THE ACCOUNTING REVIEW
Vol. 93, No. 1
January 2018
pp. 317–333

American Accounting Association
DOI: 10.2308/accr-51764

The Credibility of Financial Reporting: A Reputation-Based Approach

Ying Liang
Baruch College–CUNY

Iván Marinovic
Stanford University

Felipe Varas
Duke University

ABSTRACT: This paper studies the reliability of financial reporting when the credibility of the manager, represented by his misreporting propensity, is unknown. We show that credibility concerns affect the time-series of reported earnings, book values, and stock prices in ways that seem consistent with empirical evidence. When investors are uncertain about the credibility of the reporting process, earnings response coefficients, as well as market-to-book values (MTB), are random and time-varying; relatively low MTB reflect poor credibility of financial reporting; stock prices are s-shaped in earnings surprises and relatively insensitive to bad news. Finally, when the manager is more likely to have reporting discretion, discretionary accruals tend to be larger and more volatile. We estimate the model using U.S. earnings announcement data during 2002–2012 and find that the probability of misreporting is 7 percent. A counterfactual analysis reveals that ignoring the possibility of misreporting leads to overestimation of the mean (3.5 percent), volatility (13 percent), and persistence of earnings (17 percent).

Keywords: dynamic cheap talk; reputation; credibility.

JEL Classifications: D82; D83; D84.

I. INTRODUCTION

A manager's credibility is an asset whose value drops drastically when the manager retires because, by losing control of the firm's reporting system, the manager then loses his ability to influence the firm's stock price.

As retirement looms, the manager's incentive to exploit his credibility may strengthen, sometimes leading to aggressive misreporting. This phenomenon, referred to as the CEO horizon problem, has been empirically documented (see, e.g., Dechow and Sloan 1991). This paper studies how the evolution of the manager's credibility affects the financial reporting process and alters the time-series of reported earnings, book values, and stock prices. In essence, we propose a reputation-based theory of financial reporting.

We consider a dynamic reporting game between a manager and a mass of risk-neutral investors (the market). The manager wishes to maximize the stock price of the firm at a given date in the future, which we refer to as the retirement date. The manager faces a dynamic problem because he must report the firm's earnings in several periods prior to retirement. As in Fischer and Verrecchia (2000), the market is uncertain about the manager's reporting incentives. Specifically, following

We thank Thomas Hemmer (editor) and two anonymous referees for very helpful comments and suggestions. We also thank Jeremy Bertomeu, Ronald Dye, Ilan Guttman, and Andy Skrzypacz for insightful discussions.

Editor's note: Accepted by Thomas Hemmer, under the Senior Editorship of Mark L. DeFond.

Submitted: June 2015
Accepted: April 2017
Published Online: April 2017

Marinovic (2013), we assume there are two types of managers: a dishonest type who has discretion to manipulate financial reports, and an honest type who must report his information truthfully.[1]

In our model, misreporting takes place in a non-stationary environment such that each new report leads investors to reassess the credibility of each of the manager's previous reports, hence the reliability of the firm's entire balance sheet. To fix ideas, think of the firm value as following a random walk whose innovations are periodically reported by the firm's manager. The manager may have the ability/incentives to manipulate the reports, but investors cannot verify the truthfulness of the reports before the manager retires.

From the manager's perspective, the optimal way to *cash-in* his credibility is a subtle problem. The firm's stock price, at the retirement date, is a function of both the cumulative reports (or book value) and the manager's terminal credibility. If the manager aggressively manipulated the book value in the past by issuing a long streak of very optimistic reports prior to the terminal date, then he could damage his credibility, thereby losing his ability to manipulate the terminal price. On the other hand, issuing very conservative reports early on would lead to low book values, making it difficult for the manager to induce a high stock price at retirement, even if his credibility were high. The manager must, thus, choose a trajectory of reports that is both credible and sufficiently optimistic. However, he cannot do this in a deterministic way; he must randomize.

The dishonest manager chooses a distribution over trajectories of reports, anticipating that the market will simultaneously update the stock price and the manager's own credibility. Again, releasing a sequence of reports that are too optimistic could strongly damage the manager's credibility early on, thereby limiting his ability to induce a high terminal price. The dishonest manager must, thus, cash-in his credibility steadily, but gradually.

Despite the problem's non-stationary nature (the book value is growing, on average, and the dishonest manager's credibility is shrinking, on average), the equilibrium has a simple Markov structure in which the history of the game is summarized by the firm's book value. In fact, at any given point in time, both the firm's stock price and the manager's credibility depend exclusively on the current book value.

The possibility of misreporting significantly alters the time-series properties of reported earnings, notably, introducing serial correlation where otherwise there would not be any. That is, even when the true economic earnings are *independent and identically distributed* (*iid*) across periods, in equilibrium, the distribution of reported earnings depends on the entire history of reports. Thus, the persistence of reported earnings (or lack thereof) arises in this game due to the possibility of misreporting. This result speaks to the validity of persistence-based measures of "earnings quality" (see, e.g., Dechow, Ge, and Schrand 2010). Earnings persistence is often considered as a measure of earnings quality based on the notion that a higher persistence reflects better predictive power of the firm's future profitability. However, some authors have recognized that this relation may not hold when the persistence of reported earnings is an artifact of earnings manipulation, as our model predicts.[2]

The reporting behavior of honest and dishonest managers is hard to tease apart in equilibrium, because dishonest managers naturally tend to mimic honest ones. Indeed, on a basic level, the support of the distribution of reports issued by the dishonest manager is unbounded (except in the last period), which implies that the dishonest manager may issue unboundedly low reports. There are, however, important differences between the time-series of the reports issued by honest and dishonest managers that one can use to detect misreporting: for example, the book value of a dishonest manager has a positive drift even when the true book value is actually a random walk. Second, in this model (as in Fischer and Verrecchia 2000), investors estimate discretionary accruals based on the difference between realized reports and expected reports, because this difference is linked to the manager's credibility and, *a fortiori,* to the likelihood that the book value contains manipulation. This feature, elusive in many theory models, is somewhat consistent with the empirical approach proposed by Jones (1991) for estimating discretionary accruals.[3]

Our model displays random earnings response coefficients (ERC) that evolve over time in tandem with the manager's credibility, partially explaining the empirical instability of the earnings response coefficients documented by Collins and Kothari (1989). In this model, the ERCs evolve based on how the market perceives the credibility of the firm financial reports.

The behavior of stock prices is also affected by the uncertainty about the manager's truthfulness. Consistent with Freeman and Tse (1992), we find that credibility concerns induce an s-shaped pricing function. In each period, the price is relatively insensitive to

[1] Although we interpret honesty as a personal characteristic of the manager, one can alternatively think of it as representing the firm's (corporate governance) characteristics.

[2] As Dechow et al. (2010) point out, "[persistence as a measure of earnings quality] is affected both by the firm's fundamental performance and by the ability of the accounting system to measure performance."

[3] The Jones (1991) model uses the residual of a regression of reported earnings on firms' observable characteristics as a measure of discretionary accruals. In other words, it identifies discretionary accruals as the difference between reported earnings and expected true earnings. Our model also predicts a correlation between earnings surprises and the discretionary accruals: higher reported earnings surprises are associated with higher discretionary accruals. The Jones (1991) model approach does not recognize the nonlinearity and asymmetry between positive versus negative surprises as a measure of accruals. It also treats prior accounting numbers as independent of prior manipulations and non-predictive of future managerial discretion.

large earnings surprises, thus reflecting the fact that in equilibrium, good news is less credible than bad news. At retirement date, the relative insensitivity of the stock price with respect to reports is very acute: the terminal price is completely flat for sufficiently high reports. This upper bound on the terminal price shows the severe credibility problem arising at the retirement date.

