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Non-GAAP Reporting and Investment

Charles G. McClure and Anastasia A. Zakolyukina

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Charles G. McClure^a

Anastasia A. Zakolyukina^b

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ABSTRACT

The wide-spread reporting of non-GAAP earnings suggests efficiency gains from doing so. By estimating a dynamic investment model, we examine the real implications of investors using both GAAP and non-GAAP earnings to value firms. When investors use the firm's GAAP earnings only, the firm's manager—who cares about current stock prices—underinvests, and his investment is sensitive to transitory earnings. Non-GAAP earnings can improve investment efficiency by adjusting for these transitory earnings, but can also hide inefficient investment by introducing opportunistic bias. Although non-GAAP earnings induce overinvestment, they dominate GAAP-only reporting. Counterfactual analysis reveals supplementing GAAP earnings with biased non-GAAP earnings increases firm value by 3.4% relative to GAAP-only reporting. Precluding bias reduces overinvestment and further increases firm value by 1%.

Keywords: Non-GAAP; pro-forma; investment; intangible assets; real effects; structural estimation

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^aBooth School of Business, University of Chicago, IL 60637.

^bBooth School of Business, University of Chicago, IL 60637.

1. Introduction

Efficient allocation of capital requires valuing firms' shares. Investors often value firms based on earnings. But earnings, according to Generally Accepted Accounting Principles (GAAP), can include certain transitory items, which often reduce GAAP earnings such as write-offs and restructuring charges. If the manager cares about current-period stock prices, these transitory items can exacerbate distortions driven by myopia. One solution is to circumvent these distortions by supplementing GAAP earnings with non-GAAP earnings—because they do not have to follow the rules of GAAP—that exclude transitory items. However, non-GAAP earnings can induce managerial opportunism and even encourage overinvestment.¹ Therefore, it is unclear whether the prevalence of supplementing GAAP earnings with non-GAAP earnings, that is, “non-GAAP reporting,” comes with real efficiency gains. This paper quantifies the importance of non-GAAP earnings for investment in intangible assets and firm value.

We focus on investment in intangible assets because of their increasing importance for economic growth (Corrado, Hulten, and Sichel, 2005) and because GAAP requires the immediate expensing of most intangible-asset spending. Cursory evidence suggests non-GAAP reporting encourages investment in intangible assets. Figure 1 plots intangible investment when a firm reports a positive non-GAAP adjustment, which is the difference between non-GAAP and GAAP earnings, based on our sample. The simultaneous spike in investment and non-GAAP adjustment suggests non-GAAP reporting can alleviate underinvestment of GAAP-only reporting.

¹Standard setters have expressed concern that managers can use non-GAAP earnings to mislead investors, for example, <https://www.fasb.org/jsp/FASB/Page/SectionPage&cid=1176168752402>.

However, whether this increase in investment is value enhancing is unclear. Although a theoretical model can lay out the trade-offs involved, it cannot quantify the extent to which non-GAAP earnings are value enhancing or destroying. Similarly, traditional empirical analyses cannot answer a counterfactual question on whether non-GAAP reporting dominates GAAP-only reporting and to what extent precluding managers from biasing non-GAAP earnings would be beneficial. For this reason, we rely on model-based or structural estimation. Estimating a model allows us to deal with bias in non-GAAP earnings and transitory earnings being unobservable, and to quantify the valuation gains from various reporting regimes. Managers' pressure to mislead depends on how much their incentives rely on current stock prices, how much weight investors put on GAAP and non-GAAP earnings in their valuation decisions, and the extent to which investors are able to rationally anticipate managers' actions. We formalize these forces in a standard dynamic investment model.

The model features a manager who chooses investment and a bias in non-GAAP earnings. Because the manager's payoff depends on the stock price, he maximizes the sum of discounted expected future cash flows and stock prices, adjusted by the personal cost of bias in non-GAAP earnings. The manager's myopic focus on current-period stock prices combined with information asymmetry causes his investment decisions to deviate from the value-maximizing benchmark. If the manager had focused on cash flows only, his incentives would be fully aligned with the firm's investors, because he would maximize the sum of discounted expected future cash flows, that is, firm value, leading him to make efficient investment choices.

Before choosing his investment and bias, the manager observes productivity and transi-

tory earnings shocks that investors do not observe. Investors must rely on the information provided by the manager—GAAP and non-GAAP earnings—to price the firm’s shares. Both of these signals contain muddled information about fundamental cash flows: GAAP earnings muddle cash flows with the transitory shock, and non-GAAP earnings muddle cash flows with bias. Investors price the firm using a concave pricing function in GAAP and in non-GAAP earnings. This concavity induces an interaction between non-GAAP reporting and investment and allows our model to replicate the pattern in Figure 1.

The efficiency of investment decisions depends on whether the stock price is a function of GAAP earnings only versus the combination of GAAP and non-GAAP earnings. As in Stein (1989), the manager’s myopia and investors’ imperfect knowledge about his actions imply underinvestment when the stock price depends on GAAP earnings only with negative transitory shocks amplifying this underinvestment. By contrast, a value-maximizing investment would respond to fundamental productivity shocks and ignore transitory shocks. The underinvestment pattern changes when the stock price depends on both GAAP and non-GAAP earnings. Non-GAAP earnings can encourage higher investment as suggested by Figure 1. Higher investment can happen for two reasons: bias in non-GAAP earnings, which remove transitory shocks, can be used to offset income-decreasing investment; or, when setting the price, investors can start using GAAP earnings differently in the presence of non-GAAP earnings. These forces can even give rise to overinvestment.

Our model does not have a closed-form solution, so we estimate the model parameters using the simulated method of moments. This approach minimizes the difference between a set of data moments, such as means, variances, and co-variances computed from the data, and a set of moments simulated from the model. We formalize the price-earnings relation

as a non-linear S-shape function following empirical studies (Freeman and Tse, 1992; Das and Lev, 1994). For each parameter guess, we search for price as a rational expectations equilibrium given the manager's optimal investment and non-GAAP disclosure decisions. This equilibrium enforces the consistency between the manager's conjecture about the weights on GAAP and non-GAAP earnings used in the pricing equation and the actual weights used by investors.

In the estimated model, the equilibrium pricing function has a positive weight on non-GAAP earnings and a small negative weight on GAAP earnings to adjust for the impact of the equilibrium bias.² These weights arise because, although both GAAP and non-GAAP earnings provide information about fundamental cash flows, GAAP earnings are relatively more informative about bias in non-GAAP earnings than about fundamentals. That is, low GAAP earnings provide a stronger indication that the bias in non-GAAP earnings is high rather than that the fundamentals are low. Thus, investors use GAAP earnings to adjust for the expected bias from non-GAAP earnings, thereby making non-GAAP earnings an even more precise signal about fundamentals. Hence, a negative weight on GAAP earnings exists in the pricing function. Taken broadly, our model captures the well-documented fact that investors tend to focus more on non-GAAP earnings rather than on GAAP earnings (e.g., Bradshaw and Sloan, 2002).

The estimated model produces underinvestment for GAAP-only reporting and overinvestment for non-GAAP reporting. The estimated mean value of transitory earnings shock is negative, which is consistent with accounting conservatism—GAAP more readily recognizes losses over gains, resulting in mostly negative transitory items that amplify un-

²See, for instance, Admati (1985), Lundholm (1988), and Einhorn (2005).

derinvestment. This finding changes when GAAP and non-GAAP earnings are reported as a number of forces give rise to overinvestment. A positive relation exists between investment and bias; that is, higher bias in non-GAAP earnings counteracts the income-decreasing effect of higher investment. As a result, the bias in positively priced non-GAAP earnings mitigates the effect of overinvestment on the stock price. In addition, when the manager overinvests, negatively priced GAAP earnings imply a positive impact on the stock price. The overall net effect from the increase in investment on the current-period stock price is positive, which makes the overinvestment an optimal choice for the manager.

Although investment is inefficient in both reporting regimes, counterfactual analysis reveals biased non-GAAP reporting is less detrimental to firm value than GAAP-only reporting. GAAP-only reporting produces a 3.4% drop in fundamental firm value relative to the estimated value with GAAP and biased non-GAAP earnings. Stock prices also become more informative about fundamental firm value with biased non-GAAP relative to GAAP-only reporting. When bias in non-GAAP earnings is precluded, which allows investors to observe current-period fundamental cash flows, investment becomes more efficient and the average fundamental firm value increases by just under 1%. That is, we estimate the cost of bias in non-GAAP earnings to be 1% of firm value.

With the model, we estimate managers opportunistically inflate non-GAAP adjustment by about one-third. Even though we do not observe this bias in the data and no estimates exist to benchmark against, we can bound our estimate with two naïve approximations from detailed non-GAAP reconciliation data from Audit Analytics, which we have *not* used in the estimation. From these data, the upper bound on bias is 60%, which is all adjustments related to recurring items. The lower bound on bias is 19%, which is

recurring cash adjustments. Having our estimate fall between these two bounds provides some assurance that our model captures key features in non-GAAP reporting.

By evaluating the real efficiency of non-GAAP reporting and quantifying its effect on investment and firm value, we contribute to several strands of research. We add to the extensive literature on non-GAAP reporting. Prior research finds investors value non-GAAP disclosures, which can affect market prices (Bradshaw and Sloan, 2002; Marques, 2006). We add to this literature by allowing stock price to depend on earnings to capture the trade-off investors make between GAAP and non-GAAP earnings. The non-GAAP literature also shows managers define non-GAAP earnings in response to investment (Laurion, 2020). We examine this important yet underexplored economic mechanism.

We also contribute to a growing literature that examines the real effect of financial reporting. In surveys, managers admit financial reporting can influence project selection (Graham, Harvey, and Rajgopal, 2005), and theoretical work shows an ambiguous effect of noise in accounting. Some predict greater accounting noise can lead to sub-optimal investment (e.g., Kanodia, Sapra, and Venugopalan, 2004; Kanodia, Singh, and Spero, 2005), whereas others suggest improved accounting can induce managers to become more myopic and lead to worse decision-making (e.g., Gigler, Kanodia, Sapra, and Venugopalan, 2014; Edmans, Heinle, and Huang, 2016). Our basic question is how the provision of a less noisy but biased report affects firms' investment. Our counterfactual analysis supports the intuition in Dye and Verrecchia (1995) and Kanodia and Mukherji (1996) that some of the investment inefficiencies can be mitigated through flexible disclosures.

The real effects of accounting on firm investments is an empirical question. Consistent with Geng, Zhang, and Zhou (2022), we find that efforts to eliminate managerial bias

from accounting reduce intangible investment. However, without a model of optimal investment, whether observed changes move toward or away from the first-best level of investment is unclear. We find that permitting biased non-GAAP reporting is less detrimental to investors than restricting firms to only report GAAP earnings, suggesting eliminating non-GAAP reporting may inadvertently harm investors.

Finally, our paper builds on structural methods from the literature on investment to quantify the effects of financial reporting (see also Breuer and Windisch, 2019). A few recent papers attempt to quantify these effects by estimating dynamic models with reporting frictions, such as endogenous analyst earnings targets (Terry, 2017), imprecision in accounting measurement (Liang, 2020), tax-avoidance incentives (McClure, 2023), and misreporting of GAAP earnings (Terry, Whited, and Zakolyukina, 2023). These papers find the noise in accounting can lead to inefficient allocation of capital (Terry, 2017; Choi, 2021) and overinvestment (Liang, 2020), which Terry et al. (2023) show also depends on a manager's ability to misreport. We contribute to this literature by considering the role of voluntary disclosure on investment into intangible assets.³

2. The model

We model an infinitely lived firm in which a manager observes intangible capital, the productivity of capital, and transitory earnings. The manager chooses investment and reports GAAP and non-GAAP earnings. Investors use these earnings to value the firm.

³ Several recent papers have utilized structural models to answer questions in accounting. This literature covers competition in audit markets (Gerakos and Syverson, 2015), managerial incentives (e.g., Gayle and Miller, 2015; Li, 2018; Gayle, Li, and Miller, 2022), earnings misreporting (e.g., Zakolyukina, 2018; Bertomeu, Cheynel, Li, and Liang, 2021), disclosure (e.g., Bertomeu, Ma, and Marinovic, 2020; Bertomeu, Marinovic, Terry, and Varas, 2022; Zhou, 2021), and resource allocation (e.g., Choi, 2021).

2.1 Investment and expected cash flows

The firm produces profits before discretionary expenditures, y , that is a function of intangible capital, q , and a productivity shock, v_y ,

$$\log v'_y = \rho_y \log v_y + \eta'_y, \quad \eta'_y \sim^{iid} N(0, \sigma_y^2). \quad (1)$$

Throughout the paper, variables without a prime denote current period t and variables with a prime denote the following period $t + 1$. The profit function exhibits decreasing returns to scale and depends on intangible capital.⁴ We define y as

$$y = v_y q^\alpha, \quad \alpha \in (0, 1). \quad (2)$$

The manager can increase q through investment w ,

$$q' = (1 - \delta) q + w, \quad (3)$$

where δ is the depreciation rate.⁵ To focus on the relation between financial reporting and investment, we assume $w > 0$ so that the manager cannot sell w and no capital constraints exist that might limit the manager's investment choices.

Expected cash flows, which are assumed to represent dividends, d , are

$$d = y - w - \frac{\kappa_w}{2} \left(\frac{w}{q} \right)^2 q. \quad (4)$$

The final term in equation (4) is the expression for the adjustment cost from investment. This cost broadly captures the disruption to production that arises from incorporating new capital. We model these costs following prior literature (e.g., Hayashi, 1982; Whited, 1994) and assume a standard quadratic form. The expected cash flows, d , differ from actual cash flows, because d only relates to current-period activities, whereas actual cash

⁴See Falato, Kadyrzhanova, Sim, and Steri (2022), Terry (2017), and Saporta-Eksten and Terry (2018).

⁵See Li and Hall (2020) p. 3 for the motivation of R&D capital depreciation.

flows contain cash inflows and outflows that can relate to activities in other periods. To accommodate the fact that not all of the expected cash flows convert into actual cash flows during the same period and to better match the data, we allow a fraction, ρ_s , of d in period t to convert into cash in the period before $t - 1$ or after $t + 1$. We implement this reshuffling following Terry et al. (2023) as described in Internet Appendix C.

2.2 GAAP and non-GAAP earnings

The manager reports two profitability metrics—GAAP and non-GAAP earnings. The manager truthfully reports GAAP earnings, π , and they comprise expected cash flows, d , and the transitory earnings that scale with capital, v_π :

$$\pi = \underbrace{y - w - \frac{\kappa_w}{2} \left(\frac{w}{q} \right)^2}_d q + v_\pi q, v_\pi \sim^{iid} N(-\mu_\pi, \sigma_\pi^2), \mu_\pi \geq 0. \quad (5)$$

We subtract investment costs in GAAP earnings, because most internally developed intangible assets are expensed. We also allow for a non-positive mean of transitory earnings, $-\mu_\pi$, to accommodate accounting conservatism, because GAAP more readily recognizes losses over gains, resulting in mostly negative transitory items.

The transitory earnings, v_π , do not predict future transitory earnings, earnings, or dividends; thus, v_π is assumed to be independent and identically distributed. The important difference between v_π and d is that v_π is not persistent, whereas d is persistent and represents “core” earnings used for valuation. The term $v_\pi q$ includes non-recurring items such as goodwill impairments, discontinued operations, legal settlements, or (part of) restructuring expenses that have no effect on future earnings or cash flows. Although some of these transitory items can be identified by investors on their own from the financial-

statement disclosures, not all of the items can. For instance, firms often characterize (part of) restructuring expenses as non-recurring based on their private information.⁶ As a result, investors do not perfectly observe v_π , and they have difficulty ascertaining how much of GAAP earnings are a result of fundamental versus non-fundamental shocks.

Transitory earnings scale with capital to capture the idea that larger firms have larger transitory earnings; for example, larger firms have larger errors in estimates of contingent liabilities. For this reason, the firm cannot dissipate the effect of transitory earnings by getting bigger. Instead, because current-period investment feeds into the next-period capital, larger current-period investment amplifies the impact of next-period transitory earnings shocks, which affects the manager's investment decisions.

The manager's disclosure of GAAP and non-GAAP earnings implies a non-GAAP adjustment, ψ , which is the exclusions to reconcile non-GAAP with GAAP earnings.⁷ This adjustment can eliminate transitory earnings, but the manager can also introduce bias, b , that, similar to v_π , scales with capital:

$$\psi = (-v_\pi + b)q. \quad (6)$$

The transitory component of GAAP earnings, $v_\pi q$, is subtracted in ψ because the purpose of the non-GAAP adjustment is to reverse transitory items that are not useful for valuation.

Removing $v_\pi q$ is consistent with the SEC's regulation, which requires firms to state why

⁶In response to the SEC comment letter on October 3, 2016, the Procter & Gamble Company wrote about excluding part of restructuring expenses related to the multi-year transformational productivity program: "Importantly, the non-GAAP adjustments [...] only include the incremental spending above the amount incurred in the year prior to the commencement of the transformational productivity program [...] Once this program is completed, we expect to revert to the above mentioned ongoing level of restructuring activity and would not present adjustments to our GAAP earnings for that activity." See <https://www.sec.gov/Archives/edgar/data/80424/000008042416000226/filename1.htm>.

⁷If the manager chooses to not provide a non-GAAP earnings amount, $\psi = 0$.

non-GAAP earnings are particularly useful for investors.⁸

The opportunistic component, b , inflates non-GAAP earnings so that “core” earnings appear to be higher than they really are. Bias can exclude recurring expenses or continue to include transitory gains in non-GAAP earnings (e.g., Curtis, McVay, and Whipple, 2013). Accordingly, if the manager opportunistically biases his non-GAAP adjustment, he biases upwards; that is, $b \geq 0$, so that non-GAAP earnings, which are the sum of GAAP earnings and the non-GAAP adjustment, become higher at $d + bq$. The non-negative nature of opportunistic bias in the non-GAAP adjustment distinguishes it from accrual-based manipulation in prior dynamic models (Zakolyukina, 2018; Terry et al., 2023). In these papers, accrual-based manipulation is inter-temporal, so the manager can have an incentive to bias GAAP earnings downwards to benefit from the accrual reversal in the future. However, no future reversal of non-GAAP adjustments occurs, so biasing non-GAAP earnings downwards provides no apparent benefit. Indeed, 94% of non-GAAP adjustments are non-negative in the data.

2.3 Manager’s one-period payoff

The manager’s one-period payoff in his infinite-horizon optimization problem is the weighted sum of the current period’s expected cash flows and the stock price minus the personal cost from biasing non-GAAP:

$$d_M = d + \theta p - \frac{\kappa_b}{2} b^2 q, \quad (7)$$

where p is the stock price with θ capturing the short-term stock-price-related incentives, and κ_b captures the personal costs that the manager incurs from biasing non-GAAP earnings. We scale the personal costs by q to be consistent with our scaling in ψ and

⁸See Regulation S-K, Item 10(e).

our scaling in the quadratic investment costs. The personal costs from biasing include the reputational costs from being overly optimistic about the firm's profitability and, to a lesser extent, the effort required to justify biased non-GAAP earnings to investors and regulators (e.g., Hirshleifer and Teoh, 2003).

Like many papers in the literature (e.g., Nikolov and Whited, 2014; Glover and Levine, 2017; Terry et al., 2023), we do not specify a particular contract for the manager. An endogenous nature of a contract presents many challenges that go beyond the objectives of this paper. By taking the contract as given, we attempt to understand the consequences of contractual choices when managers want to maximize not only cash flows, but also earnings in order to maintain a high stock price. These competing incentives can lead to suboptimal investment decisions.⁹

2.4 Stock prices

Investors observe GAAP and non-GAAP earnings and weigh them rationally when valuing the firm (Bradshaw and Sloan, 2002; Marques, 2006; Baik, Billings, and Morton, 2008). They can scrutinize non-GAAP earnings and can unwind the most egregious adjustments when setting the price (e.g., Gu and Chen, 2004; Doyle, Jennings, and Soliman, 2013). However, we constrain their ability to do so to setting the weights in the pricing function. We assume investors focus on these two signals because they are commonly used in earnings-based valuation (e.g., Koller, Goedhart, and Wessels, 2010). Although, in reality, investors consider other information, limiting investors' information set allows us to tractably solve for the pricing equilibrium.

Investors are aware of the manager's myopia and incentives to distort non-GAAP

⁹See, for instance, Bizjak, Brickley, and Coles (1993) and Bens, Nagar, and Wong (2002).

earnings, but they do not know everything that the manager knows. They price the firm by assigning weights to non-GAAP earnings, $\pi + \psi$, and GAAP earnings, π , based on their expectation of firm value. We assume $\pi + \psi$ and π map to the stock price as follows:

$$p = \beta_0 + \beta_1 \underbrace{g(\pi + \psi)}_{d+bq} + \beta_2 \underbrace{g(\pi)}_{d+v_\pi q}. \quad (8)$$

Prior theoretical literature often assumes $g(\cdot)$ to be a linear function (e.g., Fischer and Verrecchia, 2000). But empirical evidence suggests this function is concave or S-shaped (e.g., Freeman and Tse, 1992; Das and Lev, 1994). Although a linear pricing function is common in theoretical models, in this model, a linear function delivers an optimal bias b^* , which is constant and does not depend on investment or state variables, $b^* = \frac{\theta\beta_1}{\kappa_b}$.¹⁰ Thus, linear pricing cannot reproduce a positive relation between investment and non-GAAP adjustment shown in Figure 1.

For this reason, we use a concave function and assume $g(x) = \text{sign}(x)\sqrt{|x|}$ plotted in Figure 2. Internet Appendix A shows a concave pricing function is consistent with our dynamic model. We recognize that the specific functional form we assume is ad hoc, but it delivers the concavity and the S-shape earnings-price relation in the empirical literature (Holthausen and Watts, 2001). This S-shape occurs when investors discount large earnings, because of the possibility of large transitory items or reporting opportunism (Riffe and Thompson, 1998), when investment opportunities vary (Kumar and Krishnan, 2008), or when investors are uncertain about the precision of information (Subramanyam, 1996).¹¹

¹⁰ With a linear function, the manager's problem of choosing the optimal bias reduces to $\max_b \theta\beta_1 bq - \frac{\kappa_b}{2} b^2 q$, and taking the first-order condition yields the optimal bias $b^* = \frac{\theta\beta_1}{\kappa_b}$.

¹¹ Bertomeu et al. (2021) also obtain an S-shape pattern using nonparametric estimation in a structural model of earnings misreporting, suggesting the S-shape is consistent with research that permits more flexible functional forms.

