Reporting Bias and Analyst Forecast Accuracy*

Greg Clinch†
Deakin University

Nanqin Liu‡
University of Macau

Yan Meng§

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Abstract

We investigate how managers' and analysts' shared and conflicting incentives interact to affect firms' financial reports and analysts' forecasts, the reports' association with market prices, and their information content. In our model, the analyst strives to forecast accurately while generating trading profits for a client; the manager aims to meet the analyst's forecast while seeking favorable stock price responses to their financial report. We show that the manager's incentive to meet the analyst's forecast, when combined with the analyst's incentive to forecast accurately, leads to greater forecast accuracy and a greater response coefficient to the financial report in price despite the report having lower information content. Higher quality information possessed by the analyst can result in lower forecast accuracy and less total information being conveyed to the market by the forecast and the financial report.

Keywords: reporting bias, forecast accuracy, earnings response coefficient, information content

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† Faculty of Business and Law/Deakin Business School. Email: g.clinch@deakin.edu.au.
‡ Department of Accounting and Information Management, Faculty of Business Administration, University of Macau. Email: nanqinliu@um.edu.mo.
§ Yan, formerly at Inner Mongolia University, tragically passed away before the completion of this paper.

1. Introduction

Firms' financial reports and analysts' forecasts are central to the information provided to outside investors. Prior research has documented a range of shared and (potentially) conflicting incentives faced by analysts and firm managers in their forecasting and financial reporting decisions. For example, analysts strive to forecast accurately while at the same time generating trading profits for their clients, and managers aim to meet analysts' forecasts while seeking a favorable stock price response to their financial reports.[1] However, to date, understanding is limited regarding how these shared and conflicting incentives might interact and combine to affect managers' reporting and analysts' forecasting decisions (Beyer, Cohen, Lys, and Walther 2010). Our objective is to enhance understanding on this issue and to investigate how these decisions flow through to properties of the reports and forecasts issued, such as report volatility and forecast accuracy, their association with market prices, and their information content.

We employ a model where a firm's manager and an analyst have both shared and conflicting incentives, and where each is affected by the other's decisions as well as their own. Our model setting features four participants: a firm/manager, an analyst, an informed investor who is the analyst's client, and a market maker who sets stock prices. The manager releases a public financial report about the firm's payoff based on balancing three competing objectives: truthful reporting, a favorable stock price response, and meeting the analyst's forecast (made prior to the financial report). Following Fischer and Verrecchia (2000), the manager has superior information regarding the firm's payoff and their own price-based incentives. Prior to the release of the firm's financial report, the analyst determines a forecast of the report, which is first

[1] For a review of the related literature see Beyer et al. (2010).

communicated privately to a client investor and subsequently made public. Because the client receives the analyst's forecast before it becomes public, they are able to trade profitably on that information. In determining the forecast, the analyst also faces competing objectives: increasing the client's expected trading profits and forecasting accurately. As a result, the manager and analyst have a shared interest in reducing the forecast error (or, equivalently, the "surprise" in the report) but have disparate additional motivations.

A key feature of our analysis is that the financial report and the forecast are both endogenously determined within the model. As Beyer et al. (2010) note, incorporating joint endogeneity in this way is important in developing a better understanding of the role of interdependence between firms and analysts in the information environment, and the implications for properties of financial reports and forecasts. They note that much prior related analytical research employs settings where either the financial report or the analyst forecast is endogenous, but not both, and call for research settings where endogenous reports and forecasts interact. Our research adds to the small but growing literature that responds to this call (*e.g.*, Beyer 2008; Chan and Liu 2022).

We describe several primary findings. We find that the incentives facing the analyst and the manager result in both cosmetic and informational effects on the firm's financial report and the analyst's forecast. The manager's incentive to meet the analyst's forecast causes the manager to distort the report towards the forecast, effectively "shrinking" the underlying signal within the report (via a multiplicative scaling factor). This direct effect is cosmetic (*i.e.*, does not affect the information conveyed by the report) because the analyst's forecast is public, and leads to greater forecast accuracy (all other things equal) because of the analyst's incentive to forecast accurately. However, there is also an indirect informational effect. Because the price response coefficient to the report increases as a result of the manager's cosmetic distortion in the financial report – effectively undoing the multiplicative scaling factor within the report - this encourages the manager to increase the (uncertain) price-based distortion in the financial report, which alters its informational properties. Thus, the manager's incentive to meet the analyst's forecast, when combined with the analyst's incentive to forecast accurately, leads to greater forecast accuracy and a greater response coefficient to the report in price despite the report having lower information content.

We also investigate how the quality of the analyst's private information affects forecast accuracy and the information content of the forecast and financial report. We find that for some parameter values, higher-quality information that the analyst possesses can result in lower forecast accuracy. This occurs when the analyst is strongly motivated by their client's interests because it leads them to exaggerate their expectations of the financial report in the forecast. Finally, we also show that when an analyst possesses higher-quality information less information in total makes its way to the market via the forecast and the financial report.

Our investigation makes several contributions. It enhances our understanding of the corporate information environment—specifically financial reports, analysts' forecasts, and market responses—and how it is shaped by the interaction between analysts and managers with both shared and conflicting interests. In particular, our study relates to three main streams of literature. First, assessing the usefulness of earnings to investors has generated considerable research effort since Ball and Brown (1968) and Beaver (1968). The earnings response coefficient (ERC) has been widely adopted as a proxy for investor-perceived earnings quality and informativeness (Fan and Wong 2002; Francis, Schipper, and Vincent 2005; Dechow, Ge, and Schrand 2010;

Guan, Su, Wu, and Yang 2016; Kim, Kyung, and Ng 2022; Tsang, Wang, and Zhu 2025). Prior literature frames the ERC as influenced by both accounting information (Collins and DeAngelo 1990; Wang 2006; Keung, Lin, and Shih 2010; Haggard, Howe, and Lynch 2015; Baik, Gunny, Jung, and Park 2022) and non-accounting information such as analysts' earnings forecasts (Weiss 2010; Bissessur and Veenman 2016; Drake, Moon, Twedt, and Warren 2023). However, the research into the return-to-earnings relation has been primarily empirical, and our understanding is limited concerning the theoretical relations underlying firms' mandatory disclosure decisions and analysts' information production: it remains unclear how returns should be related to earnings along with non-accounting information such as analyst's forecasts (Zhang 2010). For example, the empirical return-to-earnings research largely uses analysts' forecasts as expected earnings despite analysts being known to have incentives to manipulate forecasts towards (their expected) managers' reports (Lev 1989). Our results shed light on the returns-earnings-analyst forecast relation when managers and analysts have several shared and conflicting incentives.

Second, distortion in financial reporting is a fundamental and widely discussed topic in the accounting literature. We contribute to this line of inquiry by focusing on the interaction between managers and analysts and showing that the manager's incentive to meet the analyst's forecast increases distortion in financial reports. In addition, when investigating managers' attempts to meet outstanding expectations, the empirical literature often assumes that analysts do not undo any effects of earnings management (Beyer et al. 2010). We contribute to this literature by showing how analysts' and managers' rational anticipations of each other's actions affect their reporting and forecasting decisions. Specifically, in our setting, the analyst's incentive to forecast accurately induces the analyst's forecast to be upwardly distorted because the analyst rationally expects that the manager will upwardly bias financial reports to induce a favorable stock price. This bias in the analyst's forecast is in turn incorporated into the manager's report because the manager attempts to meet the analyst forecast.

Third, a large stream of literature examines factors associated with analyst forecast accuracy, including analyst experience, the number of firms and industries followed by an analyst, macroeconomic uncertainty, and financial reporting quality (Mikhail, Walther, and Willis 1997; Clement 1999; Hope 2003; Lehavy, Li, and Merkley, 2011). Our study adds to this research and shows when analysts' possession of better-quality information about firm performance can improve their forecast accuracy, primarily when their incentive to generate trading profits for clients is relatively weak.

Our investigation also generates several implications for empirical research. Assessing the return-earnings relation has received considerable attention in the accounting literature. Our results caution against (i) using ERC as a proxy for financial report quality, especially in settings where managers might be strongly motivated to meet analyst forecasts; and (ii) interpreting explanatory power for analyst forecasts beyond earnings report surprise as evidence of market inefficiency. Our analysis also suggests some potentially new empirical predictions (outlined in section 6.2) that relate the interplay of incentives facing both firm managers and analysts to the association between returns and earnings surprise and forecast accuracy.

The remainder of the paper is organized as follows. Section 2 discusses prior research related to our analysis. The model is outlined in Section 3, while Section 4 describes the equilibrium. Section 5 presents our primary findings. We discuss potential empirical implications in Section 6 and conclude in Section 7.

2. Related Research

Our paper incorporates aspects of two streams of research that study analyst forecasting and financial reporting. Prior research in the analyst forecasting literature that examines the bias in analyst forecasts includes Mittendorf and Zhang (2005), Beyer (2008), and Chan and Liu (2022). Beyer (2008) investigates the shared interest between an analyst (who intends to forecast earnings accurately) and a manager (who wishes to meet the analyst's forecast). Our paper complements Beyer (2008) by investigating not only the shared interests between managers and analysts but also potential conflicting interests. In addition, our model contains an additional strategic investor (the analyst's client) whose trading strategy is based on the analyst's forecast. While the results in Beyer (2008) are mainly driven by the manager's asymmetric cost when the manager's report beats the analyst forecast versus when the report does not, our results are primarily driven by the shared and conflicting interests as well as the interaction with the strategic investor. Mittendorf and Zhang (2005) examine the situation in which analysts are forecast-error- and effort-averse and managers use earnings guidance to affect analysts' forecasts. Chan and Liu (2022) focus on analysts' disciplinary effect on managers' earnings manipulation. The moving sequence of players in our paper differs from that in Mittendorf and Zhang (2005) and Chan and Liu (2022): in our model, the analyst makes their strategic forecasting decision before the manager issues the firm's financial report.