Overall, the evolution of the game, from the perspective of a dishonest manager, exhibits book values that tend to increase too fast, a reputation that slowly shrinks, and prices that become less and less sensitive to reports due to the manager's shrinking credibility.

Finally, we structurally estimate the credibility of firms' reporting systems, as well as the time-series properties of the underlying (or true) earnings using a Maximum Likelihood approach. Based on the estimation, we find that the probability of misreporting among U.S. firms is 3.5 percent. Ignoring misreporting leads to upwardly biased estimates of the volatility and persistence of earnings.

Related Literature

The credibility of financial reports has been studied by Dye (1988), Dutta and Fan (2014), Stocken (2000), Marinovic (2013), and Beyer, Guttman, and Marinovic (2014). The earnings management literature in accounting has adopted two approaches. The first approach is concerned with whether misreporting can arise as the outcome of an optimal contract. Arya, Glover, and Sunder (2003) consider the circumstances for this to happen. For example, Demski (1998) studies a two-period setting and shows that an optimal contract may sometimes induce earnings smoothing even when misreporting reverses over time. The second approach takes the manager's incentives as given, focusing instead on the capital market consequences of misreporting.

The most closely related paper is Marinovic (2013), who considers a static version of the game considered here where managers do not have long-term reputation concerns. Relative to Marinovic (2013), our contribution is twofold. Conceptually, we study the effect of the manager's horizon on the time-series of reports. In other words, we focus on whether and how reported performance evolves over the manager's tenure. A dynamic model provides less stark predictions than the static model, making it more amenable to empirical testing. For example, in the dynamic model, the price function is smooth in all periods except the last one. A dishonest manager sometimes reports bad news, unlike in the static model. The market-to-book value can be greater than 1, etc. Second, we carry out structural estimation of the model's parameters and use the estimation to run a counterfactual analysis of the effect of credibility on the stochastic properties of financial reports.

Stocken (2000) studies the credibility of reports in a repeated game with imperfect monitoring, showing that under some circumstances, truth-telling can be an equilibrium even in cheap talk settings. Dye (1988) and Dutta and Fan (2014) examine earnings management in contracting settings where the credibility of reports arises due to the existence of misreporting costs. Marinovic (2013) considers a similar setting, but assumes that the manager is myopic, thus, not being able to assess the future implications of his reporting choices. Beyer et al. (2014) solve and structurally estimate a dynamic costly misreporting model where the misreporting cost is a convex function of the bias in reported earnings. As in Beyer et al. (2014), this paper exhibits long-lasting information asymmetry about the firm's assets in place and current earnings. As the manager issues new reports, investors update their beliefs about the firm's balance sheet and the firm's current earnings. Unlike Beyer et al. (2014), in this paper, the bias and the earnings response coefficients are random, not deterministic, and the distribution of reported earnings is non-stationary, but affected by the manager's horizon.

The credibility of reports in static settings has been extensively studied in accounting. Gigler (1994) argues that financial reports are informative due to an ambivalence in managers' incentives: they aim to preempt entry in the product market and to manipulate stock prices. Fischer and Verrecchia (2000) consider a setting where the manager's equity incentives are unknown, and derive the existence of informative reports from the presence of misreporting costs. Guttman, Kadan, and Kandel (2006) show in a related setting that fully revealing equilibria are dominated, in a welfare sense, by pooling equilibria, since the latter type of equilibria provide managers with weaker manipulation incentives.

This paper builds on the literature on dynamic information transmission with uncertainty about the sender's payoff. The extant literature assumes the state of nature is *iid;* otherwise, the need to keep track of two state variables (i.e., the sender's reputation and the state of nature) would make the analysis intractable. In our setting, the value of assets is not *iid,* but the equilibrium can still be characterized by a single state variable (i.e., the cumulative report). At a technical level, our setting allows for a non-stationary environment with continuously distributed state-space. These features make the setting particularly useful for describing financial market applications, and make the analysis potentially amenable to empirical testing.

A closely related paper is Benabou and Laroque (1992). They consider a binary state/stationary setting, where the firm cash flow is *iid,* but the agent's type (honest versus dishonest) is persistent.[4] They show that the manager's reputation never completely vanishes in real time, even when there is a public signal from which the market learns the true state of nature.

[4] Other related models with persistent private information are Halac (2012) and Board and Meyer-ter-Vehn (2013).

Sobel (1985) is also an important antecedent of this paper. Sobel (1985) studies a dynamic setting with perfect monitoring, where the sender may be an "enemy," defined as someone who wishes to induce the action that hurts the receiver the most, or a friend, defined as someone who has the same preferences as the sender. Sobel (1985) shows that the sender typically cashes all his credibility in a single period. The absence of the external monitoring process leads, in our setting, to the manager expending his credibility gradually. Morris (2001) is also closely related. In Morris (2001), the sender is either biased or unbiased. Morris (2001) shows that reputation concerns may actually destroy the possibility of meaningful information transmission. In our setting, reputation leads to more information transmission. Chen (2011) and Marinovic (2013) also study the effect of perturbing cheap talk games by introducing truthful senders or naive receivers in static settings.

II. MODEL

Consider the following reporting game. There is a manager and a mass of risk-neutral investors (the market). Time is discrete and indexed by $t = 1, 2,...,T$. The firm value evolves randomly, as given by:

$$x_t = \sum_{s=1}^{t} \varepsilon_s,$$

where:[5]

$$\varepsilon_t \sim N(0, \sigma).$$

We can interpret ε_t as the firm's economic earnings in period t. Implicitly, we are assuming that the firm does not distribute dividends, so all earnings are retained. Otherwise, dividends would play an alternative information role. Also, the firm's value consists only of the firm's retained earnings.[6]

In each period t, the manager reports the earnings realization ε_t to the market. Following Benabou and Laroque (1992), we assume that the manager is privately informed about his discretion to lie about the reports. Such discretion is represented by the binary random variable $\tau \in \{0, 1\}$. In particular, with probability γ, the manager is honest ($\tau = 1$), which means he truthfully reports the value of ε_t in all periods. However, with probability $1 - \gamma$, the manager is dishonest ($\tau = 0$) which means the manager chooses his reports strategically to maximize the terminal stock price, p_T.[7]

We do not explicitly model the reversal of the manager's manipulation, but the predictions of the model would not change if we imposed a deterministic reversal of the manipulations, in the spirit of Dutta and Fan (2014) and Marinovic and Varas (2016), because as long as investors observe only a single aggregate report, the manager can always destroy the informative role of reversals by further adding manipulation to upcoming reports.[8]

Our assumption that some managers are honest aims to capture the notion that some managers face a large lying cost because of the presence of an external constraint, such as the scrutiny of the firm's board, or the manager's own moral standards. The parameter γ may, thus, capture not only the integrity of the manager, but also the quality of the firm's corporate governance, insofar as it affects the likelihood the manager can manipulate financial statements.

The market consists of a mass of risk-neutral investors pricing the firm in a Bayesian and competitive manner, based on the managers' current and past reports. For simplicity, we assume there is no discounting.

Discussion and Alternative Interpretations

Our model assumes that some managers face no lying cost. This is, of course, unrealistic when it comes to the manipulation of audited financial statements. However, the model is agnostic about the actual degree of reporting discretion faced by the average manager in the economy. We can interpret a high γ as representing a situation in which managers are

[5] Normality can be relaxed. In fact, all subsequent results hold under the weaker assumption that the pdf of ε_t is log-concave.

[6] In practice, earnings are serially correlated. A common assumption in the empirical literature is that earnings follow an AR(1) process (see, e.g., Gerakos and Kovrijnykh 2013). This, and even more complex dynamic structures, can easily be incorporated in the model, but we make the *iid* assumption to have a neutral design where serial dependence can be attributed to strategic behavior, as opposed to fundamentals (we add persistence in the empirical model, developed in Section IV).

