Project Selection, Information Feedback, and Catering to Market Belief*

Hui Chen† Jan Schneemeier‡

November 30, 2022

Abstract

We analyze a manager's optimal reporting strategy when making a project selection decision in the presence of market feedback. The project's success requires the investment decision to match the underlying fundamental correctly. The manager caters to the market by reporting a forward-looking signal consistent with the prevailing belief. The presence of informed traders reduces this catering incentive by making stock prices more informative. However, catering lowers the traders' information rents, thus reducing price informativeness and real efficiency. Contrary to prior studies, more accurate reporting crowds in informed trading and a more efficient financial market improves reporting quality. If the firm can produce information internally instead of relying on market feedback, a higher misreporting cost can lead to more misreporting in equilibrium.

Keywords: Project selection, reporting strategy, catering, price efficiency, real efficiency.

JEL Classification: G14, G30, M41.

*Comments from conference and seminar participants at the 14th Workshop on Accounting & Economics and Indiana University are greatly appreciated. This paper benefited from conversations with Pierre Chaigneau, Robert Goex, Itay Goldstein, Ilan Guttman, Eva Labro, Christian Laux, Jordan Martel, and Alessio Piccolo.

†University of Zurich, hui.chen@business.uzh.ch

‡Indiana University Bloomington, jschnee@iu.edu

1 Introduction

Firms often face project selection decisions under uncertainty. For example, they may have to decide whether to invest in green or brown technologies without knowing how stringent the environmental regulation will be. Or, they have to decide whether to pursue a capital- versus a labor-intensive production process, while the future factor market prices are unknown. A third example is that firms have to decide whether to move into one geographic region versus another but do not know the relative regional market demands. In all three cases, either project would be successful if the type of investment matches the underlying fundamental condition. However, if the investment does not match the underlying fundamental, the project will fail. Therefore, ex-ante, the projects to be selected cannot be ranked in terms of profitability since the fundamental state is unknown (Langberg and Sivaramakrishnan, 2010; Cheynel and Levine, 2020).

The literature on market feedback (e.g., Dye and Sridhar, 2002; Gao and Liang, 2013; Edmans et al., 2015; Goldstein and Yang, 2017, 2019) shows that firms could potentially learn additional information from informed traders through the market price.[1] In this paper, we examine the optimal reporting strategy of a manager who faces a project selection problem while trying to learn about the fundamental from the market. We also analyze the implications for informed trading, investment efficiency, and possible internal information production by the firm itself. We develop a parsimonious model that deviates from the conventional setting by requiring the investment to match the fundamental state of nature to generate a successful project. The firm value is thus non-monotone in the fundamental, which leads to several novel results.

In the prior literature, high-quality accounting reports typically crowd out private information acquisition in the market. On the contrary, our model demonstrates that less biased accounting disclosures could *encourage* traders to acquire information. The key to the result lies in the firm

[1]See e.g. Chen et al. (2007), Foucault and Fresard (2014), Edmans et al. (2017), and Jayaraman and Wu (2020) for empirical evidence of market feedback.

value that depends on the matching of the fundamental and the manager's investment decision. A highly biased accounting report reveals very little about the manager's private signal, which will determine the firm's subsequent investment. Therefore, even if traders have perfect information about the fundamental, they still do not gain any informational advantage in understanding the manager's investment decision. Thus, a more accurate accounting report could help traders predict the manager's subsequent investment and crowd in traders' private information acquisition about the fundamental. Vice versa, more informed trading also enhances the manager's incentive to report truthfully, as the information provided by the market feedback benefits the price and firm value.

We consider a publicly-traded firm that is run by a hired firm manager. To simplify the analysis, we assume the firm must decide between two mutually exclusive projects.[2] The manager maximizes a weighted average between the firm's short-term stock price and terminal value, which depends on the fundamental state and the manager's investment decision. If the manager makes the correct investment decision, then the firm value is maximized. On the contrary, the firm value will be low when the investment decision does not match the fundamental.

At the beginning of the game, the firm's manager learns an imperfect signal about the fundamental state of nature. The precision of the signal depends on the firm's information environment: the better the environment, the more likely the signal is accurate. The manager must issue a report later about the fundamental, which will be observed by all traders in the financial market.[3] The manager cares about the short-term stock price and prefers to report a fundamental consistent with the market's prior since the price will be higher if the market believes the firm will make the correct investment decision subsequently. We refer to this incentive as catering. As a result, the

[2] The two project setting can be easily extended to $N > 2$ projects. As long as the project's success requires the investment and the fundamental to match, the insight of our results will remain the same.

[3] This type of forward-looking information is typically disclosed in the Management's Discussion and Analysis (MD&A) section of firms' 10-K filings. Recent empirical research has found that the stock market reacts to various properties of MD&A, such as the tone and readability (e.g., Feldman et al., 2010; Li, 2010), and that managers seem to strategically report information in the MD&A (e.g., Li, 2008; Davis and Tama-Sweet, 2012).

manager always reports truthfully if her private signal equals the ex-ante more likely state. This catering incentive differs from conventional settings in which the manager prefers to report a higher accounting signal since the firm value and market price both increase in the fundamental state of nature.[4] Catering to the market is, however, costly for her due to personal effort and potential reputation damage or even litigation concerns if caught doing so.

The firm's market price is then determined through trading among investors in a competitive financial market that is similar to the setting in Kyle (1985). The market consists of atomistic informed traders, noise traders, and a competitive market maker. At the beginning of the game, informed traders can learn the firm's fundamental at a cost. After the manager has issued a public report, informed traders and noise traders submit market orders. The market maker sets the market price by observing the total order flow and the public report. After the interim price is formed, the manager selects a project to maximize the firm's long-term value. This decision is based on the equilibrium stock price and her private signal. At last, all uncertainty is resolved, and the firm's terminal value is realized.

The manager in our model thus faces two decisions: a disclosure decision and a project selection (or investment) decision. Traders also face two decisions: an information acquisition decision and a trading decision. For each decision, the players trade off the benefits and costs given the information they have at the time. We are particularly interested in how the manager's reporting strategy affects the informed traders' information acquisition strategy and vice versa. The firm manager and traders make their choices simultaneously at the initial stage, taking into account their conjectures about the other party's choice.

We derive the equilibrium by backward induction. The investment decision depends on the manager's own signal about the fundamental and potential information the manager learns from

[4]Prior models also include scenarios when the manager strictly prefers to report a lower signal to *deflate* the market price due to incentives such as to take a "big bath" in earnings or to lower stock prices for personal benefits before exercising call options, etc. However, unlike in our model, the manager's incentive is still linear in the fundamental.

the informed traders through the total order flow. If the order flow reveals the informed traders' information, the manager invests according to the information, which reflects the informed traders' aggregated signals about the fundamental. In that case, the market maker also knows that the manager will subsequently make the correct investment decision and sets the market price as high. On the contrary, if the order flow does not reveal any information, the manager can only rely on her own signal when making the investment decision. The market maker thus sets the price solely based on the manager's report and the prior. Informed traders decide how to trade based on their private information (if acquired) and the manager's report. Informed traders buy the asset if the report is consistent with their private signal because they expect the firm manager to invest correctly later. If, however, their private signal differs from the report, then they sell the asset in anticipation of a wrong investment decision and lower firm value. Depending on the volume of noise trading, the total order flow may or may not reveal their private information.

The manager decides whether to manipulate the report, while the traders simultaneously decide whether to acquire costly information about the fundamental. The traders' incentive to become informed is proportional to their expected trading profit, which *decreases* in the manager's manipulation intensity. Since the final firm value depends on the matching of the fundamental state of nature and the investment, the traders could not predict the firm value based on their own information about fundamental alone. The more likely the manager's report is manipulated, the less the traders could foresee the manager's subsequent investment decision. Hence, there is a negative relationship between the conjectured manipulation intensity and the equilibrium mass of informed traders. In the extreme case where the traders believe that the manager always manipulates, they will completely abstain from trading and never acquire any information.[5]

[5] If the manager always caters to the market belief, the firm's reports would become completely uninformative. One might think that this scenario results in a high incentive for informed traders to acquire private information due to the usual crowding-out effect of more precise information (Gao and Liang, 2013; Han et al., 2016; Edmans et al., 2016; Banerjee et al., 2018; Dugast and Foucault, 2018). However, this turns out not to be the case in our setting. Even though the informed traders have perfect knowledge about the firm's fundamental, they do not know the manager's private signal. Thus, compared to the market maker, they

We show that, as long as the manager's manipulation cost is not too low and the traders' information acquisition cost is not too high, there is a unique equilibrium concerning the manager's reporting strategy and the traders' information acquisition strategy. The manager never manipulates when her private signal is consistent with the ex-ante more likely fundamental and manipulates with a positive probability when her signal is consistent with the less likely fundamental. At the same time, a positive fraction of traders decide to acquire information and becomes informed.

In equilibrium, an increase in the manager's manipulation cost lowers the degree of manipulation and increases the equilibrium mass of informed traders and, thus, the expected firm value. Vice versa, reducing the traders' information acquisition cost increases their equilibrium mass and the degree of manipulation. Our model thus highlights an important interaction between the financial market and the firm's reporting environment. We also find that increased managerial short-termism leads to more manipulation, less informative prices, and a lower firm value. Perhaps surprisingly, an increase in the manager's private signal precision leads to less informative prices because it reduces the manager's desire to learn from the financial market. Since a higher signal precision also leads to greater investment efficiency, this feature can generate a spurious *negative* relationship between firm value and stock price informativeness.

We also study an extension by allowing the firm to alternatively choose to produce information internally instead of relying on learning from market feedback. In reality, firms always have the option to choose which channel to use for obtaining information. The decision depends on the relative benefit and cost of each channel. Specifically, we let the firm decide whether to invest a certain amount of resources in its information system to internally produce a perfect signal about the fundamental state of nature before everything else. If the firm chooses not to invest in internal

have no advantage in predicting the manager's investment decision and the final firm value. Anticipating such a consequence, the traders are not incentivized to acquire a costly signal ex-ante. Thus, the market is trapped in an equilibrium in which accounting disclosures of poor quality completely crowd out traders' private information acquisition. This finding starkly contrasts the conventional wisdom that *more precise* public disclosures reduce the incentive to acquire information.

information production, the game proceeds just as in the baseline model. If the firm chooses to invest, the manager will always report accurately without trying to cater to the market belief. The market anticipates that the manager will provide a perfect signal, and there is no incentive for traders to acquire information privately. Thus, perfect disclosure from the firm completely crowds out private information acquisition in the market.

Further, and perhaps counter-intuitively, a high cost of manipulation could result in the manager engaging in more manipulation of accounting reports if it discourages the firm's internal information production. A higher manipulation cost reduces the manager's incentive to bias the accounting report in the absence of the firm's internal information production. The resulting crowding-in effect is enhanced through more informed traders. In this case, the benefit from market feedback is higher, which makes the firm less willing to invest in producing an internal signal. Therefore, when firms face the choice of costly internal information production and learning through market feedback, a higher penalty for reporting could make the latter choice relatively more attractive.