The two earnings signals represent a trade-off between a reliance on fundamental cash flows distorted by bias, that is, non-GAAP earnings $d + bq$, or by noise, that is, GAAP earnings $d + v_\pi q$. Depending on parameters, the concave pricing function can deliver different relations between fundamental cash flow, the transitory shock, and bias. Under these different relations, investors may rationally assign positive weights to both GAAP and non-GAAP earnings signals (i.e., β_1 and β_2), or a positive weight on one and a negative weight on the other. Estimating the model allows us to quantify this bias-noise trade-off and its implications for real investment efficiency.

2.5 Manager's problem

The manager observes the state, $s = \{q, v_y, v_\pi\}$. The first state variable, q , is intangible capital. The second and third state variables, v_y and v_π , are the productivity shock and transitory shock to earnings, respectively.

Based on these state variables and model parameters, the manager chooses the optimal level of investment, w , and opportunistic bias in the non-GAAP adjustment, b , to maximize future cash flows and stock prices adjusted by the personal costs of b .¹² We set the manager's discount rate equal to the investors' discount rate r . This choice rules out the possibility of the differences in discount rates causing additional differences between the manager's choices and the value-maximizing choices investors would have made. Accordingly, the Bellman equation for the manager's optimization problem is

$$V_M(q, v_y, v_\pi) = \max_{w, b} \left\{ d_M + \frac{1}{1+r} \mathbb{E}_{v_y, v_\pi} V_M(q', v'_y, v'_\pi) \right\}. \quad (9)$$

¹²We do not model the manager's decision regarding whether to provide non-GAAP earnings. Laurion (2020) proposes the commitment to provide non-GAAP earnings as an alternative reason for aggressive non-GAAP reporting. However, over 70% of firms oscillate between not reporting and reporting non-GAAP earnings over our sample period in Internet Appendix Figure IA.1. This switching suggests commitment is not common and is unlikely to be a first-order driver of non-GAAP reporting choices.

In this Bellman equation, the manager must form expectations of the continuation payoff, $V_M(q', v'_y, v'_\pi)$, over all possible future values of v'_y and v'_π . This problem does not have a closed-form solution, and thus, we solve equation (9) numerically.

Although (9) gives lifetime managerial utility, it does not represent the fundamental value of the firm V_F , which is simply the present value of expected future cash flows, d . Given the manager's privately optimal investment policy w^* from equation (9), the fundamental firm value is

$$V_F(q, v_y, v_\pi) = d^* + \frac{1}{1+r} \mathbb{E}_{v_y, v_\pi} V_F(q', v'_y, v'_\pi), \quad (10)$$

where d^* is cash flows implied by the optimal manager-chosen policy. We note that in the absence of the incentives to manipulate the stock price, $\theta = 0$, managerial utility (9) equals fundamental firm value (10).

2.6 Optimal policies

Before discussing optimal policies, we highlight three basic results. First, the model produces underinvestment when only GAAP earnings are reported.¹³ This result follows from Stein (1989): by investing below the optimal level, the manager borrows from future earnings to inflate current-period earnings and convey a higher firm value, thereby boosting the current-period price. Second, the model can produce a positive relation between investment and bias, which happens because the marginal benefit of bias increases in investment for the concave pricing function, when non-GAAP earnings are positively priced. That is, higher income-decreasing investment makes higher bias more attractive. Third, the model allows for non-GAAP reporting to alleviate underinvestment or even

¹³See, for instance, Miller and Rock (1985), Stein (1989), Bebchuk and Stole (1993), Kanodia and Mukherji (1996), and Kanodia et al. (2004).

trigger overinvestment. There are two reasons for this: bias in non-GAAP earnings can be used to offset income-decreasing investment; or investors can start using GAAP earnings differently in the presence of non-GAAP earnings as discussed below.

First establishing a benchmark of optimal policies with GAAP-earnings-only reporting is instructive. We do so in Figure 3, Panel A. As expected, investment increases with the productivity shock (left panel), because when productivity is high, investment earns higher future cash flows, and thus, investing more is efficient. Investment would depend only on the productivity shock, if the manager did not care about the stock price. However, because the manager cares about the stock price that depends on GAAP earnings, investment increases with the transitory shock to earnings (right panel).¹⁴ It follows that a negative transitory earnings shock amplifies underinvestment, because a negative shock makes investment more expensive by decreasing GAAP earnings.

The optimal policies change when investors observe both GAAP and non-GAAP earnings in Figure 3, Panel B. In the equilibrium of the estimated model, we find investors put a positive weight on non-GAAP earnings and a small negative weight on GAAP earnings. Because pricing weights and optimal policies are jointly determined in our model with endogenous prices, we first discuss the intuition for the optimal policies and then the pricing weights. As before, investment increases with the productivity shock (top-left panel). By contrast, the bias decreases with the productivity shock (top-right panel), because, when fundamentals are good, there is less need to bias. To be precise, because of the concave pricing function in non-GAAP earnings and the positive pricing weight, the

¹⁴This sensitivity of investment to transitory earnings is similar to Tomy (2018) findings that R&D expense is reduced in response to short-term cash-flow shocks.

marginal benefit of bias decreases with better fundamentals. Next, investment decreases with the transitory earnings shock (bottom-left panel), because when the transitory shock is high, there is less impact from increasing investment to minimize the pricing effect of a high transitory earnings shock in GAAP earnings. To be precise, because of the concave pricing function in GAAP earnings and the negative pricing weight, the marginal benefit of investment decreases in the transitory earnings shock. Finally, bias also decreases with the transitory earnings shock (bottom-right panel), which is a result of a positive relation between investment and bias and investment decreasing in the transitory shock.

The optimal policies are consistent with the pricing weights. In fact, we observe a broadly similar pattern in the data in Figure 2: the weight on non-GAAP earnings is positive and statistically significant, whereas the weight on GAAP earnings is insignificant. A particular correlation pattern induced by the equilibrium policies affects the signs of the pricing weights. Both GAAP and non-GAAP earnings are imperfect signals about fundamentals, in which the “noises”—the transitory shock and bias—are correlated with fundamentals. In GAAP earnings, fundamental cash flows are *positively* correlated with the transitory shock, because income-decreasing investment decreases in the transitory shock, which is the bottom-left plot in Panel B, Figure 3. In non-GAAP earnings, fundamental cash flows are *negatively* correlated with bias, because bias and income-decreasing investment are positively correlated, resulting in higher cash flows when investment and bias are low.

In Internet Appendix B, we show a negative weight on GAAP earnings and a positive weight on non-GAAP earnings are possible when the following conditions hold. First, the correlations above are sufficiently large. Second, non-GAAP earnings are more informa-

tive about fundamentals than about the transitory shock. Third, GAAP earnings are more informative about bias in non-GAAP earnings than about fundamentals. That is, low GAAP earnings provide a stronger indication that the bias in non-GAAP earnings is high rather than that the fundamentals are low. As a result, investors use GAAP earnings to adjust for the expected bias in non-GAAP earnings, thereby making non-GAAP earnings an even more precise signal about fundamentals. Hence, a negative weight on GAAP earnings exists in the pricing function.

These pricing weights and a positive relation between investment and bias can alleviate the underinvestment of GAAP-only reporting and even trigger overinvestment. The cost of investment is incurred in the current period, whereas the benefit is realized in future periods because investment decreases current-period cash flows, d , and increases next-period capital, q' . When investment increases, current-period GAAP earnings, $d + v_{\pi}q$, decrease, because d decreases, but $v_{\pi}q$ does not change, because current-period investment does not affect current-period capital, q . At the same time, non-GAAP earnings, $d + bq$, do not decrease as much when d decreases, because a positive relation exists between investment w and bias b , and thus, the corresponding increase in b counteracts the drop in d caused by investment. Thus, when a manager increases investment, GAAP earnings decrease, which translates into an increase in price, because of the negative pricing weight. This increase in price counteracts a drop in price from a smaller decrease in non-GAAP earnings, which have the positive pricing weight. This finding implies an overall net positive effect on the current-period price from high investment.

3. Data

We combine quarterly firm-level data from Compustat and non-GAAP earnings from Bentley, Christensen, Gee, and Whipple (2018).¹⁵ We exclude regulated utilities (SIC 4900–4999), financial firms (6000–6999), and firms categorized as non-operating establishments (9000+). We require the value of total assets to be above \$5 million and the ratio of intangible capital to total assets, as defined in section 3.2, to be greater than 10% in all years a firm is in our sample. To ensure the non-GAAP disclosure decision is relevant, firms enter the sample starting the quarter they first disclose non-GAAP earnings in the Bentley et al. (2018) data. Finally, we require that all variables used in the estimation are non-missing and that each firm has at least two observations. To remove outliers, we winsorize all variables at the 1% level. The sample includes 1,416 firms that correspond to 21,216 firm-quarters over the 11-year period from 2006 to 2016. Table 1, Panel A, provides the variable definitions. Table 2 reports summary statistics.

3.1 Non-GAAP adjustments

To compute non-GAAP adjustments, we subtract GAAP earnings “as first reported” in the Compustat preliminary-history data from quarterly non-GAAP earnings.¹⁶ We convert EPS-level adjustments to earnings-level adjustments by multiplying EPS by the number of common shares for diluted EPS as in Bentley et al. (2018).

¹⁵We downloaded the data from Kurt H. Gee’s webpage at <https://sites.google.com/view/kurthgee/data> in October of 2018. In the data, about one-third of firms have not reported non-GAAP earnings. Appendix A provides an example of non-GAAP reconciliation.

¹⁶Bentley et al. (2018) collect non-GAAP EPS disclosures from firms’ earnings announcements filed in 8-K forms using non-GAAP-related words and phrases. Bentley et al. (2018) provide examples of the words and phrases identified in prior research and expanded through extensive hand collection. Among many others, these terms include “adjust,” “proforma,” “non-GAAP,” “core,” and “operating earnings.”

Table 3 provides statistics on line items in non-GAAP adjustments using Audit Analytics data. This granular sample is smaller and only covers 609 S&P 500 firms that correspond to 6,893 firm-quarters over 2014–2018.¹⁷ We sort these items into 23 categories and group them into whether they are likely to recur over time and whether they are cash or non-cash related (Black, Christensen, Ciesielski, and Whipple, 2018). We find 53.2% are recurring. Despite the SEC encouraging firms to exclude only non-recurring items, a significant number of firms still exclude recurring items. We find 42% of items are cash, with over half of these items relating to acquisitions and restructuring charges. Although none of these line items are clear indications of outright bias, given the range of exclusions, the manager can have sufficient latitude to opportunistically exclude certain items.

3.2 Intangible capital

Internally developed intangible assets are not (for the most part) capitalized in financial statements. For this reason, previous research uses a set of assumptions to estimate intangible capital, and we do the same. We measure intangible capital as the sum of knowledge and organization capital computed using the perpetual-inventory method. Following the literature, we interpret R&D expenditures as investment in knowledge capital.¹⁸ Similarly, we interpret a fraction of SG&A expenditures as investment in organization capital.¹⁹ For example, organization capital can include an investment in human capital, such as training expenses, and brand capital, such as advertising expenses.

The stock of knowledge and organization capital is computed by cumulating the de-

¹⁷Audit Analytics collects its data from Regulation G non-GAAP reconciliation tables. We exclude funds from operations (FFO), which is a common non-GAAP metric for real estate investment trusts, because little discretion exists in this industry-defined metric (Baik et al., 2008).

¹⁸See, for instance, Lev and Sougiannis (1996), Corrado and Hulten (2010), and Peters and Taylor (2017).

¹⁹See, for instance, Lev and Radhakrishnan (2005) and Eisfeldt and Papanikolaou (2013).

lated value of intangible investments

$$q_{it}^k = (1 - \delta_k)q_{it-1}^k + w_{it}^k, \quad (11)$$

where q_{it-1}^k is the existing stock of knowledge or organization capital $k = \{R\&D, SG\&A\}$, δ_k is the depreciation rate, and w_{it}^k is the investment amount. Investment in knowledge capital, $w_{it}^{R\&D}$, is defined as the R&D expense. Investment in organization capital, $w_{it}^{SG\&A}$, is defined as a fraction $\gamma_{SG\&A}$ of SG&A expense.²⁰ The stock of both intangible capital and investment are deflated by the consumer price index.

To implement this method, we need an estimate of the initial capital stock, the fraction of SG&A that represents the investment in organization capital, and the depreciation rates. We follow Eisfeldt and Papanikolaou (2014) and set the initial value to $q_0^k = \frac{w_{i1}^k}{g_k + \delta_k}$, where g^k is the average industry-specific real growth rate of firm-level investment and w_{i1}^k is the investment during the first year a firm is observed in Compustat. We identify four industries and use typical values from the literature.²¹ For organizational capital, $\gamma_{SG\&A} = 0.3$ and $\delta_{SG\&A} = 0.2$. For knowledge capital, the industry-specific depreciation rates are from Li and Hall (2020), assumed to be 15% if missing.

4. Estimation

Our model is described by 14 parameters summarized in Table 1. Three parameters relate to the pricing function, that is, the intercept β_0 , weight on non-GAAP earnings β_1 , and weight on GAAP earnings β_2 (Panel B). We do not estimate these parameters, because they do not reflect economic primitives. Rather, they arise endogenously in the

²⁰We measure SG&A expense as in Peters and Taylor (2017), Appendix B.1

²¹Eisfeldt and Papanikolaou (2014) identify five industries, but we do not use finance firms in our analyses. For typical values of $\gamma_{SG\&A}$ and $\delta_{SG\&A}$, see Hulten and Hao (2008), Eisfeldt and Papanikolaou (2014), Peters and Taylor (2017), Ewens, Peters, and Wang (2019), and Falato et al. (2022).

model's equilibrium. In this equilibrium, the manager, when choosing his investment and disclosure decisions, correctly infers the weights investors put on non-GAAP and GAAP earnings, and investors, when pricing the firm, correctly infer the manager's investment and non-GAAP disclosure decisions.²² The need to discipline the pricing coefficients within this rational-expectations framework precludes us from using prices directly from the data, because many other forces outside of the model also affect these prices.

We estimate three of the remaining 11 parameters outside of the model (Panel C). The first is the depreciation rate, δ , which we set to the weighted average of organizational and knowledge capital depreciation rates. The second is the discount rate, r . We assume a quarterly discount rate of 1.5%, which corresponds to the annual discount rate of 6%.²³ The third is the cash-flow reshuffling parameter, ρ_s , which helps us better match model-based expected cash flows to data-based cash flows discussed in Internet Appendix C.

We estimate the remaining eight parameters (Panel D) using the simulated method of moments (SMM). SMM minimizes the weighted-squared distance between empirical and simulated moments.²⁴ Our weight matrix is the inverse covariance matrix of our data.²⁵

We set our simulated data to be 20 times the size of our data to reduce simulation error.

²² We verify that the model is internally consistent in Figure IA.3 in Internet Appendix. Because investors use an S-shape function for GAAP and non-GAAP earnings when pricing firms' shares, the S-shape pattern should be present in the fundamental firm value V_F . That is, the functional form imposed on investors' beliefs should hold in the realized firm value. Indeed, Figure IA.3 shows the S-shape pattern in V_F for both GAAP and non-GAAP earnings.

²³ We introduce myopia by having the manager care about current-period stock prices in his infinite-horizon problem. An alternative (and additional) way to introduce myopia is through the manager's subjective discount rate (Bertomeu et al., 2022) or finite employment horizon (Taylor, 2010).

²⁴ For an overview of SMM, see Cameron and Trivedi (2005).

²⁵ When computing the weight matrix, we remove firm and fiscal-quarter fixed effects from all the variables used to compute our moments, including the variables used to compute means. We do not cluster our weight matrix. However, we do double-cluster the covariance matrix of moments used to compute standard errors by firm and year. For the discussion of this approach to computing a weight matrix, see Li, Whited, and Wu (2016) and Bazdresch, Kahn, and Whited (2017).

To find the parameters, we first use a particle-swarm optimization for a global search in the parameter space and then use a pattern-search optimization for a local search. In each iteration of an optimization, we find the price by solving for a rational-expectations equilibrium as described in Internet Appendix D.3.

4.1 Identification

Our SMM estimation uses 22 moments. Because we model the decisions of a representative firm, we must adjust for firm-specific heterogeneity. We do so by removing firm and fiscal-quarter fixed effects when computing all the moments, except for the moments that correspond to average values. The first two moments are the average values of investment and earnings, both scaled by intangible capital. The next six moments relate to covariances, all of which are computed using growth rates following Davis and Haltiwanger (1992) and Terry (2017).²⁶ This set of moments is a complete set of covariances of investment growth, GAAP earnings growth, and cash-flow growth.²⁷

To allow for the possibility that firms behave differently when they report non-GAAP earnings, we condition the next set of moments on the non-GAAP adjustment being positive.²⁸ The first two conditional moments are the fraction of positive non-GAAP adjustments and the average positive non-GAAP adjustment to capital. The next 10

²⁶For the variable x , we define the growth rate as $\Delta x = 0$, if $x = 0$ and $x_{-1} = 0$ and $\Delta x = 2(x - x_{-1})/(|x| + |x_{-1}|)$, otherwise. These growth rates lie in $[-2, 2]$. We compute year-over-year growth rates.

²⁷ Even though investors only observe GAAP and non-GAAP earnings, we include moments that use investment and cash flow. Doing so keeps the focus on how investors weigh noisy versus biased earnings without overcomplicating the model. If we restricted ourselves to the nine moments that exclusively rely on data investors can observe, we would be unable to identify the eight parameters. We have also re-estimated the baseline specification with investment added into the pricing function, which does not show a drastic improvement in model fit in Internet Appendix Table IA.1.

²⁸We set a lower bound for a positive non-GAAP adjustment at 1 basis point of intangible capital. We do so to make the actual data and the data simulated from the model comparable because the non-GAAP adjustment, ψ , is a continuous variable in the model, which can have very small values that would be immaterial in the actual data.

moments are a complete set of conditional covariances of investment growth, GAAP earnings, cash flow, and non-GAAP-adjustment growth. The last two moments are the coefficients on non-GAAP earnings and GAAP earnings when they are regressed on price.

Although some moments can depend on several parameters, certain parameters have strong monotonic relationships with certain moments, which are particularly relevant for identifying these parameters. We follow the literature and select our moments based on their comparative statics.²⁹ To compute comparative statics, we set our parameters to the baseline estimates in Table 4 and then vary each parameter one by one to create a plot for each simulated moment. The most relevant of these comparative statics are in Figure 4.

We start with the parameters that govern our production function. The first parameter is the curvature of the production function, α . When α increases, profit reacts more strongly to capital, which results in higher variance of earnings growth (Panel A of Figure 4). The second parameter is the adjustment cost from investment, κ_w . Because the quadratic cost of investment increases with κ_w , the cost of manipulating the stock price using investment also increases, and thus, the use of non-GAAP adjustments to influence the stock price becomes more prominent, which results in higher variance of non-GAAP adjustments (Panel B). The next two parameters govern the productivity shock, v_y . The first parameter is the persistence of the productivity shock, ρ_y . A higher persistence increases responsiveness of investment, which results in a stronger (negative) sensitivity of investment to cash-flow growth (Panel C). The second parameter is the volatility of the productivity shock, σ_y . The higher volatility of the productivity shock mechanically increases the volatility of investment growth (Panel D).

²⁹See, for instance, Hennessy and Whited (2005), Nikolov and Whited (2014), and Terry et al. (2023).

The final four parameters relate to financial reporting and incentives. The first parameter is the volatility of the transitory earnings, σ_π . Mechanically, the higher volatility of transitory earnings results in a higher variance of earnings growth. Less mechanical is σ_π 's effect on the covariance of investment and non-GAAP adjustment growth (Panel E). This covariance increases with σ_π as both investment and the non-GAAP adjustment respond to the higher volatility of transitory earnings (Figure 3). The second parameter is the relative importance of stock price in the manager's objective function, θ , which captures the strength of the manager's myopia. The more important the stock price and the signals that determine it, the more responsive the manager's non-GAAP adjustment decisions become to transitory earnings. As a result, the incidence of non-GAAP adjustments increases (Panel F). The third parameter is the manager's personal cost from introducing bias b into non-GAAP adjustment, κ_b . As biasing non-GAAP earnings becomes more costly, investors rationally set a higher weight on non-GAAP earnings (Panel G). Our fourth and final parameter is the non-positive mean of transitory earnings, $-\mu_\pi$ ($\mu_\pi \geq 0$). Because non-GAAP adjustments reverse the larger negative impact of transitory earnings when μ_π increases, the average non-GAAP adjustments increase (Panel H).

4.2 Estimation results

The results for the baseline estimation are in Table 4. In Panel A, we compare data and moments simulated from the model. In Panel B, we report the parameter estimates.

4.2.1. Parameter estimates

The parameter estimates of the firm's production function are similar to those in the literature. The curvature of the profit function, α , is 0.575, which is similar to the

productivity parameters used in Bloom, Schankerman, and Van Reenen (2013) and Terry (2017). The adjustment cost to intangible investment, κ_w , is 0.338. It is lower than the 0.500 for physical capital in Nikolov and Whited (2014), which is conceivable because increasing intangible capital is less disruptive than increasing physical capital. The persistence of the productivity shock, ρ_y , is 0.488; it is similar to Castro, Clementi, and Lee (2015) and Terry et al. (2023). The volatility of productivity, σ_y , is 0.127. When annualized, this estimate corresponds to 0.254, which is similar to the estimate in Terry et al. (2023).

The last four parameters relate to financial reporting and incentives. The transitory earnings shock, σ_π , is much lower than the volatility of the productivity shock. Because ν_π (and hence, σ_π) scales with capital, our estimated value of σ_π at 0.021 implies approximately 68% of observations have a transitory earnings shock from -3.2% to 1% of capital.³⁰ The relative importance of stock-price incentives, θ , is 0.386. To provide interpretation, note a dollar in cash flows is not directly comparable to a dollar in stock price, because one is a one-period flow and the other is the present value of one-period flows over an infinite horizon. In our data, the price-to-dividend ratio is close to 34, so that the corresponding weight on the price-implied measure of cash flows $\hat{d}$ becomes $\theta \times 34 = 13.12$; that is, a dollar increase in $\hat{d}$ is 13.12 times more important than a dollar increase in d . Accordingly, the stock-price-related incentives are substantially more important than cash flows.

The manager's personal cost of bias in non-GAAP earnings, κ_b , is reported after dividing by 10. At this estimate of κ_b and the average levels of bias b and capital q , the manager's personal cost of bias is approximately 5% of cash flows. Accordingly, the

³⁰This estimate is a result of 32% of observations drawn from a normal distribution being at least one standard deviation away from the mean, which is -1.1% based on the estimate of μ_π .

personal cost of bias seems small, and the more important constraint on the bias is the discipline investors impose through their weighing of non-GAAP and GAAP earnings.³¹ Finally, the non-positive mean of the transitory earnings shock, $-\mu_\pi$, is 0.011. Because ν_π scales with capital, this estimate implies the absolute value of the average transitory earnings is about 1.1% of capital.

