What Does the Market Know?*

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December 14, 2023

Abstract

Investors' information about different aspects of financial reporting – firm fundamentals and managers' reporting objectives – affect earnings quality and price efficiency unambiguously (Fischer and Stocken (2004)), making proper measurement of these types of information important for researchers and policymakers. I develop a structural approach that uses firms' prices and analyst forecasts to measure how much fundamental and misreporting incentives information investors know. The new technique is used to estimate the amount of information an average U.S. investor has, and the magnitude of the trade-off between reporting quality and price efficiency. I also apply the technique to complement and expand upon antecedent reduced-form studies. In particular, I study the extent to which expanded compensation disclosures increased investors' information about managers' incentives, and the extent to which early reporting firms' earnings releases spillover and subsume the information conveyed by late reporting firms.

*I appreciate helpful comments and suggestions from an anonymous referee, Gary Biddle, Tongqing Ding, Paul Fischer, Ian Gow, Wayne Guay, Luzi Hail, Mirko Heinle, Xue Jia, Chongho Kim, Jung Min Kim, Kevin Smith (discussant), Catherine Schrand, Stephen Taylor, Tong Liu, Frank Zhou, participants at the Junior Accounting Theory Conference, Duke Accounting Theory Summer Camp, the Melbourne Accounting Research Seminar, the Wharton-INSEAD Doctoral Consortium, the Financial Markets and Corporate Governance Conference, the Fifth Future of Financial Information Conference the Wharton School Workshop, the Wharton School Junior Faculty/PhD Student Summer Brown Bag Series, and at the Wharton School Finance/Accounting Doctoral Seminar.

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Introduction

Earnings are among the most important statistics employed in valuing a firm. As such, managers sometimes bias reported earnings to achieve valuation-related objectives and, to the extent that investors cannot perfectly adjust for that bias, earnings management undermines the value relevance of earnings. Given the importance of earnings for valuation, the information content of earnings and earnings management have been profoundly studied. While the focus on earnings is undoubtedly warranted, plenty of other information is available to capital market investors; and incremental value relevance of earnings depends on the nature of that other information. If that other information substitutes for earnings by providing information about firm fundamentals, the incremental value relevance of earnings decreases all else equal. All else is not equal, however, because managers' incentives to bias earnings decrease as well, which increases the information content of earnings. On the contrary, if that other information complements earnings by providing information that helps investors better adjust for the earnings bias, the incremental value relevance of earnings increases all else equal. Again, all else is not equal, because managers' incentives to manage earnings increase as well, which reduces the information content of earnings. Hence, to develop a more complete understanding of the valuation role of earnings and earnings management, we need to understand more thoroughly the nature of the other information available to investors in capital markets. In this study, I aim to fill this void and measure the amount of other information investors have about firm fundamentals, an information substitute for reported earnings, and the amount of information investors have about management reporting objectives, an information complement to reported earnings.

Because the market's information can come from many sources some of which may be unobservable, I use a structural approach to measure the two types of information in aggregate. I apply the developed technique to address two sets of questions. First, I consider the implications of the nature of other information for two constructs of particular concern to policymakers and regulators: the amount of value-relevant information impounded into stock prices – price efficiency – and the degree to which reported earnings faithfully represent the underlying fundamental earnings – earnings quality. Second, I illustrate how the approach can be employed to complement and expand upon antecedent reduced-form studies. In particular, I study the extent to which expanded compensation disclosures increased investors' information about managers' incentives, and the extent to which early reporting firms' earnings releases spillover and subsume the information conveyed by late reporting firms.

I build a dynamic earnings management model based on Fischer and Stocken (2004) that features a manager who governs a company and reports earnings every year to investors in the stock market. The manager is concerned with the firm's stock price and has full information about firm fundamentals – the actual value of the firm's earnings – and her misreporting incentives – the extent to which she cares about the price. The manager can bias the reported earnings at a cost, which is a function of not just the current bias but cumulative bias in all reports the manager released in the past. The stock market prices the firm at the expected value of its discounted future earnings. In contrast to the manager, investors know only part of the fundamental and misreporting incentives information known by the manager.

In equilibrium, how the amount of investors' information affects firm price efficiency and quality of reported earnings depends on the nature of that information. When investors know more about firm fundamentals, their reaction to the earnings report, i.e. earnings response coefficient (ERC), decreases, reducing the manager's incentives to bias earnings and thus improving the quality of earnings. On the other hand, when investors know more about the manager's reporting objective, their reaction to the earnings report increases, boosting the manager's misreporting incentives and reducing the quality of earnings. At the same time, price efficiency improves when investors know more information of either type. The different effects of different types of investors' information highlight how regulators' objectives may be at odds when considering disclosure policies. If a policymaker seeks to maximize the representational faithfulness of reported earnings for a non-market-participant (e.g., the government), she would choose to restrict investors' information about managers' reporting objectives as much as possible. Such a policy, however, would undermine the efficiency of stock prices, hurting stock market investors.

To identify unobserved investors' information, I rely on three series in the data: reported earnings, prices, and analyst forecasts. Firms' prices, representing investors' beliefs about the ultimate values of firms, serve to uncover the amount of fundamental information investors have. Analyst forecasts, which aim to closely predict the upcoming reported earnings (Mikhail et al. (1999), Hilary and Hsu (2013)), help identify both the market's information about the fundamental earnings and about the bias that the manager will add to the fundamental earnings when she reports, which is a function of the manager's incentives.

Because companies provide a lot of information besides their earnings reports on their earnings report days, I separately estimate how much information investors learn on these days and on other days during a given year. Short-window changes in firms' prices and analyst forecasts that are not explained by the earnings report help to identify the amount of information the market learns from sources other than reported earnings on the earnings report day. Prices' and analyst forecasts' movement during a year excluding the report day, in turn, measure the amount of information that the market learns on other days.

The estimates of the structural model suggest that while firm earnings are volatile, investors already know a large portion of earnings before the report is disclosed. For 32% of companies, a yearly shock to fundamental earnings deviates from its mean by more than 17% of the companies' book value. The market anticipates about 88% of this shock from sources other than the manager's report, and 18% of this 88% is learned about one year ahead, concurrently with the previous earnings report. Hence, investors appear to know a lot about firm earnings, and only a small part of this knowledge is acquired when prior earnings are released, suggesting that sources other than managerial guidance or concurrent analyst reports are important for the market learning about fundamentals. In contrast, managers' misreporting incentives are more volatile in general and more opaque to investors. In 32% of firms, a yearly shock to managers' sensitivity to the firm's stock price deviates from its mean by about 37% of the firm's book value. Investors anticipate about 53% of the managers' incentives, and almost all of this information is learned on the earnings report day from sources other than the report itself. Perhaps, corporate management's and analysts' expectations for the next earnings formed on the earnings report day set investors' beliefs about managers' reporting objectives for the next year, and other information received throughout the year does not alter investors' beliefs by a lot.

I use the obtained estimates of investors' information to evaluate earnings quality and price efficiency. The results strongly support the presence of earnings management and substantial mispricing. Reported earnings differ from the underlying fundamental earnings by about 1.4 standard deviations of reported earnings. This conclusion is broadly consistent with Beyer et al. (2019) whose tests strongly reject a null hypothesis of zero reporting noise. The market value of an average firm would be different by about one-third of the firm's book value if investors knew all the information available to the firm's management.

Next, I demonstrate how the developed technique can be employed to complement and expand upon existing reduced-form studies. First, I study the effect on investors' information of the enhanced compensation disclosures after the introduction of the Compensation Disclosure and Analysis (CD&A) section in companies' proxy statements. Prior studies (e.g., Ferri et al. (2018)) have documented an increase in the ERC for firms subject to the regulation. It remains less clear, however, which forces drive the change in the ERC. On the one hand, CD&A in 2007 could have provided investors with more information on managerial incentives, increasing the ERC. At the same time, the financial crisis in the post-2007 period may make investors less certain about firm fundamentals, also increasing the ERC. The two concurrent forces are difficult to disentangle using a standard reduced-form approach. To evaluate the magnitudes played by the two forces, I structurally estimate my model on the pre-CD&A and the post-CD&A data. I find support for both forces: the amount of investors' information about managerial incentives increased by about 37%, and the amount of investors' information about firms' fundamentals decreased by about 33% in the period after the CD&A, suggesting that the increase in the ERC cannot be attributed solely to the effect of the regulation. This finding highlights the importance of considering changes in the entire economic system when evaluating outcomes of information-related policies.

Second, I expand upon the antecedent literature on spillovers of information from firms reporting early in the earnings report cycle to firms reporting late in the earnings report cycle (e.g., Ramnath (2002), Savor and Wilson (2016), Hann et al. (2019), Ogneva et al. (2021)). Prior research has found that early reporters get substantial market reactions on their reporting days because they convey information not only about their idiosyncratic factors but also about an economy-wide factor. Following that logic, late reporters should obtain lower market reactions on their reporting days because investors have more information about late reporters' fundamentals from early reporters' reports. However, lower market reaction to late reporters' reports can also be due to investors being more uncertain about these reporters' misreporting incentives (Trueman (1990)). To disentangle the two explanations, I estimate the structural model separately for firms reporting early and firms reporting late in the earnings report cycle. Both explanations appear valid: while late reporters' fundamentals are indeed about 94% more predictable, late reporters' managers' misreporting incentives are about 68% more uncertain. The two effects taken together imply that late reporters' price efficiency and representational faithfulness of earnings are lower compared to early reporters.

This study is broadly related to two streams of literature in accounting. The first aims to measure how informative accounting numbers are for different users. Following Ball and Brown (1968) and Beaver (1968)'s discovery that financial markets react to news in earnings announcements, researchers try to measure how meaningful is the information content of accounting reports. One of the intuitive metrics is the proportion of variance in returns that is explained by earnings announcements. Ball and Shivakumar (2008) find that quarterly announcements explain about 5-9% of companies' annual returns. My approach can not be directly mapped into theirs because I am not attempting to explain the variance of firms' returns in detail and thus avoid using return variance in the estimation. However, my estimates provide an upper bound of the information about fundamentals conveyed to investors by earnings: about 12% of fundamental information is privately known by the manager and disclosed (with bias) to the market in earnings reports.

Other studies exploit statistical properties of accounting accruals to identify the amount of bias contained in reported earnings (e.g., Sloan and Sloan (1996), Dechow and Dichev (2002), Gerakos and Kovrijnykh (2013), Nikolaev (2019)). An earlier approach treated earnings with a high degree of persistence as high quality (e.g., Revsine et al. (2001), Penman (2012)). My paper shows why this method may not be accurate: bias in earnings driven by stock-price-related managerial incentives can also be persistent when managers' incentives to misreport are persistent. Gerakos and Kovrijnykh (2013) develop a novel way to measure misreporting, which is based on the notion that companies' misreporting must be correlated with their performance. Whereas this approach is a big step towards our understanding and measurement of financial reporting bias, it does not account for the extent to which managers have incentives to misrepresent their companies' fundamental performance. My study suggests that reporting objectives play a considerable role in explaining bias in financial reports. Perhaps this is the reason why our estimates of misreporting magnitude differ: Gerakos and Kovrijnykh (2013) find that median misreporting is about 0.7% of total assets, whereas my estimate is only about 0.09% of total assets.

The closest paper in this strand of literature is Beyer et al. (2019), which structurally estimates a dynamic model where earnings are noisy due to exogenous factors, such as accounting system errors. My conclusions about the presence of reporting bias are generally consistent with the findings by Beyer et al. (2019), although the nature of the bias I study is different. Beyer et al. (2019) focus on reporting noise due to any kind of accounting distortion that induces linear bias in earnings reports, whereas the center of my study is stock price-based misreporting incentives.

The second large stream of literature studies investors' uncertainty about managerial incentives and the implications of this uncertainty for financial misreporting (e.g., Ferri et al. (2018), Kim (2023), Bertomeu et al. (2019)). Ferri et al. (2018) use staggered adoption of the CD&A section in companies' proxy statements, and Kim (2023) uses investors' search for compensation-related disclosures to identify how investor uncertainty about managerial incentives affects financial reporting bias. The relative advantage of my approach is that I can distinguish fundamental and misreporting incentives information and their respective effects on misreporting, even if investors simultaneously learned both of these types of information during the CD&A adoption period or by searching for proxy statements online. Bertomeu et al. (2019) ask a question that is very close to mine – how to measure investors' uncertainty about managers' reporting objectives. However, our papers differ on multiple dimensions. I consider a dynamic problem that captures the inter-temporal trade-off that managers face when choosing misreporting amounts: overstating heavily today reduces the ability to boost prices in the future. The two studies also use different strategies to identify investor uncertainty about reporting objectives: Bertomeu et al. (2019) exploit observed earnings response to get to optimal misreporting, and I use analyst forecasts as a source of identification.

The rest of the paper is organized as follows. Section 1 presents the model and discusses the equilibrium and important insights. In section 2 I discuss the sample and show the main estimates of the model. Section 3 presents counterfactual analyses. In section 4, two applications of the technique are presented. Section 5 discusses how different assumptions affect model estimates. Section 6 concludes.

1 Model

This section discusses the model and equilibrium and presents theoretical moments that later will be used to estimate model parameters. In what follows, I denote random variables by the $\tilde{}$ sign, and their realizations without the $\tilde{}$ sign.

1.1 Setup

The model is a dynamic version of the earnings management model with uncertain incentives as in Fischer and Stocken (2004). A long-lived manager cares about firm price and is required to report earnings to investors. The report does not have to be truthful: the manager can bias it at a cost. The manager has more information than investors about firm earnings and the extent to which she cares about the firm's price.

The firm's earnings in year t can be thought of as consisting of two parts, one observed by both the manager and the market, and another privately observed by the manager. Earnings, $\tilde{\varepsilon}$, are characterized by the following process:

$$\tilde{\varepsilon}_t = \tilde{\varepsilon}_{1,t} + \tilde{\varepsilon}_{2,t}, \tag{1}$$

$$\tilde{\varepsilon}_{1,t} = \tilde{v}_{1,t} + \tilde{v}_{1,t-1} + \tilde{v}_{1,t-2}, \quad \tilde{v}_{1,t} \sim N(0, q_v \sigma_v^2), \tag{2}$$

$$\tilde{\varepsilon}_{2,t} = \tilde{v}_{2,t} + \tilde{v}_{2,t-1} + \tilde{v}_{2,t-2}, \quad \tilde{v}_{2,t} \sim N(0, (1-q_v)\sigma_v^2), \tag{3}$$

where $0 < q_v < 1$. The manager observes both parts, $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$, and the market only observes $\varepsilon_{1,t}$. The market learns $\varepsilon_{1,t}$ from sources other than the manager's report. q_v represents the fraction of total fundamental information that the market knows.

I model firm earnings as a sum of the current and two prior-year shocks to preserve important time-series properties of earnings while keeping the model tractable. The time series process for earnings in (2) and (3) ensures earnings are persistent and mean-revert (Gerakos and Kovrijnykh (2013)). Two prior-year shocks imply that to evaluate current earnings, investors mostly rely on information about earnings from the last two years. The number of relevant past earnings is consistent with prior studies (e.g., Albrecht et al. (1977)) finding that autocorrelation coefficients for earnings reports cross-sectionally vary between about 0.4 and 0.8. In addition, when earnings are a sum of a finite number of shocks rather than an AR(1) process, the manager's report in equilibrium is also a finite sum of shocks, allowing to derive a closed-form solution of the model.

The market learns its part of current earnings in two time periods. Some fraction is learned concurrently with the previous earnings report (e.g., from concurrent analyst reports), and another fraction is learned at other times during the year leading up to the earnings report. Formally, $\varepsilon_{1,t}$ is divided into two parts:

$$\tilde{\varepsilon}_{1,t} = \tilde{\varepsilon}^0_{1,t} + \tilde{\varepsilon}^1_{1,t}, \tag{4}$$

$$\tilde{\varepsilon}^0_{1,t} = \tilde{v}^0_{1,t} + \tilde{v}^0_{1,t-1} + \tilde{v}^0_{1,t-2}, \quad \tilde{v}^0_{1,t} \sim N(0, q_v q^0_v \sigma^2_v), \tag{5}$$

$$\tilde{\varepsilon}^1_{1,t} = \tilde{v}^1_{1,t} + \tilde{v}^1_{1,t-1} + \tilde{v}^1_{1,t-2}, \quad \tilde{v}^1_{1,t} \sim N(0, q_v(1-q^0_v)\sigma^2_v), \tag{6}$$

where $0 < q^0_v < 1$. $\varepsilon^0_{1,t}$ is the fraction of the market's fundamental information that arrives concurrently with the previous earnings report, $\varepsilon^1_{1,t}$ is the fraction of the market's fundamental information that arrives on other days during the year leading up to the current earnings report. The fraction of investors' earnings information that is learned together with the previous report is captured by q^0_v. The timing of information arrival is shown in figure 1.