[7] The implicit assumption is that the manager must sell his shares of the firm in period T. Endogenizing trading choices (the number of shares the manager sells or purchases) is difficult. In general, the trading activity of dishonest managers must mimic the trading plans of an honest manager—assuming the market observes the manager's order flow. However, an honest manager would generally not trade if he could abstain from doing so. So for reporting to be meaningful, one needs to assume that the honest manager must trade in an exogenous fashion. Having said that, the model could accommodate a situation where the total number of shares sold is fixed, but the timing is endogenous.

[8] Of course, the analysis would change significantly if investors had access to a second unmanipulated noisy signal of the firm's true earnings. The presence of a public signal of true earnings would modify the dishonest manager's strategy. In equilibrium, the manager would condition his reporting strategy on his private information about the true earnings, making the analysis significantly more involved.

strongly scrutinized and face a large cost of misreporting with a high probability. Also, as we shall see, managers who have a long horizon (high T) face an endogenous cost of misreporting because aggressive misreporting reduces their reputation and ability to manipulate the market belief at the retirement date.

III. EQUILIBRIUM

We next study the equilibrium of this game. Some preliminary comments are in order. For brevity, we define investors' beliefs as given by Bayes' Rule. So if $\mathbf{r}^t = \{r_1, r_2,...,r_t\}$ denotes the history of reports observed up to period t, then investors' belief about the asset value, p_t, is given by:

$$p_t = \mathbb{E}[x_t|\mathbf{r}^t]. \quad (1)$$

We shall sometimes use notation $\mathbb{E}_t\,[x_t] \equiv [x_t|\mathbf{r}^t]$ and refer to p_t as the stock price. Given the true performance x_t is payoff-irrelevant, we restrict attention to equilibria in which the dishonest manager's reporting strategy satisfies the following assumption:

Assumption 1: The dishonest manager's reporting strategy is independent of his private information. That is, the dishonest manager's reporting strategy, $\{r_t\}_{t\leq T}$, does not depend on $\{x_t\}_{t\leq T.}$

Because the manager's payoff depends exclusively upon the stock price—i.e., there are no misreporting costs—the above restriction is arguably mild. Indeed, this assumption rules out equilibria where the stock price is decreasing or discontinuous.[9] In other words, by invoking Assumption 1, we rule out theoretically intriguing, but empirically uninteresting, equilibria such as babbling equilibria, or equilibria with jumps in the price function. Of course, the independence assumption is meaningful only when misreporting is costless. We pay this price (in terms of realism) because of the tractability we gain in exchange, and because we focus on a short window event, such as the period surrounding the manager's retirement. Note, on the other hand, that the manager's reputation concern will be a powerful disciplining device that enables some information transmission. Finally, observe that the type of behavior we study in this paper is not necessarily illegal: our model may represent situations where managers exploit the discretion contemplated by existing accounting standards. The cost of doing so can be merely psychological.[10]

Hereafter, we restrict attention to equilibria satisfying Assumption 1. Our statements about uniqueness are subject to this restriction.

It is convenient to describe the equilibrium in terms of the pair $\langle\beta, \{p_t\}_{t=1}^T\rangle$, where $\beta : \mathbb{R}^T \rightarrow \mathbb{R}_+$ is the joint density of reports of a dishonest manager and $p_t : \mathbb{R}^t \rightarrow \mathbb{R}$ is the price conditional on the history of reports $\mathbf{r}^t$ observed until period t. We refer to β as the reporting strategy of the dishonest manager (in short, the reporting strategy) and to p_t as the price function. We use Perfect Bayesian Nash as equilibrium concept.

Definition 1: An equilibrium is a reporting strategy β and a sequence of price functions $\{p_t\}_{t=1}^T$ such that:

1. For all $\mathbf{x}^T$, we have that $\beta(\mathbf{r}^T) > 0$ only if $\mathbf{r}^T \in \text{argmax}_{\hat{\mathbf{r}}^T} p_T(\hat{\mathbf{r}}^T)$.
2. For all $\mathbf{r}^T$, the price is given by $p_t = E[x_t|\mathbf{r}^t]$.

Some notation is required. Let $R_t \equiv \sum_{s=1}^t r_s$ be the cumulative report observed through period t. We refer to R_t as the firm's book value. More precisely, R_t represents cumulative earnings surprises, given the normalization $E[\varepsilon_t] = 0$.

The following lemma will be helpful in characterizing the equilibrium:

Lemma 1: In equilibrium, the price $p_T\,(\mathbf{r}^T)$ only depends upon the book value R_T. In other words, the book value is a sufficient statistic with respect to $\mathbf{r}^T$ for estimating $x_{T.}$

This lemma is intuitive. If, in period T, investors think the manager is honest, then all they must consider to determine the price is the book value R_T; nothing else is relevant. Similarly, if, in period T, investors think the probability that the manager is dishonest is positive, then the trajectory the manager used to arrive at the current book value R_t cannot be informative from a valuation standpoint or else the dishonest manager would sometimes choose suboptimal trajectories. Armed with this lemma, we characterize the equilibrium.

First, observe that the terminal price must be bounded from above; otherwise, the dishonest manager would be able to induce an infinite price by announcing the proper sequence of reports. We denote by $k_T \equiv \max p_T$ the maximum terminal price that is attainable in equilibrium. Second, optimality requires that the price satisfies $p_T(\mathbf{r}^T) = k_T$ for all sequences of reports in the

---

[9] For example, when $\gamma = \frac{1}{2}$, there is a babbling equilibria in which the manager's reporting strategy is negatively correlated with his private information.
[10] This model could be interpreted as a model of fraud.

support of the (dishonest manager's) reporting strategy β; otherwise, such strategy would not be consistent with the maximization of the firm's terminal stock price. Moreover, it is easy to see that the support of the reporting strategy is $\{\mathbf{r}^T : R_T \geq k_T\}$. These observations imply that the terminal price is $p_T(R_T) = \min(R_T, k_T)$.

Next, let us consider investors' beliefs. Let $\rho_T(\mathbf{r}^T) \equiv \mathbb{P}[\tau = 1|\mathbf{r}^T]$ be investors' beliefs about the manager's type, given the history of reports, $\mathbf{r}^T$. We refer to $\rho_T(\mathbf{r}^T)$ as the manager's period T credibility. If $\beta(\mathbf{r}^T; k_T)$ denotes the probability density that the dishonest manager issues a sequence of reports $\mathbf{r}^T$, then by Bayes' Rule, we have that:

$$\rho_T(\mathbf{r}^T) = \frac{\gamma f(\mathbf{r}^T)}{\gamma f(\mathbf{r}^T) + (1-\gamma)\beta(\mathbf{r}^T; k_T)}. \tag{2}$$

A price k_T given reports $\mathbf{r}_T$ is consistent with Bayes' Rule if and only if:

$$\mathbb{E}[x_T \mid R_T \geq k_T] = \rho_T(\mathbf{r}^T)R_T + \left(1 - \rho_T(\mathbf{r}^T)\right)\mathbb{E}[x_T] = k_T. \tag{3}$$

To understand this equation, notice that with probability ρ_T the manager is truthful, in which case, the price equals the book value R_t. Otherwise, the manager is dishonest and his reports are not informative, hence the expected firm value is $\mathbb{E}(x_T)$.

