What Does the Market Know?*

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Abstract

Investors in financial markets have some information about firms' fundamental earnings and managers' incentives to manage earnings reports. These two types of information affect earnings quality in different ways (Fischer and Stocken, 2004). Researchers cannot observe all of the investors' information sources. I develop a structural approach that uses firms' earnings reports and stock prices along with analysts' forecasts to measure how much information investors have about firms' fundamentals and managers' misreporting incentives. I estimate the amount of information an average investor has about a firm and the implied quality of earnings. I find that investors know substantially more about firms' fundamentals than about managers' misreporting incentives. Moreover, between 1.7 and 8.3 percent of the variance in reported earnings is driven by reporting noise.

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Introduction

Earnings reports play a central role in capital markets by conveying information about firm performance. However, when managers engage in earnings management, these reports can become less informative, potentially distorting investors' decisions. To interpret earnings accurately, investors rely not only on the reports themselves, but also on other sources of information – particularly about firms' fundamentals and about managers' incentives to misreport. The nature of this surrounding information critically shapes the effectiveness of financial reporting and the extent of earnings management (Fischer and Stocken (2004)). When investors have more information about fundamentals, they rely more on that information and less on reported earnings, reducing managers' benefits from misreporting. In contrast, when investors know more about managers' misreporting incentives, they can better adjust for misreporting and respond more strongly to the reports – potentially increasing the manager's incentives to misreport. Understanding the informativeness and credibility of earnings reports thus requires understanding the types of information investors possess. In this study, I estimate the amounts of fundamental and incentives-related information that investors hold from sources other than earnings reports.

Estimating the amounts of investors' information about firm fundamentals and firm managers' misreporting incentives poses significant challenges because there are many sources of investor information for a firm, such as analyst reports, a plethora of the firm's disclosures, news and pundit reports, regulatory reports, and other firms' reports. While some sources of that information are observable and measurable, some are not. For example, managers' incentives, especially if nonmonetary, may not be fully captured by reported compensation structures. In addition, a single source can be an aggregation of information about both firms' fundamentals and manager's reporting incentives. For instance, compensation affects managers' reporting choices but also affects firms' fundamentals by influencing managers' productive efforts. To tackle these challenges, I use a structural estimation approach. The approach uses observed financial market outcomes – firms' earnings reports, stock prices, and analysts' earnings forecasts – interpreted through the lens of a formal model to infer estimates of the amounts of information investors have about firms' fundamentals and managers' misreporting incentives, and their effects on the quality of earnings reports.

To provide the structure for my estimation, I build a dynamic earnings management model in the spirit of Fischer and Verrecchia (2000) and Fischer and Stocken (2004), which features a firm manager who issues earnings reports to investors who price the firm given their beliefs about its fundamentals. In each period, the manager privately observes fundamental (i.e., unmanaged) earnings and issues earnings reports, which can be biased away from the fundamental earnings at a cost. The manager's reporting incentives are tied to the stock price and those incentives are unknown to investors. In addition to observing reported earnings, investors have some other sources of information about the firm's fundamental earnings and the manager's reporting incentives when they price the firm in a given period.[1] In the context of this model, the manager's equilibrium reporting strategy is to bias their earnings in light of their reporting incentives for that period, and the investors' price response to the earnings report reflects their expectation of the level of bias in the report.

I estimate the amounts of the two types of investors' information using stock prices and analysts' earnings forecasts. My approach intuitively relies on two assumptions: (1) stock price reflects only investors' beliefs about firms' fundamentals, which is consistent with the underlying theoretical model, and (2) analysts' earnings forecasts reflect expectations of reported earnings, which is consistent with analysts' compensation practices (Mikhail et al. (1999), Hilary and Hsu (2013)).[2] The first assumption implies that changes in stock prices reflect only changes in investors' beliefs about fundamental earnings. The second assumption implies that changes in analysts' forecasts, in effect, reflect changes in beliefs about fundamental earnings plus beliefs about earnings management, and hence, about the manager's misreporting incentives. I effectively rely on stock prices to identify investors' information about fundamentals, and rely on earnings forecasts, coupled with the information about fundamentals gleaned from firms' stock prices, to identify investors' information about managers' misreporting incentives.

Another important aspect of investors' information is that it arrives unevenly over time and, importantly, is often bundled with earnings reports themselves, complicating the identification of investors' information from sources other than earnings reports. For example, analysts often issue press releases and managers discuss their firms' prospects during conference calls on the days when earnings are released. To address the bundling issue, I separately estimate how much information investors learn on announcement days of earnings reports (from sources other than earnings reports themselves) and on other days during the year. Short-window changes in firms' stock prices and analysts' forecasts around earnings announcements that

[1] I assume that the manager's private information subsumes the investors' information. Later in the paper, I discuss the limitations of this assumption and why it may not be critical for my findings.

[2] I also estimate an alternative model where this assumption is relaxed and analysts are allowed to forecast a combination of reported and fundamental earnings. This exercise shows that as long as some analysts aim to forecast reported earnings, the market's information about misreporting incentives can be identified using analyst reports. I elaborate on the alternative model later in the paper.

are not explained by reported earnings help identify the amount of information investors learn from sources other than earnings on the earnings announcement day. Changes in stock prices and forecasts throughout the year excluding the announcement day, in turn, identify the amount of information investors learn on other days.

I begin by estimating the baseline model – the dynamic version of Fischer and Verrecchia (2000) and Fischer and Stocken (2004). After obtaining the baseline estimates, I augment the main model to include some important features that are plausible in the data but are omitted from the classic theory. Specifically, after the main model, I estimate (1) a model with both stock-price-driven misreporting incentives and idiosyncratic circumstances affecting the manager's report (in the spirit of Dye and Sridhar (2008)), (2) a model where analysts forecast not just reported earnings but a combination of reported and fundamental earnings, (3) a model where investors' information about firms' fundamentals and managers' misreporting incentives can be correlated. The four different versions of the model produce ranges of parameter estimates.

The estimates show that firms' fundamental earnings are highly volatile. For a typical firm, the standard deviation in fundamental earnings varies between 23.3 and 27.2% of the firm's lagged book value. For reference, the standard deviation in the reported earnings for a cross-section of US firms is 24.5%, and the median reported earnings is 13.0% of the firm's lagged book value.

Even though fundamental earnings are volatile, investors appear to already know a lot about them before managers release their earnings reports: investors know about 80.4 to 92.6% of the information about fundamental earnings from sources other than managers' earnings reports. Of the total investors' information about fundamental earnings, 14.8 to 20.5% is learned about one year ahead of the relevant earnings report, concurrently with the firm's previous earnings report.

Managers' misreporting incentives also appear to be volatile. The manager's dollar-value utility gain from a $1,000 increase in firm market price (i.e., market capitalization) has a standard deviation between $18 and $48. Importantly, these incentives do not only come from executive compensation but also from non-monetary motives, such as career concerns or pressure to meet or beat earnings forecasts. To put this result in perspective, consider the findings of other studies that have examined the sensitivity of executives' monetary compensation to shareholder value (Jensen and Murphy (1990), Aggarwal and Samwick (1999), Guay (1999), Clementi and Cooley (2009)). Jensen and Murphy (1990) estimate that a CEO's wealth increases by $3.25 for each $1000 increase in shareholders' wealth. I find that the sensitivity of managers' utility to firm price has a high variance, indicating that the sensitivity of CEOs' wealth to investors' wealth varies considerably from firm to firm and may be highly unpredictable. As one example, Clementi and Cooley (2009) find considerable variation in CEOs' compensation sensitivity for firms with low versus high fundamental volatility. My concept of misreporting incentives also includes non-monetary factors, which can vary significantly in the cross-section.

In contrast to firms' fundamentals, managers' misreporting incentives are substantially more opaque to investors. Investors appear to know only 30.8 to 42.8% of the managers' misreporting incentives. About 9.0-29.3% of this information is learned concurrently with the previous earnings report, potentially because managers and financial analysts often disclose their expectations for next year's reports to create a benchmark to beat in the following year (Burgstahler and Dichev (1997), Matsumoto (2002)).

The estimated amounts of investors' information allow me to evaluate the usefulness of earnings reports. First, I estimate the quality of earnings reports. I find that, on average, between 91.7 and 98.3% of the variance in reported earnings is driven by the variance in fundamentals, and the remaining 1.7 to 8.3% is driven by reporting noise. When I augment the model to allow for both stock-price-related earnings management and idiosyncratic circumstances affecting the manager's report, I find that roughly 21.2% of the reporting noise is due to managers' stock-price-based incentives and 78.8% is due to idiosyncratic factors affecting reports. I also evaluate the extent to which the magnitude of misreporting varies across firms. The standard deviation in the magnitude of earnings management appears large – about 3.6 to 6.9% of book value. Other studies have quantified the prevalence of earnings management and concluded that, on average, few managers manage earnings and many of them do not misstate earnings by a lot. For example, Cade et al. (2025) find that about 5.4-6.6% of executives report that they have exploited GAAP discretion to misrepresent their firms' performance and of those, 0.0-12.4% admit their misrepresentations were material. My finding adds nuance to our knowledge of misreporting: while the average magnitude of earnings management may be small, the variation in earnings management across firms and uncertainty about this earnings management are large. Similar to this study, Cheynel et al. (2024) find that the distribution of earnings management features a heavy tail. The variation in misreporting across firms may be driven by different factors: the "slippery slope" of misreporting – a situation in which a one-time earnings manipulation by the manager encourages them to keep manipulating (Schrand and Zechman (2012), Soltes (2016), Chu et al. (2019)), – variation in auditors' leniency (Corona and Randhawa (2010)), or managers' heterogeneous cultural norms (Srinivasan et al. (2015)).

My study expands multiple streams of the accounting literature. The first stream defines and measures earnings quality and the degree of earnings management. Early studies in this space used accruals or abnormal changes in earnings to identify instances of earnings management (e.g., Jones (1991), Dechow et al. (1995), Sloan (1996), Burgstahler and Dichev (1997), Dechow and Dichev (2002)) or treated persistent earnings as high quality (e.g., Revsine et al. (2001), Penman (2012)). Dechow et al. (2010) provide an extensive review of the various metrics for earnings quality. More recent studies use formal models or structural approaches to uncover the magnitudes of earnings management and the number of firms that manage earnings (e.g., Gerakos and Kovrijnykh (2013), Zakolyukina (2018), Liang et al. (2018), Beyer et al. (2019), Bertomeu et al. (2019), Bird et al. (2019), Bertomeu et al. (2021), Cheynel et al. (2024)). The study that is closest to my paper is Beyer et al. (2019). I add to this large stream of literature in at least three ways. First, existing studies have not estimated investors' uncertainty about managers' stock-price-based misreporting incentives. I evaluate the amount of investors information about managers' misreporting incentives and its effect on the quality of earnings and price efficiency. Second, my study is the first to estimate stock-price-driven earnings management and reporting noise due to idiosyncratic circumstances in one framework. I can evaluate the relative importance of the two forces in determining noise in earnings reports. Third, other studies have focused on average levels of earnings management or related mispricing. My findings improve our knowledge of misreporting because, as Fischer and Verrecchia (2000) note, average bias in earnings reports may not always properly capture the information content of earnings reports. My measure of earnings quality measures the information content of earnings reports directly. In addition, the nature of my model allows me to estimate variances rather than average levels of earnings management, refining our understanding of how financial misreporting is distributed across firms.

The second stream of literature examines investors' learning about managerial incentives and the implications for financial misreporting (e.g., Ferri et al. (2018), Bertomeu et al. (2019), Kim (2024)). Ferri et al. (2018) use the staggered adoption of the CD&A section in firms' proxy statements, and Kim (2024) uses investors' searches for compensation-related disclosures. In both studies, investors' information sources contain both information about misreporting incentives and firm fundamentals, making isolating the effects of different types of information impossible. The advantage of my approach is that I can disentangle information about fundamentals and misreporting incentives and their respective effects on misreporting, even if investors simultaneously learn both types of information.

Further, my study contributes to the large stream of literature that examines various sources of information about firms' other than earnings reports. These sources include managerial guidance (e.g., Lu and

Skinner (2020)), analyst reports (e.g., Francis et al. (2002), Lobo et al. (2017)), peer disclosures (e.g., Arif and De George (2020)), macroeconomic news (e.g., Carabias (2018)), bank loans (e.g., Best and Zhang (1993)), tender offers (e.g., Dann et al. (1991)), and more recently, social networks (e.g., Bartov et al. (2018)) and general internet searches (e.g., Drake et al. (2012)). While each of these studies analyzes one or more sources of information, they do not aggregate the amount of information investors obtain from other sources. Simply adding up the findings of different studies of individual sources may not capture the total amount of investors' information because some sources may be unobservable to researchers and others may be duplicates. My study fills this void and estimates the aggregate amount of investors' information on fundamentals and incentives. A relevant recent study by Smith (2023) uses a structural model to measure how much investors know about fundamentals from external sources and the effectiveness of earnings in accelerating the arrival of information investors would have learned elsewhere after an earnings announcement. Smith (2023) studies the precise timing of information arrival and the extent to which earnings carries this information forward; my study's focus is investors' uncertainty about managerial misreporting incentives and the resulting earnings manipulation.

The rest of the study is organized as follows: Section 1 introduces the model setup, assumptions, limitations, and the identification strategy. Section 2 presents the data and estimation procedure. Section 3 discusses results of estimating the main model and augmented models. In Section 4, I present counterfactual scenarios of changes in investors' information. Section 5 shows two applications of the structural model to evaluate the outcome of a regulation and study the implications of different timing of firms' reports. Section 6 concludes.

1 Model

The model for the primary structural estimation is a dynamic version of the models in Fischer and Verrecchia (2000) and Fischer and Stocken (2004), which feature a firm manager who reports earnings to investors who value the firm. The manager's earnings report can deviate from privately observed fundamental earnings, which is the primitive determinant of the firm's value. The deviation, if any, is selected by the manager to maximize a personal objective function, which includes a reporting benefit tied to the investors' pricing of the manager's firm and a personal cost of deviating from reporting the fundamental earnings observed, where the latter represents legal, regulatory, reputation, or psychic costs. The manager's objective is unknown to the investors and cannot be credibly communicated by the manager to investors. Hence, the uncertainty regarding the manager's objective, which drives reported earnings, is the source of noise in the manager's earnings report from the perspective of investors. Within the model's structure, then, there are two sources of investor uncertainty: uncertainty regarding the fundamental earnings and uncertainty regarding the manager's reporting objective, and the objective of my paper is to provide estimates of the amounts of information investors have related to each source of uncertainty.

1.1 Setup

The sequence of events each period consists of four stages. In the first stage, market participants obtain information relevant to the period's fundamental earnings and manager reporting incentives. In the second stage, the manager privately learns the firm's fundamental earnings for that period as well as their personal reporting incentives for that period. In the third stage the manager releases an earnings report to market participants, which is intended to convey information to investors about that period's fundamental earnings. In addition, investors also obtain some information about the next period's fundamental earnings and reporting incentives. Finally, in the fourth stage, the security market opens and firm value as of that period is determined. The stages are summarized in Figure 1.

The investors' valuation of the firm in the fourth stage of period t, p_t, is their expectation of discounted future fundamental earnings:

$$p_t = E\left[\sum_{k=t}^{\infty} \delta_I^{k-t} \tilde{\varepsilon}_k | I_t^{\text{market}}\right], \tag{1}$$

where $\delta_I \in (0,1)$ is investors' discount factor[3], $\tilde{\varepsilon}_k$ is the earnings for period k, I_t^{market} is all the information available to them at time t, and a ˜ above a variable indicates a random variable and a lack of a ˜ represents its realization. The information set each period includes all information obtained in prior periods as well as information about fundamental earnings for period t, information about the manager's reporting incentives for t, and, finally, the manager's period t earnings report.

Fundamental earnings for any t is determined by the realization of three innovations

$$\tilde{\varepsilon}_t = \tilde{v}_t + \tilde{v}_{t-1} + \tilde{v}_{t-2}$$

[3] I assume that discount factors of investors and the manager are not affected by the amount of the information investors have.

where $\tilde{v}_k$ is an innovation realized in period k, and all of the innovations are iid $N(0, \sigma_v^2)$. The specification for earnings ensures that the time series for earnings exhibits some persistence (e.g., Albrecht et al. (1977)) and mean-reverts (Gerakos and Kovrijnykh (2013)), which allows the model's reported earnings to replicate two charcteristics of observed scaled earnings processes (e.g., ROE and ROA) while still having sufficient parsimony for an equilibrium characterization. Note that a standard AR1 process could also ensure an earnings process that exhibits persistence and mean reversion, but that form is not parsimonious within the model because the earnings in any period is, in effect, a function of an infinite number of prior period innovations, as opposed to the finite number of innovations in the model employed.

The manager privately learns earnings for period t, $\tilde{\varepsilon}_t$, in the second stage and issues an earnings report, e_t, in the third stage. The manager's objective when reporting at date t is to maximize their discounted expected utility

$$E\left[\sum_{k=t}^{k=\infty} \delta_M^{k-t} \tilde{U}_k | I_t^{\text{manager}}\right],$$

where $\delta_M \in (0,1)$ is the manager's discount factor, I_t^{manager} is the manager's information set at date t and $\tilde{U}_k$ is the manager's utility for time k. The manager's realized utility for any period t is based on the firm's stock price in the fourth stage, p_t, net of the personal cost of issuing an earnings report for a period that differs from the fundamental earnings for that period:

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

where m_t is the manager's stock-price-based reporting incentive in period t and e_k is the earnings report for period k.[4] The incentive m_t does not only capture the manager's monetary compensation but can include nonmonetary benefits, such as reputation or happiness from running a successful firm. This incentive can be positive or negative. The misreporting cost for a given period, $\frac{\left(\sum_{k=0}^{t}(e_k-\varepsilon_k)\right)^2}{2}$, is an increasing convex function of the deviation of the current period's earnings report and all other deviations in prior earnings reports. That cost function captures the idea that greater accumulation of misreporting increases the likelihood of being caught and penalized. For example, it reflects the notion that misreporting-driven accruals reverse over

[4] The manager bears one 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 one unit of misreporting cost. Alternatively, the cost of misreporting can be modeled as $c\frac{\left(\sum_{k=0}^{t}(e_k-\varepsilon_k)\right)^2}{2}$ and the manager's misreporting incentives can be modeled as $M_t = cm_t$.

time and that, say, to manage up the current earnings report after managing up prior earnings reports, the manager would have to engage in even more excessive earnings management, thereby exposing the manager to a greater likelihood of detection and more extensive punishment. Note that the cost function implies that, in expectation, the manager will endogenously reverse prior periods' reported earnings deviations from fundamental earnings.

Uncertainty is introduced into the manager's objective by assuming that m_t is the realization of $\tilde{m}_t$, which is observed by the manager in the second stage. $\tilde{m}_t$ is also determined by three independent innovations, which ensure persistence and mean reversion while maintaining tractability:

$$\tilde{m}_t = \tilde{\xi}_t + \tilde{\xi}_{t-1} + \tilde{\xi}_{t-2},$$

where $\tilde{\xi}_k$ is an innovation realized in period k, and all of the innovations are iid $N(0, \sigma_{\xi}^2)$. Furthermore, all the innovations for the manager's objective are independent of all the innovations for fundamental earnings.

In addition to obtaining the manager's earnings reports, investors obtain relevant information from other sources. To capture the amount of investors' information on fundamental earnings, I split the process for fundamental earnings, $\tilde{\varepsilon}_t$, in the following way:

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

where $0 < q_v < 1$. The manager observes both parts, $\tilde{\varepsilon}_{1,t}$ and $\tilde{\varepsilon}_{2,t}$, while investors only observe $\tilde{\varepsilon}_{1,t}$. Investors learn $\tilde{\varepsilon}_{1,t}$ from sources other than the manager's earnings report. The parameter q_v represents the fraction of total information about fundamentals that investors know from these other sources. For example, $\tilde{\varepsilon}_{1,t}$ may represent systematic factors that affect the firm's productivity, such as demand or macroeconomic conditions, while $\tilde{\varepsilon}_{2,t}$ represents idiosyncratic factors, such as the firm's ability to meet demand or how the firm's creditors change their behavior given the macroeconomic conditions. Investors may learn $\tilde{\varepsilon}_{1,t}$ from disclosures of other firms, analyst forecasts, or government communication, but they have difficulty learning idiosyncratic factors without being inside the firm. The part $\tilde{\varepsilon}_{1,t}$ can also include idiosyncratic factors that the firm's management decides to share with investors through channels other than earnings.

An important feature of investors' information is that a lot of it arrives simultaneously with earnings reports. For example, company management may share their view of the firm and its future, or financial analysts may release their expectations about the firm's future performance. To properly measure all of the investors' information, I further split $\varepsilon_{1,t}$ into parts:

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

where $0 < q^0_v < 1$. $\varepsilon^0_{1,t}$ is the investors' information about fundamental earnings for period t obtained simultaneously with the third stage $(t-1)$ earnings report in $t-1$. $\varepsilon^1_{1,t}$ is the investors' information about fundamental earnings for period t obtained in the first stage of period t. The fraction of investors' information about fundamental earnings that is learned concurrently with the previous report is captured by q^0_v. To illustrate, $\varepsilon^0_{1,t}$ can be the demand for a firm's products or production costs for this year (t) that management shared during an earnings call about the last year's earnings at $t-1$. This component can also be analysts' estimates of this year's earnings that were updated live during the previous earnings call. The other component, $\varepsilon^1_{1,t}$, can be the information investors acquire during the next year from updated analyst reports, media reports, or disclosures from peer firms. The timing of investors' information arrival is shown in Figure 1.