4.2.2. Model fit

We also compare data moments and moments simulated from the model. We find no statistically significant differences in eight of the 22 moments. For the remaining 14 moments with statistically significant differences, most are not economically different. The notable exceptions are the simulated data having a higher variance of intangible investment, stronger covariance of investment and earnings, lower variance of cash flows, and a lower coefficient on non-GAAP earnings in the pricing equation. The test of overidentifying restrictions rejects the hypothesis that all 22 simulated moments equal the empirical moments at the 1% confidence level, which is common because any model can be rejected with enough data and moments.

4.2.3. Investment and non-GAAP adjustments

A positive relation between investment and bias is one of the model's basic results introduced in section 2.6. As a consistency check, we examine whether our model indeed replicates the relation between investment and non-GAAP adjustments in the data in

Figure 1. In the model, because of the concave pricing function in positively priced non-

³¹ The difference in the magnitudes of κ_w and κ_b is due to scaling. In the model, κ_w enters into the manager's objective function as $(\kappa_w/2)(w/q)^2q$, whereas the personal cost from the biasing parameter, κ_b , enters as $(\kappa_b/2)b^2q$. The averages of b and w/q in the simulated data imply the relative effect of the adjustment cost of investment is about one-sixth of the personal cost of bias, that is, $(\kappa_b/2)b^2|_{\kappa_b=28.505 \times 10, b=0.0046} = 0.00301$ vs. $(\kappa_w/2)(w/q)^2|_{\kappa_w=0.338, w/q=0.052} = 0.00045$.

GAAP earnings, the marginal benefit of bias increases with higher investment. As a result, a spike in intangible investment should coincide with a positive non-GAAP adjustment.

In Figure 5, we replicate the plots in Figure 1 using our simulated data. The outcome variables are intangible investment or non-GAAP adjustment, denoted by w_{jt} for firm j in quarter t , both scaled by capital for the quarters $[-2, 2]$ around the quarter in which the company provided a sufficiently positive non-GAAP adjustment. We use the indicator for the sufficiently positive non-GAAP adjustment, $\mathbb{I}(\text{Positive non-GAAP adj.})$, which is set to 0 for the bottom 1% of non-GAAP adjustments, and 1 otherwise, along with industry, f_{ind} , year, g_{year} , and quarter, g_{qtr} , fixed effects:

$$w_{jt} = \sum_{k=-2}^2 \beta_k \mathbb{I}(\text{Positive non-GAAP adj.})_{jt+k} + f_{ind} + g_{year} + g_{qtr} + \varepsilon_{jt}. \quad (12)$$

We double-cluster standard errors by firm and year and plot the coefficients for the non-GAAP indicators. The figure shows data simulated from our model can reproduce the positive relation between investment and non-GAAP adjustments observed in the data, which confirms inflated non-GAAP earnings can support higher investment.

4.2.4. Intangible capital intensity

Intangible investment is increasingly important in the economy, but not equally so for all firms. In Table 5, we re-estimate our model using firms for which intangible capital is less important, the lowest tercile of intangible capital intensity, or more important, the highest tercile. We define intangible capital intensity as the fraction of total capital that is intangible, where the total capital is the sum of intangible capital and plant, property, and equipment, net. High-intangible firms have a higher quadratic cost from biasing, κ_b , which likely reflects the heightened importance of non-GAAP disclosures for them. High-

intangible firms also have a larger mean of the transitory shock, μ_π , which is consistent with their higher likelihood of transitory events such as intangible-specific impairment losses and litigation (Kempf and Spalt, 2023). Finally, high-intangible firms have a lower weight on current stock prices, θ , because the payoffs on intangible capital often take years to be realized, consistent with managers of these firms being less myopic (Edmans, 2009).

4.3 Counterfactual analyses

In Table 6, we quantify the effect of non-GAAP reporting on investment and firm value. We present four sets of counterfactual experiments based on the three sets of parameter estimates in Tables 4 and 5. For each of these parameter sets, we adjust the manager's problem to reflect hypothesized scenarios not observed in the data. We focus on the average bias scaled by gross non-GAAP adjustments, change in investment intensity, residual uncertainty of the firm's value in stock price, and change in firm value.

In addition to our model as estimated (column (1)), we show a model without myopia, that is, the first-best scenario (column (2)), a model without non-GAAP reporting (column (3)), and a model with non-GAAP reporting, where the manager cannot lie but is still myopic (column (4)). The first-best scenario is implemented by setting $\theta = 0$, which reduces the manager's problem to choosing investment to maximize the fundamental value of the firm, V_F , as defined in equation (10). The model without non-GAAP reporting is implemented by excluding the non-GAAP signal from the stock price function. The model with non-GAAP reporting where the manager cannot lie is implemented by setting non-GAAP earnings equal to expected cash flows, in which case price does not depend on GAAP earnings. Except for the first-best counterfactual, which does not require solving for the

stock price, we re-solve for the rational-expectations equilibrium based on the particular counterfactual's information structure. That is, each counterfactual has a different set of pricing parameters.

The counterfactuals for the baseline estimation are in Panel A. The mean bias scaled by gross non-GAAP adjustments is 33.38%; that is, about one-third of non-GAAP adjustments are opportunistic bias that inflates non-GAAP earnings. If we naïvely assume all adjustments for recurring items or recurring cash items correspond to the bias, the fraction of "biased" adjustments in Table 3 is approximately 60% or 19%. Our estimate of the average bias falls within these bounds from data we did not use in our estimation, which provides some assurance that the model captures key features of the data. Low-intangible firms have higher bias, which is expected given that low-intangible firms place a higher weight on stock prices (i.e., greater myopia) in Panels B and C.

To assess efficiency gains from non-GAAP reporting, we first establish what investment and firm value would be in the first-best world without the short-term price pressure. Of course, we cannot observe the manager's choices in the hypothetical first-best world and cannot make this assessment directly, but estimating a structural model enables us to solve for the manager's optimal choices and investor's pricing decisions under new constraints. We use the first-best counterfactual to benchmark GAAP-only versus non-GAAP reporting regimes and find underinvestment in GAAP-only and overinvestment in the as-estimated or biased non-GAAP counterfactuals. The first-best investment intensity is 36.61%, which is defined as the ratio of investment to profits before investment costs. In the GAAP-only counterfactual, investment intensity declines to 26.67%, which represents a 27-percentage-point decline from the first-best. Because transitory earnings shocks are

negative on average, they amplify underinvestment that fundamentally stems from the manager's myopia. By contrast, in as-estimated counterfactual with biased non-GAAP earnings, investment intensity increases to 54.34%, which represents a 48-percentage-point increase from the first-best. Two key forces are behind overinvestment: bias in non-GAAP earnings is used to offset the effect of income-decreasing investment; and pricing weights, that is, a positive weight on non-GAAP earnings and a small negative on GAAP earnings, cause an overall net positive effect on the stock price from higher investment.

These differences in investment intensity translate into more modest differences in firm value because of the decreasing returns-to-scale production and the distribution of the productivity shocks. Although non-GAAP earnings induce overinvestment, they dominate GAAP-only reporting. If GAAP earnings are supplemented with biased non-GAAP earnings, firm value increases by 3.38% relative to GAAP-only reporting. This 3.38% increase in firm value implies underinvestment from GAAP-only reporting hurts value more than overinvestment from biased non-GAAP reporting. The stock prices also become more informative about fundamental firm value once GAAP earnings are supplemented with non-GAAP earnings. The ability to report non-GAAP earnings results in a 7.23-percentage-point decrease in the residual price uncertainty, namely, from 73.41% to 66.18%. When myopia and overinvestment are removed, as in the first-best counterfactual, we estimate a 1.18% increase in firm value.

In the no-bias counterfactual, the manager cannot mislead investors using non-GAAP earnings as in the as-estimated case, but he is still myopic. As a result, he ends up investing more efficiently by reducing the amount of overinvestment. The reduction in information asymmetry also causes stock prices to become more informative about

fundamental firm value, resulting in a 12.57-percentage-point decline in the residual price uncertainty, namely, from 66.18% to 53.61%. Eliminating bias in non-GAAP earnings increases firm value by just under 1%. Because non-GAAP earnings do not strictly follow the rules of GAAP, completely eliminating the bias would be costly and, in reality, probably impossible. The 1% estimate provides an upper bound in the benefits for any regulatory action targeted at eliminating the bias, which is likely to be costly.

4.4 Additional analysis

To explore heterogeneity in the parameter estimates, we re-estimate the model for different subsamples in Tables 7, 8, and 9. Managers with more wealth tied to the firm's stock price may be more myopic (e.g., Bizjak et al., 1993; Edmans, Fang, and Lewellen, 2017). In Table 7, we report parameter estimates for firms within the lowest and highest terciles of equity holdings of the CEO. As expected, we estimate the myopia parameter, θ , is nearly twice the size for firms in the high-equity subsample, namely, 0.396 versus 0.244. As a result, the bias is higher, namely, 35.76% versus 24.52%, in Table 9, Panels A and B. Relatedly, managers have stronger preferences for high stock prices in the fourth quarter, Q4, because many compensation plans are based on annual performance measures.³² In Table 8, the estimates are similar across Q1–Q3 versus Q4 quarters, except for θ and κ_b . In addition to the manager perceiving bias as less costly in Q4 according to the lower estimate of κ_b , the stock-price pressure θ is higher in Q4, namely, 0.670 versus 0.415. As a result, the bias is higher in Q4, namely, 46.81% versus 34.81%, in Table 9, Panels C and D.

³²See, for instance, Murphy (1999); Jacob and Jorgensen (2007); Das, Shroff, and Zhang (2009).

5. Conclusion

This paper examines real efficiency gains of non-GAAP reporting by estimating a dynamic model. The model suggests a positive relation between non-GAAP earnings and intangible investment, in that the ability to report non-GAAP earnings allows the manager to overinvest. Although non-GAAP earnings induce overinvestment, they dominate GAAP-only reporting: supplementing GAAP earnings with biased non-GAAP earnings increases firm value by 3.4% relative to GAAP-only reporting. We find the opportunistic bias destroys just under 1% of firm value, which is an upper bound of the benefit for a regulation aimed at completely eliminating misleading non-GAAP disclosures.

To estimate a dynamic model, we have to make simplifying assumptions. First, by examining the trade-off between noisy GAAP earnings and less noisy but potentially biased non-GAAP earnings, we abstract away from the individual line-item adjustments in the non-GAAP disclosures. Second, we assume a particular class of pricing functions based on empirical literature. Investors are assumed to determine stock prices solely based on two signals, GAAP and non-GAAP earnings, and these signals enter the pricing function in a specific way. We thus constrain our search for a rational-expectations equilibrium. Finally, to keep a clear focus on non-GAAP distortions, we assume the manager does not manipulate GAAP earnings. We omit this possibility because it is likely far easier for a manager to opportunistically define non-GAAP earnings. We leave the analyses of these extensions to future research.

References

- Admati, A. R., 1985. A noisy rational expectations equilibrium for multi-asset securities markets. *Econometrica* 53 (3), 629–657.
- Baik, B., Billings, B. K., Morton, R. M., 2008. Reliability and transparency of non-GAAP disclosures by real estate investment trusts (REITs). *The Accounting Review* 83 (2), 271–301.
- Bazdresch, S., Kahn, R. J., Whited, T. M., 2017. Estimating and testing dynamic corporate finance models. *Review of Financial Studies* 31 (1), 322–361.
- Bebchuk, L. A., Stole, L. A., 1993. Do short-term objectives lead to under-or overinvestment in long-term projects? *Journal of Finance* 48 (2), 719–729.
- Bens, D. A., Nagar, V., Wong, M. F., 2002. Real investment implications of employee stock option exercises. *Journal of Accounting Research* 40 (2), 359–393.
- Bentley, J. W., Christensen, T. E., Gee, K. H., Whipple, B. C., 2018. Disentangling managers' and analysts' non-GAAP reporting. *Journal of Accounting Research* 56 (4), 1039–1081.
- Bertomeu, J., Cheynel, E., Li, E. X., Liang, Y., 2021. How pervasive is earnings management? Evidence from a structural model. *Management Science* 67 (8), 5145–5162.
- Bertomeu, J., Ma, P., Marinovic, I., 2020. How often do managers withhold information? *The Accounting Review* 95 (4), 73–102.
- Bertomeu, J., Marinovic, I., Terry, S. J., Varas, F., 2022. The dynamics of concealment. *Journal of Financial Economics* 143 (1), 227–246.
- Bizjak, J. M., Brickley, J. A., Coles, J. L., 1993. Stock-based incentive compensation and investment behavior. *Journal of Accounting and Economics* 16 (1-3), 349–372.
- Black, D. E., Christensen, T. E., Ciesielski, J. T., Whipple, B. C., 2018. Non-GAAP reporting: Evidence from academia and current practice. *Journal of Business Finance & Accounting* 45 (3-4), 259–294.
- Bloom, N., Schankerman, M., Van Reenen, J., 2013. Identifying technology spillovers and product market rivalry. *Econometrica* 81 (4), 1347–1393.
- Bradshaw, M. T., Sloan, R. G., 2002. GAAP versus the Street: An empirical assessment of two alternative definitions of earnings. *Journal of Accounting Research* 40 (1), 41–66.
- Breuer, M., Windisch, D., 2019. Investment dynamics and earnings-return properties: A structural approach. *Journal of Accounting Research* 57 (3), 639–674.
- Cameron, A. C., Trivedi, P. K., 2005. *Microeconometrics: Methods and applications*. Cambridge University Press, New York, New York.
- Castro, R., Clementi, G. L., Lee, Y., 2015. Cross sectoral variation in the volatility of plant level idiosyncratic shocks. *Journal of Industrial Economics* 63 (1), 1–29.

- Choi, J. H., 2021. Accrual accounting and resource allocation: A general equilibrium analysis. *Journal of Accounting Research* 59 (4), 1179–1219.
- Corrado, C., Hulten, C., Sichel, D., 2005. Measuring capital and technology: An expanded framework. In: Corrado, C., Haltiwanger, J., Sichel, D. (Eds.), *Measuring capital in the New Economy*. University of Chicago Press, Chicago, IL, pp. 11–46.
- Corrado, C. A., Hulten, C. R., 2010. How do you measure a “technological revolution”? *American Economic Review* 100 (2), 99–104.
- Curtis, A. B., McVay, S. E., Whipple, B. C., 2013. The disclosure of non-GAAP earnings information in the presence of transitory gains. *The Accounting Review* 89 (3), 933–958.
- Das, S., Lev, B., 1994. Nonlinearity in the returns-earnings relation: Tests of alternative specifications and explanations. *Contemporary Accounting Research* 11 (1), 353–379.
- Das, S., Shroff, P. K., Zhang, H., 2009. Quarterly earnings patterns and earnings management. *Contemporary Accounting Research* 26 (3), 797–831.
- Davis, S. J., Haltiwanger, J. C., 1992. Gross job creation, gross job destruction, and employment reallocation. *Quarterly Journal of Economics* 107 (3), 819–863.
- Dechow, P. M., Dichev, I. D., 2002. The quality of accruals and earnings: The role of accrual estimation errors. *The Accounting Review* 77 (s-1), 35–59.
- Doyle, J. T., Jennings, J. N., Soliman, M. T., 2013. Do managers define non-GAAP earnings to meet or beat analyst forecasts? *Journal of Accounting and Economics* 56 (1), 40–56.
- Dye, R. A., Verrecchia, R. E., 1995. Discretion vs. uniformity: Choices among GAAP. *The Accounting Review* 70 (3), 389–415.
- Edmans, A., 2009. Blockholder trading, market efficiency, and managerial myopia. *Journal of Finance* 64 (6), 2481–2513.
- Edmans, A., Fang, V. W., Lewellen, K. A., 2017. Equity vesting and investment. *Review of Financial Studies* 30 (7), 2229–2271.
- Edmans, A., Heinle, M. S., Huang, C., 2016. The real costs of financial efficiency when some information is soft. *Review of Finance* 20 (6), 2151–2182.
- Einhorn, E., 2005. The nature of the interaction between mandatory and voluntary disclosures. *Journal of Accounting Research* 43 (4), 593–621.
- Eisfeldt, A., Papanikolaou, D., 2013. Organization capital and the cross-section of expected returns. *Journal of Finance* 68 (4), 1365–1406.
- Eisfeldt, A. L., Papanikolaou, D., 2014. The value and ownership of intangible capital. *American Economic Review* 104 (5), 189–94.

- Erickson, T., Whited, T. M., 2002. Two-step GMM estimation of the errors-in-variables model using high-order moments. *Econometric Theory* 18 (3), 776–799.
- Ewens, M., Peters, R. H., Wang, S., 2019. Acquisition prices and the measurement of intangible capital. National Bureau of Economic Research.
- Falato, A., Kadyrzhanova, D., Sim, J., Steri, R., 2022. Rising intangible capital, shrinking debt capacity, and the US corporate savings glut. *Journal of Finance* 77 (5), 2799–2852.
- Fischer, P. E., Verrecchia, R. E., 2000. Reporting bias. *The Accounting Review* 75 (2), 229–245.
- Freeman, R. N., Tse, S. Y., 1992. A nonlinear model of security price responses to unexpected earnings. *Journal of Accounting Research* 30 (2), 185–209.
- Gayle, G.-L., Li, C., Miller, R., 2022. Was Sarbanes-Oxley costly? Evidence from optimal contracting on CEO compensation. *Journal of Accounting Research* 60 (4), 1189–1234.
- Gayle, G.-L., Miller, R. A., 2015. Identifying and testing models of managerial compensation. *Review of Economic Studies* 82 (3), 1074–1118.
- Geng, H., Zhang, C., Zhou, F., 2022. Financial reporting quality and intangible investments: Theory and evidence. Available at SSRN 3650784.
- Gerakos, J., Syverson, C., 2015. Competition in the audit market: Policy implications. *Journal of Accounting Research* 53 (4), 725–775.
- Gigler, F., Kanodia, C., Sapra, H., Venugopalan, R., 2014. How frequent financial reporting can cause managerial short-termism: An analysis of the costs and benefits of increasing reporting frequency. *Journal of Accounting Research* 52 (2), 357–387.
- Glover, B., Levine, O., 2017. Idiosyncratic risk and the manager. *Journal of Financial Economics* 126 (2), 320–341.
- Graham, J. R., Harvey, C. R., Rajgopal, S., 2005. The economic implications of corporate financial reporting. *Journal of Accounting and Economics* 40 (1-3), 3–73.
- Gu, Z., Chen, T., 2004. Analysts' treatment of nonrecurring items in Street earnings. *Journal of Accounting and Economics* 38, 129–170.
- Han, C., Phillips, P. C., Sul, D., 2014. X-differencing and dynamic panel model estimation. *Econometric Theory* 30 (1), 201–251.
- Hayashi, F., 1982. Tobin's marginal q and average q: A neoclassical interpretation. *Econometrica* 50 (1), 213–224.
- Hennessy, C. A., Whited, T. M., 2005. Debt dynamics. *Journal of Finance* 60 (3), 1129–1165.
- Hirshleifer, D., Teoh, S. H., 2003. Limited attention, information disclosure, and financial reporting. *Journal of Accounting and Economics* 36 (1-3), 337–386.

- Holthausen, R. W., Watts, R. L., 2001. The relevance of the value-relevance literature for financial accounting standard setting. *Journal of Accounting and Economics* 31 (1-3), 3–75.
- Hulten, C. R., Hao, X., 2008. What is a company really worth? Intangible capital and the “market to book value” puzzle. National Bureau of Economic Research.
- Jacob, J., Jorgensen, B. N., 2007. Earnings management and accounting income aggregation. *Journal of Accounting and Economics* 43 (2-3), 369–390.
- Kanodia, C., 1980. Effects of shareholder information on corporate decisions and capital market equilibrium. *Econometrica* 48 (4), 923.
- Kanodia, C., Mukherji, A., 1996. Real effects of separating investment and operating cash flows. *Review of Accounting Studies* 1 (1), 51–71.
- Kanodia, C., Sapra, H., Venugopalan, R., 2004. Should intangibles be measured: What are the economic trade-offs? *Journal of Accounting Research* 42 (1), 89–120.
- Kanodia, C., Singh, R., Spero, A. E., 2005. Imprecision in accounting measurement: Can it be value enhancing? *Journal of Accounting Research* 43 (3), 487–519.
- Kempf, E., Spalt, O., 2023. Attracting the sharks: Corporate innovation and securities class action lawsuits. *Management Science* 69 (3), 1805–1834.
- Kochenderfer, M. J., Wheeler, T. A., 2019. Algorithms for optimization. MIT Press, Cambridge, Massachusetts.
- Koller, T., Goedhart, M., Wessels, D., 2010. Valuation: measuring and managing the value of companies. John Wiley and Sons, Hoboken, New Jersey.
- Kumar, K. R., Krishnan, G. V., 2008. The value-relevance of cash flows and accruals: The role of investment opportunities. *The Accounting Review* 83 (4), 997–1040.
- Laurion, H., 2020. Implications of non-GAAP earnings for real activities and accounting choices. *Journal of Accounting and Economics* 70 (1), 101333.
- Lev, B., Radhakrishnan, S., 2005. The valuation of organization capital. In: Corrado, C., Haltiwanger, J., Sichel, D. (Eds.), *Measuring Capital in the New Economy*. University of Chicago Press, Chicago, IL, pp. 73–110.
- Lev, B., Sougiannis, T., 1996. The capitalization, amortization, and value-relevance of R&D. *Journal of Accounting and Economics* 21 (1), 107–138.
- Li, C., 2018. Are top management teams compensated as teams? A structural modeling approach. Baruch College Zicklin School of Business Research Paper (2018-02), 02.
- Li, S., Whited, T. M., Wu, Y., 2016. Collateral, taxes, and leverage. *Review of Financial Studies* 29 (6), 1453–1500.