We find $\beta(\cdot)$ by combining Equations (2) and (3) and using the assumption $\mathbb{E}[x_T] = 0$. This yields the reporting strategy:

$$\beta(\mathbf{r}^T; k_T) = \max\left(\theta \frac{R_T - k_T}{k_T}, 0\right) f(\mathbf{r}^T),$$

where $\theta \equiv \frac{\gamma}{1-\gamma}$. Finally, since $\beta(\cdot)$ is a *pdf*, the value of k_T must satisfy:

$$\int_{\mathbb{R}^T} \beta(\mathbf{r}^T; k_T) d\mathbf{r}_T = \frac{\theta}{k_T}\mathbb{E}[\max(x_T - k_T, 0)] = 1. \tag{4}$$

We have found the stochastic process representing the reports issued by a dishonest manager. The next proposition describes this process in more detail.

Proposition 1: There exists a unique equilibrium where the reporting strategy is:

$$\beta(\mathbf{r}^T) = \max\left(\theta \frac{R_T - k_T}{k_T}, 0\right) f(\mathbf{r}^T),$$

where:

$$k_T = \sqrt{T}\sigma z(\theta)$$

with $z = z(\theta)$ being defined by:

$$\theta \int_z^\infty \frac{x - z}{z}\phi(x)dx = 1. \tag{5}$$

The price in period T is given by:

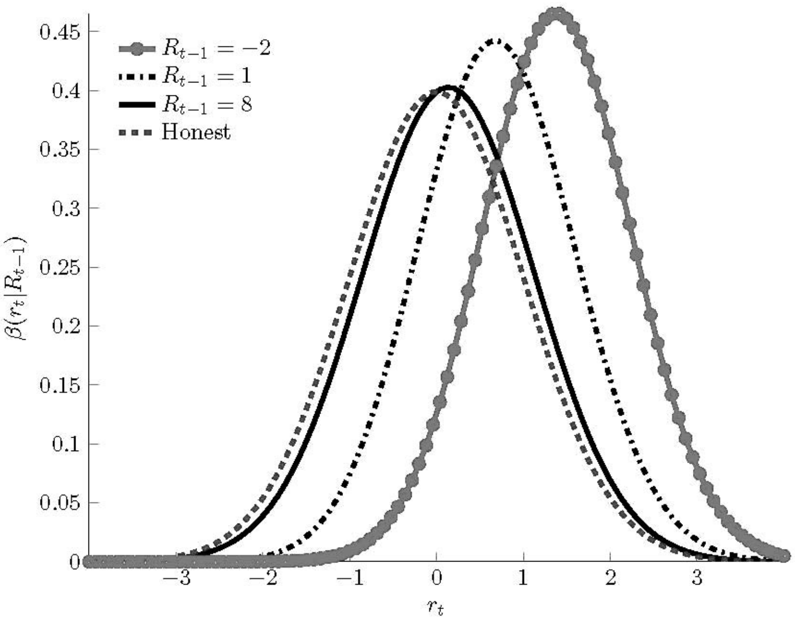
$$p_T(R_T) = \min(R_T, k_T).$$

The dishonest manager randomizes over reports period by period. As in Marinovic (2013), randomization is needed for the manager not to be detected. In fact, if the reporting strategy had a mass point, then investors would learn with positive probability the manager's type, in which case, they would ignore the manager's both past and future reports. If that happened, the only terminal price the manager would be able to induce is $\mathbb{E}(x_T)$.

Notice that despite the presence of randomization, the dishonest manager does not face uncertainty about the terminal price he will receive at time T because he only randomizes over report paths that lead to the highest terminal price p_T, namely, those that lead to a book value higher than k_T. For all interim periods $t < T$, the reports issued by the dishonest manager $\mathbf{r}^t$ have a joint distribution $\beta(\mathbf{r}^t)$. Unlike in the static version studied by Marinovic (2013), the reporting strategy here has full support on $\mathbb{R}^t$. So the dishonest manager may issue reports that are unboundedly low. This is required in equilibrium because otherwise, the manager could gain full credibility by first reporting a sufficiently low report in early periods and then—once he has established full credibility—inducing an extremely large stock price in the terminal period.

We obtain the conditional distribution of r_t given $\mathbf{r}^t$, denoted $\beta(r_t|\mathbf{r}^{t-1})$, integrating $\beta(\mathbf{r}^T)$ over $\{r_{t+1}, r_{t+2},\ldots,r_T\}$. Let f_t denote the joint density of $\varepsilon^t \equiv \{\varepsilon_1, \varepsilon_2,\ldots,\varepsilon_t\}$ and ϕ and Φ be the *pdf* and *cdf* of the standard normal distribution. Then, we have that:

FIGURE 1
The Conditional Distribution of Reports Issued by Dishonest Managers ($\sigma = 1$, $t = 8$, $T = 10$, $\theta = 1$)



The figure shows that an increase in R_{t-1} reduces the distribution of reports, in the FOSD sense, issued by the dishonest manager in period t.

$$\beta(\mathbf{r}^t) = \theta \frac{f_t(\mathbf{r}^t)}{k_T} \mathbb{E}[\max(x_T - k_T, 0) \mid x_t = R_t]$$

Using the previous expression, we can further develop the conditional distribution of reports at time t, as given by:

$$\beta(r_t \mid R_{t-1}) = \frac{(R_t - k_T)\Phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right) + \sigma\sqrt{T-t}\,\phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right)}{(R_{t-1} - k_T)\Phi\left(\frac{R_{t-1} - k_T}{\sigma\sqrt{T-t+1}}\right) + \sigma\sqrt{T-t+1}\,\phi\left(\frac{R_{t-1} - k_T}{\sigma\sqrt{T-t+1}}\right)} \frac{1}{\sigma}\phi\left(\frac{r_t}{\sigma}\right). \tag{6}$$

The conditional distribution of reports $\beta(r_t|\mathbf{r}^{t-1})$ depends upon the history only via the book value, R_{t-1}. The structure of β suggests that misreporting induces serial correlation in the reporting process, even when the underlying earnings are *iid*. In other words, serial correlation in reported earnings is induced by the strategy of the dishonest manager. Intuitively, relatively low reports in the past must be followed by high reports in the future to make sure the book value beats the threshold k_T. Similarly, relative aggressive reporting in the past must be followed by a more moderate reporting behavior in the future, so the manager's reporting behavior is not too "suspicious" in investors' eyes. In practice, this result suggests that some of the persistence in reported earnings may be generated by misreporting. Put differently, the level of persistence measured in reported earnings can be used—according to this model—to detect manipulation.

Figure 1 shows that an increase in book value R_{t-1} induces a first-order stochastic decrease in the distribution of dishonest reports, $\beta(r_t|R_{t-1})$. This reveals an important difference between the reporting behavior of dishonest and honest managers: the book value of dishonest managers is less random (it is not a random walk), but can be predicted based on the history of reports.

Proposition 2: For any period $t < T$, and $R_{t-1} > R'_{t-1}$, the distribution of reports issued by the dishonest manager in period t conditional on R'_{t-1} first-order stochastically dominates the distribution of reports conditional on R_{t-1}. In particular, this means that $\mathbb{E}[r_t|R_{t-1}]$ is a decreasing function of R_{t-1}.

Roughly speaking, this result suggests that the possibility of misreporting affects the persistence of reported earnings, lending support to the idea that "persistence" could reflect "earnings quality" (Dechow et al. 2010). Reported earnings persistence is often used in empirical research as a measure of earnings quality, based on the idea that a higher persistence reflects better predictive power of the firm's feature profitability. Some authors have nevertheless recognized that this relation may not hold when the persistence of reported earnings is an artifact of earnings manipulation. As Dechow et al. (2010) point out: "[persistence] is affected both by the firm's fundamental performance and by the ability of the accounting system to measure performance."