Similarly, to capture the amount of incentives information investors have, I split the process for incentives, $\tilde{m}_t$, in the following way:

$$\tilde{m}_t = \tilde{m}_{1,t} + \tilde{m}_{2,t},$$
$$\tilde{m}_{1,t} = \tilde{\xi}_{1,t} + \tilde{\xi}_{1,t-1} + \tilde{\xi}_{1,t-2}, \quad \tilde{\xi}_{1,k} \sim N(0, q_\xi \sigma^2_\xi),$$
$$\tilde{m}_{2,t} = \tilde{\xi}_{2,t} + \tilde{\xi}_{2,t-1} + \tilde{\xi}_{2,t-2}, \quad \tilde{\xi}_{2,k} \sim N(0, (1-q_\xi) \sigma^2_\xi),$$

where $0 < q_\xi < 1$. Both components of the incentives, $m_{1,t}$ and $m_{2,t}$, are known to the manager, and investors know only one part – $m_{1,t}$. The parameter q_ξ represents the share of information on the misreporting incentives that investors have. For instance, $m_{1,t}$ may capture the manager's stock-price-based compensation that investors learn from the firm's disclosures, while $m_{2,t}$ may be idiosyncratic circumstances that change the manager's utility from a one unit increase in the stock price, such as a need to exercise stock options or the need to switch jobs.

Like with fundamental earnings, investors may learn information about the manager's stock-price-based incentives simultaneously with releases of earnings reports. For instance, the earnings report in the current year creates a benchmark to bit next year. To account for all of the investors' information about stock-price-based incentives, I further split $m_{1,t}$ into two parts:

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

where $0 < q^0_\xi < 1$. $m^0_{1,t}$ is the investors' information about misreporting incentive for period t obtained simultaneously with the third stage $(t-1)$ earnings report in $t-1$. $m^1_{1,t}$ is the investors' information about misreporting incentive for period t obtained in the first stage of period t. The fraction of investors' information about misreporting incentives that is learned concurrently with the previous report is captured by q^0_ξ. For example, $m^0_{1,t}$ may represent the fact that previous (year-$(t-1)$) earnings serve as a target to beat in the current year (t) and so directly affect the manager's misreporting incentives. The other component, $m^1_{1,t}$, may represent stock-based compensation or other earnings targets that investors learn about during the year.

I assume that the manager and investors remember the entire history of information they ever had. This assumption implies that, at any point in time, the manager does not only know the current period's fundamental earnings, ε_t, and the current period's incentives, m_t but also knows each separate innovation, ν_t, ν_{t-1}, and ν_{t-2} and ξ_t, ξ_{t-1}, and ξ_{t-2}, that goes into the current period's fundamental earnings and incentives. Similarly, investors do not only know their information about current period's fundamental earnings, $\varepsilon_{1,t}$, and their information about current period's incentives, $m_{1,t}$ but also know each separate innovation, $\nu_{1,t}, \nu_{1,t-1}$, and $\nu_{1,t-2}$ and $\xi_{1,t}, \xi_{1,t-1}$, and $\xi_{1,t-2}$, that goes into their information about the current period's fundamental earnings and incentives.

The model has three features worth discussing. First, the full information valuation is assumed to be driven by the time series of fundamental earnings. While intuitive, that fundamental earnings process implicitly embeds the valuation implications of many management decisions, such as dividend and investment policies, in addition to economic shocks outside of management's control. Most relevant to the research question and model employed in this study, those decisions and the reporting of them may convey value relevant information to investors over reported earnings and one would expect that they will be made strategically. Within the context of the model, the information conveyed by those decisions is embedded into the other information sources within the model. Embedding many sources of information into the other information statistics in the model facilitates a focus on the information obtained in aggregate from all of those other sources, which is the primary objective of the study. With that said, the paper is silent as to identifying those sources and the source-specific information content.

Second, the model forces all noise in earnings to be attributable to uncertain manager incentives tied to price. In reality, financial reports can be noisy from investors' perspective for reasons unrelated to stock-price-driven reporting management, such as report management induced by contracts, deviations from fundamentals induced by application of accounting rules and the judgement required to implement them, or errors in the accounting system, all of which can be sources of noise in reported earnings to the extent those incentives are uncertain. These other sources of noise can be incorporated in my model by adding another uncertain parameter into the manager's earnings report in the spirit of Dye and Sridhar (2008). In Section 3.2.1, I estimate this alternative model and find that the baseline model with only stock-price-based misreporting overstates the variance of the manager's price-based incentives. The main implications of the paper, however, remain: investors appear to know a lot of fundamental information and not as much about the reporting incentives that influence reported earnings.

Finally, the model assumes that investors' pieces of information about fundamental earnings and the manager's incentives are independent of each other. They may not always be independent in reality: some common factors might drive both the firm's performance and the extent to which the manager cares about the firm's price. In Section 3.2.3, I estimate an alternative model and show that incorporating a potential common component in the investors' fundamental and incentives information does not substantially change the estimated amounts of investors' total fundamental and misreporting incentives information.

1.2 Equilibrium and Steady State

An equilibrium in the model is defined by a dynamic reporting strategy and a dynamic pricing function, or equivalently, an initial price and a change in price function, such that: (1) the reporting strategy maximizes the managers' expected discounted utility function given their beliefs about the investors' price response to the reported earnings, (2) the price each period equals the investors' discounted expected fundamental earnings given their beliefs about the manager's reporting strategy, and (3) the manager's and investors' beliefs about each other's behaviors are equilibrium consistent. Consistent with antecedent literature (e.g., Beyer et al. (2019)), I focus on linear equilibria in which the manager's reporting strategy is linear in the state variables they observe and the investors' price evolution is linear in the information variables (i.e., reported earnings and information obtained from other sources).[5,6]

In Appendix 7.1, I derive a linear equilibrium in a manner similar to Beyer et al. (2019). Like Beyer et al. (2019), I focus on the steady state of that equilibrium in structural estimation, where the steady state is the "part" of the equilibrium path in which the coefficients in the linear pricing function are constant period over period. The steady state price is of the form

$$p_t = p_{const} + \sum_{\tau=0}^{2} \alpha_\tau \left(e_{t-\tau} - E\left[e_{t-\tau} | I_{t-\tau}^{\text{market}} \setminus \{e_{t-\tau}\}\right]\right) + \sum_{\tau=0}^{2} a_\tau \nu_{1,t-\tau} + a_{-1} \nu_{1,t+1}^{0},$$

where $\left(e_k - E\left[e_k | I_k^{\text{market}} \setminus \{e_k\}\right]\right)$ denotes an earnings surprise at time k; $I_k^{\text{market}} \setminus \{e_k\}$ is all of the investors' information at time t except the period-t earnings report; p_{const}, α_τ, a_τ, and a_{-1} are endogenously derived. p_{const} is a constant, α_τ are coefficients on current (for $\tau = 0$) and past earnings surprises, a_τ are coefficients on the market's information about fundamental earnings for current (for $\tau = 0$) and past periods, and a_{-1} is a coefficient on the market's information about fundamental earnings for the next period. The current price depends not only on the current but also on the past two earnings surprises because annual innovations to fundamental earnings that investors do not observe $(\tilde{\nu}_{2,k})$ persist for three periods, and therefore, earnings surprises at times $t-2$ and $t-1$ are used by investors to form expectations about earnings at times t and $t+1$. For the same reason, the current price depends on investors' information about fundamentals from other sources about past two years' fundamental earnings.

In the steady state, the manager's earnings report at date t is of the form

$$\begin{aligned} e_t = \varepsilon_t + \alpha_0 m_t + \delta_M \alpha_1 E_t\left[m_{t+1}\right] + \delta_M^2 \alpha_2 E_t\left[m_{t+2}\right] - \left(\alpha_0 m_{t-1} + \delta_M \alpha_1 E_{t-1}\left[m_t\right] + \delta_M^2 \alpha_2 E_{t-1}\left[m_{t+1}\right]\right) \\ = \varepsilon_t + (\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2)\xi_t - \alpha_0 \xi_{t-3} - \delta_M \alpha_1 \xi_{t-2} - \delta_M^2 \alpha_2 \xi_{t-1}, \qquad (3) \end{aligned}$$

[5]A formulation where the firm's stock price is a linear function of its earnings is consistent with the Ohlson (1995) equity valuation framework. Under the assumption that earnings that stay at the firm earn the equity rate of return, the firm's dividend policy is irrelevant, and I can assume that all earnings are paid out as dividends. The expression for stock price (1) can be re-written as the sum of the firm's past earnings (book value) and current earnings (Feltham and Ohlson (1995)).

[6]Studies (Guttman et al. (2006)) have found that in an earnings management setting with uncertain managerial incentives, multiple equilibria, including nonlinear, can exist. In some of them, the manager's earnings report cannot be perfectly mapped into unmanipulated earnings but there is partial pooling where managers in the middle earnings region issue the same report. I choose to focus on smooth, linear equilibria, as this formulation is less challenging to estimate.

where α_0, α_1, and α_2 are the steady state weights in the firm's price on the current earnings report, α_0, the earnings report released a period ago, α_1, and the earnings report released two periods ago, α_2. The intuition for the report is as follows. In a static model, the equilibrium report would be $\varepsilon_t + \alpha_0 m_t$, or the manager would add a bias to the fundamental earnings that is proportional to (1) the market reaction to the report – the per unit price increase in the report (α_0) and (2) the manager's reward per unit of price increase (m_t). In a dynamic model, two additional forces are present. First, the manager's current earnings report affects the firm's price not only in the current but also in the two future periods (with coefficients α_1 and α_2). The manager cares about the future prices, but discounts their benefit (hence δ_M and δ_M^2). Second, the manager pays a cost not only for biasing the current earnings report but also for biasing all past earnings reports. The costs of prior biases naturally reduce the bias the manager can afford in the current period, causing the manager to bias by a smaller amount, hence the term $\left(-\left(\alpha_0 m_{t-1} + \delta_M \alpha_1 E_{t-1}\left[m_t\right] + \delta_M^2 \alpha_2 E_{t-1}\left[m_{t+1}\right]\right)\right)$.

To identify investors' information on firms' fundamentals, I assume that firms' prices reflect investors' beliefs about firm fundamentals and use changes in prices to identify the arrival of new information on fundamentals. As discussed above, I allow investors' information about current-year fundamental earnings to arrive both concurrently with prior-year earnings report and on other days during the year leading up to the current-year earnings report. To separate these two information arrival stages, I introduce another pricing stage in the model. I denote the "main" price in the model, denoted p_t above, by $p_t^{\text{post-report}}$, where "post-report" implies this is the firm's price just after the period-t earnings report is released. The other price is denoted $p_t^{\text{pre-report}}$ and is the firm's price right before the period-t earnings report is released. The price $p_t^{\text{pre-report}}$ incorporates all of the investors' information related to the period-t earnings report, and the price $p_t^{\text{post-report}}$ in addition incorporates (1) the period-t earnings report, e_t, and (2) the investors' information about the next period's $(t+1)$ earnings report received concurrently with the period-t earnings report. By looking at changes in the firm's prices from $p_{t-1}^{\text{post-report}}$ to $p_t^{\text{pre-report}}$, I can isolate investors' information about period-t report received during a year leading up to the period-t report not including the day of the the period-$(t-1)$ report. By looking at changes in the firm's prices from $p_t^{\text{pre-report}}$ to $p_t^{\text{post-report}}$, I can isolate investors' information about period-$(t+1)$ report received concurrently with the period-t report. The introduction of another pricing stage does not change the manager's equilibrium strategy as there is no way the manager can affect the firm's price between two earnings reports. Figure 2 shows where the price $p_t^{\text{pre-report}}$ appears in the timing of events in the model.

In the steady state, the change in the firm's price from right before the period-t earnings report release to right after is

$$p_t^{\text{post-report}} - p_t^{\text{pre-report}} = \alpha_0 \left(e_t - E[\tilde{e}_t | I_t^{\text{market}} \setminus \{e_t\}] \right) + a_{-1} v_{1,t+1}^0, \tag{4}$$

where α_0[7] and $a_{-1} = \delta_I + \delta_I^2 + \delta_I^3$ are endogenously determined coefficients. This change in the firm's price captures the change in investors' information set due to (1) the release of the period-t earnings report, which is informative about current and next two periods' fundamental earnings and (2) the simultaneous arrival of investors' information about time-$(t+1)$ fundamental earnings. The endogenous earnings response coefficient α_0 captures the amount of information in the earnings report e_t about the part of fundamental earnings investors do not observe, $v_{2,t}$, $v_{2,t-1}$, and $v_{2,t-2}$, as they relate to the pricing of current and future fundamental earnings. Because investors directly observe the part of fundamental earnings $v_{1,t+1}^0$, which will be a part of period-$(t+1)$, $(t+2)$, and $(t+3)$ fundamental earnings, the endogenous coefficient in front of it simply represents the discounting investors apply to future-periods' fundamental earnings.

The change in the firm's price from right after the period-t earnings report release to right before the period-$(t+1)$ earnings report release, $p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}}$, in the steady state has three elements. First, it captures the new investors' fundamental information, $v_{1,t+1}^1$, learned during the year, affecting period-$(t+1)$, $(t+2)$, and $(t+3)$ fundamental earnings and discounted accordingly. Second, it captures the passage of time and the fact that the expectation of period-t fundamental earnings and information used to form it are no longer relevant. Third, also because of the passage of time, the expectation of period-$(t+1)$ expected fundamental earnings is no longer discounted, and the expectations of period-$(t+2)$ and $(t+3)$ fundamental earnings are discounted less heavily.

The final model outcome I introduce is the investors' expectation of the upcoming earnings report. Combining these expectations with changes in firms' prices allows me to identify investors' information about managers' misreporting incentives. I use both levels and changes of these investors' expectations. Unlike prices, which are assumed to only impound information about fundamental earnings, expectations of the upcoming earnings report utilize both information about fundamental earnings and about the manager's stock-price-based misreporting incentives, because these incentives affect the bias in the earnings report. Hence, these constructs are needed to tease out the variation in reported earnings attributable to the uncertain management incentives, as well as the information investors have about those incentives.

[7] See Appendix 7.1 for the system of equations from which α_0 is derived.

Similarly to prices, I consider the market's expectations at two times. For an upcoming period-$(t+1)$ earnings report, I take the expectation of this report right after the period-t earnings report is released, $ME_t^{\text{post-report}} \equiv E\left[\tilde{e}_{t+1}|I_t^{\text{market}}\right]$, and right before the period-$(t+1)$ earnings report is released, $ME_{t+1}^{\text{pre-report}} \equiv E\left[\tilde{e}_{t+1}|I_{t+1}^{\text{market}} \setminus \{e_{t+1}\}\right]$. The expectation $ME_t^{\text{post-report}}$ includes all investors' information after the period-(t) earnings report release, which includes the report e_t and the information about the relevant period-$(t+1)$ report, $v_{1,t+1}^0$ and $\xi_{1,t+1}^0$. The expectation $ME_{t+1}^{\text{pre-report}}$ in addition includes the information $v_{1,t+1}^1$ and $\xi_{1,t+1}^1$ which investors obtained during the year between period-t and period-$(t+1)$ reports. Analyzing the change from $ME_t^{\text{post-report}}$ to $ME_{t+1}^{\text{pre-report}}$ thus helps me identify this new information investors learn during the year.

In the steady state linear equilibrium, the investors' expectation of the upcoming period-$(t+1)$ reported earnings, $\tilde{e}_{t+1}$, after issuance of the period t earnings report, e_t, is

$$\begin{aligned} ME_t^{\text{post-report}} = {} & v_{1,t+1}^0 + v_{1,t} + v_{1,t-1} \\ & + \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right) \xi_{1,t+1}^0 - \alpha_0 \xi_{1,t-2} - \delta_M \alpha_1 \xi_{1,t-1} - \delta_M^2 \alpha_2 \xi_{1,t} \\ & + \sum_{j=0}^{2} \beta_j \left(e_{t-j} - E[\tilde{e}_{t-j} \mid I_{t-j}^{\text{market}} \setminus \{e_{t-j}\}] \right). \end{aligned} \tag{5}$$

Note that the market's expectation of the report is the sum of the market's expectation of fundamental earnings plus the market's expectation of the bias the manager adds when issuing the report. Per (3), the bias is a linear function of the manager's misreporting incentives in multiple periods. Investors know some of this information directly from their sources: the fundamental information about period-$(t+1)$ report they have is $v_{1,t+1}^0 + v_{1,t} + v_{1,t-1}$, and the incentives information they have helps them predict a part of the bias – $\left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right) \xi_{1,t+1}^0 - \alpha_0 \xi_{1,t-2} - \delta_M \alpha_1 \xi_{1,t-1} - \delta_M^2 \alpha_2 \xi_{1,t}$. Other information investors do not observe directly but can only use the manager's earnings reports to learn about it. Because the period-$(t+1)$ earnings reports depends on fundamental earnings innovations up to period $t-1$ and on incentives innovations up to period $t-2$, investors use earnings reports up to period $t-2$ to form their expectations of the period-$(t+1)$ earnings report. The coefficients β_0, β_1, and β_2[8] capture the amount of information in period-t, $(t-1)$, and $(t-2)$ reports, respectively, useful for learning about the period-$(t+1)$ report.

[8]The analytical expressions for the coefficients are: $\beta_0 = \frac{(1-q_v)\sigma_v^2 + \sigma_{rf1}^2 - \delta_M^2 \alpha_2 \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right)(1-q_\xi)\sigma_\xi^2 - \delta_M \alpha_1 \left(-\delta_M^2 \alpha_2\right)\sigma_{ri1}^2 - \alpha_0(-\delta_M \alpha_1)\sigma_{ri2}^2}{(1-q_v)\sigma_v^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + (1-q_\xi)\sigma_\xi^2(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2)^2 + \sigma_{ri1}^2 \delta_M^4 \alpha_2^2 + \sigma_{ri2}^2 \delta_M^2 \alpha_1^2 + \sigma_{ri3}^2 \alpha_0^2}$, $\beta_1 = \frac{(1-q_v)\sigma_v^2 - \delta_M \alpha_1 \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right)(1-q_\xi)\sigma_\xi^2 - \alpha_0(-\delta_M^2 \alpha_2)\sigma_{ri1}^2}{(1-q_v)\sigma_v^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + (1-q_\xi)\sigma_\xi^2(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2)^2 + \sigma_{ri1}^2 \delta_M^4 \alpha_2^2 + \sigma_{ri2}^2 \delta_M^2 \alpha_1^2 + \sigma_{ri3}^2 \alpha_0^2}$, and $\beta_2 = \frac{-\alpha_0 \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right)(1-q_\xi)\sigma_\xi^2}{(1-q_v)\sigma_v^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + (1-q_\xi)\sigma_\xi^2(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2)^2 + \sigma_{ri1}^2 \delta_M^4 \alpha_2^2 + \sigma_{ri2}^2 \delta_M^2 \alpha_1^2 + \sigma_{ri3}^2 \alpha_0^2}$, where σ_{rf1}^2, σ_{rf2}^2, σ_{ri1}^2, σ_{ri2}^2, and σ_{ri3}^2 are endogenously derived in the system of equations with α_0, α_1, and α_2. See Appendix 7.1 for derivation.

The change in the investors' expectation of the upcoming earnings report e_{t+1}, $ME_{t+1}^{\text{pre-report}}$, during the period is:

$$ME_{t+1}^{\text{pre-report}} - ME_t^{\text{post-report}} = \nu_{1,t+1}^1 + \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right) \xi_{1,t+1}^1. \tag{6}$$

The change in the market's expectation of the upcoming report e_{t+1} during the year between the reports e_t and e_{t+1} simply captures investors learning new information from their sources about firm fundamentals, $\nu_{1,t+1}^1$, and about the manager's incentives, which affect the bias in the upcoming report, $\left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right)$ $\xi_{1,t+1}^1$.

Some of the data for estimation can be mapped closely into the model in that prices and reported earnings metrics are readily available. The data for investor expectations of reported earnings is less direct and I rely on analyst forecasts as a proxy for that construct. Hence, I assume that the goal of financial analysts is to correctly forecast the earnings report as opposed to some other earnings construct like fundamental earnings, which is consistent with evidence in antecedent literature (Mikhail et al. (1999), Hilary and Hsu (2013)). In Section 3.2.2, however, I relax this assumption and allow analysts to forecast a linear combination of reported earnings and fundamental earnings. As long as analyst forecasts contain some information about investors' expectations of earnings reports, the key findings of the paper remain similar.