The firm manager cares about stock price so that a \$1 increase in the price at time t gives her extra m_t units of utility. Misreporting incentives m_t are not just capturing the manager's compensation but can include non-monetary benefits such as reputation or happiness from governing a successful company. The incentives can be positive or negative. Misreporting incentives evolve every year and are described by the following process:

$$\tilde{m}_t = \tilde{m}_{1,t} + \tilde{m}_{2,t}, \tag{7}$$

$$\tilde{m}_{1,t} = \tilde{\xi}_{1,t} + \tilde{\xi}_{1,t-1} + \tilde{\xi}_{1,t-2}, \quad \tilde{\xi}_{1,t} \sim N(0, q_\xi \sigma_\xi^2), \tag{8}$$

$$\tilde{m}_{2,t} = \tilde{\xi}_{2,t} + \tilde{\xi}_{2,t-1} + \tilde{\xi}_{2,t-2}, \quad \tilde{\xi}_{2,t} \sim N(0, (1-q_\xi)\sigma_\xi^2), \tag{9}$$

where $0 < q_\xi < 1$. Similarly to earnings, the manager knows both components of her incentives, $m_{1,t}$ and $m_{2,t}$, and the market knows only a part of them, $m_{1,t}$. q_ξ represents the share of misreporting incentives information that the market has.

Investors learn the manager's incentives for year t partially at the time of the year-$(t-1)$ earnings report and partially at other times between the year-$(t-1)$ and year-t reports. $m_{1,t}$ consists of two parts:

$$\tilde{m}_{1,t} = \tilde{m}^0_{1,t} + \tilde{m}^1_{1,t}, \tag{10}$$

$$\tilde{m}^0_{1,t} = \tilde{\xi}^0_{1,t} + \tilde{\xi}^0_{1,t-1} + \tilde{\xi}^0_{1,t-2}, \quad \tilde{\xi}^0_{1,t} \sim N(0, q_\xi q^0_\xi \sigma_\xi^2), \tag{11}$$

$$\tilde{m}^1_{1,t} = \tilde{\xi}^1_{1,t} + \tilde{\xi}^1_{1,t-1} + \tilde{\xi}^1_{1,t-2}, \quad \tilde{\xi}^1_{1,t} \sim N(0, q_\xi(1-q^0_\xi)\sigma_\xi^2). \tag{12}$$

where $0 < q^0_\xi < 1$. $m^0_{1,t}$ is the fraction of the market's misreporting incentives information that arrives concurrently with the manager's report, $m^1_{1,t}$ is the fraction of the market's misreporting incentives information that arrives on other days during the year preceding the current earnings report.

Every year, the manager releases a report (potentially biased), e_t, about the firm's earnings and is compensated based on the firm's stock price, p_t, net of personal cost of misreporting. The misreporting cost is a function of the current period's bias in earnings, as well as all other biases in prior period earnings. Such cost function, first, can capture the increasing likelihood of being caught and penalized when the manager misreports more cumulatively. Second, the cost of prior years' misreporting naturally introduces reversal of accruals (which can happen at any point in time) because, in order to exaggerate current earnings, the manager has to bias her report by an additional amount to compensate for the reversal rate, and thus bear a higher misreporting cost. The manager's utility at time t is

$$U_t = m_t p_t - \frac{\left(\sum_{k=0}^{t}(e_k - \varepsilon_k)\right)^2}{2},[1] \tag{13}$$

where m_t is the manager's misreporting incentives.[2]

The manager faces a dynamic trade-off: if her misreporting incentive is positive ($m_t > 0$), on the one hand, by overstating earnings today, she increases firm price and thus increases her utility. On the other hand, if she heavily overstates firm earnings today ($e_t > \varepsilon_t$), she will have little room for overstatement (and boosting firm price) going forward. If the manager understates earnings today ($e_t < \varepsilon_t$), it will be costlier for him to report a higher number in the future. The manager's problem at time t is

$$\max_{e_t} \quad E\left[\sum_{k=t}^{k=\infty} \delta_M^{k-t}\left(\tilde{m}_k p_k - \frac{\left(\sum_{\tau=0}^{k}(e_\tau - \varepsilon_\tau)\right)^2}{2}\right)|I_t^{\text{manager}}\right], \tag{14}$$

where $0 < \delta_M < 1$ is the extent to which the manager cares about his future utility, and $I_t^{\text{market}} = \{\varepsilon_0, \varepsilon_1, ..., \varepsilon_t; m_0, m_1, ..., m_t\}$ is all the information available to the manager at time t, which is simply all realizations of earnings and misreporting incentives.

The market prices the firm risk-neutrally at the expectation of its current and discounted future earnings:

$$p_t = E\left[\sum_{k=t}^{\infty} \delta_I^{k-t} \tilde{\varepsilon}_k | I_t^{\text{market}}\right], \tag{15}$$

where $0 < \delta_I < 1$ is investors' discount factor, and $I_t^{\text{market}} = \{r_0, r_1, ..., r_t; \varepsilon_{1,0}, \varepsilon_{1,1}, ..., \varepsilon_{1,t}; m_{1,0}, m_{1,1}, ..., m_{1,t}\}$ is all the information available to the market at time t. It includes all past managerial reports and the history of fundamental and misreporting incentives information observed by the market.

[1]Other studies considered accounting system errors as another source of investors' uncertainty related to financial misreporting (e.g., Beyer et al. (2019)). The accounting system error can be incorporated in my model by changing the manager's misreporting cost to $\frac{\left(\sum_{k=0}^{t}(e_k - \varepsilon_k - \eta_k)\right)^2}{2}$, where η_k is the error introduced by the accounting system. Adding this feature to the model makes it considerably more complex without helping the main focus of this study – uncovering investors' uncertainty about managers' misreporting incentives, m_t. Since accounting error noise has been explored in detail in prior work (Beyer et al. (2019)), I leave the investigation of jointly misreporting incentives and accounting error uncertainty for future research.

[2]Note that the manager bears 1 unit of cost for the misreporting of size $\frac{\left(\sum_{k=0}^{t}(e_k - \varepsilon_k)\right)^2}{2}$. This implies that m_t is the manager's benefit of misreporting relative to the 1 unit of misreporting cost. Alternatively, the cost of misreporting can be modelled as $c\frac{\left(\sum_{k=0}^{t}(e_k - \varepsilon_k)\right)^2}{2}$ and the manager's misreporting incentives can be modelled as $M_t = cm_t$.

The final element that I define is the market's expectations of the annual earnings report:

$$ME_t = E\left[\tilde{e}_t | I_t^{\text{market}}\right]. \tag{16}$$

I introduce the notion of the market's expectations because it allows me to glean investors' information about the manager's misreporting incentives. The expectation of the report is the expectation of the sum of true earnings and the bias that the manager adds. The bias, in turn, is a function of the manager's incentives. Coupling market expectations with firm prices, which represent solely beliefs about firm earnings, I can disentangle investors' expectations of the reporting bias, and thus of misreporting incentives.

1.2 Analysis in equilibrium

1.2.1 Earnings reports, and evolution of prices and market's expectations

I consider equilibria with the following steady-state relations:

- The manager's earnings report is a linear function of the firm's current true earnings and the manager's misreporting incentives:

$$e_t = e_0 + e_\varepsilon \varepsilon_t + \sum_{k=0}^{k=t} e_{m_1^0,k} m_{1,t-k}^0 + \sum_{k=0}^{k=t} e_{m_1^1,k} m_{1,t-k}^1 + \sum_{k=0}^{k=t} e_{m_2,k} m_{2,t-k};$$

- Firm price is a linear function of the manager's current and prior reports, and the market's fundamental and misreporting incentives information:

$$p_t = p_0 + \sum_{j=0}^{j=t} \alpha_j^t e_j + \sum_{j=0}^{j=t} \beta_j^{0,t} \varepsilon_{1,j}^0 + \sum_{j=0}^{j=t} \beta_j^{1,t} \varepsilon_{1,j}^1 + \sum_{j=0}^{j=t} \gamma_j^{0,t} m_{1,j}^0 + \sum_{j=0}^{j=t} \gamma_j^{1,t} m_{1,j}^1;$$

- Market expectations of the manager's next earnings report is a linear function of the prior reports, and the market's fundamental and misreporting incentives information:

$$ME_t = ME_0 + \sum_{j=0}^{j=t} a_j^t e_j + \sum_{j=0}^{j=t} b_j^{0,t} \varepsilon_{1,j}^0 + \sum_{j=0}^{j=t} b_j^{1,t} \varepsilon_{1,j}^1 + \sum_{j=0}^{j=t} c_j^{0,t} m_{1,j}^0 + \sum_{j=0}^{j=t} c_j^{1,t} m_{1,j}^1.$$

α_j^t is price-t response to the managerial report, $\beta_j^{0,t}$ and $\beta_j^{1,t}$ are price-t responses to the fundamental information learned at the time of the manager's report and on other days, $\gamma_j^{0,t}$ and $\gamma_j^{1,t}$ are price-t responses to the misreporting incentives information learned at the time of the manager's report and on other days.

The firm's price and the market's expectations rely on all sources of information about true earnings and the manager's incentives. First, the market uses the information that investors learned from sources other than the manager's report. Second, the market uses the manager's earnings reports to form beliefs about unobservable parts of earnings and the manager's incentives. Investors use not only the most recent but all the past earnings reports for the following reason. Since innovations to true earnings and misreporting incentives persist for two years going forward, at least two past earnings reports are useful for gleaning innovations to true earnings and misreporting incentives in the current year. In addition, since all earnings reports are noisy signals of true earnings and misreporting incentives, and the noise across earnings reports is correlated due to persistence in misreporting incentives, earnings reports beyond the past two periods help predict the noise in the past two earnings and thus are also useful in backing out information from the current earnings report.

The proposition below describes the optimal earnings report chosen by the manager.

Proposition 1 *In the steady-state, the manager's earnings report is*

$$e_t = \varepsilon_t + (\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2)\xi_t - \alpha_0 \xi_{t-3} - \delta_M \alpha_1 \xi_{t-2} - \delta_M^2 \alpha_2 \xi_{t-1}, \tag{17}$$

where α_0, α_1, and α_2 are the current, one-year-ahead, and two-year-ahead prices' responses to the manager's earnings report, defined in the Appendix.

The manager's optimal report is the sum of the firm's true earnings (ε_t), the bias added to the current earnings $\left((\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2)\xi_t\right)$ net of the bias in the prior earnings report $\left(\alpha_0 \xi_{t-3} + \delta_M \alpha_1 \xi_{t-2} + \delta_M^2 \alpha_2 \xi_{t-1}\right)$. Such behavior represents the common notion that a bias in the report has to reverse at some point in the future. In equilibrium, the manager chooses to (at least partially) undo the bias she added to her report last year. If the product of her misreporting incentives and market response to the report are higher this year than last year, she will reverse last year's bias and also overstate current earnings.

To understand how the market's learning from the manager's report and other information sources is reflected in prices, let us analyze the firm's price at different times of the year: right before the time-t report is issued, right after it is issued, and right before the time-$t+1$ earnings report comes out. I denote by $p_t^{\text{pre-report}}$ the firm's price right before the earnings report e_t is released, and by $p_t^{\text{post-report}}$ the firm's price right after the report is released. I_t^{market} denotes the market's information at time t, which includes the time

t earnings report; $I_t^{\text{market}} \setminus \{e_t\}$ denotes the market's information excluding the current earnings report and concurrent information. Before the earnings report at time t, the market's expectation of the sum of current and discounted future earnings is

$$p_t^{\text{pre-report}} = E\left[\sum_{k=t}^{\infty} \delta_I^{k-t} \varepsilon_{1,k} | I_t^{\text{market}} \setminus \{e_t\}\right] + E\left[\sum_{k=t}^{\infty} \delta_I^{k-t} \varepsilon_{2,k} | I_t^{\text{market}} \setminus \{e_t\}\right] \tag{18}$$

$$= \varepsilon_{1,t} + \left(\delta_I \left(v_{1,t} + v_{1,t-1}\right) + \delta_I^2 v_{1,t}\right) + E\left[\sum_{k=t}^{\infty} \delta_I^{k-t} \varepsilon_{2,k} | I_t^{\text{market}} \setminus \{e_t\}\right] \tag{19}$$

The first summand $(\varepsilon_{1,t})$ represents the part of the current earnings that investors learned perfectly from other information sources, and the second summand $\left(\delta_I \left(v_{1,t} + v_{1,t-1}\right) + \delta_I^2 v_{1,t}\right)$ is investors' expectation of future part of earnings given their information from other sources. Since the two parts of earnings, ε_1 and ε_2, are independent and investors perfectly know the history of the first part, ε_1, investors do not rely on the manager's report to build their expectations about future first part of earnings, $E\left[\sum_{k=t+1}^{\infty} \delta_I^{k-t} \varepsilon_{1,k} | I_t^{\text{market}} \setminus \{e_t\}\right]$, but rather rely on their own historical knowledge. The third summand represents investors' belief about the second part of current and future earnings. Because investors do not observe these parts of earnings, the only sources of information about them are the manager's earnings reports.

At the time of the earnings release, two types of information arrive. First, the earnings report itself, e_t, provides investors with information about the current earnings, which include shocks that will persist at time $t+1$ and $t+2$. Second, concurrent information sources (e.g., earnings calls) reveal some information about the next period's earnings, $v_{1,t+1}^0$. The firm's price right after the earnings report is released is

$$p_t^{\text{post-report}} = E\left[\sum_{k=t}^{\infty} \delta_I^{k-t} \varepsilon_{1,k} | I_t^{\text{market}}\right] + E\left[\sum_{k=t}^{\infty} \delta_I^{k-t} \varepsilon_{2,k} | I_t^{\text{market}}\right] \tag{20}$$

$$= \varepsilon_{1,t} + \left(\delta_I \left(v_{1,t+1}^0 + v_{1,t} + v_{1,t-1}\right) + \delta_I^2 \left(v_{1,t+1}^0 + v_{1,t}\right) + \delta_I^3 v_{1,t+1}^0\right) + E\left[\sum_{k=t}^{\infty} \delta_I^{k-t} \varepsilon_{2,k} | I_t^{\text{market}}\right] \tag{21}$$

This price differs from the price right before the earnings report in, first, the updated expectation of the first part of the next two period's earnings, $\left(\delta_I v_{1,t+1}^0 + \delta_I^2 v_{1,t+1}^0 + \delta_I^3 v_{1,t+1}^0\right)$ and, second, investors' information set being expanded to include the current earnings report e_t. The price change around an earnings announcement is summarized in the following proposition.

Proposition 2 *In the steady state, the change in firm price after the issuance of the manager's report is*

$$p_t^{\textit{post-report}} - p_t^{\textit{pre-report}} = \left(\delta_I + \delta_I^2 + \delta_I^3\right) v_{1,t+1}^0 + \alpha_0 \left(e_t - E[\tilde{e}_t | I_t^{\textit{market}} \setminus \{e_t\}]\right), \tag{22}$$

where α_0 is the earnings response coefficient, derived in the Appendix.

The price is updated the second time when the market acquires information throughout the year after the reporting day. The price of the firm right before the time-$t+1$ earnings report release is

$$p_{t+1}^{\text{pre-report}} = E\left[\sum_{k=t+1}^{\infty} \delta_I^{k-(t+1)} \varepsilon_{1,k} | I_{t+1}^{\text{market}} \setminus \{e_{t+1}\}\right] + E\left[\sum_{k=t+1}^{\infty} \delta_I^{k-(t+1)} \varepsilon_{2,k} | I_{t+1}^{\text{market}} \setminus \{e_{t+1}\}\right] \tag{23}$$

$$= \varepsilon_{1,t+1} + \left(\delta_I \left(v_{1,t+1} + v_{1,t}\right) + \delta_I^2 v_{1,t+1}\right) + E\left[\sum_{k=t+1}^{\infty} \delta_I^{k-(t+1)} \varepsilon_{2,k} | I_{t+1}^{\text{market}} \setminus \{e_{t+1}\}\right] \tag{24}$$

The price changes during the year, first, because investors learn new information about earnings and misreporting incentives ($v_{1,t+1}^1$ and $\xi_{1,t+1}^1$) from other sources and, second, because one year passes and investors discount their expectations of future cash flows less.

Proposition 3 *In the steady-state, the change in firm price after the market learns $\varepsilon_{1,t+1}^1$ and $m_{1,t+1}^1$ is*

$$p_{t+1}^{\textit{pre-report}} - p_t^{\textit{post-report}} = \left(1 + \delta_I + \delta_I^2\right)\left(v_{1,t+1}^0 + v_{1,t+1}^1\right) - \left(\delta_I + \delta_I^2 + \delta_I^3\right) v_{1,t+1}^0$$
$$+ (\alpha_1 - \alpha_0) \times \left(e_t - E[\tilde{e}_t | I_{t+1}^{\textit{market}} \setminus \{e_t\}]\right) \tag{25}$$

Next, I discuss how the market's expectations of the next earnings report evolve during a year. The market's expectation of the time-t earnings report right before its release is:

$$ME_t^{\text{pre-report}} = \varepsilon_{1,t} + E_t\left[\varepsilon_{2,t} | I_t^{\text{market}} \setminus \{e_t\}\right] \tag{26}$$

$$+ \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right) \xi_{1,t} - \alpha_0 \xi_{1,t-3} - \delta_M \alpha_1 \xi_{1,t-2} - \delta_M^2 \alpha_2 \xi_{1,t-1} \tag{27}$$

$$-\alpha_0 E_t\left[\xi_{2,t-3} | I_t^{\text{market}} \setminus \{e_t\}\right] - \delta_M \alpha_1 E_t\left[\xi_{2,t-2} | I_t^{\text{market}} \setminus \{e_t\}\right] - \delta_M^2 \alpha_2 E_t\left[\xi_{2,t-1} | I_t^{\text{market}} \setminus \{e_t\}\right] \tag{28}$$

Similar to the pre-report price, the market's expectation of true earnings consists of two parts: the one learned perfectly from other sources $(\varepsilon_{1,t})$ and the one known imperfectly from the history of prior reports

$\left(E_t\left[\varepsilon_{2,t}|I_t^{\text{market}}\setminus\{e_t\}\right]\right)$. The market's expectation of the bias in the earnings report, which is a function of misreporting incentives, has a similar structure. Investors know some part of the information (27) from other sources and use the history of reports to form beliefs about the other part (28).