Observe that despite the fact that an increase in the book value lowers the expected subsequent reports, the reports of dishonest managers are always biased upward:

$$E(r_t \mid dishonest) > E(\varepsilon_t)$$

for all t. Hence, on average, the book value of the dishonest manager grows in all periods and for all histories. Persistent growth in book values, relative to expected growth, constitutes another trait of dishonest reporting.

These properties are recorded in the next proposition.

Proposition 3: In equilibrium, the cumulative report process, $\{R_t\}_{t \le T}$, is a submartingale under $\beta(\cdot)$ and under $\gamma f(\cdot) + (1 - \gamma)\beta(\cdot)$. Formally:

1. Conditional on the dishonest manager information: $\mathbb{E}[R_{t+1}|R_t, \tau = 0] \ge R_t$.
2. Conditional on the market information (that is, unconditional on the manager's type): $\mathbb{E}[R_{t+1}|R_t] \ge R_t$.
3. In particular, given the market information, the manager's report is biased upward, that is $\mathbb{E}[r_{t+1}|R_t] > 0$.

On average, the dishonest manager builds up the book value slowly, but steadily. This is intuitive: the manager wants to persuade investors that the firm is growing faster than expected, but sharp changes in the book value are perceived by investors with skepticism; reported growth must be moderate to be credible.

We turn to studying the evolution of the manager's credibility, defined as the conditional probability he is dishonest. Over time, investors update both the credibility of the manager ρ_t and the firm's value p_t. Naturally, a long streak of positive earnings surprises leads to a profile of decreasing credibility as markets become increasingly wary about the manager's honesty. In principle, the manager's credibility could be a very complicated function of the history. However, a straightforward computation shows that the manager's credibility ρ_t only depends on the book value R_t and is given by:

$$\rho_t(R_t) = \frac{\gamma f_t(\mathbf{r}^t)}{\gamma f_t(\mathbf{r}^t) + (1 - \gamma)\beta_t(\mathbf{r}^t)} \tag{7}$$

One can verify that $\rho_t(R_t)$ decreases in R_t, hence the manager's credibility is linked to the evolution of book values: larger book values lead to lower credibility levels. However, the erosion in the manager's credibility is slow: to be able to drive the price up to k_T, the dishonest manager cannot report trajectories that are too "unbelievable" or else he would run out of credibility before the end; he must try to mimic the behavior of the honest manager, thereby building the book value gradually. Of course, the book value must grow faster than the erosion in the manager's credibility.

Notice that the terminal credibility of the dishonest manager is random, but generally positive: the manager does not cash-in all his credibility—as in Sobel (1985). Indeed, investors never learn for sure that the manager is dishonest, but they may learn he is honest. Indeed, in period T, investors' uncertainty about the manager's type may get resolved if the manager reports a book value smaller than k_T, for this reporting behavior would prove that the manager is honest. There is, thus, a fundamental difference between the information content of good versus bad news.

Consider now the evolution of stock prices. By Bayes' Rule, the price function can be computed as:

$$p_t(R_t) = \rho_t(R_t)R_t \tag{8}$$

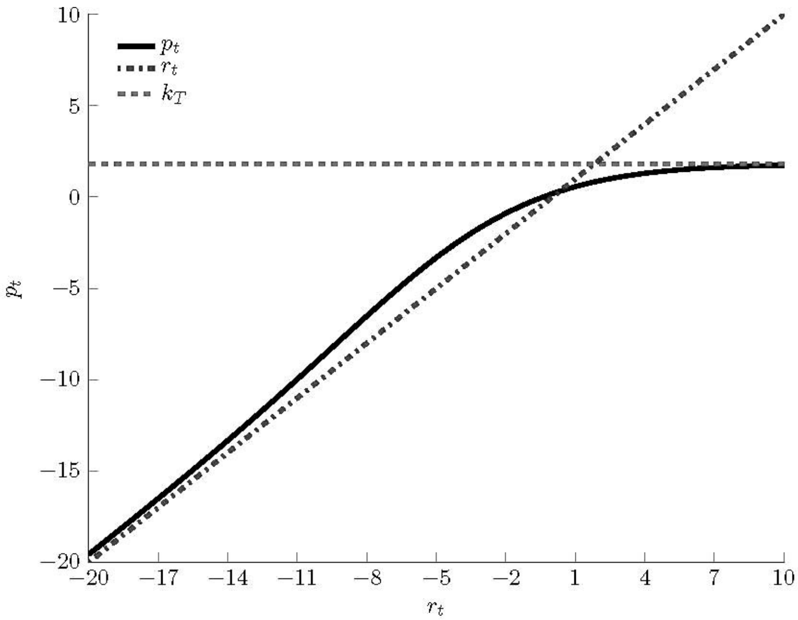
This expression shows that $\rho_t(R_t)$ captures, in our setting, the firm's market-to-book value (MTB). The MTB is, thus, random, time-varying, and linked to the credibility of financial reports. Low MTB is equivalent here to poor balance sheet credibility. An interesting aspect of the equilibrium is that interim prices can be larger than the book value in equilibrium, which would never happen in a static setting (given the *iid* and zero mean assumption). This is possible in equilibrium because the dishonest manager issues "bad news" with positive probability, so with positive probability, the bad news is not true, but mere *bluff*. Hence the market not only discounts good news by a credibility factor, but it also discounts bad news.

The price function can alternatively be expressed as:

$$p_t(R_t) = \rho_t(R_t)R_{t-1} + \rho_t(R_t)r_t,$$

which reveals that the sensitivity of prices with respect to contemporaneous announcements depends on both the book value and the manager's horizon $(T - t)$. It is tempting to interpret ρ_t as the earnings response coefficient (ERC), but notice that the price function is not linear: ρ_t is itself a function of the report r_t. The ERC in period t is defined by:

FIGURE 2
The Price Function
$\boldsymbol{p_t(\theta = \frac{1}{2}, \sigma = 5, T = 5, t = 3, R_{t-1} = 0.4)}$



$$ERC_t \equiv \frac{\partial p_t}{\partial r_t},$$

which again evolves randomly as the reporting game unfolds. The stochastic nature of the ERC may explain the lack of stability of ERCs documented by Collins and Kothari (1989) in the time-series.[11] The slope of the price function is impacted by the shocks to the firm credibility.

The price function is "*s-shaped,*" being convex for relatively low book values and concave for high book values. This is also consistent with empirical evidence: Freeman and Tse (1992) document the "s-shape" of stock prices with respect to earnings announcements. In this model, the price crosses the origin (because $E[x_t] = 0$) and lies above (below) the book value R_t whenever the book value is below (above) prior expectations (see Figure 2). As $R_t \to -\infty$, the price converges to the 45-degree line, suggesting that very low book values become fully credible at the limit. By contrast, as the book value grows large, the price approaches the constant k_T, asymptotically. The relative insensitivity of the price function with respect to high reports is a reflection of investors' skepticism, which is particularly acute for very high levels of r_t. Furthermore, as in the static case studied by Marinovic (2013), this insensitivity is very stark in the last period T: the price function p_T is kinked, being set as $p_T = \min(R_T, k_T)$. The reason behind the existence of this bound is that investors need to price protect from the manager's manipulation.[12] Observe also that for all $t < T$, the prices are strictly lower than the maximum terminal price p_T. This shows that if the dishonest manager had the option to sell, in an anonymous market, at any point before T, then he would always wait until the terminal period T.

We next study the comparative statics of k_T with respect to the model's parameters.

Corollary 1: The value of k_T increases in T, σ, and θ. Furthermore, $\lim_{\theta \to 0} k_T = E[x_T] = 0$ and $lim_{T \to \infty} k_T = \infty$.