1.3 Theoretical moments and identification

I need to identify six model parameters: overall variance in fundamental earnings and misreporting incentives, σ_ν^2 and σ_ξ^2, the parts of the information about fundamental earnings and misreporting incentives that investors know, q_ν and q_ξ, and the parts of these parts that investors learn from sources concurrent with earnings reports, q_ν^0 and q_ξ^0. I use seven theoretical moments. The first moment is the earnings response coefficient (ERC). The second is the variance in earnings reports. Other moments are covariances of earnings reports, investors' expectations of earnings reports, and firms' stock prices. I list all the moments with their mathematical expressions in Appendix 7.4.

The identification relies on the following intuition. I need to disentangle, first, the manager's information from the investors' information, which is a subset of the manager's; second, fundamental information from incentives information; and, third, for the investors' information on fundamentals and misreporting incentives, information learned on announcement days of the earnings reports from information learned on other days. For the first part, for the manager's information, I use the variance in earnings reports (moment 2) since they are affected by all of the manager's information. In addition, I use the ERC (moment 1) because it represents the amount of information in the manager's report that was unavailable to investors prior to the earnings announcement: if the report contains more new information, investors will react more to it. For the investors' information – the part of the manager's information known by investors from sources other than earnings reports – I use changes in stock prices and investors' expectations of earnings reports (represented by analysts' forecasts) unexplained by earnings reports (moments 3-7). If stock prices and analysts' forecasts change more after controlling for the content of earnings reports, the investors learn more information from sources other than earnings reports.

For the second part, to distinguish the investors' information on fundamentals from the investors' information on misreporting incentives information, I rely on two assumptions. First, as discussed above, I assume that changes in the firm's stock price represent only changes in investors' information on fundamentals and not on misreporting incentives. Therefore, changes in firms' stock prices unexplained by the content of earnings reports (moments 3-6) represent the amount of information on the fundamentals known by investors. The second assumption is that, when financial analysts try to predict the next earnings report, they forecast the report, i.e., the sum of fundamental earnings and the bias.[9] Since the bias is a function of the manager's misreporting incentives, analysts' forecasts represent a combination of the investors' knowledge of fundamental earnings and the manager's misreporting incentives. Changes in analysts' forecasts unexplained by earnings reports (moments 5-7), coupled with the amount of the investors' information on fundamentals obtained from stock prices, helps identify the investors' information about misreporting incentives. For example, if analysts' forecasts change considerably during a year but stock prices do not, investors likely learned a lot of information about misreporting incentives but not about fundamentals.

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

[9]This assumption is consistent with the evidence that analysts try to forecast reported earnings as closely as possible because of their compensation structures and career advancement determinants (Mikhail et al. (1999), Hilary and Hsu (2013)). In Section 3.2.2, I relax this assumption and show that main estimates do not change substantially.

Finally, I discuss why I cannot use the variance in stock prices in the estimation. The model assumes that firms' stock prices are efficient and there is no volatility in returns due to factors not explained by the information about fundamentals.[10] Because stock price volatility may exceed fundamental volatility (LeRoy and Porter (1981), Shiller (1980)), one might worry that estimates of my model overstate the fundamental variance. To avoid this issue, I do not use variances of stock prices as moments in the estimation. I only use covariances of changes in stock prices with earnings reports and analysts' forecasts. To the extent that additional noise in stock prices (such as discount rate variation) is uncorrelated with earnings reports or analysts' forecasts, potential noise in stock prices does not affect parameter estimates.

2 Data and estimation procedure

2.1 Data

I obtain data on annual earnings reports and analysts' forecasts from IBES, balance sheet variables from Compustat, and firms' stock prices from CRSP. For the pre-report stock prices, I take firms' market values one day before earnings announcement dates; for the post-report stock prices, I take firms' market values one day after earnings announcement dates. For investors' expectations of earnings reports, I take analysts' earnings forecasts from IBES. For the pre-report investors' expectations, I take the last forecast of analysts before an earnings announcement; for the post-report investors' expectations, I take the first forecast after an earnings announcement. I multiply the variables from IBES by the number of common shares outstanding on the corresponding date to obtain all the variables at the firm level. All variables are divided by firms' three-year lagged book values to ensure that their size does not mechanically drive their earnings volatility. Throughout the paper, the term "lagged book value" implies three-year-lagged book value.

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

The final sample contains 2,722 public US firms from 1996 to 2017, 13,123 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 28% of the sample comprises manufacturing,

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

followed by finance and insurance companies. Firms' characteristics are presented in Table 3. A median firm has a book value of about $571 million, a market-to-book ratio of 1.60, and a leverage ratio of 0.34.

[Insert Table 1 around here]

[Insert Table 2 around here]

[Insert Table 3 around here]

The summary statistics for the variables used in the estimation are in Table 4. Earnings surprises and changes in stock prices around earnings announcements and throughout the year are on average positive. Analysts' forecasts generally go down throughout the year, consistent with analyst forecast walk-downs (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 earnings announcement date approaches. This bias can be attributed to analysts' excessive optimism, desire to curry favor with firms' managers, or forecasting difficulty.

The standard deviation in the changes of stock price throughout the year is about 5.2 (5.6) times greater than the standard deviation in earnings reports (analysts' forecasts), which is consistent with the return volatility puzzle (Mehra and Prescott (1985)). As discussed above, my model may omit multiple factors affecting price volatility, and therefore I do not use variance of stock price changes in estimation.

[Insert Table 4 around here]

2.2 Estimation Procedure

I use the generalized method of moments (GMM) for the estimation (Hansen (1982)). This method identifies the values of the 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 in earnings reports as a function of the theoretical parameters) and empirical moments (e.g., variance in 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 Appendix 7.5.

For the discount factor of investors, I set $\delta_I = 0.95$, which implies the discount rate of about 5%, which is close to the discount rates assumed in the 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)).

3 Estimation results

3.1 Results of estimating the main model

Table 5 presents the estimated parameters of the baseline model presented in Section 1. The estimates show that, while firms' fundamental earnings are volatile, investors anticipate a high portion of the fundamental earnings before the earnings report is released. For a typical firm, the standard deviation in fundamental earnings equals about 23.6% of the firm's lagged book value. Investors appear to know about 92.6% of the information about fundamental earnings from sources other than the manager's earnings reports. Investors learn about 14.8% of these 92.6% around one year before the relevant earnings report from sources concurrent with the preceding earnings report.

Managers' misreporting incentives are also volatile and substantially more opaque to investors. The standard deviation of by how many dollars the manager's utility increases per $1000 increase in the firm's market value is $41. Investors appear to have little information about managers' incentives: only about 42.8% of what managers know. About a quarter (25.4%) of this information is learned concurrently with the preceding earnings report.

[Insert Table 5 around here]

Table 6 shows the values of the empirical and theoretical moments of the estimated parameters and t-values of differences between the theoretical and empirical moments. All seven theoretical moments are statistically indistinguishable from their empirical counterparts. The model matches particularly well the earnings response coefficient and the variance of earnings reports. For moments involving covariances, the model matches very closely all covariances involving investors' expectations or changes in prices around earnings reports releases, and the covariance of changes in investors' expectations and prices during the year.

Two moments that are matched less precisely are (1) covariance of price changes during the year with upcoming earnings reports and (2) covariance of investors' expectations of the current earnings report with the earnings report in three years. For (1), the covariance between price changes and upcoming earnings is larger in the data than in the model, suggesting that the model may omit components of earnings other than fundamentals that drive the relationship between prices and reported earnings. One such factor might be firms' non-financial performance that is valued by some investors yet is outside of my model. For (2), the model suggests that the expected current report and future report should be negatively correlated. In my dataset, however, they have a small positive correlation. The negative correlation in the model occurs because the manager optimally undoes part of their current earnings bias in future periods. The reason for the discrepancy between the model and the data may be that the bias in reality gets undone more gradually than in the model. In the model, an innovation to misreporting incentives persists only for three periods, while in the data it may persist longer. As a result, after the three periods in the model the manager cares about three-periods-ago incentives only to the extent they make current earnings management costlier, while in the data, the three-periods-ago incentives may still also affect the manager's benefit from earnings management.

[Insert Table 6 around here]

3.2 Results of estimating extensions of the main model

The main model I estimate is a dynamic version of the classic Fischer and Verrecchia (2000) and Fischer and Stocken (2004) models which make some assumptions about how capital market participants behave. In the data, however, the assumptions of the theoretical modeling may not always hold. To assess how relaxing some key assumptions changes the model estimates and inferences from the model, next, I estimate alternative versions of the main model where some assumptions are relaxed.

3.2.1 Other sources of noise in reported earnings

Earnings reports may contain noise from investors' perspectives due to various factors, such as inherent limitations of the accounting system. In the main model, I consider only one source of reporting noise: the manager's stock-price-based incentives. If other reasons for earnings noise are significant, my approach may mistakenly attribute all other accounting distortions solely to the manager's stock-price-based misreporting incentives.

In this subsection, I aim to understand whether the estimates of my model are sensitive to the assumption about sources of reporting noise, and also to estimate what proportion of the reporting noise is attributed to stock price-driven earnings management versus idiosyncratic circumstances affecting the manager's report. I modify the main model and assume that, after the manager chooses their report, it is delivered to investors with an additional random noise term: $e_t + \tilde{\eta}_t$, $\tilde{\eta}_t \sim N(0, \sigma_\eta^2)$, with $\tilde{\eta}_t$ independent over time and unknown to investors, in the spirit of Dye and Sridhar (2008). The parameter $\tilde{\eta}_t$ may capture any other factors that bias the earnings report, such as inherent limitations of the accounting system or idiosyncratic circumstances affecting the manager's reporting incentives.

I estimate the modified model, including the parameter capturing the magnitude of idiosyncratic circumstances – σ_η^2. I explain how the moments change in Appendix 7.7.

The estimated parameters are in Table 7. The estimated standard deviation of idiosyncratic circumstances affecting the manager's report, $\sqrt{\sigma_\eta^2}$, is of economically significant magnitude, indicating that reporting noise due to non-stock-price-related factors is substantial. The estimated standard deviation in the manager's stock-price-driven incentives is smaller than in the baseline model, which is consistent with the baseline approach misattributing some reporting noise to managers' stock-price-driven misreporting incentives. The estimates of the key parameters change a little: investors appear to know about 80.4% and 37.1% of the manager's information on fundamentals and misreporting incentives, respectively.

[Insert Table 7 around here]

3.2.2 Analyst forecasts

One of the key assumptions underlying the identification strategy is that when financial analysts forecast firms' earnings reports, they aim to accurately forecast the report, not fundamental earnings. While this assumption is consistent with analysts' compensation practices (Mikhail et al. (1999), Hilary and Hsu (2013)), at least some analysts may aim to forecast fundamental earnings, for example, because their forecasts inform trading recommendations.

To examine the sensitivity of my results to the assumption about what analysts forecast, I allow analyst forecasts to be a linear combination of the expected earnings report and the expected fundamental earnings. I re-define the investors' expectation in the model as

$$ME_\tau = \mu E\left[\tilde{e}_t | I_\tau^{\text{market}}\right] + (1-\mu) E\left[\tilde{\varepsilon}_t | I_\tau^{\text{market}}\right],$$

where the parameter μ captures either the weight a given analyst forecast puts on the earnings report or the proportion of analysts in the population who aim to forecast the earnings report. The only moment that changes as a result is moment 7, in which the theoretical part is multiplied by μ.

The estimation results for models with $\mu = 0.8$ and $\mu = 0.5$ are presented in Table 8. The estimated parameters are close to the estimates of the main model. The main conclusion that investors know a lot about firms' fundamentals (between 87.4 and 91.2%) and little about managers' misreporting incentives (between 32.6% and 43.5%) remains. Therefore, my assumption about what analysts aim to forecast is not a cornerstone for the results. As long as some analysts in reality aim to forecast reported earnings, my approach can use analyst forecasts to identify the amount of the market's information about misreporting incentives.

[Insert Table 8 around here]

3.2.3 Correlation between investors' information about firms' fundamentals and about managers' misreporting incentives

Another assumption I make in the model is that investors' information about firm fundamentals and the manager's misreporting incentives are not explicitly correlated. An implicit correlation between them is present in the model in the sense that if the firm's fundamental earnings are higher, the manager needs to overstate the earnings report by a smaller amount to achieve the same level of the stock price. However, there is no explicit correlation between investors' information about fundamental earnings ($\varepsilon_{1,t}$) and about the extent to which the manager cares about the stock price ($m_{1,t}$). One example of such correlation is information about the manager's compensation structure. If the way the manager is compensated affects firm fundamentals (through, perhaps, the manager's choice of productive effort) and the manager's misreporting incentives in the same way, the information investors receive from the compensation reports would be useful in assessing both the firm's fundamentals and the manager's misreporting incentives.

In this subsection, I assess the importance of this assumption for the main results. I modify the main model by adding the possibility that investors' information about the firm's fundamentals and about the manager's misreporting incentives are correlated. Specifically, I further separate investors' information on fundamentals and misreporting incentives learned during the year into two components: the independent component (related only to fundamentals or only to misreporting incentives) and the correlated component (related to both). Formally, I assume:

$$\nu_{1,t}^1 = \nu_{1,t,I}^1 + \phi_t, \quad \nu_{1,t,I}^1 \sim N\left(0, q_\nu(1-q_\nu^0)(1-q_\phi^\nu)\sigma_\nu^2\right), \phi_t \sim N\left(0, q_\nu(1-q_\nu^0)q_\phi^\nu\sigma_\nu^2\right);$$
$$\xi_{1,t}^1 = \xi_{1,t,I}^1 + \phi_t, \quad \xi_{1,t,I}^1 \sim N\left(0, q_\xi(1-q_\xi^0)(1-q_\phi^\xi)\sigma_\xi^2\right), \phi_t \sim N\left(0, q_\xi(1-q_\xi^0)q_\phi^\xi\sigma_\xi^2\right);$$
$$\text{s.t. } q_\nu(1-q_\nu^0)q_\phi^\nu\sigma_\nu^2 = q_\xi(1-q_\xi^0)q_\phi^\xi\sigma_\xi^2,$$

where ϕ_t is the common component in the firm's fundamentals and the manager's misreporting incentives. The parameter $0 < q_\phi^\nu < 1$ captures the extent to which investors' information about fundamentals and incentives are correlated. I explain how the moments used in the estimation are modified for the new model in Appendix 7.8.

Table 9 presents the parameter estimates for the modified model. First, I find that investors' information on fundamentals and misreporting incentives are correlated to a very small extent – about 2.6%. Importantly, the low correlation does not necessarily imply that investors use completely different sources of information to learn about fundamentals and misreporting incentives, but that they may use different pieces of information from the same information source when learning the two types of information. For example, investors may use different sections of compensation reports or process the raw information using different economic models for different purposes.

Second, accounting for potential correlation in investors' information to some extent changes my conclusions about investors' uncertainty about misreporting incentives. The incentives appear less volatile than in the main model: the standard deviation of by how many dollars the manager's utility increases per $1000 increase in the firm's market value is only $18. Investors also appear to know less about incentives than in the main model: only about 30.8% of what the manager knows.

[Insert Table 9 around here]

3.3 Conclusions from the estimation results

3.3.1 The amount of investors' information

Throughout different specifications of the model, a few important conclusions emerge. First, firms' fundamental earnings are volatile. The standard deviation in fundamental earnings equals between 23.3 and 27.2% of the firm's lagged book value. For comparison, the standard deviation of reported earnings is about 24.5%

of the firm's lagged book value, and the median reported earnings is about 13.0% of the firm's lagged book value. The large variance in fundamental earnings highlights how important the acquisition of information about firms' fundamentals is for investors.

Second, even though fundamental earnings are highly uncertain, investors appear to know and anticipate a large fraction of fundamental earnings (between 80.4 and 92.6%) before the earnings report comes out. Most of the investors' information on fundamental earnings (between 79.5 and 85.2%) is learned throughout the year leading up to the earnings report, but a sizable part (between 14.8 and 20.5%) is learned concurrently with the prior-year earnings report from sources other than the report itself.

Third, consistent across different models, managers' misreporting incentives are highly volatile but not as volatile as firms' fundamentals. The standard deviation of by how many dollars the manager's utility increases per $1000 increase in the firm's market value varies between $18 and $48. Even though the incentives I estimate come not only from executive compensation but from non-monetary motives, such as career concerns or pressure to meet or beat analysts' forecasts, to put my results in perspective, I consider the findings in other studies on the sensitivity of executive pay to shareholder value (Jensen and Murphy (1990), Aggarwal and Samwick (1999), Guay (1999), Clementi and Cooley (2009)). For example, Jensen and Murphy (1990) estimate that CEOs' wealth increases by $3.25 for each $1000 increase in shareholders' wealth. I find a high variance in this sensitivity, indicating that the sensitivity of CEOs' wealth to investors' wealth varies considerably from firm to firm. Indeed, Clementi and Cooley (2009) find, for instance, that there is considerable variation in the CEOs' compensation sensitivities for firms with low versus high performance volatility.

Fourth, investors appear to know substantially less about managers' misreporting incentives than they do about firms' fundamental earnings. The estimates suggest that investors appear to know only about 30.8-42.8% of managers' misreporting incentives. Investors learn 70.7-91.0% of their information on managers' incentives throughout the year leading up to the earnings report, and the remaining 9.0-29.3% on the day of the prior-year earnings report. Investors may learn a lot about managers' misreporting incentives on the day of the prior-year earnings report because both managers and external analysts often disclose their expectations for next year's earnings, creating a target for the manager (Matsumoto (2002)), or because prior-year earnings are often used as a benchmark to beat in the following year (Burgstahler and Dichev (1997)).

3.3.2 Implications for earnings quality and price efficiency

The parameter estimates allow me to evaluate important statistics about the usefulness of earnings reports. First, I estimate the quality of reported earnings. I define earnings quality as the proportion of the variance in earnings reports driven by the variance in the firm's fundamental earnings:

$$EQ_t = \frac{Var[\varepsilon_t]}{Var[e_t]} = \frac{3\sigma_v^2}{3\sigma_v^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2\sigma_\xi^2 + \alpha_0^2\sigma_\xi^2 + \delta_M^2\alpha_1^2\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_\xi^2} \tag{7}$$

Earnings quality measures the amount of useful information – information about the firm's fundamental earnings – in earnings reports. If the manager manipulates the report more, the manipulation drives a larger proportion of the variance in the earnings report (the term $\frac{\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2\sigma_\xi^2+\alpha_0^2\sigma_\xi^2+\delta_M^2\alpha_1^2\sigma_\xi^2+\delta_M^4\alpha_2^2\sigma_\xi^2}{3\sigma_v^2+\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2\sigma_\xi^2+\alpha_0^2\sigma_\xi^2+\delta_M^2\alpha_1^2\sigma_\xi^2+\delta_M^4\alpha_2^2\sigma_\xi^2}$ increases) and the firm's fundamentals drive a smaller proportion of the variance in the earnings report (the term $\frac{3\sigma_v^2}{3\sigma_v^2+\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2\sigma_\xi^2+\alpha_0^2\sigma_\xi^2+\delta_M^2\alpha_1^2\sigma_\xi^2+\delta_M^4\alpha_2^2\sigma_\xi^2}$ decreases); therefore, the earnings quality is lower. This definition of earnings quality captures the representational faithfulness and neutrality of earnings reports[11] and is consistent with the view of quality taken in other studies (e.g., Fischer and Stocken (2004), Dichev et al. (2013)).

The amounts of the investors' information on fundamentals and misreporting incentives – q_v and q_ξ – affect the earnings quality through the weights in the firm's stock price on earnings reports, α_0, α_1, and α_2. Figures 5 and 6 plot, for arbitrary parameter values, earnings quality as a function of the amounts of information that investors have on fundamentals and misreporting incentives. Price responses to earnings report decrease (increase) with the amount of investors' fundamental (misreporting incentives) information, decreasing (increasing) the manager's reward per unit of earnings management. As a result, the manager manages earnings less (more) when investors have more information on fundamentals (misreporting incentives).

[Insert Figure 5 around here]

[Insert Figure 6 around here]

With the parameter estimates I obtain, I find that between 91.7 and 98.3% (depending on the model specification) of the variance in earnings reports is driven by the variance in fundamental earnings, and the

[11] Financial Accounting Standards Board's (FASB's) definition of representational faithfulness is "correspondence or agreement between a measure or description and the phenomenon it purports to represent" and of neutrality as the situation when "there is no bias in the selection of what is reported" (Financial Accounting Standards Board (1980)).

remaining 1.7 to 8.3% by reporting noise. Of the total reporting noise, following the model modification in the spirit of Dye and Sridhar (2008), 21.2% is attributed to the stock-price-driven earnings management by the manager and 78.8% to idiosyncratic circumstances affecting the manager's report. Other studies have quantified the average manipulation in the population of firms and find that the average level of misreporting is small (Gerakos and Kovrijnykh (2013), Zakolyukina (2018), Bertomeu et al. (2021)). My findings improve our knowledge of misreporting because, as Fischer and Verrecchia (2000) note, bias in earnings reports may not always properly capture the information content of earnings reports. My measure of earnings quality measures the information content of the report directly. In addition, my study is the first to include both stock price-driven earnings management and exogenous accounting noise as determinants of reporting noise in one setup. I can evaluate the proportion of reporting noise coming from stock-price-driven incentives versus from idiosyncratic circumstances affecting the manager's report.