Some other papers, such as Langberg and Sivaramakrishnan (2008) and (2010), assume that managers' disclosure, which is assumed truthful, and analysts' reports provide complementary information about different aspects of a firm's terminal payoff. In Langberg and Sivaramakrishnan (2008), analysts discover the information that a manager has but is unable to convey credibly. In Langberg and Sivaramakrishnan (2010), analysts provide information that managers do not know, and thus, the managers learn about the appropriateness of firm decisions from analysts' feedback. Accordingly, Langberg and Sivaramakrishnan (2008) and (2010) are silent about analysts' forecast accuracy with respect to managers' reports. Also, the two papers assume that analysts move after managers. Other models, such as Trueman (1994), Morgan and Stocken (2003), Beyer and Guttman (2011), and Meng (2015), do not study the manager's reporting issue. In addition, these studies provide no basis for evaluating the importance of the earnings report on the market price of the firm because in their models, manages do not care about the stock price (Beyer 2008), managers' reports are binary (Mittendorf and Zhang 2005; Chan and Liu 2022), or managers do not report earnings (Trueman 1994; Morgan and Stocken 2003; Beyer and Guttman 2011; and Meng 2015). Our paper provides predictions regarding the association between the earnings report and the market's reaction to the report, given the presence of a strategic analyst.

Regarding the stream of analytical research that studies financial reporting, similar to that literature, we focus on deriving a linear pricing function that reflects the manager's incentives and, in our case, the analyst's incentives. Our model is built on the analysis in Fischer and Verrecchia (2000) but extends it in several ways. In their model, investors value the firm based on updating exogenously specified priors regarding the firm's final payoff after observing the manager's (possibly distorted) financial report. In our model, investors' priors are endogenously affected by the analyst's forecast, which is influenced by the analyst's expectation of the manager's financial report. Thus, the manager's reporting decision indirectly affects the investor's priors. In addition, the analyst's client-based incentives affect the forecast issued, and this flows through to the manager's financial reporting decision. The interaction of these effects potentially influences the measurement properties of the report and forecast, how they associate with equilibrium prices, and their information content to market participants. In addition, we study the effect of the earnings report and the analyst's forecast on the firm's market price in a way that yields some empirically testable predictions for their properties, including report volatility, forecast accuracy, price associations, and information content.

3. The Model

There is a single firm with a final payoff comprising two components: $u = u_1 + u_2$, where u_1 and u_2 are independently and normally distributed with zero mean and variances of $\alpha_u \sigma_u^2$ and $(1 - \alpha_u)\sigma_u^2$ respectively, with $0 \leq \alpha_u \leq 1$. There are three dates and four economic participants in the model. At time $t = 3$, the manager of the firm observes u and releases a public report, r. The manager chooses r subject to an objective function that we describe below. There is also an analyst who chooses a forecast, f, of the manager's report based on private information available to them and subject to their own forecasting incentives. The forecast becomes publicly available at time $t = 2$. However, prior to this (at time $t = 1$) the analyst privately communicates f to a client/investor who trades upon the information in order to maximize their expected trading profits.[2] Trading occurs at three times in the model: $t = 1$, 2, and 3, with prices P_1, P_2, and P_3 determined by a risk-neutral market maker.

3.1 The manager's information and objective function

[2] Institutional traders receive tips regarding the contents of forthcoming analysts' reports. See more discussion about the prerelease of analyst reports, namely tipping, to clients in Irvine, Lipson, and Puckett (2007), Guttman (2010), and Christophe, Ferri, and Hsieh (2010).

The manager chooses their financial report at time $t = 3$ to maximize the following objective function:

$$xP_3 - \frac{c_{Mu}}{2}(r-u)^2 - \frac{c_{Mf}}{2}(r-f)^2.$$

The objective function comprises three parts. The first component, xP_3, represents priced-based reporting incentives at the time of reporting. We assume $x = \mu_x + x_1 + x_2$ where x_1 and x_2 are independently normally distributed with zero mean and variances of $\alpha_x \sigma_x^2$ and $(1-\alpha_x)\sigma_x^2$ respectively, with $0 \leq \alpha_x \leq 1$. Only the manager knows x, however (as described below) the analyst observes a private signal about x. Economically, x represents the strength of the manager's price-based reporting incentives, and there is uncertainty for other market participants about these incentives. The second and third components of the manager's objective function, $\frac{c_{Mu}}{2}(r-u)^2$ and $\frac{c_{Mf}}{2}(r-f)^2$, represent costs to the manager from issuing a report that deviates from the underlying true value of the firm's payoff, u, and the analyst's forecast, f, respectively. c_{Mu} and c_{Mf} are parameters that reflect these costs' strength and are assumed to be positive. These two components of the manager's objective function provide the manager with incentives to report accurately and to meet the analyst's forecast. The objective function follows that used in Fischer and Verrecchia (2000) with the addition of the third component relating to incentives to meet the analyst's forecast. Setting c_{Mf} to zero results in reporting incentives identical to those in Fischer and Verrecchia (2000).

Note that in our model, the manager's overall net cost of deviating from the analyst's forecast is higher when the manager's report misses the forecast than when it beats the forecast. This cost asymmetry is consistent with Beyer (2008) and is made apparent after combining the manager's different components of incentives (i.e., the first and third terms). The benefits the manager receives from favorable stock prices, such as stock-price-based compensation and the gains from the future sale of shares, incentivize the manager to generally avoid missing the analyst's forecast but worry less about exceeding it.

3.2 The analyst's information and objective function

The analyst possesses private information regarding the firm's final payoff, u, and the firm manager's price-based reporting incentive parameter, x. Specifically, the analyst observes u_1 and x_1 which can be thought of as representing information regarding the firm's payoff and manager's reporting incentives that the analyst is able to generate via their research activities. As described above, the variances of these two signals are $\alpha_u \sigma_u^2$ and $\alpha_x \sigma_x^2$ respectively. As a result, α_u and α_x are parameters which reflect the quality of the analyst's private information regarding the firm's final payoff and the manager's reporting incentives.

The analyst chooses their forecast, f, to maximize the following objective function given the private information available to them:

$$kE[\Pi_I | u_1, x_1] - \frac{c_A}{2} E[(r - f)^2 | u_1, x_1].$$

The objective function comprises two parts. The first part, $kE[\Pi_I | u_1, x_1]$, is the expected trading profit, Π_I, of the analyst's client times a parameter k, where we assume that $k > 0$. This component of the analyst's objective function ties the analyst's incentives to those of their client, with k reflecting the importance of the client's interests to the analyst. The second part of the analyst's objective function, $\frac{c_A}{2} E[(r - f)^2 | u_1, x_1]$, indicates that the analyst is also motivated to forecast accurately, with the parameter $c_A \geq 0$ reflecting the importance of forecast accuracy to the analyst. This, together with the manager's interest in meeting the analyst's forecast (as described above), means that the analyst and the manager have a shared interest in minimizing the extent to which the report and the forecast disagree. However, they both also have conflicting motivations as indicated by the other components of their respective objective functions. We assume that c_A is sufficiently large such that the analyst's objective function is concave in f and their decision problem has a unique interior solution.[3]

3.3 The informed investor's information and objective function

The analyst's client privately receives the analyst's forecast, f, at time $t = 1$. The client chooses the amount they wish to trade at that time, z_I, in order to maximize their expected profit from trading. Because the analyst's forecast becomes publicly known at time $t = 2$ their informational advantage is short-lived. Specifically, the client's profit from trading on the information is $\Pi_I = z_I(P_2 - P_1)$. They choose z_I to maximize $E[z_I(P_2 - P_1)|f]$. Following Kyle (1985), we assume that the client anticipates and accounts for the effect of their trading decision on prices at time $t = 1$ when choosing z_I.

3.4 The market maker's information and objective function

Following Kyle (1985), the market maker is assumed to set prices in each period so that their expected profit (given information available to them) is zero. This means that they price the firm at each time equal to the expected value of the firm's payoff at that time. At time $t = 1$ the market maker recognizes that there is an informed trader

[3] The inequality $c_A > \frac{k\omega^2}{4\gamma(1-\lambda)^2(1+\theta)^2}$ satisfies this assumption, where λ, ω, γ and θ are defined later in Proposition 1 and Expression (1).

who knows f and whose trade, z_I, reflects that information. There is also uncertain trade from uninformed traders, z_U, where z_U is independently normally distributed with zero mean and variance equal to σ_z^2. The market maker observes total trade, $z = z_I + z_U$, at time $t = 1$ and sets price to $P_1 = E[u|z]$.

At time $t = 2$ the analyst's forecast becomes publicly known. This means that the total trade at time $t = 1$ becomes redundant information to the market maker at time $t = 2$ and they set price equal to $P_2 = E[u|f]$. At time $t = 3$ the firm manager's report, r, also becomes publicly known and the market maker sets price equal to $P_3 = E[u|r, f]$.

In summary, the model shares elements of its structure with both Kyle (1985) and Fischer and Verrecchia (2000), but with the addition of an analyst, and with partially shared interests between the informed trader/client and analyst, and between the analyst and the manager. In the following section, we derive and discuss the equilibrium for this model.