- Li, W. C., Hall, B. H., 2020. Depreciation of business R&D capital. *Review of Income and Wealth* 66 (1), 161–180.
- Liang, Y., 2020. How much does imprecision in accounting measurement enhance value? Unpublished Working Paper.
- Lundholm, R. J., 1988. Price-signal relations in the presence of correlated public and private information. *Journal of Accounting Research* 26 (1), 107–118.
- Marques, A., 2006. SEC interventions and the frequency and usefulness of non-GAAP financial measures. *Review of Accounting Studies* 11 (4), 549–574.
- McClure, C., 2023. How costly is tax avoidance? Evidence from structural estimation. *The Accounting Review*. Forthcoming.
- Miller, M. H., Rock, K., 1985. Dividend policy under asymmetric information. *Journal of finance* 40 (4), 1031–1051.
- Murphy, K. J., 1999. Executive compensation. Vol. 3. Elsevier, Amsterdam, Holland.
- Nikolov, B., Whited, T. M., 2014. Agency conflicts and cash: Estimates from a dynamic model. *Journal of Finance* 69 (5), 1883–1921.
- Peters, R. H., Taylor, L. A., 2017. Intangible capital and the investment-q relation. *Journal of Financial Economics* 123 (2), 251–272.
- Riffe, S., Thompson, R., 1998. The relation between stock prices and accounting information. *Review of Accounting Studies* 2 (4), 325–351.
- Saporta-Eksten, I., Terry, S. J., 2018. Short-term shocks and long-term investment. Boston University Working Paper.
- Stein, J. C., 1989. Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *Quarterly Journal of Economics* 104 (4), 655–669.
- Subramanyam, K., 1996. Uncertain precision and price reactions to information. *The Accounting Review* 71 (2), 207–219.
- Tauchen, G., 1986. Finite state Markov-chain approximations to univariate and vector autoregressions. *Economics Letters* 20 (2), 177–181.
- Taylor, L. A., 2010. Why are CEOs rarely fired? Evidence from structural estimation. *Journal of Finance* 65 (6), 2051–2087.
- Terry, S., Whited, T. M., Zakolyukina, A. A., 2023. Information versus investment. *Review of Financial Studies* 36, 1148–1191.
- Terry, S. J., 2017. The macro impact of short-termism. Boston University Working Paper, 15–022.

- Tomy, R. E., 2018. Input price shocks and investment: Evidence from OEMs. Available at SSRN 3294451.
- Whited, T. M., 1994. Problems with identifying adjustment costs from regressions of investment on q . *Economics Letters* 46 (4), 327–332.
- Zakolyukina, A. A., 2018. How common are intentional GAAP violations? Estimates from a dynamic model. *Journal of Accounting Research* 56 (1), 5–44.
- Zhou, F. S., 2021. Disclosure dynamics and investor learning. *Management Science* 67 (6), 3429–3446.

A. Non-GAAP reconciliations

Non-GAAP disclosures have consistently been a focus of standard setters. In 2003, as part of the Sarbanes-Oxley Act, Regulation G established standards for firms' presentation of non-GAAP information, including the requirement that firms must reconcile non-GAAP metrics with their GAAP counterparts. We refer to the reconciliation amounts as the non-GAAP adjustment. In response to concerns that non-GAAP earnings can mislead investors, the SEC issued a Compliance and Disclosure Interpretations update in 2016 to address common questions relating to these disclosures.³³ However, the SEC also acknowledges that non-GAAP "can provide investors with useful information regarding how management monitors performance."³⁴ Although firms have discretion over what to include (or exclude) in non-GAAP earnings, the SEC encourages firms to provide consistent non-GAAP adjustments between periods and to include recurring expenses necessary for their business.³⁵

Below, we present an example of the non-GAAP reconciliations. The table reports the reconciliation of adjusted earnings per share (EPS) to reported EPS for Walmart for the fourth quarter of 2018.³⁶

Figure A.1: Walmart non-GAAP reconciliation, Q4, 2018

Three Months Ended January 31, 2018			
Diluted earnings per share:			
Reported EPS			\$0.73
Adjustments:	Pre-Tax Impact	Tax Impact 1	Net Impact
Restructuring charges 2	\$0.40	-\$0.12	\$0.28
Loss on extinguishment of debt	0.34	-0.13	0.21
Asset impairments and write-offs 3	0.18	-0.06	0.12
Associate lump sum bonus	0.15	-0.06	0.09
U.S. tax reform benefit	—	-0.07	-0.07
Legal settlement recovery	-0.05	0.02	-0.03
Net adjustments			\$0.60
Adjusted EPS			\$1.33

³³<https://deloitte.wsj.com/cfo/2016/06/03/sec-urges-companies-to-take-a-fresh-look-at-non-gaap-measures/>

³⁴<https://www.sec.gov/news/speech/speech-bricker-040318>

³⁵<https://www.sec.gov/divisions/corpfin/guidance/nongaapinterp.htm>

³⁶<https://www.sec.gov/Archives/edgar/data/104169/000010416918000020/earningsrelease-1312018.htm>

Figure 1: Investment and non-GAAP adjustment around positive non-GAAP adjustments:
Data

This figure depicts investment and non-GAAP adjustment around positive non-GAAP adjustment events in the data. Each solid line plots the estimate coefficients $\beta_k, k = -2, \dots, 2$ from the panel regression $w_{jt} = \sum_{k=-2}^2 \beta_k \mathbb{I}(\text{Positive non-GAAP adj.})_{jt+k} + f_{ind} + g_{year} + g_{qtr} + \varepsilon_{jt}$, where $\mathbb{I}$ indicates whether the firm j issued positive non-GAAP adjustment in quarter t , and f_{ind} , g_{year} , and g_{qtr} are industry, year, and quarter fixed effects, respectively. The variable w_{jt} is intangible investment or non-GAAP adjustment, both scaled by capital. The plotted error bands are 95% confidence intervals based on standard errors double-clustered by firm and year.

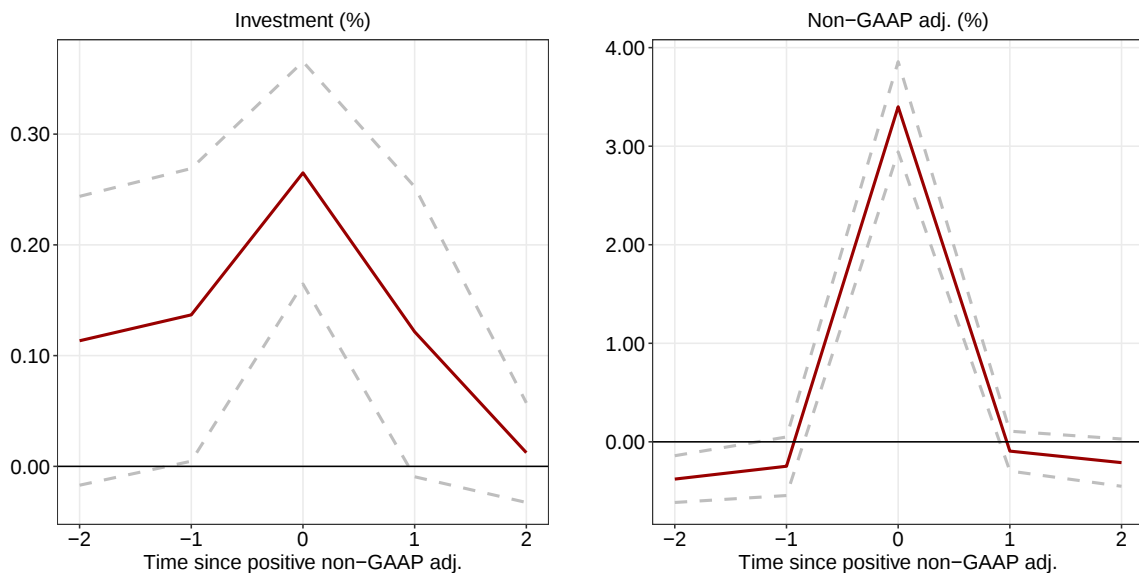
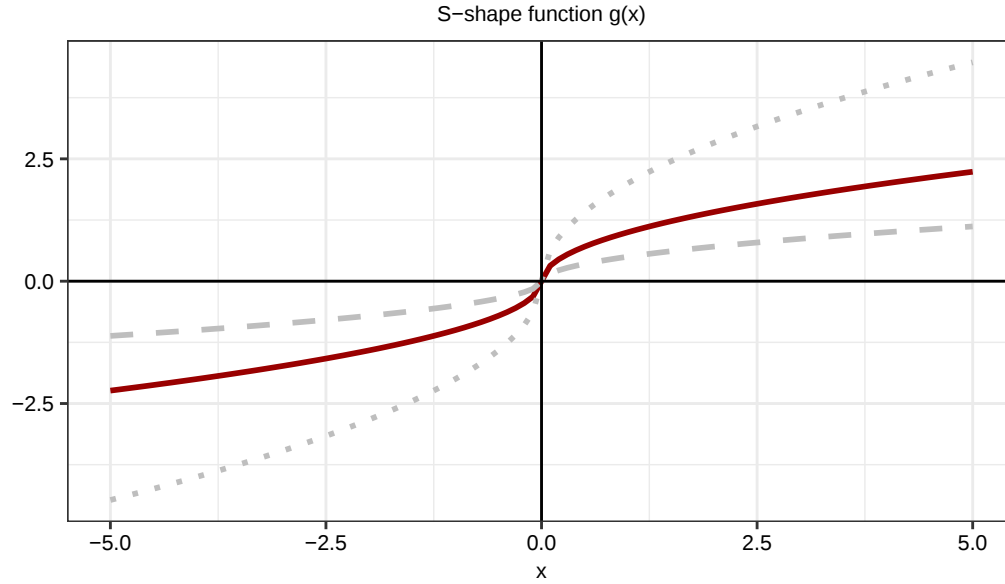


Figure 2: The non-linear relation between the stock price and earnings

This figure plots the S-shape relation between non-GAAP earnings and the stock price, $g(\cdot)$, where $g(x) = \text{sign}(x)\sqrt{|x|}$. The solid line corresponds to $g(x)$, and the other two lines correspond to $g(x)$ multiplied by 0.5 or 2. The equation shows the coefficient estimates from the linear regression of the firm value V_F/q defined as market capitalization scaled by intangible capital on $g((\pi + \psi)/q)$ and $g(\pi/q)$, where $\pi + \psi$ is non-GAAP earnings, π is GAAP earnings, and q is intangible capital. The regression includes firm-fiscal-quarter fixed effects, and thus, the intercept is zero by construction. Robust standard errors clustered by firm are in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

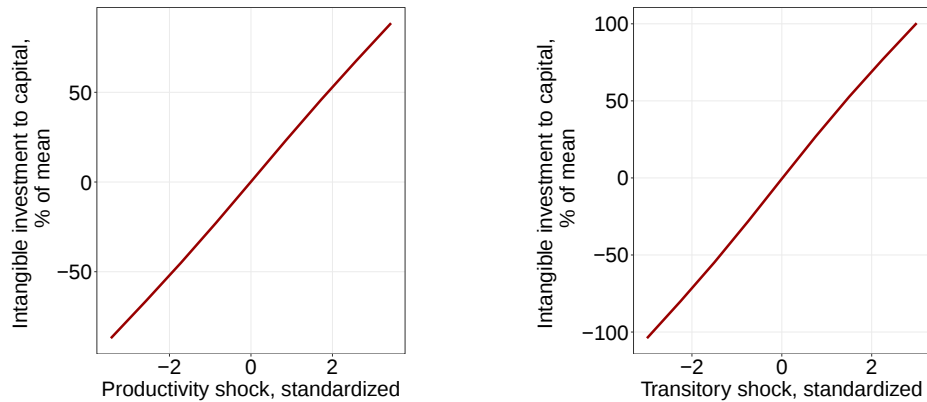


$$\frac{V_F}{q}_{it} = \frac{6.073}{(0.553)^{***}} \cdot g\left(\frac{\pi + \psi}{q}\right)_{it} + \frac{0.303}{(0.301)} \cdot g\left(\frac{\pi}{q}\right)_{it} + f_{firm-qtr} + \varepsilon_{it}$$

Figure 3: Optimal policies

This figure depicts optimal policies when the manager can only report GAAP earnings in Panel A and GAAP and non-GAAP earnings in Panel B using parameters reported in Table 4. In both panels, we standardize the shocks (i.e., v_y and v_π), report the policy functions (i.e., w/q) *relative to the mean* over the ergodic distribution of the model, and fix the level of capital, q . In Panel A, the row presents the optimal investment as the productivity shock, v_y , varies (left) and as the transitory shock, v_π , varies (right). In Panel B, the top row presents the optimal investment (left) and bias (right) as the productivity shock, v_y , varies. For these two upper plots, we fix the transitory shock, v_π . The bottom row presents optimal investment (left) and bias (right) as the transitory shock, v_π , varies. For the two lower plots, we fix the productivity shock, v_y . We scale investment by capital (i.e., w/q), and bias, $b \geq 0$, is already a fraction of capital.

Panel A: GAAP-only reporting



Panel B: GAAP and non-GAAP reporting

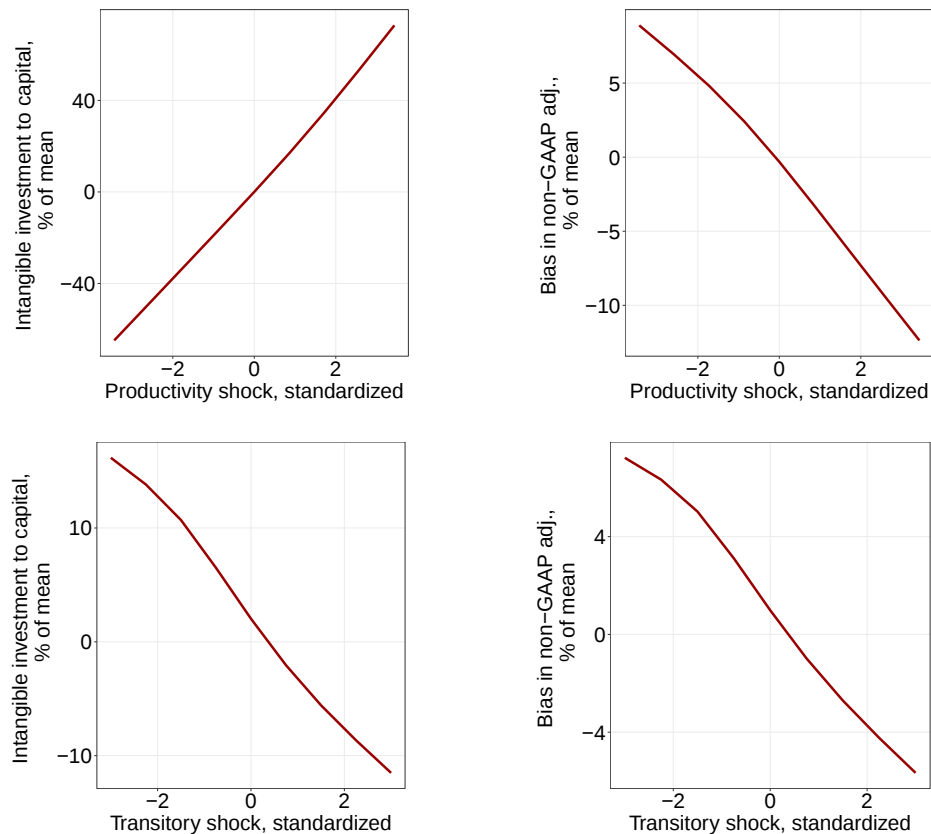
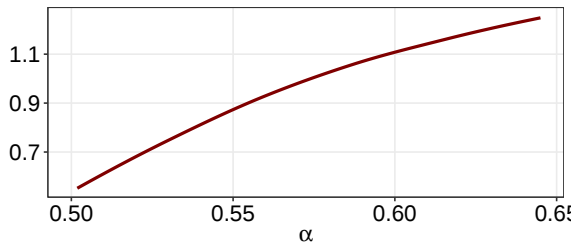


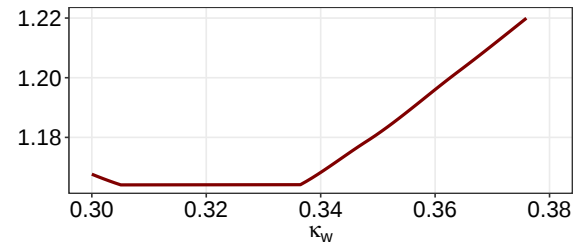
Figure 4: Comparative statics

Each panel of this figure plots the relation between a moment on the y -axis and a parameter of the x -axis. The curve is obtained by locally weighted smoothing of a discrete set of experiments.

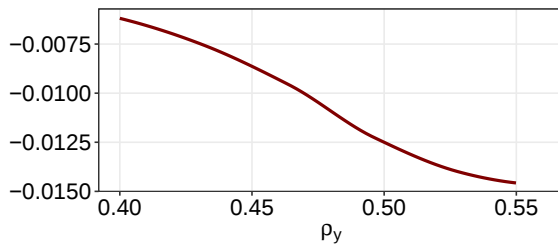
Panel A: Variance of earnings growth



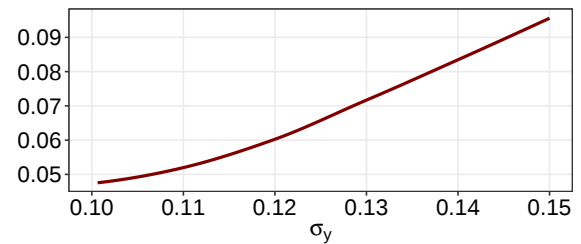
Panel B: Variance of non-GAAP adj. growth, given pos. adj.



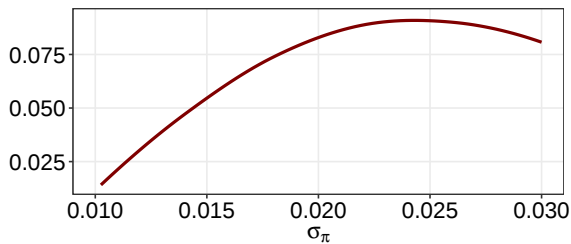
Panel C: Covariance of investment and cash flow growth



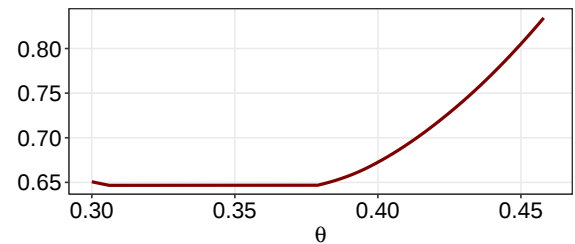
Panel D: Variance of intang. investment growth



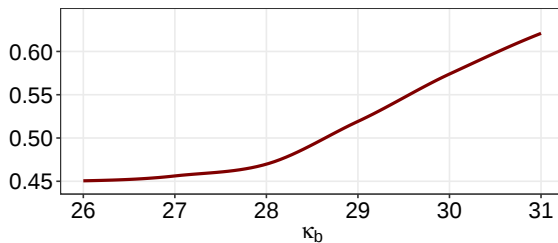
Panel E: Cov. of investment and non-GAAP adj. growth, given pos. adj.



Panel F: Incidence of positive non-GAAP adj.



Panel G: Coefficient on non-GAAP earnings in the pricing eqn.



Panel H: Mean non-GAAP adj., given pos. non-GAAP adj.

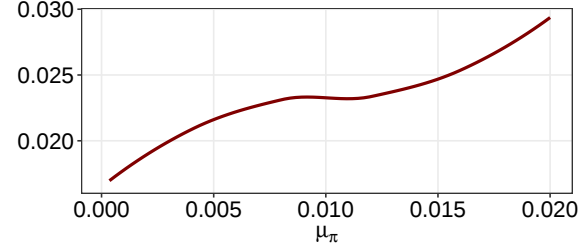


Figure 5: Investment and non-GAAP adjustment around positive non-GAAP adjustments:
Simulated data

This figure depicts investment and non-GAAP adjustment around positive non-GAAP adjustment events in the simulated data using the baseline estimates from Table 4. Each solid line plots the estimate coefficients $\beta_k, k = -2, \dots, 2$ from the panel regression $w_{jt} = \sum_{k=-2}^2 \beta_k \mathbb{I}(\text{Positive non-GAAP adj.})_{jt+k} + f_{ind} + g_{year} + g_{qtr} + \varepsilon_{jt}$, where $\mathbb{I}$ is an indicator variable for a positive non-GAAP adjustment, which is set to 0 for the bottom 1% of non-GAAP adjustments, and 1 otherwise, and f_{ind} , g_{year} , and g_{qtr} are industry, year, and quarter fixed effects, respectively. This definition of a positive non-GAAP adjustment differs from Figure 1, which uses an indicator for whether the firm issues a positive non-GAAP adjustment because, in the model, non-GAAP adjustments are always positive. The variable w_{jt} is intangible investment or non-GAAP adjustment, both scaled by capital. The plotted error bands are 95% confidence intervals based on standard errors double-clustered by firm and year.

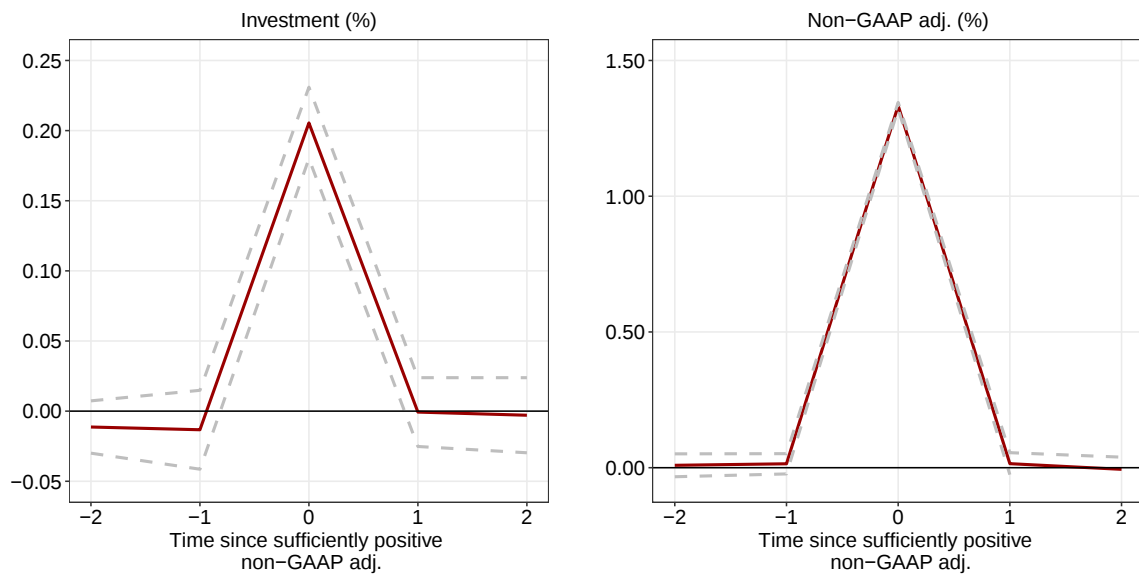


Table 1: Data and parameter definitions

This table presents the definitions and data sources for variables used in the estimation and parameters. All dollar values are deflated by the consumer price index. Compustat data codes are in parentheses. Panel A presents variables used in estimation. Panel B reports parameters that arise from the endogenous pricing function (i.e., equation (8)). Panel C displays parameters that are estimated or assumed from outside the model. Panel D reports parameters that are estimated using the simulated method of moments.