When the earnings report is released, the market uses it to update its beliefs and also gets information about $\nu^0_{1,t+1}$ and $\xi^0_{1,t+1}$ from concurrent sources. The next proposition describes the market's expectation of the $t+1$ earnings report at time t, right after the earnings report e_t arrives.

Proposition 4 *In the steady-state, the market's expectation of the manager's next earnings report e_{t+1} after the issuance of the manager's report e_t is*

$$ME_t^{\textit{post-report}} = \nu^0_{1,t+1} + \nu_{1,t} + \nu_{1,t-1} \quad (29)$$

$$+\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)\xi^0_{1,t+1} - \alpha_0\xi_{1,t-2} - \delta_M\alpha_1\xi_{1,t-1} - \delta_M^2\alpha_2\xi_{1,t} \quad (30)$$

$$+\beta_0\times\left(e_t - E[\tilde{e}_t|I_t^{market}\setminus\{e_t\}]\right) + \beta_1\times\left(e_{t-1} - E[\tilde{e}_{t-1}|I_{t-1}^{market}\setminus\{e_{t-1}\}]\right) + \beta_2\times\left(e_{t-2} - E[\tilde{e}_{t-2}|I_{t-2}^{market}\setminus\{e_{t-2}\}]\right) \quad (31)$$

$$+g\left(e_{t-3}, e_{t-4}, \ldots e_0\right) \quad (32)$$

where β_0, β_1, and β_2 are the regression coefficients of the market's expectations of the time-$t+1$ earnings report on the surprise in the time-t earnings report, defined in the Appendix. The function $g\left(e_{t-3}, e_{t-4}, \ldots e_0\right)$ is a linear function of the past earnings reports $e_{t-3}, e_{t-4}, \ldots e_0$.

Lines (29) and (30) show the market's known parts of true earnings and bias at time $t+1$, respectively. $\nu^0_{1,t+1}$ and $\xi^0_{1,t+1}$ were learned from sources concurrent with the time-t earnings report, and $\nu_{1,t}$, $\nu_{1,t-1}$, $\xi_{1,t}$, $\xi_{1,t-1}$, and $\xi_{1,t-2}$ were learned at earlier periods. The lines (31) represent the market's updated beliefs about true earnings and bias in the time-$t+1$ report based on the earnings reports at all times.

During the year, investors learn information about fundamentals, $\nu^1_{1,t+1}$, and misreporting incentives, $\xi^1_{1,t+1}$ from sources other than earnings reports. This new information makes the market change its expectation of the earnings report at time $t+1$.

Proposition 5 *In the steady-state, the change in the market's expectation of the manager's next earnings report e_{t+1} during the year is*

$$ME_{t+1}^{\textit{pre-report}} - ME_t^{\textit{post-report}} = \nu^1_{1,t+1} + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)\xi^1_{1,t+1} \quad (33)$$

1.2.2 Earnings Quality

I define earnings quality as the negative ratio of the expected bias in the manager's earnings report to the standard deviation of earnings:

$$EQ_t = \frac{-\sqrt{E[(\varepsilon_t - e_t)^2]}}{\sqrt{Var[\varepsilon_t]}} = \frac{-\sqrt{\sigma_\xi^2\left(\left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2 + \alpha_0^2 + \delta_M^2\alpha_1^2 + \delta_M^4\alpha_2^2\right)}}{\sqrt{3\sigma_v^2}} \tag{34}$$

The market's information – q_v and q_ξ – affect the measure of earnings quality through the price responses to the manager's report, α_0, α_1, and α_2. Figures 2 and 3 plot firm price responses to the earnings report. In line with Fischer and Stocken (2004), as investors know more fundamental information (q_v increases), prices become less responsive to the manager's report, reducing the reward that the manager gets per unit of manipulated earnings. As a result, earnings quality improves. Vice versa, when the market learns more information about the manager's misreporting incentives (q_ξ increases), investors are relying more on the earnings report, or become more responsive to it. The manager's reward for misreporting increases, and earnings quality declines. Figures 4 and 5 show how earnings quality changes with the amount of fundamental and misreporting incentives information that investors have, respectively.

[Insert Figure 2 around here]

[Insert Figure 3 around here]

[Insert Figure 4 around here]

[Insert Figure 5 around here]

1.2.3 Price Efficiency

I define price efficiency as the negative deviation of the firm's price from its hypothetical value if the market knew all the information that the manager knows:

$$
\begin{aligned}
PE_t &= -\sqrt{E[(p_t - \text{True Expected Value})^2]} \\
&= -\sqrt{E\left[\left(E\left[\sum_{k=0}^{k=t}\tilde{\varepsilon}_k + \sum_{k=t+1}^{k=\infty}\delta_I^{k-t}\tilde{\varepsilon}_k | I_t^{\text{market}}\right] - E\left[\sum_{k=0}^{k=t}\tilde{\varepsilon}_k + \sum_{k=t+1}^{k=\infty}\delta_I^{k-t}\tilde{\varepsilon}_k | I_t^{\text{manager}}\right]\right)^2\right]} \\
= -&\sqrt{(1-q_v)\sigma_v^2\left(\left(\delta_I+\delta_I^2\right)^2+\delta_I^2\right)+(1-q_\xi)\sigma_\xi^2\left(\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2+\left(\alpha_0+\delta_M\alpha_1\right)^2+\alpha_0^2\right)} \quad (35)
\end{aligned}
$$

In figures 6 and 7 I plot price efficiency as a function of the market's fundamental (q_v) and misreporting incentives (q_ξ) information, respectively. In contrast to earnings quality, price efficiency is increasing in both types of information: the more investors know, the more efficient is the price.

[Insert Figure 6 around here]

[Insert Figure 7 around here]

The fact that investors' misreporting incentives information affects earnings quality and price efficiency in opposite directions points to a trade-off faced by regulators. For example, a policy that requires corporations to disclose more information on executive compensation will make investors better off because companies will be traded closer to their fundamental values. At the same time, external users of financial information will be worse off because the information will get noisier. The regulators' ultimate decision will be determined by their objective function, or the extent to which they prioritize traders on the market versus the precision of reported earnings numbers.

1.2.4 The role of discount factors

Investors' response to earnings, and thus bias in earnings numbers and price efficiency are sensitive to discount rates of the manager and investors. Therefore, assumptions about discount factors might affect estimation results. Let us discuss how key statistics of the model vary with the extent to which investors and the manager care about the future.

Investors' discount factor affects ERC, earnings quality, and price efficiency monotonically. When market participants care more about the future, they react more strongly to earnings information (figure 8), reducing earnings quality (figure 9). Price efficiency also goes down as investors' discount factor increases (figure 10). When traders value future cash flows more, they put a higher weight on the expected financial performance of the firm, and the uncertainty about the fundamentals loads higher in price variance.

[Insert Figure 8 around here]

[Insert Figure 9 around here]

[Insert Figure 10 around here]

The impact of the manager's discount factor is more complicated. The ERC is decreasing when the manager cares more about her future utility (figure 11), implying an unambiguous effect on the quality of earnings. On the one hand, when the manager values future utility more, she values the effect of her bias on future prices more and misreports more. This positive effect is offset by the decreasing ERC: as the manager is more forward-looking, investors do not react as strongly to her report, reducing the value of the bias. The two forces generate an inverse-U-shaped earnings quality as a function of the manager's discount factor (figure 12). Price efficiency also changes non-monotonically when the manager's discount factor increases (figure 13). Similarly to the investors' discount factor, a higher manager's discount factor means the price varies more with investors' uncertainty. At the same time, this uncertainty is reduced when investors react less strongly to the earnings. For very myopic managers, the first effect dominates, and as the manager becomes more farsighted, the second effect wins.

[Insert Figure 11 around here]

[Insert Figure 12 around here]

[Insert Figure 13 around here]

1.3 Theoretical moments and identification

In this section, I list theoretical moments and explain how they help identify model parameters: the total fundamental and misreporting incentives uncertainty, σ_v^2 and σ_ξ^2, the fractions of fundamental and misreporting incentives information that the market knows, q_ν and q_ξ, and the part of these fractions that investors learn from sources concurrent with earnings reports, q_ν^0 and q_ξ^0. In total, I use nine theoretical moments. The first moment is a mean moment – earnings response coefficient. The next two moments are the variance of earnings reports and the variance of change in the market's expectation of the next earnings report during a year. Finally, I use covariances of earnings reports, the market's expectations of earnings reports, and firm prices with each other. I list all the moments with their mathematical expressions in the Appendix.

The intuition for identification is the following. I need to disentangle, first, the manager's information from the market's information, which is a subset of the manager's. Second, fundamental information from incentives information. Third, within the market's fundamental and incentives information, information learned on earnings announcement days from information learned on other days. For the first part, for the manager's information, I use the variance of earnings reports (moment 2) since they are affected by all of the manager's information. In addition, I use the earnings response coefficient (moment 1) as it represents the amount of information contained in the manager's report that was not available to investors prior to the earnings release: if the report contains more new information, investors will react stronger to it. For the market's information – the part of the manager's information that investors learn from elsewhere – I use statistics that represent the evolution of price and the market's expectations of the next report (proxied by analyst forecasts) unexplained by the manager's report (moments 3-9). If prices and analyst forecasts evolve more even after "controlling" for earnings, the market learns more information from other sources.

For the second part, to distinguish the market's fundamental from the market's incentives information, I rely on two assumptions. First, I assume that a firm's price changes only when investors update their beliefs about firm fundamentals, but not about the firm manager's misreporting incentives.[3] Therefore, changes in firms' prices unexplained by earnings (moments 4, 5, 8, and 9) represent the amount of fundamental information known by the market. The second assumption is that when financial analysts try to predict the next earnings report, they forecast both true earnings and the bias that will be added to true earnings by the manager.[4] Since the bias is increasing in the manager's misreporting incentives, analyst forecasts represent a combination of the market's knowledge about fundamentals (true earnings) and the manager's incentives (bias). The evolution of analyst forecasts unexplained by earnings (moments 3, 6, and 7), coupled with

[3]This assumption implies that the manager's price-related misreporting incentives are orthogonal to the firm's fundamental characteristics. Any correlation between the manager's incentives to manage earnings and the firm's financial performance, such as the selection of managers that are more likely to manipulate into certain kinds of companies, would violate my assumption.

[4]This assumption is consistent with the evidence that analysts try to forecast the reported earnings number as closely as possible because forecast precision is the key driver in analysts' compensation and career (Mikhail et al. (1999), Hilary and Hsu (2013)).

the knowledge of the market's fundamental information obtained from prices, helps identify the market's misreporting incentives information learned from other sources. For example, if analyst forecasts vary considerably during a year but prices do not, the market likely learned a lot of misreporting incentives information but not fundamental information.

For the third part, I exploit the timing of changes in firm prices and analyst forecasts. Residual changes in prices and analyst forecasts around earnings announcements after controlling for earnings (moments 4, 6, and 8) represent information on fundamentals and incentives learned during the earnings announcement window from sources other than the earnings report. Changes in prices and analyst forecasts during the year excluding the earnings announcement window (moments 3, 5, 7, and 9) indicate the amount of information investors learned on other days of the year.

Finally, I discuss one important limitation of the model that precludes me from using price variances in estimation and only keeping covariances of prices with earnings reports and analyst forecasts. The model assumes that firms' prices are efficient and there is no volatility in returns due to factors not explained by the information about firm fundamentals.[5] Because price volatility may exceed fundamental volatility (LeRoy and Porter (1981), Shiller (1980)), one might worry that estimates of my model overstate the effect of the firm's reports and investors' information on prices. To avoid this upward bias, I do not use variances of firm prices as moments in the estimation. I only use covariance of price changes with earnings reports and changes in analyst forecasts. To the extent that additional noise in prices (such as discount rate variation) is uncorrelated with earnings or analyst forecasts, potential noise in prices does not affect parameter estimates.

2 Empirical analysis

This section describes the data I use to estimate the model, the estimation procedure, and the main results.

2.1 Data

Annual earnings reports come from the IBES database, balance sheet variables come from Compustat, and firm prices co from the CRSP database. For pre-report prices, I take firms' market values one day before earnings release dates; for post-report prices, I take firms' market values one day after earnings release dates. A proxy for the market's expectations is analyst earnings forecasts from IBES. For pre-report

[5] One of these factors can be variation in discount rates. For example, Vuolteenaho (2002) finds that 33% of price variation in individual stocks is explained by discount rate variation.

expectations, I take the last analyst forecast before an earnings release; for post-report expectations, I take the first analyst forecast after an earnings release. I multiply variables from IBES by the number of common shares outstanding on the corresponding date to obtain all the variables on the firm level. All the variables are divided by firms' three-year-lagged book values to make sure firm size does not mechanically drive firm-level volatility of earnings innovations.

I remove firms that have missing data on one or more variables and firms with negative book value, firms with market-to-book ratio above 10, and firms with stock prices below $1. I winsorize all the variables at the 0.1% level.

The final sample contains 4,141 public firms in the United States with fiscal years from 1995 to 2020, 47,819 observations in total. Table 1 describes the sample selection procedure; table 2 presents the percent of firms in each North American Industry Classification System (NAICS) sector. More than 25% of the sample comprise manufacturing companies, followed by finance and insurance. Firms' characteristics are presented in table 3. A median company is a large company with a market-to-book ratio slightly above 1.5 and a healthy leverage ratio.

[Insert Table 1 around here]

[Insert Table 2 around here]

[Insert Table 3 around here]

Summary statistics for the variables used in estimation are in Table 4. Earnings surprises and changes in prices are positive on average. Analysts' forecasts generally go down during a year, consistent with the well-documented analyst forecast walk-down (e.g., Richardson et al. (2004), Bradshaw et al. (2016)): analysts tend to be more optimistic at the beginning of the forecasting period and gradually reduce their expectations as the date moves closer to the reporting date. This bias can be attributed to analysts' excessive optimism, desire to curry favor with companies' managers, or forecasting difficulty.

The standard deviation of price changes between two annual reports is about 4.6 (4.8) times greater than the standard deviation of earnings reports (analyst forecasts), consistent with the return volatility puzzle (Mehra and Prescott (1985)). Since my model is not primarily about companies' valuation, I do not aim to closely match the volatility of price changes in the data.

[Insert Table 4 around here]

2.2 Estimation Procedure

I use the two-step Generalized Method of Moments (GMM) to estimate the model (Hansen (1982)). The method looks for the values of theoretical parameters (σ_v^2, q_v, q_v^0, σ_ξ^2, q_ξ, and q_ξ^0) that minimize the distance between theoretical moments (e.g., variance of earnings reports as a function of the theoretical parameters), and empirical moments (e.g., variance of earnings report calculated from the data). The distance is measured as a quadratic form of differences between theoretical and empirical moments with a weighting matrix. I describe the estimation procedure in more detail in the Appendix.

Next, I discuss how I choose the discount factors of investors and the manager. For investors' discount factor, I set $\delta_I = 0.95$, which implies a discount rate of about 5%, which is close to discount rates assumed in prior literature (Cooper and Ejarque (2003), Hennessy and Whited (2005), Hennessy and Whited (2007)). For the manager's discount factor, I follow Bertomeu et al. (2022) and set $\delta_M = 0.7$. Bertomeu et al. (2022) compute this discount factor using median vesting duration (Gopalan et al. (2014)). I examine robustness of the model's estimates to the assumptions about discount in section 5.

2.3 Main Results and Model Fit

Table 5 presents the estimated parameters. The estimates suggest that while firm earnings are volatile, investors anticipate a high portion of earnings before the report is released. The total variance of annual innovations in firms' earnings is 0.029, implying that for 32% of companies, innovation of unbiased earnings deviates from the mean by more than 17.0% of these companies' three-year-lagged book value.[6] The market knows 88.3% of this innovation from sources other than the manager's report, and 18.4% of this 88.3% is learned about one year ahead, concurrently with the previous earnings report. Investors seem to know a lot about firm earnings, and only a small part of this knowledge is acquired when prior earnings are released, suggesting that sources other than managerial guidance or concurrent analyst reports are important for the market learning about fundamentals.

Managers' misreporting incentives are considerably more uncertain in general and more opaque to investors. The total variance of innovations in the manager's misreporting incentives is 0.136. For 32% of firms, innovation of the manager's utility gain per $1 increase in firm prices deviates from its mean by 36.9% of the firm's 3-year-lagged book value. The market knows 52.8% of this innovation, and almost all of

[6] This inference is calculated as the fraction of observations from a normal distribution not within one standard deviation of the mean.

it (99.7%) is learned concurrently with the previous earnings report. Compared to fundamentals, the market is less aware of managers' incentives to manipulate reported earnings. Interestingly, prior earnings report day is more significant for learning about reporting incentives than about fundamentals, perhaps because both company management and external analysts often disclose their expectations for next year's earnings on that day.