4. The Equilibrium

The model described above is complex, involving four economic participants over three time periods. Deriving the equilibrium involves determining each participant's optimal strategy given other participants' conjectured strategies, then finding the combination of optimal strategies that are consistent with the conjectured strategies.[4]

[4] Consistent with prior related research (*e.g.*, Kyle 1985; Fischer and Verrecchia 2000) we restrict attention to a "linear equilibrium", *i.e.*, an equilibrium that involves linear strategies by participants in the model. The proof of proposition 1 shows that for each model participant, a linear strategy is optimal given other participants' linear strategies.

We begin with the following definitions that are useful in deriving and presenting the model's equilibrium:

Definitions:

Let $P_3 = \beta_0 + \beta_r(r - f) + \beta_f f$ be the expression for price set by the market maker at time $t = 3$ based on the manager's report, r, and the analyst's forecast, f.[5] Then define:

$$\hat{r} = u + \frac{\beta_r}{c_{Mu}} x,$$

$$\hat{f} = E(\hat{r}|u_1, x_1) = u_1 + \frac{\beta_r}{c_{Mu}}(\mu_x + x_1),$$

$$\omega = \frac{\mathrm{Cov}(u,\hat{f})}{\mathrm{Var}(\hat{f})} = \frac{\alpha_u \sigma_u^2}{\alpha_u \sigma_u^2 + \left(\frac{\beta_r}{c_{Mu}}\right)^2 \alpha_x \sigma_x^2},$$

$$\lambda = \frac{c_{Mf}}{c_{Mf} + c_{Mu}}. \quad (1)$$

Note that $\hat{r}$ is the report the firm's manager would issue if $c_{Mf} = 0$, *i.e.*, if the manager were not motivated to meet the analyst's forecast. It is the same as the equilibrium reporting solution in Fischer and Verrecchia (2000), where the manager's report is equal to the firm's payoff distorted by a (random) factor, $\frac{\beta_r}{c_{Mu}} x$, which reflects the manager's reporting incentives, x, the responsiveness of $t = 3$ price to the report, β_r, and the importance to the manager of "truthful" reporting, c_{Mu}. $\hat{f}$ is the expected value of $\hat{r}$ given the analyst's information. ω is the response coefficient on $\hat{f}$ in $E[u|\hat{f}]$. Finally, λ reflects the relative importance to the manager of meeting the analyst's forecast compared with reporting truthfully.

[5] The P_3 expression is presented in the form of "report surprise" (*i.e.*, $r - f$) and the forecast as the two information constructs, which is informationally equivalent to the (r, f) pair.

Given these definitions the following proposition describes the model's equilibrium (all proofs are in the appendix):

Proposition 1

Given the definitions in (1) the equilibrium is given by:

Manager's report: $$r = \hat{r} + \lambda(f - \hat{r}), \tag{2}$$

Analyst's forecast: $$f = \hat{f} + \theta\big(\hat{f} - E(\hat{f})\big), \tag{3}$$

Informed investor's trade $$z_I = \frac{\omega}{2\gamma(1+\theta)}(f - E(f)), \tag{4}$$

Prices:
$$P_1 = \gamma z,$$
$$P_2 = \frac{\omega}{1+\theta}(f - E(f)),$$
$$P_3 = \beta_r(r - f) + \beta_f(f - E(f)), \tag{5}$$

where:

$$\theta = \frac{1}{2}\left(\sqrt{1 + \frac{2k\omega^2}{c_A(1-\lambda)^2\gamma}} - 1\right),$$

$$\gamma = \frac{1}{2}\sqrt{\frac{\omega\alpha_u\sigma_u^2}{\sigma_z^2}},$$

$$\beta_f = \frac{\theta(1-\lambda)\beta_r + \omega}{1+\theta},$$

and β_r is the (unique) solution to the following equation:

$$(1-\lambda)\beta_r = \frac{(1-\alpha_u)\sigma_u^2}{(1-\alpha_u)\sigma_u^2 + \left(\frac{\beta_r}{c_{Mu}}\right)^2(1-\alpha_x)\sigma_x^2}. \tag{6}$$

There are several notable features of the equilibrium described in Proposition 1. First, the manager's financial report, $r = \lambda f + (1-\lambda)\,\hat{r}$, is a weighted average of (i) f, the analyst's forecast, with weight λ, which reflects the relative importance to the manager of meeting the analyst's forecast compared with reporting truthfully and (ii)

$\hat{r}$, the report the manager will issue if they have no incentive to meet the analyst's forecast, with weight $(1-\lambda)$. Equation (2) indicates that the report can be rewritten as $\hat{r}$ plus an additional component, $\lambda(f-\hat{r})$. As noted above in equation (1), $\hat{r} = u + \frac{\beta_r}{c_{Mu}}x$ is equal to the firm's true final payoff distorted by $\frac{\beta_r}{c_{Mu}}x$, reflecting the manager's price-based reporting incentives, x. Because the reporting incentives are uncertain to the market maker, the distortion in $\hat{r}$ has informational effects. That is, it affects the information about u that can be extracted from the report. Equation (2) in Proposition 1 indicates that the manager's incentive to meet the analyst's forecast creates an additional source of distortion in the financial report, $\lambda(f-\hat{r})$. Specifically, the manager distorts the financial report by moving it towards the analyst's forecast. The extent of this distortion is influenced by λ. However, this distortion has no informational effect on the financial report since the effective signal contained within the report, $\hat{r}$, can be inferred from the report (together with the forecast) irrespective of the distortion. Thus, this source of distortion is cosmetic in nature – it affects the reported value without affecting its information content, which is provided by $\hat{r}$.

Regarding the analyst's forecast, equation (3) in Proposition 1 indicates that the forecast is equal to $\hat{f}$, the analyst's expected value of $\hat{r}$ given their information, distorted by the term $\theta[\hat{f} - E(\hat{f})]$. As noted above in equation (1), $\hat{f} = E(\hat{r}|u_1, x_1) = u_1 + \frac{\beta_r}{c_{Mu}}(\mu_x + x_1)$ represents the effective information signal about the firm's final payoff that the analyst's client and market maker can extract from the forecast, and is equal to the analyst's expected value of the final payoff, u_1, distorted by $\frac{\beta_r}{c_{Mu}}(\mu_x + x_1)$, representing the analyst's expectation of the distortion in the financial report driven by the manager's price-based reporting incentives. As in the case for the manager's report, this distortion in the analyst's forecast is uncertain to the client and the market maker and so affects the information content of the forecast. It occurs because the analyst has an incentive to forecast accurately, *i.e.*, to forecast the manager's report, which as discussed above is affected by the manager's price-based reporting incentives.[6] Equation (3) in Proposition 1 indicates that the analyst's incentive to increase their client's expected trading profit creates an additional source of distortion in the forecast, $\theta[\hat{f} - E(\hat{f})]$. If the analyst is not motivated by their client's trading profits, *i.e.*, if $k = 0$, then $\theta = 0$ and this source of distortion disappears. In addition, the distortion does not affect the information content of the forecast because $\hat{f}$ can be inferred from the forecast irrespective of the value of $\theta[\hat{f} - E(\hat{f})]$. As the proof of the proposition and equations (4) and (5) make clear, this source of distortion in the analyst's forecast occurs because the market maker and client base their respective pricing and trading strategies on the analyst's forecast, f. The idea is that the surprise in the analyst's forecast, $\hat{f} - E(\hat{f})$, drives the quantity of stock the client wishes to trade, the change in stock price, and hence the client's profit. Specifically, the larger the magnitude of surprise, $\hat{f} - E(\hat{f})$, the more the client can profit from the analyst's report, given the analyst's forecasting strategy. In other words, the client's expected profit can be increased through the analyst's exaggeration of the news content of $\hat{f}$. This is reflected in the forecast via the $\theta[\hat{f} - E(\hat{f})]$ term. In equilibrium, both the market maker and the client anticipate this exaggeration, making this source of distortion cosmetic in nature.[7] This cosmetic property of the distortion in analyst forecast is similar in nature to Beyer (2008) in that the price-setting market maker can perfectly infer the analyst's effective

[6] In section 6.1 we discuss the impact on the model of assuming that the analyst's incentive is to forecast the firm's final payoff rather than the manager's report.
[7] The proof of Proposition 1 indicates that if the analyst has no incentive to forecast accurately, *i.e.*, if $c_A = 0$, then the analyst's incentive to increase their client's trading profits is unbounded (*i.e.*, θ approaches infinity) and no equilibrium exists. In effect, the analyst's incentive to forecast accurately acts as a brake on their client-based forecasting incentives.

signal about the manager's report (in our paper $\hat{f}$) because the analyst's incentives are publicly known. However, in our setup the market maker is unable to use $\hat{f}$ to perfectly infer the analyst's information about the firm's final payoff because the analyst's forecast is one signal which combines the two original signals the analyst has regarding the firm's final payoff and the manager's uncertain price-based incentive.

In summary, Proposition 1 reveals that the equilibrium financial report and analyst forecast distort the effective information signals contained within each due to the manager's incentive to meet the analyst's forecast and induce a favorable stock price as well as the analyst's incentives to forecast accurately and improve their client's trading profit. In the next section we investigate the effects of these distortions on the properties of the financial report and analyst forecast, their association with market prices, and their information content.

5. Properties, Information Content and Market Associations

5.1 Properties of financial report and analyst forecast

5.1.1 Financial report properties

We discuss three properties of the manager's equilibrium financial report in this subsection: bias in the report, volatility of the report, and "smoothing" in the report (towards the firm's true underlying payoff).