A. Data definitions	
q	Intangible capital stock is computed as the sum of knowledge and organization capital. Knowledge and organization capital are computed using the perpetual inventory method described in section 3. Compustat.
w	Investment into intangible capital computed as the sum of investment into knowledge and organization capital. Investment into knowledge capital is R&D expense (XRDQ). Investment into organization capital is the fraction of SG&A expense (XSGAQ) as described in section 3. Compustat.
π	GAAP earnings defined as the product of (diluted) EPS including extraordinary items (EPSFIQ) and common shares for diluted EPS (CSHFDQ). Compustat.
$\tilde{d}$	Free cash flow calculated as cash from operations (OANCFQ) minus net capital expenditures (CAPXQ - SPPEQ). In the simulated data, this variable is computed by re-shuffling expected cash flows d as described in Internet Appendix C. Compustat.
ψ	Non-GAAP adjustment is the difference between non-GAAP EPS (MGR_NG_EPS) from Bentley et al. (2018) and GAAP EPS (EPSFIQ) multiplied by common shares for diluted EPS (CSHFDQ). Compustat and non-GAAP earnings from Bentley et al. (2018).
B. Endogenous parameters for the pricing function	
β_0	Intercept
β_1	Coefficient on non-GAAP earnings term
β_2	Coefficient on GAAP earnings term
C. Estimated outside of the model	
δ	Quarterly depreciation of intangible capital, set to 5.15%
r	Quarterly discount rate, assumed to be 1.5%; similar to Terry et al. (2023)
ρ_s	Cash flow reshuffling parameter, set to 11.21%
D. Estimated within the model	
α	Curvature of profit function
κ_w	Adjustment cost from investment
ρ_y	Persistence of the productivity shock
σ_y	Volatility of the productivity shock
σ_π	Volatility of the transitory earnings shock
θ	Relative importance of financial reporting
κ_b	Personal cost from biasing non-GAAP earnings
μ_π	Mean of the transitory earnings shock

Table 2: Descriptive statistics

This table presents the descriptive statistics for variables used in the estimation. The sample is based on Compustat and non-GAAP earnings from Bentley et al. (2018). The sample covers the period from 2006 to 2016 at a quarterly frequency. Compustat data codes are in parentheses. *Obs.* is the number of observations per firm. *Market value* is the product of common shares outstanding (CSHOQ) and the quarter-end closing price (PRCCQ). *Total assets* is total assets (ATQ). *Sales* is sales revenue (SALEQ). *Market-to-book* is the sum of market value and total assets minus the book value of equity divided by total assets. *Intangible capital stock* is the sum of knowledge and organization capital computed using the perpetual-inventory method as described in section 3. *Intangible investment* is the sum of knowledge and organization capital investment as described in section 3. *Earnings* is earnings that include extraordinary items ($EPSFIQ \times CSHFDQ$) with earnings from Compustat preliminary history or, if missing, from Compustat quarterly. *Cash flow* is cash from operations (OANCFQ) minus capital expenditures (CAPXQ - SPPEQ). *Non-GAAP adj.* is the difference between *Earnings* and *non-GAAP* earnings from Bentley et al. (2018). All growth rates are computed as described in section 4.1 based on year-over-year differences in quarterly amounts. We exclude utilities (4900–4999), finance (6000–6999), and public service, international affairs, or non-operating firms (9000+). All variables are winsorized at the 1st and 99th percentiles.

	Obs.	Mean	Std.Dev	p1	p25	p50	p75	p99
Firm characteristics (N = 1,416)								
Obs.	21,216	21.854	9.749	2.000	14.000	22.000	29.000	41.000
Market value (\$bn)	21,216	7.469	21.611	0.026	0.365	1.106	4.167	151.895
Total assets (\$bn)	21,216	4.407	12.051	0.027	0.294	0.823	2.654	83.942
Sales (\$bn)	21,216	1.154	2.983	0.004	0.072	0.217	0.717	19.440
Market-to-book	21,216	2.869	5.293	0.642	1.235	1.724	2.586	43.461
Intangible capital stock (\$bn)	21,216	1.862	4.829	0.022	0.154	0.371	1.138	32.406
Intangible investment (\$bn)	21,216	0.116	0.299	0.001	0.010	0.024	0.075	2.043
Variables used in estimation								
Intangible investment to capital	21,216	0.066	0.021	0.023	0.051	0.062	0.077	0.135
Earnings to intangible capital	21,216	0.030	0.070	-0.258	0.000	0.029	0.062	0.241
Cash flows to intangible capital	21,216	0.037	0.093	-0.244	-0.012	0.031	0.080	0.348
Non-GAAP adj. to intangible capital	21,216	0.011	0.029	-0.050	0.000	0.000	0.013	0.183
Intangible investment growth	21,216	0.044	0.210	-0.530	-0.041	0.041	0.127	0.622
Earnings growth	21,216	0.004	1.030	-2.000	-0.426	0.054	0.441	2.000
Cash flows growth	21,216	0.025	1.205	-2.000	-0.692	0.040	0.753	2.000
Non-GAAP adj. growth	21,216	0.093	1.144	-2.000	-0.040	0.000	0.451	2.000

Table 3: Non-GAAP reconciliation descriptive statistics

This table presents descriptive statistics for the Regulation G reconciliation line items between GAAP and non-GAAP numbers from Audit Analytics. This sample covers quarterly earnings-related non-GAAP disclosures for S&P 500 firms from 2014 through 2018. We categorize non-GAAP adjustments into 23 separate categories and divide these into recurring (rows 1 through 15) and non-recurring items (rows 16 through 23). Within the recurring/non-recurring split, we further divide categories based on whether they are primarily cash or non-cash related. For each grouping of categories, we report the fraction of adjustments (%), the fraction of positive adjustments (% (Pos.)), and the firm average of the dollar value in the specific category, only if it is positive, divided by the sum of this dollar value and the absolute value of the remainder of the total non-GAAP adjustments (% (\$ Pos.)). The calculation of % (\$ Pos.) maps into how we compute the fraction of opportunistic bias in Table 6, namely, $\mathbb{E}[b/(b + |\nu_\pi|)]$; that is, b is assumed to be a dollar value in the specific category and ν_π is the remainder of the total non-GAAP adjustments. Following the *Category* column, we report the fraction of adjustments in counts of our sample within the category. The last two columns report the mean and median of the adjustment scaled by current period sales (*REVTQ*) reported in percentage points. All unbounded amounts are winsorized at 1% and 99%.

	%	% (Pos.)	% (\$ Pos.)		%	% (Pos.)	% (\$ Pos.)	Category	%	Sales (%)	
										Mean	Med
Recurring	53.18	36.40	59.65	Cash	13.25	8.09	19.09	Interest expense	6.30	5.25	3.02
								Capital expenditures	4.02	-10.93	-7.63
								Cost of goods sold	1.10	0.53	0.17
								Dividends	0.90	-2.55	0.04
								Rent	0.64	2.59	1.10
								R&D	0.20	2.71	0.94
				Non-Cash	39.93	28.31	56.24	Working capital	0.09	0.83	0.78
								Tax expense	10.84	0.53	0.02
								Amortization and depreciation	10.34	8.89	4.03
								Stock compensation	4.42	3.61	2.47
								Minority interest	3.82	-0.44	0.01
								Investment gains/losses	3.07	-0.09	-0.06
								Fair value	2.90	1.43	0.09
								Pension	2.80	1.32	0.37
								Currency	1.73	1.44	0.52
Non-Recurring	46.82	37.02	52.08	Cash	28.95	24.17	43.45	Acquisitions	13.71	0.52	0.36
								Restructuring	9.11	1.23	0.61
								Legal settlements	3.06	1.29	0.27
								Debt extinguishments	2.12	1.42	0.43
				Non-Cash	17.88	12.85	32.71	Initiative costs	0.94	1.17	0.60
								Uncommon	10.05	1.62	0.41
								Impairments	4.18	6.20	1.07
								Tax adjustment	3.65	0.54	-0.11

Table 4: Baseline estimation results

The estimation is done with a simulated minimum distance estimator, which chooses structural model parameters by matching the moments from a simulated panel of firms to the corresponding moments from the data. Panel A reports the simulated and actual moments and the t-statistics for the differences between the corresponding moments. Panel B reports the estimated structural parameters with standard errors in parentheses. α is the curvature of the profit function. κ_w is the adjustment cost of investment. ρ_y is the persistence of the productivity shock. σ_y is the volatility of the productivity shock. σ_π is the volatility of the transitory earnings. θ is the importance of stock price relative to cash flows. κ_b is the manager's personal cost from biasing non-GAAP earnings divided by 10. μ_π is the mean of the transitory earnings shock. The standard errors are double-clustered by firm and year in both panels.

A. Moments

	Data moments	Simulated moments	t-statistics
Mean intang. investment to capital	0.066	0.052	-34.67
Mean earnings to capital	0.030	0.049	17.82
Variance of intang. investment growth	0.033	0.065	40.56
Covariance of investment and earnings growth	-0.010	-0.113	-18.25
Covariance of investment and cash flow growth	-0.013	-0.009	1.06
Variance of earnings growth	0.934	1.037	5.37
Covariance of earnings and cash flow growth	0.189	0.149	-1.84
Variance of cash flow growth	1.322	0.037	-37.46
Incidence of positive non-GAAP adj.	0.442	0.646	19.02
Mean non-GAAP adj., given pos. non-GAAP adj.	0.027	0.028	0.45
Variance of intang. investment growth, given pos. adj.	0.038	0.066	9.16
Cov. of investment and earnings growth, given pos. adj.	-0.020	-0.127	-7.71
Cov. of investment and cash flow growth, given pos. adj.	-0.008	-0.012	-1.56
Cov. of investment and non-GAAP adj. growth, given pos. adj.	0.033	0.086	4.35
Variance of earnings growth, given pos. adj.	1.055	1.143	4.65
Cov. of earnings and cash flow growth, given pos. adj.	0.212	0.169	-1.57
Cov. of earnings and non-GAAP adj. growth, given pos. adj.	-0.533	-0.753	-7.16
Variance of cash flow growth, given pos. adj.	1.261	0.040	-32.65
Cov. of cash flow and non-GAAP adj. growth, given pos. adj.	-0.060	-0.086	-1.44
Variance of non-GAAP adj. growth, given pos. adj.	1.224	1.165	-0.73
Coefficient on non-GAAP earnings in the pricing eqn.	6.073	0.426	-11.15
Coefficient on earnings in the pricing eqn.	0.303	-0.075	-1.43

B. Parameter estimates

α	κ_w	ρ_y	σ_y	σ_π	θ	κ_b	μ_π
0.575 (0.011)	0.338 (0.051)	0.488 (0.050)	0.127 (0.014)	0.021 (0.000)	0.386 (0.047)	28.505 (5.563)	0.011 (0.000)

Table 5: Low versus high intangible intensity

The estimation is done with a simulated minimum distance estimator, which chooses structural model parameters by matching the moments from a simulated panel of firms to the corresponding moments from the data for the sample of firms with low vs. high intangible intensity. Parameters are defined in Table 1. The standard errors are double-clustered by firm and year in both panels.

A. Moments

	Low intangible intensity			High intangible intensity		
	Data moments	Simulated moments	<i>t</i> -statistics	Data moments	Simulated moments	<i>t</i> -statistics
Mean intang. investment to capital	0.063	0.051	-29.40	0.067	0.053	-35.99
Mean earnings to capital	0.050	0.054	5.14	0.006	0.039	20.48
Variance of intang. investment growth	0.029	0.058	10.65	0.042	0.094	9.67
Covariance of investment and earnings growth	0.010	-0.063	-14.25	-0.031	-0.114	-53.27
Covariance of investment and cash flow growth	-0.011	0.005	2.04	-0.021	-0.009	3.55
Variance of earnings growth	0.795	0.740	-3.45	1.156	1.578	11.84
Covariance of earnings and cash flow growth	0.094	0.100	0.19	0.329	0.172	-3.71
Variance of cash flow growth	1.355	0.030	-26.25	1.396	0.046	-22.36
Incidence of positive non-GAAP adj.	0.345	0.646	31.72	0.502	0.648	5.93
Mean non-GAAP adj., given pos. non-GAAP adj.	0.029	0.027	-1.16	0.029	0.034	4.35
Variance of intang. investment growth, given pos. adj.	0.042	0.056	1.49	0.040	0.091	11.02
Cov. of investment and earnings growth, given pos. adj.	0.008	-0.065	-6.51	-0.035	-0.107	-13.80
Cov. of investment and cash flow growth, given pos. adj.	-0.003	0.004	0.65	-0.017	-0.010	1.36
Cov. of investment and non-GAAP adj. growth, given pos. adj.	0.016	0.067	2.65	0.043	0.075	2.37
Variance of earnings growth, given pos. adj.	0.964	0.790	-4.18	1.191	1.680	7.87
Cov. of earnings and cash flow growth, given pos. adj.	0.103	0.110	0.15	0.330	0.180	-3.06
Cov. of earnings and non-GAAP adj. growth, given pos. adj.	-0.575	-0.641	-0.93	-0.488	-0.976	-9.70
Variance of cash flow growth, given pos. adj.	1.307	0.031	-19.35	1.321	0.049	-19.94
Cov. of cash flow and non-GAAP adj. growth, given pos. adj.	-0.011	-0.064	-1.41	-0.110	-0.083	0.87
Variance of non-GAAP adj. growth, given pos. adj.	1.430	1.183	-2.37	1.024	1.177	2.68
Coefficient on non-GAAP earnings in the pricing eqn.	6.427	0.781	-6.26	3.792	2.316	-2.48
Coefficient on earnings in the pricing eqn.	0.664	-0.084	-2.05	0.390	-0.179	-1.34

B. Parameter estimates

α	κ_w	ρ_y	σ_y	σ_π	θ	κ_b	μ_π
Low intangible intensity							
0.571	0.419	0.481	0.142	0.021	0.564	15.015	0.003
(0.017)	(0.100)	(0.129)	(0.029)	(0.003)	(0.033)	(5.811)	(0.004)
High intangible intensity							
0.636	0.486	0.515	0.158	0.026	0.408	23.294	0.012
(0.006)	(0.037)	(0.028)	(0.005)	(0.002)	(0.018)	(5.324)	(0.002)

**Table 6: Non-GAAP reporting versus value:
Counterfactual experiments**

This table reports the results of our counterfactual experiments. Column 1 provides results from the baseline model. Column 2 reports results when the manager is not myopic and chooses the first-best level of investment. Column 3 reports results when the manager cannot disclose non-GAAP adjustments. Column 4 reports results when the manager, who is still myopic, can disclose non-GAAP earnings but cannot introduce opportunistic bias. The first row of this table reports the fraction of non-GAAP adjustments that are opportunistic, i.e., $\mathbb{E}[b/(b + |\nu_\pi|)]$. The second row of this table reports investment intensity, namely, $\mathbb{E}[w/(\pi + w + \frac{\kappa_w}{2} (\frac{w}{q})^2 q)]$. The third row reports the residual uncertainty, that is, the ratio of the variance of the residual from the regression of firm value on price to the variance of firm value. The last row reports the change in fundamental value relative to the baseline results. All amounts are in percentage points.

	Estimated	First best	GAAP only	No bias
A. Baseline estimation				
Biased adjustment (%)	33.382	0.000	0.000	0.000
Investment intensity (%)	54.337	36.608	26.670	48.314
Residual uncertainty (%)	66.179	0.000	73.412	53.608
Change in value (%)	0.000	1.184	-3.379	0.959
B. Low intangible intensity				
Biased adjustment (%)	46.510	0.000	0.000	0.000
Investment intensity (%)	50.876	22.342	28.823	42.813
Residual uncertainty (%)	54.465	0.000	71.834	44.888
Change in value (%)	0.000	1.773	-5.595	1.446
C. High intangible intensity				
Biased adjustment (%)	36.016	0.000	0.000	0.000
Investment intensity (%)	62.969	45.180	26.879	55.809
Residual uncertainty (%)	72.761	0.000	79.564	45.601
Change in value (%)	0.000	5.080	-1.434	4.706

Table 7: Low versus high equity holdings

The estimation is done with a simulated minimum distance estimator, which chooses structural model parameters by matching the moments from a simulated panel of firms to the corresponding moments from the data for the sample of firms with low versus high equity holdings for the CEO. Parameters are defined in Table 1. The standard errors are double-clustered by firm and year in both panels.

A. Moments

	Low equity holdings			High equity holdings		
	Data moments	Simulated moments	<i>t</i> -statistics	Data moments	Simulated moments	<i>t</i> -statistics
Mean intang. investment to capital	0.062	0.051	-57.43	0.070	0.052	-18.56
Mean earnings to capital	0.017	0.034	14.10	0.041	0.042	0.19
Variance of intang. investment growth	0.039	0.069	18.05	0.027	0.021	-2.64
Covariance of investment and earnings growth	-0.017	-0.028	-4.27	-0.010	-0.012	-0.49
Covariance of investment and cash flow growth	-0.016	0.013	5.65	-0.014	0.006	6.13
Variance of earnings growth	1.076	1.355	12.30	0.819	0.763	-1.80
Covariance of earnings and cash flow growth	0.200	0.098	-3.06	0.176	0.043	-6.08
Variance of cash flow growth	1.455	0.033	-30.07	1.275	0.014	-27.87
Incidence of positive non-GAAP adj.	0.399	0.646	10.38	0.425	0.646	8.29
Mean non-GAAP adj., given pos. non-GAAP adj.	0.028	0.027	-1.06	0.027	0.024	-2.60
Variance of intang. investment growth, given pos. adj.	0.042	0.067	7.28	0.033	0.021	-2.95
Cov. of investment and earnings growth, given pos. adj.	-0.026	-0.023	0.46	-0.029	-0.013	3.17
Cov. of investment and cash flow growth, given pos. adj.	-0.008	0.013	2.51	-0.009	0.005	2.49
Cov. of investment and non-GAAP adj. growth, given pos. adj.	0.040	0.037	-0.38	0.039	0.015	-2.44
Variance of earnings growth, given pos. adj.	1.228	1.435	3.05	0.931	0.790	-2.71
Cov. of earnings and cash flow growth, given pos. adj.	0.222	0.106	-3.40	0.205	0.049	-4.31
Cov. of earnings and non-GAAP adj. growth, given pos. adj.	-0.607	-0.938	-6.63	-0.471	-0.682	-2.99
Variance of cash flow growth, given pos. adj.	1.425	0.034	-21.62	1.184	0.015	-21.30
Cov. of cash flow and non-GAAP adj. growth, given pos. adj.	-0.076	-0.043	1.29	-0.070	-0.020	1.75
Variance of non-GAAP adj. growth, given pos. adj.	1.317	1.202	-1.59	1.141	1.197	0.89
Coefficient on non-GAAP earnings in the pricing eqn.	5.030	0.037	-12.73	8.763	1.514	-7.50
Coefficient on earnings in the pricing eqn.	0.510	-0.008	-1.29	-0.937	-0.068	1.29

B. Parameter estimates

α	κ_w	ρ_y	σ_y	σ_π	θ	κ_b	μ_π
Low equity holdings							
0.681	0.566	0.439	0.166	0.022	0.244	30.525	0.011
(0.039)	(0.138)	(0.206)	(0.008)	(0.002)	(0.064)	(13.403)	(0.003)
High equity holdings							
0.659	0.650	0.530	0.106	0.020	0.396	26.417	0.007
(0.008)	(0.113)	(0.008)	(0.012)	(0.001)	(0.049)	(2.035)	(0.001)

Table 8: Q1–Q3 versus Q4 reporting

The estimation is done with a simulated minimum distance estimator, which chooses structural model parameters by matching the moments from a simulated panel of firms to the corresponding moments from the data for the sample of firms with Q1–Q3 versus Q4 reporting. Parameters are defined in Table 1. The standard errors are double-clustered by firm and year in both panels.

A. Moments

	Q1–Q3 reporting			Q4 reporting		
	Data moments	Simulated moments	<i>t</i> -statistics	Data moments	Simulated moments	<i>t</i> -statistics
Mean intang. investment to capital	0.064	0.051	-13.08	0.070	0.051	-37.15
Mean earnings to capital	0.030	0.050	34.43	0.029	0.044	17.31
Variance of intang. investment growth	0.033	0.076	15.27	0.032	0.055	20.26
Covariance of investment and earnings growth	-0.008	-0.139	-32.39	-0.016	-0.096	-32.11
Covariance of investment and cash flow growth	-0.014	-0.016	-0.36	-0.008	-0.005	0.62
Variance of earnings growth	0.889	1.059	4.43	1.085	1.116	0.37
Covariance of earnings and cash flow growth	0.182	0.180	-0.17	0.212	0.151	-1.56
Variance of cash flow growth	1.383	0.048	-35.86	1.116	0.038	-21.43
Incidence of positive non-GAAP adj.	0.428	0.646	26.74	0.489	0.647	9.53
Mean non-GAAP adj., given pos. non-GAAP adj.	0.025	0.028	4.01	0.033	0.028	-3.19
Variance of intang. investment growth, given pos. adj.	0.039	0.077	8.51	0.035	0.054	6.23
Cov. of investment and earnings growth, given pos. adj.	-0.019	-0.156	-14.42	-0.024	-0.103	-12.84
Cov. of investment and cash flow growth, given pos. adj.	-0.009	-0.021	-2.24	-0.006	-0.008	-0.27
Cov. of investment and non-GAAP adj. growth, given pos. adj.	0.033	0.102	7.79	0.031	0.072	5.77
Variance of earnings growth, given pos. adj.	1.014	1.168	4.56	1.173	1.209	0.32
Cov. of earnings and cash flow growth, given pos. adj.	0.212	0.203	-0.54	0.212	0.166	-0.88
Cov. of earnings and non-GAAP adj. growth, given pos. adj.	-0.480	-0.759	-8.56	-0.689	-0.813	-1.71
Variance of cash flow growth, given pos. adj.	1.342	0.053	-32.86	1.023	0.041	-17.10
Cov. of cash flow and non-GAAP adj. growth, given pos. adj.	-0.046	-0.103	-2.88	-0.100	-0.090	0.34
Variance of non-GAAP adj. growth, given pos. adj.	1.190	1.159	-0.68	1.322	1.188	-1.68
Coefficient on non-GAAP earnings in the pricing eqn.	6.435	0.490	-8.75	4.975	2.288	-4.79
Coefficient on earnings in the pricing eqn.	0.391	-0.083	-1.28	0.324	-0.226	-1.71

B. Parameter estimates

α	κ_w	ρ_y	σ_y	σ_π	θ	κ_b	μ_π
Q1–Q3 reporting							
0.569	0.335	0.472	0.129	0.021	0.415	29.032	0.011
(0.005)	(0.007)	(0.022)	(0.012)	(0.001)	(0.009)	(11.762)	(0.000)
Q4 reporting							
0.631	0.695	0.511	0.132	0.022	0.670	20.714	0.004
(0.021)	(0.048)	(0.033)	(0.012)	(0.001)	(0.077)	(5.703)	(0.000)

Table 9: Non-GAAP reporting versus value:
Additional counterfactual experiments

This table reports the results of our counterfactual experiments. Column 1 provides results from the baseline model. Column 2 reports results when the manager is not myopic and chooses the first-best level of investment. Column 3 reports results when the manager cannot disclose non-GAAP adjustments. Column 4 reports results when the manager, who is still myopic, can disclose non-GAAP earnings but cannot introduce opportunistic bias. The first row of this table reports the fraction of non-GAAP adjustments that are opportunistic, i.e., $\mathbb{E}[b/(b + |\nu_\pi|)]$. The second row of this table reports investment intensity, that is, $\mathbb{E}[w/(\pi + w + \frac{\kappa_w}{2} (\frac{w}{q})^2 q)]$. The third row reports the residual uncertainty, that is, the ratio of the variance of the residual from the regression of firm value on price to the variance of firm value. The last row reports the change in fundamental value relative to the baseline results. All amounts are in percentage points.

