THE ACCOUNTING REVIEW
Vol. 75, No. 2
April 2000
pp. 229–245

Reporting Bias

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ABSTRACT: We present a simple model of managerial reporting bias for a setting in which the capital market is uncertain about the manager's reporting objective. In this setting, the manager's reporting bias reduces the value relevance of the manager's report; that is, it adds noise to the report. Through comparative static results, our model yields insights into factors that affect the slope and intercept terms in a regression of price on earnings. Specifically, we find that the information content of the manager's report, as captured by the earnings slope coefficient, falls as the private cost to the manager of biasing reports falls, and as the uncertainty about the manager's objective increases. We also find that the magnitude of the adjustment for the expected amount of bias, as captured by the absolute value of the intercept, falls as the uncertainty about the manager's objective increases. Finally, to highlight conditions under which managers would lobby to retain an option to bias reports (i.e., retain reporting flexibility), we analyze the effect of the option to bias on the manager's welfare. For example, we show that the *ex ante* benefit from biasing the report is positive if there is sufficient uncertainty about the manager's reporting objective.

Key Words: *Bias, Disclosure, Reporting discretion.*

I. INTRODUCTION

Standard setters and users of accounting information often claim that unobservable bias (e.g., earnings manipulation) reduces the usefulness, or value relevance, of reports of firm performance. For example, the Financial Accounting Standards Board (FASB) asserts in Statement of Financial Accounting Concepts No. 2:

> To be reliable, information must have representational faithfulness and it must be verifiable and neutral....Accounting information may not represent faithfully what it purports to represent because it has one or both of two kinds of bias. (FASB 1995, 56)

This paper has benefited from workshop participants' comments at the University of British Columbia, the University of Chicago, Dartmouth College, the University of Michigan, the University of Minnesota, Notre Dame University, Penn State University, Southern Methodist University, as well as from comments received in conjunction with presentations at the 1998 European Accounting Association meetings and the 1998 American Accounting Association meetings. Finally, we would like to thank Raffi Indjejikian and an anonymous referee for their helpful suggestions and comments, and Lihong Liang and Edward Riedl for their editorial assistance.

Submitted June 1999
Accepted November 1999

The FASB refers to bias arising from the measurement method, and bias arising from the measurer's application of the measurement method. Our paper addresses the latter.

Users of accounting information express similar concerns about bias, as indicated in the Association for Investment Management and Research (AIMR) report, which states:

> In addition to timely dissemination, fairness also requires neutrality—presentation of data that are without bias. (Knutson 1993, 37)

Despite the compelling nature of these claims, in many models of financial reporting biasing activity does not affect the value relevance of a financial report.[1] These prior models assume that users of the report: (1) develop rational expectations, and (2) have perfect common knowledge of the preparer's reporting objective. These two assumptions generally imply that, in a rational expectations equilibrium, users of the report perfectly ''back out'' any bias in the report. For example, when users of the report know the preparer has incentives to set his report to 10 plus the earnings observed, users simply subtract 10 from the report to infer perfectly the underlying earnings. Consequently, the bias in the report does not affect the information content of the report.

Our paper presents a simple model of financial reporting that shows how reporting bias can affect informativeness. Our model assumes that a risk-neutral manager of a firm observes the firm's earnings, and then makes a potentially biased report of earnings to a risk-neutral market. Thus, bias in our model is the difference between the realization of earnings and the manager's *actual* earnings report. The manager's motivation to bias reports is that he seeks to manipulate the market's valuation of the firm, subject to some cost associated with bias. The market, however, does not know the manager's marginal benefit from manipulating the price; that is, we relax the assumption that the market knows the manager's reporting objective. Because the market is unable to observe the manager's objective, the market is unable to perfectly adjust for the bias the manager adds to the report. The market's (user's) inability to perfectly adjust for the manager's bias effectively means that, from the market's perspective, the manager's biasing activity adds noise to the report. In other words, reporting bias reduces the information content of the report. Consistent with this intuition, we show that more bias reduces the association between share price and reported earnings, and reduces the extent to which price reflects all available information.

The model allows us to derive a number of empirically relevant comparative static results. We show how the cost to the manager of biasing the report and the market's uncertainty about the manager's objective affect the slope (e.g., earnings association) *and* the intercept term in a regression of market price on the earnings report. Specifically, we find that the information content of the manager's report, as captured by the earnings slope coefficient, falls as the private cost to the manager of biasing reports falls, and as the uncertainty about the manager's objective increases. We also find that the magnitude of the adjustment for the expected amount of bias, as captured by the absolute value of the intercept, falls as the uncertainty about the manager's objective increases.

We also consider the value to the manager of the option to bias the report. In prior models the manager generally ends up taking costly actions to bias the report despite the fact that the market perfectly anticipates this bias. This result implies that the manager is worse off with the option to bias.[2] Consequently, these models suggest that managers would

[1] For an example in the earnings management literature see Verrecchia (1986). See also the literature concerned with myopic investment behavior, for example, Narayanan (1985), Stein (1989), or the survey in Hirshleifer (1993).

[2] This is often referred to as ''shoot oneself in the foot'' behavior because biasing is costly to the manager and yields no benefit. See, for example, Narayanan (1985), Stein (1989), or the survey in Hirshleifer (1993).

lobby to reduce reporting discretion that makes it possible for them to bias reports. In our model, in contrast, the market correctly anticipates the manager's bias *on average* (not perfectly). Because the market imperfectly anticipates the manager's bias, our model yields the result that managers may be better off with the option to bias. Thus, our model suggests that some managers would lobby to retain reporting discretion.

The remainder of the paper proceeds as follows. The next section briefly reviews related literature. Section III introduces a game in which a manager makes potentially biased reports of firm performance. We characterize an equilibrium to this game in Section IV. We present comparative static results and empirical predictions in Section V. In Section VI we consider the value of the option to bias to the manager. A final section summarizes our findings.