[Insert Table 5 around here]

Table 6 shows values of the empirical and theoretical moments at the estimated parameters and t-values of differences between the theoretical and empirical moments. For eight out of nine moments, differences between estimated theoretical and empirical values are statistically indistinguishable from zero. The only moment that the model matches poorly is the covariance of changes in prices with changes in the market's expectations during a year. The estimated theoretical moment, however, is economically close to its data counterpart.

[Insert Table 6 around here]

The estimated parameters suggest that the level of earnings quality is -1.36, or reported earnings on average differ from true earnings by about 136% of the standard deviation of true earnings. For a median company in my sample, misreporting is about 0.09% of the company's total assets.

Price efficiency is estimated to be low: for a representative company in my sample, the actual market value is different from a hypothetical market value without information asymmetry between investors and the manager by about 34.29% of the company's book value.

3 Counterfactual analyses

A structural model allows researchers to predict how financial markets would behave in different counterfactual scenarios without implementing these scenarios in real markets. In this section, I use this advantage of structural modeling to assess how different hypothetical regulations and other exogenous changes to the economic environment may affect the informativeness of financial information and the efficiency of firms' prices. First, I summarize the sensitivities of earnings quality and price efficiency to the overall uncertainty and the market's knowledge of firm fundamentals and managers' misreporting incentives. Next, I consider more substantial changes to the information environment.

3.1 Sensitivities of Earnings Quality and Price Efficiency

To better understand which factors affect the bias in reported earnings and deviation of firm prices from their fundamental values, I study several changes to the model's parameters. For every parameter governing overall uncertainty or investors' knowledge, I change the estimated value by 10% up and down while keeping other parameters fixed. I then look at the resulting changes in earnings quality and price efficiency. This analysis shows which factors (e.g., fundamental or misreporting incentives uncertainty or investors' knowledge) primarily move financial market outcomes.

Histograms of sensitivities are presented in figures 14 and 15. The analysis suggests that the factor with the largest marginal effect is the amount of fundamental information known by investors. Both earnings quality and price efficiency are most sensitive to investors' fundamental information, and this sensitivity more than four times exceeds sensitivities to other economic parameters. A policy that reduces stock market investors' information about firm fundamentals, such as decreased mandatory disclosure, by about 10%, will cause about a 17% drop in price efficiency and about a 15% drop in earnings quality.

The non-trivial effects of investors' misreporting incentives information can be seen in the last bars of the histograms. When investors acquire more information about managers' incentives, price efficiency improves while earnings quality goes down. Changes in the two statistics are of similar magnitudes, suggesting a meaningful trade-off regulators face when deciding whether to increase the amount of misreporting incentives information provided to investors.

Earnings quality and price efficiency co-move when misreporting incentives uncertainty changes but move in opposite directions when fundamental uncertainty changes. A firm's price is closer to its value under full information when investors are less uncertain about fundamentals or misreporting incentives. This feature does not hold for earnings quality. When misreporting incentives uncertainty is high, the noisy term in earnings reports is large, making them less informative. In contrast, higher fundamental uncertainty increases the signal-to-noise ratio in earnings, providing users of earnings numbers with better information.

[Insert figures 14 and 15 around here.]

3.2 Fundamental changes in information environment

Next, I consider more profound changes to the information environment. First, I analyze and compare two economies: in one, fundamental uncertainty is a considerably greater concern than misreporting incentives uncertainty – perhaps an economy with a harsher regulatory environment, – and in another, misreporting incentives are considerably more uncertain than firms' fundamentals. The second set of counterfactuals considers economies with close-to-perfect information. In the first economy, investors know almost everything about companies' fundamentals; in the second economy, investors almost perfectly understand managers' incentives to misreport financial information.

3.2.1 Fundamental vs. misreporting incentives uncertainty

The first set of counterfactual analyses aims to understand the characteristics of financial markets where one type of uncertainty is a primary concern: uncertainty about fundamentals or about misreporting incentives. The results suggest that high misreporting incentives uncertainty is more harmful to earnings quality and price efficiency than fundamental uncertainty. The first two rows of table **??** show estimated earnings quality and price efficiency in scenarios where fundamental uncertainty is infinitely higher than misreporting incentives uncertainty and vice versa. In an economy where fundamental uncertainty is a primary concern (first row of table **??**), a representative company's earnings number is very close to its unbiased earnings. Even though investors in this economy obtain close to truthful financial information, the market price still deviates from its value without information asymmetry by about 12.22% of companies' book value. The reason is that at an arbitrary point in time, capital market participants do not know all fundamental information before the manager releases the annual report. For the economy where misreporting incentives are the primary concern, financial information quality and price efficiency are considerably worse. When investors are substantially uncertain about managers' misreporting incentives, even a small piece of information about incentives from other sources makes traders think they understand reports much better, tremendously increasing the earnings response coefficient. As a result, managers benefit more from misreporting and bias earnings by a lot. The bias can achieve a few thousand percent of the standard deviation of true earnings. The price is also less efficient in such an economy: it deviates from its value under full information by about 42.19% of companies' book value.

3.2.2 Perfect knowledge of fundamentals vs. of misreporting incentives

Next, I consider scenarios where market participants know close to all information about companies' fundamentals (third row of table **??**) and managers' incentives to misreport (fourth row of table **??**). If a social planner were to choose between giving investors more fundamental or more misreporting incentives information, she would face a trade-off. Increasing fundamental information makes earnings numbers a more precise signal about true earnings; however, providing more information about incentives substantially improves price efficiency.

Counterfactual analyses demonstrate how nuanced the regulators' problem is when designing information provision systems. If we take overall fundamental and incentives uncertainties as fixed characteristics of an economy, whether to provide traders with information about fundamentals or incentives depends on the regulators' objective function. A regulator who mostly cares about market participants' welfare, which can be interpreted as price efficiency, providing investors with as much information as possible about both fundamentals and incentives is the best strategy. Misreporting incentives information would have a greater positive effect; thus, the regulator would prioritize incentives disclosures. In contrast, a regulator seeking to make earnings numbers less biased would prefer that investors know little about misreporting incentives but can largely predict companies' fundamental performance.

[Insert table **??** around here.]

4 Applications: the effect of expanded compensation disclosure and information spillovers

Researchers face challenges when evaluating the effects of disclosure policies and thus can be limited in their ability to inform regulators. Leuz and Wysocki (2016) note that the reduced-form approach relies on proper identification to be able to provide magnitudes of policies' effects. Without the magnitudes, it is difficult for policymakers to weigh regulations' benefits against their costs. Moreover, even if standard empirical methods find a credible identification strategy, it is hard for them to measure policies' externalities or economy-wide implications. Policymakers, however, must consider the complete picture of the economy and information environment in their decisions.

This study highlights how financial market consequences that regulators care about – price efficiency and earnings quality – hinge on the nature of financial market investors' information. Because different objectives can be at odds for some information-related regulations, it is important to be able to disentangle the two types of investors' information and their relative effects. Structural estimation can serve this objective by directly evaluating multiple economic parameters and how they change after regulations or vary with companies' characteristics. In this part of the paper, I demonstrate how the structural estimation technique can be applied to measure the two types of investors' information in two settings: the introduction of the CD&A section and information spillover during an earnings cycle.

4.1 Expanded compensation disclosure and investors' information

The Securities and Exchange Commission (SEC) proposed revised rules for executive compensation disclosures in January 2006. The primary goal of the regulation was to provide investors with more information about managerial compensation and its sensitivity to company performance. Consistent with theory (Fischer and Stocken (2004)), reduced-form empirical evidence has confirmed that the introduction of CD&A has increased the earnings response coefficient (Ferri et al. (2018)), which may induce more earnings management.

It remains less clear, however, which forces drive the change in ERC. On the one hand, CD&A in 2007 could have provided investors with more information on managerial incentives, increasing the ERC. At the same time, the financial crisis in the post-2007 period may make investors less certain about firm fundamentals, also increasing the ERC. The two concurrent forces are difficult to disentangle using a standard reduced-form approach. To evaluate the magnitudes played by the two forces, I structurally estimate my model on the pre-CD&A and the post-CD&A data.

The revisions of the proxy statements were released by the SEC in August 2006 and were effective for firms with the fiscal year ending on or after December 15, 2006. To estimate the effect of the regulation, I divide my sample into two groups: before and after the compensation disclosure regulation. The "before" period is the fiscal year ends before the SEC proposal date, January 26, 2006, and the "after" period is the fiscal year ends after December 15, 2009.[7]

The results, presented in table 8, support both mechanisms that could potentially drive an increase in the ERC. Firstly, the introduction of CD&A appears to have achieved its main goal: the fraction of misreporting incentives information known by investors has increased from 53.2% before the regulation to 73.1% after the regulation. Next, presumably due to the financial crisis, investors' information about firms' fundamentals decreased from 87.9% to 59.2%. The findings suggest that researchers and regulators should be cautious when attributing the increase in the ERC in the post-2007 period solely to the expanded compensation

[7] Since in my model every shock to firm fundamentals or misreporting incentives persists for three periods, the model needs at least three periods after a shock to converge to a new steady-state.

disclosure. Part of this decrease occurred as a result of concurrent changes in the other aspect of investors' information – fundamentals information.

In addition, the estimates suggest that in the post-2009 period the overall variance of managers' misreporting incentives went down considerably. This change could result from the adoption of FAS 123R,[8] after which corporations reduced the amount of option grants in executive compensation packages (Hayes et al. (2012)) and thus different managers' incentives became more homogenous and predictable. Because of this change in compensation packages, even though investors appear to have more incentives information and less fundamental information after 2009, the reduction in the overall variance of misreporting incentives outweighed these changes and both firms' earnings quality and price efficiency improved in the post-2009 period.

[Insert table 8 around here.]

4.2 Information spillovers and investors' information

Empirical studies have widely documented information spillovers from companies that announce earnings earlier to their peers (e.g., Ramnath (2002), Savor and Wilson (2016), Hann et al. (2019), Ogneva et al. (2021)). Ramnath (2002) shows that financial analysts and investors can better predict the earnings of firms announcing later in the reporting cycle, and the prediction partially comes from earlier reports. Savor and Wilson (2016) document higher abnormal returns for early earnings announcers. The authors posit that investors use announcers' disclosures to revise their beliefs about non-announcers, which increases covariance between early announcers' and market-wide cash flow news – early announcers' systemic risk. Following that logic, late reporters should obtain lower market reactions on their reporting days because investors have more information about late reporters' fundamentals from early reporters' reports. However, lower market reaction to late reporters' reports can also be due to investors being more uncertain about these reporters' misreporting incentives (Trueman (1990)). To disentangle the two explanations, I estimate the structural model separately for firms reporting early and firms reporting late in the earnings report cycle.

I split my sample into early and late reporters. A company is classified as a late reporter if it reports earnings later than three-quarters of companies in a given year, and as an early reporter if it reports earnings

[8] The accounting treatment of stock options changed after the adoption of FAS 123R in 2005. For a summary of the statement, see https://www.fasb.org/page/PageContent?pageId=/reference-library/superseded-standards/summary-of-statement-no-123-revised-2004.htmlbcpath=tff.

earlier than three-quarters of companies in a given year. Table 9 presents the estimation results.

[Insert table 9 around here.]

The estimated parameters for early and late reporters suggest that, while investors indeed seem to know more information about firms reporting earnings later, these firms' misreporting incentives are considerably more opaque, and as a result, late reporters have worse earnings quality than early reporters. Spillover of fundamental information during the reporting cycle is significant: for companies reporting later, investors know 84.8% of fundamental information, which is more than 40 percentage points more than for companies reporting early. Nevertheless, the quality of earnings of late reporters is about 126% smaller. The reason is that these companies have more uncertain misreporting incentives. Managers' incentives for late reporters are about 100 times more volatile, and investors know only 28.8% of these incentives.

Late reporters' incentives may be more opaque because firms that report later in the earnings cycle tend to (or are believed to) manage earnings more. Trueman (1990) offers a theory that connects companies' earnings management to their choice of disclosure timing. First, earnings management itself may result in delayed reporting and second, a manager who wants to manipulate may choose to observe other reports first to better understand what the market's expectations are for the earnings of her firm. Whether late firms have incentives to misreport may therefore be unclear to investors, and this uncertainty seems to outweigh the gain from learning more about fundamentals from other companies' early reports.

5 Alternative discount factors

Section 1.2.4 demonstrated that the market statistics about earnings and prices are sensitive to the manager's and investors' discount factors. As a result, the estimates of other parameters in the model likely change when I assume different discount factors. To test how the results of the study vary with the assumptions, I estimate two alternative specifications of the model. In the first specification, I reduce the investors' discount factor and set it below the manager's. In the second specification, I increase the manager's discount factor.

The results (table 10) suggest that parameter estimates are not sensitive to the manager's discount rate, but are sensitive to the investors' discount rate. The estimates in the first column, for the main specification, are generally the same as the estimates in the third column, for the specification where the manager assumed to be farsighted ($\delta_M = 0.99$). The estimates in the second column suggest greater fundamental and lower misreporting incentives uncertainty (both overall and investors'). For intuition, recall that when investor discount future cash flows more heavily, the earnings response coefficient decreases (figure 8). Therefore, to match the earnings response coefficient observed in the data, the search algorithm needs to find parameter values to boost earnings response coefficient, and estimates higher fundamental and lower misreporting incentives uncertainty.

[Insert table 10 around here.]

6 Conclusion

Measuring how much information investors know is valuable to researchers and regulators because investors' information has an unambiguous effect on financial reporting quality and price efficiency. This paper develops a structural estimation technique to measure how much information the market knows about firm fundamentals and managers' misreporting incentives, and how these types of information affect accounting quality and price efficiency.

I further take advantage of the technique to study two settings where investor information plays considerable role. First, I assess the effect of introducing the Compensation Disclosure & Analysis (CD&A) section in companies' proxy statements in 2007. The structural approach allows me to disentangle multiple concurrent events in financial markets that might have affected investors' information in the post-2007. I find that, while CD&A indeed provided investors with more incentives information, investors are significantly more uncertain about firm fundamentals in the post-2007 period, presumably because of the Financial Crisis. The increased fundamental uncertainty outweighed better information about incentives, and financial reporting quality did not worsen following CD&A.

Second, I study information spillover during earnings reporting cycle. The common belief is that investors acquire information from early reporters' disclosures and thus anticipate greater portion of late reporters' disclosures. I confirm this prediction and show that spillover of fundamental information is substantial, however, late reporters' incentives are much more opaque to investors than early reporters'. As a result, late reporters have less efficient price.

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Table 1: Sample selection procedure

Sample reduction reason	Sample size
Initial sample, containing all the variables needed from I/B/E/S and CRSP	81,138
Non-missing book value in Compustat	65,183
Positive book value	62,004
Market-to-book ratio less than or equal to 10	56,900
Price above or equal to $1	56,060
Firms with non-missing lagged and lead variables	22,503

Table 2: Percent of observations in NAICS sectors in the sample

NAICS	% of total sample
Agriculture, Forestry, Fishing and Hunting	0.15
Mining	2.64
Utilities	2.58
Construction	0.96
Manufacturing	28.42
Wholesale Trade	1.60
Retail Trade	4.21
Transportation and Warehousing	2.51
Information	4.82
Finance and Insurance	15.66
Real Estate Rental and Leasing	2.78
Professional, Scientific, and Technical Services	3.98
Management of Companies and Enterprises	1.76
Administrative and Support and Waste Management and Remediation Services	1.17
Educational Services	0.40
Health Care and Social Assistance	1.11
Arts, Entertainment, and Recreation	0.70
Accommodation and Food Services	1.20
Other Services (except Public Administration)	0.28
Missing NAICS	23.06

Table 3: Descriptive statistics

Statistic	N	Mean	St. Dev.	Pctl(25)	Median	Pctl(75)
Book value (in $ 100 mil)	22,503	31.923	122.154	1.995	5.570	16.354
Market value (in $ 100 mil)	22,503	57.523	207.649	2.991	9.309	30.204
Total assets (in $ 100 mil)	22,253	183.145	1,243.988	4.492	15.256	52.119
Market-to-book ratio	22,503	2.046	1.451	1.093	1.648	2.535
ROA	22,253	0.023	0.129	0.007	0.031	0.066
Leverage ratio	17,880	0.688	1.525	0.045	0.363	0.816

Table 4: Summary statistics for the variables used in estimation

Statistic	N	Mean	St. Dev.	Pctl(25)	Median	Pctl(75)
Reported earnings, e_t	22,503	0.174	0.550	0.051	0.127	0.226
Earnings surprise, $e_t - E[\tilde{e}_t \mid I_t^{\text{market}} \setminus \{e_t\}]$	22,503	0.0004	0.087	−0.003	0.001	0.007
Price change around earnings announcements, $p_t^{\text{post-report}} - p_t^{\text{pre-report}}$	22,503	0.002	0.447	−0.066	0.001	0.078
Price change during a year, $p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}}$	22,503	0.291	2.546	−0.242	0.123	0.615
First analyst forecast after an earnings announcement, $ME_t^{\text{post-report}}$	22,503	0.187	0.524	0.064	0.132	0.227
Analyst forecast during a year, $ME_{t+1}^{\text{pre-report}} - ME_t^{\text{post-report}}$	22,503	−0.013	0.196	−0.029	−0.002	0.016

Table 5: Estimated model parameters

Parameter	Estimate
Fundamental variance, σ_v^2	0.029 (0.014)
Market's total share of fundamental information, q_v	0.883 (0.500)
Market's share of fundamental information received concurrently with the manager's report, q_v^0	0.184 (0.132)
Incentives variance, σ_ξ^2	0.136 (0.702)
Market's total share of incentives information, q_ξ	0.528 (0.343)
Market's total share of incentives information received concurrently with the manager's report, q_ξ^0	0.997 (0.088)
J-statistic	6.309

Note: Standard errors are in parentheses. The parameters are estimated assuming discount rates $\delta_M = 0.7$ and $\delta_I = 0.95$.