Second, I evaluate the extent to which the magnitude of misreporting varies across firms. I define this magnitude of variation as $\sqrt{Var[e_t - \varepsilon_t]} = \sqrt{(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2)^2 \sigma_\xi^2 + \alpha_0^2 \sigma_\xi^2 + \delta_M^2 \alpha_1^2 \sigma_\xi^2 + \delta_M^4 \alpha_2^2 \sigma_\xi^2}$, or the standard deviation of the difference between the firm's fundamental and reported earnings. This standard deviation appears large – between 3.6 and 6.9% of book value. This high estimated variation of misreporting across firms adds a nuance to the existing evidence: while an average magnitude of earnings manipulation may be small, some firms might manipulate a little and others might manipulate a lot. Similarly to my study, Cheynel et al. (2024) find that, for extreme cases of fraud, misstatement magnitudes in principle can be infinite. The variation in misreporting across firms may be driven by the "slippery slope" of misreporting – a situation when a manager that does misreport enforces themselves to keep misreporting (Schrand and Zechman (2012), Soltes (2016), Chu et al. (2019)) while some managers never misreport, – variation in auditor leniency (Corona and Randhawa (2010)), or firms' managers' cultural norms (Srinivasan et al. (2015)).

Third, I estimate stock price efficiency. I define stock price efficiency as the proportion of the variance in the firm's stock price[12] that is driven by the variance in fundamentals, or by the variance of the firm's stock price if there was no information asymmetry between the firm's manager and investors.

[12]Importantly, my study does not attempt to explain stock price volatility ($Var[p_t]$) in general. Instead, I aim to measure the mispricing implications of earnings management and use overall stock price volatility only as a numerator to provide a sense of the magnitudes of earnings management-driven mispricing and to compare degrees of mispricing in various hypothetical scenarios.

$$PE_t = \frac{Var[\text{True Expected Value}_t]}{Var[p_t]} = \frac{Var\left[\sum_{k=t+1}^{k=\infty} \delta_I^{k-t} \tilde{\varepsilon}_k | I_t^{\text{manager}}\right]}{Var\left[\sum_{k=t+1}^{k=\infty} \delta_I^{k-t} \tilde{\varepsilon}_k | I_t^{\text{market}}\right]}$$

$$= \frac{Var[p_t] - (1-q_\nu)\sigma_\nu^2 \left(\left(\delta_I + \delta_I^2\right)^2 + \delta_I^2\right) - (1-q_\xi)\sigma_\xi^2 \left(\left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right)^2 + \left(\alpha_0 + \delta_M \alpha_1\right)^2 + \alpha_0^2\right)}{Var[p_t]} \quad (8)$$

The measure of stock price efficiency captures the amount of information asymmetry between investors and the manager about the firm's fundamental value. If investors knew the same fundamental information as the manager ($q_\nu = 1$) and all of the manager's misreporting incentives ($q_\xi = 1$), the efficiency of the stock price would be at its highest level. Such definition is consistent with the definition of market efficiency proposed by Beaver (1981): "Market efficiency is defined ... in terms of the equality of security prices under two information configurations (i.e., with and without universal access to the information system of interest)."

In Figures 7 and 8, I plot, for arbitrary parameter values, stock price efficiency as a function of investors' information on fundamentals (q_ν) and misreporting incentives (q_ξ). In contrast to earnings quality, stock price efficiency increases with both types of information: the more investors know, the more efficient the stock price. The conclusion that investors' information about misreporting incentives affects the earnings quality and stock price efficiency in opposite directions reflects the trade-off faced by regulators. For example, a policy that requires greater disclosure of executive compensation will benefit investors because firms' stocks will be traded closer to their fundamental values. At the same time, external users of financial information will bear costs because the information in earnings reports will be noisier. The regulators' ultimate decision would be determined by the extent to which they prioritize traders facing a fair stock price over the precision of reported earnings.

[Insert Figure 7 around here]

[Insert Figure 8 around here]

The estimates of the model suggest that on average, between 0.021 and 0.038% of price volatility comes from mispricing due to information asymmetry between investors and the manager regarding firm fundamentals and the manager's incentives. This volatility would have been eliminated if investors knew all of the managers' information about firms' fundamentals and managers' misreporting incentives.

Finally, I quantify cross-sectional variation in mispricing. I measure this variation as the standard deviation of the difference between a firm's price with and without information asymmetry: $\sqrt{Var[p_t - \text{True Expected Value}_t]} = \sqrt{E\left[\left(E\left[\sum_{k=t+1}^{k=\infty} \delta_I^{k-t}\tilde{\varepsilon}_k | I_t^{\text{market}}\right] - E\left[+\sum_{k=t+1}^{k=\infty} \delta_I^{k-t}\tilde{\varepsilon}_k | I_t^{\text{manager}}\right]\right)\right]^2} = \sqrt{(1-q_v)\sigma_v^2\left(\left(\delta_I + \delta_I^2\right)^2 + \delta_I^2\right) + (1-q_\xi)\sigma_\xi^2\left(\left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2 + (\alpha_0 + \delta_M\alpha_1)^2 + \alpha_0^2\right)}$. Similar to the variation in misreporting, mispricing due to information asymmetry varies substantially across firms: the standard deviation in the difference between the actual price on the market and the fair price in the absence of information asymmetry is 9.5 to 13.2% of a firm's book value. The large variance in mispricing adds to the literature that finds that the average mispricing is 2.02% (Zakolyukina (2018)) or 0.2% of lagged total assets (Bertomeu et al. (2019)).

4 Counterfactual analyses

In this section, I use my structural model to assess how different hypothetical changes to the economic environment may affect earnings quality and stock price efficiency. Because conclusions from estimates are similar across different models, I use the main model for the counterfactual analyses. First, I study how earnings quality and stock price efficiency respond to small changes in investors' information about the firm's fundamentals and managers' misreporting incentives. Next, I consider large changes to the information environment. Finally, I study how managers' and investors' discount rates affect earnings quality and stock price efficiency.

4.1 Small changes in investors' information

To study the marginal effects of the model's parameters on earnings quality and stock price efficiency, for every model parameter, I change the estimated value by 1% up and down while keeping other parameters fixed. I then examine the resulting changes in earnings quality and stock price efficiency.

Histograms of the effects on earnings quality and stock price efficiency are presented in Figures 9 and 10. The analyses show that the factor with the largest marginal effect is the amount of information on fundamentals known by investors. Both earnings quality and stock price efficiency are the most sensitive to investors' information on fundamentals, and this sensitivity is more than ten times larger than sensitivities to other economic parameters. An event that reduces the investors' information about fundamentals by about 1% will cause about a $2.06 \times 10^{-3}\%$ drop in stock price efficiency and about a 0.28% drop in earnings quality.

The fourth bar in the histograms shows the non-trivial consequences of increasing investors' information on misreporting incentives. When investors have more information about managers' incentives, stock price efficiency improves while earnings quality deteriorates. The magnitudes indicate a meaningful trade-off regulators may face when deciding whether to increase the amount of misreporting incentives information provided to investors.

Earnings quality and stock price efficiency co-move when the uncertainty about misreporting incentives changes but move in opposite directions when the uncertainty about fundamentals changes. A firm's price is closer to its value under full information when investors are more informed about fundamentals or misreporting incentives. This mechanism does not work for earnings quality. When investors are more uncertain about misreporting incentives, the amount of noise in earnings reports increases, making them less informative. In contrast, higher uncertainty about fundamentals increases the signal-to-noise ratio in earnings, making them more informative.

[Insert Figures 9 and 10 around here.]

4.2 Large changes in investors' information

Next, I consider large changes in the information environment. First, I examine scenarios where the fundamentals are considerably more volatile than misreporting incentives and vice versa. Second, I study scenarios where investors' information on fundamentals is close to perfect and where their information about misreporting incentives is close to perfect.

4.2.1 Uncertainty about fundamentals and misreporting incentives

The first set of counterfactual analyses considers financial markets where only one type of uncertainty is a primary concern: uncertainty about fundamentals or about misreporting incentives. In scenario 1 in Table 10, I set the variance of misreporting incentives close to zero. Earnings quality in this scenario is almost perfect: almost 100% of the variation in earnings reports is due to variation in fundamentals; in other words, the report perfectly informs its users about the firm's fundamental earnings. This result is intuitive: if the manager's misreporting incentives do not vary, their manipulation of the report is a constant, and investors can interpret any change in the report as driven by a change in firm fundamentals. Price efficiency also substantially improves in this scenario.

In scenario 2 in Table 10, I reduce uncertainty about fundamentals to almost zero. When firms' fundamentals are perfectly stable, the quality of earnings is zero. Any variation in the report is due to variation in the manager's misreporting incentives and thus in the reporting noise, rendering the report useless for understanding the firm's earnings. Price efficiency, however, is high: the fraction of price volatility coming from mispricing due to information asymmetry between investors and the manager is only about 0.001%.

4.2.2 Perfect knowledge of fundamentals and misreporting incentives

Next, I consider scenarios where investors know close to all information about firms' fundamentals (scenario 3 in Table 10) and managers' incentives to misreport (scenario 4 in Table 10). If a social planner were to choose between giving investors more information on fundamentals or misreporting incentives, they would face a trade-off. Increasing information on fundamentals makes earnings numbers a more precise measure of fundamental earnings while providing more information about incentives substantially improves stock price efficiency yet reduces earnings quality.

Counterfactual analyses demonstrate how nuanced the regulators' problem is when designing information provision systems. When investors have perfect knowledge of firms' fundamentals, earnings quality is very high – about 99.45% and when investors have perfect knowledge of managers' incentives, earnings quality is substantially lower – 91.15%. At the same time, stock prices are substantially more efficient when investors have perfect knowledge of either managers' incentives (stock price inefficiency is 0.014%) or of fundamentals (price inefficiency is 0.001%).

4.3 Manager's and investors' discount rates

Next, I study how changes in managers' and investors' horizons affect earnings quality and stock price efficiency in the economy. In the baseline specification, I set the manager's discount factor at $\delta_M = 0.7$ and the investors' discount factor at $\delta_I = 0.95$. In Table 10, I consider three counterfactual scenarios for discount factors: investors and the manager have the same discount factor (scenario 5), investors' discount factor is smaller than the manager's and both factors are low (scenario 6), and investors' discount factor is smaller than the manager's and both factors are high (scenario 7).

[Insert Table 10 around here.]

Keeping the manager's discount factor constant, lowering the discount factor of investors improves earnings quality and stock price efficiency, although at a moderate rate (scenarios 5 and 6). A large drop in investors' discount factor – from 0.95 to 0.7 (0.5) – only improves earnings quality by 1.0 (1.8)%. Stock price efficiency is more sensitive to investors' discounting: a drop in the discount factor to 0.7 (0.5) means about a 42.9 (66.7)% improvement in price efficiency.

An increase in the manager's discount factor from the baseline of 0.7 to the counterfactual of 0.99 leads to a decrease in earnings quality and does not change stock price efficiency substantially (scenario 7). Earnings quality is more sensitive to the manager's discount factor than to investors', while stock price efficiency is less sensitive: an increase in the manager's discount factor from 0.7 to 0.99 leads to about a 1.2% decrease in earnings quality yet barely decreases stock price efficiency.

5 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 provide the magnitudes of the effects that policies have. Without magnitudes, it is difficult for policymakers to weigh the benefits against the costs of regulations. Moreover, even if standard empirical methods do 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 that financial market characteristics regulators care about – stock price efficiency and earnings quality – hinge on the nature of stock market investors' information. Because different objectives can be at odds with some information-related regulations, it is important to be able to disentangle the two types of information and their effects. Structural estimation can achieve this by directly evaluating multiple economic parameters and how they change after regulations or vary with firms' characteristics. In this section, I demonstrate how structural estimation 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. Like for counterfactual analyses, I use the main specification of the model.

5.1 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)), the reduced-form empirical evidence confirmed that the introduction of the Compensation Discussion and Analysis (CD&A) section increased the ERC (Ferri et al. (2018)) and might have increased earnings management.

It remains less clear, however, which forces drove the change in the ERC. On the one hand, since 2007 the CD&A could have provided investors with more information on managerial incentives, increasing the ERC. At the same time, the financial crisis in the post period may have made 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 of the two forces, I structurally estimate my model on the pre- and post-CD&A subsamples.

The revisions of the proxy statement guidelines 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 regulation. The before period is the fiscal year-end before the SEC proposal date, January 26, 2006, and the after period is the fiscal year-end after December 15, 2006. The results, presented in Table 11, show that both mechanisms drove an increase in the ERC. First, the introduction of CD&A appears to have achieved its main goal: the fraction of information on misreporting incentives known by investors increased from 34.0% before the regulation to 90.6% after. The large magnitude of investors' information in the post period suggests the CD&A section is the key source of investors' information on misreporting incentives. In addition, presumably due to the financial crisis, investors' information about firm fundamentals decreased from 89.2% to 71.1%. The findings indicate that researchers and regulators should be cautious when attributing the increase in the ERC in the post-CD&A period solely to the expanded compensation disclosures. Part of this decrease is a result of concurrent changes in another type of investors' information – about firms' fundamentals.

The combination of more information on misreporting incentives and less on fundamentals substantially reduced earnings quality: in the pre-CD&A period, about 92.2% of the variation in earnings reports was driven by variance in fundamentals. In the post-CD&A period, this number falls as low as 66.9%. For stock price efficiency, the decrease in investors' information on fundamentals outweighs the increase in misreporting incentives information, and stock price efficiency also declined in the post-CD&A period.

[Insert Table 11 around here.]

5.2 Information spillovers and investors' information

Empirical studies have widely documented information spillovers from firms 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 early announcers' reports. Savor and Wilson (2016) find higher abnormal returns for early announcers. The authors posit that because investors use announcers' disclosures to revise their beliefs about non-announcers, the covariance between early announcers' and market-wide cash flow news – early announcers' systemic risk – increases. Following that logic, late reporters should obtain lower market reactions on their reporting days because investors have more information about their fundamentals from earlier announcers' reports. However, the market's weaker reaction to later reports can also be due to investors believing that firms reporting late are more likely to manage earnings (Trueman (1990)). To disentangle the two explanations, I estimate the structural model separately for firms that report early and late in the earnings reporting cycle.

I split my sample into early and late reporters. A firm is classified as a late reporter if it announces its earnings later than the median firm in a given year and as an early reporter if it announces earnings earlier than the median firm in a given year. Table 12 presents the estimation results.

[Insert Table 12 around here.]

The estimated parameters for early and late reporters indicate a small spillover of fundamental information: investors know about 88.0% of early reporters' information and about 90.1% of late reporters' information on fundamentals.

Trueman (1990) offers a theory that connects firms' earnings management to their choice of disclosure timing. First, earnings management itself may result in delayed reporting, and, second, a manager who wants to manage earnings may choose to observe other reports first to better understand what the investors' expectations are for the earnings of their firm. Empirically, whether late firms have incentives to misreport may be unclear to investors, and this uncertainty might even outweigh the gain from learning more about fundamentals from other firms' early reports. Consistent with this view, I find that late reporters' misreporting incentives are about notably more uncertain than early reporters': investors know about 84.3% of early reporters' incentives and only about 46.7% of late reporters' incentives.

6 Conclusion and future research paths

In this study, I develop a structural estimation technique to measure how much information investors know about firm fundamentals and managers' misreporting incentives and how these types of information affect accounting quality and stock price efficiency. Measuring how much information investors know is valuable to researchers and regulators because that information has an unambiguous effect on earnings quality and stock price efficiency.

My main result is that both firms' fundamentals and managers' misreporting incentives are highly volatile and investors have a lot more information about firms' fundamentals than about managers' misreporting incentives. This knowledge leads to a meaningful amount of noise in earnings reports, however, does not generate very high price inefficiency.

I present different versions of the model: the main – the dynamic version of Fischer and Verrecchia (2000) and Fischer and Stocken (2004), and its different modifications that relax different theoretical assumptions. There are, however, other omissions of my approach.

The first omission is that the manager in the model has full information about their firm's fundamentals and their misreporting incentives. While it is reasonable that an economic agent fully understands their own incentives, managers may not always have complete knowledge of their firm's fundamental earnings. The research has shown that managers learn from stock market participants, such as investors or financial analysts (e.g., Jayaraman and Wu (2019), Bae et al. (2022)).

My model does not allow me to estimate the amount of the investors' information that the manager does not know. However, this omission does not limit the answer to my main research question of how much **of the manager's information** investors know and how this investors' information affects earnings management. The results of the model and the estimation will remain unchanged if I introduce additional information that investors know and the manager does not, as long as the manager pays a cost of biasing the earnings report away just from the fundamental earnings she observes privately.

The results can change, however, in two cases. The first case is when the manager pays the cost for biasing the report away not from her privately observed fundamental but from the overall fundamental (part of which the manager does not know about). The manager will be learning from price about the component of the fundamental she does not observe, creating a dual role for the firm's price in the model. The second case is if I introduce investment level choice by the manager. The manager will again learn from prices and also face a trade-off between accrual and real earnings management (Terry et al. (2022)). Both of these cases are outside the scope of the current paper and are a promising avenue for future research.

The second omission is that the model assumes that unmanaged earnings accurately represent the firm's economic earnings. This assumption implies that any alterations that the manager makes when they report earnings reduce the information content of the report to investors. It might be the case, however, that managers exercise their reporting discretion to make the earnings report more informative about the firm's economic value. Existing theoretical literature has not yet examined the manager's reporting decisions in such a context, so I cannot rely on prior work to modify my model to include the possibility of managers improving investors' learning instead of distorting it. Compiling such a framework is a promising objective, which is outside of the score of this paper.

The current paper's focus is on information-distorting earnings management and the effect of the investors' information on it. Unmanaged earnings in my model can be interpreted as the earnings measure that already incorporates the manager's discretionary choices aimed at improving informational content. The estimates of misreporting should then be interpreted as the bias on top of the most informative earnings figure.

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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
Removed firms with missing book value in Compustat	65,183
Removed firms with negative or zero book value	62,004
Removed firms with market-to-book ratio above 10	56,900
Removed firms with stock price less than $1	56,060
Removed firms with missing lagged and lead variables	13,123

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

NAICS	% of total sample
Agriculture, Forestry, Fishing and Hunting	0.09
Mining	2.28
Utilities	2.82
Construction	0.96
Manufacturing	28.16
Wholesale Trade	1.57
Retail Trade	4.24
Transportation and Warehousing	2.35
Information	4.05
Finance and Insurance	15.61
Real Estate Rental and Leasing	2.67
Professional, Scientific, and Technical Services	3.63
Management of Companies and Enterprises	1.91
Administrative and Support, Waste Management, and Remediation Services	1.10
Educational Services	0.40
Health Care and Social Assistance	1.01
Arts, Entertainment, and Recreation	0.70
Accommodation and Food Services	1.10
Other Services (except Public Administration)	0.30
Missing NAICS	25.03

Table 3: Descriptive statistics. All the variables are taken from or calculated from the Compustat database. The market value is the product of the firm's price multiplied by the number of shares outstanding. The book value is the product of the book value per share multiplied by the number of shares. The market-to-book ratio is market value divided by book value. ROA is net income divided by total assets. The leverage ratio is the total amount of debt divided by stockholders' equity. The number of observations for the leverage ratio is less than for other variables because not all firms in the sample have data on debt and stockholders' equity.

Statistic	N	Mean	St. Dev.	Pctl(25)	Median	Pctl(75)
Book value (in $ 100 mil)	13,123	31.076	119.787	2.185	5.714	16.065
Market value (in $ 100 mil)	13,123	53.995	197.783	3.188	9.141	27.857
Total assets (in $ 100 mil)	12,957	188.813	1,300.387	4.901	15.534	50.488
Market-to-book ratio	13,123	1.942	1.351	1.060	1.603	2.403
ROA	12,957	0.029	0.093	0.008	0.033	0.068
Leverage ratio	10,410	0.631	1.509	0.041	0.339	0.753

Table 4: Summary statistics for the variables used in estimation. All variables are winsorized at the 1% level. All variables are in fractions of the 3-year lagged book value. Reported earnings and analyst forecasts are from the IBES database. Prices are from CRSP database. The detailed description of variables is given in Appendix 7.6.

Statistic	N	Mean	St. Dev.	Pctl(25)	Median	Pctl(75)
Reported earnings, e_t	13,123	0.173	0.245	0.058	0.130	0.228
Earnings surprise, $e_t - E[\tilde{e}_t \mid I_t^{\text{market}} \setminus \{e_t\}]$	13,123	0.001	0.031	−0.003	0.001	0.007
Price change around earnings announcements, $p_t^{\text{post-report}} - p_t^{\text{pre-report}}$	13,123	0.008	0.245	−0.062	0.003	0.078
Price change during a year, $p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}}$	13,123	0.268	1.280	−0.218	0.154	0.639
First analyst forecast after an earnings announcement, FAF_t	13,123	0.184	0.228	0.070	0.136	0.231
Analyst forecast during a year, $LAF_{t+1} - FAF_t$	13,123	−0.012	0.084	−0.030	−0.002	0.016

Table 5: Estimated model parameters. Standard deviations of unmanipulated earnings and incentives are in fractions of one-year-lagged booked value. Standard errors are in parentheses. The parameters are estimated assuming discount factors $\delta_M = 0.7$ and $\delta_I = 0.95$. The estimation procedure and calculation of standard errors are described in Appendix 7.5. Earnings quality is calculated according to the formula (7); price inefficiency is calculated as one minus the expression in the formula (8).