II. PRIOR MODELS OF REPORTING BIAS

Prior work has considered capital market settings in which private information is not fully revealed in equilibrium.[3] For example, Dye (1988) considers a setting in which there is uncertainty about the manager's reporting objective, or, more precisely, the manager's optimization problem. Specifically, in Dye's (1988) model the manager's feasible reporting space and/or the cost of bias is uncertain. Sansing (1992) and Trueman and Titman (1988) also analyze models in which the feasible reporting space of the manager is uncertain. None of these papers, however, directly considers the questions that motivate our analysis: (1) how does bias affect the informativeness of an earnings report; (2) how does the extent of uncertainty regarding the manager's reporting objective affect the informativeness of his earnings report; and (3) how does the option to bias affect the manager's welfare? Instead, Dye (1988) focuses on identifying the conditions that give rise to earnings management, Sansing (1992) focuses on explaining the differential price responses to good news and bad news management forecasts, and Trueman and Titman (1988) explain how a manager's desire to alter beliefs about default risk can induce the manager to smooth earnings.

Voluntary disclosure models also have the feature that full revelation of information does not occur. Full revelation does not occur because either the manager faces disclosure costs (e.g., Verrecchia 1983; Wagenhofer 1990) or uncertainty exists about whether the manager has private information (e.g., Jung and Kwon 1988). These models differ from ours primarily in that they assume that disclosure is truthful, when it occurs. Thus, these models emphasize the decision to disclose vs. not to disclose, and not bias *per se*.

Finally, ''cheap-talk'' models originating with Crawford and Sobel (1982) typically show that the receiver of a report cannot back into the sender's information (e.g., Newman and Sansing 1993; Gigler 1994). In these models, there are no implicit reporting standards that form a benchmark for defining misreporting and for imposing misreporting costs. Instead, incentives for the sender to communicate information depend only on the receiver's responses to the sender's reports. Because there are no reporting standards *per se* in cheap-talk models, there is no notion of reporting bias.

III. THE MODEL

Consider a one-period reporting game with a risk-neutral manager of a firm and a perfectly competitive, risk-neutral market. The firm yields a terminal value of $\tilde{v}$, where the

[3] Another related stream of literature includes papers in the optimal-contracting (i.e., principal-agent) literature that identify conditions under which the revelation principle fails to hold. Obviously, if the revelation principle fails to hold, full disclosure need not occur under any optimal contract. See, for example, the principal-agent model in Dye (1988). For a broad discussion of settings in which the revelation principle fails to hold, see Arya et al. (1998).

manager's and the market's priors for $\tilde{v}$ are normally distributed with mean 0 and variance σ_v^2. During the period, the manager privately observes earnings, $\tilde{e} = \tilde{v} + \tilde{n}$, where it is common knowledge that $\tilde{v}$ and $\tilde{n}$ are independent and $\tilde{n}$ has a normal distribution with mean 0 and variance σ_n^2. After observing the earnings realization, the manager provides an earnings report, r, to the market and the market price is determined. Unlike the manager, the market does not observe the realization of $\tilde{e}$. Consequently, market price is a function of the market's prior beliefs, as well as the manager's earnings report. Because the market is assumed to be perfectly competitive and risk-neutral, the price is the rational expectation of terminal value, $\tilde{v}$, conditioned upon the manager's earnings report, r:

$$P = E[\tilde{v}|r]. \tag{1}$$

Earnings can be thought of as the outcome of fundamental economic events coupled with the accounting for those events. The manager is assumed to have some discretion over the accounting for the earnings report and can use that discretion to disclose the observed earnings, $\tilde{e}$, or to report some other number. We interpret the difference between the observed earnings and the number actually reported as the ''bias'' in the accounting report. Formally, conditional on the manager observing earnings of $\tilde{e} = e$, the earnings report, r, equals $e + b$ where b is the bias the manager introduces into the report. Note that b can be either positive or negative (or zero). When b is positive, we interpret this as the manager ''inflating'' the report; when b is negative, we interpret this as the manager ''deflating'' the report.

In choosing a level of bias, the manager attempts to maximize his objective function, which is characterized by the expression:

$$xP - \frac{cb^2}{2}, \tag{2}$$

where $\tilde{x} = x$ is the realization of a random event that the manager alone observes, P is the market price for the firm, c is some known positive parameter, and $cb^2/2$ represents the known cost of bias to the manager. In other words, for a given realization of $\tilde{x} = x$, the manager attempts to maximize xP subject to some cost of using bias as a vehicle to maximize this objective. The term xP captures the benefit to the manager of inducing a marginal change in price by biasing his report.[4] The term $cb^2/2$ captures the cost function, and reflects the manager's litigation risks, psychic costs, or reputation costs of biasing a report. We assume that it is common knowledge that the variable $\tilde{x}$ has a normal distribution with mean μ_x and variance σ_x^2, and that $\tilde{x}$, $\tilde{v}$, and $\tilde{n}$ are jointly independent.[5]

[4] The discretionary disclosure literature generally assumes managers make disclosure decisions to influence market prices (see, for example, Verrecchia 1983; Jung and Kwon 1988). We employ a similar assumption. Our results continue to hold as long as the manager is attempting to manipulate the expectation of $\tilde{v}$ for some other risk-neutral party (e.g., regulators, labor unions, bankers, or members of the board of directors).

[5] Allowing these parameters to be related does not affect our results in a qualitative sense, but does complicate the analysis. One reason the analysis is complicated is that, when $\tilde{x}$ covaries with $\tilde{v}$ and/or $\tilde{n}$, there can exist up to three linear equilibria. There always exists a linear equilibrium in which price is increasing in the report and, in many cases, this is the unique linear equilibrium. In some cases when *covariance* $(\tilde{x}, \tilde{e})$ is positive there exist two equilibria in which price is decreasing in the report, in addition to the one linear equilibrium in which the price is increasing in the report. Finally, in some cases when *covariance* $(\tilde{x}, \tilde{e})$ is sufficiently negative and *variance* $(\tilde{e})c - $ *covariance* $(\tilde{x}, \tilde{v})$ is positive, there exist three linear equilibria in which price is increasing the report.