	Estimated	First best	GAAP only	No bias
A. Low equity holdings				
Biased adjustment (%)	24.520	0.000	0.000	0.000
Investment intensity (%)	64.330	54.306	34.472	59.979
Residual uncertainty (%)	56.776	0.000	75.562	43.889
Change in value (%)	0.000	1.580	-3.093	1.218
B. High equity holdings				
Biased adjustment (%)	35.764	0.000	0.000	0.000
Investment intensity (%)	57.786	48.567	38.648	53.332
Residual uncertainty (%)	63.395	0.000	76.226	46.042
Change in value (%)	0.000	2.090	-0.044	1.905
C. Q1–Q3 reporting				
Biased adjustment (%)	34.810	0.000	0.000	0.000
Investment intensity (%)	54.317	34.998	25.416	47.528
Residual uncertainty (%)	68.895	0.000	72.345	55.828
Change in value (%)	0.000	1.305	-3.516	1.076
D. Q4 reporting				
Biased adjustment (%)	46.805	0.000	0.000	0.000
Investment intensity (%)	57.061	24.896	30.723	47.831
Residual uncertainty (%)	66.118	0.000	74.672	48.128
Change in value (%)	0.000	4.853	-10.633	4.492

Internet Appendix for “Non-GAAP Reporting and Investment”

Charles G. McClure

Anastasia A. Zakolyukina¹

A. S-shaped price function

A.1 Introduction

In this section, we explain the S-shaped dependence of the stock price on GAAP and non-GAAP earnings. We assume the stock price is determined as an equilibrium price in the market. For this purpose, we construct a general equilibrium model by introducing an additional agent, called “consumer,” whose demand for the stock determines the equilibrium price. The consumer’s decision regarding current investments into the stock represents her inter-temporal choice, where the investments pay back in the future as dividends.

Formally, we follow the approach of Kanodia (1980) and consider a general equilibrium dynamic model with an imperfectly informed capital market. The firm produces the only consumer good in the economy, using a single source, its capital stock. The firm also has one perfectly divisible equity share, the holder of which is entitled to dividends in the proportion of the owned share. The capital stock depreciates over time at a fixed rate. However, the firm can reinvest some of the produced good to build up its capital stock at an additional cost. The produced good cannot be stored, so the good remaining after investing in the future capital is paid out to shareholders in terms of dividends. The firm is controlled by a manager, whose objective is to maximize both dividends (or cash flows) and the current-period price of the stock, which he can manipulate directly subject to a personal cost.

A single representative consumer acts as a price taker. The consumer also serves as the sole recipient of dividends according to the amount of shares she possesses. To simplify the setup, we assume the firm’s dividends can be consumed directly, so the consumer simply decides which portion of them to consume in the current period and which to spend on shares of the firm. Purchasing firm shares is the only way the consumer can optimize her consumption. Accordingly, the consumer’s problem in each period can be described as one to resolve the trade-off between the current and future consumption to maximize the expected infinite sum of the discounted utilities of consumption.

The stochastic and informational structure of the model is as follows. In the beginning of each period, the manager observes the firm’s capital stock as well as two random

¹Booth School of Business, University of Chicago, IL 60637.

shocks: the productivity shock and the transitory shock to earnings. He then announces GAAP and non-GAAP earnings to the consumer and decides on current investment that determines the next-period capital stock as well as the current dividends. Accordingly, the manager of the firm has full information about the current state when making decisions. The consumer, on the other hand, has no knowledge regarding the true state besides the reported values of GAAP and non-GAAP earnings.

Following Kanodia (1980), we further assume that in the equilibrium, both parties learn the equilibrium strategies of the other. Thus, for each state (whether observed or unobserved), they have rational expectations regarding each others choices. In particular, this means the consumer knows the manager's decision in each (true and unobserved) state, and the observation of the two reported values provides her additional information regarding the unobserved state, so that her posterior beliefs regarding the unobserved state change accordingly. This provides an opportunity for the manager to manipulate the market by deviating from the chosen strategy: by introducing a bias into reported values, the manager affects the consumer's posterior beliefs regarding the current and future states. Of course, the equilibrium condition is the one that ensures any such deviations from the equilibrium strategy of the manager make him worse off.

This setup closely follows the one proposed in Kanodia (1980) with a few key differences, which we discuss below. Note, however, that, although the two models are very close, and in fact, the model by Kanodia (1980) inspired this model, certain differences exist in modelling assumptions, some of which significantly complicate derivations and preclude us from using Kanodia (1980)'s results directly.

A few changes that we have introduced in our model on their own would not divert us too far away from Kanodia (1980)'s model, and his results would still be applicable. One such change is that we assume the firm's dividends are consumed directly. This way, we eliminate the need to introduce a price in the consumer good market. In his own words, Kanodia (1980) introduces the two prices in the consumer good and stock markets for convenience in the formal construction of the model only, where merely the ratio of the two prices matters at any time to clear the markets. We are, however, only interested in the shape of the stock price function, so for us, avoiding the introduction of other markets and prices is more convenient.

Another difference is that Kanodia (1980) assumes the depreciation rate to be stochastic and independent across periods, whereas we assume it to be fixed. Kanodia (1980) assumes stochastic capital depreciation to ensure one of the two shocks he introduces is permanent. In our model, however, the permanent nature of the productivity shock is achieved by the assumption that it is modeled as an AR(1)-process. From the point of view of dividends and firm valuation, the two approaches are identical in the sense that the dividends in Kanodia (1980)'s model also have the same AR(1) structure, where the auto-correlation is ensured by permanent changes in the capital stock.

At the same time, a few aspects of this model significantly distinguish it from that of Kanodia (1980) to the extent that his results on the existence of an equilibrium cannot be applied directly to our case.

First, the main goal of our paper is to study the effect of the manager's information manipulation on the firm's stock price. As such, we have to assume the manager learns and in the equilibrium understands how his manipulation affects the market in general

and the stock price of the firm in particular. Kanodia (1980), on the other hand, assumes many identical firms exist, so he considers a representative firm, which is assumed to be a price taker, and therefore cannot manipulate the price of the stock.

Second, Kanodia (1980) assumes a specific form of the production function, where the amount of output produced depends on the values of the two shocks via their product only. He provides several arguments to justify his choice, but the power of this very specific functional form lies in the fact that it allows the author to make a certain conjecture that leads to the existence of the equilibrium. To better understand this last statement, Kanodia (1980) shows the existence of an equilibrium as follows: First, conjecture a specific property that is likely to hold in the equilibrium; second, derive the consumer's information set with the assumption that this property holds; and, third, given this information set, solve the consumer's problem and verify that the property indeed holds in the equilibrium. In fact, the conjecture that Kanodia (1980) makes reflects the specific form of the production function he chooses; namely, he conjectures that the equilibrium dividend policy depends on the two shocks via their product only, and clearly this conjecture is supported in the equilibrium by the same assumed property of the production function. We, however, have no such assumptions regarding the production function, and coming up with other explicit combinations of the two shocks such that the equilibrium policies would only depend on this combination of the two shocks seems hard. In other words, Kanodia (1980)'s approach to showing the existence of an equilibrium cannot be applied in our case.

Given all these differences, we are unable to use any of the results stated in Kanodia (1980) directly to justify the existence of the equilibrium, and instead in what follows, we provide our own arguments. At the same time, our questions are quite different from those Kanodia (1980) aims to address in his paper. Accordingly, we use only those arguments that are needed to support our conjecture regarding the shape of the price function rather than addressing more general questions stated in Kanodia (1980).

Our approach to argue the shape of the price function is as follows. We first formally state the dynamic model with imperfect information similar to that of Kanodia (1980), and describe information sets of both parties and the equilibrium. We then derive first-order conditions that must hold in the equilibrium. Finally, based on these first-order conditions, we argue the derivative of the price function with respect to the earnings of the firm must behave in such a way that the resulting function indeed has an S-shaped form.

A.2 Model

In the model that follows, we use the same notation and make the same functional-form assumptions as in the model estimated in the paper, except for the part related to the consumer and general equilibrium. The only notable difference in the naming convention is that we refer to d as "cash flows" in the paper and as "dividends" in this model.

The economy is described by a dynamic model with two agents, the manager and the consumer, and a single consumer good. In the beginning of each period, the manager observes the firm's capital stock q , and two shocks: the productivity shock v_y and the transitory shock to earnings v_π .

The manager first chooses an optimal amount w of investments into the capital stock, which determines the current GAAP earnings

$$\begin{aligned}\pi &= d + v_\pi q \\ &= y - w - \frac{\kappa_w}{2} \left(\frac{w}{q}\right)^2 q + v_\pi q.\end{aligned}$$

Here, y is the profit function that exhibits decreasing returns to scale given by

$$y = v_y q^\alpha, \alpha \in (0, 1).$$

The earnings account for the quadratic costs associated with investment. Without further justification, we uniformly assume all costs in our model are quadratic.

The manager then decides on the optimal non-GAAP adjustment $\psi = (-v_\pi + b)q$ to GAAP earnings

$$\begin{aligned}\pi + \psi &= \pi + (-v_\pi + b)q \\ &= d + bq.\end{aligned}$$

The manager incurs a quadratic personal cost $\frac{\kappa_b}{2} b^2 q$ associated with the opportunistic component b , which we attribute to the fact that a significant overestimation of true earnings has a severe negative effect on the manager's reputation.

At the end of the period, the capital stock depreciates at a fixed rate δ , so the capital stock available to the firm at the beginning of the next period is given by

$$q' = (1 - \delta)q + w.$$

We use primes to indicate the next period's values.

In the beginning of each period, the consumer owns z shares of the firm's stock, which provide her with zd units of the consumption good in the form of dividends d , which are unobserved to the consumer. The good can either be consumed immediately or traded for firm shares at the current stock price P . Because the good cannot be saved across periods, the latter choice represents the only opportunity to optimize future consumption, and hence the trade-off between the current and future consumption. Accordingly, given the current price of the stock P , the consumer in the beginning of the period has an initial endowment of

$$zd + zP,$$

which she spends on the current consumption c and z' shares that cost $z'P$. Because the consumer does not know the true value of d , the best she can do is predict the dividends based on the information she has. The difference between her predictions and actual dividends is costly to the consumer because it triggers suboptimal over- or under-consumption. Accordingly, we assume a quadratic cost is associated with an error in such prediction:

$$\frac{\kappa_c}{2} \mathbb{E} \frac{(c + (z' - z)P - zd)^2}{zd},$$

where the numerator is the difference between the consumer's choice of consumption and new investment, $c + z'P$, and an endowment that has an uncertain value to the consumer because the consumer does not know d , $zd + zP$; and the denominator is her dividend share, zd . Thus, the prediction error is more costly to the consumer when it constitutes a larger fraction of her current dividend payoff. Although this quadratic cost function may seem complicated, it has exactly the same structure as the two quadratic cost functions for the manager we introduced earlier.

A.3 Equilibrium

Following Kanodia (1980), we assume that in the equilibrium, both the manager and the consumer learn the equilibrium strategies of each other, and hence have rational expectations regarding each other's choices in each state (whether observed or unobserved). Because the manager has full information about the true state, his state is described by the triple (q, v_y, v_π) . The only information the consumer has is $(\pi, \pi + \psi)$, which describes the state from the consumer's point of view. Knowing the equilibrium strategy of the consumer, the manager can partially manipulate the demand for the product, and hence the current price of the stock, by changing the reported value of $\pi + \psi$. However, given the manager's personal cost of manipulation, the manager chooses to do so only if the benefit of doing so exceeds the cost.

Initially, the consumer, in the beginning of each period, has some prior distribution of the true state. She also knows the manager's decision in each true and unobserved state, so that the observation of the reported values provides her additional information regarding the unobserved state, and she calculates her posterior beliefs accordingly.

Given this informational structure, the manager maximizes a weighted sum of dividends and the price of the stock, taking into account all associated costs. Specifically, the manager maximizes the present value of

$$d_M = d + \theta P - \frac{\kappa_b}{2} b^2 q.$$

Accordingly, the manager's problem can be written as

$$\phi(q, v_y, v_\pi) = \max_{w, b} \left\{ d + \theta P - \frac{\kappa_b}{2} b^2 q + \frac{1}{1+r} \mathbb{E} \phi'(q', v'_y, v'_\pi) \right\},$$

where

$$d = v_y q^\alpha - \left[\frac{\kappa_w}{2} \left(\frac{w}{q} \right)^2 + \frac{w}{q} \right] q, \text{ and}$$

$$q' = \left(1 - \delta + \frac{w}{q} \right) q.$$

When choosing $\omega = \frac{w}{q}$, which is the fraction of the capital being reinvested, the trade-off is that increasing this fraction decreases d but increases q' , and hence $\mathbb{E} \phi'$. These are direct effects of choosing current investments, but the choice of ω also affects the objective function via the price of the stock, as will become clear in what follows.

When choosing b , the trade-off is as follows. The manager of the firm tries to manipulate the price of the stock by choosing some positive b , that is, by creating a positive bias in the reported non-GAAP earnings. Because we assume that in the equilibrium, the manager knows how the reported GAAP earnings

$$\pi = v_y q^\alpha + \left(v_\pi - \frac{\kappa_w}{2} \left(\frac{w}{q} \right)^2 - \frac{w}{q} \right) q$$

and non-GAAP earnings

$$\pi + \psi = v_y q^\alpha + \left(b - \frac{\kappa_w}{2} \left(\frac{w}{q} \right)^2 - \frac{w}{q} \right) q$$

affect the market, he can estimate the positive effect of such manipulations on the stock price

$$P = P(\pi, \pi + \psi).$$

However, we also find a direct quadratic cost associated with an increase in b . Note that our model contains no other direct effect of increasing b on the manager's objective, because the distribution of the future state (q', v'_y, v'_π) does not depend on the choice of b .

We define the consumer's current-period utility as $U(c)$, so that the consumer's problem is

$$v(z, \pi, \psi) = \max_{c, z'} \left\{ U(c) - \frac{\kappa_c}{2} \mathbb{E} \frac{(c + (z' - z)P - zd)^2}{zd} + \frac{1}{1 + r} \mathbb{E} v'(z', \pi', \psi') \right\}.$$

Here, both expectations are taken with respect to (w.r.t.) the posterior distributions of the current and possible future true states after obtaining the values of the current firm earnings.

When choosing consumption c , the trade-off is between the current consumption and the costs associated with spending too much or too little consumption, represented by the second term.

When choosing new stock ownership z' , the trade-off can be described as follows. Increasing z' requires spending more on stocks in the current period and either consuming less or paying a higher cost in terms of the expected under- or over-consumption. However, increasing z' also increases $\mathbb{E} v'$, which positively depends on the share of stock at hand.

Following Kanodia (1980), we assume that in the equilibrium, the demand for shares of stock equals the supply, that is, 1, so the price of the stock is adjusted in such a way that the consumer does not actually trade shares, and in the equilibrium,

$$z' = z = 1$$

is the optimal choice. In other words, in the equilibrium, at $z' = 1$, the marginal benefit of spending an extra dollar on investing in shares equals that of consuming it in the current period. The equilibrium price of the stock is set in each period at the level such that at this price, the consumer is willing to buy exactly $z' = 1$ shares of stock.

A.4 First-order conditions

Let $\omega = \frac{w}{q}$ be the fraction of the capital stock that is reinvested. Because the objective function of the manager depends on w via the ratio $\omega = \frac{w}{q}$ only, we can consider ω instead of w in solving for the first-order conditions (FOCs).

The manager's FOCs w.r.t. ω and b are

$$[1 + \theta(P_1 + P_2)](\kappa_w \omega + 1) = \frac{1}{1+r} \mathbb{E} \phi'_1, \text{ and} \\ \theta P_2 = \kappa_b b,$$

respectively. As before, primes indicate values in the next period, whereas (partial) derivatives are indicated with subindices, for example, P_1 . The expectations are w.r.t. known distributions of future shocks.

The P_1 and P_2 are the partial derivatives of the stock price function $P(\pi, \pi + \psi)$ w.r.t. its arguments π and $\pi + \psi$. For example, as noted above, the trade-off when choosing b is between the resulting change in the stock price and the associated quadratic costs. And between π and $\pi + \psi$, only the latter depends on b , so when taking the derivative of the stock price function w.r.t. b , only the second partial derivative is non-zero.

The consumer's FOCs w.r.t. c and z' are

$$U'(c) = \kappa_c (\mathbb{E} \frac{c+(z'-z)P}{zd} - 1), \text{ and} \\ \frac{1}{1+r} \mathbb{E} v'_1 = \kappa_c P (\mathbb{E} \frac{c+(z'-z)P}{zd} - 1),$$

respectively. Expectations here are w.r.t. the consumer's information set, more specifically, her posterior beliefs regarding future states.

As said before, in the equilibrium, the price of the stock P is set at the level such that the demand for the stock in the equilibrium is always $z' = 1$. Hence, in the dynamic equilibrium, z is also always 1, and we can rewrite the consumer equilibrium conditions as

$$U'(c) = \kappa_c (\mathbb{E} \frac{c}{d} - 1), \text{ and} \\ P = \frac{1}{1+r} \frac{\mathbb{E} v'_1(1, \pi', \psi')}{U'(c)}.$$

A.5 S-shaped price function derivation

We are now at the point when we can justify the assumption that the stock price function as a function of GAAP and non-GAAP earnings has the S-shaped form. We do so by considering the price function from two different perspectives: the consumer and the manager. The former aims to explain the shape of the stock price function by considering the market that determines the stock price and, accordingly, by considering the consumer's incentives. The latter, on the other hand, relates the given stock price function to the manager's incentives and optimal decisions, and explains the shape of the stock price function via some observable characteristics of the manager's decisions that

then should be caused by the S-shape of the stock price function.

Before considering the two arguments, we note that because the price function is non-negative, the left tail of the function must be convex, forming the left part of the S-shape. Therefore, considering only the right tail of the function is necessary, and we argue that the derivative of the stock price function w.r.t. earnings decreases as earnings become very large, forming the right part of the S-shape.

A.5.1. From the consumer's perspective

From the consumer's perspective, the price of the stock represents the cost of the trade-off between the current and future consumption. The price is formed as the result of the consumer's expectations and preferences regarding current and future dividends. Specifically, it is set in the equilibrium at the level that clears the stock market in such a way that the demand for the stock is exactly 1.

Now, assume that we increase GAAP earnings π to some very large value. From the point of view of the consumer, who does not know the true state, such an increase could be caused either by a large value of capital q or by large values of the productivity shock v_y or the transitory shock to earnings v_π . For any fixed value of q , as π goes up, the probability of the latter case decreases to 0, because in this case, as earnings go up, for a fixed value of q , v_y or v_π must increase with earnings, but the probability of such abnormal shocks goes rapidly to 0. Therefore, the consumer's posterior distribution of possible tuples (q, v_y, v_π) shifts toward larger values of q as π goes up. Intuitively, after observing large GAAP earnings, the consumer believes these earnings are more likely due to a high value of the unobserved q , rather than highly abnormal productivity or transitory earnings shocks. Accordingly, the expected dividends increase as well.

However, when we increase GAAP earnings, and the consumer's posterior distributions of q and d shift toward larger values, the relative attractiveness of investing in the future decreases due to diminishing returns on capital. The first consumer's FOC shows that when the expected dividends increase, if the current consumption were to increase proportionally, the right-hand side of the FOC would not change, whereas the marginal benefit of consumption on the left-hand side would decrease. Therefore, the current consumption increases at a rate lower than the rate of increase in the expected dividends. At the same time, the expected dividends increase proportionally to the current expected dividends due to the AR(1) structure of the process. This has a proportional effect on the expected future consumption, which, however, promises a decreased marginal utility due to the concave shape of the consumer's utility function. Accordingly, the growth of the price slows down as the expected earnings increase.

To illustrate the argument, let us consider the steady-state equilibrium. Let us further assume

$$U(c) = \ln c,$$

so that the marginal utility of consumption is

$$U'(c) = \frac{1}{c}.$$

In the steady-state equilibrium, we ignore the shock v_π , assuming it to be 0, so that the

consumer, in fact, knows the current dividends based on the reported value of π , that is,

$$d = \pi.$$

The first FOC of the consumer then becomes

$$\frac{1}{c} = \kappa_c \left(\frac{c}{\pi} - 1 \right),$$

or

$$c = \frac{\pi}{2} + \sqrt{\frac{\pi^2}{4} + \frac{\pi}{\kappa_c}}.$$

The second FOC of the consumer then defines the equilibrium price as the ratio of the two marginal benefits. In the steady-state equilibrium, the expected value of the firm is a constant, so we can rewrite the steady-state price, $P_{\text{st.st.}}$, up to a constant A

$$\begin{aligned} P_{\text{st.st.}} &= \frac{A}{U'(c)} \\ &\propto \frac{\pi}{2} + \sqrt{\frac{\pi^2}{4} + \frac{\pi}{\kappa_c}}. \end{aligned}$$

This function is concave, as can be verified by its derivative w.r.t. π , which is decreasing:

$$\frac{1}{2} + \frac{\frac{\pi}{2} + \frac{1}{\kappa_c}}{\sqrt{\frac{\pi^2}{4} + \frac{\pi}{\kappa_c}}}.$$

Although this example shows the claimed fact only for a specific utility function and at about a steady-state equilibrium, it helps illustrate the point above.