All these comparative statics are intuitive. Since the uncertainty about the firm's underlying value x_t accumulates over time, a larger T allows the dishonest manager to report greater values without losing as much credibility: higher values are *ex ante* more likely when T or σ are larger, hence more credible. The manager is, thus, able to induce a higher terminal price. On the other hand, an increase in θ means that the manager has a higher initial reputation, which allows him to issue more aggressive

[11] In practice, there is significant cross-sectional and time-series variation in firms' MTB. Some of this variation may perhaps reflect differences in the credibility of firms' reporting systems.

[12] In practice, the relative insensitivity of stock prices with respect to positive earnings surprises is consistent with this finding. Kothari, Shu, and Wysocki (2009) show empirically that stock prices are indeed more sensitive to negative earnings surprises than to positive earnings surprises.

reports without affecting his credibility as much. This, in turn, allows the dishonest manager to induce a higher terminal price. Taken together, these results suggest that having a larger horizon has the same effect on k_T as having a greater credibility.

We record the previous results in the following corollary.

Corollary 2: There exists a unique equilibrium where:

1. The reporting strategy is:

$$\beta(r_t \mid R_{t-1}) = \frac{(R_t - k_T)\Phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right) + \sigma\sqrt{T-t}\phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right)}{(R_{t-1} - k_T)\Phi\left(\frac{R_{t-1} - k_T}{\sigma\sqrt{T-t+1}}\right) + \sigma\sqrt{T-t+1}\phi\left(\frac{R_{t-1} - k_T}{\sigma\sqrt{T-t+1}}\right)} \frac{1}{\sigma}\phi\left(\frac{r_t}{\sigma}\right)$$

2. The manager's credibility is:

$$\rho_t(R_t) = \frac{1}{1 + \left(\frac{R_t}{k_T} - 1\right)\Phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right) + \frac{\sigma\sqrt{T-t}}{k_T}\phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right)},$$

which is a decreasing function of R_t.

3. The market price is:

$$p_t(R_t) = \rho_t(R_t)R_t,$$

which is bounded above by k_T for all t. Moreover, $p_t(R_t) < k_T$ for all $t < T$.

Discussion

We propose a reputation-based theory of the credibility of financial reporting. The theory is tractable and remarkably simple, but delivers predictions that seem consistent with a number of facts documented by the empirical literature. Below, we summarize the results that (we believe) are robust predictions rather than mere artifacts of the model's assumptions:[13]

1. The persistence of reported earnings is partially induced by the possibility of misreporting. This is a novel result and calls to attention the practice of measuring earnings quality based on the persistence of reported earnings. Our paper shows that some of the persistence is artificially induced by misreporting, even in the absence of an accrual reversal process.
2. Reported earnings surprises are correlated with discretionary accruals (manipulation). In many theory models (see, e.g., Dye 1988), notably agency models, reported earnings surprises are not correlated with discretionary accruals, contradicting the intuition behind many empirical accrual models (Jones 1991). For example, in Stein (1989), the manager's manipulation is deterministic and constant over time. In our model, by contrast, reported earnings is correlated with discretionary accruals because the manager's credibility is monotonically decreasing in the magnitude of reported earnings. This feature also arises in Fischer and Verrecchia (2000).
3. Insensitivity of prices to good news. Most earnings management models (see, e.g., Fischer and Verrecchia 2000; Dutta and Fan 2014) assume linear price functions in which the sensitivity of prices to reported earnings is constant, contradicting the observation that prices are relatively insensitive to bad news. Our model shows that an s-shaped price function arises in equilibrium in response to credibility concerns, as documented by Freeman and Tse (1992).
4. ERCs are random and time-varying. The empirical literature has documented the instability of the ERC across time (see Collins and Kothari 1989). We show that this feature is an inherent property of financial reporting under credibility/reputation issues. In particular, the sensitivity of stock prices to new information depends crucially on the history of reports and, very particularly, on the evolution of the book value.
5. Low market-to-book values (MTB) reflect low levels of credibility. Empirically, there is significant cross-sectional and time-series variation in MTBs. Traditionally, this variation has been interpreted as reflecting differential growth and investment opportunities (see, for example, Berk, Green, and Naik 1999; Carlson, Fisher, and Giammarino 2004). Our analysis suggests that this variation can be partially explained by concerns about the reliability of firms' balance sheet.

IV. ESTIMATION

In this section, we estimate the parameters of the model by Maximum Likelihood (MLE). To allow for serial correlation in underlying earnings, which we denote e_t, we assume the underlying earnings follow an AR(1) process:

13 By contrast, the prediction that dishonest managers can sustain inflated prices forever is obviously an artifact of our assumptions.

$$e_t = \mu + \varphi e_{t-1} + n_t;\ n_t \sim N(0, \sigma^2).$$

Persistence in underlying earnings introduces new conceptual issues: when earnings are persistent, the stock price is an assessment of both the firm's assets in place (because earnings are retained and reinvested) and the future expected earnings.[14] To avoid dealing with reinvestment of retained earnings, which is beyond the scope of our study, we assume the manager's payoff depends on the market expectation of the total earnings realized throughout his tenure, as captured by $x_T \equiv \sum_{t=1}^{T} e_t$. We also estimate an alternative model where the manager's payoff depends on the market expectation of $x_T + \lambda e_T$, where λ is an additional parameter.[15] The latter model captures, in a reduced form, the idea that the last period report (r_T) may be particularly relevant to the manager, given its importance in predicting the firm's future earnings, under an AR(1) process.

In this setting, the reporting strategy of the dishonest manager is given by:

$$\beta(\mathbf{r}^T) = \max\left(\theta \frac{R_T - k_T}{k_T - E[x_T]} f(\mathbf{r}^T), 0\right),$$

where f is the joint density of $\mathbf{e}^T$, and:

$$k_T = E[x_T] + \sqrt{Var(x_T)} z(\theta).$$

The pdf of the vector of reports is, thus, given by:

$$g(\mathbf{r}^T;\ \alpha) = \gamma f(\mathbf{r}^T) + (1 - \gamma)\beta(\mathbf{r}^T),$$

where $\alpha \equiv \{\gamma, \mu, \sigma, \varphi\}$.[16] To estimate this model, we use U.S. data from 2002 to 2012. Since we are interested in CEO horizon effects, we drop firms for which we do not know the manager's actual retirement date T. Also, we restrict attention to managers that retire during the sample period, and remove firms where the manager voluntarily moved to another firm or was terminated. We implicitly assume that all managers start their term with the same reputation. The economy is, thus, characterized by a single γ representing the perceived credibility of a new manager.

Our primary observation is the firm's annual earnings announcements r_t. We use data from Fortune 500 firms. From 2002 to 2012, there are 96 CEO retirement cases. In total, we have 768 firm-year observations from 92 unique CEOs/firms. The average tenure is 10.5 years and the average retirement age is 61. The results of the estimation are presented in Table 1; the main descriptive statistics are reported in Table 2.

We estimate the model by MLE. For comparison, we estimate four models: (*i*) Model naive, where the underlying earnings follow an AR(1), but γ is restricted to be 1; (*ii*) Model *iid,* where φ is restricted to be 0; (*iii*) Baseline model, where both φ and γ are free; and (*iv*) General model, where all three parameters (φ, γ, λ) are free.

