining whether or not the manager issues a forecast in the second period is the second period no disclosure price, the result follows.

In the penultimate corollary, we describe how the parameters α , k_0, and k_1 *jointly* interact to affect the manager's first period equilibrium disclosure policy. Related comparative statics are presented in Corollary 6.

Corollary 5 *Define*

$$\omega \equiv \frac{\alpha}{1-\alpha}\frac{1+k_1}{k_0}. \tag{10}$$

The manager's first period equilibrium disclosure policy depends on the parameters α , k_0, *and* k_1 *only to the extent that they affect the parameter* ω.

The corollary contains three implicit predictions. First, it indicates that increasing the persistence of the firm's earnings (that is, increasing k_1) has the same effect on the firm's first period disclosure policy as reducing the importance the manager attaches to reputation formation (that is, increasing α). This is intuitive, particularly when we consider extreme cases: if k_1 were to increase without bound (while holding all other parameters fixed), then were the manager to disclose the period 1 earnings forecast x_1, this disclosure in substance would determine the firm's earnings for both periods-because the high value of the persistence parameter k_1 coupled with the disclosure of x_1 implies that most of the uncertainty concerning the firm's second period earnings is resolved upon the disclosure of x_1. In that case, the value-relevance of period 2 disclosures diminishes, and the manager's disclosure decision in the first period becomes more akin to the disclosure decision he would face in a one period model. That is, increasing the persistence of the firm's earnings is economically equivalent to decreasing the manager's concern for building his reputation.

Second, increases in the volatility of the second period's earnings, as proxied by increases in k_0—have the opposite effect of increases in persistence: increases in the volatility of second period earnings are tantamount to increasing the manager's

[20] The proof of this corollary follows directly from (18) in the appendix, which shows that a necessary condition for the first period disclosure policy to be right-tailed is that $E[\tilde{t}|d_1 = x_1, t^*] \leq E[\tilde{t}|d_1 = nd_1, x_1, t^*]$, which proves the result upon recalling that $x_2^c(\cdot)$ is a decreasing function.

emphasis on developing his reputation. The intuition is that, as the volatility of the firm's second period earnings increases, the first period earnings forecast becomes less value-relevant in assessing the firm's second period earnings relative to the second period earnings forecast. Accordingly, investors will put more weight on the manager's second period disclosure or nondisclosure in assessing the firm's value in the second period. This increase in investors' attention on the second period disclosure is economically equivalent to the manager increasing the importance he attaches to his reputation.

Third, in the limit as k_1 approaches -1, that is, as earnings become increasingly negatively auto-correlated, changes in the parameters k_0 and α become irrelevant for determining the firm's first period disclosure policy. In that case, the first period price of the firm conditional on the disclosure of x_1, $(1 + k_1)x_1$, equals 0 for every forecast x_1 disclosed, which is also the same as the firm's first period no disclosure price $E[\tilde{x}_1 + \tilde{x}_2 | nd_1] = 0$,[21] which renders the disclosure or nondisclosure of the manager's first period forecast x_1 moot.

In the final corollary, we generate comparative statics that describe how individual changes in the parameters α, k_1, and k_0 affect a strategic manager's equilibrium first period disclosure policy and also the firm's first period no disclosure price.

Corollary 6

(a) *As the manager becomes less concerned about his reputation when making his first period disclosure decision, the first period no disclosure price of the firm decreases, that is,* $\frac{\partial P_1(nd_1)}{\partial \alpha} < 0$. *Moreover, the first period no disclosure price increases in the variability of second period earnings, that is,* $\frac{\partial P_1(nd_1)}{\partial k_0} \geq 0$, *and decreases in the persistence of earnings, that is,* $\frac{\partial P_1(nd_1)}{\partial k_1} < 0$.

(b) *There exists a threshold value of managers' types,* $t^c(\omega, p)$, *such that, for* $t < t^c(\omega, p)$, *the first period disclosure threshold* x_1^c *increases in* k_0 *and decreases in* α *and* k_1 *and such that, for* $t \geq t^c(\omega, p)$, *the first period disclosure threshold increases in* α *and* k_1 *and decreases in* k_0,

(c) $\underline{t}$ *does not vary with either* k_0 *or* k_1 *(or* α *or* p*), that is, the set of managers who manage their reputations* $(t > \underline{t})$ *does not depend on either the variability of second period earnings or the persistence of earnings across periods.*

The explanation for the comparative statics in part (a) of this corollary for the first period no disclosure price is straightforward: if managers were to increase their emphasis on their firms' second period price (that is, $1 - \alpha$ goes up), they will want, on average, to issue forecasts in the first period more often, so as to increase investors' perceptions of the probability that they are not behaving strategically in the second period when they don't issue a forecast in the second period. As a consequence, investors will interpret the lack of forecasts by managers in the first period as more likely attributable to the lack of managers' receipt of information

[21] This equation follows since $E[\tilde{x}_1 + \tilde{x}_2 | nd_1] = E[E[\tilde{x}_1 + \tilde{x}_2 | x_1] | nd_1] = E[E[0 | x_1] | nd_1] = 0$.

rather than to managers purposefully hiding information, thereby causing the first period no disclosure price to increase. Since, as was noted in the previous corollary, increasing $1 - \alpha$ has the same effect as decreasing k_1 or increasing k_0, the other comparative statics in part (a) of the corollary have similar explanations.

The explanation for the comparative statics in part (b) of the corollary runs as follows. Changing any of the parameters α, k_0, or k_1 in a way that results in a decrease in ω defined in (10) has two distinct effects on a strategic manager's first period disclosure policy. The first is the direct "objective function" effect. A smaller value of ω means that the manager effectively places more importance on the firm's second period price, which, by itself, would suggest that the manager would issue a forecast more often in the first period so as to improve his reputation for being forthcoming. This effect alone would tend to make the threshold $x_1^c(t)$ decrease as ω decreases. But, if investors anticipate this effect—that the manager will issue a forecast more often in the first period—then investors will revise upwards the first period no disclosure price $P_1(nd)$. Increasing $P_1(nd_1)$ increases the manager's opportunity cost of issuing a forecast in the first period. This latter effect, by itself, would tend to counter the former effect and tend to make $x_1^c(t)$ increase as ω decreases. Part (b) of the corollary establishes that which of these two effects dominates depends on the manager's probability t of behaving strategically in the second period: if t is sufficiently high, then the manager anticipates he will benefit more by being perceived as forthcoming when ω is reduced and hence he will issue forecasts more often in the first period. If t is sufficiently low, this effect reverses: a reduction in ω and the attendant increase in the first period no disclosure price will lead the manager to issue a first period forecast less often.

Figure 4 illustrates these last predictions of Corollary 6. The figure shows the no disclosure price, $P_1(nd_1)$, and the first period disclosure threshold as a function of the manager's reputation concerns (as measured by α), for managers with three distinct probabilities of behaving strategically in a period: $t = 0.8$, $t = 0.9$, and $t = 1$. As predicted by Corollary 6, Fig. 4 shows that for managers who have a high probability of being strategic in the second period $x_1^c(t, \alpha)$ is decreasing in α, that is, that these managers are willing to disclose less favorable information as their reputation becomes more important to them. As a result, investors interpret nondisclosure to be less likely due to the manager strategically withholding information. Consistent with the reduced adverse selection problem for lower values of α, Fig. 4 shows that, as a result the first period no disclosure price, $P_1(nd_1)$, decreases in α as predicted in Corollary 6. Since the disclosure threshold, $x_1^c(t, \alpha)$, for managers with probability $t \leq \underline{t}$ of behaving strategically in the second period equals the no disclosure price, the figure also illustrates that the effect of increasing α for managers who have a low probability of behaving strategically in the second period is opposite to that of managers who have a high probability of behaving strategically in the second period, as predicted by Corollary 6.