A.5.2. From the manager's perspective

From the manager's point of view, the stock price as an increasing function of non-GAAP earnings $\pi + \psi$ provides an opportunity to directly increase the stock price by misreporting these earnings. However, in our model, we assume a direct cost of such misreporting. Because the costs are assumed to be quadratic, the marginal costs are linear in b , and, hence, the optimal value of b is given by a simple equation stated as the second FOC of the manager above:

$$\theta P_2 = \kappa_b b.$$

The interpretation of this FOC is straightforward: the manager chooses the optimal value of bias b such that the marginal benefits, that is, the increase in the stock price, and costs, that is, the private cost of bias, coincide. We arrive at this equation as follows: the left-hand side of this equation is the marginal benefit of the increase in the price w.r.t. the increase in $\pi + \psi$, multiplied by the marginal change in $\pi + \psi$ due to the increase in b , which is simply q . The right-hand side is the marginal cost of b , which is proportional to bq because of the quadratic cost function. After cancelling q on both sides, we arrive at the formula above. If we considered a different or more general form of the costs, the resulting expression would probably be less elegant, but this would not affect our main

conclusion, namely, that in different equilibrium states, the smaller the value of b (and hence the smaller the marginal cost of increasing b), the smaller the derivative of the stock price function w.r.t. non-GAAP earnings (and hence the smaller the benefit of increasing b).

Accordingly, for the S-shape to hold, it is sufficient to argue that, in equilibrium states, b must decrease in capital q and/or GAAP earnings π . To reiterate, if b decreases in capital q and/or GAAP earnings π , the derivative of the stock price with respect to non-GAAP earnings $\pi + \psi$ will also decrease and the S-shaped price function would follow. Note that even when the relative value b decreases with earnings, the absolute value bq may still increase, so we only argue that whereas small companies may significantly over-report their non-GAAP earnings in relative terms, large companies are unable to do the same.

Because we do not have an explicit expression for optimal b , we cannot derive the conjecture above in the closed form. Instead, we rely on the patterns in the data to show this conjecture is plausible. We show the decreasing pattern for b based on both the data used for estimating the model and the data simulated from the estimated model in Figure IA.2. In data used for estimation, we do not observe b ; instead, we only observe a non-GAAP adjustment $\psi = (-v_\pi + b)q$. Under the assumption that the transitory shock to earnings v_π is i.i.d., any dependence between capital q and/or GAAP earnings π stems from bias b . Indeed, in Figure IA.2, Panel (a), the non-GAAP adjustment scaled by capital $\psi/q = -v_\pi + b$ decreases in both q and π . We confirm this pattern also holds in the data simulated from the baseline estimated model that assumes the S-shaped price function in Figure IA.2, Panel (b). The bias b decreases in both both q and π . These patterns combined with the FOC for the manager's choice of b suggest the S-shape for price as a function of non-GAAP earnings. This argument together with the theoretical analysis of the consumer's choice provided above justifies the S-shape of the stock price function P w.r.t. GAAP and non-GAAP earnings.

B. Pricing weights

We derive the intuition for the signs of the pricing weights on GAAP and non-GAAP earnings using a stylized model with correlated signals. The fundamentals that investors are learning about are denoted by x and correspond to the expected cash flows d in the model we estimate. Both GAAP earnings y_1 and non-GAAP earnings y_2 are noisy signals about x . GAAP earnings contain non-fundamental noise denoted by ϵ_1 . Non-GAAP earnings contain bias denoted by $\sigma\epsilon_2$, which is assumed to be a random variable. The variables x , ϵ_1 , and ϵ_2 are assumed to be jointly normal as defined below.

We follow the comparative statics in Figure 3 and assume both ϵ_1 and $\sigma\epsilon_2$ are correlated with fundamentals x . In GAAP earnings, x and ϵ_1 are *positively* correlated with correlation $\rho_1 > 0$. That is, from the bottom-left plot in Panel B, Figure 3, a high transitory earnings shock corresponds to lower investment, and thus higher expected cash flows or fundamentals x . In non-GAAP earnings, x and $\sigma\epsilon_2$ are *negatively* correlated with correlation $\rho_2 < 0$. That is, in the model, bias and investment are positively correlated (complementary), and thus, higher bias corresponds to higher investment that results in lower expected cash flows or fundamentals x . Investors estimate fundamentals, x , from

the two signals they observe, namely, GAAP, y_1 , and non-GAAP earnings, y_2 , knowing the correlation structure as described below.

$$y_1 = x + \epsilon_1, \quad (\text{IA.1})$$

$$y_2 = x + \sigma\epsilon_2, \quad (\text{IA.2})$$

where

$$\begin{pmatrix} x \\ \epsilon_1 \\ \epsilon_2 \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho_1 & \rho_2 \\ \rho_1 & 1 & 0 \\ \rho_2 & 0 & 1 \end{pmatrix} \right), \quad \rho_1^2 + \rho_2^2 \leq 1. \quad (\text{IA.3})$$

As discussed above, $\rho_1 > 0$ and $\rho_2 < 0$.

We can rewrite this as

$$y_1 = (1 + \rho_1)x + \eta_1, \quad \eta_1 = \epsilon_1 - \rho_1 x, \quad (\text{IA.4})$$

$$y_2 = (1 + \sigma\rho_2)x + \eta_2, \quad \eta_2 = \sigma\epsilon_2 - \sigma\rho_2 x, \quad (\text{IA.5})$$

where

$$\begin{pmatrix} x \\ \eta_1 \\ \eta_2 \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 - \rho_1^2 & -\sigma\rho_1\rho_2 \\ 0 & -\sigma\rho_1\rho_2 & \sigma^2(1 - \rho_2^2) \end{pmatrix} \right). \quad (\text{IA.6})$$

Therefore, η_1 and η_2 are uncorrelated with x . To simplify the argument, consider a corner condition in which $\rho_1^2 + \rho_2^2 = 1$. Then, because $\sqrt{1 - \rho_1^2} = -\rho_2$,

$$y_1 = (1 + \rho_1)x - \rho_2\eta, \quad (\text{IA.7})$$

$$y_2 = (1 + \sigma\rho_2)x + \sigma\rho_1\eta, \quad (\text{IA.8})$$

and one can solve for x explicitly, namely,

$$x = \frac{\sigma\rho_1 y_1 + \rho_2 y_2}{\sigma\rho_1(1 + \rho_1) + \rho_2(1 + \sigma\rho_2)}. \quad (\text{IA.9})$$

We see the coefficients in equation (IA.9) on y_1 and y_2 have *opposite* signs, and the first one on y_1 is *negative* when

$$0 < \frac{1 + \rho_1}{-\rho_2} < \frac{1 + \sigma\rho_2}{\sigma\rho_1}. \quad (\text{IA.10})$$

By continuity, when the correlation between η_1 and η_2 is high, that is, when $\rho_1^2 + \rho_2^2$ is close to the corner condition above, the first coefficient remains negative.

To simplify interpretation, equation (IA.10) can be rewritten as

$$0 < -\frac{\text{Cov}(y_1, x)}{\text{Cov}(y_1, \epsilon_2)} < \frac{1}{\sigma} \frac{\text{Cov}(y_2, x)}{\text{Cov}(y_2, \epsilon_1)}. \quad (\text{IA.11})$$

This expression suggests that for y_1 to have a negative sign and for y_2 to have a positive sign, the following conditions should hold. First, y_2 should be more informative about x than about ϵ_1 , that is, noise in the other signal y_1 . Second, y_1 should be less informative about x than about ϵ_2 , that is, noise in the signal y_2 , which makes it optimal to use y_1 to adjust for the expected noise ϵ_2 , and thus makes y_2 even more precise signal about x . Third, this effect is amplified when y_2 is more precise, that is, σ is low.

The result of this stylized model can be stated in terms of GAAP and non-GAAP earnings as well. In equilibrium, because GAAP earnings are relatively more informative about bias in non-GAAP earnings than about fundamentals, GAAP earnings are used to remove the expected bias from non-GAAP earnings, thereby making non-GAAP earnings an even more precise signal about fundamentals. Hence, a negative weight on GAAP earnings exists in the pricing function. In turn, because non-GAAP earnings are a relatively more precise signal about fundamentals than about a non-fundamental shock, non-GAAP earnings receive a positive weight. The likelihood of these pricing weights increases when non-GAAP earnings become an even more precise signal about fundamentals.

C. Expected and realized cash flows

We implement the cash-flow movement across periods following Terry et al. (2023). First, we define parameter $\rho_s \in (0, 1)$ as the probability of intertemporal cash-flow reshuffling. Next, we draw a set of uniform shocks, ζ_{it} , for each firm i and time t . The observed (realized) cash flows, $\tilde{d}_{it}$, are initialized at time 1 as cash flows simulated from the model, that is, $\tilde{d}_{i1} \equiv d_{i1}$. Finally, iteratively progressing from $t = 2, \dots, T - 1$ for each firm i , we update the observed cash-flow series by including the following rules:

$$\text{If } \zeta_{it} < 0.5, \text{ set } \tilde{d}_{it-1} = \tilde{d}_{it-1} + 2\rho_s(0.5 - \zeta_{it}) \text{ and } \tilde{d}_{it} = \tilde{d}_{it} - 2\rho_s(0.5 - \zeta_{it}) \quad (\text{IA.12})$$

$$\text{If } \zeta_{it} \geq 0.5, \text{ set } \tilde{d}_{it+1} = \tilde{d}_{it+1} + 2\rho_s(0.5 - \zeta_{it}) \text{ and } \tilde{d}_{it} = \tilde{d}_{it} - 2\rho_s(0.5 - \zeta_{it}). \quad (\text{IA.13})$$

This procedure randomly pushes some portion of today's expected cash flows into tomorrow or yesterday, keeping the sum of cash flows over any three-year horizon unchanged. These ideas are based on Dechow and Dichev (2002).

We estimate ρ_s as an average of β_{t-1} and β_{t+1} , using the following regression:

$$\pi_t = \alpha + \beta_{t-1}\tilde{d}_{t-1} + \beta_t\tilde{d}_t + \beta_{t+1}\tilde{d}_{t+1} + v_t \quad (\text{IA.14})$$

where π_t ($\tilde{d}_t$) is GAAP earnings (cash flows). For our sample, ρ_s equals 11.2%, which implies 11.2% of GAAP earnings in t converts to cash in either $t - 1$ or $t + 1$.

D. Model solution and estimation

This section describes how we numerically solve our model and details our estimation. Briefly, our model solution requires a rational expectations equilibrium for the stock price. The manager maximizes his objective function, assuming a conjectured set of weights the market places on GAAP and non-GAAP earnings when pricing the firm. We achieve an equilibrium if the manager's conjectured weights correspond to the actual weights the market uses. When this is satisfied, we use this model solution to simulate a vector of moments. We compare the simulated moments to data moments and choose the set of parameters that minimizes the weighted-squared distance between the two sets of moments.

D.1 Manager's problem

We solve the manager's objective function for a conjectured set of pricing weights. To solve the manager's problem, we discretize the state space for the three state variables, q , v_y , and v_π . We have 21 grid points for capital, q , centered around the steady-state level of capital q , which is derived in the next section.² The q grid is then set in multiples of the depreciation rate around the steady-state q , that is, in multiples of $(1 - \delta)$ below and $1/(1 - \delta)$ above.

For the two shocks, v_y and v_π , we allow 9 points of support. These variables evolve as a discrete-state Markov chain over the interval $[-3\sigma_x, 3\sigma_x]$, where $x \in \{y, \pi\}$, and we estimate their evolution using Tauchen (1986).

We allow each control variable, w and b , to assume one of 61 possible values. The maximum value of w is 35% of the maximum value of q , $\bar{q}$. Because b is a multiple of q , we set its maximum to be 15%, so that bias cannot be larger than 15% of a firm's capital. However, most solutions require w and b to be closer to 0, so we concentrate most choices to be much smaller than these extreme values. We use log-linear spacing for w between 0 and $0.35\bar{q}$. For b , we set six choices to lie between 0.035 and 0.15. The remaining 56 choices of b are equally spaced between 0 and 0.035.

We solve the manager's Bellman equation using policy iterations. This optimization routine produces a policy function, $\{w, b\} = p(q, v_y, v_\pi)$, which provides the optimal choice of w and b for each element for the state space.

D.2 Steady-state level of capital q

In this section, we derive a steady-state value of capital q that we use to create the grid for q .

²For some parameter values, the steady-state value of capital cannot be determined. In these cases, we set the midpoint of q to be the steady-state value of q from the standard investment model, that is, $q^* = \left(\frac{r+\delta}{\alpha}\right)^{1/(\alpha-1)}$.

The manager has a one-period payoff at

$$d_M = d + \theta P - \frac{\kappa_b}{2} b^2 q, \quad (\text{IA.15})$$

$$q' = (1 - \delta)q + w \quad (\text{IA.16})$$

$$d = v_y q^\alpha - w - \frac{\kappa_w}{2} \left(\frac{w}{q} \right)^2 q \quad (\text{IA.17})$$

$$P = \beta_0 + \beta_1 g(d + bq) + \beta_2 g(d + v_\pi q), \quad g(x) = \sqrt{x} \quad (\text{IA.18})$$

Consider the steady state with the following assumptions: (1) $v_y = v'_y = 1$; (2) $v_\pi = v'_\pi = -\mu_\pi$; (3) $g'(d + bq) = \gamma_1$; and (4) $g'(d - \mu_\pi q) = \gamma_2$.

For convenience, denote

$$\lambda = \frac{1}{1 + r}. \quad (\text{IA.19})$$

In the steady state, $q = q'$ and $b = b'$, where prime indicates the next-period values. Because b is a one-period decision, we can solve for the steady-state b using a one-period payoff. The first-order condition for b is

$$0 = \theta \beta_1 \gamma_1 q - \kappa_b b q, \quad (\text{IA.20})$$

$$b = \theta \frac{\beta_1 \gamma_1}{\kappa_b}. \quad (\text{IA.21})$$

Note this optimal decision does not depend on q .

At the steady-state path, we change q' but keep $q'' = q$. This affects w and w' , and hence d and d' , as well as P and P' .

Because

$$\frac{dd}{dq'} = \frac{dq}{dq'} \left(\alpha q^{\alpha-1} + \frac{\kappa_w}{2} \left(\frac{w}{q} \right)^2 \right) - \frac{dw}{dq'} \left(1 + \kappa_w \frac{w}{q} \right), \quad (\text{IA.22})$$

and

$$\frac{dq}{dq'} = 0, \quad \frac{dw}{dq'} = 1, \quad \frac{dq'}{dq'} = 1, \quad \frac{dw'}{dq'} = -(1 - \delta), \quad (\text{IA.23})$$

we have

$$\frac{dd}{dq'} = -1 - \kappa_w \frac{w}{q}, \quad (\text{IA.24})$$

$$\frac{dd'}{dq'} = \alpha q'^{\alpha-1} + \frac{\kappa_w}{2} \left(\frac{w'}{q'} \right)^2 + (1 - \delta) \left(1 + \kappa_w \frac{w'}{q'} \right). \quad (\text{IA.25})$$

For convenience, we introduce two new variables that represent these derivatives in the

equilibrium, namely,

$$D := \left. \frac{dd}{dq'} \right|_{\text{st.st.}} = -1 - \kappa_w \delta \quad (\text{IA.26})$$

and

$$D' := \left. \frac{dd'}{dq'} \right|_{\text{st.st.}} = 1 - \delta + \left(1 - \frac{\delta}{2}\right) \kappa_w \delta + \alpha q^{\alpha-1}. \quad (\text{IA.27})$$

Further,

$$\left. \frac{dP}{d\cdot} \right|_{\text{st.st.}} = \frac{dd}{d\cdot} (\beta_1 \gamma_1 + \beta_2 \gamma_2) + \frac{dq}{d\cdot} (\beta_1 \gamma_1 b - \beta_2 \gamma_2 \mu_\pi). \quad (\text{IA.28})$$

In particular, in the steady state,

$$\left. \frac{dP}{dq'} \right|_{\text{st.st.}} = (\beta_1 \gamma_1 + \beta_2 \gamma_2) D, \quad (\text{IA.29})$$

$$\left. \frac{dP'}{dq'} \right|_{\text{st.st.}} = (\beta_1 \gamma_1 + \beta_2 \gamma_2) D' + (\beta_1 \gamma_1 b - \beta_2 \gamma_2 \mu_\pi). \quad (\text{IA.30})$$

Hence, the first-order condition is

$$\begin{aligned} 0 &= \left(D + \lambda D' \right) + \theta \left((\beta_1 \gamma_1 + \beta_2 \gamma_2) (D + \lambda D') + \lambda (\beta_1 \gamma_1 b - \beta_2 \gamma_2 \mu_\pi) \right) \\ &\quad - \theta^2 \lambda \frac{\beta_1^2 \gamma_1^2}{2\kappa_b}. \end{aligned} \quad (\text{IA.31})$$

To separate the terms containing q , let

$$\begin{aligned} D + \lambda D' &= - \left[1 - \lambda(1 - \delta) + \left(1 - \lambda \left(1 - \frac{\delta}{2}\right)\right) \kappa_w \delta \right] + \lambda \alpha q^{\alpha-1} \\ &=: -C + \lambda \alpha q^{\alpha-1}. \end{aligned} \quad (\text{IA.32})$$

In particular, $C > 0$.

Then, in the steady state,

$$\begin{aligned} C &= \lambda \alpha q^{\alpha-1} - \theta^2 \lambda \frac{\beta_1^2}{2\kappa_b} \gamma_1^2 \\ &\quad + \theta \left(\lambda \alpha (\beta_1 \gamma_1 + \beta_2 \gamma_2) q^{\alpha-1} + (\lambda b - C) \beta_1 \gamma_1 - (\lambda \mu_\pi + C) \beta_2 \gamma_2 \right). \end{aligned} \quad (\text{IA.33})$$

Substituting b gives us further

$$C = \lambda \alpha q^{\alpha-1} + \theta \left(\lambda \alpha (\beta_1 \gamma_1 + \beta_2 \gamma_2) q^{\alpha-1} + (\theta \lambda \frac{\beta_1 \gamma_1}{2 \kappa_b} - C) \beta_1 \gamma_1 - (\lambda \mu_\pi + C) \beta_2 \gamma_2 \right). \quad (\text{IA.34})$$

In the steady state, we further require that

$$\gamma_1 = \frac{1}{2\sqrt{d+bq}}, \gamma_2 = \frac{1}{2\sqrt{d-\mu_\pi q}}, \quad (\text{IA.35})$$

so that, in the steady state,

$$d = q^\alpha - \left(1 + \frac{\kappa_w}{2} \delta\right) \delta q, \quad (\text{IA.36})$$

$$b = \theta \frac{\beta_1}{\kappa_b} \frac{1}{2\sqrt{d+bq}}. \quad (\text{IA.37})$$

This is an implicit equation that would need to be solved for b .

As an alternative, we approximate both gammas so that they both are assumed to be equal to γ such that

$$\gamma = \frac{1}{2\sqrt{d}}. \quad (\text{IA.38})$$

We can do this assuming the deviations $+bq$ and $-\mu_\pi q$ are relatively small (they are also of opposite signs, so we take a some sort of average). And this will also allow us to prevent an optimal solution to increase dividends to $+\infty$.

$$C = \lambda \alpha q^{\alpha-1} + \theta \left(\lambda \alpha \frac{\beta_1 + \beta_2}{2} q^{\alpha-1} d^{-\frac{1}{2}} + \theta \lambda \frac{\beta_1^2}{8 \kappa_b} d^{-1} - \left(C \frac{\beta_1 + \beta_2}{2} + \lambda \mu_\pi \frac{\beta_2}{2} \right) d^{-\frac{1}{2}} \right). \quad (\text{IA.39})$$

For stability, we need the second-order condition to be positive

$$1 + \theta \frac{\beta_1 + \beta_2}{2\sqrt{d}} > 0; \quad (\text{IA.40})$$

that is, all steady-state equilibria are stable.

To find the steady-state q , we need to solve the implicit equation (IA.39) using (IA.36). This implicit equation can be solved on the interval $[0, \bar{q}]$. The lower bound at 0 is obvious. The upper bound $\bar{q}$ turns d_M to zero with the investment replacing the capital to the same level $\bar{q}$, that is, $w = \delta \bar{q}$. We do not need to know the exact $\bar{q}$, and any $q > \bar{q}$ would suffice as an upper bound. Hence, we can bound d_M from the above, and find q that sets this

upper bound to zero. Set shocks to the following values: (1) $\nu_y = e^{\sigma_y^2/2} \Big|_{\sigma=0.50} = e^{0.125}$; (2) $\nu_\pi = -\mu_\pi$. Also, note $g(x) = \sqrt{x} < x$ for sufficiently high $x > 1$ and, therefore,

$$\begin{aligned} P &= \beta_0 + \beta_1 g(d + bq) + \beta_2 (d - \mu_\pi q) \leq \\ &\underbrace{\beta_0}_{\leq 1/(1-\lambda)d} + \beta_1 \underbrace{(d + bq)}_{\leq d} + \beta_2 \underbrace{(d - \mu_\pi q)}_{\geq 0} \leq \\ &\left(\frac{1}{1-\lambda} + 2\beta_1 + \beta_2 \right) d \end{aligned} \quad (\text{IA.41})$$

$$\begin{aligned} d_M &= (1 - \theta)d + \theta(1 - \lambda)P - \underbrace{\frac{\kappa_b}{2} b^2 q}_{\geq 0} \leq \\ &(1 - \theta)d + \theta(1 - \lambda) \left(\frac{1}{1-\lambda} + 2\beta_1 + \beta_2 \right) d = \\ &\underbrace{\left(1 - \theta + \theta(1 - \lambda) \left(\frac{1}{1-\lambda} + 2\beta_1 + \beta_2 \right) \right)}_{>0} d = 0 \end{aligned} \quad (\text{IA.42})$$

Thus, upper bound $\bar{q}$ can be found from $d = 0$

$$d = e^{0.125} \bar{q}^\alpha - \delta \bar{q} - \frac{\kappa_w}{2} \delta^2 \bar{q} = 0 \quad (\text{IA.43})$$

$$\Rightarrow \bar{q} = \left(\frac{\delta}{e^{0.125}} \left(1 + \frac{\kappa_w}{2} \delta \right) \right)^{1/(\alpha-1)} \quad (\text{IA.44})$$

We compute the steady-state level of capital q by numerically solving the the implicit equation (IA.39) using (IA.36) on the interval $[0, \bar{q}]$. We further center our grid for q around this steady-state value.