Bias in the financial report

As is the case in Fischer and Verrecchia (2000), it is clear from equation (2) in Proposition 1 that the manager's report is upwardly biased relative to the expected firm payoff, $E(u) = 0$. Specifically, $E(r) = E(\hat{r}) = \frac{\beta_r}{c_{Mu}}\mu_x > 0$, where the magnitude of the bias is related to the expected manager's price-based incentive parameter, μ_x, the equilibrium price association coefficient for the report, β_r, and the strength of the manager's incentive for truthful reporting, c_{Mu}. Although the bias is not directly linked to the manager's incentive to meet the analyst's forecast, represented by λ, it is indirectly related because λ influences equilibrium β_r. Specifically, as we discuss below in subsection 5.2 regarding market associations, it is clear from equation (6) that equilibrium β_r is increasing in λ (holding c_{Mu} constant), and thus the positive bias in the manager's report is increasing in the strength of the manager's incentive to meet the analyst's forecast.

Of note, however, is that the analyst's incentives do not affect the level of bias in the financial report. Specifically, k and c_A, which reflect the importance to the analyst of their client's trading profitability and accurate forecasting respectively, do not affect bias in the financial report. This is despite the manager being motivated to meet the analyst's forecast. As noted previously, equation (2) in Proposition 1 indicates that the manager's incentive to meet the analyst's forecast creates an additional source of distortion in the financial report equal to $\lambda(f - \hat{r})$. But as equation (3) indicates, both f and $\hat{r}$ have the same expected value. The reason is that the analyst's forecast f deviates from $\hat{f}$, their expectation about $\hat{r}$, to exaggerate the information surprise in their forecast (i.e., $\hat{f} - E(\hat{f})$). However, *ex ante* there is no information surprise on average in the analyst's forecast, and thus the expectation of the distortion $\lambda(f - \hat{r})$ equals zero. In other words, the influence of the analyst's forecast on the manager's report indicated in equation (2) "averages out" resulting in no effect on the bias in the financial report.

Volatility of the financial report

Using equation (2) from Proposition 1, $\text{Var}(r) = \text{Var}(\hat{r}) + \lambda^2\text{Var}(f - \hat{r}) + 2\lambda\text{Cov}(\hat{r}, f - \hat{r})$. $\text{Var}(\hat{r})$ represents the volatility of the underlying information signal about the firm's payoff contained within the report. Using equation (1), it comprises the variance of the firm's payoff, σ_u^2, plus the variance of the distortion in the signal due to the manager's price-based reporting motives, $\left(\frac{\beta_r}{c_{Mu}}\right)^2 \sigma_x^2$.

Because the manager's priced-based incentive parameter, x, is assumed to be uncorrelated with the firm's payoff, $\mathrm{Var}(\hat{r}) > \sigma_u^2$. Thus, the manager's price-based reporting incentives result in increased volatility in the financial report. In contrast, the manager's incentive to meet the analyst's forecast can result in increased or decreased volatility. This is because the cosmetic component of the report, $\lambda(f - \hat{r})$, covaries negatively with $\hat{r}$ for some parameter values. Note that $f - \hat{r} = \hat{f} - \hat{r} + \theta\left(\hat{f} - E(\hat{f})\right) = -\left[u_2 + \left(\frac{\beta_r}{c_{Mu}}\right)x_2\right] + \theta\left[u_1 + \left(\frac{\beta_r}{c_{Mu}}\right)x_1\right]$. The analyst's forecast deviates from $\hat{r}$ for two reasons. First, the analyst misses some information due to inability (that is, the analyst cannot learn about u_2 or x_2), causing $f - \hat{r}$ to covary negatively with $\hat{r}$. Second, the analyst exaggerates the signal they have (i.e., u_1 and x_1) for the client's trading profit, causing a positive association between $f - \hat{r}$ and $\hat{r}$. If the analyst is not motivated by their client's trading profitability (*e.g.*, if $k = 0$, or $c_A \to \infty$) then the analyst has no incentive to exaggerate their signals about u_1 and x_1 in the forecast (*i.e.*, equilibrium $\theta = 0$), then $\mathrm{Cov}(\hat{r}, f - \hat{r}) < 0$. In this case, it is straightforward to show that $\mathrm{Var}(r) = \mathrm{Var}(\hat{r}) - \lambda(2 - \lambda)\mathrm{Var}(\hat{r} - \hat{f}) < \mathrm{Var}(\hat{r})$. Intuitively, in this case the manager's incentive to meet the analyst's forecast causes the manager to distort their report towards the analyst's expectation of $\hat{r}$, which has lower variability than $\hat{r}$. In contrast, if k is sufficiently large or c_A is sufficiently low (*i.e.*, the analyst is motivated primarily by their client's trading profitability), equilibrium θ will be large and the variability of the financial report will be increased because the manager is motivated to meet a forecast whose variability is (cosmetically) exaggerated by the analyst.

In summary, the manager's and analyst's incentives interact to influence the volatility of the financial report and, depending on the strength of the analyst's incentive to exaggerate their expectations, can result in increased or decreased volatility compared with the case where the manager is not motivated to meet the analyst's forecast.

Smoothing in the financial report

The extent to which the financial report is "smoothed" towards the firm's true underlying final payoff is captured by $\text{Cov}(r - u, u)$, the covariance between the distortion in the report relative to the final payoff, $r - u$, and u. A simple sufficient and necessary condition for the covariance to be negative is: $\text{Cov}(r - u, u) < 0$ if and only if $\alpha_u < \bar{\alpha}_u = \frac{1}{1+\theta}$, where it is clear that $\bar{\alpha}_u \in (0,1)$.[8]

The condition shows that the financial report will be smoothed towards the firm's underlying true payoff when α_u is small (*i.e.*, when the analyst's private information about the firm's payoff is of poor quality) and be managed away from the firm's true value when α_u is large. To understand why, note that using equation (2) in Proposition 1 yields: $r - u = \hat{r} - u + \lambda(f - \hat{r})$. The first part of this expression, $\hat{r} - u$, isolates the "noise" in the information signal in the financial report about u, *i.e.*, $\hat{r} - u = \left(\frac{\beta_r}{c_{Mu}}\right) x_1$, which is uncorrelated with u. This means that any smoothing effects reflected by $\text{Cov}(r - u, u)$ are due entirely to $\lambda(f - \hat{r})$, the cosmetic component of the firm's financial report, and exist only if the manager is motivated to meet the analyst's forecast (*i.e.*, $\lambda > 0$). Furthermore, as noted above, $f - \hat{r}$ also comprises two parts, *i.e.*,

[8] It is straightforward to show that $\text{Cov}(r - u, u) < 0$ if and only if $\alpha_u < \frac{1}{1+\theta}$. One can show that $\alpha_u(1 + \theta)$ is monotonically increasing in α_u. From the expression for θ in Proposition 1, it is clear that if $\alpha_u = 0$ then $\theta = 0$ and the condition $\alpha_u < \frac{1}{1+\theta}$ is met. In contrast, when $\alpha_u = 1$, equilibrium $\theta > 0$, and the condition $\alpha_u < \frac{1}{1+\theta}$ is not met. By continuity, this implies that there exists a threshold $\bar{\alpha}_u \in (0,1)$ such that $\text{Cov}(r - u, u) < 0$ if and only if $\alpha_u < \bar{\alpha}_u$.

$f - \hat{r} = -\left[u_2 + \left(\frac{\beta_r}{c_{Mu}}\right) x_2\right] + \theta \left[u_1 + \left(\frac{\beta_r}{c_{Mu}}\right) x_1\right]$. The first part, $-\left[u_2 + \left(\frac{\beta_r}{c_{Mu}}\right) x_2\right]$, reflects the analyst's inability to observe u_2 and causes the cosmetic component of the financial report to covary negatively with u. The second part, $\theta \left[u_1 + \left(\frac{\beta_r}{c_{Mu}}\right) x_1\right]$, reflects the analyst's incentive to exaggerate their signal about u and causes a positive covariance with u. When the analyst's information about u is poor (good), *i.e.*, when α_u is small (large), the first (second) effect dominates and the financial report is smoothed towards u (managed away from u, and towards the exaggeration in the analyst's forecast).

5.1.2 Analyst forecast properties

We discuss three properties of the analyst forecast in this subsection: forecast bias, forecast accuracy, and the covariance between the forecast error and the forecast.

Bias in the analyst forecast

From equation (3), it is clear that $E(f) = E(\hat{f}) = \frac{\beta_r}{c_{Mu}} \mu_x = E(r)$. Thus, the analyst's forecast is unbiased with respect to the financial report, but positively biased with respect to the firm's underlying payoff. This reflects the analyst's incentive to forecast the financial report which, as discussed above, is biased with respect to the firm's payoff.

Forecast accuracy

Forecast inaccuracy is captured by $E[(r-f)^2] = (1-\lambda)^2\left(E[(\hat{r}-\hat{f})^2] + \theta^2 \mathrm{Var}(\hat{f})\right)$. The first part, $(1-\lambda)^2 E[(\hat{r}-\hat{f})^2]$, captures the analyst's forecast inaccuracy due to their signal imperfection. The second part $(1-\lambda)^2\theta^2\mathrm{Var}(\hat{f}) = (1-\lambda)^2\theta^2 E[(\hat{f} - E[\hat{f}])^2]$ is due to the analyst's incentive to increase their client's trading profits. As expected, forecast accuracy is improved when the manager is motivated to meet the analyst's forecast (i.e., as λ increases) because the manager distorts the report towards the forecast.[9] In contrast, forecast accuracy is decreasing in θ, which reflects the analyst's incentive to generate trading profits for their client. Accordingly, it is possible for $E[(r-f)^2]$ to be greater than or less than $E[(\hat{r}-\hat{f})^2]$. If $\theta = 0$, forecast accuracy is improved relative to $E[(\hat{r}-\hat{f})^2]$. This occurs because the manager manipulates the financial report towards the analyst's forecast which when $\theta = 0$ is the analyst's expectation of $\hat{r}$. In contrast, if θ is sufficiently large, forecast accuracy is worsened relative to $E[(\hat{r}-\hat{f})^2]$. In this case, the analyst's incentive to exaggerate their expectations in the forecast is not fully countered by the manager's incentive to meet the forecast, resulting in less accurate forecasts.