The main parameter of interest is the probability of honest reporting, γ (see Table 1). According to the Baseline model, the probability of misreporting is relatively small, roughly 7 percent. Although misreporting is relatively rare, relative to prior studies, the null hypothesis of no misreporting (i.e., the Naive model) is rejected at the 1 percent significance level, based on a standard likelihood ratio test. Our prediction that 7 percent of the firms manipulate earnings is lower than the results of Zakolyukina (2014), who finds that "the fraction of CEOs who misstate earnings at least once is 60 percent." This discrepancy is perhaps surprising, because unlike Zakolyukina (2014), we assume that the manager is not monitored, nor does he bear penalties from manipulating earnings. Perhaps the discrepancy between our results and those in Zakolyukina (2014) is due to different assumptions on the price formation mechanism. Prices are exogenous in Zakolyukina (2014), whereas they obey Bayes' Rule in our model, which is generally a disciplining device.[17]

---

[14] Assuming the interest rate is $r = 0$ and $\mu = 0$, the value of the firm becomes $V_T = R_T + \frac{\varphi e_T}{1-\varphi}$. The reporting strategy becomes $\beta(\mathbf{r}^T) = \max\left(\theta \frac{R_T + r_T \frac{\varphi}{1-\varphi} - k_T}{k_T - E\left(x_T + e_T \frac{\varphi}{1-\varphi}\right)} f(\mathbf{r}^T), 0\right)$. However, when $\mu > 0$, the price is defined only if $r > 0$. But when $r > 0$, the total book value ceases to be a sufficient statistic for the value of the firm at time T: since earnings are reinvested, earlier reports are weighted more heavily than later ones.

[15] If $\mu = 0$, $r = 0$, then $\gamma = \frac{\varphi}{1-\varphi}$.

[16] As is customary in the time-series literature, we make the following steady-state assumption: $\mathbf{e}^T \sim N\left(\begin{bmatrix} \frac{\mu}{1-\varphi} \\ \frac{\mu}{1-\varphi} \\ . \\ . \\ \frac{\mu}{1-\varphi} \end{bmatrix}, \frac{\sigma^2}{1-\varphi^2}\begin{bmatrix} 1 & \varphi & . & . & \varphi^{T-1} \\ \varphi & 1 & \varphi & . & \varphi^{T-2} \\ \varphi^2 & . & . & . & . \\ . & . & . & . & . \\ \varphi^{T-1} & . & . & \varphi & 1 \end{bmatrix}\right)$

[17] Our prediction is also lower than reduced form estimates such as in Dyck, Morse, and Zingales (2010), who find that 14.5 percent per year commit corporate fraud.

TABLE 1

Model Estimation

Models	γ	μ	σ	φ	λ	Log lik
Model Naive	—	1.183	1.242	0.506	—	−1261.37
with $\gamma = 1$		(0.053)	(0.032)	(0.019)		
Model *iid*, ($\varphi = 0$)	0.993	2.406	1.444	—	—	−1310.47
with $V = x_T$	(0.009)	(0.053)	(0.038)			
Model Baseline, AR(1)	0.932	1.201	1.231	0.480	—	−1257.01
with $V = x_T$	(0.040)	(0.087)	(0.031)	(0.032)		
Model General, AR(1)	0.932	1.200	1.231	0.480	0.001	−1257.01
with $V = x_T + \lambda e_T$	(0.040)	(0.087)	(0.031)	(0.032)	(0.022)	

The estimation is conducted using the Particle swarm optimization (PSO) algorithm. PSO starts with a group of particles (solutions) randomly drawn from the region. In each iteration, each particle will update its velocity and position after comparing the best solution (fitness value) it has achieved and the global best obtained by any particle in the population. We estimate four models using *Actual EPS*. In the first model, the manager is naively assumed to be honest with probability 1, i.e., $\gamma = 1$. The second model assumes that the true earnings follow an *iid* process. The third model is the baseline model, where the true earnings follow an AR(1) process and the manager's payoff is $E_T[x_T]$. The last model also assumes the true earnings follow an AR(1) process and the manager's incentive is $E_T[x_T + \lambda e_T]$. Standard errors are presented in parentheses.

In Table 1, the Model *iid* predicts that the probability of truthful reporting γ is 99 percent, whereas the Baseline model predicts only $\gamma = 93$ percent. This discrepancy suggests that ignoring the persistence of earnings leads us to overestimate the probability of misreporting. The reason is that reporting by dishonest managers is relatively more persistent, hence the *iid* model tends to attribute persistence to misreporting behavior. Overall, a comparison between the Naive model and the Baseline model suggests that ignoring the possibility of misreporting leads to overestimating the mean (3.5 percent), volatility (13 percent), and persistence (17 percent) of underlying earnings.

Our model does not nest other misreporting models, such as Beyer et al. (2014) or Zakolyukina (2014), so it is hard to say *a priori* which one fits the data better. In principle, we think our model should be better prepared to handle non-stationarities in the distribution of earnings along the manager's tenure—since the other two papers assume a stationary reporting environment. However, we use a less rich dataset and do not control for firms' observable characteristics.

V. CONCLUDING REMARKS

A key source of uncertainty in capital markets is the reliability of the firm's financial reporting system. This type of uncertainty gives rise to a dynamic phenomenon. Doubts about the credibility of an earnings announcement may induce doubts about the credibility of the firm's balance sheet, leading investors to revise their beliefs about the firm's book value. Conversely, managers who wish to exploit their reporting discretion need to take into account that aggressive manipulations in the present could deteriorate their credibility and reduce their ability to manipulate stock prices in the future. To account for this phenomenon, we propose a reputation-based theory of the credibility of financial reporting, and show that the credibility of

TABLE 2

Summary Statistics

Variable	Obs.	Mean	Std. Dev.	p25	Median	p75	Skew
Age	768	61.05	4.21	59	62	64	−0.24
Tenure	768	10.45	5.09	6.67	9.17	13.13	1.25
Total Asset (millions)	768	23103.4	76644.67	2923.68	8403.68	21938.2	10.25
Mkt Cap (millions)	768	13334.59	19117.29	2538.63	7525.39	15564.95	3.10
Actual EPS	768	2.44	1.45	1.43	2.21	3.18	0.83

Variable Definitions:
Age = the age when CEOs retired;
Tenure = the total term of office as CEO in the firm;
Total Asset (in millions) = the book value of asset per firm-year observation;
Mkt Cap (in millions) = the market capitalization per firm-year observation; and
Actual EPS = the earnings per share for the firm the CEO worked for.

financial reports shapes the time-series of reported earnings, book values, and stock prices in ways that seem consistent with stylized facts.

Our analysis can be extended in several directions. Future research may consider the case in which the manager may experience liquidity shocks that force him to sell his shares early on. From the perspective of the manager, this possibility creates a trade-off between increasing the future reputation by issuing low reports, and inducing a high short-term price to "weather" the possibility of a liquidity shock. Another extension may consider the presence of a public, but noisy, signal about fundamentals that disciplines the manager's reporting behavior. This feature would add realism to our game. Third, one could consider the case in which the manager's honesty is not constant, but changes over time, being perhaps a Markov process. Finally, one could study how the presence of buyers' risk aversion affects the behavior of the manager and the time-series of reports and prices.

Our analysis has a number of limitations. First, in practice, misreporting is costly for the manager and the firm because it can trigger litigation costs. We have omitted misreporting costs to emphasize reputation as the driver of the credibility of financial reports. Second, in practice, misreporting reverses over time by the very mechanics of the accounting system. In our model, this is something that can limit the ability of the manager to build a large stock of discretionary accruals, potentially altering the dynamics of the game. Third, as previously mentioned, investors have access to external signals such as analyst forecasts. They also observe the firm's cash flows, which, although not completely free of manipulation, are harder to manipulate than accruals. Fourth, investors are uncertain not only about the manager's credibility, but also about the properties of the underlying earnings. They do not know the properties of the underlying process, but try to infer these properties from the reported earnings. Finally, the true earnings process is not exogenous to the accounting system. In reality, the true earnings are affected by the reporting process (see Plantin, Sapra, and Shin 2008; Kanodia, Sapra, and Venugopalan 2004). Our model is too simple to capture such phenomena. One could, however, think of the true earnings as consisting of the manager's hidden effort plus random shocks. In such an extension, the uncertain credibility would affect the effort profile chosen by the (honest) manager, thus affecting his effort choices.