Because the manager's uncertain reporting objective is crucial to our model, it is important to provide some motivation for the introduction of uncertainty and for our specific modeling of that uncertainty. At a broad level, the notion that a manager's reporting objective is uncertain seems reasonable because, in real markets, a manager's reporting objective at any point in time is not known precisely. For example, at any point in time, the market does not know: the precise nature of the manager's compensation; the manager's time horizon; the manager's rate of time preference and degree of risk-aversion; the manager's psychic costs associated with bias; the manager's perceptions of litigation risks and reputation costs associated with bias; or the level of effort or resources the manager must expend to achieve a workable bias scheme. Given its inability to discern the manager's precise objective, the market can only conjecture the extent to which the manager has incentives to inflate or deflate expectations. In our model, we formalize this uncertainty by introducing the random variable $\tilde{x}$ into the manager's objective function.

Specifically, we assume that the manager manipulates his report to influence stock price and that the marginal benefit to the manager from shifting price is uncertain. The conventional wisdom in prior work is that managers prefer a higher price; our model is consistent with this objective when x is positive. Note, however, that the realization of $\tilde{x}$ can also assume negative values because $\tilde{x}$ is normally distributed. In these cases, the manager prefers a lower price. This deviation from the conventional wisdom recognizes that there are points in time when a manager can benefit by deflating stock price. For example, a manager who is a large blockholder might deflate price if he intends to hold his shares over the long term and his firm must repurchase shares in the near term to cover employee stock options (e.g., Bill Gates of Microsoft®). Similarly, managers can benefit by driving down price if they intend to engage in a management buyout (see, for example, the evidence in Perry and Williams [1994]). Similarly, a manager who is about to receive a new option grant may attempt to drive down price in order to lower the strike price for options granted (see, for example, the evidence in Aboody and Kasznik 1998). In short, there are times when the conventional wisdom may not hold; our model allows for these possibilities. Finally, even if some managers almost surely have incentives to inflate price at every point in time, the parameters of the distribution can be chosen to reflect this belief by making the probability of a negative realization for $\tilde{x}$ arbitrarily close to 0. This is achieved by assuming that the mean of $\tilde{x}$, μ_x, exceeds the standard deviation of $\tilde{x}$, σ_x, by a large amount.

An equilibrium to the reporting bias game just described consists of a bias function for the manager, b(e, x), and a pricing function for the market, P(r), such that three conditions are satisfied. First, the manager's choice of bias for each realization {e, x}, b(e, x), must solve his optimization problem given his conjecture as to how the market responds to his report:

$$b(e, x) = \arg\max_b x\hat{P}(r = e + b) - \frac{cb^2}{2}, \tag{3}$$

where $\hat{P}(r = e + b)$ is the manager's conjecture about the market-pricing function. Second, the market price must equal expectation of firm value, $\tilde{v}$, based on a report $r = e + b$ and a conjecture about the bias strategy of each manager type (i.e., the bias choice conditional upon the realizations of $\tilde{e}$ and $\tilde{x}$):

$$P(r) = E[\tilde{v}|r; \hat{b}(e, x)],$$

where $\hat{b}(e, x)$ is the market's conjecture about the manager's bias function. Finally, to constitute a rational expectations equilibrium, both the manager's and the market's conjectures must be rational in the sense that they are fulfilled, that is:

$$\hat{b}(e, x) = b(e, x) \tag{4}$$

for all {e, x} and

$$\hat{P}(r) = P(r) \tag{5}$$

for all r.

IV. A LINEAR EQUILIBRIUM

In this section, we construct an equilibrium to our reporting-bias game. We restrict our analysis to linear equilibria (i.e., price is linear in r and bias is linear in e and x) because they are easily characterized and yield intuition that is compelling.[6] Thus, we conjecture an equilibrium of the form:

$$b(e, x) = \lambda_e e + \lambda_x x + \delta, \tag{6}$$

and

$$P(r) = \beta r + \alpha. \tag{7}$$

We will use the manager's optimization problem and the market-pricing function to prove that there exists a unique linear equilibrium.

The Manager's Problem

To begin, suppose that the manager conjectures that the price of the firm based on a report r is of the form given by equation (7). This implies that, based on a report r, the manager conjectures that the market will set firm value equal to:

$$\begin{aligned} P &= \hat{\beta} r + \hat{\alpha} \\ &= \hat{\beta} e + \hat{\beta} b + \hat{\alpha}, \end{aligned} \tag{8}$$

where, as before, a caret (i.e., "ˆ") denotes a conjecture. The linear conjecture about the pricing function, coupled with the objective function in equation (3), implies that the manager's objective is strictly concave in b. Thus, the manager's optimal bias is given by the first-order condition, which yields:

$$b(e, x) = \frac{\hat{\beta}}{c} x \tag{9}$$

for all {e, x}. Equation (9) implies that the manager's bias is a linear function of the form $b(e, x) = \lambda_e e + \lambda_x x + \delta$, where:

[6] For the remainder of the paper, the expression equilibrium is used as shorthand for a linear equilibrium.

$$\lambda_e = 0, \quad \lambda_x = \frac{\hat{\beta}}{c}, \quad \text{and} \quad \delta = 0. \tag{10}$$

Because $\lambda_e = 0$ and $\delta = 0$ regardless of the conjecture about the linear-pricing function, we restrict both to 0 for the remaining analysis.