Of particular interest is how forecast accuracy is affected by α_u and α_x which represent the quality of information possessed by the analyst regarding the firm's payoff and the manager's reporting incentives respectively. Casual intuition might suggest that higher quality information held by the analyst will lead to more accurate forecasts. The following proposition indicates that this need not be the case.

Proposition 2

Forecast accuracy is decreasing in α_u for some model parameter values. A sufficient condition for forecast accuracy to decrease in α_u is that k is sufficiently large relative to c_A. In contrast, forecast accuracy is increasing in α_x for all parameter values.

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[9] $E[(r-f)^2]$ can be rewritten as $(1-\lambda)^2(1-\alpha_u)\sigma_u^2 + \left\{\frac{(1-\alpha_u)\sigma_u^2}{c_{Mu}\left[(1-\alpha_u)\sigma_u^2+\left(\frac{\beta_r}{c_{Mu}}\right)^2(1-\alpha_x)\sigma_x^2\right]}\right\}^2 (1-\alpha_x)\sigma_x^2 + \theta^2(1-\lambda)^2\alpha_u\sigma_u^2 + \left\{\frac{(1-\alpha_u)\sigma_u^2}{c_{Mu}\left[(1-\alpha_u)\sigma_u^2+\left(\frac{\beta_r}{c_{Mu}}\right)^2(1-\alpha_x)\sigma_x^2\right]}\right\}^2 \alpha_x\sigma_x^2$, which is decreasing in λ since $\frac{d\beta_r}{d\lambda} > 0$ as suggested by equation (6).

As noted previously, forecast inaccuracy is represented by $E[(r-f)^2] = (1-\lambda)^2\left(E[(\hat{r}-\hat{f})^2] + \theta^2\text{Var}(\hat{f})\right)$, and it is straightforward to show that the part of inaccuracy due to the analyst's signal imperfection (that is, $E[(\hat{r}-\hat{f})^2]$) is decreasing in both α_u and α_x as expected. This is because $\hat{f}$ represents the analyst's expectation of $\hat{r}$, and so better-quality information results in a more accurate expectation. It also means that if $\theta = 0$, *e.g.*, when the analyst is not motivated by their client's trading profits, forecast accuracy is increasing in both α_u and α_x for all model parameter values. However, as Proposition 2 indicates, when $\theta > 0$, it is possible for higher quality analyst information about the firm's payoff (*i.e.*, higher α_u) to result in lower forecast accuracy. This occurs when $\frac{k}{c_A}$ is large, *i.e.*, when the analyst's client-based incentives are large relative to their incentive to forecast accurately. Better quality information about the firm's payoff causes the analyst's client to respond more strongly to the forecast which in turn motivates the analyst to increase the exaggeration in their forecast (represented by θ). This has the effect of reducing forecast accuracy. When $\frac{k}{c_A}$ is large enough this effect outweighs the reduction in $E[(\hat{r}-\hat{f})^2]$, and overall forecast accuracy declines. In contrast, if the analyst has better quality information about the manager's price-based reporting incentives (*i.e.*, higher α_x), this results in $\hat{f}$ being a poorer signal about the firm's final payoff and causes the analyst to reduce the exaggeration in their forecast. This has the effect of increasing forecast accuracy in addition to the reduction in $E[(\hat{r}-\hat{f})^2]$. The result is improved forecast accuracy for all model parameter values.

Covariance between the forecast error and the forecast

As is clear from Proposition 1, because the forecast is distorted by the analyst's client-based incentives (when $\theta > 0$), it does not equal the analyst's expected value of the financial report. That is, $f \neq E(r|u_1, x_1)$. This means that the forecast error, $r - f$, will covary with f. It is straightforward to calculate that $\text{Cov}(r - f, f) = -(1 - \lambda)\theta(1 + \theta)\text{Var}(\hat{f})$. In effect, the cosmetic exaggeration in the analyst's forecast only partially flows through to the financial report because $\lambda < 1$ (*i.e.*, the manager is only partially motivated to meet the forecast), resulting in negative covariation between the forecast and forecast error. As discussed in the next subsection, this has implications for the association between market prices/returns and the financial report and forecast.

5.2 Market associations

In this subsection we discuss the association between the market price and the report "surprise" $r - f$ and analyst forecast f, as indicated by equation (5) in Proposition 1.

5.2.1 Association between market price and earnings "surprise"

We focus primarily on the coefficient for $r - f$ as it is analogous to the earnings response coefficient, which is the core of much empirical work.

Proposition 1 indicates that equilibrium β_r is the solution to equation (6). The RHS of equation (6) is equal to the response coefficient on $\hat{r} - \hat{f}$ in $E(u|\hat{r} - \hat{f}, \hat{f})$, while the LHS is $(1 - \lambda)\beta_r$. This immediately implies that if $\lambda > 0$ then equilibrium β_r is greater than would be the case if the manager were not motivated to meet the analyst's forecast (keeping all other parameters unchanged). However, this increased responsiveness does not reflect greater information contained in the report. As defined in equation (1), $\hat{r} = u + \frac{\beta_r}{c_{Mu}}x$, is the effective information signal about the firm's payoff that can be extracted from the financial report together with the analyst forecast.

A higher equilibrium β_r implies increased noise in $\hat{r}$, and thus lower incremental information content from the signal.[10]

Remark

The manager's incentive to meet the analyst's forecast leads to a higher price response coefficient for the financial report β_r, while simultaneously reducing the report's information content (incremental to the forecast).

This may seem counterintuitive because the earnings response coefficient has been widely adopted as an empirical proxy for investor-perceived earnings quality and informativeness (Fan and Wong 2002; Francis et al. 2005; Guan et al. 2016; Kim et al. 2022; Tsang et al. 2025). The underlying intuition is that the first half of the remark 1 (regarding the higher β_r) is driven by the cosmetic effects of the manager's incentives—there is no information effect. With a higher λ, investors understand that the manager has a stronger incentive to meet the analyst's forecast. Thus, given the earnings surprise $r - f$, investors correctly infer a higher $\hat{r} - \hat{f}$ and thus respond more strongly. This is purely a *multiplicative scale effect* and can be seen by re-expressing r from equation (2) as $r = \lambda f + (1 - \lambda)\hat{r}$. That is, the financial report is a weighted average of the analyst's forecast and the underlying information signal available from the report. It is immediately clear that the manager's incentive to meet the analyst's forecast introduces a multiplicative scale effect relating to the information signal equal to $1 - \lambda$. This shrinking of the scale of the information signal within r causes the price response coefficient to be correspondingly magnified – to undo the effect of the

[10] This is echoed in Proposition 4 below, which formally shows that the information content of the financial report incremental to the analyst's forecast is decreasing in c_{Mf}.

shrinking of the information signal in the report. The result is a higher price response coefficient.[11] An implication is that it suggests care should be taken when employing the response coefficient as an indicator of the quality of information contained in financial reports.

More generally, the following proposition provides comparative statics for β_r with respect to the model parameters.

Proposition 3

β_r, the time $t = 3$ price response coefficient for $r - f$ is:

(1) increasing in σ_u^2 and decreasing in σ_x^2;

(2) increasing in α_x, and decreasing in α_u;

(3) increasing in c_{Mf};

(4) increasing in c_{Mu} if and only if $(1 - \lambda)\beta_r < 1 - \frac{\lambda}{2}$.

There are several notable aspects of Proposition 3. The comparative statics with respect to σ_u^2 and σ_x^2 mimic similar results in Fischer and Verrecchia (2000): β_r is increasing (decreasing) in σ_u^2 (σ_x^2) because there is more information (noise) in the financial report. Relatedly, increasing α_u (α_x) results in less incremental information (noise) in the financial report beyond the analyst's forecast, causing β_r to decrease (increase), also consistent with results in Fischer and Verrecchia (2000). In effect, the availability of the analyst's forecast acts to change the market maker's assessment of

[11] The effect is analogous to empirical estimation of a regression coefficient. Multiplying a RHS variable by a constant results in an estimated slope coefficient that is deflated by that same constant, without affecting any inferences (*e.g., t* statistics, R-squares, *etc.*). Note also that there is an additive cosmetic effect in the financial report as well: λf. However, because it is additive it does not affect the response coefficient, β_r. It does, however, affect the intercept term in the equilibrium price expression.

the distribution of u and x with similar effects to those shown in Fischer and Verrecchia (2000).

Of particular note, Proposition 3 indicates that the price response to the financial report is increasing in c_{Mf}, the strength of the manager's incentive to meet the analyst's forecast. As discussed above, the manager's incentive to meet the forecast results in the financial report containing a cosmetic multiplicative factor of $1-\lambda$ applied to the effective information signal in the report. The equilibrium response coefficient, β_r, "undoes" this cosmetic effect, resulting in a higher β_r. As increasing c_{Mf} means a higher λ, this cosmetic effect is greater when the manager has stronger incentives to meet the analyst's forecast, leading to an increased response coefficient. At the same time, the higher response coefficient means there is more noise in the signal contained within the financial report, $\hat{r} - \hat{f}$, because the manager manipulates more, causing the response coefficient to be lower. Proposition 3 indicates that in equilibrium, the cosmetic effect outweighs the indirect informational effect, and strengthening the manager's incentive to meet the analyst's forecast results in an increased response coefficient despite the report containing a noisier signal regarding the firm's payoff.