Finally, part (c) of Corollary 6 establishes that the set of managers who manage their reputations $(t > \underline{t})$ depends only on the distribution of the managers' types, that is, on μ and δ, and does not vary with any of: the variability, k_0, or persistence,

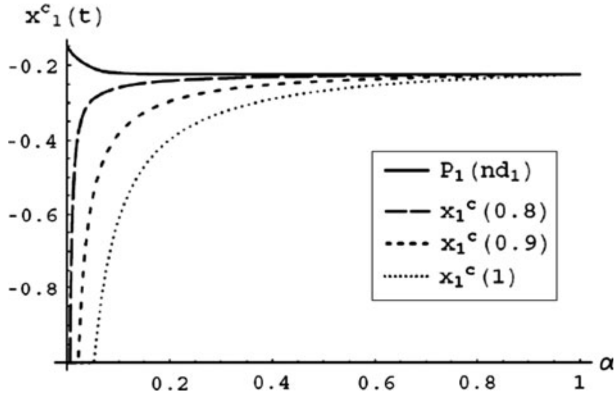

Fig. 4 First period no disclosure price, $P_1(nd_1) = x_1^c(t)$, which equals the first period disclosure thresholds for firms with $t \leq \frac{3}{4}$ and first period disclosure thresholds for firms with $t = 0.8$, $t = 0.9$, and $t = 1$. The first period disclosure thresholds are plotted as a function of α. The graph is based on $p = 3/4$ and $\mu = \delta = 0.5$ and $k_0 = 1$ and $k_1 = 0$

k_1, of firms' earnings, managers' concern for developing a reputation, α, or the probability managers are informed, p.

6 Conclusions

Reputational considerations are central to the functioning of capital markets. Managers work to develop, maintain, and occasionally exploit their reputations with investors, and investors respond by evaluating, relying on, and sometimes questioning the reputations of the managers of the firms they invest in. This paper studies one aspect of reputations in capital markets, that involving managers' reputation for being forthcoming and disclosing their private information in a timely manner. In the model, managers can enhance or exploit their reputation for being forthcoming over time through their disclosure choices, and investors price firms with the understanding that the firms' managers attempt to manage investors' perceptions of their reputations.

The paper contains a broad array of predictions, including the following: (1) reputational considerations alone can induce managers to disclose unfavorable information that they would not otherwise disclose; (2) as a manager's incentives for developing a reputation in the future increase, the firm's current price in the event the manager issues no forecast increases; (3) as the probability that a manager will behave strategically (and exploit his reputation for being forthcoming) in the future increases, the manager is more likely to issue a forecast in the present; (4) if managers become more concerned about their reputation, then those managers who have a high probability of behaving strategically in the future issue forecasts more often in the present, whereas managers who have a low probability of behaving strategically in the future issue forecasts less often in the present; (5) managers are more likely to "manage their reputations" by issuing a forecast that decreases the current price of the firm as investors become more uncertain about managers' overall propensity to behave strategically in the future, and managers are less likely to manage their reputations as investors believe managers become overall more likely to behave strategically in the future; (6) an increase in the persistence of a firm's earnings or a decrease in the variability of a firm's future earnings has the same effect on a strategic manager's disclosure behavior as does a (suitable) decrease in the manager's concern for developing his reputation for being forthcoming.

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Appendix

Proof of proposition 1

The proof is presented in six steps.

Step 1. Fixing investors' beliefs about some first period right-tailed disclosure policy $t^* = t^*(x_1)$ (as defined in the last paragraph of Sect. 3) and a first period "no disclosure" price $P_1(nd_1)$, Lemma 1 computes investors' posterior assessment of the probability the manager will be unconstrained in period 2.

Lemma 1 *If* $t^*(x_1) \in [\mu - \delta, \mu + \delta]$ *and investors believe that strategic managers with* $t < t^*(x_1)$ *do not disclose* x_1 *and that strategic managers with* $t \geq t^*(x_1)$ *issue the forecast* x_1, *then*

$$\bar{t}_d(t^*(x_1)) \equiv E[\tilde{t}|d_1 = x_1, t^*(x_1)] = \frac{12\delta\mu - 2\left(t^*(x_1)^3 - (\mu - \delta)^3\right)}{12\delta - 3\left(t^*(x_1)^2 - (\mu - \delta)^2\right)} \text{ and} \tag{11}$$

$$\bar{t}_{nd}(t^*(x_1)) \equiv E[\tilde{t}|d_1 = nd, x_1, t^*(x_1)] = \frac{12(1-p)\delta\mu + 2p\left(t^*(x_1)^3 - (\mu - \delta)^3\right)}{12(1-p)\delta + 3p\left(t^*(x_1)^2 - (\mu - \delta)^2\right)} \tag{12}$$

Proof Forthcoming managers always issue a forecast if they receive information in period 1. Strategic managers disclose $\tilde{x}_1 = x_1$ if they receive information and $t \geq t^*(x_1)$. So,

$$\Pr(d_1 = x_1) = pf_1(x_1)\left[\int_{\mu-\delta}^{\mu+\delta}(1-t)h(t)dt + \int_{t^*(x_1)}^{\mu+\delta} th(t)dt\right]$$
$$= \frac{p}{2}\left(1 - \frac{t^*(x_1)^2 - (\mu - \delta)^2}{4\delta}\right).$$

where $f_1(\cdot)$ denotes the pdf of $x_1 \sim U[-1,1]$ and $h(\cdot)$ denotes the pdf of $t \sim U[\mu-\delta, \mu+\delta]$. We now compute $\Pr(\widetilde{t}=t|d_1=x_1)$. A manager with $t<t^*(x_1)$ discloses x_1 only when he is forthcoming in period 1. Thus, for $t<t^*(x_1)$,

$$\begin{aligned}\Pr(\widetilde{t}=t|d_1=x_1) &= \frac{\Pr(\tilde{x}_1=x_1)\Pr(d_1=x_1|\widetilde{s}_1=0,t)\Pr(\widetilde{s}_1=0|t)h(t)}{\Pr(d_1=x_1)}\\ &= \frac{pf_1(x_1)(1-t)h(t)}{\frac{p}{2}\left(1-\frac{t^*(x_1)^2-(\mu-\delta)^2}{4\delta}\right)} = \frac{\frac{p}{2}(1-t)\frac{1}{2\delta}}{\frac{p}{2}\left(1-\frac{t^*(x_1)^2-(\mu-\delta)^2}{4\delta}\right)}\\ &= \frac{1-t}{2\delta-\frac{t^*(x_1)^2-(\mu-\delta)^2}{2}}.\end{aligned}$$

Every manager with $t \geq t^*(x_1)$ discloses x_1, regardless of whether he is forthcoming in period 1, so for all such t,

$$\begin{aligned}\Pr(\widetilde{t}=t|d_1=x_1) &= \frac{\Pr(\tilde{x}_1=x_1)\Pr(d_1=x_1|\widetilde{t}=t)h(t)}{\Pr(d_1=x_1)}\\ &= \frac{pf_1(x_1)h(t)}{\frac{p}{2}\left(1-\frac{t^*(x_1)^2-(\mu-\delta)^2}{4\delta}\right)} = \frac{\frac{p}{2}\frac{1}{2\delta}}{\frac{p}{2}\left(1-\frac{t^*(x_1)^2-(\mu-\delta)^2}{4\delta}\right)}\\ &= \frac{1}{2\delta-\frac{t^*(x_1)^2-(\mu-\delta)^2}{2}}.\end{aligned}$$

Therefore,

$$\begin{aligned}E[\widetilde{t}|d_1=x_1,t^*] &= \int_{\mu-\delta}^{\mu+\delta} t\Pr(\widetilde{t}=t|d_1=x_1)dt\\ &= \frac{1}{2\delta-\frac{t^*(x_1)^2-(\mu-\delta)^2}{2}}\left[\int_{\mu-\delta}^{t^*(x_1)} t(1-t)dt + \int_{t^*(x_1)}^{\mu+\delta} tdt\right]\\ &= \frac{12\delta\mu-2\left(t^*(x_1)^3-(\mu-\delta)^3\right)}{12\delta-3\left(t^*(x_1)^2-(\mu-\delta)^2\right)}.\end{aligned}$$

A similar procedure can be followed to compute $E[\widetilde{t}|d_1=nd,x_1,t^*]$. To save space, we do not present this procedure here. Details are available from the authors. □

Step 2. Given investors' posterior beliefs (from step 1), we recall that (4) in the text defines both the unique period 2 cutoff $x_2^c(E[\widetilde{t}|d_1,x_1,t^*],x_1)$ associated with a strategic manager's second period equilibrium disclosure policy and also the equilibrium period 2 no-disclosure price $P_2(d_1,x_1,nd_2)$.

Step 3. Given the results in step 1 and 2, Lemma 2 calculates the expected period 2 price, $E\left[P_2\left(d_1, x_1, \tilde{d}_2\right)|x_1, t\right]$ of the firm as perceived by a manager of type t at the end of period 1, conditional on whether he issues ($d_1 = x_1$) or does not issue the forecast x_1 ($d_1 = nd$) in period 1.