Parameter	Estimate
Standard deviation of unmanipulated earnings, $\sqrt{3\sigma_v^2}$	0.236 (0.009)
Investors' total share of fundamental information, q_v	0.926 (0.139)
Investors' share of fundamental information received concurrently with the manager's report, q_v^0	0.148 (0.051)
Standard deviation of incentives, $\sqrt{3\sigma_\xi^2}$	0.041 (0.025)
Investors' total share of incentives information, q_ξ	0.428 (0.020)
Investors' share of incentives information received concurrently with the manager's report, q_ξ^0	0.254 (0.006)
Earnings quality, fraction of the variance in the earnings report variance driven by the variance in fundamentals, %	94.180
Price inefficiency, fraction of price volatility coming from mispricing due to information asymmetry between investors and the manager, %	0.021

Table 6: Data moments and theoretical moments at the estimated parameters. The estimated parameters are in Table 5. A detailed description of how the theoretical and empirical moments are calculated are in Appendix 7.6. Summary statistics for data used to calculate empirical moments are in Table 4. The t-statistics are for the test whether empirical values of the moments are statistically different from the theoretical values of the moments.

	Moment	Empirical value	Theoretical value	t-statistic [p-value]
1	Earnings response coefficient	0.00000	0.00000	-0.077 [0.939]
2	Variance of earnings reports	0.05980	0.05931	-0.293 [0.770]
3	Covariance of the earnings report at time $(t+1)$ with residuals of the "ERC" regression at time t	0.00742	0.00692	-0.261 [0.794]
4	Covariance of the earnings report at time $(t+1)$ with residuals from regressing price change during year $(t+1)$ on earnings surprises at time t, $t-1$, and $t-2$	0.10930	0.01033	-2.082 [0.037]
5	Covariance of residuals of the time-t "ERC" regression with residuals from regressing the investors' expectations of the earnings report at time $(t+1)$ for time t on the surprise in the earnings report surprise, the surprise in the earnings report at time $(t-1)$, and the surprise in the earnings report at time $(t-2)$	0.00500	0.00692	0.920 [0.358]
6	Covariance of the residuals from regressing price change during year $(t+1)$ on earnings surprises at time t, $(t-1)$, and $(t-2)$ with changes in the investors' expectations of time-$(t+1)$ earnings reports during year $(t+1)$	0.05904	0.04191	-0.850 [0.395]
7	Covariance of time-$(t+4)$ earnings with the change in investors' expectations of time-$(t+1)$ earnings reports during the year $(t+1)$	0.00370	-0.00049	-2.158 [0.031]

Table 7: Estimated parameters for the model with exogenous reporting noise. Standard deviations in the unmanipulated earnings and incentives are in fractions of one-year lagged booked value. The parameters are estimated assuming discount factors $\delta_M = 0.7$ and $\delta_I = 0.95$. The estimation procedure and calculation of standard errors are described in Appendix 7.5. Earnings quality is calculated according to the formula: $EQ_t = \frac{3\sigma_v^2}{3\sigma_v^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2\sigma_\xi^2 + \alpha_0^2\sigma_\xi^2 + \delta_M^2\alpha_1^2\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_\xi^2 + \sigma_\eta^2}$; the fraction of the variance in the earnings report variance driven by the variance in the manager's stock-price-driven incentives is calculated according to the formula: $\frac{\left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2\sigma_\xi^2 + \alpha_0^2\sigma_\xi^2 + \delta_M^2\alpha_1^2\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_\xi^2}{3\sigma_v^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2\sigma_\xi^2 + \alpha_0^2\sigma_\xi^2 + \delta_M^2\alpha_1^2\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_\xi^2 + \sigma_\eta^2}$; price inefficiency is calculated as one minus the expression in the formula (8).

Parameter	Estimate
Standard deviation of unmanipulated earnings, $\sqrt{3\sigma_v^2}$	0.233 (0.064)
Investors' total share of fundamental information, q_v	0.804 (0.004)
Investors' share of fundamental information received concurrently with the manager's report, q_v^0	0.173 (0.005)
Standard deviation of incentives, $\sqrt{3\sigma_\xi^2}$	0.022 (0.171)
Investors' total share of incentives information, q_ξ	0.371 (0.013)
Investors' share of incentives information received concurrently with the manager's report, q_ξ^0	0.165 (0.007)
Standard deviation of exogenous reporting noise, $\sqrt{\sigma_\eta^2}$	0.062 (0.018)
Earnings quality, fraction of the variance in the earnings report variance driven by the variance in fundamentals, %	91.721
Fraction of the variance in the earnings report variance driven by the variance in the manager's stock-price-driven incentives, %	1.752
Price inefficiency, fraction of price volatility coming from mispricing due to information asymmetry between investors and the manager, %	0.038

Table 8: Estimated model parameters for alternative assumptions about financial analysts' forecasts. The parameter μ is the weight on the earnings report, and $(1-\mu)$ is the weight on the unmanipulated earnings. Standard deviations in the unmanipulated earnings and incentives are in fractions of the one-year lagged booked value. Standard errors are in parentheses. The parameters are estimated assuming discount factors $\delta_M = 0.7$ and $\delta_I = 0.95$. The estimation procedure and calculation of standard errors are described in Appendix 7.5. Earnings quality is calculated according to the formula (7); price inefficiency is calculated as one minus the expression in the formula (8).

Parameter	$\mu = 0.8$	$\mu = 0.5$
Standard deviation of unmanipulated earnings, $\sqrt{3\sigma_v^2}$	0.233 (0.004)	0.235 (0.004)
Investors' total share of fundamental information, q_v	0.874 (0.050)	0.912 (0.006)
Investors' share of fundamental information received concurrently with the manager's report, q_v^0	0.155 (0.004)	0.152 (0.001)
Standard deviation of incentives, $\sqrt{3\sigma_\xi^2}$	0.048 (0.092)	0.045 (0.006)
Investors' total share of incentives information, q_ξ	0.326 (0.087)	0.435 (0.003)
Investors' share of incentives information received concurrently with the manager's report, q_ξ^0	0.293 (0.015)	0.235 (0.030)
Earnings quality, fraction of the variance in the earnings report variance driven by the variance in fundamentals, %	91.934	93.068
Price inefficiency, fraction of price volatility coming from mispricing due to information asymmetry between investors and the manager, %	0.034	0.024

Table 9: Estimated parameters for the model where investors' information on fundamentals and misreporting incentives is correlated. Standard deviations in the unmanipulated earnings and incentives are in fractions of one-year lagged booked value. Standard errors are in parentheses. The parameters are estimated assuming discount factors $\delta_M = 0.7$ and $\delta_I = 0.95$. The estimation procedure and calculation of standard errors are described in Appendix 7.5. Earnings quality is calculated according to the formula (7); price inefficiency is calculated as one minus the expression in the formula (8).

Parameter	Estimate
Standard deviation of true earnings, $\sqrt{3\sigma_v^2}$	0.272 (0.0001)
Investors' total share of fundamental information, q_v	0.905 (0.000)
Investors' share of fundamental information received concurrently with the manager's report, q_v^0	0.205 (0.000)
Standard deviation of incentives, $\sqrt{3\sigma_\xi^2}$	0.018 (0.001)
Investors' total share of incentives information, q_ξ	0.308 (0.000)
Investors' share of incentives information received concurrently with the manager's report, q_ξ^0	0.090 (0.000)
Fraction of the investors' share of incentives information that is also the investors' incentives information, q_ϕ^v	0.026 (0.000)
Earnings quality, fraction of the variance in the earnings report variance driven by the variance in fundamentals, %	98.285
Price inefficiency, fraction of price volatility coming from mispricing due to information asymmetry between investors and the manager, %	0.027

Table 10: Earnings quality and price efficiency in counterfactual scenarios. Earnings quality is calculated according to the formula (7); price inefficiency is calculated as one minus the expression in the formula (8). In the counterfactual scenario 1, σ_ξ^2 is set to 0.00001. In the counterfactual scenario 2, σ_v^2 is set to 0.00001. In the counterfactual scenario 3, q_v is set to 0.99999. In the counterfactual scenario 4, q_ξ is set to 0.99999.

Scenario	Earnings quality, fraction of the variance in the earnings report driven by the variance in the fundamentals, %	Price inefficiency, fraction of price volatility coming from mispricing due to information asymmetry between investors and the manager, %
0. Baseline estimates, $\delta_I = 0.95$, $\delta_M = 0.7$.	94.180	0.021
1. Uncertainty about fundamentals is much greater than that about misreporting incentives, $\sigma_\xi^2 \to 0$.	99.998	0.014
2. Uncertainty about misreporting incentives is much greater than that about fundamentals, $\sigma_v^2 \to 0$.	0.097	0.001
3. Investors perfectly know fundamentals, $q_v \to 1$.	99.446	0.001
4. Investors perfectly know misreporting incentives, $q_\xi \to 1$.	91.145	0.014
5. Investors' discount factor is the same as the manager's, $\delta_I = \delta_M = 0.7$.	95.163	0.012
6. Investors' discount factor is smaller than the manager's, and both discount factors are low, $\delta_I = 0.5$, $\delta_M = 0.7$.	95.875	0.007
7. Investors' discount factor is smaller than the manager's, and both discount factors are high, $\delta_I = 0.95$, $\delta_M = 0.99$.	93.292	0.021

Table 11: Estimated model parameters before and after the introduction of CD&A. Standard deviations of unmanipulated earnings and incentives are in fractions of the one-year lagged booked value. Standard errors are in parentheses. The "before CD&A" period is fiscal-year that ends before January 26, 2006. The "after CD&A" period is the fiscal-year that ends after December 15, 2009. The parameters are estimated assuming discount factors $\delta_M = 0.7$ and $\delta_I = 0.95$. The estimation procedure and calculation of standard errors are described in Appendix 7.5. Earnings quality is calculated according to the formula (7); price inefficiency is calculated as one minus the expression in the formula (8).

Parameter	Before CD&A	After CD&A
Standard deviation of unmanipulated earnings, $\sqrt{3\sigma_v^2}$	0.274 (0.008)	0.183 (0.032)
Investors' total share of fundamental information, q_v	0.892 (0.013)	0.711 (0.423)
Investors' share of fundamental information received concurrently with the manager's report, q_v^0	0.250 (0.060)	0.137 (0.156)
Standard deviation of incentives, $\sqrt{3\sigma_\xi^2}$	0.057 (0.001)	0.068 (0.025)
Investors' total share of incentives information, q_ξ	0.340 (0.001)	0.906 (0.090)
Investors' share of incentives information received concurrently with the manager's report, q_ξ^0	0.860 (0.000)	0.684 (0.371)
Earnings quality, fraction of the variance in the earnings report variance driven by the variance in fundamentals, %	92.220	66.856
Price inefficiency, fraction of price volatility coming from mispricing due to information asymmetry between investors and the manager, %	0.024	0.045

Table 12: Estimated model parameters for early and late earnings reporters. Standard deviations of unmanipulated earnings and misreporting incentives are in the fractions of the one-year lagged booked value. Standard errors are in parentheses. A firm is classified as a late reporter if it reports earnings later than three quarters of all other firms in a given year, and as an early reporter if it reports earnings earlier than three quarters of all other firms in a given year. The parameters are estimated assuming discount factors $\delta_M = 0.7$ and $\delta_I = 0.95$. The estimation procedure and calculation of standard errors are described in Appendix 7.5. Earnings quality is calculated according to the formula (7); price inefficiency is calculated as one minus the expression in the formula (8).

Parameter	Early reporters	Late reporters
Standard deviation of unmanipulated earnings, $\sqrt{3\sigma_v^2}$	0.216 (0.000)	0.240 (0.015)
Investors' total share of fundamental information, q_v	0.880 (0.000)	0.901 (0.004)
Investors' share of fundamental information received concurrently with the manager's report, q_v^0	0.161 (0.000)	0.076 (0.052)
Standard deviation of incentives, $\sqrt{3\sigma_\xi^2}$	0.053 (0.0001)	0.045 (0.040)
Investors' total share of incentives information, q_ξ	0.843 (0.000)	0.467 (0.001)
Investors' share of incentives information received concurrently with the manager's report, q_ξ^0	0.005 (0.000)	0.052 (0.004)
Earnings quality, fraction of the variance in the earnings report variance driven by the variance in fundamentals, %	66.856	92.797
Price inefficiency, fraction of price volatility coming from mispricing due to information asymmetry between investors and the manager, %	0.025	0.030

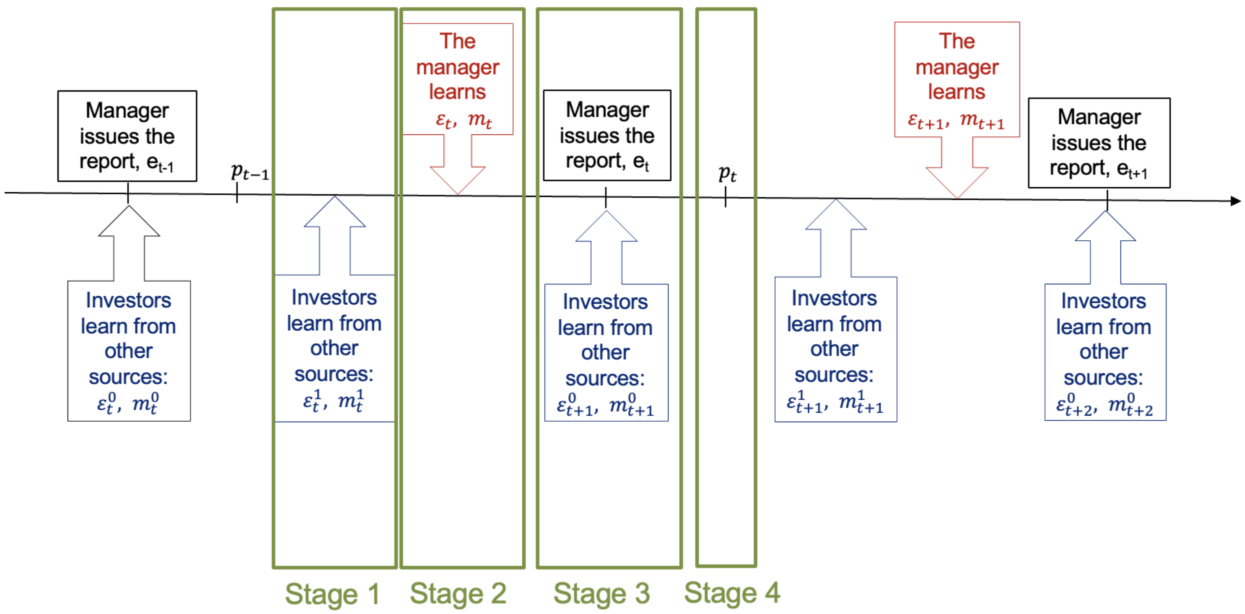

Figure 1: Timing of events in the model.

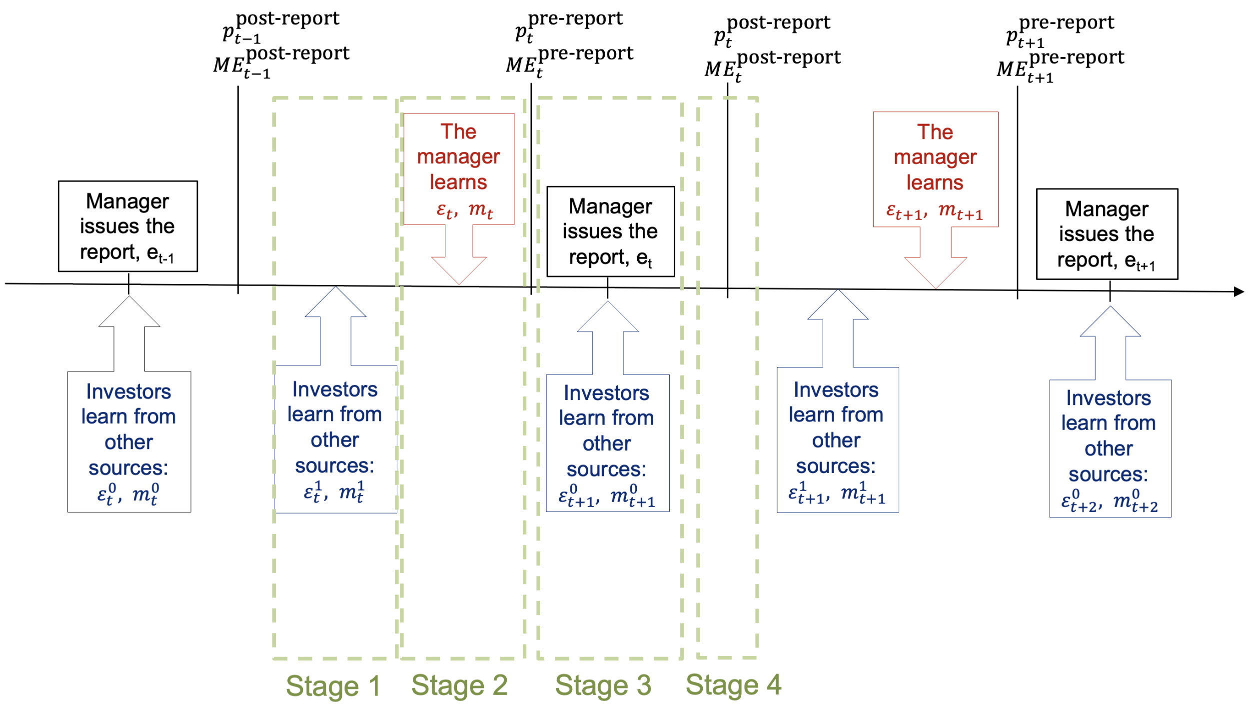

Figure 2: Timing of formation of the firm's prices and the investors' expectations.

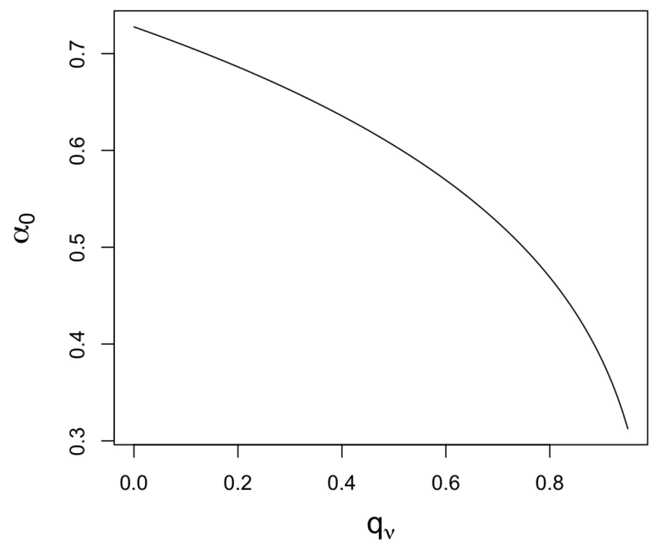

Figure 3: Earnings response coefficient as a function of the investors' information on fundamentals, q_ν. $\sigma_\nu^2 = 0.8$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

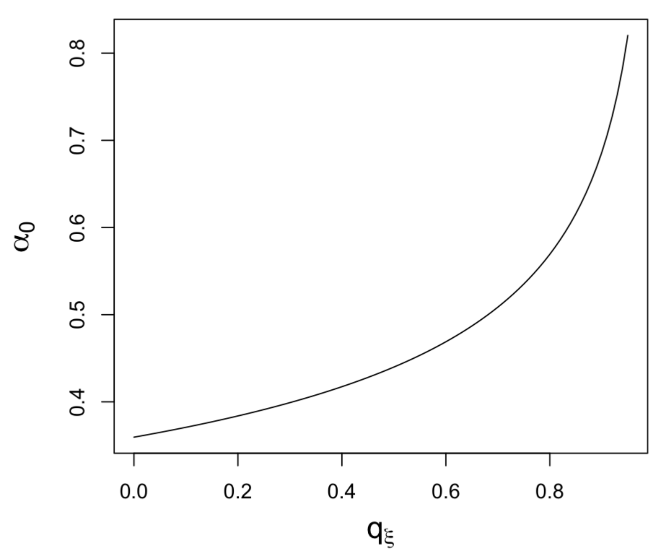

Figure 4: Earnings response coefficient as a function of the investors' information on misreporting incentives, q_ξ. $q_\nu = 0.8$, $\sigma_\nu^2 = 0.08$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

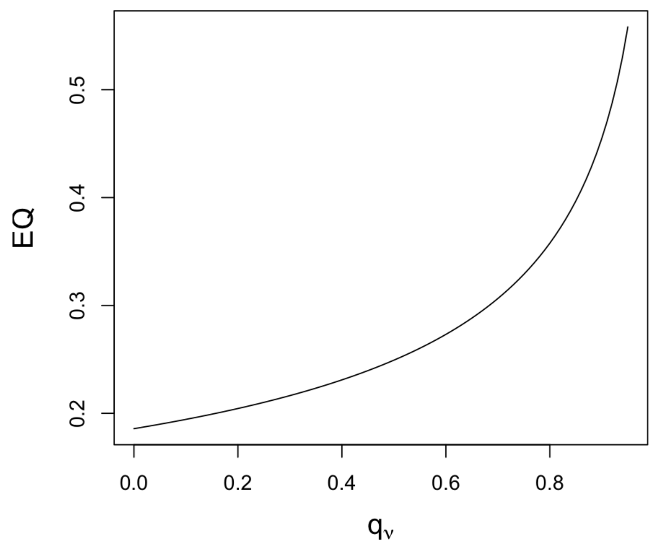

Figure 5: Earnings quality as a function of the investors' information on fundamentals, q_v. $\sigma_v^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

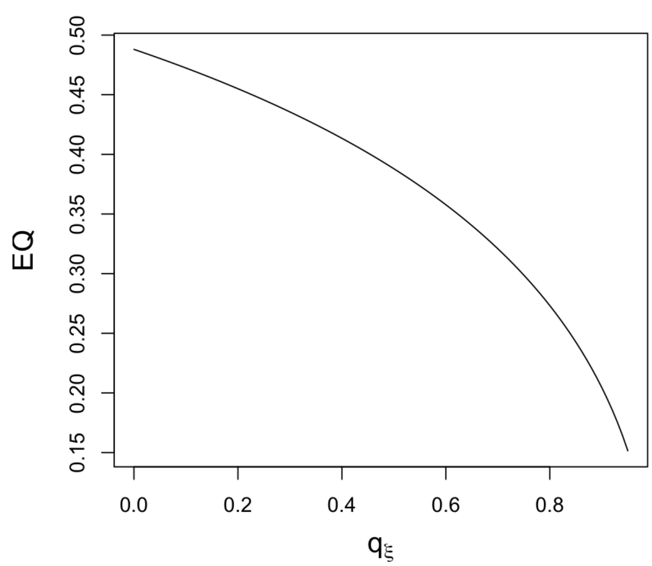

Figure 6: Earnings quality as a function of the investors' information on misreporting incentives, q_ξ. $q_v = 0.8$, $\sigma_v^2 = 0.08$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$.