Regarding the manager's incentive to report truthfully, part (4) of Proposition 3 indicates that increasing the strength of this incentive, c_{Mu}, can result in a lower response coefficient. When the manager has no incentive to meet the analyst forecast, i.e., when $\lambda = 0$, an increase in c_{Mu} always leads to a higher response coefficient, because it decreases the amount of noise in the financial report about the firm's payoff, $\hat{r} = u + \frac{\beta_r}{c_{Mu}} x$. When $\lambda > 0$, increasing c_{Mu} has an additional countervailing effect: it increases $1 - \lambda$ which, as discussed above, reduces the cosmetic multiplicative scale effect, decreasing the response coefficient.

5.2.2 Association between market price and analyst forecast

Comparative statics for β_f, the response coefficient in $t = 3$ for the analyst's forecast, are more complex. Proposition 1 indicates that $\beta_f = \frac{\theta(1-\lambda)\beta_r+\omega}{1+\theta}$ which reflects the influence of several factors. First note that if the analyst has no client-related incentives (*i.e.*, $\theta = 0$) then the analyst's forecast equals $\hat{f}$ and the coefficient on f in $t = 3$ price collapses as expected to $\beta_f = \omega$, which is the response coefficient on $\hat{f}$ in $E(u|\hat{r} - \hat{f}, \hat{f})$. The presence of the analyst's client-related incentives causes β_f to deviate from ω in two ways – via the additive term, $\theta(1 - \lambda)\beta_r$, and via the divisor, $1 + \theta$. To better understand why, it is useful to re-arrange the expressions for f and $r - f$ from Proposition 1:

$$f = (1 + \theta)\hat{f} - \theta E(\hat{f}),$$

$$r - f = (1 - \lambda)(\hat{r} - \hat{f}) - (1 - \lambda)\theta[\hat{f} - E(\hat{f})].$$

The expression for f indicates that a cosmetic multiplicative scaling factor of $1 + \theta$ is applied to $\hat{f}$ in the forecast. This effect is reflected in the divisor in the expression for β_f, which effectively "undoes" the multiplicative scaling. The expression for $r - f$ equals a first component, $(1 - \lambda)(\hat{r} - \hat{f})$ that relates to the incremental information available from r given the analyst's forecast, "contaminated" by a second term, $(1 - \lambda)\theta(\hat{f} - E(\hat{f}))$, which is caused by the manager's incentive to meet the analyst's forecast and the analyst's incentive to generate trading profit for clients. This second term can be interpreted as the "measurement error" in $r - f$ relating to the underlying information signal about u, $\hat{r} - \hat{f}$, being extracted by the market maker in setting price. Moreover, it is clear that f is perfectly negatively correlated with this measurement error. The term $\theta(1 - \lambda)\beta_r$ in the expression for β_f represents an adjustment to "absorb" the effects of this measurement error that would otherwise influence β_r.

The combination of these effects means that analysis of β_f is complex. One question of interest is whether β_f is greater than or less than ω, the response coefficient on $\hat{f}$ in $E(u|\hat{r}-\hat{f},\hat{f})$, which reflects the information about u that can be distilled from the analyst's forecast. Differences between β_f and ω reflect how the cosmetic effects on the financial report and forecast induced by the manager's and analyst's incentives affect the responsiveness of price to the forecast. It is straightforward to show that β_f is greater (less) than ω if and only if $(1-\lambda)\beta_r$ is greater (less) than ω. Since $(1-\lambda)\beta_r$ is the response coefficient on $\hat{r}-\hat{f}$ in $E(u|\hat{r}-\hat{f},\hat{f})$ and thus reflects the amount of information about u that can be extracted from the financial report incremental to the forecast, this condition indicates that β_f will overstate (understate) ω when the analyst's forecast is a relatively poor (good) source of information compared to the financial report surprise. This contrasts with β_r which always overstates the response coefficient on $\hat{r}-\hat{f}$ in $E(u|\hat{r}-\hat{f},\hat{f})$.

5.2.3 Association between returns and earnings surprise

Because much empirical research relates to the association between returns and earnings surprise, it is also useful to investigate the change in price between $t=2$ (when the analyst's forecast becomes publicly available) and $t=3$ (when the firm's financial report is released). Using the expressions for P_2 and P_3 in Proposition 1 yields:

$$P_3 - P_2 = \beta_r(r-f) + \frac{\theta(1-\lambda)\beta_r}{1+\theta}[f - E(f)]. \tag{7}$$

Importantly, there is a non-zero coefficient on f if $\theta > 0$, *i.e.*, if the analyst's forecast is distorted by their client-based incentives. As noted in the previous subsection, in this case the analyst's forecast is negatively correlated with $r-f$. Specifically, the forecast is negatively correlated with the distortion, or measurement error, in $r - f$ with respect to $\hat{r} - \hat{f}$, the information that causes prices to change. This results in a positive coefficient on f in equation (7) despite f containing no information that affects the price change. Instead, f loads in the expression because it "undoes" the measurement error in $r - f$. In empirical work regressing returns on earnings surprise measured based on analyst forecasted earnings, a significant coefficient on the forecast might typically be interpreted as evidence of market inefficiency. Our model identifies an additional possibility within an informationally efficient market: the forecast might measure analysts' expectation with error due to the incentives faced by analysts.

5.3 Information content

In this subsection we investigate the information content of the financial report and that of the analyst forecast and how they are affected by the quality of the information possessed by the analyst as well as the strength of the manager's incentive to meet the analyst forecast.

We measure information content using the fraction of the variance of the firm's final payoff that is revealed publicly by the manager's report and the analyst's forecast. Specifically, information content is measured by the variance of $E(u|r, f)$ divided by the variance of u: $IC = \frac{\mathrm{Var}[E(u|r,f)]}{\sigma_u^2}$. Note that $P_3 = E(u|r, f)$. IC captures the extent to which the financial report and the analyst forecast move price (relative to total variation in the firm's payoff), and is equivalent to the R-square that would be obtained from a regression of u on $r - f$ and f.

Because the pair (r, f) is informationally equivalent to $(\hat{r} - \hat{f}, \hat{f})$, it is convenient to measure information content as $IC = IC_{\hat{r}-\hat{f}} + IC_{\hat{f}}$, where $IC_{\hat{r}-\hat{f}} =$

$\frac{\mathrm{Var}[E(u|\hat{r}-\hat{f})]}{\sigma_u^2} = (1-\lambda)\beta_r(1-\alpha_u)$ and $IC_{\hat{f}} = \frac{\mathrm{Var}[E(u|\hat{f})]}{\sigma_u^2} = \omega\alpha_u$. $IC_{\hat{r}-\hat{f}}$ and $IC_{\hat{f}}$ respectively represent the information content of the financial report incremental to the analyst's forecast and that of the analyst's forecast and are equivalent to the incremental R-squares from a regression of u on $\hat{r}-\hat{f}$ and $\hat{f}$. It is clear from the definitions of $IC_{\hat{r}-\hat{f}}$ and $IC_{\hat{f}}$ that both are less than or equal to 1, as is their sum, total information content IC.

The following proposition describes how $IC_{\hat{r}-\hat{f}}$, $IC_{\hat{f}}$ and IC are affected by the quality of information possessed by the analyst, α_u and α_x, and the strength of the manager's incentives to meet the analyst's forecast, c_{Mf}, and to report truthfully, c_{Mu}.

Proposition 4

(1) The information content of the analyst's forecast, $IC_{\hat{f}}$, is increasing in α_u and c_{Mu}, and decreasing in α_x and c_{Mf}.

(2) The information content of the financial report incremental to the analyst's forecast, $IC_{\hat{r}-\hat{f}}$, is increasing in α_x and c_{Mu}, and decreasing in α_u and c_{Mf}.

(3) Total information content, IC, is (i) decreasing in α_u if and only if α_u is below a threshold, (ii) decreasing in α_x if and only if α_x is below a threshold, (iii) increasing in c_{Mu}, and (iv) decreasing in c_{Mf}.

Proposition 4 indicates that improving α_u, the quality of the analyst's information regarding the firm's payoff, increases the information content of the forecast but decreases the incremental information content of the financial report. Regarding the financial report, an increase in α_u means an increase in the information provided by the analyst's forecast about the firm's payoff, so there is less potential incremental information to be obtained from the financial report. Offsetting this, the coefficient in price, β_r, is lower reducing the manager's incentives to distort the report, resulting in less noise in the financial report. However, this is insufficient to outweigh the first effect, and the information content of the report decreases. Regarding the analyst's forecast, better-quality information about the firm's payoff is reinforced by the reduced noise in their forecast because the distortion in the financial report being forecast is reduced. Both of these effects lead to an increase in the forecast's information content. Perhaps surprisingly, part (3) of Proposition 4 indicates that when α_u is low, the decreasing effect on the information content of the manager's report outweighs the increasing effect on the information content of the analyst's forecast—possession by the analyst of higher-quality information about the firm's payoff can result in *less* total information being made available to the market.