Lemma 2 *Taking investors' perceptions of the second period cutoff* $x_2^c \in [-k_0 + k_1x_1, k_0 + k_1x_1]$ *as given, the second period expected selling price of the firm, as perceived by a manager of type t as of the end of the first period is given by*

$$\pi\left(t, x_2^c, x_1\right) \equiv E\left[P_2\left(d_1, x_1, \tilde{d}_2\right)|x_1, t\right] = pk_1x_1 + (1-p)x_2^c + tp\frac{\left(x_2^c + k_0 - k_1x_1\right)^2}{4k_0}. \tag{13}$$

Proof As was discussed in step 2, $x_2^c(E[\tilde{t}|d_1, x_1, t^*], x_1) = P_2(d_1, x_1, nd_2)$. Hence,

$$\begin{aligned}
\pi\left(t, x_2^c, x_1\right) &= (1-p)P_2(d_1, x_1, nd_2) + (1-t)pE[\tilde{x}_2|x_1] \\
&\quad + tp\left[\int_{-k_0+k_1x_1}^{x_2^c} P_2(d_1, x_1, nd_2)f_2(x_2|x_1)dx_2 + \int_{x_2^c}^{k_0+k_1x_1} x_2f_2(x_2|x_1)dx_2\right] \\
&= pk_1x_1 + (1-p)x_2^c + tp\left[\int_{-k_0+k_1x_1}^{x_2^c} x_2^cf_2(x_2|x_1)dx_2\right. \\
&\quad \left. + \int_{x_2^c}^{k_0+k_1x_1} x_2f_2(x_2|x_1)dx_2 - k_1x_1\right] \\
&= pk_1x_1 + (1-p)x_2^c + tp\frac{\left(x_2^c + k_0 - k_1x_1\right)^2}{4k_0}. \qquad (14)
\end{aligned}$$

□

Step 4. A manager of type t who learns x_1 and is strategic in period 1 will choose to issue the forecast $x_1$if and only if the following inequality holds:

$$\alpha(1+k_1)x_1 + (1-\alpha)E\left[P_2\left(d_1 = x_1, \tilde{d}_2\right)|x_1, t\right] \geq \alpha P_1(nd_1) + (1-\alpha)E\left[P_2\left(nd_1, x_1, \tilde{d}_2\right)|x_1, t\right]. \tag{15}$$

We call the manager's first period disclosure policy as described by inequality (15) the first period disclosure policy *induced* by investors' beliefs. Lemma 3 shows that if investors' beliefs $t^*(x_1)$ (from step 1) are interior then the first period disclosure policy induced by investors' beliefs will be right-tailed if and only if $t^*(x_1) \in [\underline{t}, \mu + \delta)$.

Lemma 3 *Given investors' beliefs* $(t^*(x_1), P_1(nd))$ *for* $t^*(x_1) \in (\mu - \delta, \mu + \delta)$, *the manager's induced disclosure policy in the first period will be right-tailed if and* *only if* $t^*(x_1) \geq \underline{t}$ *where* $\underline{t}$ *is the unique* $t \in [\mu - \delta, \mu + \delta]$ *that solves* $t^2(2t - 3\mu) + (\mu + 2\delta)(\mu - \delta)^2 = 0$.

Proof For this proof, we hold x_1 fixed and sometimes shorten $t^*(x_1)$ to t^*. Substituting expected second period prices (13) from Lemma 2 yields:

$$\begin{aligned}
&\alpha(1+k_1)x_1+(1-\alpha)\left(pk_1x_1+(1-p)x_2^c(\bar{t}_d(t^*),x_1)+tp\frac{\left(x_2^c(\bar{t}_d(t^*),x_1)+k_0-k_1x_1\right)^2}{4k_0}\right)\\
&\geq\alpha P_1(nd_1)+(1-\alpha)\left(pk_1x_1+(1-p)x_2^c(\bar{t}_{nd}(t^*),x_1)+tp\frac{\left(x_2^c(\bar{t}_{nd}(t^*),x_1)+k_0-k_1x_1\right)^2}{4k_0}\right).
\end{aligned} \tag{16}$$

where $\bar{t}_d(t^*)$ and $\bar{t}_{nd}(t^*)$ are defined in Lemma 1. A manager's induced disclosure policy will be right-tailed if the difference between LHS(16) and RHS(16) is weakly increasing in t. Since $x_2^c(\cdot) > -k_0+k_1x_1$, this difference is weakly increasing in t if

$$x_2^c(\bar{t}_d(t^*), x_1) \geq x_2^c(\bar{t}_{nd}(t^*), x_1). \tag{17}$$

$x_2^c(\cdot, x_1)$ is strictly decreasing in its first argument, so (17) is equivalent to

$$E[\tilde{t}|d_1 = x_1, t^*(x_1)] = \bar{t}_d(t^*) \leq \bar{t}_{nd}(t^*) = E[\tilde{t}|d_1 = nd, x_1, t^*(x_1)]. \tag{18}$$

Substituting the explicit expressions for the expectations appearing in (18) from Lemma 1 yields:

$$\begin{aligned}
&\frac{1}{2\delta - \frac{t^{*2}-(\mu-\delta)^2}{2}}\left[2\delta\mu - \frac{t^{*3} - (\mu-\delta)^3}{3}\right]\\
&\quad\leq \frac{1}{2\delta(1-p) + p\frac{t^{*2}-(\mu-\delta)^2}{2}}\left[2(1-p)\delta\mu + p\frac{t^{*3} - (\mu-\delta)^3}{3}\right]\\
&0 \leq t^{*2}(2t^* - 3\mu) + (2\delta + \mu)(\mu - \delta)^2.
\end{aligned} \tag{19}$$

In the accompanying footnote, we show that there is a unique $\underline{t} \in (\mu, \mu + \delta)$ such the RHS(19) $= 0$ at $t^* = \underline{t}$, and RHS(19) >0 on $[\mu - \delta,\ \mu + \delta]$ if and only if $t^* > \underline{t}$.[22] This proves the lemma. □

[22] First, notice RHS(19) evaluted at $t^* = \mu - \delta$ is 0. Next, notice RHS(19) evaluted at $t^* = \mu + \delta$ equals $4\delta^3$ and hence is positive. Next, differentiating RHS(19) confirms that RHS(19) has a unique local optimum on the set $\{t^*|t^* > \mu - \delta\}$ at $t^* = \mu$, and that this local optimum is in fact a local minimum. Hence, RHS(19) decreases from 0 to some negative number (which is RHS(19) evaluated at $t^* = \mu$) over the interval $[\mu - \delta,\ \mu\,]$ and increases from some negative number (which, again, is RHS(19) evaluated at $t^* = \mu$) to $4\delta^3$ over the interval $[\mu\,,\ \mu + \delta]$. Hence, there is a unique $\underline{t} \in (\mu, \mu + \delta)$ such that the RHS(19) equals 0 at $t^* = \underline{t}$ and is positive on $[\mu - \delta,\ \mu + \delta]$ if and only if $t^* > \underline{t}$.

Step 5. Step 3 and 4 above are both implicitly predicated on the (so far, exogenously specified) first period no disclosure price $P_1(nd_1)$. Lemma 5 establishes, for each potential equilibrium $P_1(nd_1)$, there is a fixed point in $t^*(x_1)$, that is, there is a function $t^*(x_1)$ s.t. if investors' beliefs are specified by the pair $t^*(x_1)$ and $P_1(nd_1)$, then the first period disclosure policy induced by investors' beliefs is both right-tailed and defined by $t^*(x_1)$. To emphasize the dependence of the fixed point $t^*(x_1)$ on $P_1(nd_1)$, we sometimes write $t^*(x_1, P_1(nd_1))$ in place of $t^*(x_1)$.)

We begin step 5 with the following lemma; it is a technical result used later in the proof of the proposition.