Market Pricing Function

Now we turn to the market pricing function. Assume a conjectured bias function of the form specified by equation (6), where $\hat{\lambda}_e$ and $\hat{\delta}$ equal 0. The market price of the firm is equal to the expectation of the firm's terminal value conditional on the report:

$$\begin{aligned} P &= E[\tilde{v}|r] \\ &= \frac{\sigma_v^2}{\sigma_v^2 + \sigma_n^2 + \hat{\lambda}_x^2\sigma_x^2}(r - \hat{\lambda}_x\mu_x). \end{aligned} \tag{11}$$

Intuitively, equation (11) provides the expression for firm value that results from regressing terminal value, $\tilde{v}$, on reported earnings, r. Equation (11) implies that the market price is a linear function of the report: $P = \beta r + \alpha$ where

$$\beta = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_n^2 + \hat{\lambda}_x^2\sigma_x^2}, \tag{12}$$

and

$$\alpha = -\beta\hat{\lambda}_x\mu_x. \tag{13}$$

The link between the market's beliefs (conjectures) about the extent of reporting bias and value relevance of the earnings report can be explained as follows. Note that the conjectured coefficient on the realization of $\tilde{x}$ in the manager's bias function, $\hat{\lambda}_x$, captures the conjectured extent of bias; for any realization x, the greater the magnitude of $\hat{\lambda}_x$ (i.e., $|\hat{\lambda}_x|$), the greater the magnitude of the bias (i.e., $|b|$). Furthermore, as $|\hat{\lambda}_x|$ becomes larger, more of the variance of reported earnings is attributable to $\tilde{x}$. From the market's perspective, the increase in earnings-report variance attributable to $\tilde{x}$, in turn, causes the earnings report to become a noisier statistic for updating beliefs regarding terminal value, $\tilde{v}$. As a consequence, the value relevance of the earnings report, as captured by the earnings association parameter β, decreases when the market believes that the manager is biasing reports to a greater extent. At the extremes, when the market believes that the manager is not biasing the report, $\hat{\lambda}_x = 0$, the value relevance is maximized (i.e., $\beta = \sigma_v^2/[\sigma_v^2 + \sigma_n^2]$). When the market believes that bias is infinite, $\hat{\lambda}_x \to \infty$ or $\hat{\lambda}_x \to -\infty$, the value relevance approaches its lower bound (i.e., $\beta \to 0$).

The above discussion implies that, in our model, the manager's earnings report would be more value relevant (i.e., less noisy) if the manager did not have the discretion to bias the report. Our model, however, can easily be altered to show how managerial discretion enhances the value relevance of the earnings report.[7] For example, if the incentive parameter, $\tilde{x}$, is negatively correlated with the noise in the earnings observed by the manager, $\tilde{n}$,

[7] For example, Palepu et al. (1997, chap. 3, p. 8) suggest that "When managers can use their accounting flexibility, they can use it either to communicate their firm's economic situation or to hide true performance."

then the manager's biasing activities tend to offset the noise, resulting in more value-relevant reports. We do not pursue such an alteration in our model because our focus is on settings in which biasing activity reduces the information content of reports.

The Unique Linear Equilibrium

The equilibrium requirement that conjectures are self-fulfilling, coupled with the parameter specifications provided by the analysis of the manager's problem and the market pricing function, equations (10), (12), and (13), allow us to characterize the unique linear equilibrium. We do so by replacing the conjectures with the candidate equilibrium values (i.e., eliminating all of the carets over the variables) and then showing that the three equations have a unique solution.

First, replace all of the conjectures in the three equations, and note that equations (10) and (13) imply that λ_e, δ, and α, are all unique functions of λ_x and/or β. To prove the existence of a unique solution, there must exist a unique pair $\{\lambda_x, \beta\}$ that solves equations (10) and (12). From equation (10), it is easy to see that λ_x can be written as a unique function of β. We complete the proof by taking the solution for λ_x derived from equation (10), substituting it in for λ_x in equation (12), and showing that the resulting equation has a unique solution for β:

$$\beta = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_n^2 + \left(\frac{\beta}{c}\right)^2 \sigma_x^2}. \tag{14}$$

Rearranging terms in equation (14) yields the following third-order polynomial equation:

$$\beta^3\sigma_x^2 + \beta(\sigma_v^2 + \sigma_n^2)c^2 - \sigma_v^2 c^2 = 0. \tag{15}$$

Any solution β for equation (15) must be weakly positive (i.e., if β is negative, then the left-hand side is negative). Furthermore, there must exist a unique positive solution because the left-hand side is negative when $\beta = 0$, is monotonically increasing in β, and approaches positive infinity as β approaches positive infinity. Finally, the solution value for β is strictly less than $\sigma_v^2/(\sigma_v^2 + \sigma_n^2)$ because the left-hand side is strictly positive when β equals $\sigma_v^2/(\sigma_v^2 + \sigma_n^2)$. This latter observation is not surprising in that $\beta = \sigma_v^2/(\sigma_v^2 + \sigma_n^2)$ when the manager is constrained to report the earnings he observes (i.e., he cannot bias earnings).

In summary, we have the following proposition.

Proposition 1: There exists a unique linear equilibrium for the reporting game: $P(r) = \beta r + \alpha$ and $b(e, x) = \lambda_e e + \lambda_x x + \delta$, where $\beta \in (0, \sigma_v^2/[\sigma_v^2 + \sigma_n^2])$, $\alpha = -(\beta^2\mu_x/c)$, $\lambda_e = 0$, $\lambda_x = \beta/c$, and $\delta = 0$.

One immediate implication of Proposition 1 is that the uncertainty regarding the manager's incentive to bias reduces the information content of reported earnings, as characterized by the pricing coefficient β, see for example, equation (14). Specifically, in the extreme case where there is no uncertainty regarding the manager's incentives (i.e., $\sigma_x^2 = 0$), β equals $\sigma_v^2/(\sigma_v^2 + \sigma_n^2)$. Note that this value for the coefficient is identical to that attained when the manager is constrained to report the earnings he observes. Thus, in our model, uncertainty about managerial incentives is crucial for managers' biasing activity to affect the value relevance of reported earnings.