To see the reason behind part (3) of Proposition 4, we rewrite a signal's information content as a convexly increasing function of the quality of the signal about u: $IC_{\hat{r}-\hat{f}} = \frac{[\text{Cov}(u,\hat{r}-\hat{f})]^2}{\sigma_u^2\left[\text{Cov}(u,\hat{r}-\hat{f})+\text{Var}\left(\frac{\beta_r}{c_{Mu}}x_2\right)\right]}$ and $IC_{\hat{f}} = \frac{[\text{Cov}(u,\hat{f})]^2}{\sigma_u^2\left[\text{Cov}(u,\hat{f})+\text{Var}\left(\frac{\beta_r}{c_{Mu}}x_1\right)\right]}$. One can verify that $\frac{\partial IC_{\hat{r}-\hat{f}}}{\partial \text{Cov}(u,\hat{r}-\hat{f})} > 0$, $\frac{\partial IC_{\hat{f}}}{\partial \text{Cov}(u,\hat{f})} > 0$, $\frac{\partial^2 IC_{\hat{r}-\hat{f}}}{\partial^2 \text{Cov}(u,\hat{r}-\hat{f})} > 0$, and $\frac{\partial^2 IC_{\hat{f}}}{\partial^2 \text{Cov}(u,\hat{r})} > 0$. Without the informational distortions, $IC_{\hat{r}-\hat{f}}$ and $IC_{\hat{f}}$ are the respective linear functions of the quality of the signals $\hat{r}-\hat{f}$ and $\hat{f}$: $IC_{\hat{r}-\hat{f}} = \text{Cov}(u,\hat{r}-\hat{f})/\sigma_u^2$ and $IC_{\hat{f}} = \text{Cov}(u,\hat{f})/\sigma_u^2$. The manager's price-based incentive leads to the informational distortion $\frac{\beta_r}{c_{Mu}}x_2$ in $\hat{r}-\hat{f}$. To forecast accurately, the analyst distorts their forecast towards $\hat{r}$ and accordingly introduces the informational distortion $\frac{\beta_r}{c_{Mu}}x_1$ into $\hat{f}$. These informational distortions in signals endow the corresponding information content proxy IC with the convexity property: *IC* increases in the quality of a related signal at a faster rate when the quality of the signal is higher. When the analyst's signal and hence forecast is uninformative, the manager's report contains much information incremental to the analyst's forecast; that is, when α_u is low, $\mathrm{Cov}(u, \hat{f})$ is small whereas $\mathrm{Cov}(u, \hat{r} - \hat{f})$ is large; as a result, $IC_{\hat{f}}$ increases in α_u at a low rate whereas $IC_{\hat{r}-\hat{f}}$ decreases in α_u at a high rate.

Proposition 4 also indicates comparative statics regarding α_x that are the reverse of those for α_u. When the analyst has better-quality information about the manager's price-based incentives, they are better able to forecast the distortion in the financial report, which their forecasts will then reflect. As a result, the analyst's forecast becomes a noisier signal about the firm's final payoff and has lower information content. In contrast, the financial report contains less noise since there is less uncertainty about the manager's price-based incentives, increasing its information content. Part (3) of the proposition indicates that when the quality of the analyst's information is low, the decrease in the information content of the analyst's forecast outweighs the corresponding increase in the financial report—improving the quality of the analyst's information can result in less total information being made available to the market. The reason why is similar to that discussed in the previous paragraph regarding α_u: IC is convexly decreasing in the noise represented by α_x.

Finally, Proposition 4 shows that when the manager places greater importance on meeting the analyst's forecasts (*i.e.,* increasing c_{Mf}), the information content of both the forecast and the report declines. This occurs because increasing c_{Mf} reduces $1 - \lambda$, the multiplicative scale factor on the underlying information signal, $\hat{r} - \hat{f}$, in the financial report. Although this is a cosmetic effect, it results in a higher response coefficient in price as explained in the previous subsection, which encourages the manager to distort the financial report further. The analyst, thus, distorts more in the pursuit of forecast accuracy. These greater distortions respectively diminish the information content in the financial report and the analyst's forecast. In contrast, when managers face stronger incentives to report truthfully (*i.e.,* increasing c_{Mu}), the resulting financial report and analyst forecast both contain greater information content.

6. Empirical Implications

Our model has implications for prior empirical research as well as suggesting some potential additional empirical analyses.

6.1 Implications for prior research

The manager's incentive to meet the analyst's forecast results in a cosmetic multiplicative scaling factor in the financial report. This is recognised by the market maker and thus causes the price response coefficient to the report to be overstated (relative to the coefficient that would be attached to the underlying information signal). Moreover, because an increase in the strength of the manager's incentive to meet the forecast increases the cosmetic multiplicative scaling effect but also decreases the quality of the information in the report, it will induce a negative association between the quality of the information in the report and the price response coefficient. As noted in the previous section, this cautions against using the response coefficient (*e.g.*, the earnings response coefficient) as a proxy for the quality of the information contained in the financial report (*e.g.,* Fan and Wong 2002; Francis et al. 2005; Dechow et al. 2010; Guan et al. 2016; Kim et al. 2022; Tsang et al. 2025), particularly in settings where managers may have a strong motivation to meet analyst's forecasts.

Our analysis also shows that when a report contains an informational distortion, R-square contributed by the report has a convexity property: it increases in the quality of the report more quickly when the quality of the report is higher. When managers are interested in inducing favorable stock prices and analysts care about forecast accuracy, both managers' reports and analysts' forecasts contain informational distortions, causing the R-square to first decrease and then increase in analysts' information quality about firm payoff. This convexity property of R-square may affect the results when investigating the effects of regulatory changes on information content.

In addition, as discussed in section 5.2 (see equation (7)), our model indicates that when the analyst is motivated to distort their forecast the forecast will have a non-zero response coefficient in a regression of returns on the report "surprise", $r - f$, and the forecast, f. This occurs because the report surprise is contaminated as a measure of the underlying information signal due to cosmetic effects arising from the manager and analyst's incentives. In these circumstances, leaving f out of the returns regression will cause the estimated coefficient on report surprise to be biased towards zero. This has potential implications for research that estimates earnings response coefficients using analyst forecasts as the earnings expectation benchmark.

6.2 Additional empirical implications

Our model suggests several new empirical predictions. Following from the discussion in the previous section, the coefficient on the analyst forecast from a returns regression on earnings surprise and the forecast might be used as a proxy for θ, which reflects the distorting effect of the analyst's client-related incentives on the forecast. The results in section 5.1 indicate that this will be negatively associated with forecast accuracy. The results in section 5.1 also suggest that it will be associated with smoothing in the financial report, such as the association between discretionary accruals and non-discretionary earnings or cash flows. This could also be linked to empirical proxies for analysts' misalignment of incentives employed in prior research (*e.g.*, Ljungqvist, Marston and Wilhelm 2006; Ljungqvist, Marston, Starks, Wei, and Yan 2007; Malmendier and Shanthikumar 2014).

In addition, the model indicates that the manager's incentive to meet the analyst's forecast results in a cosmetic multiplicative scaling effect in the financial report which causes the price response coefficient for the report to be overstated relative to its information content. At the same time, it increases forecast accuracy. In an earnings setting, this suggests an empirical association between forecast accuracy and the divergence between estimated earnings response coefficients and explanatory power (incremental R-square).

7. Conclusion

In this paper we model the interaction between a firm's manager and analyst, who have both shared and conflicting incentives, and investigate how these incentives combine and interact to influence the equilibrium properties of financial reports and analyst forecasts, their association with market prices, and their information content. We show that the manager's incentive to meet the analyst's forecast, when combined with the analyst's incentive to forecast accurately, leads to greater forecast accuracy, a greater response coefficient to the firm's report in price but lower information content in financial reports.

When the analyst possesses higher-quality information, the result can be less accurate forecasts and a less informative corporate environment. We are able to characterize important empirical phenomena such as earnings response coefficients and R-square in the context of the management and analyst incentives. Our model provides several implications for prior empirical research and new empirical predictions for future research that account for these parties' incentives simultaneously.

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Appendix – Proofs

Proof of Proposition 1

Determining the equilibrium involves backward induction from time 3 back to time 1.

Time 3 – manager's reporting strategy

At time 3, the manager conjectures that $P_3 = \beta_0 + \beta_r(r - f) + \beta_f f$. The manager's objective function is $xP_3 - \frac{c_{Mu}}{2}(r-u)^2 - \frac{c_{Mf}}{2}(r-f)^2$. Maximizing this with respect to r yields the reporting strategy, $r = \frac{c_{Mu}}{c_{Mu}+c_{Mf}}u + \frac{c_{Mf}}{c_{Mu}+c_{Mf}}f + \frac{\beta_r}{c_{Mu}+c_{Mf}}x$, which, using the definitions for λ and $\hat{r}$ from section 4, rearranges to the expression in equation (2) of Proposition 1:

$$r = \hat{r} + \lambda(f - \hat{r}).$$

Time 3 – price

The market maker at time 3 conjectures that the manager's reporting strategy is $r = \hat{r} + \lambda(f - \hat{r})$, and the analyst's forecasting strategy is $f = \hat{f} + \theta\big(\hat{f} - E(\hat{f})\big)$. Then P_3 can be rewritten as: $P_3 = \beta_0 + \beta_r(r - f) + \beta_f f$, yields the equilibrium expressions for P_3, β_r and β_f in Proposition 1.

Finally, to prove uniqueness of the β_r solution to equation (6) from Proposition 1, $(1-\lambda)\beta_r = \frac{(1-\alpha_u)\sigma_u^2}{(1-\alpha_u)\sigma_u^2 + \left(\frac{\beta_r}{c_{Mu}}\right)^2 (1-\alpha_x)\sigma_x^2}$, note that the LHS is increasing in β_r, while the RHS is always positive, and is decreasing to zero in β_r for $\beta_r > 0$, which implies there is a unique $\beta_r > 0$ satisfying the equation.