Lemma 4 *$z(t)$ is strictly decreasing in t for $t \geq \underline{t}$ and $z(\underline{t}) = 0$.*

Proof Recall that $z(t)$ is defined in (5). We want to show $z'(t) \leq 0$, when $z(t)$ is evaluated at a right-tailed equilibrium first period disclosure policy $t = t^* = t^*(x_1)$. In the notation of Lemmas 1 and 2, $z(t^*)$ can be written as:

$$z(t^*) = \pi\big(t^*, x_2^c(\bar{t}_{nd}(t^*), x_1), x_1\big) - \pi\big(t^*, x_2^c(\bar{t}_d(t^*), x_1), x_1\big).^{23} \tag{20}$$

In view of (20), it suffices to show (21) below:

$$\frac{d\pi\big(t^*, x_2^c(\bar{t}_{nd}(t^*), x_1), x_1\big)}{dt^*} < \frac{d\pi\big(t^*, x_2^c(\bar{t}_d(t^*), x_1), x_1\big)}{dt^*} \tag{21}$$

for all $t \geq \underline{t}$. By (13), evaluating $\frac{d\pi\left(t^*, x_2^c(\bar{t}, x_1), x_1\right)}{dt^*}$ at $\bar{t}(t^*) = \bar{t}_d(t^*)$ or at $\bar{t}(t^*) = \bar{t}_{nd}(t^*)$ yields:

$$\begin{aligned}\frac{d\pi\big(t^*, x_2^c(\bar{t}(t^*), x_1), x_1\big)}{dt^*} = {} & p\frac{\big(x_2^c(\bar{t}, x_1) + k_0 - k_1x_1\big)^2}{4k_0} \\ & + \left(1 - p + t^*p\frac{x_2^c(\bar{t}, x_1) + k_0 - k_1x_1}{2k_0}\right)\frac{\partial x_2^c(\bar{t}, x_1)}{\partial \bar{t}}\frac{\partial \bar{t}}{\partial t^*}.\end{aligned}$$

Recalling that $x_2^c(\bar{t}_{d_1}, x_1)$ is strictly declining in $\bar{t}_{d_1}$, (21) will follow if

$$0 < x_2^c(\bar{t}_{nd}(t^*), x_1) + k_0 - k_1x_1 < x_2^c(\bar{t}_d(t^*), x_1) + k_0 - k_1x_1 \text{ and} \tag{22}$$

$$\frac{\partial \bar{t}_d(t^*)}{\partial t^*} < 0 \leq \frac{\partial \bar{t}_{nd}(t^*)}{\partial t^*} \tag{23}$$

both hold. That (22) holds follows immediately from $\bar{t}_{nd}(t^*) > \bar{t}_d(t^*)$ for all $t^* \geq \underline{t}$ (Lemma 3) and (as is apparent from (4)) that $x_2^c(\bar{t}_{d_1}, x_1)$ is always strictly above the lower bound $k_1x_1 - k_0$ of $\tilde{x}_2's$ support. The second inequality in (23) is proven as follows. From Lemma 1, we can write $\bar{t}_{nd}(t^*)$ as $\bar{t}_{nd}(t^*) \equiv \frac{a+2pt^{*3}}{b+3pt^{*2}}$ where $a \equiv 12(1-p)\delta\mu - 2p(\mu-\delta)^3$ and $b \equiv 12(1-p)\delta - 3p(\mu-\delta)^2$. Neither of these constants depends on t^*, so

[23] It is apparent by inspection of $\pi(\cdot)$ in (13) and $x_2^c(\cdot)$ in (4) that when holding t^* fixed, $z(t^*)$ does not vary with x_1, justifying the absence of x_1 from $z(t^*)'s$ arguments.

$$sgn\frac{\partial \bar{t}_{nd}(t^*)}{\partial t^*} = sgn\left(6pt^{*2}\left(b+3pt^{*2}\right) - 6pt^*\left(a+2pt^{*3}\right)\right)$$
$$= sgn\left(t^*\left(b+3pt^{*2}\right) - \left(a+2pt^{*3}\right)\right).$$

This last term is nonnegative iff $t^*(b+3pt^{*2}) - (a+2pt^{*3}) \geq 0$, that is, iff

$$t^* \geq \frac{a+2pt^{*3}}{b+3pt^{*2}} = \bar{t}_{nd}(t^*) \tag{24}$$

To prove (24), we calculate $\bar{t}_{nd}(t^*) = \bar{t}_{nd}(t^*(x_1))$:

$$\bar{t}_{nd}(t^*(x_1)) = E[\tilde{t}|d_1 = nd, x_1, t^*(x_1)] = \int_{\mu-\delta}^{\mu+\delta} t\,\Pr(\tilde{t} = t|d_1 = nd, t^*(x_1))dt$$
$$= \frac{1}{\Pr(d_1 = nd|t^*(x_1))}\left[\int_{\mu-\delta}^{t^*(x_1)} t(1-p+pt)\frac{1}{2\delta}dt + \int_{t^*(x_1)}^{\mu+\delta} t(1-p)\frac{1}{2\delta}dt\right]$$
$$\equiv \frac{(1-p)}{1-p+p\widehat{H}(t^*(x_1))}\times\mu + \frac{p\widehat{H}(t^*(x_1))}{1-p+p\widehat{H}(t^*(x_1))}\times\int_{\mu-\delta}^{t^*(x_1)} t\frac{\widehat{h}(t)}{\widehat{H}(t^*(x_1))}dt$$

where $\widehat{h}(t) \equiv \frac{t}{2\delta}$ and $\widehat{H}(t^*) \equiv \int_{\mu-\delta}^{t^*}\widehat{h}(t)dt = \frac{t^{*2}-(\mu-\delta)^2}{4\delta}$. Hence, $\bar{t}_{nd}(t^*)$ is a weighted average of μ and $\int_{\mu-\delta}^{t^*} t\frac{\widehat{h}(t)}{\widehat{H}(t^*)}dt$. Since $\mu < \underline{t} \leq t^*(x_1)$ (see proof of Lemma 3) and $\int_{\mu-\delta}^{t^*(x_1)} t\frac{\widehat{h}(t)}{\widehat{H}(t^*)}dt \leq t^*(x_1)$, it follows that $\bar{t}_{nd}(t^*) \leq t^*(x_1)$. This proves (24). Next, we prove the first inequality in (23). Write $\bar{t}_d(t^*)$ as it appears in (11) as $\bar{t}_d(t^*) = \frac{c-2t^{*3}}{d-3t^{*2}}$, where $c = 12\delta\mu + 2(\mu-\delta)^3$ and $d = 12\delta + 3(\mu-\delta)^2$. Then, $\frac{\partial\bar{t}_d(t^*)}{\partial t^*}$ yields

$$\frac{\partial}{\partial t^*}\frac{c-2t^{*3}}{d-3t^{*2}} = \frac{-6t^{*2}(d-3t^{*2}) + 6t^*(c-2t^{*3})}{(d-3t^{*2})^2} = 6t^*\frac{-t^*(d-3t^{*2}) + (c-2t^{*3})}{(d-3t^{*2})^2}$$

Hence, $\frac{\partial\bar{t}_d(t^*)}{\partial t^*} \leq 0$ iff $-t^*(d-3t^{*2}) + (c-2t^{*3}) \leq 0$, i.e., iff $\bar{t}_d(t^*) = \frac{c-2t^{*3}}{d-3t^{*2}} < t^*$, which always holds because $\bar{t}_d(t^*(x_1)) \leq \mu < \underline{t} \leq t^*$ (again, see proof of Lemma 3). Finally, the assertion that $z(\underline{t}) = 0$ follows by directly evaluating $\bar{t}_d(t^*(x_1)$ and $\bar{t}_{nd}(t^*(x_1))$ in Lemma 1 at $t^*(x_1) = \underline{t}$. This evaluation leads to $\bar{t}_d(t^*(x_1) = \bar{t}_{nd}(t^*(x_1)) = \mu$, and hence that $z(\underline{t}) = 0$. □

Lemma 5 *Taking* $P_1(nd_1)$ *as given, a fixed point*[24] $t^*(x_1, P_1(nd_1))$ *is defined as follows:*

(a) *when* $\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1} \geq -1$,

[24] "Fixed point" here has the meaning described in step 5 above.

$$t^*(x_1,P_1(nd_1))=\begin{cases}\mu+\delta & \text{if } x_1\le\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1}\\ z^{-1}\left(\frac{\alpha}{1-\alpha}((1+k_1)x_1-P_1(nd_1))\right) & \text{if } \frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1}<x_1\le\frac{P_1(nd_1)}{1+k_1}\\ \mu-\delta & \text{if } \frac{P_1(nd_1)}{1+k_1}<x_1;\end{cases}$$

(b) *when* $\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1}<-1$,

$$t^*(x_1,P_1(nd_1))=\begin{cases}z^{-1}\left(\frac{\alpha}{1-\alpha}((1+k_1)x_1-P_1(nd_1))\right) & \text{if } x_1\le\frac{P_1(nd_1)}{1+k_1}\\ \mu-\delta & \text{if } \frac{P_1(nd_1)}{1+k_1}<x_1\end{cases}.$$