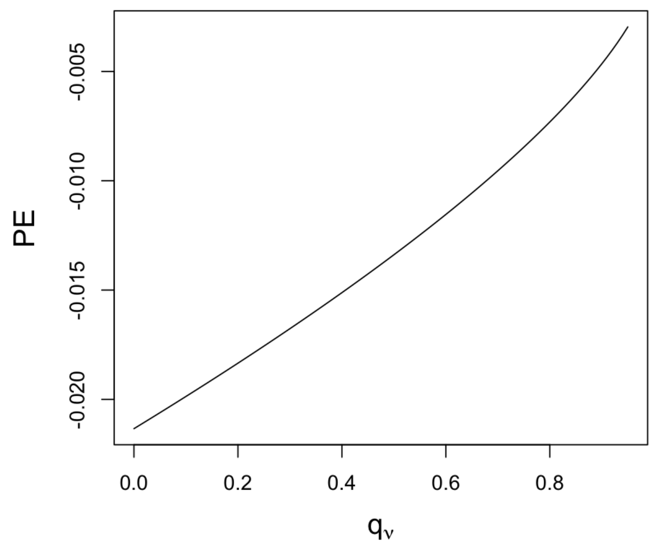

Figure 7: Stock price efficiency as a function of the investors' information on fundamentals, q_ν. $\sigma_\nu^2 = 0.08$, $q_\xi = 0.6$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$, $Var[p_t] = 1$.

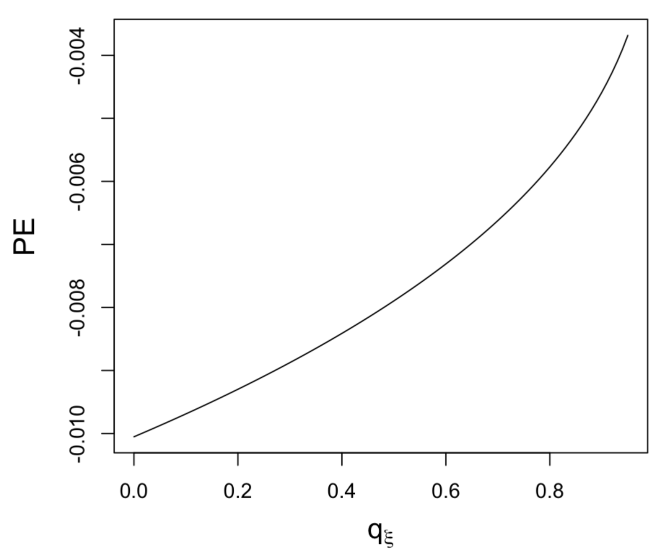

Figure 8: Stock price efficiency as a function of the investors' information on misreporting incentives, q_ξ. $q_\nu = 0.8$, $\sigma_\nu^2 = 0.08$, $\sigma_\xi^2 = 0.5$, $\delta_M = 0.9$, $\delta_I = 0.9$, $Var[p_t] = 1$.

Figure 9: Sensitivity of earnings quality to model parameters. Parameter estimates and the baseline level of earnings quality are in Table 5. To compute an effect of a 1% parameter increase (decrease) on earnings quality, I increase (decrease) the value of this parameter by 1% from the estimated levels, keeping other parameters unchanged; I also compute the percentage change in the earnings quality relative to the baseline level. Earnings quality is calculated according to the formula (7).

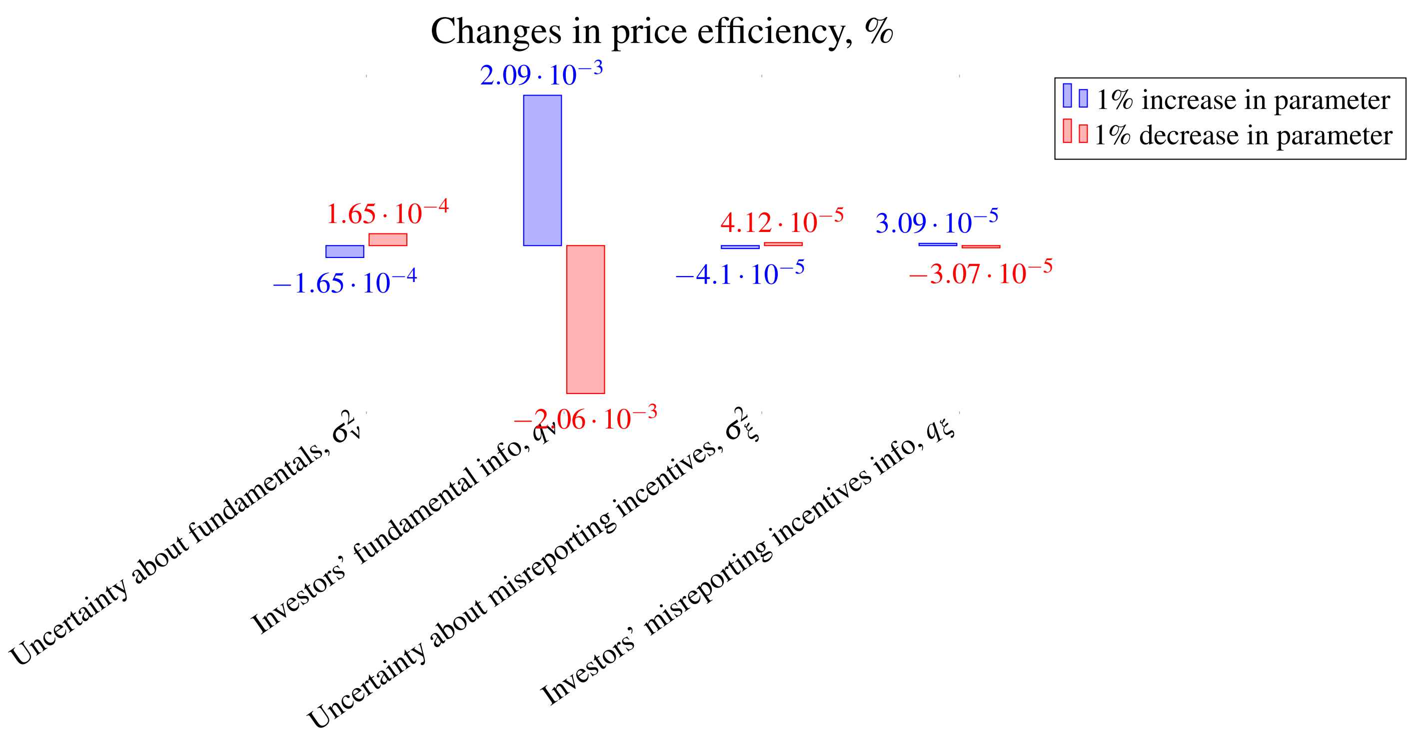

Figure 10: Sensitivity of price efficiency to model parameters. Parameter estimates and the baseline level of price efficiency are in Table 5. To compute an effect of a 1% parameter increase (decrease) on price efficiency, I increase (decrease) the value of this parameter by 1% from the estimated levels, keeping other parameters unchanged; then I compute the percentage change in the price efficiency relative to the baseline level. Price efficiency is calculated according to the formula (8).

7 Appendix

7.1 Steady state

7.1.1 The manager's report

In what follows, I denote by I_t all the information available to investors right after the time-t earnings report is released, and by $I_t \setminus \{e_t\}$ all the information available to investors right before the time-t earnings report is released. I_t includes everything in $I_t \setminus \{e_t\}$ and $e_t, \varepsilon^0_{t+1,1}, m^0_{t+1,1}$.

Because I assume the manager and investors remember all the information about firms' fundamentals and the manager's misreporting incentives they ever received, I can say that the manager and investors know not only realizations of information about fundamentals and incentives, e.g., $\varepsilon_{1,t} = \nu_{1,t-2} + \nu_{1,t-1} + \nu_{1,t}$ and $m_{1,t} = \xi_{1,t-2} + \xi_{1,t-1} + \xi_{1,t}$, but each particular innovation, i.e., $\nu_{1,t}$ and $\xi_{1,t}$, in every period.

I conjecture a linear equilibrium with the following steady-state relations:

- The firm's stock price after the release of the earnings report at time t is a linear function of surprises in earnings reports and innovations to the firm's fundamentals known by investors:

$$p_t = p_{const} + \alpha_0 \left(e_t - E\left[e_t | I_t \setminus \{e_t\}\right]\right) + \alpha_1 \left(e_{t-1} - E\left[e_{t-1} | I_{t-1} \setminus \{e_{t-1}\}\right]\right) +$$
$$\alpha_2 \left(e_{t-2} - E\left[e_{t-2} | I_{t-2} \setminus \{e_{t-2}\}\right]\right) + a_0 \nu_{1,t} + a_1 \nu_{1,t-1} + a_2 \nu_{1,t-2} + a_{-1} \nu^0_{1,t+1}; \qquad \text{(A9)}$$

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

$$e_t = e_{const} + c_0 \varepsilon_t + b_0 \xi_t + b_1 \xi_{t-1} + b_2 \xi_{t-2} + b_3 \xi_{t-3}; \qquad \text{(A10)}$$

where $p_{const}, \alpha_0, \alpha_1, \alpha_2, a_0, a_1, a_2, a_{-1}, e_{const}, c_0, b_0, b_1, b_2, b_3$ are constants.

First, given the conjectured pricing function, let us derive the manager's steady-state equilibrium strategy. Consider a manager who has finite tenure at the firm at time T. At time T, the manager's problem is:

$$\max_{e_T} \quad m_T p_T - \frac{\left(e_T - \varepsilon_T + \sum_{k=0}^{T-1}(e_k - \varepsilon_k)\right)^2}{2} = m_T \left(p_{const} + \alpha_0 \left(e_T - E\left[e_T | I_T \setminus \{e_T\}\right]\right) + \alpha_1 \left(e_{T-1} - E\left[e_{T-1} | I_{T-1} \setminus \{e_{T-1}\}\right]\right) + \alpha_2 \left(e_{T-2} - E\left[e_{T-2} | I_{T-2} \setminus \{e_{T-2}\}\right]\right) + a_0 \nu_{1,T} + a_1 \nu_{1,T-1} + a_2 \nu_{1,T-2}\right) - \frac{\left(e_T - \varepsilon_T + \sum_{k=0}^{T-1}(e_k - \varepsilon_k)\right)^2}{2} \tag{A11}$$

The optimal report is:

$$e_T^* = \varepsilon_T - \sum_{k=0}^{T-1}(e_k - \varepsilon_k) + m_T \alpha_0 \tag{A12}$$

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

$$\max_{e_{T-1}} \quad m_{T-1} p_{T-1} - \frac{\left(e_{T-1} - \varepsilon_{T-1} + \sum_{k=0}^{T-2}(e_k - \varepsilon_k)\right)^2}{2} + \delta_M E_{T-1}[U_T] \tag{A13}$$

The expected utility at time T is

$$E_{T-1}[U_T] = E_{T-1}[m_T p_T + \frac{(m_T \alpha_0)^2}{2}] = E_{T-1}\left[m_T \times \left(p_{const} + \alpha_0 \left(e_T - E\left[e_T | I_T \setminus \{e_T\}\right]\right) + \alpha_1 \left(e_{T-1} - E\left[e_{T-1} | I_{T-1} \setminus \{e_{T-1}\}\right]\right) + \alpha_2 \left(e_{T-2} - E\left[e_{T-2} | I_{T-2} \setminus \{e_{T-2}\}\right]\right) + a_0 \nu_{1,T} + a_1 \nu_{1,T-1} + a_2 \nu_{1,T-2}\right)\right] + E_{T-1}[\frac{(m_T \alpha_0)^2}{2}] =$$
$$E_{T-1}\left[\xi_T \left(p_{const} + \alpha_0 \left(e_T - E\left[e_T | I_T \setminus \{e_T\}\right]\right) + \alpha_1 \left(e_{T-1} - E\left[e_{T-1} | I_{T-1} \setminus \{e_{T-1}\}\right]\right) + \alpha_2 \left(e_{T-2} - E\left[e_{T-2} | I_{T-2} \setminus \{e_{T-2}\}\right]\right) + a_0 \nu_{1,T} + a_1 \nu_{1,T-1} + a_2 \nu_{1,T-2}\right)\right] +$$
$$\left(\xi_{T-1} + \xi_{T-2}\right) E_{T-1}\left[\left(p_{const} + \alpha_0 \left(e_T - E\left[e_T | I_T \setminus \{e_T\}\right]\right) + \alpha_1 \left(e_{T-1} - E\left[e_{T-1} | I_{T-1} \setminus \{e_{T-1}\}\right]\right) + \alpha_2 \left(e_{T-2} - E\left[e_{T-2} | I_{T-2} \setminus \{e_{T-2}\}\right]\right) + a_0 \nu_{1,T} + a_1 \nu_{1,T-1} + a_2 \nu_{1,T-2}\right)\right] + E_{T-1}[\frac{(m_T \alpha_0)^2}{2}] \tag{A14}$$

Note that $E[\xi_T]$ and $\left(e_T - E\left[e_T | I_T \setminus \{e_T\}\right]\right)$ are zero at time $T-1$ from the manager's perspective. The expected utility reduced to only the parts that the manager controls is $\left(\xi_{T-1} + \xi_{T-2}\right) \alpha_1 e_{T-1}$.

The optimal report at time $T-1$ is

$$e_{T-1} = \varepsilon_{T-1} - \sum_{k=0}^{T-2}(e_k - \varepsilon_k) + m_{T-1} \alpha_0 + \delta_M \left(\xi_{T-1} + \xi_{T-2}\right) \alpha_1 \tag{A15}$$

The manager's problem at time $T-2$ is:

$$\max_{e_{T-2}} \quad m_{T-2}p_{T-2} - \frac{\left(e_{T-2} - \varepsilon_{T-2} + \sum_{k=0}^{T-3}(e_k - \varepsilon_k)\right)^2}{2} + \delta_M E_{T-2}[U_{T-1}] + \delta_M^2 E_{T-2}[U_T] \tag{A16}$$

Following the derivation above, the expected utility $E_{T-2}[U_{T-1}]$ reduced to only the parts that the manager controls is $(\xi_{T-2}+\xi_{T-3})\,\alpha_1 e_{T-2}$.

The expected utility $E_{T-2}[U_T]$ is:

$$\begin{aligned}
E_{T-2}[U_T] = E_{T-2}[m_T p_T + \frac{(m_T\alpha_0)^2}{2}] = \\
E_{T-2}\left[(\xi_T+\xi_{T-1})\left(p_{const} + \alpha_0\left(e_T - E\left[e_T|I_T\setminus\{e_T\}\right]\right) + \alpha_1\left(e_{T-1} - E\left[e_{T-1}|I_{T-1}\setminus\{e_{T-1}\}\right]\right) + \right.\right. \\
\left.\left. \alpha_2\left(e_{T-2} - E\left[e_{T-2}|I_{T-2}\setminus\{e_{T-2}\}\right]\right) + a_0\nu_{1,T} + a_1\nu_{1,T-1} + a_2\nu_{1,T-2}\right)\right] + \\
\xi_{T-2}E_{T-2}\left[\left(p_{const} + \alpha_0\left(e_T - E\left[e_T|I_T\setminus\{e_T\}\right]\right) + \alpha_1\left(e_{T-1} - E\left[e_{T-1}|I_{T-1}\setminus\{e_{T-1}\}\right]\right) + \right.\right. \\
\left.\left. \alpha_2\left(e_{T-2} - E\left[e_{T-2}|I_{T-2}\setminus\{e_{T-2}\}\right]\right) + a_0\nu_{1,T} + a_1\nu_{1,T-1} + a_2\nu_{1,T-2}\right)\right] \\
+E_{T-1}[\frac{(m_T\alpha_0)^2}{2}]
\end{aligned} \tag{A17}$$

The expected utility reduced to only the parts that the manager controls is $\xi_{T-2}\alpha_2 e_{T-2}$.

The optimal report at time $T-2$ is

$$e_{T-2} = \varepsilon_{T-2} - \sum_{k=0}^{T-3}(e_k - \varepsilon_k) + m_{T-2}\alpha_0 + \delta_M\left(\xi_{T-2}+\xi_{T-3}\right)\alpha_1 + \delta_M^2\xi_{T-2}\alpha_2. \tag{A18}$$

At time $T-3$, the expected utility $E_{T-3}[U_{T-2}]$ reduced to only controlled parts is $(\xi_{T-3}+\xi_{T-4})\,\alpha_1 e_{T-3}$, and the expected utility $E_{T-3}[U_{T-1}]$ reduced to only controlled parts is $\xi_{T-3}\alpha_2 e_{T-3}$. Because the manager does not know any components of the time-T incentives, the expected utility $E_{T-3}[U_T]$ reduced to only controlled parts is zero.

The optimal report at time $T-3$ is

$$e_{T-3} = \varepsilon_{T-3} - \sum_{k=0}^{T-4}(e_k - \varepsilon_k) + m_{T-3}\alpha_0 + \delta_M\left(\xi_{T-3}+\xi_{T-4}\right)\alpha_1 + \delta_M^2\xi_{T-3}\alpha_2. \tag{A19}$$

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

$$e_t = \varepsilon_t - \sum_{k=0}^{t-1} (e_k - \varepsilon_k) + m_t \alpha_0 + \delta_M (\xi_t + \xi_{t-1}) \alpha_1 + \delta_M^2 \xi_t \alpha_2. \tag{A20}$$

Now work forward from $t = 0$:

$$e_0 = \varepsilon_0 + \alpha_0 \xi_0 + \delta_M \alpha_1 \xi_0 + \delta_M^2 \alpha_2 \xi_0 \tag{A21}$$

$$\begin{aligned} e_1 = \varepsilon_1 &- \left(\alpha_0 \xi_0 + \delta_M \alpha_1 \xi_0 + \delta_M^2 \alpha_2 \xi_0\right) \\ &+ (\xi_0 + \xi_1) \alpha_0 + \delta_M (\xi_0 + \xi_1) \alpha_1 + \delta_M^2 \xi_1 \alpha_2 \\ &= \varepsilon_1 + \xi_1 \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right) - \xi_0 \delta_M^2 \alpha_2 \end{aligned} \tag{A22}$$

$$\begin{aligned} e_2 = \varepsilon_2 &- \Big(- \left(\alpha_0 \xi_0 + \delta_M \alpha_1 \xi_0 + \delta_M^2 \alpha_2 \xi_0\right) \\ &+ (\xi_0 + \xi_1) \alpha_0 + \delta_M (\xi_0 + \xi_1) \alpha_1 + \delta_M^2 \xi_1 \alpha_2\Big) \\ &- \left(\alpha_0 \xi_0 + \delta_M \alpha_1 \xi_0 + \delta_M^2 \alpha_2 \xi_0\right) \\ &+ (\xi_0 + \xi_1 + \xi_2) \alpha_0 + \delta_M (\xi_1 + \xi_2) \alpha_1 + \delta_M^2 \xi_2 \alpha_2 \\ &= \varepsilon_2 + \xi_2 \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right) - \xi_1 \delta_M^2 \alpha_2 - \xi_0 \delta_M \alpha_1 \end{aligned} \tag{A23}$$

$$\begin{aligned} e_3 = \varepsilon_3 &- \Big(- \Big(- \left(\alpha_0 \xi_0 + \delta_M \alpha_1 \xi_0 + \delta_M^2 \alpha_2 \xi_0\right) \\ &+ (\xi_0 + \xi_1) \alpha_0 + \delta_M (\xi_0 + \xi_1) \alpha_1 + \delta_M^2 \xi_1 \alpha_2\Big) \\ &- \left(\alpha_0 \xi_0 + \delta_M \alpha_1 \xi_0 + \delta_M^2 \alpha_2 \xi_0\right) \\ &+ (\xi_0 + \xi_1 + \xi_2) \alpha_0 + \delta_M (\xi_1 + \xi_2) \alpha_1 + \delta_M^2 \xi_2 \alpha_2\Big) \\ &- \Big(- \left(\alpha_0 \xi_0 + \delta_M \alpha_1 \xi_0 + \delta_M^2 \alpha_2 \xi_0\right) \\ &+ (\xi_0 + \xi_1) \alpha_0 + \delta_M (\xi_0 + \xi_1) \alpha_1 + \delta_M^2 \xi_1 \alpha_2\Big) \\ &- \left(\alpha_0 \xi_0 + \delta_M \alpha_1 \xi_0 + \delta_M^2 \alpha_2 \xi_0\right) \\ &+ (\xi_0 + \xi_1 + \xi_2) \alpha_0 + \delta_M (\xi_1 + \xi_2) \alpha_1 + \delta_M^2 \xi_2 \alpha_2 \\ &= \varepsilon_3 + \xi_3 \left(_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right) - \xi_2 \delta_M^2 \alpha_2 - \xi_1 \delta_M \alpha_1 - \xi_0 \alpha_0 \end{aligned} \tag{A24}$$

Finally,

$$e_t = \varepsilon_t + (\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2) \xi_t - \alpha_0 \xi_{t-3} - \delta_M \alpha_1 \xi_{t-2} - \delta_M^2 \alpha_2 \xi_{t-1}. \tag{A25}$$

In the conjectured equilibrium, $e_{const} = 0$, $c_0 = 1$, $b_0 = \alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2$, $b_1 = -\delta_M^2 \alpha_2$, $b_2 = -\delta_M \alpha_1$,

$b_3 = -\alpha_0$.