Our study is closely related and contributes to three streams of literature. The first is the literature on the roles of public versus private information through feedback effects in financial markets. In this literature, market prices reflect the aggregate information from all sources, including those publicly disclosed by the firm and those privately acquired by investors. A common theme in this literature is the so-called *crowding-out* effect: more public information lowers the incentives for private information production in the market.[6] Gao and Liang (2013) show that more precise disclosure leads to lower private information acquisition by traders and harms market feedback. In Han et al. (2016), disclosure reduces price efficiency by increasing the mass of discretionary liquidity traders. Similarly, Banerjee et al. (2018) show that increased transparency can make prices less informative because disclosures discourage learning about fundamentals.[7] Other

[6]See Goldstein and Yang (2017) for a survey of this literature.

[7]Bond and Goldstein (2015) and Goldstein and Yang (2019) highlight that the type of information being disclosed determines whether disclosure is desirable.

important contributions to this literature include Dye and Sridhar (2002), Arya et al. (2017), and Chen et al. (2021).

In contrast, our study shows that public disclosure of good quality can *crowd-in* private information acquisition. This result comes from the fact that public disclosure of poor quality renders the traders' information useless in predicting the firm's subsequent investment decision, and thus deprives the traders of participating in the trade and destroys the feedback effect of the market price. The setting in Benhabib et al. (2019) also features a crowding-in effect of more precise public information. However, in their setting, the precision of this signal is taken as exogenous, while we endogenize this precision.

Langberg and Sivaramakrishnan (2010) also examine feedback in a similar setting of project selection where the firm value depends on the fundamental value multiplied by a binary state variable. The information to be disclosed by the manager is the fundamental value, while the feedback is about the state variable. However, their paper builds on a voluntary disclosure model as in Dye (1985) and Jung and Kwon (1988) and the feedback is provided by an analyst rather than through trading and price. In their model, feedback strictly improves long-term firm value, but the analyst only gives feedback if the manager discloses. The manager thus has to trade off the benefits of disclosing to solicit feedback and the cost of voluntarily disclosing bad information. Since the manager with private information of high quality has less need to solicit additional information from the analyst, feedback actually results in less disclosure in equilibrium.

The setting and results of Langberg and Sivaramakrishnan (2010) thus differ significantly from our paper. The information disclosed and provided through feedback in our model is the same state variable, and the feedback effect is generated through informed trading by strategic traders. Moreover, the disclosure is mandatory, and the manager is incentivized to bias the report to cater to the predominant market belief. As a result, we show that the rationing of information by firms would crowd out private information acquisition in the financial market, which is the opposite from

Langberg and Sivaramakrishnan (2010) and most of the other prior papers on market feedback.

The second stream of literature our study is related to is the literature on reporting bias and earnings manipulation, which examines managers' incentive to bias their disclosures in a mandatory reporting environment. Different from the typical model of reporting bias (see e.g., Fischer and Verrecchia, 2000; Dye and Sridhar, 2004), our setting is more stylized with a publicly known degree of managerial short-termism, and thus does not involve signal jamming as prior papers often do.

The third piece of literature is the real effects of accounting disclosure through investment. The real effects literature (see e.g., Kanodia, 1980; Kanodia and Mukherji, 1996; Kanodia et al., 2004) focuses on how accounting measures and reports affect the market price and the firm's investment efficiency. Unlike our setting, the timeline of the real effect models requires the investment to be made before the price is formed. Also, there are no informed traders nor informational feedback from the market price.

2 The model

The model has three dates $t \in \{1, 2, 3\}$. There is a single firm that is run by a hired manager. At $t = 1$, the firm manager observes a private signal and then exerts effort to manipulate the signal to make a public report. Simultaneously, a mass n of informed traders acquires a private signal about the firm's fundamental. At $t = 2$, the firm issues a public report, which might be successfully manipulated, and its stock is traded in a secondary financial market. At $t = 3$, the firm manager makes an investment (or project selection) decision, and the terminal firm value realizes. All agents are risk-neutral, and the risk-free rate is normalized to zero.

The firm's terminal value depends on the fundamental $\theta \in \{\alpha, \beta\}$ with $\Pr(\theta = \alpha) = q \in \left(\frac{1}{2}, 1\right)$ and the firm's investment decision $I \in \{a, b\}$. As discussed before, α and β represent two different states of nature, each requiring a matching investment strategy. However, neither state of nature is necessarily better than the other in terms of payoff. Based on the commonly-shared prior belief,

α is ex-ante more likely than β to be the realized state of nature, although we have assumed so without loss of generality. We could simply re-label the more likely of the two "β" and the less likely "α", and all the intuition will remain the same. The firm's terminal value v is defined as follows:

$$v(\theta, I) = \begin{cases} \overline{v} > 0 & \text{if } \{\theta = \alpha, I = a\} \text{ and if } \{\theta = \beta, I = b\}, \\ \\ \underline{v} = 0 & \text{if } \{\theta = \beta, I = a\} \text{ and if } \{\theta = \alpha, I = b\}. \end{cases} \tag{1}$$

If the fundamental θ is equal to α, then the value-maximizing decision is $I = a$. Similarly, if θ is equal to β, then the value-maximizing decision is $I = b$. If the firm invests correctly, the terminal value equals $v = \overline{v} > 0$. If the firm makes the incorrect decision, the value is equal to $v = \underline{v}$, normalized to zero.

The payoff structure of the investment decision is an important feature of our model. The firm's value is high when the investment decision matches the fundamental and low otherwise, regardless of the realized value of the fundamental itself. This structure differs from the usual payoff structure in the prior literature, which typically assumes the investment and the payoff increase in the fundamental monotonically. Our setting is thus similar to Edmans et al. (2015) or Chen et al. (2021), in which the firm could invest or divest by one unit from the status quo and obtain the same payoff. Langberg and Sivaramakrishnan (2010) and Cheynel and Levine (2020) also include specifications where two parts of information may be positively or negatively linked, and higher signals do not always lead to higher values.

The firm manager's utility U is specified as follows:

$$U = \omega p + (1 - \omega)v - \frac{c}{2}m^2, \tag{2}$$

where p is the equilibrium stock price at $t = 2$ and v is the firm's terminal value at $t = 3$ defined in equation (1). The constant $\omega \in (0, 1)$ determines the relative importance of p vis-a-vis the firm's terminal value v and can be interpreted as the degree of managerial short-termism. We follow the existing literature such as Edmans et al. (2016), Gao and Zhang (2019), or Guttman and Meng (2021) and treat ω as exogenously given. The manager's incentive to maximize the future stock price can reflect concerns for managerial reputation as in Narayanan (1985) and Scharfstein and Stein (1990), or managerial myopia as in Stein (1989). The manager's manipulation effort, given her private signal y, is $m(y) \in [0,1]$. The manager's choice of $m(y)$ determines the probability with which the report is successfully manipulated. With probability $1-m(y)$, the manager reports truthfully. The constant $c > \bar{c}$ captures the manager's private cost of manipulation, such as potential litigation cost and reputation damage.[8] The positive constant $\bar{c}$ ensures an interior equilibrium and is explicitly defined in Appendix A.2.

At $t = 1$, the manager observes a private signal $y \in \{\alpha, \beta\}$. We treat the signal precision λ in the baseline model as exogenous. Section 4 considers a model extension in which we endogenize the signal precision. The parameter λ reflects the quality of the firm's information environment; mathematically, $\lambda = \Pr(y = \alpha|\theta = \alpha) = \Pr(y = \beta|\theta = \beta)$ with $\lambda \in \left(\frac{1}{2}, 1\right)$. The higher λ, the more likely the manager will obtain accurate information. To ensure that the manager's investment decision depends on her private signal, we assume that the signal is sufficiently precise, $\lambda > q$.[9]

Given her private signal, the manager chooses a reporting strategy, i.e., her manipulation effort $m(y) \in [0,1]$. Her reporting strategy determines the distribution of the public report $z \in \{\alpha, \beta\}$. With probability $m(y)$, the manager manipulates successfully and reports $z \neq y$; with probability $1-m(y)$, she reports truthfully and $z = y$. The manager's manipulation choice $m(y)$ is private and cannot be observed by outsiders. We denote the market's conjecture of the manager's reporting strategy by $\widehat{m}(y)$, which is equal to $m(y)$ in equilibrium.

The financial market features the following three types of traders following Kyle (1985). First, a competitive market maker sets the equilibrium price conditional on total order flow and the firm's

[8] We have confirmed that our results continue to hold under a linear cost function.

[9] We formally show in Appendix A.1 that the manager does not rely on her private signal when choosing I if $\lambda \leq q$.

public report to break even in expectation. Second, a continuum of liquidity (or noise) traders trade for exogenous reasons and collectively demand u. For tractability, we assume that liquidity trading is bounded as in Glosten and Milgrom (1985). To obtain analytic solutions, we assume that u is drawn from a uniform distribution on the interval $[-1, 1]$ and that it is independent of all other random variables. Third, there is a mass of informed traders who observe private signals $s_i \in \{\alpha, \beta\}$ and submit demands $\delta_i \in [-1, 1]$.[10] We denote an individual informed trader by $i \in [0, n]$. A zero-profit condition determines the total mass of informed traders n at $t = 1$. We assume that the informed traders' signal is perfectly informative ($s_i = \theta$) to keep the analysis more tractable, but all of our main results are robust to relaxing this assumption. The private signal has a constant acquisition cost of $\tau > 0$.

At $t = 2$, the manager makes a report z, and all traders submit their demand orders. The market maker observes the firm's public report and total order flow for the firm's shares $x \equiv \int_0^n \delta_i di + u$. As is conventional in Kyle-type models, the market maker cannot distinguish the demand orders from the informed traders and the noise traders. The equilibrium stock price is set such that the market maker breaks even in expectation:

$$p(x, z) = \mathbb{E}[v|x, z]. \tag{3}$$

To enable market feedback (e.g., Edmans et al., 2015; Goldstein and Yang, 2019), we assume the manager can also observe the order flow.[11] Like the market maker, she can only observe the total order flow but cannot distinguish the respective demand orders from the informed traders and the noise traders. At $t = 3$, the manager makes an investment decision I based on her information x and y. Figure 1 describes the timeline for our main model.

[10] This assumption can be justified by borrowing or short-selling constraints and is common in models featuring atomistic risk-neutral traders. See, for instance, Goldstein et al. (2013), Goldstein and Yang (2019), Huang et al. (2020), and Schneemeier (2022) for recent papers with similar assumptions.

[11] Edmans et al. (2015) argue that, in practice, there is little secrecy in the order flow and microstructure databases provide such information with a short lag. They conclude that it is reasonable to assume that managers have easy access to information about trading quantities.

$\mathbf{t = 1}$	$\mathbf{t = 2}$	$\mathbf{t = 3}$
1. manager observes y and chooses $m(y)$ privately;	1. firm reports z;	1. manager invests I;
2. mass n of informed traders acquires private signal $s_i = \theta$.	2. traders submit demands;	2. firm value v realizes.
	3. market maker sets price p.	

Figure 1: Timeline for the main model.