V. EMPIRICAL IMPLICATIONS

To highlight the model's insights and empirical implications, we now undertake some comparative static exercises. Before proceeding, however, it is important to clarify our notion of bias. In our model, bias is the *realized* difference between economic earnings and reported earnings. This definition of bias differs from that in the classical statistical sense, where bias is the *expected* difference between economic earnings and reported earnings. This classical, statistical notion of bias is captured in our model by the intercept term in the pricing function, α. Specifically, α is market participants' adjustment for the *expectation* of the difference between the earnings realization and the earnings report, scaled by the market response to marginal changes in the report; that is, $\alpha = -\beta E[b] = -(\beta^2\mu_x/c)$. To contrast these two notions, note that $\mu_x = 0$ implies there is no bias from the statistical (and the market's) perspective because the *expectation* of the difference between economic earnings and reported earnings is 0. On the other hand, bias—as we have defined the term in our paper—is still present because the manager is almost surely reporting earnings that are different from those that he observed. This bias, from the statistical (and the market's) perspective, gives rise to additional noise in earnings.

Regression of Price on Earnings

The association between price and earnings is commonly studied by regressing price on earnings. Our model offers some insights into the determinants of *both* the slope and intercept terms in such a regression because it fits cleanly into a regression framework. In such a regression, the slope coefficient is represented by the earnings association, β, and the intercept is represented by the constant, α. By examining the determinants of both the intercept and slope, we provide predictions about both bias in a classical, statistical sense, as captured by the intercept, and value relevance, as captured by the slope.

Results Concerning the Slope

In models in which the market perfectly backs out any reporting bias, there should be no relation between the value relevance of the report, proxied by the earnings association (or slope), and reporting bias. This occurs because the market perfectly adjusts for reporting bias through the intercept term. In our model, the market does not perfectly back out the bias so we can provide predictions linking the earnings association (i.e., the slope in the regression) to the exogenous determinants of reporting bias: the marginal cost of bias, c, and the uncertainty about the manager's returns to manipulating price, σ_x^2.

Recall that more bias makes the report less informative in our model. Therefore, it is not surprising that the information content of the report (captured by the equilibrium earnings association, β) is increasing in the marginal cost of biasing, c:

$$\frac{d\beta}{dc} = \frac{-2\beta(\sigma_v^2 + \sigma_n^2)c + 2\sigma_v^2 c}{3\beta^2\sigma_x^2 + c^2(\sigma_v^2 + \sigma_n^2)} > 0, \tag{16}$$

because equation (15) requires that $\beta(\sigma_v^2 + \sigma_n^2) - \sigma_v^2 < 0$ in equilibrium. Note that β approaches its lower bound of 0 as c approaches 0 and that β approaches its upper bound of $\sigma_v^2/(\sigma_v^2 + \sigma_n^2)$ as c approaches ∞.

Uncertainty regarding the manager's objective function also affects the relation between bias and the earnings association. Specifically, a comparative static that ties the earnings association, β, to the uncertainty regarding the manager's objective, σ_x^2, is:

$$\frac{d\beta}{d\sigma_x^2} = -\frac{\beta^3}{3\beta^2\sigma_x^2 + c^2(\sigma_v^2 + \sigma_n^2)} < 0. \tag{17}$$

As the uncertainty regarding the manager's objectives increases (as captured by an increase in the variance of $\tilde{x}$), the market places less credence in the report (as reflected in a lower earnings association) because the report provides less precise information regarding the firm's fundamentals. As noted earlier, the earnings association is $\sigma_v^2/(\sigma_v^2 + \sigma_n^2)$ when there is no uncertainty (i.e., $\sigma_x^2 = 0$). In contrast, the earnings association approaches 0 when uncertainty is total (i.e., $\sigma_x^2 \rightarrow \infty$).

The final two exogenous variables we consider have been considered in the prior literature. The first of these is σ_n^2, the inherent quality of the earnings observed by the manager. In the absence of reporting bias, prior literature (e.g., Holthausen and Verrecchia 1988) suggests that the earnings association should be decreasing in σ_n^2 because less noise in reported earnings implies greater earnings association. In our model with reporting bias, however, there is a countervailing force. Specifically, lower earnings association decreases the incentives for reporting bias (i.e., implies a lower value for λ_x). Decreasing the incentives for reporting bias reduces bias, which, in turn, reduces the noise in reported earnings and serves to increase the earnings association. This indirect effect partially offsets the direct effect identified in the prior literature. Nonetheless, the direct effect dominated the indirect effect:

$$\frac{d\beta}{d\sigma_n^2} = -\frac{\beta c^2}{3\beta^2\sigma_x^2 + c^2(\sigma_v^2 + \sigma_n^2)} < 0.$$

The second variable considered in the prior literature is the prior uncertainty regarding the terminal value, σ_v^2. The prior literature (e.g., Holthausen and Verrecchia 1988) again suggests a direct effect of a change in prior uncertainty on the earnings association; the earnings association should be increasing in σ_v^2 because greater noise in prior beliefs implies that new information receives more weight in the posterior expectation. With reporting bias, the indirect effect again provides a countervailing force; if new information receives more weight, incentives to bias—and thus bias—are greater. Nonetheless, the direct effect again dominates the indirect effect:

$$\frac{d\beta}{d\sigma_v^2} = \frac{-\beta c^2 + c^2}{3\beta^2\sigma_x^2 + c^2(\sigma_v^2 + \sigma_n^2)} > 0, \tag{18}$$

because $\beta < 1$ in equilibrium.

Corollary 1 summarizes our results regarding the slope coefficient.

Corollary 1: When price is regressed on earnings, the slope on earnings in the regression, or earnings association, is increasing in the marginal cost of bias, decreasing in the uncertainty regarding the manager's objective, increasing in the quality of the earnings observed by the manager, and increasing in prior uncertainty regarding terminal value: $d\beta/dc > 0$, $d\beta/d\sigma_x^2 < 0$, $d\beta/d\sigma_n^2 < 0$, and $d\beta/d\sigma_v^2 > 0$.