D.3 A rational expectations equilibrium

Our model relies on a rational expectations equilibrium, so we must establish a pricing function that is consistent between the manager's conjectured pricing weights and those that the market uses. To ensure consistency, we perform the following steps for a given set of parameter values:

First, we conjecture signal weights for the pricing equation, $\beta^{(1)}$. This conjecture ensures the manager can conjecture a price for each element of the discretized state space. We initialize the pricing weight for $g(\pi + \psi)$ and $g(\pi)$, that is, β_1 and β_2 , to the estimates from the data in Figure 1, and the intercept to the average firm value from the policy-iteration initialization step. Second, we use these weights to solve the manager's problem, as described in section D.1. Third, we use the resulting policy function to compute firm

value, V_F , by value-function iteration. Fourth, we regress non-GAAP and GAAP earnings (after S-shape transformation) on V_F to produce updated pricing weights, $\beta^{(2)}$. Last, we check if the weights have significantly changed between iterations. We continue to iterate steps two through four until we find less than a 5% change or an absolute change of less than 1×10^{-4} for all of the pricing coefficients. When these two conditions are satisfied, an equilibrium has been achieved.

For some parameter values, multiple equilibria or no equilibrium can exist for a pricing function in a non-linear dynamic model. If the equilibrium is not achieved within 150 iterations, we stop searching for an equilibrium and assume this set of parameters cannot produce a unique equilibrium.

We verify that the model is internally consistent in Figure IA.3. Because investors use S-shape function for GAAP and non-GAAP earnings when pricing firms' shares, the S-shape pattern should also be present in the fundamental firm value V_F . That is, functional form imposed on investors beliefs should hold in the realized firm value. Indeed, Figure IA.3 shows the S-shape pattern in V_F for both GAAP and non-GAAP earnings. To obtain this figure, we take the data from the model solution in the baseline parameter values from Table 4. The data specifies a set $\{\pi, \pi + \psi, V_F\}$ for each value of state variables $\{q, v_y, v_\pi\}$. To integrate over state variables, we sort GAAP and non-GAAP earnings into 100 bins and compute the average of firm value V_F in each bin. We then plot these averages and fit the $g(x) = \sqrt{x}$ function used in the paper for the S-shape pricing. The figure focuses on the region with positive earnings because we intentionally constrain the manager's actions in the negative earnings region to keep the stock price positive, which distorts the S-shape pattern in the negative earnings region. We note that this constraint has a negligible effect because it is optimal for the manager to stay in the positive earnings region.

D.4 Simulated moments

Once we have established a model solution that satisfies the rational expectations equilibrium, we compute the simulated data. To ensure our simulated moments are not adversely affected by simulation error, we average our moments over 20 simulations. For each simulation, $s = 1, \dots, 20$, we simulate the shocks v_y and v_π for $t = 0, \dots, T$ periods and $i = 1, \dots, N$ firms. We set $T = 240$ and $N = 1,500$ so that after our "burn-in" period (described below), the data within a simulation roughly correspond to our sample. In $t = 0$, we initialize q uniformly over the range of permissible values based on our state-space grid. We use these initial values of q and the shocks to interpolate the optimal choice of w and b from our policy function. We update q in each successive period using the equation for capital so that we have a complete set of actions and states for each i and t . To ensure our simulated moments reflect the steady state, we drop observations for $t \leq 200$, so we are left with 40 periods.

To ensure we do not choose parameters that imply the manager should set infinitely large w or b , or have capital that is either infinitely large or 0, we impose several bunching tolerances. A valid set of parameters cannot have more than 5% of the simulated values of q at either the maximum or the minimum value of q . Furthermore, no more than 5% of the simulated data can have the optimal choice of w and b at the upper bounds (i.e., $0.35\bar{q}$ and 0.15). We place no such bunching restrictions on the lower bounds of w and b .

because not investing or biasing non-GAAP earnings can be optimal.

After simulating data, y_s , that satisfy the bunching restrictions, we compute the simulated moments. Let Θ be the vector of model parameters and define the vector of moments as $h(y_s(\Theta))$. The equivalent moments using data x are denoted as $h(x)$. Thus, our moment condition is

$$g(x, \Theta) = h(x) - \frac{1}{S} \sum_{s=1}^S h(y_s(\Theta)) \quad (\text{IA.45})$$

The simulated method of moments estimate for Θ is the solution to the minimization of

$$\hat{\Theta} = \arg \min_{\theta} g(x, \Theta)' \hat{W} g(x, \theta), \quad (\text{IA.46})$$

where $\hat{W}$ is a positive definite matrix. We search for the parameters that minimize equation (IA.46), using a combination of particle-swarm and Hooke-Jeeves optimization algorithms,³ and restart this two-step routine from multiple initial points to ensure we are able to find a global minimum in the parameter space.

D.5 Choice of weight matrix

Although any positive-definite weight matrix in equation (IA.46) allows estimated parameters to converge to the true parameters in the limit, many are inefficient and can arbitrarily over- or under-weight certain moments. For example, setting $\hat{W}$ to the identity matrix will over-emphasize the moment with the largest magnitude. Therefore, we set $\hat{W}$ to the inverse of the covariance of data moments. When computing the weight matrix, we remove firm-fiscal-quarter fixed effects from all the variables used to compute our moments, including the variables used to compute means. The only exception is the variables we use to compute the AR(1) coefficient of GAAP earnings scaled by capital because these are already de-measured by firm-fiscal-quarter using the X-differencing approach in Han, Phillips, and Sul (2014). We use influence functions, $\phi_{h(x)}$, to construct $\hat{W}$ as in Erickson and Whited (2002). We do not cluster our weight matrix. For the discussion of this approach to computing a weight matrix, see Li et al. (2016) and Bazdresch et al. (2017)

This method to construct a weight matrix accomplishes our objective of weighting moments based on within-firm-fiscal-quarter variation. However, $\hat{W}$ is not the optimal weight matrix because it ignores the time-series nature of the data. To address this concern, we compute standard errors with a clustered moment covariance matrix, $\hat{\Omega}$. We double-cluster the co-variance matrix of moments used to compute standard errors by firm and year. When we compute $\hat{\Omega}$ using influence functions, we do not demean mean moments. However, we continue to demean variances and autocorrelations. The estimate

³For an overview of both particle-swarm and Hooke-Jeeves optimization, see Kochenderfer and Wheeler (2019).

of $\widehat{\Omega}$ is defined as

$$\widehat{\Omega} = \frac{1}{NT} \sum_{i=1}^N \left(\sum_{t=1}^T \phi_{h(x_{it})} \right) \left(\sum_{t=1}^T \phi_{h(x_{it})} \right)' \quad (\text{IA.47})$$

We plug this covariance matrix into the standard covariance matrix for parameters in a simulated method of moments estimator

$$\left(1 + \frac{1}{S} \right) \left(G(x, \Theta)' \widehat{W} G(x, \Theta) \right)^{-1} G(x, \Theta)' \widehat{W} \widehat{\Omega} \widehat{W} G(x, \Theta) \left(G(x, \Theta)' \widehat{W} G(x, \Theta) \right)^{-1}, \quad (\text{IA.48})$$

where $G(x, \Theta)$ is the Jacobian of the moment condition $g(x, \Theta)$.

D.6 Estimating counterfactuals

Our paper focuses on firms' responses and the resulting valuation effects from three counterfactuals. The first counterfactual considers when the manager invests to maximize the firm's fundamental value. The second counterfactual considers when the firm can only disclose GAAP earnings, and the third considers if the firm can report non-GAAP earnings but cannot bias the report. Generally, we set the model parameters for all counterfactuals to equal those estimated in our baseline analysis, and then adjust the parameters to reflect each counterfactual.

Our first counterfactual is when the manager invests to maximize the firm's fundamental value. In this counterfactual, we set the parameter that dictates the manager's weight on price, θ , to zero. Without an incentive to maximize share price, we solve the manager's investment problem without the need to find a rational expectations equilibrium. Therefore, the manager solves the following problem:

$$V(q, v_y, v_\pi) = \max_w \left\{ d + \frac{1}{1+r} \mathbb{E}_{v_y, v_\pi} V(q', v'_y, v'_\pi) \right\}. \quad (\text{IA.49})$$

This optimization is a standard investment problem that is commonly found in the economics and finance literature (e.g., Hennessy and Whited, 2005).

Our second and third counterfactuals relate to the GAAP-only and no-bias counterfactuals. For these counterfactuals, we allow the pricing coefficients to vary so that investors can re-weight the signals to reflect the alternate information environment. The model solutions for both of these counterfactuals are calculated similarly to our baseline specification. Our grid size and menu of permissible choices for w remain unchanged; however, neither counterfactual uses b . As a result, the manager only chooses an investment level, w , so his objective function becomes

$$V_M(q, v_y, v_\pi) = \max_w \left\{ d_M + \frac{1}{1+r} \mathbb{E}_{v_y, v_\pi} V_M(q', v'_y, v'_\pi) \right\} \quad (\text{IA.50})$$

Like our baseline analysis, we conjecture pricing weights to maximize the manager's utility, calculate V_M , and iterate until the conjectured weights match those used by the market.

However, we adjust the model to reflect the specific policy question our counterfactual hopes to answer.

In particular, the GAAP-only counterfactual considers how firms would respond if they could only report GAAP earnings. To implement this counterfactual, we fix the non-GAAP adjustment, ψ , to 0, and thus, the pricing function no longer has a term for non-GAAP earnings. Our third counterfactual is the no-bias counterfactual. It considers an environment in which the manager can report non-GAAP earnings but cannot insert any bias. Under this counterfactual, non-GAAP adjustment becomes $\psi = -v_\pi q$. Without bias, non-GAAP earnings eliminate the transitory noise, so that non-GAAP earnings equal expected cash flows, that is, $\pi + \psi = d$. When this is the case, investors have a perfect signal of expected cash flows from non-GAAP earnings and thus disregard GAAP earnings, which we operationalize by removing GAAP earnings from the pricing function.

After solving the model for our counterfactuals, we compute changes in w and V_F using the simulated states from our baseline specification (i.e., we hold fixed $\{q, v_y, v_\pi\}$). This approach ensures our counterfactuals are not affected by simulated data settling in different regions of the state space. We fix the state space of the simulated data to ensure the measured changes are a result of different actions for a given state, not differences in the distribution in the state space.⁴

We examine three aspects of the model, average bias scaled by gross non-GAAP adjustments, $\mathbb{E}[b/(b + |v_\pi|)]$, investment intensity, $\mathbb{E}[w/(\pi + w + \frac{\kappa_w}{2} (\frac{w}{q})^2 q)]$, and changes in firm value, V_F . For each of these metrics, we average these amounts over our simulated data and compare them with our baseline specification.

⁴For example, our baseline specification leads to over-investment relative to the case in which the manager maximizes fundamentals only. Compounded over the burn-in period of our simulation period, this over-investment would mechanically lead to $V_F^{baseline} > V_F^{FB}$, simply because over-investment induces to higher levels of capital (and value).

Figure IA.1: Persistence of non-GAAP reporting

This figure depicts the fraction of firms that switch between reporting and not reporting non-GAAP earnings, stop reporting non-GAAP earnings, or always report non-GAAP earnings in our estimation sample as described in section 4. The sample is restricted to firms with at least 12 quarters.

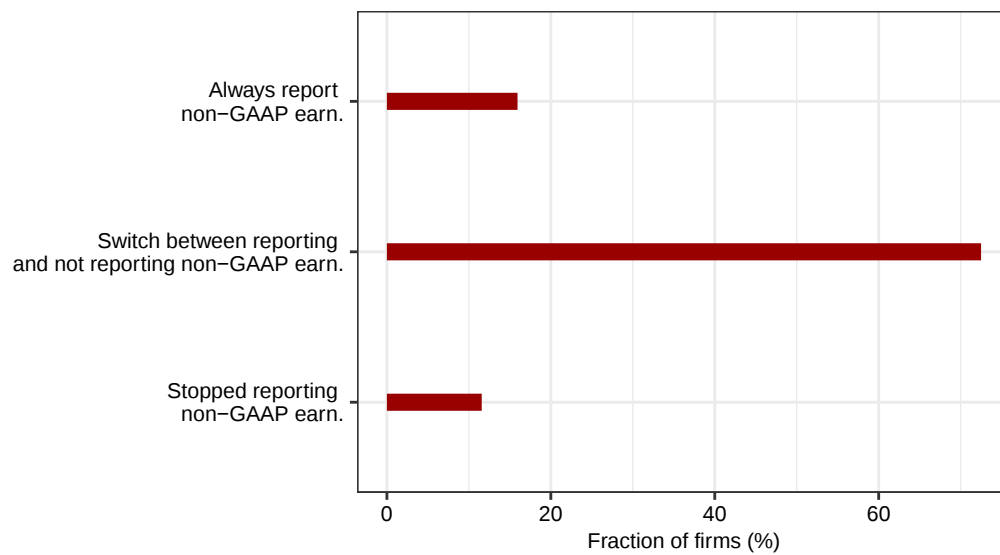
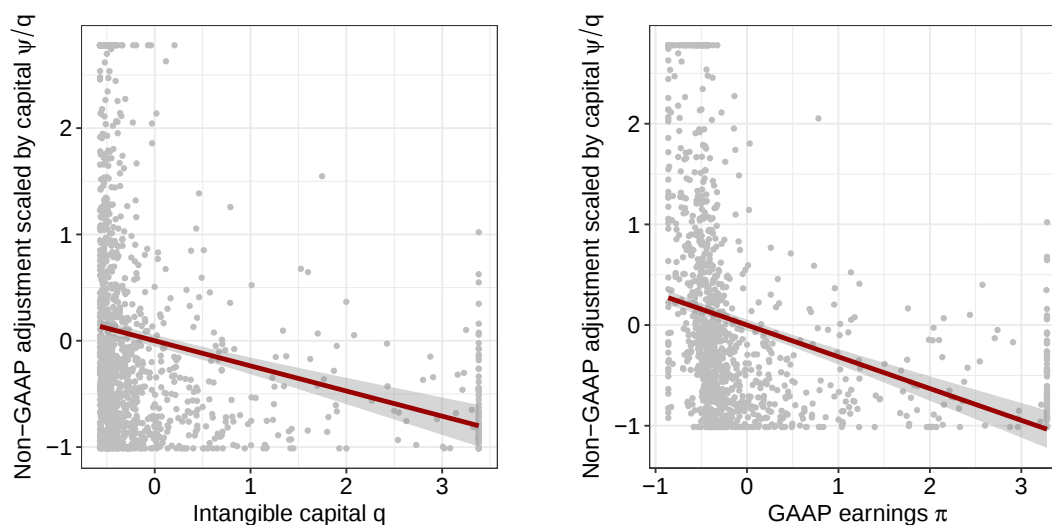


Figure IA.2: Relative bias decreases with capital and GAAP earnings

This figure depicts relative non-GAAP adjustment ψ/q (data) and bias b/q (simulated data) against intangible capital q or GAAP earnings π . Each observation corresponds to a firm with the non-GAAP adjustment, bias, capital, and GAAP earnings averaged over all observations for that firm in our data. The top row is based on the data that we use in estimation, and the bottom row is based on the data simulated from the baseline model. The lines correspond to linear regression lines with 95% confidence intervals around them. All variables are standardized to zero mean and unit standard deviation.

Panel A: Data



Panel B: Simulated data

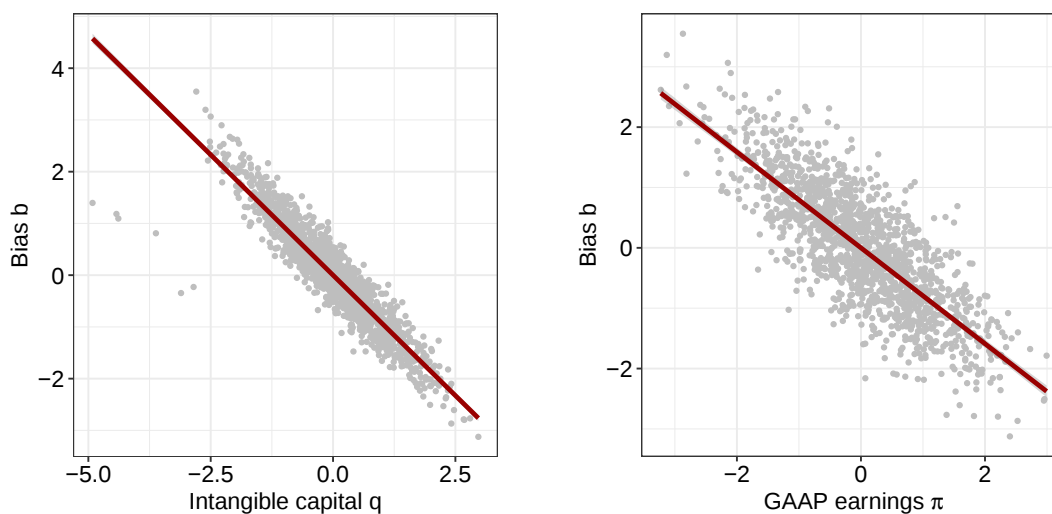


Figure IA.3: Firm value V_F in the model

This figure depicts firm value, V_F , in the model as a function of GAAP, π , and non-GAAP, $\pi + \psi$, earnings. Both firm value and earnings are measured in model-specific units. This data corresponds to the model solution in the baseline parameter values from Table 4. The data specifies a set $\{\pi, \pi + \psi, V_F\}$ for each value of state variables $\{q, v_y, v_\pi\}$. To integrate over state variables, we sort GAAP and non-GAAP earnings into 100 bins and compute the average of firm value V_F in each bin. We then plot these averages and fit the $g(x) = \sqrt{x}$ function used in the paper for the S-shape pricing. The figure focuses on the region with positive earnings.

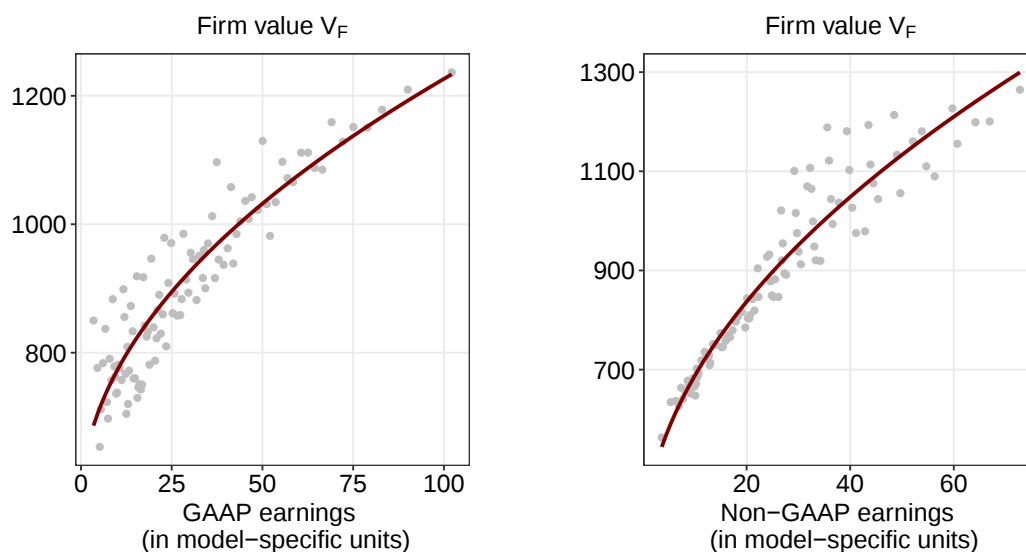


Table IA.1: Baseline estimation results when pricing function includes investment

The estimation is done with a simulated minimum distance estimator, which chooses structural model parameters by matching the moments from a simulated panel of firms to the corresponding moments from the data. Panel A reports the simulated and actual moments and the t-statistics for the differences between the corresponding moments. Panel B reports the estimated structural parameters with standard errors in parentheses. α is the curvature of the profit function. κ_w is the adjustment cost of investment. ρ_y is the persistence of the productivity shock. σ_y is the volatility of the productivity shock. σ_π is the volatility of the transitory earnings. θ is the importance of stock price relative to cash flows. κ_b is the manager's personal cost from biasing non-GAAP earnings divided by 10. μ_π is the mean of the transitory earnings shock. The standard errors are double-clustered by firm and year in both panels.

A. Moments

	Data moments	Simulated moments	t-statistics
Mean intang. investment to capital	0.066	0.052	-177.52
Mean earnings to capital	0.030	0.039	14.92
Variance of intang. investment growth	0.033	0.005	-7.51
Covariance of investment and earnings growth	-0.010	-0.004	2.46
Covariance of investment and cash flow growth	-0.013	0.004	2.48
Variance of earnings growth	0.934	1.574	60.38
Covariance of earnings and cash flow growth	0.189	0.032	-11.24
Variance of cash flow growth	1.322	0.020	-48.36
Incidence of positive non-GAAP adj.	0.442	0.647	12.85
Mean non-GAAP adj., given pos. non-GAAP adj.	0.027	0.044	38.81
Variance of intang. investment growth, given pos. adj.	0.038	0.005	-7.04
Cov. of investment and earnings growth, given pos. adj.	-0.020	-0.003	2.91
Cov. of investment and cash flow growth, given pos. adj.	-0.008	0.004	2.17
Cov. of investment and non-GAAP adj. growth, given pos. adj.	0.033	0.005	-3.29
Variance of earnings growth, given pos. adj.	1.055	1.608	20.08
Cov. of earnings and cash flow growth, given pos. adj.	0.212	0.036	-10.30
Cov. of earnings and non-GAAP adj. growth, given pos. adj.	-0.533	-1.055	-20.31
Variance of cash flow growth, given pos. adj.	1.261	0.020	-39.86
Cov. of cash flow and non-GAAP adj. growth, given pos. adj.	-0.060	-0.009	2.80
Variance of non-GAAP adj. growth, given pos. adj.	1.224	1.185	-1.08
Coefficient on non-GAAP earnings in the pricing eqn.	6.073	1.075	-6.64
Coefficient on earnings in the pricing eqn.	0.303	-0.005	-1.10

B. Parameter estimates

α	κ_w	ρ_y	σ_y	σ_π	θ	κ_b	μ_π
0.680	0.418	0.597	0.076	0.035	0.446	34.168	0.002
(0.010)	(0.218)	(0.386)	(0.034)	(0.002)	(0.044)	(4.283)	(0.001)