Table 6: Data moments and theoretical moments at the estimated parameters

	Moment	Empirical value	Theoretical value	t-statistic [p-value]
1	Earnings response coefficient moment	0.44435	0.42497	0.782 [0.435]
2	Variance of earnings reports	0.30267	0.25217	-1.237 [0.216]
3	Variance of change in the market's expectation of the next earnings report during a year	0.02573	0.02141	-1.435 [0.151]
4	Covariance of time-$t+1$ earnings reports with residuals of the time-t "ERC" regression	0.01518	0.01294	-0.452 [0.651]
5	Covariance of time-$t+1$ earnings reports with residuals from regressing change in prices from right after the time-t report to right before the time-$t+1$ report on the time-t earnings report surprise	0.06588	0.06120	-0.093 [0.926]
6	Covariance of time-$t+1$ earnings reports with residuals of the market's expectation of the time-$t+1$ earnings report	0.18323	0.14302	-1.451 [0.147]
7	Covariance of time-$t+1$ earnings reports with changes in the market's expectations of the next earnings reports during a year	0.00932	0.02141	1.626 [0.104]
8	Covariance of the residuals from regressing $\left(p_t^{\text{post-report}} - p_t^{\text{pre-report}}\right)$ on the time-t earnings surprise with residuals of $ME_t^{\text{post-report}}$	0.01281	0.01294	0.028 [0.978]
9	Covariance of the residuals from regressing $\left(p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}}\right)$ on the time-t earnings surprise with changes in the market's expectations of next earnings reports during a year	0.06774	0.06052	4.036 [0.0001]

|1. Fundamental uncertaintyis much greater than misreportingincentives uncertainty, $\sigma_\xi^2 \to 0$.

|71,837.69 |42.1933. Investors perfec

|42.6004. Investors perfectly knowmisreporting incentives, $q_\xi \to 1$.

Table 8: Estimated model parameters before and after the introduction of CD&A

Parameter estimate	**Before CD&A**	**After CD&A**
Fundamental variance, σ_v^2	0.034 (0.026)	0.033 (0.025)
Market's total share of fundamental information, q_v	0.879 (0.122)	0.592 (0.415)
Market's share of fundamental information received concurrently with the manager's report, q_v^0	0.149 (0.103)	0.162 (0.169)
Incentives variance, σ_ξ^2	0.282 (0.101)	0.005 (0.004)
Market's total share of incentives information, q_ξ	0.532 (0.161)	0.731 (0.272)
Market's total share of incentives information received concurrently with the manager's report, q_ξ^0	0.997 (0.222)	0.986 (0.436)
Earnings quality, negative bias in earnings, % of st.dev. of unbiased earnings	−1.648	−0.942
Price efficiency, negative deviation of price from fair value, % of the company's book value	−0.433	−0.301

Note: Standard errors are in parentheses. The parameters are estimated assuming discount rates $\delta_M = 0.7$ and $\delta_I = 0.95$.

Table 9: Estimated model parameters for early and late earnings reporters

Parameter estimate	**Early reporters**	**Late reporters**
Fundamental variance, σ_v^2	0.043 (0.032)	0.018 (0.039)
Market's total share of fundamental information, q_v	0.438 (0.419)	0.848 (0.315)
Market's share of fundamental information received concurrently with the manager's report, q_v^0	0.164 (0.263)	0.391 (0.872)
Incentives variance, σ_ξ^2	0.002 (0.002)	0.195 (0.070)
Market's total share of incentives information, q_ξ	0.902 (0.148)	0.288 (0.242)
Market's total share of incentives information received concurrently with the manager's report, q_ξ^0	0.999 (0.475)	0.756 (0.566)
Earnings quality, negative bias in earnings, % of st.dev. of unbiased earnings	−0.833	−1.886
Price efficiency, negative deviation of price from fair value, % of the company's book value	−0.340	−0.438

Note: Standard errors are in parentheses. The parameters are estimated assuming discount rates $\delta_M = 0.7$ and $\delta_I = 0.95$.

Table 10: Estimated model parameters for alternative values of discount rates

Parameter estimate	**Baseline estimates,** $\delta_I = 0.95$, $\delta_M = 0.7$	$\delta_I = 0.65$, $\delta_M = 0.7$	$\delta_I = 0.95$, $\delta_M = 0.99$
Fundamental variance, σ_v^2	0.029 (0.014)	0.047 (0.017)	0.029 (0.015)
Market's total share of fundamental information, q_v	0.883 (0.500)	0.573 (0.208)	0.912 (0.075)
Market's share of fundamental information received concurrently with the manager's report, q_v^0	0.184 (0.132)	0.205 (0.123)	0.198 (0.127)
Incentives variance, σ_ξ^2	0.136 (0.702)	0.008 (0.004)	0.136 (0.054)
Market's total share of incentives information, q_ξ	0.528 (0.343)	0.631 (0.193)	0.519 (0.172)
Market's share of incentives information received concurrently with the manager's report, q_ξ^0	0.997 (0.088)	0.999 (0.318)	0.999 (0.234)
Earnings quality, negative bias in earnings, % of st.dev. of unbiased earnings	−1.36	−0.90	−1.38
Price efficiency, negative deviation of price from fair value, % of the company's book value	−0.34	−0.29	−0.32

Note: Standard errors are in parentheses.

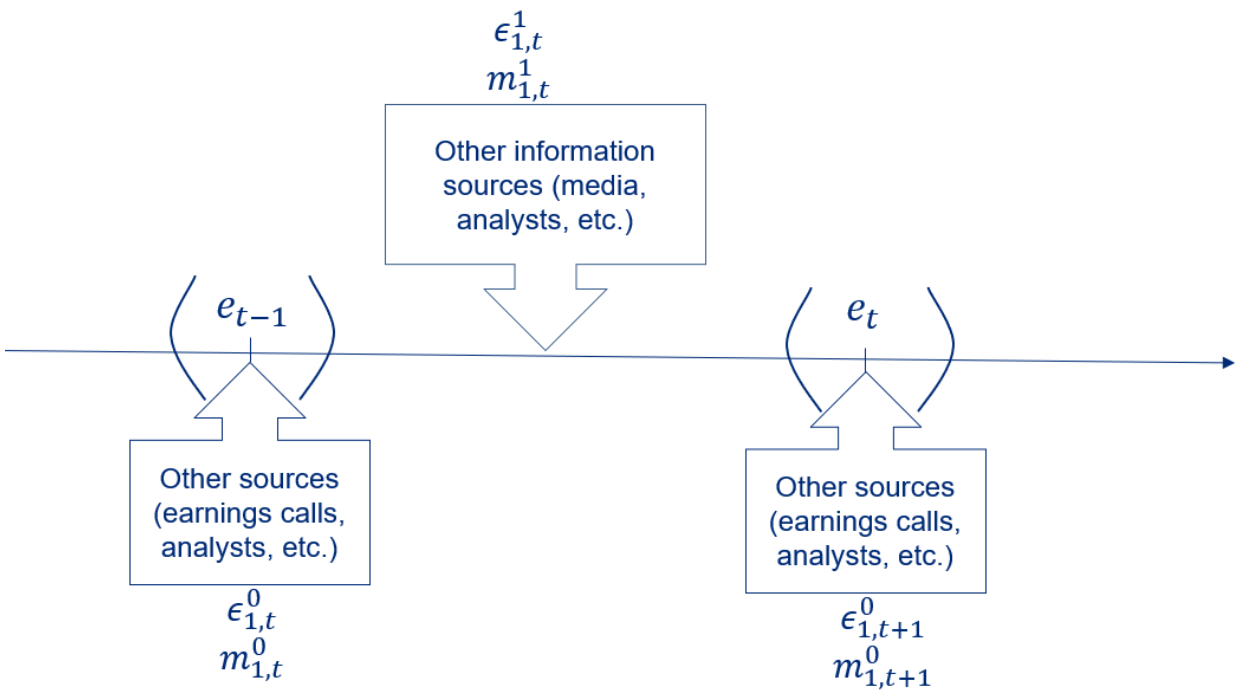

Figure 1: Timing of information arrivals to investors in the model. e_τ is an earnings report issued at time τ, ε_τ and m_τ are investors' earnings and misreporting incentives information related to the earnings report at time τ.

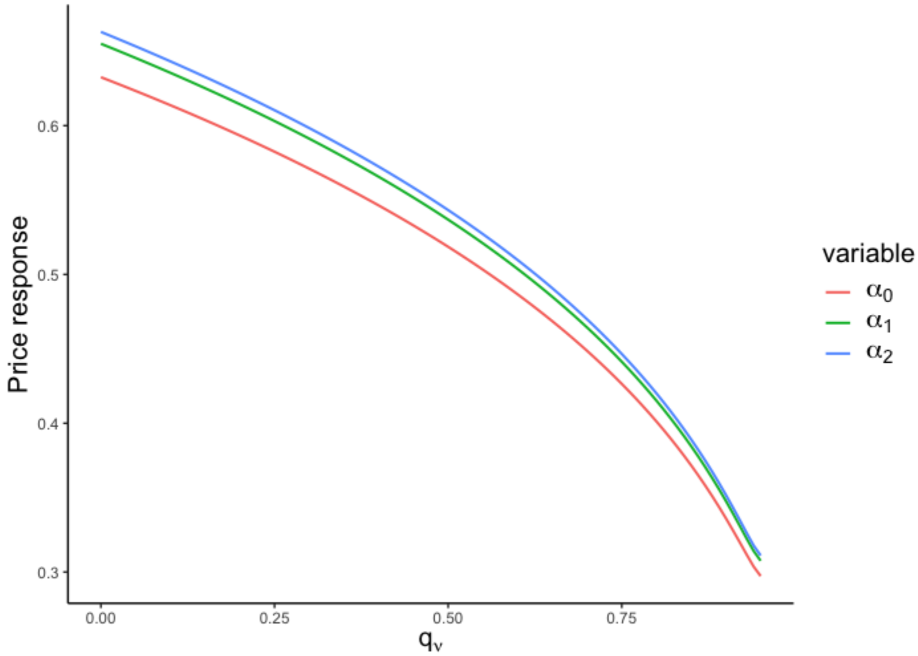

Figure 2: Price responses to the manager's report as a function of the market's fundamental information, q_ν. $\sigma_\nu^2 = 0.8$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

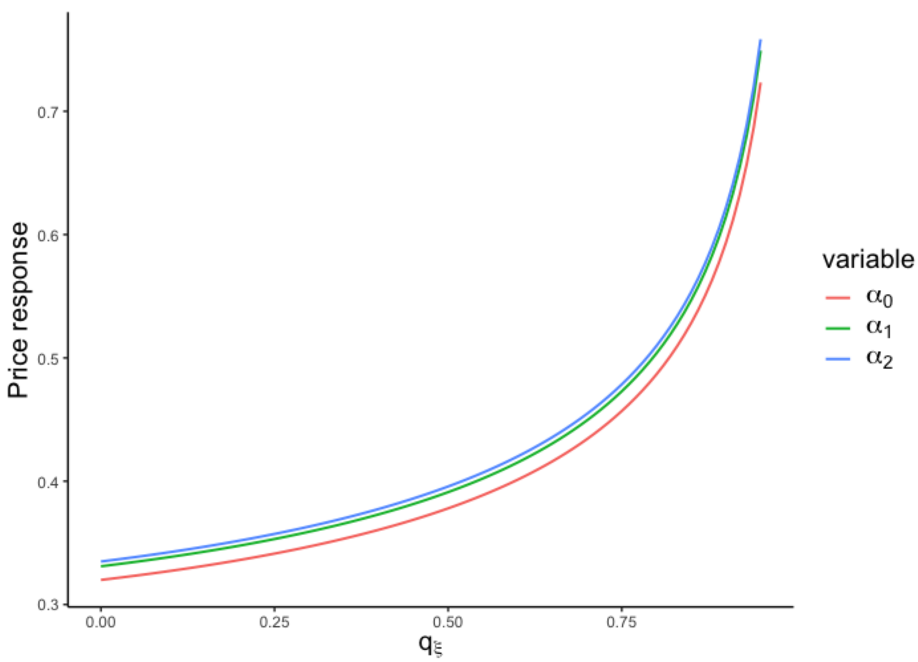

Figure 3: Price responses to the manager's report as a function of the market's misreporting incentives information, q_ξ. $q_\nu = 0.8$, $\sigma_\nu^2 = 0.08$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

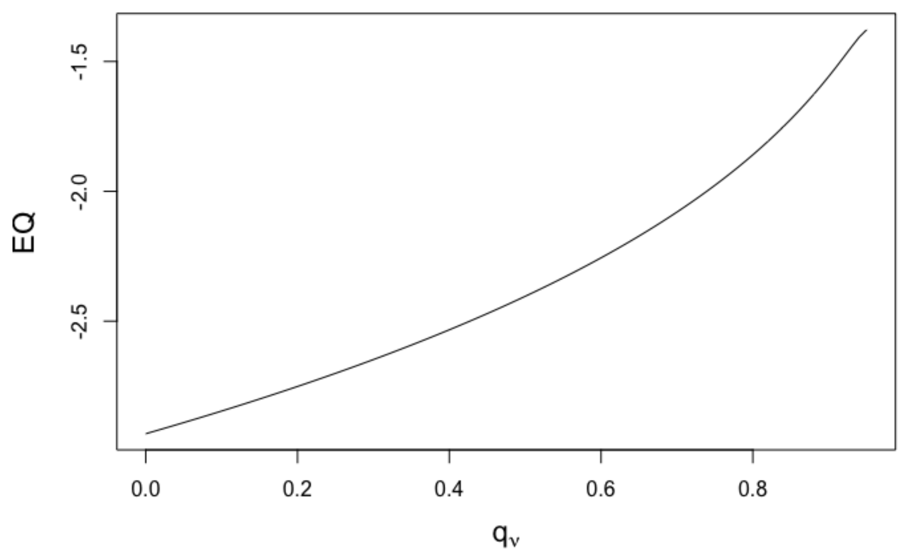

Figure 4: Earnings quality as a function of the market's fundamental information, q_ν. $\sigma_\nu^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

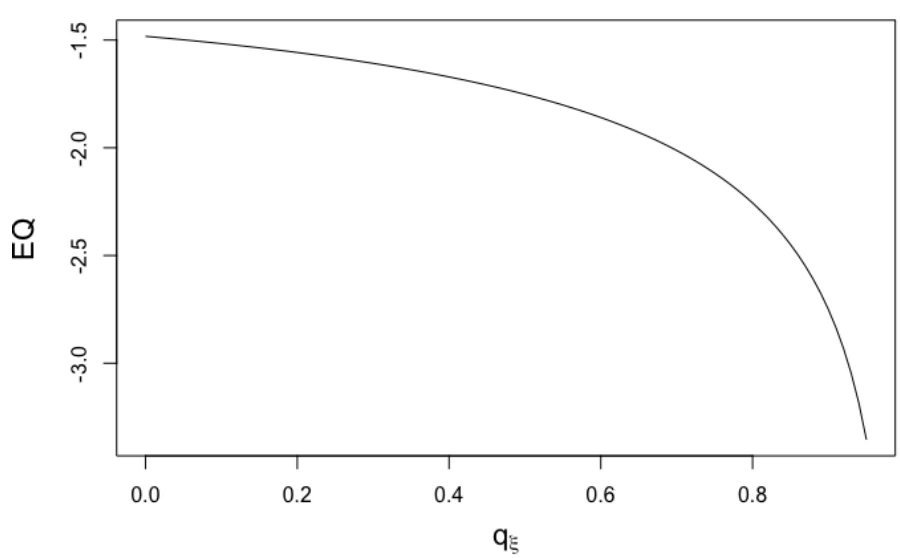

Figure 5: Earnings quality as a function of the market's misreporting incentives information, q_ξ. $q_\nu = 0.8$, $\sigma_\nu^2 = 0.08$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

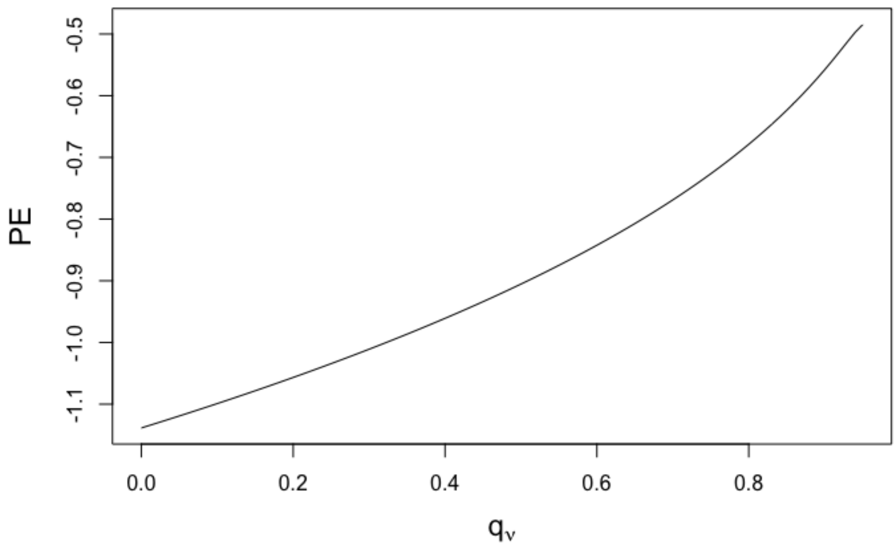

Figure 6: Price efficiency as a function of the market's fundamental information, q_ν. $\sigma_\nu^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