Results on the Intercept

To see how exogenous variables affect the intercept term, first recall that $\alpha = -\beta E[\tilde{b}] = -(\beta^2\mu_x/c)$. Thus, the intercept term is merely the slope times the expected bias in the report. As such it adjusts for the expected amount of bias. When $\mu_x > 0$ (i.e., the likelihood that the manager wants to inflate price exceeds one-half), the intercept term is negative because, on average, the manager biases reported earnings upward; consequently, the adjustment for expected bias is negative. When $\mu_x < 0$ (i.e., the likelihood that the manager wants to inflate price is less than one-half), the intercept term is positive because, on average, the manager biases reported earnings downward.

Throughout our analysis of the intercept term, we assume that $\mu_x > 0$. When $\mu_x < 0$, the comparative static results for the intercept term are the converse of those when $\mu_x > 0$ for all the exogenous variables except μ_x. The comparative static with respect to μ_x is the same in both cases.

We first consider the impact of the marginal cost of bias on the intercept term. The relation between the marginal cost of bias, c, and the intercept term, $\alpha = -(\beta^2\mu_x/c)$, is a function of two countervailing forces. As discussed above, an increase in c increases the association between price and reported earnings, β. This increases the incentives for bias, which drives down the intercept (i.e., a greater adjustment for expected positive bias is needed). On the other hand, an increase in c reduces the incentives for bias because it increases the cost of bias. This reduction in bias increases the intercept term (i.e., a smaller adjustment for expected positive bias is needed). The net of these two forces is generally ambiguous and depends on the magnitude of c. Exploiting the equilibrium conditions, the comparative static relating c to α is:

$$\begin{aligned}\frac{d\alpha}{dc} &= -\frac{d\beta}{dc}\frac{2\beta\mu_x}{c} + \frac{\beta^2\mu_x}{c^2}\\ &= -\frac{-2\beta(\sigma_v^2 + \sigma_n^2)c + 2\sigma_v^2 c}{3\beta^2\sigma_x^2 + c^2(\sigma_v^2 + \sigma_n^2)}\frac{2\beta\mu_x}{c} + \frac{\beta^2\mu_x}{c^2}\\ &\propto 3\beta^3\sigma_x^2 + 5\beta(\sigma_v^2 + \sigma_n^2)c^2 - 4\sigma_v^2 c^2\\ &\propto 2\beta - \frac{\sigma_v^2}{\sigma_v^2 + \sigma_n^2}. \end{aligned} \tag{19}$$

Recall that the equilibrium value for β is between 0 and $\sigma_v^2/(\sigma_v^2 + \sigma_n^2)$. In addition, β is increasing in c, β approaches 0 as c approaches 0, and β approaches $\sigma_v^2/(\sigma_v^2 + \sigma_n^2)$ as c approaches ∞. From these observations, it follows from equation (19) that α is initially decreasing and then subsequently increasing in c when μ_x is positive.

Using Corollary 1, it is a straightforward exercise to show that the remaining comparative statics are unambiguous. Corollary 2 summarizes these results.

Corollary 2: Assume that the manager is more likely to inflate price (i.e., $\mu_x > 0$). The intercept term in a regression of price on earnings, α, is initially decreasing and then subsequently increasing in the marginal cost of bias, increasing in the uncertainty regarding the manager's objective, decreasing in the quality of the earnings observed by the manager, decreasing in prior uncertainty regarding terminal value, and decreasing in the probability that the manager inflates price: $d\alpha/dc > (<) 0$ if $c > (<) \sigma_x\sigma_v^2/2(\sigma_v^2 + \sigma_n^2)^{3/2}$, $d\alpha/d\sigma_x^2 > 0$, $d\alpha/d\sigma_n^2 > 0$, $d\alpha/d\sigma_v^2 < 0$, and $d\alpha/d\mu_x < 0$.

Intuitive explanations for the unambiguous comparative static results in Corollary 2 are as follows. When the uncertainty regarding the manager's objective, as represented by σ_x^2, increases, the association between price and earnings is smaller. This reduces the manager's incentives for bias, which manifests itself in less positive expected bias. Because there is less positive expected bias, a smaller adjustment is needed to adjust for the positive expected bias. Consequently, the intercept term rises to a value that is closer to 0. Likewise, when the quality of earnings observed by the manager, as represented by σ_n^2, decreases, the earnings association is smaller because there is less information in earnings. This decline induces the manager to bias less, which implies lower positive expected bias. Consequently, the necessary adjustment for that bias is smaller, which makes the intercept term rise to a value that is closer to 0. Similar reasoning also applies when the quality of prior information improves (as represented by a decrease in σ_v^2). Specifically, when σ_v^2 decreases, the earnings association is smaller because earnings conveys *relatively* less information. Consequently, the incentives for bias decrease and a smaller adjustment for expected bias is needed in equilibrium. Finally, when μ_x increases, the magnitude of the adjustment for expected bias increases because the manager has greater incentives to bias (on average).

Determinants of Value Relevance

One measure of value relevance is the earnings association, β. The comparative statics results in Corollary 1 yield insight into the determinants of β. An alternative metric for assessing the information content of reported earnings is the degree of "price efficiency" (i.e., the extent to which price reflects all relevant public and private information). One measure of price efficiency is the variance of terminal value conditional upon the market price, $Var[\tilde{v}|P]$, divided by the prior variance, σ_v^2. This measure reflects the proportion of uncertainty remaining after the earnings report.

To perform the comparative statics analysis for price efficiency, it is useful to express $Var[\tilde{v}|P]/\sigma_v^2$ in terms of the model's fundamental parameters:

$$\frac{Var[\tilde{v}|P]}{\sigma_v^2} = \frac{Var[\tilde{v}] - \dfrac{Cov[\tilde{v}, \tilde{P}]^2}{Var[\tilde{P}]}}{\sigma_v^2}$$

$$= \frac{\sigma_v^2 - \dfrac{\sigma_v^4}{\sigma_v^2 + \sigma_n^2 + (\beta/c)^2\sigma_x^2}}{\sigma_v^2}. \tag{20}$$

Using the equilibrium condition in equation (14) allows equation (20) to be rewritten as:

$$\frac{Var[\tilde{v}|P]}{\sigma_v^2} = (1 - \beta). \tag{21}$$

Equation (21) ties price efficiency to earnings association; a higher earnings association (i.e., β) is associated with more efficient prices. From equation (21) it is clear that we can use the comparative statics for the earnings association in Corollary 1 to derive the comparative statics for price efficiency. We summarize the results in Corollary 3.