An equilibrium of the game is defined as follows:

Definition 1. *An equilibrium is a tuple (m, n, I, p), where*

1. *the choices m and I maximize the manager's expected utility given the signals y and $\{x, y\}$, respectively;*
2. *the market maker sets the equilibrium stock price p based on $\{x, z\}$ to break even in expectation;*
3. *informed traders make their information acquisition and trading decisions to maximize expected trading profits;*
4. *all agents have rational expectations and use Bayes' rule to update their beliefs, if possible. The conjectures $\widehat{m}(y)$ and $\widehat{n}$ are correct in equilibrium.*

3 Equilibrium analysis

Before we formally describe the firm's optimal investment decision and the financial market equilibrium, we derive the manager's marginal benefit of manipulation. We differentiate the manager's expected utility net of the manipulation cost, given private signal y, in equation (2) with respect to m:

$$\text{MB}(y) = \frac{\partial \mathbb{E}[\omega p + (1-\omega)v|y]}{\partial m} = \omega\left(\mathbb{E}[p|z \neq y] - \mathbb{E}[p|z = y]\right) \tag{4}$$

for $y \in \{\alpha, \beta\}$. The manager benefits from a manipulated signal through its impact on the short-term stock price p. The long-term firm value v is not *directly* affected because the manager's choice of m is privately observed. The expected firm value, therefore, only depends on the conjectured value for m. In equilibrium, the manager's manipulation choice affects v indirectly through its impact on the mass of informed traders, as shown below.

In an interior equilibrium, we have that the marginal benefit equals the marginal cost, i.e., $\text{MB}(y) = cm$. It follows from $\text{MB}(\alpha) = -\text{MB}(\beta)$ that the manager either chooses $m(\alpha) \geq 0$ and $m(\beta) = 0$ or $m(\alpha) = 0$ and $m(\beta) \geq 0$. That is, depending on her catering incentives, she only manipulates one type of signal. We will show later that only the second case arises in equilibrium, which follows from our previous assumption that $\Pr(\theta = \alpha) > \Pr(\theta = \beta)$. If instead $\theta = \beta$ were more likely than $\theta = \alpha$, then the manager would optimally try to manipulate $y = \alpha$ but not $y = \beta$.

We proceed with our analysis by backward induction. We first solve for the firm manager's optimal investment decision at $t = 3$ and the equilibrium stock price at $t = 2$. We formally show in Proposition 1 that informed traders demand one unit ($\delta_i = 1$) if the reported signal equals their private signal and that they sell one unit ($\delta_i = -1$) otherwise.[12] It follows that the total order flow is equal to:

$$x(\theta, z) = \begin{cases} +n + u & \text{if } \{\theta = \alpha, z = \alpha\} \text{ or if } \{\theta = \beta, z = \beta\} \\ -n + u & \text{otherwise.} \end{cases} \tag{5}$$

Total order flow is uninformative if $n = 0$ because liquidity demand u is orthogonal to the funda-

[12]Note that uninformed speculators do not trade because they expect to make zero trading profits. This follows from the market maker's pricing function in equation (3) and the Law of Iterated Expectations, which implies that $\mathbb{E}[v - p|z] = \mathbb{E}[v - \mathbb{E}[v|x, z]|z] = 0$.

mental θ. However, if $n > 0$ and a positive mass of traders has acquired a private signal, then the market maker might be able to infer the informed traders' private information from x. More specifically, x reveals that the informed traders bought the asset if $x > 1-n$, and it reveals that they sold if $x < n-1$. In the intermediate range $x \in (n-1, 1-n)$, total order flow is uninformative, and the market maker uses only the reported signal to set the price. Total order flow, therefore, indicates whether informed traders agree or disagree with the reported signal z. As formally shown below, informed traders anticipate a relatively high payoff if their private signal matches the reported signal because they deem it more likely that the manager will take the correct action.

We follow the existing literature (Edmans et al., 2015; Chen et al., 2021) and assume that the firm manager can observe the total order flow x and potentially learn about the informed traders' information at $t = 2$. The manager is aware that the informed traders have additional information about the fundamental and thus relies on this learned information when making the investment decision at $t = 3$. She learns from particularly high or low order flows about the informed traders' information and invests accordingly. In the intermediate range of order flow, where no information is revealed, the manager relies on her private signal y. Note that the manager's investment decision is always firm value maximizing at the time when it is made. At this point, the interim price has already been formed, and the manager's short-termism is no longer hindering her action. However, the information available to her at the time when she makes the investment decision depends on her earlier disclosure decision.

The following proposition formally describes the firm's optimal investment decision and the financial market equilibrium.

Proposition 1 (Investment and Stock Price)**.** *Consider a conjectured mass $\widehat{n} \in [0, 1]$ of informed traders and conjectured manipulation choices $\{\widehat{m}(\alpha) = 0, \widehat{m}(\beta) \geq 0\}$ or $\{\widehat{m}(\alpha) \geq 0, \widehat{m}(\beta) = 0\}$. Informed traders buy ($\delta_i = 1$) if their signal is equal to the disclosed signal and sell ($\delta_i = -1$)*

otherwise. The firm manager's optimal investment decision is given by:

$$I = \begin{cases} a & \text{if } z = \alpha \text{ and } x > 1 - \widehat{n} \text{ or } z = \beta \text{ and } x < \widehat{n} - 1 \text{ or } y = \alpha \text{ and } x \in (\widehat{n} - 1, 1 - \widehat{n}) \\ b & \text{otherwise.} \end{cases} \tag{6}$$

The equilibrium stock price is given by:

$$p(x, z) = \begin{cases} \overline{v} & \text{if } x > 1 - \widehat{n} \text{ or } x < \widehat{n} - 1 \\ p_{\emptyset}(z) \equiv \mathbb{E}[v|z] & \text{otherwise.} \end{cases} \tag{7}$$

Proof. See Appendix A.1. ■

The manager's equilibrium investment decision is intuitive. Since she only receives a noisy private signal about θ, she can learn additional information from the financial market. Particularly high ($x > 1 - \widehat{n}$) or low ($x < \widehat{n} - 1$) realizations of total order flow reveal the trading behavior of informed investors. More specifically, $x > 1 - \widehat{n}$ indicates that informed investors have bought the stock because they agree with the disclosed signal. As a result, the manager learns that z coincides with θ and can therefore take the correct action $I \in \{a, b\}$. On the contrary, order flows in the range $x < \widehat{n} - 1$ indicate the informed investors disagree with the disclosed signal. The manager can again infer the true value of θ and invest optimally. When the order flow is not informative and does not reveal any information from the informed traders, i.e., $\widehat{n} - 1 < x < 1 - \widehat{n}$, she has to resort to her own signal y for the investment decision.

The market maker sets the price for the firm based on the manager's report z and the total order flow x. When x confirms z, the market maker knows that the manager has the right information and will make a subsequent investment decision consistent with the fundamental. The market price is therefore set as $\overline{v}$. When x shows information opposite to z, the market maker will still set the price as $\overline{v}$, as the manager will learn from the price and make the correct investment down the road. When x is uninformative, the market maker understands that the manager's information is imperfect and the subsequent investment may be incorrect.

We next analyze the manager's manipulation and the informed investors' information acquisition decision. The firm manager conjectures that a mass $\widehat{n}$ of informed traders acquires the private signal s_i. She then chooses m given her private signal $y \in \{L, H\}$ to maximize her expected utility, specified in equation (2).

Lemma 1 (Manager's Best-Response)**.** *Given a private signal $y \in \{\alpha, \beta\}$ and a conjecture $\widehat{n} \in [0, 1]$, the firm manager's optimal manipulation decisions are as follows:*

$$m(\alpha) = 0 \quad \textit{and} \quad m(\beta) \in [0, 1). \tag{8}$$

Moreover, m decreases in the conjectured mass of informed traders $\widehat{n}$.

Proof. See Appendix A.2. ■

The manager's reporting strategy critically depends on the cost of manipulation and the mass of informed traders. We find that the manager never manipulates if $y = \alpha$, but that she might manipulate if $y = \beta$. This result follows from our assumption that $\theta = \alpha$ is more likely than $\theta = \beta$: $\Pr(\theta = \alpha) = 1 - \Pr(\theta = \beta) > 1/2$. Therefore, a public signal $z = \beta$ "contradicts" the prior belief for θ and results in a lower stock price: $p_{\emptyset}(\beta) < p_{\emptyset}(\alpha)$. This mechanism is similar to Gentzkow and Shapiro (2006), who show that Bayes' rule implies that a consumer who is uncertain about the quality of an information source will infer that the source is of higher quality when its reports conform with her prior. For the same reason, the manager might be incentivized to manipulate if $y = \beta$.

Given the mass of informed traders in the market, the manager trades off the benefit of manipulation with the associated cost. To obtain an interior solution for m, we impose the condition that the manager's manipulation cost is sufficiently high. In this case, the manager manipulates the signal with a positive probability when the benefits of doing so outweigh the costs. The equilibrium mass of informed investors $\widehat{n}$ decreases the manager's benefit of manipulation. An increase in $\widehat{n}$ makes total order flow more informative and reduces the impact of the disclosed signal on the equilibrium stock price. In the limit $\widehat{n} \to 1$, the manager has no incentive to manipulate because $p = \overline{v}$.

We continue with the investors' acquisition of information. Investor i acquires a private signal if his expected trading profits $\Pi_{0i} \equiv \mathbb{E}[\delta_i(v-p)]$ exceed the information acquisition cost τ.

Lemma 2 (Traders' Best-Response). *Given a conjecture* $\max\{\widehat{m}(\alpha), \widehat{m}(\beta)\} = \widehat{m} \in [0,1]$ *and* $\min\{\widehat{m}(\alpha), \widehat{m}(\beta)\} = 0$*, the equilibrium mass of informed traders is given as follows:*

1. *If* $\Pi_{0i}(n = 0, \widehat{m}) \leq \tau$*, then* $n = 0$*.*

2. *If* $\Pi_{0i}(n^{int}, \widehat{m}) = \tau$*, then we obtain an interior solution* $n^{int} \in (0,1)$ *.*

Π_{0i} *decreases in* $\widehat{m}$ *and* n*.*

Proof. See Appendix A.3. ■

Contrary to conventional wisdom, Lemma 2 shows that the incentives for private information acquisition are greatest when accounting information is truthful, i.e., when $\widehat{m} = 0$. To understand the intuition behind this result, it is helpful to consider the limiting case $\widehat{m} \to 1$ in which the manager never reports truthfully. In this extreme case, informed traders lose their informational advantage vis-a-vis the market maker and make zero trading profits. Both types know that the manager takes the correct action with probability λ. As a result, informed traders cannot profit from their private information about θ and are not incentivized to acquire costly information ex-ante. On the other hand, if the investors conjecture that the manager's report is informative, i.e., if $\widehat{m} < 1$, then informed traders can use their private signal about θ to predict the terminal cash flow. In this case, a positive mass of traders might be willing to acquire information if the information acquisition cost τ is sufficiently low.

Next, we combine the results in Lemma 1 and Lemma 2 to characterize the equilibrium manipulation and information acquisition decisions at the initial stage.

Proposition 2 (Equilibrium Manipulation and Information Acquisition)**.** *Suppose that $\tau < \overline{\tau}$. There exists a unique equilibrium triple $m^*(\beta) \in (0, 1)$, $m^*(\alpha) = 0$, and $n^* \in (0, 1)$. The threshold $\overline{\tau} > 0$ is defined in Appendix A.4.*

Proof. See Appendix A.4. ■

Proposition 2 establishes the conditions for the equilibrium results of the manager's manipulation strategy and informed traders' information acquisition decision. The two assumptions regarding the cost coefficients for the manager's reporting strategy and the traders' information acquisition, $c > \overline{c}$ and $\tau < \overline{\tau}$, ensure a unique equilibrium. As shown before, the manager never manipulates $y = \alpha$. If $y = \beta$, she caters to the prevailing market belief and successfully manipulates with a strictly positive probability. Moreover, we find that the equilibrium mass of informed traders is strictly between zero and one. The equilibrium triple $(m^*(\alpha), m^*(\beta), n^*)$ depends on the model parameters $(c, \tau, \omega, \lambda, q)$. The following corollary presents the main model implications.