Time 2 – price

At time 2, the market maker conjectures that the analyst's forecasting strategy is $f = \hat{f} + \theta(\hat{f} - E(\hat{f}))$, and sets price equal to $P_2 = E(u|f) = \frac{\omega}{1+\theta}(f - E(f))$, which is the expression time 2 price in Proposition 1.

Time 1 – informed investor's trading strategy

At time 1 investors choose their trade, z_I, to maximize their expected trading profit, $E(\Pi_I|f) = z_I\left(\frac{\omega}{1+\theta}(f - E(f)) - \gamma z_I\right)$. Rearranging the resulting first order condition yields $z_I = \frac{\omega}{2\gamma(1+\theta)}(f - E(f))$, which is equation (4) from Proposition 1.

Time 1 – price

At time 1 the market maker sets price equal to $P_1 = E(u|z) = \frac{\frac{\omega\alpha_u\sigma_u^2}{2\gamma}}{\left(\frac{\omega}{2\gamma}\right)^2 \mathrm{var}(\hat{f}) + \sigma_z^2} z$.

Equating the slope coefficient from this expression with γ (the slope coefficient on z in the informed trader's conjectured price) and rearranging yields $\gamma = \frac{1}{2}\sqrt{\frac{\omega\alpha_u\sigma_u^2}{\sigma_z^2}}$, the expression in Proposition 1.

Time 1 – analyst's forecasting strategy

At time 1 the analyst chooses their forecast, f, to maximize the objective function: $kE[\Pi_I|u_1, x_1] - \frac{c_A}{2}E[(r - f)^2|u_1, x_1]$. Taking the derivative of the analyst's objective function yields the following first order condition, $\frac{k\omega^2}{2\gamma(1+\theta)^2}(f - E(\hat{f})) - c_A(1-\lambda)^2(f - \hat{f}) = 0$, and rearranging yields:[12]

$$f = \hat{f} + \frac{\frac{k\omega^2}{2\gamma(1+\theta)^2}}{c_A(1+\lambda)^2 - \frac{k\omega^2}{2\gamma(1+\theta)^2}}(\hat{f} - E(\hat{f})). \tag{8}$$

[12] Note that the denominator in the slope coefficient in equation (8) must be positive for the first order condition to yield a maximum. If it is negative, the first order condition yields a minimum for the objective junction. In that case, maximizing the objective function would require the analyst to set their forecast to infinity (positive of negative), and an equilibrium would not exist.

This is consistent with the linear conjecture by the informed trader and market maker: $f = \hat{f} + \theta(\hat{f} - E(\hat{f}))$, and so the equilibrium θ is found by equating coefficients:

$$\theta = \frac{\frac{k\omega^2}{2\gamma(1+\theta)^2}}{c_A(1+\lambda)^2 - \frac{k\omega^2}{2\gamma(1+\theta)^2}}.$$

Rearranging yields a quadratic equation in θ where the solution is $\theta = \frac{1}{2}\left(\sqrt{1 + \frac{2k\omega^2}{c_A(1-\lambda)^2\gamma}} - 1\right)$, the expression in Proposition 1.

Proof of Proposition 2

Forecast inaccuracy is represented by $E[(r-f)^2] = (1-\lambda)^2\left(E[(\hat{r}-\hat{f})^2] + \theta^2 \mathrm{Var}(\hat{f})\right)$. Because $\hat{f} = E[\hat{r}|u_1, x_1]$, $E[(\hat{r}-\hat{f})^2]$ is decreasing in both α_u and α_x. Further, it is straightforward to show that $\theta^2 \mathrm{Var}(\hat{f}) = \frac{\theta^2 \alpha_u \sigma_u^2}{\omega}$. Taking the derivative of this with respect to α_x yields $\frac{\partial}{\partial \alpha_x}\left[\theta^2 \mathrm{Var}(\hat{f})\right] = \frac{\theta^2 \alpha_u \sigma_u^2}{\omega^2}\left(\frac{\theta+2}{2\theta+1}\right)\frac{\partial \omega}{\partial \alpha_x}$. Thus, the sign of the derivative is determined by the sign of $\frac{\partial \omega}{\partial \alpha_x}$ which is negative. This means that both components of $E[(r-f)^2]$ are decreasing in α_x which establishes the second part of Proposition 2.

Regarding α_u, it is straightforward to show that $\frac{\partial}{\partial \alpha_u}\left[\theta^2 \mathrm{Var}(\hat{f})\right] = \frac{\theta^2 \sigma_u^2}{\omega^2(2\theta+1)}\left(\theta\omega + (\theta+2)\alpha_u \frac{\partial \omega}{\partial \alpha_u}\right)$, which is positive because $\frac{\partial \omega}{\partial \alpha_u} > 0$. Thus, the first component of $E[(r-f)^2]$ is decreasing in α_u while the second component is increasing in α_u. This means that $E[(r-f)^2]$ may be increasing in α_u (that is, forecast accuracy may be decreasing in α_u) for some parameter values. From the expression for θ in Proposition 1, it is straightforward to see that $\frac{\partial}{\partial \alpha_u}\left[\theta^2 \mathrm{Var}(\hat{f})\right] = \frac{\theta^2 \sigma_u^2}{\omega^2(2\theta+1)}\Big(\theta\omega + (\theta+2)\alpha_u \frac{\partial \omega}{\partial \alpha_u}\Big)$ becomes large for large values of $\frac{k}{c_A}$, while the derivative of $E[(\hat{r} -$

$\hat{f})^2]$ with respect to α_u is unaffected by $\frac{k}{c_A}$. This means that for sufficiently large values of $\frac{k}{c_A}$ forecast accuracy is decreasing in α_u, which establishes the first part of Proposition 2.

Proof of Proposition 3

β_r is determined by equation (6) in Proposition 3. It straightforward to see that The RHS of equation (6) is decreasing in α_u and σ_x^2, while the LHS is unaffected. This implies that the β_r solution is decreasing in α_u and σ_x^2. Similarly, the RHS of equation (6) is increasing in α_x and σ_u^2 while the RHS is invariant, implying that β_r is increasing in these two parameters. Also, the LHS is decreasing in c_{Mf} while the RHS is invariant, implying that β_r is increasing in c_{Mf}. These establishes parts (1) to (3) of the proposition.

For part (4) of the proposition, it is straightforward to establish that the derivative of the LHS of equation (6) with respect to c_{Mu} is equal to $\lambda(1-\lambda)\frac{\beta_r}{c_{Mu}}$, and the derivative of the RHS is equal to $2(1-\lambda)\frac{\beta_r}{c_{Mu}}(1-(1-\lambda)\beta_r)$. Since β_r is increasing in c_{Mu} if and only if the derivative of the RHS is greater than the derivative of the LHS, rearranging yields the condition stated in the proposition.

Proof of Proposition 4

The information content of the analyst's forecast is given by $IC_{\hat{f}} = \frac{\mathrm{Var}[E(u|\hat{f})]}{\sigma_u^2} = \omega\alpha_u$, where $\omega = \frac{cov(u,\hat{f})}{var(\hat{f})} = \frac{\alpha_u\sigma_u^2}{\alpha_u\sigma_u^2+\left(\frac{\beta_r}{c_{Mu}}\right)^2\alpha_x\sigma_x^2}$. It is straightforward to show that ω is increasing in α_u and c_{Mu}, and decreasing in α_x and c_{Mf}, which establishes part (i) of the proposition. The information content of the financial report (incremental to the analyst's forecast) is given by $IC_{\hat{r}-\hat{f}} = \frac{\mathrm{Var}[E(u|\hat{r}-\hat{f})]}{\sigma_u^2} = (1-\lambda)\beta_r(1-\alpha_u)$. Using equation (6) from Proposition 1 it is straightforward to show that $(1-\lambda)\beta_r$ is increasing in α_x and c_{Mu}, and decreasing in α_u and c_{Mf}, which establishes part (ii) of the proposition.

Because both information content metrics are increasing (decreasing) in c_{Mu} (c_{Mf}), total information content is also increasing (decreasing) in c_{Mu} (c_{Mf}). This establishes the first part of (iii) in the proposition. Furthermore, because the derivative of $IC_{\hat{f}}$ with respect to α_u is equal to zero when $\alpha_u = 0$, while the derivative of $IC_{\hat{r}-\hat{f}}$ is negative when $\alpha_u = 0$, continuity implies that total informativeness is decreasing in α_u for low values of α_u (below some threshold).

Finally, it is straightforward, though tedious, to show that the derivative of $IC_{\hat{f}}$ with respect to α_x evaluated at $\alpha_x = 0$ is equal to $-\left(\frac{\beta_r}{c_{Mu}}\right)^2 \frac{\sigma_x^2}{\sigma_u^2}$, and that the derivative of $IC_{\hat{r}-\hat{f}}$ with respect to α_x evaluated at $\alpha_x = 0$ is equal to $\left[\frac{(1-\alpha_u)\sigma_u^2}{(1-\alpha_u)\sigma_u^2 + 3\left(\frac{\beta_r}{c_{Mu}}\right)^2 \sigma_x^2}(1-\lambda)\beta_r\right]\left(\frac{\beta_r}{c_{Mu}}\right)^2 \frac{\sigma_x^2}{\sigma_u^2}$. It is clear that the expression in the square brackets is less than one because $(1-\lambda)\beta_r$ is less than one. This implies that derivative of total informativeness with respect to α_x evaluated at $\alpha_x = 0$ is negative, and that by continuity total informativeness is decreasing in α_x for low values of α_x.