Corollary 3: Price efficiency is increasing in the marginal cost of bias, decreasing in the uncertainty regarding the manager's objective function, increasing in the quality of the earnings observed by the manager, and decreasing in the prior uncertainty regarding terminal value: $d(\mathrm{Var}[\tilde{v}|P]/\sigma_v^2)/dc < 0$, $d(\mathrm{Var}[\tilde{v}|P]/\sigma_v^2)/d\sigma_x^2 > 0$, $d(\mathrm{Var}[\tilde{v}|P]/\sigma_v^2)/d\sigma_n^2 > 0$, and $d(\mathrm{Var}[\tilde{v}|P]/\sigma_v^2)/d\sigma_v^2 < 0$.

Corollaries 1 and 3 provide a number of insights pertaining to value relevance. First, they offer some theoretical support for the claim that greater enforcement of disclosure regulations, or stiffer penalties for violations of those regulations (as represented by an increase in c) increase the value relevance of firm disclosures. In addition, they suggest that greater disclosure abut manager's objectives (e.g., managerial incentive plans) that reduces σ_x^2 may, in turn, result in more value-relevant reports. Note that this increase in value relevance does not arise because the disclosure provides information about compensation expense. Rather, the increase in value relevance arises because the disclosure increases the user's *understanding* of the manager's incentives to bias the report.

Expected Bias

Expected bias in reports is the final metric we examine. Recall that the manager's choice of bias is $b = (\beta/c)x$. This implies that:

$$E[\tilde{b}] = \frac{\beta}{c} E[\tilde{x}] = \frac{\beta}{c} \mu_x. \tag{22}$$

If, on average, there are greater incentives for managers to inflate current price, then $\mu_x > 0$ and expected bias is increasing in the earnings association. Conversely, if, on average, there are greater incentives for managers to deflate current price, then $\mu_x < 0$ and the expected bias is decreasing in the earnings association. For the remainder of our analysis of expected bias, we assume that the manager, on average, has greater incentives to inflate price (i.e., $\mu_x > 0$). Analogous results hold in the converse case.

Corollary 4 summarizes comparative static results on expected bias.

Corollary 4: Assume that the manager is more likely to inflate price (i.e., $\mu_x > 0$). Expected bias is decreasing in the marginal cost of bias, decreasing in the uncertainty regarding the manager's objective, increasing in the quality of the earnings observed by the manager, increasing in prior uncertainty regarding terminal value, and increasing in the probability that the manager inflates price: $dE[\tilde{b}]/dc < 0$, $dE[\tilde{b}]/d\sigma_x^2 < 0$, $dE[\tilde{b}]/d\sigma_n^2 < 0$, $dE[\tilde{b}]/d\sigma_v^2 > 0$, and $dE[\tilde{b}]/d\mu_x > 0$.

With regard to the first comparative static, note that:

$$\frac{dE[\tilde{b}]}{dc} = -\frac{\beta\mu_x}{c^2} + \frac{\mu_x}{c}\frac{d\beta}{dc} = -\frac{\mu_x}{c^2}\frac{3\beta^3\sigma_x^2 + 3\beta(\sigma_v^2 + \sigma_n^2)c^2 - 2\sigma_v^2c^2}{3\beta^2\sigma_x^2 + c^2(\sigma_v^2 + \sigma_n^2)} < 0. \tag{23}$$

Because $d\beta/dc > 0$, the sign of this comparative static might appear to be ambiguous.

This is because the direct effect of an increase in the marginal cost of bias, $-(\beta/c^2)\mu_x < 0$, is countered by the indirect effect of an increase in the price association with earnings, $(\mu_x/c)(d\beta/dc) > 0$. As is shown, however, the direct effect always dominates because the equilibrium condition for β, equation (15), implies that $3\beta^3\sigma_x^2 + 3\beta(\sigma_v^2 + \sigma_n^2)c^2 - 2\sigma_v^2c^2 = \sigma_v^2c^2 > 0$. The second, third, and fourth comparative statics follow directly from the effect of the variable on the earnings association, β (see Corollary 1). The last comparative static arises because an increase in μ_x is associated with an increase in the manager's average incentives to bias reported earnings upward. Consequently, an increase in μ_x leads to more expected bias in equilibrium.

VI. MANAGERIAL BENEFITS FROM REPORTING BIAS

The introduction explained that many models with reporting bias suggest that the ability to bias the report does not make the manager better off. This outcome arises because these models assume: (1) the market has rational expectations, and (2) the market has perfect knowledge of the manager's reporting objective (i.e., optimization problem). In the presence of these two assumptions, the market perfectly backs out the bias in equilibrium. Consequently, in equilibrium, the manager's bias does not successfully ''fool'' anyone. Furthermore, because bias is costly, the manager bears some cost. Thus, the manager is worse off as a result of being able to bias his report. Because our setting relaxes the assumption that the market knows the manager's reporting objective, we reconsider whether the manager's ability to bias his report renders him worse off.

We first consider the manager's welfare from an *ex ante* perspective by analyzing his welfare before the realization of $\tilde{x}$ and $\tilde{e}$. Second, we analyze the manager's *ex post* welfare conditional on the realization of $\tilde{x}$ (but not $\tilde{e}$). In both cases, we demonstrate that the manager may be better off with the option to bias. Thus, in contrast to the prior literature, our model suggests that the manager is not necessarily made worse off with the option to bias.