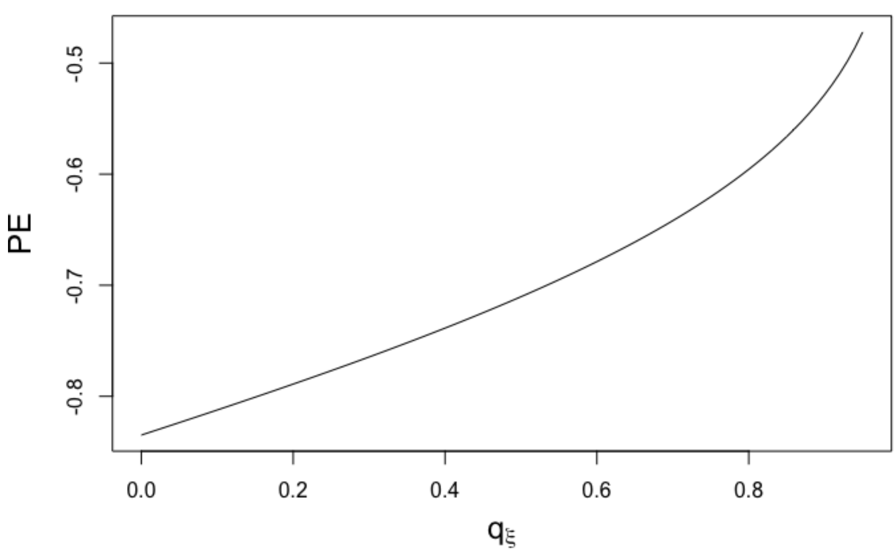

Figure 7: Price efficiency as a function of the market's misreporting incentives information, q_ξ. $q_\nu = 0.8$, $\sigma_\nu^2 = 0.08$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

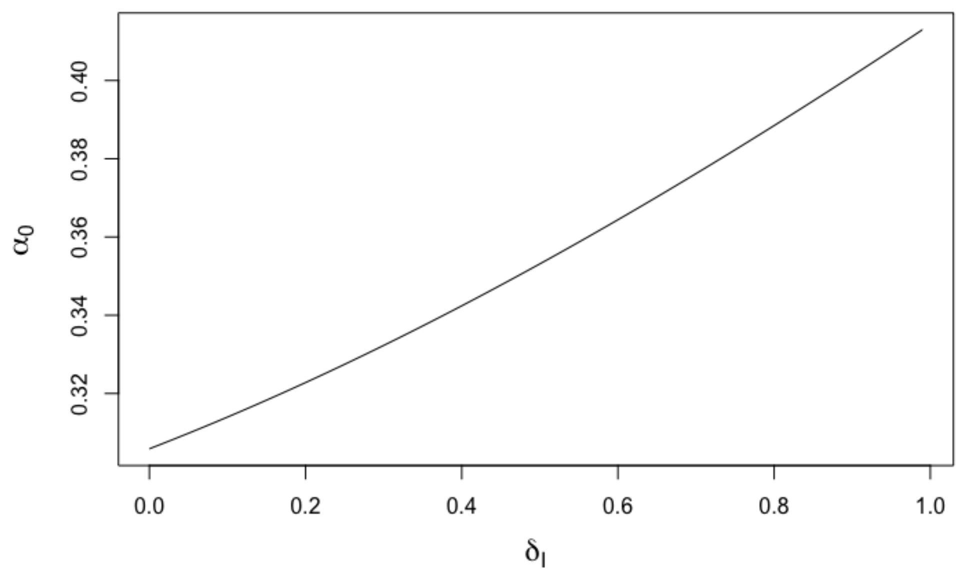

Figure 8: Earnings response coefficient as a function of investors' discount factor, δ_I. $q_\nu = 0.8, \sigma_\nu^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$.

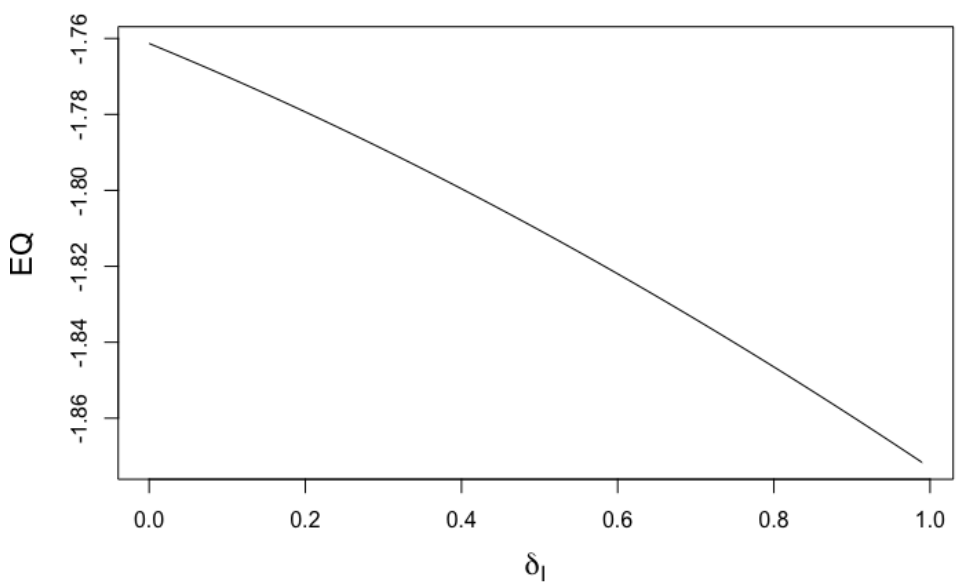

Figure 9: Earnings quality as a function of investors' discount factor, δ_I. $q_\nu = 0.8, \sigma_\nu^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$.

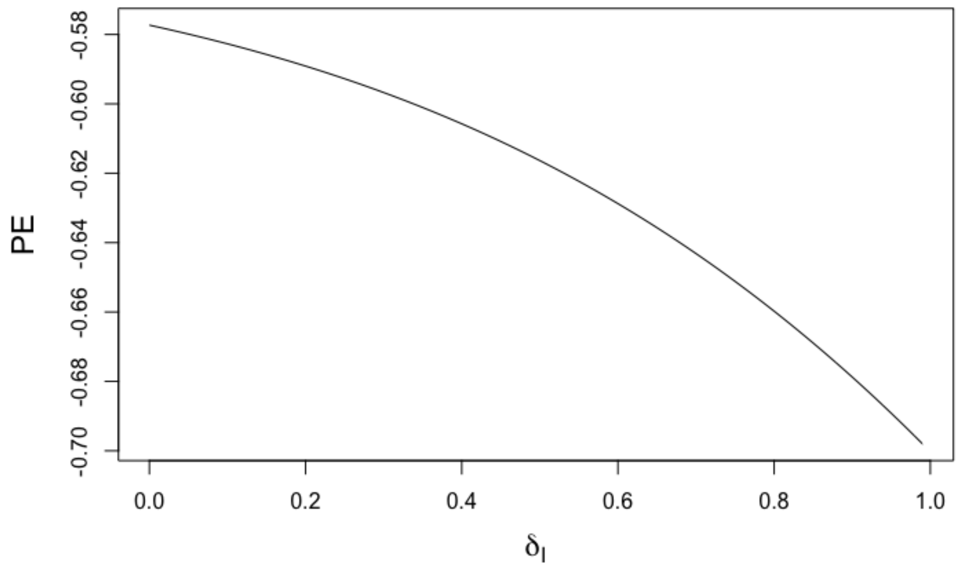

Figure 10: Price efficiency as a function of investors' discount factor, δ_I. $q_\nu = 0.8, \sigma_\nu^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$.

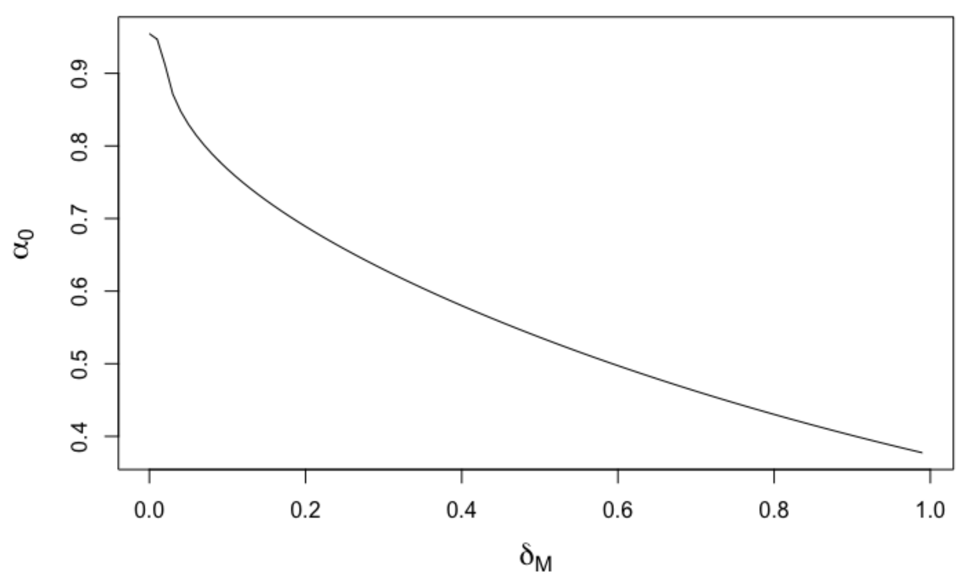

Figure 11: Earnings response coefficient as a function of the manager's discount factor, δ_M. $q_\nu = 0.8, \sigma_\nu^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_I = 0.9$.

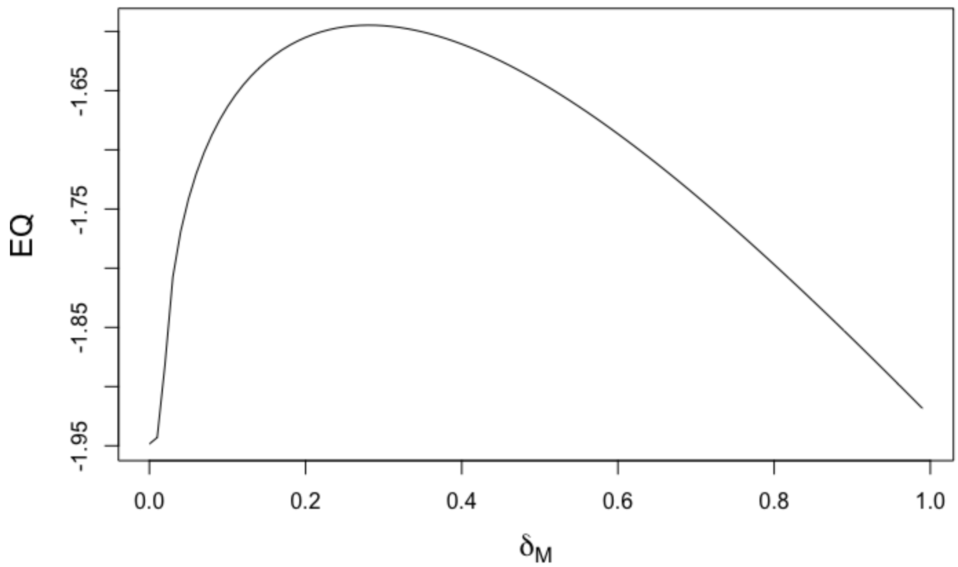

Figure 12: Earnings quality as a function of the manager's discount factor, δ_M. $q_\nu = 0.8, \sigma_\nu^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_I = 0.9$.

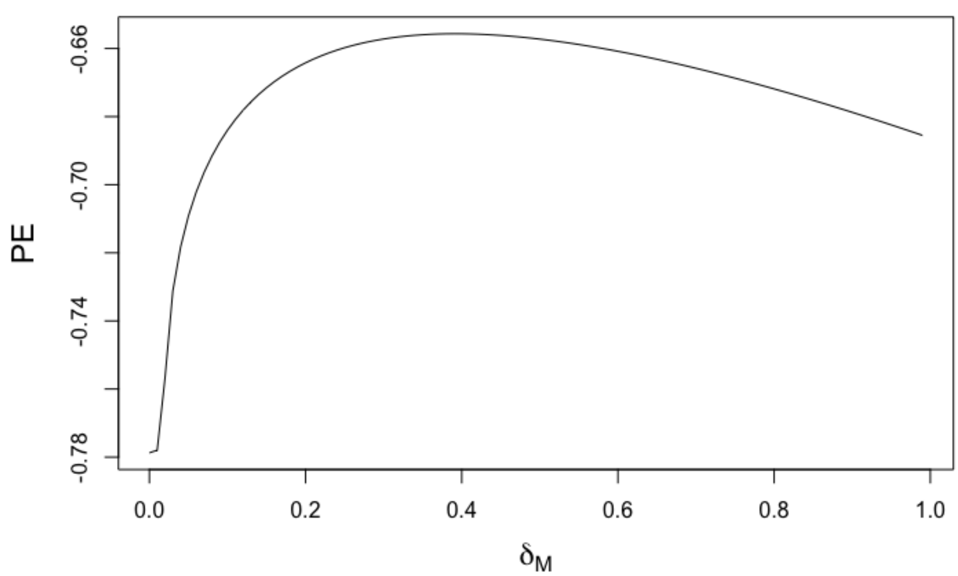

Figure 13: Price efficiency as a function of the manager's discount factor, δ_M. $q_\nu = 0.8, \sigma_\nu^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_I = 0.9$.

[title = Changes in earnings quality, %, ybar, x axis line style = opacity = 0 , axis y line = none, tickwidth = 1pt, bar width=5mm, x tick label style = rotate=35, anchor=east, title style=font=, enlarge y limits = 0.06, enlarge x limits = 0.1 , symbolic x coords = Fundamental uncertainty, σ_v^2, Investors' fundamental info, q_v, Misreporting incentives uncertainty, σ_ξ^2, Investors' misreporting incentives info, q_ξ, xtick=data, nodes near coords, width=11cm, height=6cm, legend style=at=(1.05,1), anchor=north west] coordinates (Fundamental uncertainty, σ_v^2,2.487) (Investors' fundamental info, q_v,3.932) (Misreporting incentives uncertainty, σ_ξ^2,-2.630) (Investors' misreporting incentives info, q_ξ,-2.842); coordinates (Fundamental uncertainty, σ_v^2,-2.917) (Investors' fundamental info, q_v, -15.064) (Misreporting incentives uncertainty, σ_ξ^2,2.742) (Investors' misreporting incentives info, q_ξ,2.377); 10% increase in parameter, 10% decrease in parameter

Figure 14: Sensitivity of earnings quality to model parameters. The values of parameters are as estimated (see Table 5).

[title = Changes in price efficiency, %, ybar, x axis line style = opacity = 0 , axis y line = none, tickwidth = 1pt, bar width=5mm, x tick label style = rotate=35, anchor=east, title style=font=, enlarge y limits = 0.06, enlarge x limits = 0.1 , symbolic x coords = Fundamental uncertainty, σ_v^2, Investors' fundamental info, q_v, Misreporting incentives uncertainty, σ_ξ^2, Investors' misreporting incentives info, q_ξ, xtick=data, nodes near coords, width=11cm, height=6cm, legend style=at=(1.05,1), anchor=north west] coordinates (Fundamental uncertainty, σ_v^2,-2.873) (Investors' fundamental info, q_v,8.494) (Misreporting incentives uncertainty, σ_ξ^2,-2.300) (Investors' misreporting incentives info, q_ξ,2.676); coordinates (Fundamental uncertainty, σ_v^2,2.712) (Investors' fundamental info, q_v, -17.413) (Misreporting incentives uncertainty, σ_ξ^2,2.389) (Investors' misreporting incentives info, q_ξ,-2.564); 10% increase in parameter, 10% decrease in parameter

Figure 15: Sensitivity of price efficiency to model parameters. The values of parameters are as estimated (see Table 5).