Proof Fix $P_1(nd_1), x_1$ and $t^*=t^*(x_1)$. For t^* to be a fixed point when $\tilde{x}_1=x_1$, it must be the case that if investors believe that managers use the right-tailed disclosure policy defined by t^* in period 1 when $\tilde{x}_1=x_1$, then strategic managers of type $t\ge t^*$ must prefer to disclose x_1 and strategic managers of type $t<t^*$ must prefer to withhold x_1. When t^* is interior, inequality (16) must hold as an equality when $t=t^*$, that is, that t^* must satisfy the following equation:

$$\begin{aligned}\alpha(1+k_1)x_1+(1-\alpha)\pi\left(t,x_2^c(\bar{t}_d(t^*),x_1)\right)&=\alpha P_1(nd_1)\\&+(1-\alpha)\pi\left(t,x_2^c(\bar{t}_{nd}(t^*),x_1)\right).\end{aligned}\tag{25}$$

Recalling the definition of $z(t^*)$ in (20) above, and rearranging terms, equation (25) can be written as

$$x_1=\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(t^*)}{1+k_1}.\tag{26}$$

Given x_1, equation (26) defines the equilibrium value of the right tailed disclosure policy $t^*=t^*(x_1)$ at x_1 if t^* is interior, and this t^* induces the manager to adopt a right-tailed disclosure policy. We know from Lemma 3 that this is the case if $t^*\in[\underline{t},\mu+\delta)$. Equivalently, as t^* sweeps across the interval $[\underline{t},\mu+\delta)$, equation (26) determines the set of $x_1\in[-1,1]$ for which an interior first-period, right-tailed equilibrium disclosure policy exists. This set of $x_1's$ is given by

$$[-1,1]\cap\left\{\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(t^*)}{1+k_1}\middle|t^*\in[\underline{t},\mu+\delta)\right\},\tag{27}$$

or alternatively, because Lemma 4 shows that $z(t)$ is strictly monotonically decreasing in t for $t\in[\underline{t},\mu+\delta)$ and $z(\underline{t})=0$, this set of $x_1's$ is given by

$$[-1,1]\cap\left(\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1},\frac{P_1(nd_1)}{1+k_1}\right].\tag{28}$$

To extend the definition of $t^*(x_1)$ to any $x_1\in[-1,1]$ not in (28), we employ (29) and (30) below:

$$\text{for all } x_1>\frac{P_1(nd_1)}{1+k_1} \text{ define } t^*=\mu-\delta\tag{29}$$

(implying that investors believe every type of strategic manager will disclose $x_1 > \frac{P_1(nd_1)}{1+k_1}$). In this case, investors' posterior expectations are given by $E[\widetilde{t}|d_1 = x_1, t^*(x_1)] = \bar{t}_d(t^*)|_{t^*=\mu-\delta} = \mu$ and $E[\widetilde{t}|d_1 = nd, x_1, t^*(x_1)] = \bar{t}_{nd}(t^*)|_{t^*=\mu-\delta} = \mu$. When $\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1} < -1$, (28) and (29) cover the entirety of the interval $x_1 \in [-1, 1]$. When $\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1} \geq -1$, we need the following additional specification:

$$\text{for all } x_1 \leq \frac{P_1(nd_1) + \frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1} \text{ define } t^* = \mu + \delta \tag{30}$$

(implying that investors believe every type of strategic manager will withhold $x_1 \leq \frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1}$). In this case, investors' posterior expectations are given: $E[\widetilde{t}|d_1 = x_1] = \bar{t}_d(t^*)|_{t^*=\mu+\delta} = \frac{3\mu-\left(3\mu^2+\delta^2\right)}{3(1-\mu)}$ and $E[\widetilde{t}|d_1 = nd, x_1] = \bar{t}_{nd}(t^*)|_{t^*=\mu+\delta} = \frac{3(1-p)\mu+p\left(3\mu^2+\delta^2\right)}{3(1-p)+3\mu p}$. The accompanying footnote establishes that the specifications of t^* in these two "corner" cases (29) and (30) are sustained in equilibrium (that is, if investors believe that these specifications describe managers' behavior, managers will in turn behave in accordance with these specifications).[25] To summarize, we have shown that when $x_1 \in (28), t^*(x_1)$ is defined by the unique solution to (26) and, for all other $x_1, t^*(x_1)$ is defined by one of (29) or (30) as appropriate. That is, $t^*(x_1) = t^*(x_1, P_1(nd_1))$ is as specified in the statement of the lemma.

Finally, in this step, in Lemma 6, we invert $t^*(x_1, P_1(nd_1))$ so that the first period disclosure policy can be written in the form $x_1^c(t)$ s.t. a strategic manager of type t will prefer to disclose x_1 in period 1 if and only if $x_1 \geq x_1^c(t)$. (This is advantageous for step 6.) □

Lemma 6 *Taking* $P_1(nd_1)$ *as given, the right-tailed disclosure policy* $t^*(x_1, P_1(nd_1))$ *defined in Lemma 5 above can be alternatively written as*

$$x_1^c(t) = \begin{cases} \frac{P_1(nd_1)}{1+k_1} & \text{if} \quad \mu-\delta \leq t < \underline{t} \\ \max\left\{\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(t)}{1+k_1}, -1\right\} & \text{if} \quad \underline{t} \leq t \leq \mu+\delta \end{cases},$$

with a type-t manager disclosing x_1 *if and only if* $x_1 > x_1^c(t)$.

[25] When (29) holds, investors conjecture that, if $x_1 > \frac{P_1(nd_1)}{1+k_1}$, all types of strategic managers prefer issuing a forecast x_1 over not issuing such forecast. To be sustained in equilibrium, it must be true that, for all t, the $LHS(15)$ must exceed the $RHS(15)$. From $E[\widetilde{t}|d_1 = x_1] = E[\widetilde{t}|d_1 = nd, x_1] = \mu$, it follows that $E\left[P_2\left(d_1 = x_1, \tilde{d}_2\right)|x_1, t\right] = E\left[P_2\left(nd_1, x_1, \tilde{d}_2\right)|x_1, t\right]$, and hence $LHS(15) > RHS(15)$ for $x_1 > \frac{P_1(nd_1)}{1+k_1}$.

When (30) holds, investors conjecture that, if $x_1 \leq \frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1}$, all types of strategic managers prefer not to issue the forecast x_1. To be sustained in equilibrium, it must be true that, for all t, the $RHS(15)$ must exceed the $LHS(15)$. Rearranging this inequality in the same way we rearranged (25) to get (26), yields $\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1} \geq x_1$, which, of course, holds by definition of the present situation (that is, when (30) holds).

Proof Essentially all that has to be done is to calculate the inverse of the function of $t^*(x_1, P_1(nd_1))$ defined in Lemma 5. The only potential problems in calculating this inverse arise for those values of x_1 for which $t^*(x_1, P_1(nd_1))$ is either not one-to-one (that is, when $x_1 > \frac{P_1(nd_1)}{1+k_1}$) or when the range of $t^*(x_1, P_1(nd_1))$ does not stretch across all of $[\mu - \delta, \mu + \delta]$ (that is, for $t^* \in [\mu - \delta, \underline{t})$, or when $\frac{P_1(nd_1)+\frac{1-\alpha}{\alpha}z(\mu+\delta)}{1+k_1} < -1$. Any potential indeterminacy arising from any of these situations is resolved by requiring that, no matter how $x_1^c(t)$ is defined, it must preserve the same boundary between the "disclosure" and "no disclosure" sets as does $t^*(x_1)$. It is easy to check that, when $x_1^c(t)$ is defined as in this lemma's statement, the same boundary sets are preserved under $x_1^c(t)$ as under $t^*(x_1, P_1(nd_1))$ as specified in Lemma 5. □

Step 6. The final step of the proof involves endogenously determining $P_1(nd_1)$. Lemma 7 identifies implicitly that value for $P_1(nd_1)$ s.t. if $t^*(x_1, P_1(nd_1))$ is the fixed point associated with $P_1(nd_1)$, then $P_1(nd_1)$ equals the expected value of the firm's first period earnings, given that the manager does not issue a forecast and uses the first period disclosure policy $t^*(x_1, P_1(nd_1))$.