7.1.2 The evolution of investors' uncertainty

In the steady state, how uncertain investors are about an object depends only on how distant the object is in time, but not on the time period itself. Let us derive investors' uncertainty about unobserved parts of innovations to the firm's fundamentals and the manager's incentives. The only source of information investors have about these innovations are the manager's reports. Consider time t, after the report e_t is released. As shown in the previous section, the report at time t contains information about $\nu_{2,t}, \nu_{2,t-1}, \nu_{2,t-2}, \xi_t, \xi_{t-1}, \xi_{t-2}$, and ξ_{t-3}. Therefore, investors' uncertainty about more distant past innovations, $\nu_{2,k}, k < t-2$ and $\xi_{2,n}, n < t-3$, and future innovations $\nu_{2,l}, l > t$ and $\xi_{2,l}, l > t$, remain unchanged.

Let us derive how investors' uncertainty changes with the release of the time-t report. Before the report is released, investors do not know anything about this year's innovations $\nu_{2,t}$ and $\xi_{2,t}$, so their variances from the investors' perspective are $(1-q_\nu)\sigma_\nu^2$ and $(1-q_\xi)\sigma_\xi^2$. Investors' however, have some information about prior-years shocks from previous reports. Denote $\sigma_{rf1}^2 \equiv Var[\nu_{2,t-1}|e_{t-1}]$, $\sigma_{rf2}^2 \equiv Var[\nu_{2,t-2}|e_{t-1}, e_{t-2}]$, $\sigma_{ri1}^2 \equiv Var[\xi_{2,t-1}|e_{t-1}]$, $\sigma_{ri2}^2 \equiv Var[\xi_{2,t-2}|e_{t-1}, e_{t-2}]$, and $\sigma_{ri3}^2 \equiv Var[\xi_{2,t-3}|e_{t-1}, e_{t-2}, e_{t-3}]$. The manager's report and the innovations to the firm's fundamentals and the manager's incentives are jointly normally distributed, and innovations are mutually independent.

$$Var_t\left[\begin{pmatrix}\nu_{2,t}\\ \nu_{2,t-1}\\ \xi_{2,t}\\ \xi_{2,t-1}\\ \xi_{2,t-2}\end{pmatrix}|e_t\right] = Var_t\begin{pmatrix}\nu_{2,t}\\ \nu_{2,t-1}\\ \xi_{2,t}\\ \xi_{2,t-1}\\ \xi_{2,t-2}\end{pmatrix} - \frac{1}{Var_t[e_t]} \times \left(Cov_t\left[\begin{pmatrix}\nu_{2,t}\\ \nu_{2,t-1}\\ \xi_{2,t}\\ \xi_{2,t-1}\\ \xi_{2,t-2}\end{pmatrix}, e_t\right]\right)^2 \quad \text{(A26)}$$

$$\begin{pmatrix}\sigma_{rf1}^2\\ \sigma_{rf_2}^2\\ \sigma_{ri1}^2\\ \sigma_{ri2}^2\\ \sigma_{ri3}^2\end{pmatrix} = \begin{pmatrix}(1-q_\nu)\sigma_\nu^2\\ \sigma_{rf1}^2\\ (1-q_\xi)\sigma_\xi^2\\ \sigma_{ri1}^2\\ \sigma_{ri2}^2\end{pmatrix} - \begin{pmatrix}(1-q_\nu)^2\sigma_\nu^4\\ \sigma_{rf1}^4\\ \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)^2\sigma_\xi^4\\ \delta_M^4\alpha_2^2\sigma_{ri1}^4\\ \delta_M^2\alpha_1^2\sigma_{ri2}^4\end{pmatrix} \times$$

$$\frac{1}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2 + \alpha_0^2\sigma_{ri3}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2} \quad \text{(A27)}$$

7.1.3 The firm's prices

Consider time $t=0$ after the release of the manager's earnings report. The manager's report is $e_0 = \nu_0 + \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right)\xi_0$. The firm's price is

$$p_0 = E\left[\varepsilon_0 + \sum_{k=1}^{\infty} \delta_I^k \varepsilon_k\right] = \left(1+\delta_I+\delta_I^2\right)\left(\nu_{1,0} + E\left[\nu_{2,0}|e_0\right]\right) + \left(\delta_I+\delta_I^2+\delta_I^3\right)\nu_{1,1}^0, \tag{A28}$$

$$E\left[\nu_{2,0}|e_0\right] = \left(e_0 - E\left[e_0|I_o \setminus \{e_0\}\right]\right) \times \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2} =$$

$$e_0 \times \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2}. \tag{A29}$$

At time $t=1$, after the manager releases their second report, $e_1 = \varepsilon_1 + \xi_1\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right) - \xi_0\delta_M^2\alpha_2$, the firm's price is

$$p_1 = (1+\delta_I)\left(\nu_{1,0}+E\left[\nu_{2,0}|e_0,e_1\right]\right) + \left(1+\delta_I+\delta_I^2\right)\left(\nu_{1,1}+E\left[\nu_{2,1}|e_1\right]\right) + \left(\delta_I+\delta_I^2+\delta_I^3\right)\nu_{1,2}^0, \tag{A30}$$

$$E\left[\nu_{2,0}|e_0,e_1\right] = E\left[\nu_{2,0}|e_0\right] + \left(e_1 - E\left[e_1|I_1\setminus\{e_1\}\right]\right) \times$$

$$\frac{\sigma_{rf1}^2}{\sigma_{rf1}^2 + (1-q_\nu)\sigma_\nu^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2}, \tag{A31}$$

$$E\left[\nu_{2,1}|e_1\right] = \left(e_1 - E\left[e_1|I_1\setminus\{e_1\}\right]\right) \times \frac{(1-q_\nu)\sigma_\nu^2}{\sigma_{rf1}^2 + (1-q_\nu)\sigma_\nu^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2} \tag{A32}$$

At time $t=2$, after the manager releases their third report, $e_2 = \varepsilon_2 + \xi_2\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right) - \xi_1\delta_M^2\alpha_2 -$

$\xi_0 \delta_M \alpha_1$, the firm's price is

$$p_2 = \nu_{1,0} + E\left[\nu_{2,0}|e_0, e_1, e_2\right] + (1+\delta_I)\left(\nu_{1,1} + E\left[\nu_{2,1}|e_1, e_2\right]\right) + \left(1+\delta_I+\delta_I^2\right)\left(\nu_{1,2} + E\left[\nu_{2,2}|e_2\right]\right) + \left(\delta_I+\delta_I^2+\delta_I^3\right)\nu_{1,3}^0, \tag{A33}$$

$$E\left[\nu_{2,0}|e_0, e_1, e_2\right] = E\left[\nu_{2,0}|e_0, e_1\right] + \left(e_2 + E\left[e_2|I_2 \setminus \{e_2\}\right]\right) \times \frac{\sigma_{rf2}^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2 (1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2}, \tag{A34}$$

$$E\left[\nu_{2,1}|e_1, e_2\right] = E\left[\nu_{2,1}|e_1\right] + \left(e_2 + E\left[e_2|I_2 \setminus \{e_2\}\right]\right) \times \frac{\sigma_{rf1}^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2 (1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2}, \tag{A35}$$

$$E\left[\nu_{2,2}|e_2\right] = \left(e_2 + E\left[e_2|I_2 \setminus \{e_2\}\right]\right) \times \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2 (1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2}. \tag{A36}$$

Similarly, the price at time $t = 3$:

$$p_3 = \nu_{1,1} + E\left[\nu_{2,1}|e_1, e_2, e_3\right] + (1+\delta_I)\left(\nu_{1,2} + E\left[\nu_{2,2}|e_2, e_3\right]\right) + \left(1+\delta_I+\delta_I^2\right)\left(\nu_{1,3} + E\left[\nu_{2,3}|e_3\right]\right) + \left(\delta_I+\delta_I^2+\delta_I^3\right)\nu_{1,4}^0, \tag{A37}$$

$$E\left[\nu_{2,1}|e_1, e_2, e_3\right] = E\left[\nu_{2,1}|e_1, e_2\right] + \left(e_3 + E\left[e_3|I_3 \setminus \{e_3\}\right]\right) \times \frac{\sigma_{rf2}^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2 (1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \alpha_0^2\sigma_{ri3}^2}, \tag{A38}$$

$$E\left[\nu_{2,2}|e_2, e_3\right] = E\left[\nu_{2,2}|e_2\right] + \left(e_3 + E\left[e_3|I_3 \setminus \{e_3\}\right]\right) \times \frac{\sigma_{rf1}^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2 (1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \alpha_0^2\sigma_{ri3}^2}, \tag{A39}$$

$$E\left[\nu_{2,3}|e_3\right] = \left(e_3 + E\left[e_3|I_3 \setminus \{e_3\}\right]\right) \times \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2 (1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \alpha_0^2\sigma_{ri3}^2}. \tag{A40}$$

Finally, the firm's price at time $t=4$ is

$$p_4 = \nu_{1,2} + E\left[\nu_{2,2}|e_2,e_3,e_4\right] + (1+\delta_I)\left(\nu_{1,3} + E\left[\nu_{2,3}|e_3,e_4\right]\right) + \left(1+\delta_I+\delta_I^2\right)\left(\nu_{1,4} + E\left[\nu_{2,4}|e_4\right]\right) + \left(\delta_I+\delta_I^2+\delta_I^3\right)\nu_{1,5}^0, \quad \text{(A41)}$$

$$E\left[\nu_{2,2}|e_2,e_3,e_4\right] = E\left[\nu_{2,2}|e_2,e_3\right] + \left(e_4 + E\left[e_4|I_4\setminus\{e_4\}\right]\right)\times \frac{\sigma_{rf2}^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \alpha_0^2\sigma_{ri3}^2}, \quad \text{(A42)}$$

$$E\left[\nu_{2,3}|e_3,e_4\right] = E\left[\nu_{2,3}|e_3\right] + \left(e_4 + E\left[e_4|I_4\setminus\{e_4\}\right]\right)\times \frac{\sigma_{rf1}^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \alpha_0^2\sigma_{ri3}^2}, \quad \text{(A43)}$$

$$E\left[\nu_{2,4}|e_4\right] = \left(e_4 + E\left[e_4|I_4\setminus\{e_4\}\right]\right)\times \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \alpha_0^2\sigma_{ri3}^2}. \quad \text{(A44)}$$

By induction, the firm's price at time t is

$$p_t = \alpha_0\left(e_t - E\left[e_t|I_t\setminus\{e_t\}\right]\right) + \alpha_1\left(e_{t-1} - E\left[e_{t-1}|I_{t-1}\setminus\{e_{t-1}\}\right]\right) + \alpha_2\left(e_{t-2} - E\left[e_{t-2}|I_{t-2}\setminus\{e_{t-2}\}\right]\right) + \left(1+\delta_I+\delta_I^2\right)\nu_{1,t} + (1+\delta_I)\nu_{1,t-1} + \nu_{1,t-2} + \left(\delta_I+\delta_I^2+\delta_I^3\right)\nu_{1,t+1}^0, \quad \text{(A45)}$$

where $\alpha_0, \alpha_1, \alpha_2$, together with $\sigma_{rf1}^2, \sigma_{rf2}^2, \sigma_{ri1}^2, \sigma_{ri2}^2, \sigma_{ri3}^2$, solve

$$\alpha_0 = \frac{\left(1+\delta_I+\delta_I^2\right)(1-q_\nu)\sigma_\nu^2 + (1+\delta_I)\sigma_{rf1}^2 + \sigma_{rf2}^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \alpha_0^2\sigma_{ri3}^2}, \quad \text{(A46)}$$

$$\alpha_1 = \frac{(1+\delta_I)(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \alpha_0^2\sigma_{ri3}^2}, \quad \text{(A47)}$$

$$\alpha_2 = \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 + \sigma_{rf2}^2 + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2(1-q_\xi)\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_{ri1}^2 + \delta_M^2\alpha_1^2\sigma_{ri2}^2 + \alpha_0^2\sigma_{ri3}^2}, \quad \text{(A48)}$$

and (A27).

When estimating the model, I solve this system of equations numerically. The numerical examination shows that the equilibrium appears to be unique.

In the conjectured equilibrium, $p_{const}=0$, $a_0 = 1+\delta_I+\delta_I^2$, $a_1 = 1+\delta_I$, $a_2=1$, $a_{-1} = \delta_I+\delta_I^2+\delta_I^3$.

7.2 Separation of changes in stock prices

To separately identify which of its information the market learns concurrently with earnings reports and which on other days, I derive the firm's prices before and after an earnings report is released.

Denote by $p_t^{\text{post-report}} \equiv p_t$ the prices described in the previous section. Denote by $p_t^{\text{pre-report}}$ the firm's prices right before the time-t earnings report, e_t, is released.

$$p_t^{\text{pre-report}} = \nu_{1,t-2} + E\left[\nu_{2,t-2}|e_{t-2},e_{t-1}\right] + (1+\delta_I)\left(\nu_{1,t-1} + E\left[\nu_{2,t-1}|e_{t-1}\right]\right) + \left(1+\delta_I+\delta_I^2\right)\nu_{1,t} =$$
$$\alpha_1\left(e_{t-1} - E\left[e_{t-1}|I_{t-1}\setminus\{e_{t-1}\}\right]\right) + \alpha_2\left(e_{t-2} - E\left[e_{t-2}|I_{t-2}\setminus\{e_{t-2}\}\right]\right) + \left(1+\delta_I+\delta_I^2\right)\nu_{1,t} + (1+\delta_I)\,\nu_{1,t-1} + \nu_{1,t-2} \quad \text{(A49)}$$

The change in the firm's price from before the report e_t to after the report is

$$p_t^{\text{post-report}} - p_t^{\text{pre-report}} = \alpha_0\left(e_t - E\left[e_t|I_t\setminus\{e_t\}\right]\right) + \left(\delta_I+\delta_I^2+\delta_I^3\right)\nu_{1,t+1}^0. \quad \text{(A50)}$$

The change in the firm's price from after the release of the earnings report e_t to before the release of the next earnings report e_{t+1} is

$$p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}} = (\alpha_1-\alpha_0)\left(e_t - E\left[e_t|I_t\setminus\{e_t\}\right]\right) + (\alpha_2-\alpha_1)\left(e_{t-1} - E\left[e_{t-1}|I_{t-1}\setminus\{e_{t-1}\}\right]\right) +$$
$$(-\alpha_2)\left(e_{t-2} - E\left[e_{t-2}|I_{t-2}\setminus\{e_{t-2}\}\right]\right) - \nu_{1,t-2} - \delta_I\nu_{1,t-1} - \delta_I^2\nu_{1,t} + \left(1-\delta_I^3\right)\nu_{1,t+1}^0 + \left(1+\delta_I+\delta_I^2\right)\nu_{1,t+1}^1 \quad \text{(A51)}$$

7.3 The market's expectation of the earnings report

To identify the market's information about the manager's misreporting incentives, I introduce the market's expectation of the manager's earnings report.

The investors' expectation of the time-t earnings report right before the time-t report is issued is:

$$ME_t^{\text{pre-report}} = E\left[\tilde{e}_t|I_t^{\text{market}}\setminus\{e_t\}\right] = \quad \text{(A52)}$$
$$\varepsilon_{1,t} + E_t\left[\varepsilon_{2,t}|I_t^{\text{market}}\setminus\{e_t\}\right] \quad \text{(A53)}$$
$$+\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)\xi_{1,t} - \alpha_0\xi_{1,t-3} - \delta_M\alpha_1\xi_{1,t-2} - \delta_M^2\alpha_2\xi_{1,t-1} \quad \text{(A54)}$$
$$-\alpha_0 E_t\left[\xi_{2,t-3}|I_t^{\text{market}}\setminus\{e_t\}\right] - \delta_M\alpha_1 E_t\left[\xi_{2,t-2}|I_t^{\text{market}}\setminus\{e_t\}\right] - \delta_M^2\alpha_2 E_t\left[\xi_{2,t-1}|I_t^{\text{market}}\setminus\{e_t\}\right] \quad \text{(A55)}$$

When the time-t earnings report is issued, the investors use it to update their beliefs and also learn information about unmanipulated earnings ($\varepsilon^0_{1,t+1}$) and misreporting incentives ($m^0_{1,t+1}$) related to the upcoming time-$(t+1)$ report. The updated expectations about the unobserved parts of misreporting incentives and unmanipulated earnings are

$$E_t[\xi_{2,t}|e_t] = \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2} \quad \text{(A56)}$$

$$\begin{aligned}E_t[\xi_{2,t-1}|e_t,e_{t-1}] &= \left(e_{t-1} - E\left[e_{t-1}|I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) \times \frac{\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2} \\ &+ \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{-\delta_M^2\alpha_2\sigma_{ri1}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2} \quad \text{(A57)}\end{aligned}$$

$$\begin{aligned}E_t[\xi_{2,t-2}|e_t,e_{t-1},e_{t-2}] &= \left(e_{t-2} - E\left[e_{t-2}|I_{t-2}^{\text{market}} \setminus \{e_{t-2}\}\right]\right) \times \frac{\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2} \\ &+ \left(e_{t-1} - E\left[e_{t-1}|I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) \times \frac{-\delta_M^2\alpha_2\sigma_{ri1}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2} \\ &+ \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{-\delta_M\alpha_1\sigma_{ri2}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2} \quad \text{(A58)}\end{aligned}$$

$$E_t[\nu_{2,t}|e_t] = \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2} \quad \text{(A59)}$$

$$\begin{aligned}E_t[\nu_{2,t-1}|e_t,e_{t-1}] &= \left(e_{t-1} - E\left[e_{t-1}|I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) \times \frac{(1-q_\nu)\sigma_\nu^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2} \\ &+ \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right) \times \frac{\sigma_{rf1}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2} \quad \text{(A60)}\end{aligned}$$

Therefore,

$$\begin{aligned}ME_t^{\text{post-report}} = \quad & \nu^0_{1,t+1} + \nu_{1,t} + \nu_{1,t-1} && \text{(A61)} \\ & +(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)\xi^0_{1,t+1} - \alpha_0\xi_{1,t-2} - \delta_M\alpha_1\xi_{1,t-1} - \delta_M^2\alpha_2\xi_{1,t} && \text{(A62)} \\ & +E_t[\nu_{2,t}+\nu_{2,t-1}|e_t,e_{t-1}] && \text{(A63)} \\ & E_t[(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)\xi^0_{2,t+1} - \alpha_0\xi_{2,t-2} - \delta_M\alpha_1\xi_{2,t-1} - \delta_M^2\alpha_2\xi_{2,t}|e_t,e_{t-1},e_{t-2}] && \text{(A64)}\end{aligned}$$

or

$$ME_t^{\text{post-report}} = \nu^0_{1,t+1} + \nu_{1,t} + \nu_{1,t-1} \tag{A65}$$

$$+(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2)\xi^0_{1,t+1} - \alpha_0 \xi_{1,t-2} - \delta_M \alpha_1 \xi_{1,t-1} - \delta_M^2 \alpha_2 \xi_{1,t} \tag{A66}$$

$$+\beta_0 \times \left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) + \beta_1 \times \left(e_{t-1} - E\left[e_{t-1} | I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) + \beta_2 \times \left(e_{t-2} - E\left[e_{t-2} | I_{t-2}^{\text{market}} \setminus \{e_{t-2}\}\right]\right), \tag{A67}$$

where $\beta_0 = \frac{(1-q_\nu)\sigma_\nu^2 + \sigma_{rf1}^2 - \delta_M^2\alpha_2\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)(1-q_\xi)\sigma_\xi^2 - \delta_M\alpha_1\left(-\delta_M^2\alpha_2\right)\sigma_{ri1}^2 - \alpha_0(-\delta_M\alpha_1)\sigma_{ri2}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2}$,
$\beta_1 = \frac{(1-q_\nu)\sigma_\nu^2 - \delta_M\alpha_1\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)(1-q_\xi)\sigma_\xi^2 - \alpha_0(-\delta_M^2\alpha_2)\sigma_{ri1}^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2}$, and
$\beta_2 = \frac{-\alpha_0\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)(1-q_\xi)\sigma_\xi^2}{(1-q_\nu)\sigma_\nu^2+\sigma_{rf1}^2+\sigma_{rf2}^2+(1-q_\xi)\sigma_\xi^2(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2)^2+\sigma_{ri1}^2\delta_M^4\alpha_2^2+\sigma_{ri2}^2\delta_M^2\alpha_1^2+\sigma_{ri3}^2\alpha_0^2}$.