Appendix

A.1 Proof of Proposition 1

Let us start with a manager who has finite tenure, that is, works at a firm with certainty up until time T. At time T, the manager's problem is:

$$\max_{r_T} \quad m_T p_T - \frac{\left(e_T - \varepsilon_T + \sum_{k=0}^{T-1}(e_k - \varepsilon_k)\right)^2}{2} \tag{A36}$$

$$= m_T(p_0 + \sum_{j=0}^{j=T} \alpha_j^T e_j + \sum_{j=0}^{j=T} \beta_j^{0,T} \varepsilon_{1,j}^0 + \sum_{j=0}^{j=T} \beta_j^{1,T} \varepsilon_{1,j}^1 + \sum_{j=0}^{j=T} \gamma_j^{0,T} m_{1,j}^0 + \sum_{j=0}^{j=T} \gamma_j^{1,T} m_{1,j}^1) - \frac{\left(e_T - \varepsilon_T + \sum_{k=0}^{T-1}(e_k - \varepsilon_k)\right)^2}{2} \tag{A37}$$

The optimal report is:

$$e_T^* = \varepsilon_T - \sum_{k=0}^{T-1}(e_k - \varepsilon_k) + m_T \alpha_T^T \tag{A38}$$

Given the optimal choice at time T, the manager's problem at time $T-1$ is:

$$\max_{r_{T-1}} \quad m_{T-1} p_{T-1} - \frac{\left(e_{T-1} - \varepsilon_{T-1} + \sum_{k=0}^{T-2}(e_k - \varepsilon_k)\right)^2}{2} + \delta_M E_{T-1}[U_T] \tag{A39}$$

The expected utility at time T is

$$E_{T-1}[U_T] = E_{T-1}[m_T p_T + \frac{(m_T \alpha_T^T)^2}{2}]$$
$$= E_{T-1}[m_T]\left(p_0 + \sum_{j=0}^{j=T-1} \alpha_j^{T-1} e_j + \sum_{j=0}^{j=T-1} \beta_j^{0,T-1} \varepsilon_{1,j}^0 + \sum_{j=0}^{j=T-1} \beta_j^{1,T-1} \varepsilon_{1,j}^1 + \sum_{j=0}^{j=T-1} \gamma_j^{0,T-1} m_{1,j}^0 + \sum_{j=0}^{j=T-1} \gamma_j^{1,T-1} m_{1,j}^1\right)$$
$$+ E_{T-1}[\frac{(m_T \alpha_T^T)^2}{2}] \tag{A40}$$

The optimal report at time $T-1$ is

$$e_{T-1} = \varepsilon_{T-1} - \sum_{k=0}^{T-2}(e_k - \varepsilon_k) + m_{T-1}\alpha_{T-1}^{T-1} + \delta_M E_{T-1}[m_T]\alpha_{T-1}^T \tag{A41}$$

By induction, the manager's optimal report at time t is

$$e_t = \varepsilon_t - \sum_{k=0}^{t-1}(e_k - \varepsilon_k) + m_t\alpha_t^t + \delta_M\alpha_t^{t+1}E_t[m_{t+1}] + \delta_M^2\alpha_t^{t+2}E_t[m_{t+2}] \tag{A42}$$

Now work forwards starting from $t = 0$:

$$e_0 = \varepsilon_0 + \alpha_0^0 m_0 + \delta_M\alpha_0^1 E_0[m_1] + \delta_M^2\alpha_0^2 E_0[m_2] \tag{A43}$$

$$\begin{aligned} e_1 = \varepsilon_1 &- \left(\alpha_0^0 m_0 + \delta_M\alpha_0^1 E_0[m_1] + \delta_M^2\alpha_0^2 E_0[m_2]\right) \\ &+\alpha_1^1 m_1 + \delta_M\alpha_1^2 E_1[m_2] + \delta_M^2\alpha_1^3 E_1[m_3] \end{aligned} \tag{A44}$$

$$\begin{aligned} e_2 = \varepsilon_2 - \left(-\left(\alpha_0^0 m_0 + \delta_M\alpha_0^1 E_0[m_1] + \delta_M^2\alpha_0^2 E_0[m_2]\right) + \alpha_1^1 m_1 + \delta_M\alpha_1^2 E_1[m_2] + \delta_M^2\alpha_1^3 E_1[m_3]\right) \\ - \left(\alpha_0^0 m_0 + \delta_M\alpha_0^1 E_0[m_1] + \delta_M^2\alpha_0^2 E_0[m_2]\right) \\ +\alpha_2^2 m_2 + \delta_M\alpha_2^3 E_2[m_3] + \delta_M^2\alpha_2^4 E_2[m_4] \\ = \varepsilon_2 - \left(\alpha_1^1 m_1 + \delta_M\alpha_1^2 E_1[m_2] + \delta_M^2\alpha_1^3 E_1[m_3]\right) \\ +\alpha_2^2 m_2 + \delta_M\alpha_2^3 E_2[m_3] + \delta_M^2\alpha_2^4 E_2[m_4] \end{aligned} \tag{A45}$$

Finally,

$$e_t = \varepsilon_t + \alpha_t^t m_t + \sum_{k=0}^{\infty}\delta_M^k\alpha_t^{t+k}E_t[m_{t+k}] - \alpha_{t-1}^{t-1}m_{t-1} - \sum_{k=0}^{\infty}\delta_M^k\alpha_{t-1}^{t+k}E_{t-1}[m_{t+k}] \tag{A46}$$

In the paper, I focus on the steady-state, i.e. $T \to \infty$.

A.2 Proof of Proposition 2

Denote by α_0, α_1 and α_2 the steady-state responses of current, one-year ahead and two-years ahead prices' to a current managerial report. Managerial report in steady-state is then:

$$e_t = \varepsilon_t + (\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2)\xi_t - \alpha_0\xi_{t-3} - \delta_M\alpha_1\xi_{t-2} - \delta_M^2\alpha_2\xi_{t-1} \tag{A47}$$

Right before the report e_t is released, variance of the report from investors' perspective is

$$Var[e_t] = (1-q_\nu)\sigma_\nu^2 + Var[\nu_{2,t-1}|e_{t-1}] + Var[\nu_{2,t-2}|e_{t-1},e_{t-2}]$$
$$+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2 + Var[\xi_{2,t-1}|e_{t-1}]\delta_M^4\alpha_2^2$$
$$+Var[\xi_{2,t-2}|e_{t-1},e_{t-2}]\delta_M^2\alpha_1^2 + Var[\xi_{2,t-3}|e_{t-1},e_{t-2},e_{t-3}]\alpha_0^2 \quad \text{(A48)}$$

Denote $\sigma_{\nu 1}^2 \equiv Var[\nu_{2,t-1}|e_{t-1}]$, $\sigma_{\nu 2}^2 \equiv Var[\nu_{2,t-2}|e_{t-1},e_{t-2}]$, $\sigma_{\xi 1}^2 \equiv Var[\xi_{2,t-1}|e_{t-1}]$, $\sigma_{\xi 2}^2 \equiv Var[\xi_{2,t-2}|e_{t-1},e_{t-2}]$, and $\sigma_{\xi 3}^2 \equiv Var[\xi_{2,t-3}|e_{t-1},e_{t-2},e_{t-3}]$. In this notation,

$$Var[e_t] = (1-q_\nu)\sigma_\nu^2 + \sigma_{\nu 1}^2 + \sigma_{\nu 2}^2 + (1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2 + \sigma_{\xi 1}^2\delta_M^4\alpha_2^2 + \sigma_{\xi 2}^2\delta_M^2\alpha_1^2 + \sigma_{\xi 3}^2\alpha_0^2 \quad \text{(A49)}$$

$$cov[e_t,\nu_t] = \sigma_\nu^2(1-q_\nu) \quad \text{(A50)}$$

Therefore,

$$Var[\nu_t|e_t] = (1-q_\nu)\sigma_\nu^2$$
$$-\frac{(1-q_\nu)^2\sigma_\nu^4}{(1-q_\nu)\sigma_\nu^2 + \sigma_{\nu 1}^2 + \sigma_{\nu 2}^2 + (1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2 + \sigma_{\xi 1}^2\delta_M^4\alpha_2^2 + \sigma_{\xi 2}^2\delta_M^2\alpha_1^2 + \sigma_{\xi 3}^2\alpha_0^2} \quad \text{(A51)}$$

In the steady-state, $\sigma^2_{\nu 1}$, $\sigma^2_{\nu 2}$, $\sigma^2_{\xi 1}$, $\sigma^2_{\xi 2}$, and $\sigma^2_{\xi 3}$ are the solution to:

$$\sigma^2_{\nu 1} = (1-q_\nu)\sigma^2_\nu - \frac{(1-q_\nu)^2\sigma^4_\nu}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0} \quad \text{(A52)}$$

$$\sigma^2_{\nu 2} = \sigma^2_{\nu 1} - \frac{\sigma^4_{\nu 1}}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0} \quad \text{(A53)}$$

$$\sigma^2_{\xi 1} = (1-q_\xi)\sigma^2_\xi - \frac{(1-q_\xi)^2\sigma^4_\xi}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0} \quad \text{(A54)}$$

$$\sigma^2_{\xi 2} = \sigma^2_{\xi 1} - \frac{\sigma^4_{\xi 1}\delta^8_M\alpha^4_2}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0} \quad \text{(A55)}$$

$$\sigma^2_{\xi 3} = \sigma^2_{\xi 2} - \frac{\sigma^4_{\xi 2}\delta^4_M\alpha^4_1}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0} \quad \text{(A56)}$$

The change in the firm's price around the earnings report release includes updating based on the report and on the concurrent information. The concurrent information provides $\nu^0_{1,t+1}$, and the earnings report provides information about $\nu_{2,t}$, $\nu_{2,t-1}$, and $\nu_{2,t-2}$.

$$p^{\text{post-report}}_t - p^{\text{pre-report}}_t = \left(\delta_I + \delta^2_I + \delta^3_I\right)\nu^0_{1,t+1} \quad \text{(A57)}$$

$$+(1+\delta_I+\delta^2_I)\left(e_t - E\left[e_t|I^{\text{market}}_t \setminus \{e_t\}\right]\right) \times \frac{(1-q_\nu)\sigma^2_\nu}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0} \quad \text{(A58)}$$

$$+(1+1+\delta_I)\left(e_t - E\left[e_t|I^{\text{market}}_t \setminus \{e_t\}\right]\right) \times \frac{\sigma^2_{\nu 1}}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0} \quad \text{(A59)}$$

$$+3\left(e_t - E\left[e_t|I^{\text{market}}_t \setminus \{e_t\}\right]\right) \times \frac{\sigma^2_{\nu 2}}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0}, \quad \text{(A60)}$$

where $\left(e_t - E\left[e_t|I^{\text{market}}_t \setminus \{e_t\}\right]\right) \times \frac{(1-q_\nu)\sigma^2_\nu}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0} = E[\nu_{2,t}|e_t]$,
$\left(e_t - E\left[e_t|I^{\text{market}}_t \setminus \{e_t\}\right]\right) \times \frac{\sigma^2_{\nu 1}}{(1-q_\nu)\sigma^2_\nu + \sigma^2_{\nu 1} + \sigma^2_{\nu 2} + (1-q_\xi)\sigma^2_\xi(\alpha_0 + \delta_M\alpha_1 + \delta^2_M\alpha_2)^2 + \sigma^2_{\xi 1}\delta^4_M\alpha^2_2 + \sigma^2_{\xi 2}\delta^2_M\alpha^2_1 + \sigma^2_{\xi 3}\alpha^2_0} = E[\nu_{2,t-1}|e_t, e_{t-1}]$,

and $\left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{\sigma_{\nu 2}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} = E[\nu_{2,t-2}|e_t, e_{t-1}, e_{t-2}]$.
The earnings response coefficients solve

$$\alpha_0 = \frac{(1+\delta_I+\delta_I^2)(1-q_\nu)\sigma_\nu^2 + (2+\delta_I)\sigma_{\nu 1}^2 + 3\sigma_{\nu 2}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \quad \text{(A61)}$$

$$\alpha_1 = \frac{(2+\delta_I)(1-q_\nu)\sigma_\nu^2 + 3\sigma_{\nu 1}^2 + 3\sigma_{\nu 2}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \quad \text{(A62)}$$

$$\alpha_2 = \frac{3\left((1-q_\nu)\sigma_\nu^2\sigma_{\nu 1}^2 + \sigma_{\nu 2}^2\right)}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \quad \text{(A63)}$$

A.3 Proof of Proposition 3

Between any two earnings reports, the market only learns about ε_1^1 and m_1^1. Since ε_1 and ε_2 and m_1 and m_2 are independent, the market's beliefs about ε_2 and m_2 remain unchanged: $E[e_t | I_{t+1}^{\text{market}} \setminus \{e_t\}] = E[e_t | I_t^{\text{market}}]$.

The change in the firm price during a year between two earnings reports is

$$\begin{aligned} p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}} &= \left(\nu_{1,t+1}^1 + \nu_{1,t+1}^0\right) + \left(\delta_I \nu_{1,t+1}^1 + \delta_I \nu_{1,t+1}^0\right) \\ &+ \left(\delta_I^2 \nu_{1,t+1}^1 + \delta_I^2 \nu_{1,t+1}^0\right) - \left(\delta_I + \delta_I^2 + \delta_I^3\right) \nu_{1,t+1}^0 \\ &+ (e_t - E[e_t]) \times (\alpha_1 - \alpha_0) \end{aligned} \quad \text{(A64)}$$

A.4 Proof of Proposition 4

$$\begin{aligned} & E_t[\xi_{2,t} | e_t] \\ &= \left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \end{aligned} \quad \text{(A65)}$$

$$\begin{aligned} & E_t[\xi_{2,t-1} | e_t, e_{t-1}] \\ &= \left(e_{t-1} - E\left[e_{t-1} | I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) \times \frac{(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \\ &+ \left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{\sigma_{\xi 1}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \end{aligned} \quad \text{(A66)}$$

$$\begin{aligned} & E_t[\xi_{2,t-2} | e_t, e_{t-1}, e_{t-2}] \\ &= \left(e_{t-2} - E\left[e_{t-2} | I_{t-2}^{\text{market}} \setminus \{e_{t-2}\}\right]\right) \times \frac{(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \\ &+ \left(e_{t-1} - E\left[e_{t-1} | I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) \times \frac{\sigma_{\xi 1}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \\ &+ \left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{\sigma_{\xi 2}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \end{aligned} \quad \text{(A67)}$$

$$E_t[\nu_{2,t}|e_t]$$
$$= \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \quad \text{(A68)}$$

$$E_t[\nu_{2,t-1}|e_t, e_{t-1}]$$
$$= \left(e_{t-1} - E\left[e_{t-1}|I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) \times \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2}$$
$$+ \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{\sigma_{\nu 1}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2} \quad \text{(A69)}$$

$$ME_t^{\text{post-report}} = \nu_{1,t+1}^0 + \nu_{1,t} + \nu_{1,t-1} \quad \text{(A70)}$$
$$+(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)\xi_{1,t+1}^0 - \alpha_0\xi_{1,t-2} - \delta_M\alpha_1\xi_{1,t-1} - \delta_M^2\alpha_2\xi_{1,t} \quad \text{(A71)}$$
$$+E_t[\nu_{2,t} + \nu_{2,t-1}|e_t, e_{t-1}] \quad \text{(A72)}$$
$$E_t[(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)\xi_{2,t+1}^0 - \alpha_0\xi_{2,t-2} - \delta_M\alpha_1\xi_{2,t-1} - \delta_M^2\alpha_2\xi_{2,t}|e_t, e_{t-1}, e_{t-2}] \quad \text{(A73)}$$

or

$$ME_t^{\text{post-report}} = \nu_{1,t+1}^0 + \nu_{1,t} + \nu_{1,t-1} \quad \text{(A74)}$$
$$+(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)\xi_{1,t+1}^0 - \alpha_0\xi_{1,t-2} - \delta_M\alpha_1\xi_{1,t-1} - \delta_M^2\alpha_2\xi_{1,t} \quad \text{(A75)}$$
$$+\beta_0 \times \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right) + \beta_1 \times \left(e_{t-1} - E\left[e_{t-1}|I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) + \beta_2 \times \left(e_{t-2} - E\left[e_{t-2}|I_{t-2}^{\text{market}} \setminus \{e_{t-2}\}\right]\right), \quad \text{(A76)}$$

where $\beta_0 = \frac{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2-\alpha_0\sigma_{\xi 2}^2-\delta_M\alpha_1\sigma_{\xi 1}^2-\delta_M^2\alpha_2(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2}$,
$\beta_1 = \frac{(1-q_\nu)\sigma_\nu^2-\alpha_0\sigma_{\xi 1}^2-\delta_M\alpha_1(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2}$, and
$\beta_2 = \frac{-\alpha_0(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{\nu 1}^2+\sigma_{\nu 2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{\xi 1}^2\delta_M^4\alpha_2^2+\sigma_{\xi 2}^2\delta_M^2\alpha_1^2+\sigma_{\xi 3}^2\alpha_0^2}$.