The *Ex Ante* Value of Bias

Using the equilibrium condition that $b = x(\beta/c)$, we can express the *ex ante* value of the manager's objective function as:

$$E\left[\tilde{x}(\beta(\tilde{e} + \tilde{b}) + \alpha) - \frac{c\tilde{b}^2}{2}\right] = \frac{\beta^2}{2c}(\sigma_x^2 - \mu_x^2). \tag{24}$$

In contrast, if the manager has no option to bias (i.e., b is restricted to 0), his *ex ante* expected utility is given by:

$$E\left[\tilde{x}\,\frac{\sigma_v^2}{\sigma_v^2 + \sigma_n^2}\,\tilde{e}\right] = 0. \tag{25}$$

Thus, it follows from equations (24) and (25) that the manager is better off when he has the option to bias whenever $(\beta^2/2c)(\sigma_x^2 - \mu_x^2) > 0$, or, equivalently, whenever:

$$\sigma_x^2 - \mu_x^2 > 0. \tag{26}$$

Equation (26) has an interesting economic interpretation. Think of a value of $\sigma_x^2 - \mu_x^2$ as capturing the uncertainty about whether the manager will try to inflate or deflate price. Specifically, when σ_x^2 is large or when μ_x is close to 0, the probability that the manager will inflate his report (and the price) and the probability that he will deflate his report (and the price) move closer together (i.e., each probability approaches one-half). With this interpretation, equation (26) suggests that when *ex ante* uncertainty about types is large (σ_x^2 is large or μ_x is close to 0), the manager is better off with the option to bias. Alternatively, when the uncertainty is small (σ_x^2 is small or μ_x is far from 0), he is worse off with the option to bias. We formalize this discussion with the following corollary.

Corollary 5: The *ex ante* net benefit to the manager from biasing the report is positive if there is sufficient uncertainty as to whether the manager inflates or deflates price; that is, the *ex ante* benefit to the manager from biasing reports assumes a strictly positive value if, and only if, $\sigma_x^2 - \mu_x^2 > 0$.

To offer some intuition for Corollary 5, note that the manager sometimes wants to induce a price that is too high ($x > 0$) and sometimes wants to induce a price that is too low ($x < 0$). In a sense, these different types of realizations create a positive externality for each other. The fact that the manager sometimes wants to induce a lower price, $x < 0$, allows the manager to achieve a higher price in a more cost-efficient manner when $x > 0$. This occurs because investors do not perfectly adjust for the manager's bias through the intercept term in the price function.

When the probability that the manager wants to induce a higher price is sufficiently close to the probability the manager wants to induce a lower price (i.e., σ_x^2 is large or μ_x is close to 0), the intercept term is small in magnitude because investors are highly uncertain as to whether the manager is attempting to induce a price that is too high or a price that is too low. This small intercept term makes the *ex ante* returns to biasing behavior positive. On the other hand, when the manager almost always desires a higher or lower price (i.e., σ_x^2 is small or μ_x is far from 0), the intercept term becomes large in magnitude, which makes the *ex ante* returns to biasing behavior negative. Thus, if one believes the manager only wants to bias price upward ($\mu_x > 0$ and $\sigma_x^2 = 0$), then our model yields the standard outcome.

Finally, the fact that managers may benefit *ex ante* from biasing reports should not be interpreted as suggesting that some other parties lose *ex ante*. The only other parties in the model are risk-neutral investors and they do not lose *ex ante* because price is equal to their (rational) expectation of firm value based on what is reported. In effect, managers can benefit *ex ante* because the game is not structured as a zero sum game.

The *Ex Post* Value of Bias

Our analysis of *ex post* manager welfare addresses the following question: for what realizations of $\tilde{x}$ does the option to bias make the manager better off? Using the equilibrium condition that $b = x(\beta/c)$, the manager's expected utility conditional upon the realization x can be written as:

$$E\left[\tilde{x}(\beta(\tilde{e} + \tilde{b}) + \alpha) - \frac{c\tilde{b}^2}{2}\middle|\tilde{x} = x\right] = \frac{\beta^2}{2c}[(x - \mu_x)^2 - \mu_x^2]. \tag{27}$$

In contrast, when the manager cannot bias (b is restricted to 0), the manager's expected utility conditional upon the realization of x is given by:

$$E\left[\tilde{x}\,\frac{\sigma_v^2}{\sigma_v^2 + \sigma_n^2}\,\tilde{e}|\tilde{x} = x\right] = 0. \tag{28}$$

It follows from equations (27) and (28) that the manager is better off with the option to bias if:

$$(x - \mu_x)^2 - \mu_x^2 > 0. \tag{29}$$

Equation (29) implies that the manager is better off with the option to bias when the realization x is sufficiently far from expectations. The intuition underlying this result is that the manager is better off with the option to bias in those states where he has a high marginal return to manipulating the market price. This leads to the following corollary.

Corollary 6: The *ex post* net benefit to the manager from biasing the report is positive if his marginal benefit from manipulating price is large; that is, the manager is better off in a setting where he has the option to bias if and only if $(x - \mu_x)^2 - \mu_x^2 > 0$.

Note that the manager benefits for all state realizations of x in the special case in which $\mu_x = 0$. The reason for this is that $\mu_x = 0$ implies that the intercept term in the pricing function is 0. For example, the positive bias of, say 10, in x's report is offset by the negative bias of -10 in $-x$'s report because the probability density for x equals the probability density for $-x$.

VII. SUMMARY

In this paper we develop a parsimonious model that explains how managers' reporting bias can be value relevant. The key to our model is the relaxation of the assumption that the market (perfectly) knows the manager's reporting objective. Upon relaxing this assumption, we find that bias in the manager's report reduces the value relevance, or the information content, of the report. The model yields comparative statics that provide insight into factors that affect the slope and intercept terms in a regression of price on earnings. For example, we show that the information content of the manager's report, as captured by the earnings slope coefficient, falls as the private cost to the manager of biasing reports falls, and as the uncertainty about the manager's objective increases. In addition, we show that the magnitude of the adjustment for the expected amount of bias, as captured by the absolute value of the intercept, falls as the uncertainty about the manager's objective increases. In contrast with other models of reporting where investors can perfectly adjust for the manager's bias, we also demonstrate that when the market cannot perfectly adjust, the manager may be strictly better off with the option to bias.

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