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

$$ME_{t+1}^{\text{pre-report}} - ME_t^{\text{post-report}} = \nu^1_{1,t+1} + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)\xi^1_{1,t+1} \tag{A68}$$

7.4 Theoretical moments

In this section 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 investors know, 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 seven theoretical moments:

1. Earnings response coefficient:

$$E\left[\left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right)\left(p_t^{\text{post-report}} - p_t^{\text{pre-report}} - \alpha_0 \times \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right)\right)\right] = 0 \tag{A69}$$

2. Variance of earnings reports:

$$Var\left[e_t\right] = 3\sigma_\nu^2 + \left(\alpha_0 + \delta_M\alpha_1 + \delta_M^2\alpha_2\right)^2\sigma_\xi^2 + \alpha_0^2\sigma_\xi^2 + \delta_M^2\alpha_1^2\sigma_\xi^2 + \delta_M^4\alpha_2^2\sigma_\xi^2 \tag{A70}$$

3. Covariance of the earnings report at time $(t+1)$ with residuals of the "ERC" regression at time t:

$$Cov\left[e_{t+1}, p_t^{\text{post-report}} - p_t^{\text{pre-report}} - \alpha_0 \times \left(e_t - E\left[e_t|I_t^{\text{market}} \setminus \{e_t\}\right]\right)\right] = q_\nu q_\nu^0 \sigma_\nu^2 \left(\delta_I + \delta_I^2 + \delta_I^3\right) \tag{A71}$$

4. Covariance of the earnings report at time $(t+1)$ with residuals from regressing price change during year $(t+1)$

on earnings surprises at time t, $(t-1)$, and $(t-2)$:

$$Cov\left[e_{t+1}, p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}} - (\alpha_1 - \alpha_0) \times \left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) - \right.$$
$$\left.(\alpha_2 - \alpha_1) \times \left(e_{t-1} - E\left[e_{t-1} | I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) + \alpha_2 \left(e_{t-2} - E\left[e_{t-2} | I_{t-2}^{\text{market}} \setminus \{e_{t-2}\}\right]\right)\right]$$
$$= -\delta_I q_v \sigma_v^2 - \delta_I^2 q_v \sigma_v^2 + \left(1 - \delta_I^3\right) q_v q_v^0 \sigma_v^2 + \left(1 + \delta_I + \delta_I^2\right) q_v \left(1 - q_v^0\right) \sigma_v^2 \quad \text{(A72)}$$

5. Covariance of residuals of the time-t "ERC" regression with residuals from regressing investors' expectations of time-$(t+1)$ earnings report at time t on the time-t earnings report surprise, the time-$(t-1)$ earnings report surprise, and the time-$(t-2)$ earnings report surprise:

$$Cov\left[p_t^{\text{post-report}} - p_t^{\text{pre-report}} - \alpha_0 \left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right), \right.$$
$$\left. ME_t^{\text{post-report}} - \beta_0 \left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) - \beta_1 \left(e_{t-1} - E\left[e_{t-1} | I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) - \beta_2 \left(e_{t-2} - E\left[e_{t-2} | I_{t-2}^{\text{market}} \setminus \{e_{t-2}\}\right]\right)\right]$$
$$= q_v q_v^0 \sigma_v^2 \left(\delta_I + \delta_I^2 + \delta_I^3\right) \quad \text{(A73)}$$

6. Covariance of the residuals from regressing price change during year $(t+1)$ on earnings surprises at time t, $(t-1)$, and $(t-2)$ with changes in the investors' expectations of time-$(t+1)$ earnings reports during year $(t+1)$:

$$Cov\left[ME_{t+1}^{\text{pre-report}} - ME_t^{\text{post-report}}, p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}} - (\alpha_1 - \alpha_0) \times \left(e_t - E\left[e_t | I_t^{\text{market}} \setminus \{e_t\}\right]\right) - \right.$$
$$\left.(\alpha_2 - \alpha_1) \times \left(e_{t-1} - E\left[e_{t-1} | I_{t-1}^{\text{market}} \setminus \{e_{t-1}\}\right]\right) + \alpha_2 \left(e_{t-2} - E\left[e_{t-2} | I_{t-2}^{\text{market}} \setminus \{e_{t-2}\}\right]\right)\right]$$
$$= q_v \left(1 - q_v^0\right) \sigma_v^2 \left(1 + \delta_I + \delta_I^2\right) \quad \text{(A74)}$$

7. Covariance of time-$(t+4)$ earnings with the change in investors' expectations of time-$(t+1)$ earnings reports during the year $(t+1)$:

$$Cov\left[e_{t+4}, ME_{t+1}^{\text{pre-report}} - ME_t^{\text{post-report}}\right] = -\alpha_0 \left(\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2\right) q_\xi \left(1 - q_\xi^0\right) \sigma_\xi^2 \quad \text{(A75)}$$

7.5 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

$$\hat{\theta} = \text{argmin}_{\theta \in \Theta} \quad \left(\frac{1}{N} \sum_{i=1}^{N} g(Y_i, \theta)\right)^T \hat{W} \left(\frac{1}{N} \sum_{i=1}^{N} g(Y_i, \theta)\right), \quad \text{(A76)}$$

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 13 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 A76 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 A76 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 Nelder-Mead algorithm (Nelder and Mead (1965)) 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:

$$\mathbf{V} \equiv \frac{1}{N}\left[\hat{G}\hat{\Omega}^{-1}\hat{G}^{T}\right]^{-1}, \tag{A77}$$

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 a small percentage of itself (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 the value of the change in $\hat{\theta}_p$.

7.6 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 seven moments, consisting of a regression coefficient (the ERC), the variance of earnings reports, and covariances of earnings reports, the investors' expectations of earnings reports, and firm prices with each other.

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.

For each observation i, I have the following 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. 4-year-lead reported earnings, e_{t+4}^i, – earnings reported at time $4+1$.
4. 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.
5. 1-year-lagged earnings surprise, $e_{t-1}^i - LAF_{t-1}^i$, – the difference between the reported earnings number at time $(t-1)$ and the last analyst forecast before the earnings announcement.
6. 2-year-lagged earnings surprise, $e_{t-2}^i - LAF_{t-2}^i$, – the difference between the reported earnings number at time $(t-2)$ and the last analyst forecast before the earnings announcement.
7. 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.
8. 1-year-lagged change in firm prices around an earnings announcement, $p_{t-1}^{\text{post-report}i} - p_{t-1}^{\text{pre-report}i}$, – firm price on the first trading day after an earnings announcement at time $(t-1)$ minus firm price on the last trading day before the earnings announcement.
9. 2-year-lagged change in firm prices around an earnings announcement, $p_{t-2}^{\text{post-report}i} - p_{t-2}^{\text{pre-report}i}$, – firm price on the first trading day after an earnings announcement at time $(t-2)$ minus firm price on the last trading day before the earnings announcement.
10. 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.

11. 1-year-lagged change in firm prices during the year following an earnings announcement, $p_t^{\text{pre-report}_i} - p_{t-1}^{\text{post-report}_i}$, – firm price on the last trading day before an earnings announcement at time t minus firm price on the first trading day after an earnings announcement at time $(t-1)$.

12. 2-year-lagged change in firm prices during the year following an earnings announcement, $p_{t-1}^{\text{pre-report}_i} - p_{t-2}^{\text{post-report}_i}$, – 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 $(t-2)$.

13. 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.

14. 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.

In the Table 13 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 use $^{\text{pre}}$ and $^{\text{post}}$ superscripts. The coefficients α_0, α_1, α_2, β_0, β_1, and β_2 are functions of the model's primitive parameters that solve the system of equations provided above.

7.7 An alternative model with exogenous reporting noise

With the modified manager's utility function, the new equilibrium earnings report is

$$e_t = \eta_t + \varepsilon_t + (\alpha_0 + \delta_M \alpha_1 + \delta_M^2 \alpha_2)\xi_t - \alpha_0 \xi_{t-3} - \delta_M \alpha_1 \xi_{t-2} - \delta_M^2 \alpha_2 \xi_{t-1} \tag{A78}$$

With the new expression for the earnings report, all the equations to solve for the optimal response coefficients, $\alpha_0, \alpha_1, \alpha_2, \beta_0, \beta_1$, and β_2, include an additional summand – σ_η^2 – in the denominator. Because all the moments include these response coefficients, all the moments are updated. In addition, moment 2, variance of earnings reports, now includes an additional summand, σ_η^2.

Table 13: Formulas to calculate differences between empirical and theoretical moments

Moment	**Formula for difference between empirical and theoretical moments**
1. Earnings response coefficient	$\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_t^{\text{post}\,i}-p_t^{\text{pre}\,i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)\right)\left(e_t^i-LAF_t^i\right)$
2. Variance of earnings reports	$\frac{1}{N}\sum_{i=1}^{N}\left(e_i-\left(\frac{1}{N}\sum_{i=1}^{N}e_i\right)\right)^2-\left[3\sigma_\nu^2+\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)^2\sigma_\xi^2+\alpha_0^2\sigma_\xi^2+\delta_M^2\alpha_1^2\sigma_\xi^2+\delta_M^4\alpha_2^2\sigma_\xi^2\right]$
3. Covariance of the earnings report at time $(t+1)$ with residuals of the "ERC" regression at time t	$\frac{1}{N}\sum_{i=1}^{N}\left[e_{t+1}^i-\frac{1}{N}\sum_{i=1}^{N}e_{t+1}^i\right]$ $\left[\left(p_t^{\text{post}\,i}-p_t^{\text{pre}\,i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)-\left(\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_t^{\text{post}\,i}-p_t^{\text{pre}\,i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)\right)\right)\right]-$ $\left[q_\nu q_\nu^0\sigma_\nu^2\left(\delta_I+\delta_I^2+\delta_I^3\right)\right]$
4. Covariance of the earnings report at time $(t+1)$ with residuals from regressing price change during year $(t+1)$ on earnings surprises at time t, $(t-1)$, and $(t-2)$	$\frac{1}{N}\sum_{i=1}^{N}\left[e_{t+1}^i-\frac{1}{N}\sum_{i=1}^{N}e_{t+1}^i\right]$ $\left[\left(p_{t+1}^{\text{pre}\,i}-p_t^{\text{post}\,i}\right)-(\alpha_1-\alpha_0)\times\left(e_t^i-LAF_t^i\right)-(\alpha_2-\alpha_1)\times\left(e_{t-1}^i-LAF_{t-1}^i\right)+\alpha_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)-\right.$ $\left.\left(\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_{t+1}^{\text{pre}\,i}-p_t^{\text{post}\,i}\right)-(\alpha_1-\alpha_0)\times\left(e_t^i-LAF_t^i\right)-(\alpha_2-\alpha_1)\times\left(e_{t-1}^i-LAF_{t-1}^i\right)+\alpha_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)\right)\right)\right]-$ $\left[-\delta_I q_\nu\sigma_\nu^2-\delta_I^2 q_\nu\sigma_\nu^2+\left(1-\delta_I^3\right)q_\nu q_\nu^0\sigma_\nu^2+\left(1+\delta_I+\delta_I^2\right)q_\nu\left(1-q_\nu^0\right)\sigma_\nu^2\right]$
5. Covariance of residuals of the time-t "ERC" regression with residuals from regressing investors' expectations of time-$(t+1)$ earnings report at time t on the time-t earnings report surprise, the time-$(t-1)$ earnings report surprise, and the time-$(t-2)$ earnings report surprise	$\frac{1}{N}\sum_{i=1}^{N}\left[\left(p_t^{\text{post}\,i}-p_t^{\text{pre}\,i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)-\left(\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_t^{\text{post}\,i}-p_t^{\text{pre}\,i}\right)-\alpha_0\times\left(e_t^i-LAF_t^i\right)\right)\right)\right]$ $\left[FAF_t^i-\beta_0\times\left(e_t^i-LAF_t^i\right)-\beta_1\times\left(e_{t-1}^i-LAF_{t-1}^i\right)-\beta_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)\right.$ $\left.-\left(\frac{1}{N}\sum_{i=1}^{N}\left(FAF_t^i-\beta_0\times\left(e_t^i-LAF_t^i\right)-\beta_1\times\left(e_{t-1}^i-LAF_{t-1}^i\right)-\beta_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)\right)\right)\right]-$ $\left[q_\nu q_\nu^0\sigma_\nu^2\left(\delta_I+\delta_I^2+\delta_I^3\right)\right]$
6. Covariance of the residuals from regressing price change during year $(t+1)$ on earnings surprises at time t, $(t-1)$, and $(t-2)$ with changes in the investors' expectations of time-$(t+1)$ earnings reports during year $(t+1)$	$\frac{1}{N}\sum_{i=1}^{N}\left[\left(p_{t+1}^{\text{pre}\,i}-p_t^{\text{post}\,i}\right)-(\alpha_1-\alpha_0)\times\left(e_t^i-LAF_t^i\right)-(\alpha_2-\alpha_1)\times\left(e_{t-1}^i-LAF_{t-1}^i\right)+\alpha_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)-\right.$ $\left.\left(\frac{1}{N}\sum_{i=1}^{N}\left(\left(p_{t+1}^{\text{pre}\,i}-p_t^{\text{post}\,i}\right)-(\alpha_1-\alpha_0)\times\left(e_t^i-LAF_t^i\right)-(\alpha_2-\alpha_1)\times\left(e_{t-1}^i-LAF_{t-1}^i\right)+\alpha_2\times\left(e_{t-2}^i-LAF_{t-2}^i\right)\right)\right)\right]$ $\left[LAF_{t+1}^i-FAF_t^i-\frac{1}{N}\sum_{i=1}^{N}\left(LAF_{t+1}^i-FAF_t^i\right)\right]-$ $\left[q_\nu(1-q_\nu^0)\sigma_\nu^2\left(1+\delta_I+\delta_I^2\right)\right]$
7. Covariance of time-$(t+4)$ earnings with the change in investors' expectations of time-$(t+1)$ earnings reports during the year $(t+1)$	$\frac{1}{N}\sum_{i=1}^{N}\left[e_{t+4}^i-\frac{1}{N}\sum_{i=1}^{N}e_{t+4}^i\left[LAF_{t+1}^i-FAF_t^i-\frac{1}{N}\sum_{i=1}^{N}\left(LAF_{t+1}^i-FAF_t^i\right)\right]-\left[-\alpha_0\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)q_\xi\left(1-q_\xi^0\right)\sigma_\xi^2\right]\right.$

7.8 An alternative model where investors' fundamental and misreporting incentives information are correlated

In this section, I further separate investors' fundamental and incentives information learned during the year into two components: the independent component (related only to fundamentals or only to incentives, respectively) and the correlated component (related to both fundamentals and incentives). Formally, I set

$$\begin{aligned}
\nu_{1,t}^{1} = \nu_{1,t,I}^{1} + \phi_t, \quad \nu_{1,t,I}^{1} &\sim N\left(0, q_\nu(1-q_\nu^0)(1-q_\phi^\nu)\sigma_\nu^2\right), \phi_t \sim N\left(0, q_\nu(1-q_\nu^0)q_\phi^\nu\sigma_\nu^2\right); \\
\xi_{1,t}^{1} = \xi_{1,t,I}^{1} + \phi_t, \quad \xi_{1,t,I}^{1} &\sim N\left(0, q_\xi(1-q_\xi^0)(1-q_\phi^\xi)\sigma_\xi^2\right), \phi_t \sim N\left(0, q_\xi(1-q_\xi^0)q_\phi^\xi\sigma_\xi^2\right); \\
&\text{s.t. } q_\nu(1-q_\nu^0)q_\phi^\nu\sigma_\nu^2 = q_\xi(1-q_\xi^0)q_\phi^\xi\sigma_\xi^2,
\end{aligned}$$

where ϕ_t is the common component in the firm's fundamentals and the manager's misreporting incentives.

With the new model formulation, moments 1-3 and 5 remain unchanged because they are related either to learning information unknown to investors or to learning information concurrently with earnings reports. Moments 4, 6, and 7, however, need to be modified. Below are modified moments with changes in blue.

4. Covariance of the earnings report at time $(t+1)$ with residuals from regressing price change during year $(t+1)$ on earnings surprises at time t, $(t-1)$, and $(t-2)$:

$$\begin{aligned}
&Cov\left[e_{t+1}, p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}} - (\alpha_1-\alpha_0)\times\left(e_t - E\left[e_t|I_t^{\text{market}}\setminus\{e_t\}\right]\right) - \right. \\
&\left.(\alpha_2-\alpha_1)\times\left(e_{t-1} - E\left[e_{t-1}|I_{t-1}^{\text{market}}\setminus\{e_{t-1}\}\right]\right) + \alpha_2\left(e_{t-2} - E\left[e_{t-2}|I_{t-2}^{\text{market}}\setminus\{e_{t-2}\}\right]\right)\right] \\
&= -\delta_I q_\nu\sigma_\nu^2 - \delta_I^2 q_\nu\sigma_\nu^2 + \left(1-\delta_I^3\right)q_\nu q_\nu^0\sigma_\nu^2 + \left(1+\delta_I+\delta_I^2\right)q_\nu\left(1-q_\nu^0\right)\sigma_\nu^2 + \\
&\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)\left(1+\delta_I+\delta_I^2\right)q_\nu\left(1-q_\nu^0\right)q_\phi^\nu\sigma_\nu^2 + \alpha_0 q_\nu\left(1-q_\nu^0\right)q_\phi^\nu\sigma_\nu^2 + \\
&\delta_M\delta_I\alpha_1 q_\nu\left(1-q_\nu^0\right)q_\phi^\nu\sigma_\nu^2 + \delta_M^2\delta_I^2\alpha_2 q_\nu\left(1-q_\nu^0\right)q_\phi^\nu\sigma_\nu^2
\end{aligned} \tag{A79}$$

6. Covariance of the residuals from regressing price change during year $(t+1)$ on earnings surprises at time t, $(t-1)$, and $(t-2)$ with changes in the investors' expectations of time-$(t+1)$ earnings reports during year $(t+1)$:

$$\begin{aligned}
&Cov\left[ME_{t+1}^{\text{pre-report}} - ME_t^{\text{post-report}}, p_{t+1}^{\text{pre-report}} - p_t^{\text{post-report}} - (\alpha_1-\alpha_0)\times\left(e_t - E\left[e_t|I_t^{\text{market}}\setminus\{e_t\}\right]\right) - \right. \\
&\left.(\alpha_2-\alpha_1)\times\left(e_{t-1} - E\left[e_{t-1}|I_{t-1}^{\text{market}}\setminus\{e_{t-1}\}\right]\right) + \alpha_2\left(e_{t-2} - E\left[e_{t-2}|I_{t-2}^{\text{market}}\setminus\{e_{t-2}\}\right]\right)\right] \\
&= q_\nu\left(1-q_\nu^0\right)\sigma_\nu^2\left(1+\delta_I+\delta_I^2\right) + \left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)\left(1+\delta_I+\delta_I^2\right)q_\nu\left(1-q_\nu^0\right)q_\phi^\nu\sigma_\nu^2
\end{aligned} \tag{A80}$$

7. Covariance of time-$(t+4)$ earnings with the change in investors' expectations of time-$(t+1)$ earnings reports during the year $(t+1)$:

$$Cov\left[e_{t+4}, ME_{t+1}^{\text{pre-report}} - ME_{t}^{\text{post-report}}\right] = -\alpha_0\left(\alpha_0+\delta_M\alpha_1+\delta_M^2\alpha_2\right)q_\xi\left(1-q_\xi^0\right)\sigma_\xi^2+\left(-\alpha_0\right)q_\nu\left(1-q_\nu^0\right)q_\phi^\nu\sigma_\nu^2 \tag{A81}$$

Table 9 presents estimation results.