A.5 Proof of Proposition 5

Since the market's beliefs about ε_2 and m_2 remain unchanged during a year between two reports, the market's expectation of the next earnings report changes only because investors learn $\nu^1_{1,t+1}$ and $\xi^1_{1,t+1}$:

$$ME^{\text{pre-report}}_{t+1} - ME^{\text{post-report}}_{t} = \nu^1_{1,t+1} + \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right) \xi^1_{1,t+1} \tag{A77}$$

A.6 Theoretical moments

In this Appendix, I list theoretical moments and explain how they help identify model parameters: the total fundamental and misreporting incentives uncertainty, σ_ν^2 and σ_ξ^2, the fractions of fundamental and misreporting incentives information that the market knows, q_ν and q_ξ, and the part of these fractions that investors learn from sources concurrent with earnings reports, q_ν^0 and q_ξ^0. In total, I use nine theoretical moments:

1. Earnings response coefficient:

$$E\left[p^{\text{post-report}}_t - p^{\text{pre-report}}_t - \alpha_0 \times \left(e_t - E\left[e_t | I^{\text{market}}_t \setminus \{e_t\}\right]\right)\right] = 0 \tag{A78}$$

2. Variance of earnings reports:

$$Var\left[e_t\right] = 3\sigma_\nu^2 + \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right)^2 \sigma_\xi^2 + \alpha_0^2 \sigma_\xi^2 + \delta_M^2 \alpha_1^2 \sigma_\xi^2 + \delta_M^4 \alpha_2^2 \sigma_\xi^2 \tag{A79}$$

3. Variance of change in the market's expectation of the next earnings report during a year:

$$Var\left[ME^{\text{pre-report}}_{t+1} - ME^{\text{post-report}}_{t}\right] = q_\nu (1 - q_\nu^0) \sigma_\nu^2 + q_\xi (1 - q_\xi^0) \sigma_\xi^2 \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right)^2 \tag{A80}$$

4. Covariance of time-$(t+1)$ earnings reports with residuals of the time-t "ERC" regression:

$$Cov\left[e_{t+1}, p^{\text{post-report}}_t - p^{\text{pre-report}}_t - \alpha_0 \times \left(e_t - E\left[e_t | I^{\text{market}}_t \setminus \{e_t\}\right]\right)\right] = q_\nu q_\nu^0 \sigma_\nu^2 \left(\delta_I + \delta_I^2 + \delta_I^3\right) \tag{A81}$$

5. Covariance of time-$(t+1)$ earnings reports with residuals from regressing change in prices from right after the time-t report to right before the time-$(t+1)$ report on the time-t earnings report surprise:

$$\begin{aligned} Cov\Big[e_{t+1}, p^{\text{pre-report}}_{t+1} - p^{\text{post-report}}_t - (\alpha_1 - \alpha_0) \times \left(e_t - E\left[e_t | I^{\text{market}}_t \setminus \{e_t\}\right]\right)\Big] \\ = q_\nu q_\nu^0 \sigma_\nu^2 (1 - \delta_I^3) + q_\nu (1 - q_\nu^0) \sigma_\nu^2 (1 + \delta_I + \delta_I^2) \end{aligned} \tag{A82}$$

6. Covariance of time-$(t+1)$ earnings reports with residuals from regressing the market's expectation of the time-$(t+1)$ earnings report on the time-t earnings report surprise, the time-$(t-1)$ earnings report surprise, and the time-$(t-2)$ earnings report surprise:

$$Cov\left[e_{t+1}, ME_t^{\text{post-report}} - \beta_0\left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) - \beta_1\left(e_{t-1} - E\left[e_{t-1} | I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) - \beta_2\left(e_{t-2} - E\left[e_{t-2} | I_{t-2}^{\text{market}} \setminus \{e_{t-2}\}\right]\right)\right]$$
$$= q_\nu q_\nu^0 \sigma_\nu^2 + 2q_\nu \sigma_\nu^2 + q_\xi q_\xi^0 \sigma_\xi^2 \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right)^2 + q_\xi \sigma_\xi^2 \alpha_0^2 + q_\xi \sigma_\xi^2 \delta_M^2 \alpha_1^2 + q_\xi \sigma_\xi^2 \delta_M^4 \alpha_2^2 \quad \text{(A83)}$$

7. Covariance of time-$(t+1)$ earnings reports with changes in the market's expectations of the next earnings reports during a year:

$$Cov\left[e_{t+1}, ME_{t+1}^{\text{pre-report}} - ME_t^{\text{post-report}}\right] = q_\nu(1-q_\nu^0)\sigma_\nu^2 + q_\xi(1-q_\xi^0)\sigma_\xi^2\left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2 \quad \text{(A84)}$$

8. Covariance of the residuals from regressing $\left(p_t^{\text{post-report}} - p_t^{\text{pre-report}}\right)$ on the time-t earnings surprise with residuals from regressing $ME_t^{\text{post-report}}$ on the time-t earnings report surprise, the time-$(t-1)$ earnings report surprise, and the time-$(t-2)$ earnings report surprise:

$$Cov\left[p_t^{\text{post-report}} - p_t^{\text{pre-report}} - \alpha_0\left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right),\right.$$
$$\left. ME_t^{\text{post-report}} - \beta_0\left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) - \beta_1\left(e_{t-1} - E\left[e_{t-1} | I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) - \beta_2\left(e_{t-2} - E\left[e_{t-2} | I_{t-2}^{\text{market}} \setminus \{e_{t-2}\}\right]\right)\right]$$
$$= q_\nu q_\nu^0 \sigma_\nu^2 \left(\delta_I + \delta_I^2 + \delta_I^3\right) \quad \text{(A85)}$$

9. Covariance of the residuals from regressing $\left(p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}}\right)$ on the time-t earnings surprise with changes in the market's expectations of next earnings reports during a year:

$$Cov\left[p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}} - (\alpha_1 - \alpha_0) \times \left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right), ME_{t+1}^{\text{pre-report}} - ME_t^{\text{post-report}}\right]$$
$$= q_\nu(1-q_\nu^0)\sigma_\nu^2\left(1 + \delta_I + \delta_I^2\right) \quad \text{(A86)}$$

A.7 Estimation procedure

The objective of the GMM procedure is to minimize the distance between the theoretical moments, which are functions of the model parameters, and empirical moments, which are calculated from the data. In other words, the goal is to find a set of parameters $\hat{\theta}$ such that

$$\hat{\theta} = \text{argmin}_{\theta \in \blacksquare} \quad \left(\frac{1}{N}\sum_{i=1}^{N} g(Y_i, \theta)\right)^T \hat{W} \left(\frac{1}{N}\sum_{i=1}^{N} g(Y_i, \theta)\right), \quad \text{(A87)}$$

where $\frac{1}{N}\sum_{i=1}^{N} g(Y_i,\theta) = m(d) - \hat{m}(\theta)$ is the vector of average differences between moments computed from the data $m(d)$ – a function of data d – and their counterparts computed from the model $\hat{m}(\theta)$ the model – a function of the model's parameters θ. I show how each element of this vector is calculated in table 11 below. The matrix W is the weighting matrix.

The estimation is conducted in two steps. In the first step, the algorithm searches for $\hat{\theta}_1$ that minimizes A87 with an identity matrix as the weighting matrix $\hat{W}_1 = E$. Next, I take the obtained estimates $\hat{\theta}_1$, plug them into the vector $\frac{1}{N}\sum_{i=1}^{N} g(Y_i,\theta)$, and calculate the covariance matrix of this vector, $\hat{\Omega} \equiv \frac{1}{N}\sum_{i=1}^{N} [g(Y_i,\theta)][g(Y_i,\theta)]'$. In the second step, the algorithm searches for $\hat{\theta}_2$ that minimizes A87 where the weighting matrix is the inverse of the covariance matrix: $\hat{W}_2 = \hat{\Omega}^{-1}$. The parameter estimates obtained in the second step $\hat{\theta}_2$ are the ultimate estimates. I use the Controlled Random Search algorithm (Price (1983), Kaelo and Ali (2006)) to search for $\hat{\theta}$ in both steps.

I calculate standard errors of the estimates using the formula for the asymptotic covariance matrix of estimates:

$$\mathbf{V} \equiv \frac{1}{N}\left[\hat{G}\hat{\Omega}^{-1}\hat{G}^{T}\right]^{-1}, \tag{A88}$$

where $\hat{G} \equiv \frac{\partial\left(\frac{1}{N}\sum_{i=1}^{N} g(Y_i,\theta)\right)}{\partial\theta}$ is the Jacobian matrix, evaluated at $\hat{\theta}_2$. The derivative of moment k with respect to parameter p, $\frac{\partial\left(\frac{1}{N}\sum_{i=1}^{N} g(Y_i,\theta)\right)_k}{\partial\theta_p}$, is calculated by increasing parameter $\hat{\theta}_p$ by 0.01% (keeping other parameters constant) and dividing the difference between the new value of the moment and the value of the moment at the $\hat{\theta}_p$, $\left(\frac{1}{N}\sum_{i=1}^{N} g(Y_i,\theta)\right)_k\left(1.0001\hat{\theta}_p\right) - \left(\frac{1}{N}\sum_{i=1}^{N} g(Y_i,\theta)\right)_k\left(\hat{\theta}_p\right)$ by 0.01% of $\hat{\theta}_p$.

The J-statistic is $J = N\left(\frac{1}{N}\sum_{i=1}^{N} g(Y_i,\theta)\right)^T \hat{\Omega}^{-1}\left(\frac{1}{N}\sum_{i=1}^{N} g(Y_i,\theta)\right)$ and follows a χ^2 distribution with the degrees of freedom equal to the number of moments in excess of the number of parameters (9-6=3 in my case) under the null hypothesis that the model does not fail to match all moments.

A.8 Calculation of differences between empirical and theoretical moments

In this Appendix, I explain how the empirical moments used to fit the model are computed. The paper uses nine moments: one mean moment (earning response coefficient), two variance moments (variances of earnings reports and changes in market expectations during a year), and six covariance moments.

The data series used in estimation are reported annual earnings and analyst forecasts of annual earnings from the IBES database, firm prices from the CRSP database, and book values (for normalization) from the Compustat database.

I start by computing aggregate reported earnings, analyst forecasts, and firm value by multiplying IBES earnings-per-share, forecasts of earnings-per-share, and prices, respectively, by the total number of shares outstanding. Next, I normalize the aggregate values by dividing them by 3-year lagged book values.

I treat my data as cross-sectional. For each observation i, I have 9 columns:

1. Reported earnings, e_t^i, – earnings reported at time t.

2. 1-year-lead reported earnings, e_{t+1}^i, – earnings reported at time $t+1$.

3. Earnings surprise, $e_t^i - LAF_t^i$, – the difference between the reported earnings number at time t and the last analyst forecast before the earnings announcement.

4. Change in firm prices around an earnings announcement, $p_t^{\text{post-report}i} - p_t^{\text{pre-report}i}$, – firm price on the first trading day after an earnings announcement at time t minus firm price on the last trading day before the earnings announcement.

5. Change in firm prices during the year following an earnings announcement, $p_{t+1}^{\text{pre-report}i} - p_t^{\text{post-report}i}$, – firm price on the last trading day before an earnings announcement at time $t+1$ minus firm price on the first trading day after an earnings announcement at time t.

6. First analyst forecast after an earnings announcement, FAF_t^i, – the first analyst forecast of time-$t+1$ earnings issued after the earnings report at time t.

7. Change in analyst forecasts during a year following an earnings announcement, $LAF_{t+1}^i - FAF_t^i$, – the last analyst forecast of time-$t+1$ earnings issued before the $t+1$ earnings announcement minus the first analyst forecast of time-$t+1$ earnings issued after the t earnings announcement.

8. 1-year-lagged earnings surprise, $e_{t-1}^i - LAF_{t-1}^i$.

9. 2-years-lagged earnings surprise, $e_{t-2}^i - LAF_{t-2}^i$.

In the table 11 below, I provide formulas used to calculate differences between empirical and theoretical moments. To save the space, instead of $^{\text{pre-report}}$ and $^{\text{post-report}}$ superscripts, I write $^{\text{pre}}$ and $^{\text{post}}$.

Table 11: Formulas to calculate differences between empirical and theoretical moments

Moment	**Formula for difference between empirical and theoretical moments**
Earnings response coefficient moment	$\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_t^{\text{post}i}-p_t^{\text{pre}i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)\right)$
Variance of earnings reports	$\frac{1}{N}\sum_{i=1}^{N}\left(e_i-\left(\frac{1}{N}\sum_{i=1}^{N}e_i\right)\right)^2-$ $\left[3\sigma_v^2+\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2\sigma_\xi^2+\alpha_0^2\sigma_\xi^2+\delta_M^2\alpha_1^2\sigma_\xi^2+\delta_M^4\alpha_2^2\sigma_\xi^2\right]$
Variance of change in the market's expectation of the next earnings report during a year	$\frac{1}{N}\sum_{i=1}^{N}\left(LAF_{t+1}^i-FAF_t^i-\frac{1}{N}\sum_{i=1}^{N}\left(LAF_{t+1}^i-FAF_t^i\right)\right)^2-$ $\left[q_v(1-q_v^0)\sigma_v^2+q_\xi(1-q_\xi^0)\sigma_\xi^2\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2\right]$
Covariance of time-$t+1$ earnings reports with residuals of the time-t "ERC" regression	$\frac{1}{N}\sum_{i=1}^{N}\left[e_{t+1}^i-\frac{1}{N}\sum_{i=1}^{N}e_{t+1}^i\right]$ $\left[\left(p_t^{\text{post}i}-p_t^{\text{pre}i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)-\left(\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_t^{\text{post}i}-p_t^{\text{pre}i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)\right)\right)\right]-$ $\left[q_vq_v^0\sigma_v^2\left(\delta_I+\delta_I^2+\delta_I^3\right)\right]$
Covariance of time-$t+1$ earnings reports with residuals from regressing change in prices from right after the time-t report to right before the time-$t+1$ report on the time-t earnings report surprise	$\frac{1}{N}\sum_{i=1}^{N}\left[e_{t+1}^i-\frac{1}{N}\sum_{i=1}^{N}e_{t+1}^i\right]$ $\left[\left(p_{t+1}^{\text{pre}\,i}-p_t^{\text{post}i}\right)-(\alpha_1-\alpha_0)\times\left(e_t^i-LAF_t^i\right)-\left(\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_{t+1}^{\text{pre}\,i}-p_t^{\text{post}i}\right)-(\alpha_1-\alpha_0)\times\left(e_t^i-LAF_t^i\right)\right)\right)\right]-$ $\left[q_vq_v^0\sigma_v^2(1-\delta_I^3)+q_v(1-q_v^0)\sigma_v^2(1+\delta_I+\delta_I^2)\right]$
Covariance of time-$t+1$ earnings reports with residuals from regressing the market's expectation of the time-$t+1$ earnings report on the time-t earnings report surprise	$\frac{1}{N}\sum_{i=1}^{N}\left[e_{t+1}^i-\frac{1}{N}\sum_{i=1}^{N}e_{t+1}^i\right]$ $\left[FAF_t^i-\beta_0\times\left(e_t^i-LAF_t^i\right)-\beta_1\times\left(e_{t-1}^i-LAF_{t-1}^i\right)-\beta_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)\right.$ $\left.-\left(\frac{1}{N}\sum_{i=1}^{N}\left(FAF_t^i-\beta_0\times\left(e_t^i-LAF_t^i\right)-\beta_1\times\left(e_{t-1}^i-LAF_{t-1}^i\right)-\beta_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)\right)\right)\right]-$ $\left[q_vq_v^0\sigma_v^2+2q_v\sigma_v^2+q_\xi q_\xi^0\sigma_\xi^2\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2+q_\xi\sigma_\xi^2\alpha_0^2+q_\xi\sigma_\xi^2\delta_M^2\alpha_1^2+q_\xi\sigma_\xi^2\delta_M^4\alpha_2^2\right]$
Covariance of time-$t+1$ earnings reports with changes in the market's expectations of the next earnings reports during a year	$\frac{1}{N}\sum_{i=1}^{N}\left[LAF_{t+1}^i-FAF_t^i-\frac{1}{N}\sum_{i=1}^{N}\left(LAF_{t+1}^i-FAF_t^i\right)\right]\left[e_{t+1}^i-\frac{1}{N}\sum_{i=1}^{N}e_{t+1}^i\right]-$ $\left[q_v(1-q_v^0)\sigma_v^2+q_\xi(1-q_\xi^0)\sigma_\xi^2\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2\right]$
Covariance of the residuals from regressing $\left(p_t^{\text{post-report}}-p_t^{\text{pre-report}}\right)$ on the time-t earnings surprise with residuals from regressing $ME_t^{\text{post-report}}$ on the same surprise	$\frac{1}{N}\sum_{i=1}^{N}\left[\left(p_t^{\text{post}i}-p_t^{\text{pre}i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)-\left(\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_t^{\text{post}i}-p_t^{\text{pre}i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)\right)\right)\right]$ $\left[FAF_t^i-\beta_0\times\left(e_t^i-LAF_t^i\right)-\beta_1\times\left(e_{t-1}^i-LAF_{t-1}^i\right)-\beta_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)\right.$ $\left.-\left(\frac{1}{N}\sum_{i=1}^{N}\left(FAF_t^i-\beta_0\times\left(e_t^i-LAF_t^i\right)-\beta_1\times\left(e_{t-1}^i-LAF_{t-1}^i\right)-\beta_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)\right)\right)\right]-$ $\left[q_vq_v^0\sigma_v^2\left(\delta_I+\delta_I^2+\delta_I^3\right)\right]$
Covariance of the residuals from regressing $\left(p_{t+1}^{\text{pre-report}}-p_t^{\text{post-report}}\right)$ on the time-t earnings surprise with changes in the market's expectations of next earnings reports during a year	$\frac{1}{N}\sum_{i=1}^{N}\left[\left(p_{t+1}^{\text{pre}\,i}-p_t^{\text{post}i}\right)-(\alpha_1-\alpha_0)\left(e_t^i-LAF_t^i\right)-\left(\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_{t+1}^{\text{pre}\,i}-p_t^{\text{post}i}\right)-(\alpha_1-\alpha_0)\left(e_t^i-LAF_t^i\right)\right)\right)\right]$ $\left[LAF_{t+1}^i-FAF_t^i-\frac{1}{N}\sum_{i=1}^{N}\left(LAF_{t+1}^i-FAF_t^i\right)\right]-$ $\left[q_v(1-q_v^0)\sigma_v^2\left(1+\delta_I+\delta_I^2\right)\right]$