Corollary 1 (Model Implications)**.** *In the equilibrium of Proposition 2, the following results hold:*

1. *The manager's manipulation intensity $m^*(\beta)$ increases in τ, λ, q, and ω; it decreases in c.*

2. *The equilibrium mass of informed traders n^* increases in c; it decreases in τ, λ, q, and ω.*

3. *The expected firm value $\mathbb{E}[v]$ increases in c and λ; it decreases in τ, q, and ω.*

Proof. See Appendix A.5. ■

Parts 1 and 2 in Corollary 1 show how the manager's manipulation intensity $m^*(\beta)$ and the mass of informed traders n^* depend on model parameters. The traders' information acquisition cost τ only has a *direct* (negative) effect on the mass of informed traders but not on the manager's manipulation choice. However, because the manager's choice depends negatively on n, it follows that the equilibrium manipulation intensity decreases in τ. For a similar reason, we find that the manipulation cost c positively affects n^*. A higher manipulation cost leads to a reduction in $m^*(\beta)$, which in turn crowds in more informed traders. An increase in ω, the degree of managerial short-termism, increases the manager's incentive to manipulate. Thus it increases $m^*(\beta)$ directly, and it decreases n^* indirectly. The effects of λ, which measures the manager's signal precision, and q, which measures the ex-ante probability of $\theta = \alpha$, are more nuanced. An increase in both parameters increases the manager's incentive to manipulate but lowers the traders' incentives to acquire information.

The expected firm value in equilibrium equals:

$$\mathbb{E}[v] = [n^* + (1 - n^*)\lambda]\,\overline{v}. \tag{9}$$

It follows that the expected firm value increases in the mass of informed traders. Corollary 1 shows that the expected firm value decreases in τ and ω because these two parameters are negatively related to n^*. For the same reason, $\mathbb{E}[v]$ increases in the manipulation cost c. An increase in signal precision λ has a more nuanced effect on real efficiency. On the one hand, there is a direct positive effect because a better-informed manager can more efficiently select between the different projects. On the other hand, there is a negative indirect effect because an increase in λ decreases price efficiency. We formally show in Appendix A.5 that the direct effect always dominates.

Corollary 1 also provides implications about price efficiency and real efficiency, proxied by the mass of informed traders and the final firm value, respectively.[13] For instance, an increase in c leads to an increase in both efficiency measures. An increase in λ, however, increases real efficiency and decreases price efficiency. While a better information environment improves the manager's

[13] The existing literature, such as Goldstein et al. (2013) and Goldstein and Yang (2017), defines real efficiency as the expected firm value.

private signal accuracy and her subsequent investment decision, it reduces the informed traders' informational advantage and discourages them from entering the market.

In sum, these results demonstrate that manipulation has a real cost in our setting. Contrary to the typical result in the feedback literature that shows more/better public disclosure crowds out private information acquisition, our analysis shows that truthful reporting is beneficial and *encourages* the traders to become informed. As discussed, this result comes from the functional form of the firm value, which depends on the matching between the fundamental and the subsequent investment. When the manager manipulates too much, the informed traders' information can no longer help them predict the final firm value, thus reducing their incentive to participate in the trade. As a result, the manager also loses her chance to learn about the true fundamental through market feedback.

4 Internal information production

In this section, we relax the assumption that the manager's signal precision is exogenously given. In reality, firms could utilize information provided by the market through feedback but could also invest in their own information system to produce better signals about the fundamental. The following analysis explores the manager's choice between these two channels to obtain information.[14] We extend the timeline by adding an initial date $t = 0$ and allow the firm to decide whether to produce information internally through a better information system or externally through market feedback.

Specifically, the firm (or its board of directors) chooses between $d = 1$ ("produce information internally") and $d = 0$ ("do not produce information internally") to maximize the expected long-

[14]Prior literature has examined multiple information sources in different settings. For example, in the contracting literature, prior studies have investigated the role of "sufficient statistic" in optimal contracting (Holmström, 1979), the use of multiple performance measurements (e.g., Feltham and Xie, 1994), and the complementarity between performance measures and monitoring Chaigneau and Sahuguet (2022). In the setting of investor decision-making, prior studies have examined additional information sources such as analyst reports (Einhorn, 2018) and media coverage (Goldman et al., 2022). However, to our knowledge, there is no study that examines multiple information sources for the decision-making by the firm itself.

term value at the beginning of the game. If $d = 0$, then the game proceeds as in the baseline model, and the manager observes a private signal with precision $\lambda \in \left(\frac{1}{2}, 1\right)$. If $d = 1$, the firm invests to produce information internally, and the manager observes a more precise signal at an exogenous cost $\kappa > 0$, which reduces the firm's terminal value. For simplicity, we assume this internal information production results in a perfect signal, but the insights derived in this section remain if this assumption is relaxed. With the perfect signal, the firm manager observes θ without noise and does not require additional feedback from the financial market. The improvement of internal information production is publicly observed at the beginning of the game.

If the firm chooses $d = 1$, then the manager makes the correct investment decision, and the firm's terminal value is always equal to $v_{d=1} = \overline{v} - \kappa$. If the firm does not acquire the additional signal, then the value is equal to $v_{d=0} = [\lambda + n_{d=0}(1-\lambda)]\,\overline{v}$, as shown in equation (9) above. It is optimal to acquire the additional signal if and only if $v_{d=1} > v_{d=0}$, which is equivalent to:

$$\kappa < (1-\lambda)(1-n_{d=0})\overline{v} \equiv \widehat{\kappa}. \tag{10}$$

Intuitively, the firm is more likely to choose to produce information internally if the baseline signal is less precise (i.e., if λ is low) and if market feedback is weak (i.e., if $n_{d=0}$ is low). The following proposition formalizes this result.

Proposition 3 (Information acquisition)**.** *Suppose that $\tau < \overline{\tau}$. The firm is willing to invest to obtain a perfect signal internally at cost κ if and only if $\kappa < \widehat{\kappa}$ where $\widehat{\kappa}$ is defined in equation (10). In this case, the terminal firm value equals $\overline{v} - \kappa$, the mass of informed traders equals zero, and the manager does not manipulate the disclosed signal. The threshold $\widehat{\kappa}$ decreases in c and λ and increases in τ, q, and ω.*

Proof. See Appendix A.6. ■

Proposition 3 states that a perfectly informed manager is not incentivized to manipulate the disclosed signal. In this case, the catering incentive vanishes because all traders rationally anticipate the manager to invest optimally. It further follows that the firm discloses an accurate signal, which in turn fully crowds out informed traders. This result is consistent with prior literature showing that better public information crowds out private information acquisition by investors.

Further, the likelihood of switching from relying only on market feedback to investing in own information production decreases in the manipulation cost c and the information quality of the manager's signal λ. Intuitively, a high manipulation cost improves informed trading in the case of market feedback and makes internal information production less attractive for the manager. A high λ implies high quality of the firm's existing information environment, also making investments in an internally produced signal less appealing. On the contrary, the switch decision becomes more likely when the traders' information acquisition cost τ is high, which results in less informed trading and benefits for the firm

Corollary 2 (Model Implications with Information Acquisition)**.** *In the equilibrium of Proposition 3, the following results hold:*

1. *The manager's manipulation intensity $m^*(\beta)$ increases in λ; it is non-monotone in τ, q, ω, and c.*

2. *The equilibrium mass of informed traders n^* increases in c; it decreases in τ, q, and ω; it is non-monotone in λ.*

3. *The expected firm value (net of κ) increases in c and λ; it decreases in τ, q, and ω.*

Proof. See Appendix A.7. ■

Corollary 2 describes the model implications in this extension with possible additional internal information production by the firm. The effects of the main parameters on the mass of informed traders and expected firm value are very similar to those in the baseline model. The only discrepancy

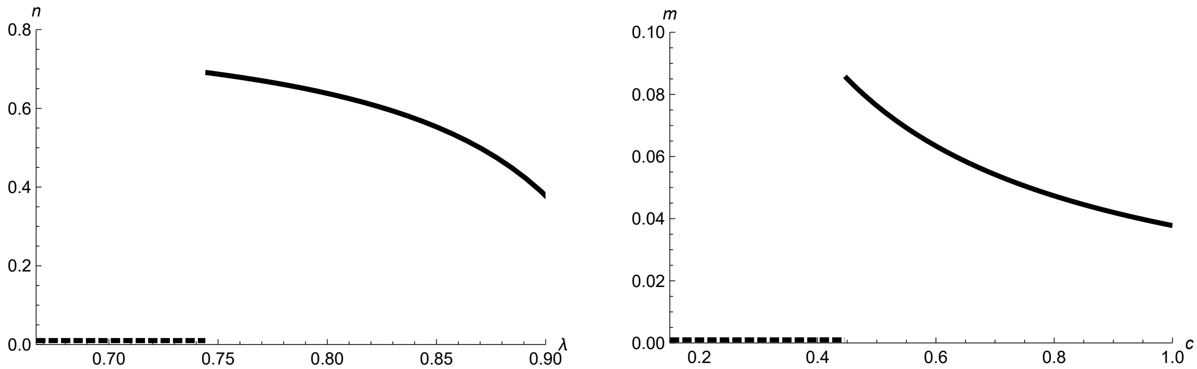

Figure 2: The left panel plots the equilibrium mass of informed traders n as a function of the signal precision λ. The right panel plots the equilibrium manipulation intensity m as a function of the manipulation cost c. Parameters: $q = \frac{2}{3}$, $\omega = \frac{1}{2}$, $\kappa = 0.079$, and $\tau = \frac{1}{10}$. Left panel: $c = \frac{1}{2}$. Right panel: $\lambda = \frac{3}{4}$.

arises concerning the effect of λ, the precision of the manager's signal if $d = 0$, on informed trading. In contrast to the baseline model, a higher precision might increase informed trading in equilibrium through its impact on the threshold $\widehat{\kappa}$, which determines the firm's choice of additional information production. Intuitively, a higher λ implies a better information system that is already in place in the firm, making it less attractive for the firm to invest further in information production. We have shown above that producing the additional signal lowers the equilibrium mass of informed traders. Moreover, the threshold $\widehat{\kappa}$ decreases in λ so that an increase in λ can incentivize information production (i.e., $d = 1$). As a result, an increase in λ can lead to an increase in n^* around the threshold $\widehat{\kappa}$.

We illustrate this discontinuous effect of λ on n in the left panel of Figure 2. When λ, the information quality of the manager's original signal, is sufficiently low, the firm would always choose to invest in internal information production, which completely crowds out informed trading. When λ is high enough so that the firm does not bother with producing information internally, the firm relies solely on market feedback. At the threshold point of the decision switch, the amount of informed trading n jumps from zero to the highest point. As λ increases beyond the threshold, n starts to decrease again due to traders' shrinking profits, just as in the baseline model.