Lemma 7 *The firm's first period equilibrium price in the event that the manager does not issue a forecast in the first period, $P_1(nd_1)$, is uniquely defined by the following equation:*

$$8\delta(1-p)(1+k_1)P_1(nd_1) + p\frac{(1+k_1+P_1(nd_1))^2}{2}\left(\hat{t}^2 - (\mu-\delta)^2\right)$$
$$-p\left(\frac{1-\alpha}{\alpha}\right)^2 \int_{\underline{t}}^{\hat{t}} t' * z(t')^2 dt' = 0. \tag{31}$$

Proof Initially, suppose investors knew that a manager's type was t and that they also knew that strategic managers in the first period decide to withhold or disclose the information x_1 they receive in the first period on the basis of whether $x_1 < x_1^c(t)$. Under these conditions, the probability a manager of type t does not issue a forecast in the first period is $\Pr\left(\widetilde{d}_1 = nd|t\right) = 1 - p + pt\Pr\left(\widetilde{x}_1 < x_1^c(t)\right) = 1 - p + pt\frac{x_1^c(t)+1}{2}$. So the expected value of the firm's first period earnings for a manager of known type t who adopts the disclosure policy $x_1^c(t)$ and who issues no forecast in the first period is given by (recall $E[\widetilde{x}_1] = 0$):

$$E[\widetilde{x}_1|nd_1, t] = \frac{(1-p)E[\widetilde{x}_1] + ptF\left(x_1^c(t)\right)E\left[\widetilde{x}_1|\widetilde{x}_1 < x_1^c(t)\right]}{\Pr(d_1 = nd|t)}$$
$$= \frac{pt\frac{x_1^c(t)+1}{2}\frac{x_1^c(t)-1}{2}}{1-p+pt\frac{x_1^c(t)+1}{2}} = \frac{\frac{p}{4}t\left(\left(x_1^c(t)\right)^2 - 1\right)}{1-p+\frac{p}{2}t\left(x_1^c(t)+1\right)}.$$

Of course, investors don't get to observe the manager's type. However, they update their beliefs about the manager being of type t when they observe that the manager did not issue a forecast in the first period to

$$\Pr(t|nd_1) = \frac{\Pr(nd_1|t)h(t)}{\Pr(nd_1)} = \frac{\left(1 - p + \frac{p}{2}t\left(x_1^c(t) + 1\right)\right)\frac{1}{2\delta}}{1 - p + \frac{1}{2\delta}\frac{p}{2}\int_{\mu-\delta}^{\mu+\delta} t' * \left(x_1^c(t') + 1\right)dt'}.$$

With that we can compute $P_1(nd_1) = E[\widetilde{x}_1 + \widetilde{x}_2|nd_1]$ as

$$\begin{aligned} P_1(nd_1) &= E[\widetilde{x}_1 + \widetilde{x}_2|nd_1] = (1 + k_1)E[\widetilde{x}_1|nd_1] \\ &= (1 + k_1)\int_{\mu-\delta}^{\mu+\delta} E[\widetilde{x}_1|nd_1, t]\Pr(t|nd_1)dt \\ &= \frac{1 + k_1}{2\delta}\frac{\frac{p}{4}\int_{\mu-\delta}^{\mu+\delta} t\left(\left(x_1^c(t)\right)^2 - 1\right)dt}{1 - p + \frac{1}{2\delta}\frac{p}{2}\int_{\mu-\delta}^{\mu+\delta} t' * \left(x_1^c(t) + 1\right)dt'}. \end{aligned} \tag{32}$$

To solve for $P_1(nd_1)$, we need to plug $x_1^c(t)$ into the above equation because so far we expressed $x_1^c(t)$ as a function of $P_1(nd_1)$. With $\widehat{t} \equiv \min\left\{z^{-1}\left(-\frac{\alpha}{1-\alpha}(1 + k_1 + P_1(nd_1))\right), \mu + \delta\right\}$, $x_1^c(t)$ in Lemma 6 can be written as

$$x_1^c(t) = \begin{cases} \frac{P_1(nd_1)}{1+k_1} & \text{if} \quad \mu - \delta \leq t < \underline{t} \\ \frac{P_1(nd_1) + \frac{1-\alpha}{\alpha}z(t)}{1+k_1} & \text{if} \quad \underline{t} \leq t \leq \widehat{t} \\ -1 & \text{if} \quad \widehat{t} < t \leq \mu + \delta \end{cases}.$$

With that observation, we can rewrite (32) as

$$\begin{aligned} &P_1(nd_1) \\ &= \frac{1 + k_1}{2\delta}\frac{p}{4}\frac{\int_{\mu-\delta}^{\underline{t}} t * \left(x_1^c(t)\right)^2 dt + \int_{\underline{t}}^{\widehat{t}} t * \left(x_1^c(t)\right)^2 dt + \int_{\widehat{t}}^{\mu+\delta} tdt - \int_{\mu-\delta}^{\mu+\delta} tdt}{1 - p + \frac{1}{2\delta}\frac{p}{2}\left(\int_{\mu-\delta}^{\underline{t}} t * x_1^c(t)dt + \int_{\underline{t}}^{\widehat{t}} t * x_1^c(t)dt - \int_{\widehat{t}}^{\mu+\delta} tdt + \int_{\mu-\delta}^{\mu+\delta} tdt\right)} \\ &= \frac{1}{2\delta}\frac{p}{4}\frac{P_1(nd_1)^2\frac{\underline{t}^2 - (\mu-\delta)^2}{2} + \int_{\underline{t}}^{\widehat{t}} t * \left(\left(z(t)\frac{1-\alpha}{\alpha}\right)^2 + 2z(t)\frac{1-\alpha}{\alpha}P_1(nd_1)\right)dt - (1 + k_1)^2\frac{\widehat{t}^2 - (\mu-\delta)^2}{2}}{(1 - p)(1 + k_1) + \frac{1}{2\delta}\frac{p}{2}\left(P_1(nd_1)\frac{\underline{t}^2 - (\mu-\delta)^2}{2} + \int_{\underline{t}}^{\widehat{t}} t * z(t)\frac{1-\alpha}{\alpha}dt + (1 + k_1)\frac{\widehat{t}^2 - (\mu-\delta)^2}{2}\right)}. \end{aligned}$$

Simplifying the above equation yields

$$\begin{aligned} &(1 - p)(1 + k_1)P_1(nd_1) + \frac{1}{2\delta}\frac{p}{2}\begin{pmatrix} \frac{1}{2}P_1(nd_1)^2\frac{\underline{t}^2 - (\mu-\delta)^2}{2} + (1 + k_1)P_1(nd_1)\frac{\widehat{t}^2 - (\mu-\delta)^2}{2} \\ + \frac{1}{2}(1 + k_1)^2\frac{\widehat{t}^2 - (\mu-\delta)^2}{2} \end{pmatrix} \\ &= \frac{1}{2\delta}\frac{p}{4}\left(\frac{1 - \alpha}{\alpha}\right)^2\int_{\underline{t}}^{\widehat{t}} t' * z(t')^2 dt'. \end{aligned}$$

Upon rearrangement, this last equation is equivalent to (31). Since this equation is quadratic in $P_1(nd_1)$, one can solve it and select the applicable root-the one inside the interval $[-(1+k_1),(1+k_1)]$-to obtain the closed form expression for $P_1(nd_1)$ appearing in (7). This completes the proof of both the lemma and the proposition. $\square$

Proof of corollary 1

First, we show that $x_1^c(t)<0$ holds for all t. From Proposition 1 and Lemma 4, this will follow upon showing $P_1(nd_1)<0$. We will prove the latter by showing: first that LHS(31) is strictly increasing in $P_1(nd_1)$; second, that LHS(31) is negative at $P_1(nd_1)=-(1+k_1)$; and third, that LHS(31) is positive at $P_1(nd_1)=0$. Taking the derivative of the LHS(31) with respect to $P_1(nd_1)$ yields

$$8\delta(1-p)(1+k_1)+p(1+k_1+P_1(nd_1))\left(\widehat{t}^2-(\mu-\delta)^2\right)>0,$$

where the last equality follows from the following observation: If $\widehat{t}=\mu+\delta$ then $\frac{\partial\widehat{t}}{\partial P_1(nd_1)}=0$. If $\widehat{t}=z^{-1}\left(-\frac{\alpha}{1-\alpha}(1+k_1+P_1(nd_1))\right)$, then (by definition) $\frac{1-\alpha}{\alpha}z\left(\widehat{t}\right)=1+k_1+P_1(nd_1)$, and hence $(1+k_1+P_1(nd_1))^2-\left(\frac{1-\alpha}{\alpha}\right)^2z\left(\widehat{t}\right)^2=0$. Next, note that LHS(31) evaluated at $P_1(nd_1)=-(1+k_1)$ yields

$$-8\delta(1-p)(1+k_1)^2-p\left(\frac{1-\alpha}{\alpha}\right)^2\int\limits_{\underline{t}}^{\widehat{t}}t'*z(t')^2dt'<0.$$