The implications concerning the manager's manipulation choice are fundamentally different.

More specifically, all model parameters (except for λ) can either increase or decrease the manipulation intensity once the manager's signal precision is endogenized. Consider, for instance, an increase in the manipulation cost c, which has two counteracting effects on m^*. First, there is a direct negative effect as in the baseline model, showing manipulation decreases in the manipulation cost. Second, there is also a novel indirect effect because c changes the firm's internal information production choice, i.e., the threshold $\widehat{\kappa}$. Proposition 3 shows that an increase in c decreases the threshold $\widehat{\kappa}$ and makes the internal information production less likely. This indirect effect tends to increase m^* because the manager is only willing to manipulate if the additional signal is *not* acquired. Combining these two forces implies that a higher manipulation cost can lead to more manipulation in equilibrium if it disincentives the firm's internal information production (see Figure 2, right panel).

It is important to note that the crowding-in effect of more precise disclosures plays an important role in this result. We have shown in equation (10) that the threshold $\widehat{\kappa}$ only depends on the manipulation cost through the mass of informed traders $n_{d=0}$. Moreover, our analysis in Section 3 highlights that c only affects the mass of informed traders n through its impact on the manager's manipulation efforts, i.e., $\frac{dn}{dc} = \frac{dn}{dm}\frac{dm}{dc}$. Since $\frac{dm}{dc} < 0$ and $\frac{dn}{dm} < 0$ (i.e., "crowding-in"), we find that n increases in c so that $\widehat{\kappa}$ decreases in c. Thus, the crowding-in effect is necessary for the non-monotone dependence of m^* on the model parameters.

Intuitively, when the cost of reporting manipulation is high for the manager, the resulting reporting quality is higher, which leads to more informed trading in our setting. This effect increases the benefits for the firm to rely on market feedback and reduces its likelihood of producing information internally. In the absence of internal information production, the manager must manipulate to cater to the market belief. Our results thus warn against a possible side effect of high penalty for behaviors such as earnings management, which may discourage firms from producing information internally and ultimately leads to more earnings management.

5 Conclusion

We consider a setting where a firm manager may wish to cater to the prevailing market belief about a fundamental state of nature by manipulating the firm's disclosure. Either possible realization of the fundamental could lead to success as long as it is matched by the subsequent investment decision. The manager only has an imperfect signal about the fundamental, but could potentially learn additional information from the informed traders by observing the market order flow. If the firm chooses to invest internally to produce a perfect signal instead of relying on market feedback, the manager always reports truthfully, and the traders thus have no incentive to become informed. However, if the firm chooses to learn through market feedback, less biased reporting can crowd in informed trading, and informed trading, in turn, also encourages more truthful reporting.

Our paper thus complements prior literature that suggests public disclosure crowds out private information production in the financial market (e.g., Morris and Shin, 2002; Goldstein and Yang, 2019), by showing that accounting reports without bias could lead to improved price and real efficiency. Our results thus offer a defense of unbiased accounting information in the presence of market feedback, especially in project selections where the success depends on the matching of the fundamental and investment. Therefore, increasing the manager's private cost of manipulation through tighter regulations or decreasing the manager's short-termism through incentive contracts could mitigate incentives to manipulate.

Our results are broadly consistent with empirical findings on market feedback. Chen et al. (2007) use price nonsynchronicity and probability of informed trading (PIN) to measure the level of private information in stock prices and find that they are significantly correlated with the sensitivity of investment to price. Their results provide evidence that managers learn information from stock prices to improve their investment decisions. A key property of the information being disclosed in our model is that it is a forward-looking estimate of the state of nature. Jayaraman and Wu

(2020) find that managers voluntarily disclose forecast capital expenditure information to solicit information from the stock market. Based on the stock market's reaction to their disclosures, managers make upward or downward adjustments to the actual capital expenditure decisions. The adjustments are especially strong when the forecast information encourages market information acquisition. Further, the adjustments are also correlated with better future firm performance. Similarly, Luo (2005) and Kau et al. (2008) find evidence that market feedback plays an important role to guide firms' mergers and acquisition activities.

Our paper, therefore, also contributes to the empirical research on market feedback by providing a theoretical foundation on the relation between disclosure of forward-looking information and investment efficiency through the mechanism of learning from the market price. We can also further develop new predictions on the quality of disclosure, especially in the setting of project selections. We hypothesize that accounting disclosures of high quality could further enhance informed trading and market feedback, which results in improved price informativeness and future investment efficiency.

References

Arya, A., B. Mittendorf, and R. N. Ramanan (2017). Synergy between accounting disclosures and forward-looking information in stock prices. *The Accounting Review 92*(2), 1–17.

Banerjee, S., J. Davis, and N. Gondhi (2018). When transparency improves, must prices reflect fundamentals better? *Review of Financial Studies 31*(6), 2377–2414.

Benhabib, J., X. Liu, and P. Wang (2019). Financial markets, the real economy, and self-fulfilling uncertainties. *Journal of Finance 74*(3), 1503–1557.

Bond, P. and I. Goldstein (2015). Government intervention and information aggregation by prices. *Journal of Finance 70*(6), 2777–2812.

Chaigneau, P. and N. Sahuguet (2022). The complementarity between signal informativeness and monitoring. *Journal of Accounting Research (forthcoming)*.

Chen, Q., I. Goldstein, and W. Jiang (2007). Price informativeness and investment sensitivity to stock price. *Review of Financial Studies 20*(3), 619–650.

Chen, Q., Z. Huang, X. Jiang, G. Zhang, and Y. Zhang (2021). Asymmetric reporting timeliness and informational feedback. *Management Science 67*(8), 5194–5208.

Cheynel, E. and C. B. Levine (2020). Public disclosures and information asymmetry: A theory of the mosaic. *The Accounting Review 95*(1), 79–99.

Davis, A. K. and I. Tama-Sweet (2012). Managers' use of language across alternative disclosure outlets: earnings press releases versus MD&A. *Contemporary Accounting Research 29*(3), 804–837.

Dugast, J. and T. Foucault (2018). Data abundance and asset price informativeness. *Journal of Financial Economics 130*(2), 367–391.

Dye, R. A. (1985). Disclosure of nonproprietary information. *Journal of Accounting Research 23*(1), 123–145.

Dye, R. A. and S. Sridhar (2002). Resource allocation effects of price reactions to disclosures. *Contemporary Accounting Research 19*(3), 385–410.

Dye, R. A. and S. S. Sridhar (2004). Reliability-relevance trade-offs and the efficiency of aggregation. *Journal of Accounting Research 42*(1), 51–88.

Edmans, A., I. Goldstein, and W. Jiang (2015). Feedback effects, asymmetric trading, and the limits to arbitrage. *American Economic Review 105*(12), 3766–97.

Edmans, A., M. S. Heinle, and C. Huang (2016). The real costs of financial efficiency when some information is soft. *Review of Finance 20*(6), 2151–2182.

Edmans, A., S. Jayaraman, and J. Schneemeier (2017). The source of information in prices and investment-price sensitivity. *Journal of Financial Economics 126*(1), 74–96.

Einhorn, E. (2018). Competing information sources. *The Accounting Review 93*(4), 151–176.

Feldman, R., S. Govindaraj, J. Livnat, and B. Segal (2010). Management's tone change, post earnings announcement drift and accruals. *Review of Accounting Studies 15*(4), 915–953.

Feltham, G. A. and J. Xie (1994). Performance measure congruity and diversity in multi-task principal/agent relations. *The Accounting Review*, 429–453.

Fischer, P. E. and R. E. Verrecchia (2000). Reporting bias. *The Accounting Review 75*(2), 229–245.

Foucault, T. and L. Fresard (2014). Learning from peers' stock prices and corporate investment. *Journal of Financial Economics 111*(3), 554–577.

Gao, P. and P. J. Liang (2013). Informational feedback, adverse selection, and optimal disclosure policy. *Journal of Accounting Research 51*(5), 1133–1158.

Gao, P. and G. Zhang (2019). Accounting manipulation, peer pressure, and internal control. *The Accounting Review 94*(1), 127–151.

Gentzkow, M. and J. M. Shapiro (2006). Media bias and reputation. *Journal of Political Economy 114*(2), 280–316.

Glosten, L. R. and P. R. Milgrom (1985). Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. *Journal of Financial Economics 14*(1), 71–100.

Goldman, E., J. Martel, and J. Schneemeier (2022). A theory of financial media. *Journal of Financial Economics 145*(1), 239–258.

Goldstein, I., E. Ozdenoren, and K. Yuan (2013). Trading frenzies and their impact on real investment. *Journal of Financial Economics 109*(2), 566–582.

Goldstein, I. and L. Yang (2017). Information disclosure in financial markets. *Annual Review of Financial Economics 9*, 101–125.

Goldstein, I. and L. Yang (2019). Good disclosure, bad disclosure. *Journal of Financial Economics 131*(1), 118–138.

Guttman, I. and X. Meng (2021). The effect of voluntary disclosure on investment inefficiency. *The Accounting Review 96*(1), 199–223.

Han, B., Y. Tang, and L. Yang (2016). Public information and uninformed trading: Implications for market liquidity and price efficiency. *Journal of Economic Theory 163*, 604–643.

Holmström, B. (1979). Moral hazard and observability. *The Bell Journal of Economics*, 74–91.

Huang, S., J. Schneemeier, A. Subrahmanyam, and L. Yang (2020). Securities markets where some investors receive information about cash flow betas. *Available at SSRN 3691730*.

Jayaraman, S. and J. Wu (2020). Should I stay or should I grow? Using voluntary disclosure to elicit market feedback. *Review of Financial Studies 33*(8), 3854–3888.

Jung, W.-O. and Y. K. Kwon (1988). Disclosure when the market is unsure of information endowment of managers. *Journal of Accounting Research*, 146–153.

Kanodia, C. (1980). Effects of shareholder information on corporate decisions and capital market equilibrium. *Econometrica*, 923–953.

Kanodia, C. and A. Mukherji (1996). Real effects of separating investment and operating cash flows. *Review of Accounting Studies 1*(1), 51–71.

Kanodia, C., H. Sapra, and R. Venugopalan (2004). Should intangibles be measured: What are the economic trade-offs? *Journal of Accounting Research 42*(1), 89–120.

Kau, J. B., J. S. Linck, and P. H. Rubin (2008). Do managers listen to the market? *Journal of Corporate Finance 14*(4), 347–362.

Kyle, A. S. (1985). Continuous auctions and insider trading. *Econometrica*, 1315–1335.

Langberg, N. and K. Sivaramakrishnan (2010). Voluntary disclosures and analyst feedback. *Journal of Accounting Research 48*(3), 603–646.

Li, F. (2008). Annual report readability, current earnings, and earnings persistence. *Journal of Accounting and Economics 45*(2-3), 221–247.

Li, F. (2010). The information content of forward-looking statements in corporate filings—a naïve bayesian machine learning approach. *Journal of Accounting Research 48*(5), 1049–1102.

Luo, Y. (2005). Do insiders learn from outsiders? Evidence from mergers and acquisitions. *Journal of Finance 60*(4), 1951–1982.

Morris, S. and H. S. Shin (2002). Social value of public information. *American Economic Review 92*(5), 1521–1534.

Narayanan, M. (1985). Managerial incentives for short-term results. *Journal of Finance 40*(5), 1469–1484.

Scharfstein, D. S. and J. C. Stein (1990). Herd behavior and investment. *American Economic Review 80*(3), 465–479.

Schneemeier, J. (2022). Voluntary precision disclosure and endogenous market feedback. *Management Science (forthcoming)*.

Stein, J. C. (1989). Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *Quarterly Journal of Economics 104*(4), 655–669.

A Proofs

A.1 Proof of Proposition 1

We proceed as follows. First, we take the informed traders' conjectured trading policy as given and solve for the manager's optimal investment decision. Second, we solve for the market maker's pricing function. Third, we verify that the conjectured trading policy is optimal.

Investment decision. The manager chooses $I \in \{a, b\}$ to maximize the expected firm value $\mathbb{E}[v|x, y, z]$. She optimally chooses $I = a$ if $\Pr(\theta = \alpha|x, y, z) > \frac{1}{2}$ and $I = b$ if $\Pr(\theta = \alpha|x, y, z) < \frac{1}{2}$. If $\Pr(\theta = \alpha|x, y, z) = \frac{1}{2}$, she is indifferent. Without loss of generality, we assume that $I = a$ in this case. Next, we describe the manager's inference from the total order flow.

1. If $z = \alpha$ and $x > 1 - n$, the manager infers that $\theta = \alpha$. It follows that $I = a$. In this case, informed traders confirm the manager's information.

2. If $z = \alpha$ and $x < n - 1$, the manager infers that $\theta = \beta$. It follows that $I = b$. In this case, informed traders contradict the manager's information.

3. If $z = \beta$ and $x > 1 - n$, the manager infers that $\theta = \beta$. It follows that $I = b$. In this case, informed traders confirm the manager's information.

4. If $z = \beta$ and $x < n - 1$, the manager infers that $\theta = \alpha$. It follows that $I = a$. In this case, informed traders contradict the manager's information.

5. If $x \in (n - 1, 1 - n)$ order flow is uninformative and the manager relies on her private signal $y \in \{\alpha, \beta\}$. It follows from Bayes' rule that

$$\Pr(\theta = \alpha|y) = \begin{cases} \frac{\lambda q}{\lambda q + (1-\lambda)(1-q)} & \text{if } y = \alpha \\ \frac{(1-\lambda)q}{(1-\lambda)q + \lambda(1-q)} & \text{if } y = \beta \end{cases} \tag{A.1}$$

having used the facts that $\Pr(\theta = \alpha) = q$, $\Pr(y = \alpha|\theta = \alpha) = \lambda$, and $\Pr(y = \beta|\theta = \beta) = \lambda$. By assumption, $q \in (1/2, 1)$ and $\lambda \in (q, 1)$. Now $\Pr(\theta = \alpha|y = \alpha) > \Pr(\theta = \beta|y = \alpha)$ if and only if $q > 1 - \lambda$ (which is true by assumption) and $\Pr(\theta = \beta|y = \beta) > \Pr(\theta = \alpha|y = \beta)$ if and only if $\lambda > q$. Therefore, if $q \in (1/2, \lambda)$, the manager optimally chooses $I = a$ if $y = \alpha$ and $I = b$ if $y = \beta$, and if $q \in [\lambda, 1)$, the manager always chooses $I = a$ (since in this case, $\Pr(\theta = \alpha|y) \geq \Pr(\theta = \beta|y)$ for any y).

Pricing function. The market maker observes total order flow x and the firm's report $z \in \{\alpha, \beta\}$. The equilibrium price equals $p(x, z) = \mathbb{E}[v|x, z]$. If $x > 1 - n$, the market maker knows that the firm manager infers that informed traders have bought the asset, implying that the fundamental θ is equal to the reported signal z. As a result, the firm manager takes the correct investment decision and $p = \overline{v}$. Similarly, $p = \overline{v}$ if $x < n - 1$ because the manager learns that the fundamental θ is not equal to the reported signal z and revises her beliefs before investment. In the intermediate range, $x \in (n - 1, 1 - n)$, the market maker only uses the reported signal $z \in \{\alpha, \beta\}$ to set the equilibrium price:

$$p_{\emptyset}(z) = [\Pr(\theta = \alpha, y = \alpha|z) + \Pr(\theta = \beta, y = \beta|z)]\,\overline{v} \tag{A.2}$$

with

$$\Pr(\theta = \alpha, y = \alpha|z = \alpha) = \frac{q\lambda\,(1 - m(\alpha))}{(q\lambda + (1-q)(1-\lambda))\,(1 - m(\alpha)) + ((1-q)\lambda + q(1-\lambda))m(\beta)} \tag{A.3}$$

$$\Pr(\theta = \beta, y = \beta|z = \alpha) = \frac{(1-q)\lambda m(\beta)}{(q\lambda + (1-q)(1-\lambda))\,(1 - m(\alpha)) + ((1-q)\lambda + q(1-\lambda))m(\beta)} \tag{A.4}$$

$$\Pr(\theta = \alpha, y = \alpha|z = \beta) = \frac{q\lambda m(\alpha)}{(q\lambda + (1-q)(1-\lambda))m(\alpha) + ((1-q)\lambda + q(1-\lambda))(1 - m(\beta))} \tag{A.5}$$

$$\Pr(\theta = \beta, y = \beta|z = \beta) = \frac{(1-q)\lambda(1 - m(\beta))}{(q\lambda + (1-q)(1-\lambda))m(\alpha) + ((1-q)\lambda + q(1-\lambda))(1 - m(\beta))}. \tag{A.6}$$

Hence,

$$p_\emptyset(\alpha) = \frac{(q\lambda(1-m(\alpha)) + (1-q)\lambda m(\beta))\overline{v}}{(q\lambda + (1-q)(1-\lambda))(1-m(\alpha)) + ((1-q)\lambda + q(1-\lambda))m(\beta)} \tag{A.7}$$

$$p_\emptyset(\beta) = \frac{(q\lambda m(\alpha) + (1-q)\lambda(1-m(\beta)))\overline{v}}{(q\lambda + (1-q)(1-\lambda))m(\alpha) + ((1-q)\lambda + q(1-\lambda))(1-m(\beta))}. \tag{A.8}$$

Trading profits. In this step, we verify the informed traders' optimal trading strategy. We denote an informed investor's realized trading profit, given the private signal $s_i = \theta$ and the public signal z, by $\Pi(s_i, z)$. We also note that total order flow becomes perfectly revealing with probability n. In this case, the market maker infers the informed investors' private signal so that trading profits are equal to zero.

1. If $\theta = \alpha$ and $z = \alpha$, informed investors buy. It follows that their trading profit is equal to

$$\Pi(\alpha, \alpha) = (1-n)\left(\Pr(y = \alpha | \theta = \alpha, z = \alpha)\overline{v} - p_\emptyset(\alpha)\right), \tag{A.9}$$

   where $1-n$ is the probability that total order flow is not perfectly revealing, $\Pr(y = \alpha | \theta = \alpha, z = \alpha)\overline{v}$ is the expected firm value given that $\theta = \alpha$ and $z = \alpha$, and $p_\emptyset(\alpha)$ is the price set by the market maker given that total order flow is not perfectly revealing and $z = \alpha$.

2. If $\theta = \beta$ and $z = \alpha$, informed investors sell, and hence

$$\Pi(\beta, \alpha) = (1-n)\left(p_\emptyset(\alpha) - \Pr(y = \beta | \theta = \beta, z = \alpha)\overline{v}\right). \tag{A.10}$$

3. If $\theta = \alpha$ and $z = \beta$, informed investors sell, and hence

$$\Pi(\alpha, \beta) = (1-n)\left(p_\emptyset(\beta) - \Pr(y = \alpha | \theta = \alpha, z = \beta)\overline{v}\right). \tag{A.11}$$

4. If $\theta = \beta$ and $z = \beta$, informed investors buy, and hence

$$\Pi(\beta, \beta) = (1 - n) \left(\Pr(y = \beta | \theta = \beta, z = \beta) \overline{v} - p_{\emptyset}(\beta) \right). \tag{A.12}$$

We have shown in the main text that either $m(\alpha) = 0$ or $m(\beta) = 0$. First, suppose that $m(\alpha) = 0$. Then, equations (A.7) and (A.8) yield

$$p_{\emptyset}(\alpha) = \frac{(q\lambda + (1-q)\lambda m(\beta))\overline{v}}{q\lambda + (1-q)(1-\lambda) + ((1-q)\lambda + q(1-\lambda))m(\beta)} \quad \text{and} \tag{A.13}$$

$$p_{\emptyset}(\beta) = \frac{(1-q)\lambda\overline{v}}{(1-q)\lambda + q(1-\lambda)}. \tag{A.14}$$

Moreover, given that $m(\alpha) = 0$, it follows that $\Pr(y = \beta | \theta = \beta, z = \beta) = 1$, $\Pr(y = \alpha | \theta = \beta, z = \beta) = 0$, $\Pr(y = \beta | \theta = \alpha, z = \beta) = 1$, and $\Pr(y = \alpha | \theta = \alpha, z = \beta) = 0$. Furthermore, we have that:

$$\Pr(y = \alpha | \theta = \alpha, z = \alpha) = \frac{\lambda}{\lambda + (1-\lambda)m(\beta)} = 1 - \Pr(y = \beta | \theta = \alpha, z = \alpha) \tag{A.15}$$

$$\Pr(y = \beta | \theta = \beta, z = \alpha) = \frac{\lambda m(\beta)}{\lambda m(\beta) + 1 - \lambda} = 1 - \Pr(y = \alpha | \theta = \beta, z = \alpha). \tag{A.16}$$

It follows that realized trading profits are given as:

$$\Pi(\beta, \beta) = (1-n)(\overline{v} - p_{\emptyset}(\beta)) > 0 \tag{A.17}$$

$$\Pi(\alpha, \beta) = (1-n)p_{\emptyset}(\beta) > 0 \tag{A.18}$$

$$\Pi(\beta, \alpha) = (1-n)\left(p_{\emptyset}(\alpha) - \frac{\lambda m(\beta)\overline{v}}{\lambda m(\beta) + 1 - \lambda}\right) > 0 \tag{A.19}$$

$$\Pi(\alpha, \alpha) = (1-n)\left(\frac{\lambda\overline{v}}{\lambda + (1-\lambda)m(\beta)} - p_{\emptyset}(\alpha)\right) > 0, \tag{A.20}$$

if $m(\beta) < 1$. If $m(\beta) = 1$, then $z = \beta$ is never observed and $p_{\emptyset}(\alpha) = \lambda\overline{v}$. It follows that $\Pi(\beta, \alpha) = \Pi(\alpha, \alpha) = 0$ so that informed investors are indifferent. Without loss of generality, we assume that they trade according to the conjecture in this case. Our previous condition $c > \overline{c}$ ensures that $m(\beta) < 1$ in equilibrium.