Finally, evaluating the LHS of (31) at $P_1(nd_1)=0$ yields

$$p\left(\frac{(1+k_1)^2}{2}\left(\widehat{t}^2-(\mu-\delta)^2\right)-\left(\frac{1-\alpha}{\alpha}\right)^2\int\limits_{\underline{t}}^{\widehat{t}}t'*z(t')^2dt'\right). \tag{33}$$

where $\widehat{t}\equiv\min\left\{z^{-1}\left(-\frac{\alpha}{1-\alpha}(1+k_1)\right),\mu+\delta\right\}$. To evaluate (33), we must consider two cases. First case: $\widehat{t}=\mu+\delta$, i.e., when $z_y^{-1}\left(-\frac{\alpha}{1-\alpha}(1+k_1)\right)>\mu+\delta$. Then the fact that $z(\cdot)$ is strictly decreasing implies $-\frac{\alpha}{1-\alpha}(1+k_1)<z(\mu+\delta)$. From this it follows that $-\frac{\alpha}{1-\alpha}(1+k_1)<z(\mu+\delta)\leq z(t)\leq 0$ for all $t\geq\underline{t}$, and hence $\left(\frac{\alpha}{1-\alpha}(1+k_1)\right)^2>z(\mu+\delta)^2\geq z(t)^2\geq 0$. With that, we can compute the following lower bound for LHS(31) when $P_1(nd_1)=0$:

$$p\left(\frac{(1+k_1)^2}{2}\left((\mu+\delta)^2-(\mu-\delta)^2\right)-\left(\frac{1-\alpha}{\alpha}\right)^2\int\limits_{\underline{t}}^{\mu+\delta}t'\left(\frac{\alpha}{1-\alpha}(1+k_1)\right)^2dt'\right)>0.$$

Second case: $\widehat{t}=z^{-1}\left(-\frac{\alpha}{1-\alpha}(1+k_1)\right)$, i.e., when $z^{-1}\left(-\frac{\alpha}{1-\alpha}(1+k_1)\right)<\mu+\delta$. Then, for $t\in\left(\underline{t},\widehat{t}\right)$, we have $0>z(t)>z\left(\widehat{t}\right)=-\frac{\alpha}{1-\alpha}(1+k_1)$ which implies $0<z(t)^2<\left(\frac{\alpha}{1-\alpha}(1+k_1)\right)^2$. With that, we can compute the following lower bound for LHS(31) when $P_1(nd_1)=0$ as

$$p\left(\frac{(1+k_1)^2}{2}\left(\hat{t}^2-(\mu-\delta)^2\right)-\left(\frac{1-\alpha}{\alpha}\right)^2\int_{\underline{t}}^{\hat{t}}t'\left(\frac{\alpha}{1-\alpha}(1+k_1)\right)^2dt'\right)>0$$

This proves that there exists a unique value for $P_1(nd_1)$ in the interval $(-(1+k_1),0)$ that solves (31). It is easy to verify that $x_2^c\in(-k_0+k_1x_1,k_1x_1)$ (recall that $\bar{t}_{d_1}>0$).

Proof of corollary 2

Proved in Lemma 3.

Proof of corollary 3

Note that $\Pr(t>\underline{t})=\frac{\mu+\delta-\underline{t}}{2\delta}$.

(a) $\frac{\partial\Pr\left(t>\underline{t}\right)}{\partial\mu}=\frac{1}{2\delta}\left(1-\frac{\partial\underline{t}}{\partial\mu}\right)$. Applying the implicit function theorem to $\underline{t}^2(2\underline{t}-3\mu)+(2\delta+\mu)(\mu-\delta)^2=0$ to obtain $\frac{\partial\underline{t}}{\partial\mu}$ and computing $1-\frac{\partial\underline{t}}{\partial\mu}$ yields

$$1-\frac{\partial\underline{t}}{\partial\mu}=\frac{3(\underline{t}-\mu)^2+\delta^2+2\mu\delta}{6\underline{t}(\underline{t}-\mu)}>0.$$

(b) $\frac{\partial\Pr\left(t>\underline{t}\right)}{\partial\delta}=\frac{\delta\left(1-\frac{\partial\underline{t}}{\partial\delta}\right)-\left(\mu+\delta-\underline{t}\right)}{2\delta^2}=\frac{\underline{t}-\mu-\delta\frac{\partial\underline{t}}{\partial\delta}}{2\delta^2}$. Again, applying the implicit function theorem yields

$$\frac{\partial\underline{t}}{\partial\delta}=-\frac{2(\mu-\delta)^2+2\delta(2\delta+\mu)}{6\underline{t}(\underline{t}-\mu)}<0.$$

We want to show that $\underline{t}-\mu-\delta\frac{\partial\underline{t}}{\partial\delta}>0$. This follows immediately from $\frac{\partial\underline{t}}{\partial\delta}<0$ and $\underline{t}>\mu$.

Proof of corollary 5

We shall show that the first period disclosure policy depends on the parameters α, k_0, and k_1 only through the scalar ω. To demonstrate this, we begin by transforming the firm's second period earnings forecast $\tilde{x}_2$ conditional on x_1, along with various associated functions defined in terms of x_2, into a new "scaled" earnings forecast $\tilde{y}_2$, along with various associated functions defined in terms of y_2, that is independent of α, k_0 and k_1, and depends on x_1 at most through the associated disclosure policy $t^*(x_1)$. The transformation is given by $Y_2(x_2)\equiv\frac{x_2-k_1x_1}{k_0}$. It follows that $\tilde{y}_2\equiv Y_2(\tilde{x}_2)$ is distributed uniformly on [−1,1]. The inverse of Y_2, which is also used in the following, is given by $X_2(y_2)\equiv k_0y_2+k_1x_1$. The various associated functions defined in term of y_2 are $x_2^c(\bar{t}_{d_1},x_1)$ defined in (4) corresponds to

$$y_2^c(\bar{t}_{d_1}) \equiv Y_2(x_2^c(\bar{t}_{d_1}, x_1)) = -\frac{2(1-p) + p\bar{t}_{d_1} - 2\sqrt{(1-p)(1-p+p\bar{t}_{d_1})}}{p\bar{t}_{d_1}}. \quad (34)$$

$\pi\left(t, x_2^c, x_1\right)$ defined in (13) corresponds to

$$\begin{aligned}\pi_y\left(t, y_2^c\right) &\equiv \frac{\pi\left(t, X_2(y_2^c), x_1\right) - k_1 x_1}{k_0} = \frac{\pi\left(t, k_0 y_2^c + k_1 x_1, x_1\right) - k_1 x_1}{k_0} \\ &= (1-p)y_2^c + tp\frac{\left(y_2^c + 1\right)^2}{4}.\end{aligned}$$

Finally, $z(t^*)$ defined in (20) corresponds to

$$z_y(t^*) \equiv \pi_y\left(t, y_2^c(\bar{t}_{nd}(t^*))\right) - \pi_y\left(t, y_2^c(\bar{t}_d(t^*))\right) = k_0 z_y(t^*). \quad (35)$$

We can now rewrite the first-period disclosure policy. Recall $x_1^c(t)\big|_{t<\underline{t}} = \frac{P_1(nd_1)}{1+k_1} \equiv \bar{x}_1^c$. Then,

$$\bar{x}_1^c = -\frac{2(1-p) + \bar{s}_1 p - 2\sqrt{(1-p)(1-p+\bar{s}_1 p) + \frac{p^2 \bar{s}_1}{8\delta}\left(\frac{1-\alpha}{\alpha}\frac{k_0}{1+k_1}\right)^2 \int_{\underline{t}}^{\widehat{t}} t' * z_y(t')^2 dt'}}{\bar{s}_1 p}, \quad (36)$$

where $\widehat{t} \equiv \min\left\{z_y^{-1}\left(-\omega * \left(1 + \bar{x}_1^c\right)\right), \mu + \delta\right\}$.