Second, suppose that $m(\beta) = 0$ and $m(\alpha) \in [0, 1]$. Equations (A.7) and (A.8) yield

$$p_\emptyset(\alpha) = \frac{q\lambda\,(1 - m(\alpha))\,\overline{v}}{(q\lambda + (1-q)(1-\lambda))\,(1 - m(\alpha))} \tag{A.21}$$

$$p_\emptyset(\beta) = \frac{(q\lambda m(\alpha) + (1-q)\lambda)\overline{v}}{(q\lambda + (1-q)(1-\lambda))m(\alpha) + ((1-q)\lambda + q(1-\lambda))}. \tag{A.22}$$

Moreover, given that $m(\beta) = 0$, it follows that $\Pr(y = \alpha|\theta = \alpha, z = \alpha) = 1$, $\Pr(y = \beta|\theta = \alpha, z = \alpha) = 0$, $\Pr(y = \alpha|\theta = \beta, z = \alpha) = 1$, $\Pr(y = \beta|\theta = \beta, z = \alpha) = 0$. Furthermore, we have that:

$$\Pr(y = \beta|\theta = \beta, z = \beta) \;=\; \frac{\lambda}{\lambda + (1-\lambda)m(\alpha)} = 1 - \Pr(y = \alpha|\theta = \beta, z = \beta) \tag{A.23}$$

$$\Pr(y = \alpha|\theta = \alpha, z = \beta) \;=\; \frac{\lambda m(\alpha)}{\lambda m(\alpha) + 1 - \lambda} = 1 - \Pr(y = \beta|\theta = \alpha, z = \beta). \tag{A.24}$$

It follows that expected trading profits are given as

$$\Pi(\beta, \beta) \;=\; (1-n)\left(\frac{\lambda\overline{v}}{\lambda + (1-\lambda)m(\alpha)} - p_\emptyset(\beta)\right) > 0 \tag{A.25}$$

$$\Pi(\alpha, \beta) \;=\; (1-n)\left(p_\emptyset(\beta) - \frac{\lambda m(\alpha)\overline{v}}{\lambda m(\alpha) + 1 - \lambda}\right) > 0 \tag{A.26}$$

$$\Pi(\beta, \alpha) \;=\; (1-n)p_\emptyset(\alpha) > 0 \tag{A.27}$$

$$\Pi(\alpha, \alpha) \;=\; (1-n)\left(\overline{v} - p_\emptyset(\alpha)\right) > 0, \tag{A.28}$$

if $m(\alpha) < 1$. If $m(\alpha) = 1$, then $z = \alpha$ is never observed and $p_\emptyset(\beta) = \lambda\overline{v}$. It follows that $\Pi(\alpha, \beta) = \Pi(\beta, \beta) = 0$ so that informed investors are indifferent. Without loss of generality, we assume that they trade according to the conjecture in this case. We will show below that $m(\alpha) = 0$ in equilibrium.

A.2 Proof of Lemma 1

We derived in the main text that the manager's marginal benefit is given by

$$MB(y) = \omega\left(\mathbb{E}[p|z \neq y] - \mathbb{E}[p|z = y]\right). \tag{A.29}$$

Proposition 1 shows that the equilibrium stock price depends on z only in the uninformative range, $x \in (n-1, 1-n)$. In the two extreme intervals, $p = \overline{v}$. It follows that we can re-write the marginal benefit as

$$MB(y) = \omega(1-\widehat{n})\left(p_{\emptyset}(z \neq y) - p_{\emptyset}(z = y)\right), \tag{A.30}$$

where $1-\widehat{n}$ is the (conjectured) probability that the order flow is not perfectly revealing and

$$p_{\emptyset}(\alpha) = \frac{(q\lambda\,(1-m(\alpha)) + (1-q)\lambda m(\beta))\overline{v}}{(q\lambda + (1-q)(1-\lambda))\,(1-m(\alpha)) + ((1-q)\lambda + q(1-\lambda))m(\beta)} \tag{A.31}$$

$$p_{\emptyset}(\beta) = \frac{(q\lambda m(\alpha) + (1-q)\lambda(1-m(\beta)))\overline{v}}{(q\lambda + (1-q)(1-\lambda))m(\alpha) + ((1-q)\lambda + q(1-\lambda))(1-m(\beta))}. \tag{A.32}$$

First, suppose that $m(\alpha) \geq 0$ and $m(\beta) = 0$. In this case, the marginal benefit, given $y = \alpha$, is equal to

$$\begin{aligned} MB(\alpha) &= \omega(1-\widehat{n})\left(p_{\emptyset}(\beta) - p_{\emptyset}(\alpha)\right) \\ &= -\frac{\omega(1-\widehat{n})(1-\lambda)\lambda(2q-1)}{(1-\lambda+(2\lambda-1)q)(q-\lambda(1-m(\alpha))(2q-1)+m(\alpha)(1-q))} \leq 0, \end{aligned} \tag{A.33}$$

where we have used $q > \lambda(2q-1)$ which follows from $\frac{1}{2} < q < \lambda < 1$. Hence, we find that $m(\alpha) = 0$ so that the manager does not manipulate if $y = \alpha$.

Next, we consider $m(\alpha) = 0$ and $m(\beta) \geq 0$. For $y = \beta$, the marginal benefit of manipulation is equal to

$$\mathrm{MB}(\beta) = \frac{(1-\lambda)\lambda(2q-1)\omega(1-\widehat{n})\overline{v}}{(\lambda-(2\lambda-1)q) - (1-m(\beta))(\lambda-(2\lambda-1)q)^2}. \tag{A.34}$$

The marginal benefit decreases in $\widehat{n}$. Next, we set the marginal benefit equal to the marginal cost to solve for the manager's best-response function:

$$m(\widehat{n}) = \frac{(1-\ell)\left(\sqrt{\frac{4(1-\widehat{n})\omega(q+\ell-1)(q-\ell)}{c(2q-1)(1-\ell)^2}+1}-1\right)}{2\ell} \tag{A.35}$$

where $\ell \equiv \lambda - (2\lambda - 1)q \in \left(0, \frac{1}{2}\right)$. To ensure an interior solution, we set $c > \overline{c}$ with

$$\overline{c} \equiv \frac{(1-\lambda)\lambda(2q-1)}{\lambda + q - 2\lambda q} > 0, \tag{A.36}$$

which implies that the manager's marginal benefit at $\widehat{n} = 0$ and $m = 1$ is strictly lower than the marginal cost so that $m(\widehat{n}) < 1 \ \forall \ \widehat{n} \in [0, 1]$.

A.3 Proof of Lemma 2

If the manager sets $m(\alpha) = 1$ or $m(\beta) = 1$, then we have shown in Proposition 1 that informed traders do not trade. Consequently, their expected trading profits are equal to zero, and no informed trader is willing to acquire a private signal.

For $\widehat{m}(\alpha) = 0$ and $\widehat{m}(\beta) < 1$, we obtain

$$\begin{aligned} \Pi_{0i} \quad &= \quad q(\lambda + (1-\lambda)\widehat{m}(\beta))\Pi(\alpha, \alpha) + q(1-\lambda)(1-\widehat{m}(\beta))\Pi(\alpha, \beta) && \text{(A.37)} \\ &+ \quad (1-q)(1-\lambda+\lambda\widehat{m}(\beta))\Pi(\beta, \alpha) + (1-q)\lambda(1-\widehat{m}(\beta))\Pi(\beta, \beta) && \text{(A.38)} \end{aligned}$$

where $\Pi(\theta, z)$ is given in the proof of Proposition 1. It follows that

$$\begin{aligned} \Pi_{0i} \quad &= \quad (1-n)\left[q(\lambda + (1-\lambda)\widehat{m})\left(\frac{\lambda\overline{v}}{\lambda + (1-\lambda)\widehat{m}} - p_\emptyset(\alpha)\right) + q(1-\lambda)(1-\widehat{m})p_\emptyset(\beta)\right] \\ &+ \quad (1-n)\left[(1-q)(1-\lambda+\lambda\widehat{m})\left(p_\emptyset(\alpha) - \frac{\lambda\widehat{m}\overline{v}}{\lambda\widehat{m} + 1 - \lambda}\right) + (1-q)\lambda(1-\widehat{m})(\overline{v} - p_\emptyset(\beta))\right] \\ &= \quad (1-n)\left[q\lambda - (1-q)\lambda\widehat{m} + (1-q)\lambda(1-\widehat{m})\right]\overline{v} + (1-n)\left[q(1-\lambda) - (1-q)\lambda)\right](1-\widehat{m})p_\emptyset(\beta) \\ &+ \quad (1-n)\left[(1-q)(1-\lambda+\lambda\widehat{m}) - q(\lambda + (1-\lambda)\widehat{m})\right]p_\emptyset(\alpha) \end{aligned}$$

with

$$p_\emptyset(\alpha) = \frac{q\lambda + (1-q)\lambda\widehat{m}}{q\lambda + (1-q)(1-\lambda) + ((1-q)\lambda + q(1-\lambda))\widehat{m}}\overline{v} \tag{A.39}$$

and

$$p_{\emptyset}(\beta)=\frac{(1-q)\lambda}{(1-q)\lambda+q(1-\lambda)}\overline{v}. \tag{A.40}$$

Plugging in these two expressions leads to

$$\Pi_0(\widehat{m})=\frac{2(1-\lambda)\lambda(1-\widehat{m})(1-n)(1-q)q(2\widehat{m}(\lambda-(2\lambda-1)q)+1)}{(\lambda-(2\lambda-1)q)(1-(1-\widehat{m})(\lambda-(2\lambda-1)q))}. \tag{A.41}$$

It follows that $\Pi_0(1)=0$, $\Pi_0(0)=\frac{2(1-\lambda)\lambda(1-n)(1-q)q}{(1-(\lambda-2\lambda q+q))(\lambda-2\lambda q+q)}>0$, and that $\frac{\partial\Pi_0}{\partial\widehat{m}}<0$. If $\widehat{m}\in[0,1)$, then there is an interior solution $n\in(0,1)$ if $\tau<\Pi_0(0)$. If $\tau\geq\Pi_0(0)$, then we also find $n=0$.

Similarly, if $\widehat{m}(\alpha)<1$ and $\widehat{m}(\beta)=0$, we obtain:

$$\begin{aligned}\Pi_{0i} &= q\lambda\left(1-\widehat{m}\right)\Pi(\alpha,\alpha)+q\left(\lambda\widehat{m}+1-\lambda\right)\Pi(\alpha,\beta) && \text{(A.42)}\\ &+ (1-q)(1-\lambda)(1-\widehat{m})\Pi(\beta,\alpha)+(1-q)\left(\lambda+(1-\lambda)\widehat{m}\right)\Pi(\beta,\beta) && \text{(A.43)}\end{aligned}$$

where $\Pi(\theta,z)$ is given in the proof of Proposition 1. Proceeding as before yields that Π_0 decreases in $\widehat{m}$.

A.4 Proof of Proposition 2

We have shown above that the manager's best response is given by:

$$m(\widehat{n})=\frac{(1-\ell)\left(\sqrt{\frac{4(1-\widehat{n})\omega(q+\ell-1)(q-\ell)}{c(2q-1)(1-\ell)^2}+1}-1\right)}{2\ell}\in[0,1) \tag{A.44}$$

and that the best response for informed traders is given by:

$$n(\widehat{m})=\begin{cases}0 & \text{if } \widehat{m}>\overline{m}\\ 1-\frac{\tau\ell(1-\ell+\widehat{m}\ell)}{2(1-\lambda)\lambda(1-q)q(1-\widehat{m})(2\widehat{m}\ell+1)} & \text{if } \widehat{m}\leq\overline{m}.\end{cases} \tag{A.45}$$

where we have used $\ell = \lambda - (2\lambda - 1)q$. The threshold $\overline{m} \in (0,1)$ is implicitly given by $\Pi_0 = \tau$ at $n = 0$. To obtain an interior solution for (n, m), we require $n(m(0)) > 0$. Plugging $m(0)$ into the traders' best-response yields the following condition for an interior equilibrium:

$$\tau\ell(1 - \ell + m(0)\ell) < 2(1 - \lambda)\lambda(1 - q)q(1 - m(0))(2m(0)\ell + 1). \tag{A.46}$$

We have shown before that $m(0)$ satisfies:

$$m(0)\ell\,(1 - \ell + m(0)\ell) = \frac{(2q-1)\omega(1-\lambda)\lambda}{c} \tag{A.47}$$

which, in turn, implies that the condition for an interior equilibrium becomes:

$$\begin{aligned} & \tau\frac{(2q-1)\omega(1-\lambda)\lambda}{cm(0)} < 2(1-\lambda)\lambda(1-q)q(1-m(0))(2m(0)\ell+1) \\ \Leftrightarrow \quad & \tau < \frac{2(1-q)q}{(2q-1)\omega} m(0)(1-m(0))(2m(0)\ell+1)c. \end{aligned} \tag{A.48}$$

We have assumed that $c > \overline{c} = \frac{(1-\lambda)\lambda(2q-1)\omega}{\ell(1-\ell)}$ so that a sufficient condition is that τ is (strictly) less than the right-hand side evaluated at $c = \overline{c}$:

$$\tau < \frac{2(1-q)q(1-\lambda)\lambda}{\ell(1-\ell)} m(0)(1-m(0))(2m(0)\ell+1) \equiv \overline{\tau} > 0 \tag{A.49}$$

with

$$m(0) = \frac{(1-\ell)\left(\sqrt{\frac{4\omega(q+\ell-1)(q-\ell)}{c(2q-1)(1-\ell)^2} + 1} - 1\right)}{2\ell} \in (0,1). \tag{A.50}$$

To summarize, the two conditions $c > \overline{c}$ and $\tau < \overline{\tau}$ imply that:

1. $n(m(0)) > 0$ and $n(m(1)) = n(0) < 1$;
2. $m(n(0)) > 0$ and $m(n(1)) = m(0) < 1$.

Hence, the equilibrium is interior. Next, we will prove uniqueness.

We know from the best responses that the equilibrium pair (m, n) is characterized by:

$$cm\ell(1-\ell+m\ell) = (1-n)(2q-1)\omega(1-\lambda)\lambda \tag{A.51}$$

and

$$2\lambda(1-\lambda)(1-q)q(2m\ell+1)(1-m)(1-n) = \tau\ell(1-\ell+m\ell). \tag{A.52}$$

Combining these two conditions leads to the following:

$$m(1-m)(2m\ell+1) = \frac{(2q-1)}{2(1-q)q}\frac{\omega\tau}{c} \tag{A.53}$$

with $m \leq m(0)$. At $m = m(0)$, we find that:

$$\begin{aligned}
& m(0)(1-m(0))(2m(0)\ell+1) - \frac{(2q-1)}{2(1-q)q}\frac{\omega\tau}{c} \\
> \;& m(0)(1-m(0))(2m(0)\ell+1) - \frac{(2q-1)}{2(1-q)q}\frac{\omega\overline{\tau}}{c} \\
= \;& m(0)(1-m(0))(2m(0)\ell+1)\left[1 - \frac{\omega}{c}\frac{(2q-1)(1-\lambda)\lambda}{\ell(1-\ell)}\right] \\
> \;& m(0)(1-m(0))(2m(0)\ell+1)\left[1 - \frac{\omega}{\overline{c}}\frac{(2q-1)(1-\lambda)\lambda}{\ell(1-\ell)}\right] \\
= \;& m(0)(1-m(0))(2m(0)\ell+1)\left[1-1\right] = 0.
\end{aligned}$$

Define the concave function $g(m) = m(1-m)(2m\ell+1) - \frac{(2q-1)}{2(1-q)q}\frac{\omega\tau}{c}$. It follows from $g(0) < 0$ and $g(1) < 0$ that there are two roots for $m \in (0,1)$. Since $g(m(0)) > 0$, it follows that there is a unique solution for $m \in (0, m(0))$.

A.5 Proof of Corollary 1

Equilibrium Manipulation. We have shown above that m^* is characterized by the concave function $g(m) = m(1-m)(2m\ell+1) - \frac{(2q-1)}{2(1-q)q}\frac{\omega\tau}{c}$ in the range $m \in (0, m(0))$. It follows immediately that m^* increases in (ω, τ) and decreases in c.

With regards to (λ, q), we note that $\ell = \lambda - (2\lambda - 1)q$. It follows that the comparative statics are given by:

$$\frac{dg(m)}{d\lambda} = \frac{\partial g}{\partial \ell}\frac{\partial \ell}{\partial \lambda} = 2m^2(1-m)\,(1-2q) < 0 \tag{A.54}$$

because $q > 1/2$. It follows that m^* increases in λ. Similarly, we find that:

$$\frac{dg(m)}{dq} = \frac{\partial g}{\partial \ell}\frac{\partial \ell}{\partial q} + \frac{\partial g}{\partial q} = -2m^2(1-m)(2\lambda-1) - \frac{\omega\tau}{c}\frac{1}{2}\left(\frac{1}{q^2} + \frac{1}{(1-q)^2}\right) < 0 \tag{A.55}$$

because $\lambda > q > 1/2$. It follows that m^* increases in q.

Equilibrium Informed Trading. We have shown above that the traders' best response (in an interior equilibrium) is given by:

$$n(\widehat{m}) = 1 - \frac{\tau\ell(1-\ell+\widehat{m}\ell)}{2(1-\lambda)\lambda(1-q)q(1-\widehat{m})(2\widehat{m}\ell+1)} \tag{A.56}$$

with $\frac{\partial n}{\partial \widehat{m}} < 0$. It immediately follows that n^* increases in c and decreases in ω because these two parameters only affect n indirectly through m. Moreover, the manager's best response is independent of τ so that n^* decreases in τ.

To find the comparative statics concerning λ, we totally differentiate the traders' best response at m^*:

$$\frac{dn}{d\lambda} = \frac{\partial n}{\partial m}\frac{\partial m}{\partial \lambda} + \frac{\partial n}{\partial \lambda}. \tag{A.57}$$

We have shown above that $\frac{\partial n}{\partial m} < 0$ and $\frac{\partial m}{\partial \lambda} > 0$. Moreover, we find that $\frac{\partial n}{\partial \lambda}$ is equal to

$$\frac{(2\lambda-1)\tau\left((\lambda-1)\lambda + 2(2(\lambda-1)\lambda+1)(m-1)m\ell^3 + \ell^2(m(2(\lambda-1)\lambda(m+3)+3)-1) + 2(\lambda-1)\lambda m\ell + \ell\right)}{2(\lambda-1)^2\lambda^2(m-1)(2m\ell+1)^2(\lambda-\ell)(\lambda+\ell-1)}$$

which is negative because $\lambda \in (1/2, 1)$ and $\ell \in (0,1)$. It follows that $\frac{dn}{d\lambda} < 0$. Following a similar approach, we can also confirm that $\frac{dn}{dq} < 0$.

Equilibrium Expected Firm Value. We have shown above that the manager learns θ from the financial market with probability n. With probability $1-n$, the manager relies on her private signal. In this case, she chooses the correct project with probability λ. As a result, the expected firm value is given by:

$$\mathbb{E}[v] = [n^* + (1-n^*)\lambda]\,\overline{v}. \tag{A.58}$$

It follows directly from $\lambda \in (1/2, 1)$ that $\mathbb{E}[v]$ increases in c and decreases in ω, τ, and q. The effect of λ is given by:

$$\frac{d\mathbb{E}[v]}{d\lambda} = \left[(1-n^*) + (1-\lambda)\frac{dn^*}{d\lambda}\right]\overline{v}. \tag{A.59}$$

We can show that $\frac{d\mathbb{E}[v]}{d\lambda} > 0$.

A.6 Proof of Proposition 3

The firm invests to produce an additional signal if and only if the expected firm value with the additional signal (net of the production cost) exceeds the expected firm value without the additional signal. As shown in the main text, it follows that $d = 1$ if κ is lower than the threshold $\widehat{\kappa} = (1-\lambda)(1-n_{d=0})\overline{v}$ where $n_{d=0}$ is characterized in Proposition 2.

If the firm produces the additional signal ($d = 1$), then the manager's marginal benefit of manipulation (Lemma 1 evaluated at $\lambda = 1$) is equal to zero. It follows that the manager chooses not to manipulate, i.e., $m_{d=1} = 0$. The results in Lemma 2 imply that trading profits are equal to zero so that $n_{d=1} = 0$. Since the firm always invests correctly, the expected firm value equals $\overline{v}$.

The comparative statics of $\widehat{\kappa}$ with respect to (c, τ, q, ω) follow directly from the (inverse of) the comparative statics for $n_{d=0}$ derived in Corollary 1. The comparative statics concerning λ is given by:

$$\frac{d\widehat{\kappa}}{d\lambda} = -\left[(1-\lambda)\frac{dn_{d=0}}{d\lambda} + (1-n_{d=0})\right]\overline{v} = -\frac{dv_{d=0}}{d\lambda}. \tag{A.60}$$

We have shown in Corollary 1 that $\frac{dv_{d=0}}{d\lambda} > 0$ so that $\widehat{\kappa}$ decreases in λ.

A.7 Proof of Corollary 2

1. **Equilibrium manipulation.** We have shown in Proposition 3 that $m^* = 0$ if $\kappa < \widehat{\kappa}$ and (weakly) positive otherwise. We have also shown that $\widehat{\kappa}$ decreases in c and λ, and increases in τ, q, and ω. As a result, around the threshold, m^* increases in c and λ and decreases in τ, q, and ω. In the range $\kappa \geq \widehat{\kappa}$, we have shown in Corollary 1 that m^* decreases in c and increases in τ, ω, q, and λ.

2. **Equilibrium mass of informed traders.** We have shown in Proposition 3 that $n^* = 0$ if $\kappa < \widehat{\kappa}$ and (weakly) positive otherwise. We have also shown that $\widehat{\kappa}$ decreases in c and λ, and increases in τ, q, and ω. As a result, around the threshold, n^* increases in c and λ and decreases in τ, q, and ω. In the range $\kappa \geq \widehat{\kappa}$, we have shown in Corollary 1 that n^* increases in c and decreases in τ, ω, q, and λ.

3. **Equilibrium expected firm value.** We have shown in Proposition 3 that the expected firm value equals $\overline{v} - \kappa$ if $\kappa < \widehat{\kappa}$ and $[\lambda + (1-\lambda)n_{d=0}]\,\overline{v}$ otherwise. The firm chooses $d \in \{0, 1\}$ to maximize the expected value. Moreover, the expected value with $d = 1$ decreases in κ, while that with $d = 0$ is independent of κ. As a result, around the threshold, the equilibrium firm value (minus the potential information production cost) decreases in κ, and thus it increases in c and λ; it decreases in τ, q, and ω. In the range $\kappa \geq \widehat{\kappa}$, we have shown in Corollary 1 that $v_{d=0}$ increases in c and λ; it decreases in τ, q, and ω.