Proof of corollary 6

Part (a). We first derive how $\bar{x}_1^c$ varies with the scalar ω. Rearranging (36) yields

$$4(1-p)\bar{x}_1^c + \left(\bar{x}_1^c + 1\right)^2 \bar{s}_1 p - \frac{p}{2\delta}\frac{1}{\omega^2}\int_{\underline{t}}^{\widehat{t}} t' * z_y(t')^2 dt' = 0. \quad (37)$$

Showing that the LHS of (37) increases monotonically in $\bar{x}_1^c$ follows the same steps as showing that the LHS of (31) increases monotonically $P_1(nd_1)$ (see proof of Corollary 1) and is omitted for brevity. Next, we show that the LHS of (37) increases monotonically in ω.

$$\begin{aligned}\frac{\partial LHS(37)}{\partial\omega} &= \frac{p}{\delta}\frac{1}{\omega^3}\int_{\underline{t}}^{\widehat{t}} t' * z_y(t')^2 dt' + \left(\left(\bar{x}_1^c + 1\right)^2 \frac{\partial \bar{s}_1}{\partial \widehat{t}} p - \frac{p}{2\delta}\frac{1}{\omega^2}\widehat{t} * z_y\left(\widehat{t}\right)^2\right)\frac{d\widehat{t}}{d\omega} \\ &= \frac{p}{\delta}\frac{1}{\omega^3}\int_{\underline{t}}^{\widehat{t}} t' * z_y(t')^2 dt' > 0\end{aligned}$$

where the last equality follows from the following observation: If $\widehat{t} = \mu + \delta$ then $\frac{\partial \widehat{t}}{\partial \omega} = 0$. If $\widehat{t} = z_y^{-1}\left(-\omega * \left(1 + \bar{x}_1^c\right)\right)$ then (by definition) $z_y\left(\widehat{t}\right) = -\omega * \left(1 + \bar{x}_1^c\right)$ and hence $\left(\bar{x}_1^c + 1\right)^2 - \frac{1}{\omega^2} z_y\left(\widehat{t}\right)^2 = 0$. We conclude:

$$\frac{d\bar{x}_1^c}{d\omega} = -\frac{\frac{\partial LHS(37)}{\partial \omega}}{\frac{\partial LHS(37)}{\partial \bar{x}_1^c}} = -\frac{\frac{p}{\delta}\frac{1}{\omega^3}\int_{\underline{t}}^{\widehat{t}} t' * z_y(t')^2 dt'}{4(1-p) + 2\left(\bar{x}_1^c + 1\right)\bar{s}_1 p} < 0. \tag{38}$$

The comparative statics of $\bar{x}_1^c$ and $P_1(nd_1)$ with respect to α, k_0 and k_1 now follow immediately from $\frac{\partial \bar{x}_1^c}{\partial \omega} < 0$. Specifically, since

$$\frac{\partial \omega}{\partial \alpha} = \frac{1}{(1-\alpha)^2}\frac{1+k_1}{k_0} > 0; \quad \frac{\partial \omega}{\partial k_0} = -\frac{\alpha}{1-\alpha}\frac{1+k_1}{k_0^2} < 0; \quad \frac{\partial \omega}{\partial k_1} = \frac{\alpha}{1-\alpha}\frac{1}{k_0} > 0, \tag{39}$$

we conclude: $\frac{\partial \bar{x}_1^c}{\partial \alpha} < 0, \frac{\partial \bar{x}_1^c}{\partial k_0} > 0, \frac{\partial \bar{x}_1^c}{\partial k_1} < 0$. Moreover, from $P_1(nd_1) = (1 + k_1)\bar{x}_1^c$, it follows that $\frac{\partial P_1(nd_1)}{\partial \alpha} < 0, \frac{\partial P_1(nd_1)}{\partial k_0} > 0$ and

$$\frac{\partial P_1(nd_1)}{\partial k_1} = \bar{x}_1^c + (1 + k_1)\frac{\partial \bar{x}_1^c}{\partial k_1} = \bar{x}_1^c + (1 + k_1)\frac{\partial \bar{x}_1^c}{\partial \omega}\frac{\alpha}{1-\alpha}\frac{1}{k_0} = \bar{x}_1^c + \omega\frac{\partial \bar{x}_1^c}{\partial \omega} < 0,$$

where the last inequality follows from $\bar{x}_1^c < 0$ and $\frac{\partial \bar{x}_1^c}{\partial \omega} < 0$.

Part (b). In part (a), we have already shown how $\bar{x}_1^c$ (i.e., $x_1^c(t)$ for $t \leq \underline{t}$) varies with α, k_0, and k_1. Next, we show how $x_1^c(t)$ varies with α, k_0, and k_1 for $t > \underline{t}$. Proposition 1 gives the first period disclosure threshold $x_1^c(t)$ for $t > \underline{t}$. For $\underline{t} \leq t \leq \widehat{t}$, substituting $k_0 z_y(t)$ for $z(t)$ yields

$$x_1^c(t) = \frac{P_1(nd_1) + \frac{1-\alpha}{\alpha}k_0 z_y(t)}{1 + k_1} = \frac{P_1(nd_1)}{1 + k_1} + \frac{1-\alpha}{\alpha}\frac{k_0}{1 + k_1}z_y(t) = \bar{x}_1^c + \frac{1}{\omega}z_y(t),$$

where the last equality follows from the definitions of ω and $\bar{x}_1^c$. Thus, for $t \geq \underline{t}$, the first period disclosure threshold is given by

$$x_1^c(t) = \begin{cases} \bar{x}_1^c & \text{if } \underline{t} \geq t \\ \bar{x}_1^c + \frac{1}{\omega}z_y(t) & \text{if } \underline{t} < t \leq \widehat{t} \\ -1 & \text{if } \widehat{t} < t \leq \mu + \delta \end{cases}.$$

In part (a), we have shown that $\frac{\partial \bar{x}_1^c}{\partial \omega} < 0$. Hence, $\frac{\partial x_1^c(t)}{\partial \omega} < 0$ for all $t \leq \underline{t}$. $\frac{\partial}{\partial t}\frac{\partial x_1^c(t)}{\partial \omega} > 0$ for all $\underline{t} \leq t \leq \widehat{t}$ and that $\left.\frac{\partial x_1^c(t)}{\partial \omega}\right|_{t=\mu+\delta} > 0$ will imply that there is a cutoff $t(\omega, p)$ s.t. $x_1^c(t)$ is strictly decreasing in ω for $t < t(\omega, p)$ and strictly increasing in ω for $t > t(\omega, p)$. Notice that $\underline{t} \leq t \leq \widehat{t}$:

$$\frac{\partial x_1^c(t)}{\partial \omega} = \frac{\partial \bar{x}_1^c}{\partial \omega} - \frac{1}{\omega^2}z_y(t) = -\frac{\frac{p}{\delta}\frac{1}{\omega^3}\int_{\underline{t}}^{\widehat{t}} t' * z_y(t')^2 dt'}{4(1-p) + 2\left(\bar{x}_1^c + 1\right)\bar{s}_1 p} - \frac{1}{\omega^2}z_y(t), \tag{40}$$

and hence $\frac{\partial}{\partial t}\frac{\partial x_1^c(t)}{\partial \omega} = -\frac{1}{\omega^2}z_y'(t) > 0$, as claimed. Showing that $\frac{\partial x_1^c(t)}{\partial \omega}$ is positive at $t = \mu + \delta$ will complete the argument. This part is omitted for brevity and available from the authors. This completes the proof of the claim about the existence of the cutoff $t(\omega, p)$ s.t. $x_1^c(t)$ is strictly decreasing in ω for $t < t(\omega, p)$ and strictly increasing in ω for $t > t(\omega, p)$. From this and (39), we immediately deduce that for $t < t(\omega, p): \frac{\partial x_1^c(t)}{\partial \alpha} < 0, \frac{\partial x_1^c(t)}{\partial k_0} > 0, \frac{\partial x_1^c(t)}{\partial k_1} < 0,$ and for $t \geq t(\omega, p), \frac{\partial x_1^c(t)}{\partial \alpha} \geq 0, \frac{\partial x_1^c(t)}{\partial k_0} \leq 0, \frac{\partial x_1^c(t)}{\partial k_1} \geq 0.$

Part (*c*). $\underline{t}$ is given by $\underline{t}^2(2\underline{t} - 3\mu) + (2\delta + \mu)(\mu - \delta)^2 = 0$ which does not depend on α, k_0 or k_1.

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