REFERENCES

Arya, A., J. C. Glover, and S. Sunder. 2003. Are unmanaged earnings always better for shareholders? *Accounting Horizons* 17 (s-1): 111–116. doi:10.2308/acch.2003.17.s-1.111

Benabou, R., and G. Laroque. 1992. Using privileged information to manipulate markets: Insiders, gurus, and credibility. *Quarterly Journal of Economics* 107 (3): 921–958. doi:10.2307/2118369

Berk, J. B., R. C. Green, and V. Naik. 1999. Optimal investment, growth options, and security returns. *Journal of Finance* 54 (5): 1553–1607. doi:10.1111/0022-1082.00161

Beyer, A., I. Guttman, and I. Marinovic. 2014. *Earnings Management and Earnings Quality: Theory and Evidence*. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2516538

Board, S., and M. Meyer-ter-Vehn. 2013. Reputation for quality. *Econometrica* 81 (6): 2381–2462. doi:10.3982/ECTA9039

Carlson, M., A. Fisher, and R. Giammarino. 2004. Corporate investment and asset price dynamics: Implications for the cross-section of returns. *Journal of Finance* 59 (6): 2577–2603. doi:10.1111/j.1540-6261.2004.00709.x

Chen, Y. 2011. Perturbed communication games with honest senders and naive receivers. *Journal of Economic Theory* 146 (2): 401–424. doi:10.1016/j.jet.2010.08.001

Collins, D. W., and S. P. Kothari. 1989. An analysis of intertemporal and cross-sectional determinants of earnings response coefficients. *Journal of Accounting and Economics* 11 (2/3): 143–181. doi:10.1016/0165-4101(89)90004-9

Dechow, P. M., and R. G. Sloan. 1991. Executive incentives and the horizon problem: An empirical investigation. *Journal of Accounting and Economics* 14 (1): 51–89. doi:10.1016/0167-7187(91)90058-S

Dechow, P., W. Ge, and C. Schrand. 2010. Understanding earnings quality: A review of the proxies, their determinants and their consequences. *Journal of Accounting and Economics* 50 (2/3): 344–401. doi:10.1016/j.jacceco.2010.09.001

Demski, J. S. 1998. Performance measure manipulation. *Contemporary Accounting Research* 15 (3): 261–285. doi:10.1111/j.1911-3846.1998.tb00560.x

Dutta, S., and Q. Fan. 2014. Equilibrium earnings management and managerial compensation in a multiperiod agency setting. *Review of Accounting Studies* 19 (3): 1047–1077. doi:10.1007/s11142-014-9279-6

Dyck, A., A. Morse, and L. Zingales. 2010. Who blows the whistle on corporate fraud? *Journal of Finance* 65 (6): 2213–2253. doi:10.1111/j.1540-6261.2010.01614.x

Dye, R. A. 1988. Earnings management in an overlapping generations model. *Journal of Accounting Research* 26 (2): 195–235. doi:10.2307/2491102

Fischer, P. E., and R. E. Verrecchia. 2000. Reporting bias. *The Accounting Review* 75 (2): 229–245. doi:10.2308/accr.2000.75.2.229

Freeman, R. N., and S. Y. Tse. 1992. A nonlinear model of security price responses to unexpected earnings. *Journal of Accounting Research* 30 (2): 185–209. doi:10.2307/2491123

Gerakos, J., and A. Kovrijnykh. 2013. Performance shocks and misreporting. *Journal of Accounting and Economics* 56 (1): 57–72. doi:10.1016/j.jacceco.2013.04.001
Gigler, F. 1994. Self-enforcing voluntary disclosures. *Journal of Accounting Research* 32 (2): 224–240. doi:10.2307/2491283
Guttman, I., O. Kadan, and E. Kandel. 2006. A rational expectations theory of kinks in financial reporting. *The Accounting Review* 81 (4): 811–848. doi:10.1521/accr.2006.81.4.811
Halac, M. 2012. Relational contracts and the value of relationships. *American Economic Review* 102 (2): 750–779. doi:10.1257/aer.102.2.750
Heckman, J. J., and B. E. Honoré. 1990. The empirical content of the Roy model. *Econometrica* 58 (5): 1121–1149. doi:10.2307/2938303
Huson, M. R., Y. Tian, C. I. Wiedman, and H. A. Wier. 2012. Compensation committees' treatment of earnings components in CEOs' terminal years. *The Accounting Review* 87 (1): 231–259. doi:10.2308/accr-10164
Jones, J. J. 1991. Earnings management during import relief investigations. *Journal of Accounting Research* 29 (2): 193–228. doi:10.2307/2491047
Kanodia, C., H. Sapra, and R. Venugopalan. 2004. Should intangibles be measured: What are the economic trade-offs? *Journal of Accounting Research* 42 (1): 89–120. doi:10.1111/j.1475-679X.2004.00130.x
Kothari, S. P., S. Shu, and P. D. Wysocki. 2009. Do managers withhold bad news? *Journal of Accounting Research* 47 (1): 241–276. doi:10.1111/j.1475-679X.2008.00318.x
Marinovic, I. 2013. Internal control system, earnings quality, and the dynamics of financial reporting. *Rand Journal of Economics* 44 (1): 145–167. doi:10.1111/1756-2171.12015
Marinovic, I., and F. Varas. 2016. *CEO Horizon, Optimal Duration and the Escalation of Short-Termism*. Stanford GSB Research Paper. Available at: https://www.mccombs.utexas.edu/~/media/Files/MSB/Centers/HMTF/TFF/Marinovic_Varas.pdf
Morris, S. 2001. Political correctness. *Journal of Political Economy* 109 (2): 231–265. doi:10.1086/319554
Plantin, G., H. Sapra, and H. S. Shin. 2008. Marking-to-market: Panacea or Pandora's Box? *Journal of Accounting Research* 46 (2): 435–460. doi:10.1111/j.1475-679X.2008.00281.x
Sobel, J. 1985. A theory of credibility. *Review of Economic Studies* 52 (4): 557–573. doi:10.2307/2297732
Stein, J. C. 1989. Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *Quarterly Journal of Economics* 104 (4): 655–669. doi:10.2307/2937861
Stocken, P. C. 2000. Credibility of voluntary disclosure. *RAND Journal of Economics* 31 (2): 359–374. doi:10.2307/2601045
Zakolyukina, A. A. 2014. *Measuring Intentional GAAP Violations: A Structural Approach,* 13–45. Chicago Booth Research Paper, The University of Chicago.

APPENDIX A
Omitted Proofs

Proof of Lemma 1

Suppose not. Then there must exist two different vectors of reports $\mathbf{r}_T^1$ and $\mathbf{r}_T^2$ inducing the same book value $R_T^1 = R_T^2$, but different prices. Without loss of generality, assume $p_T(\mathbf{r}_T^1) > p_T(\mathbf{r}_T^2)$. Clearly, the dishonest manager must always attach zero density to vector $\mathbf{r}_T^2$; therefore, this report must be fully credible in equilibrium, hence $p(\mathbf{r}_T^2) = R_T^2$. Two cases must be considered: (1) if the dishonest manager attaches zero density to $\mathbf{r}_T^1$, then both $\mathbf{r}_T^1$ and $\mathbf{r}_T^2$ must be fully credible, and induce the same price, given that their associated book values are the same. (2) If the dishonest manager attaches positive density to $\mathbf{r}_T^1$, then the price:

$$\begin{aligned} p_T(\mathbf{r}_T^1) &< R_1^T \\ &= R_2^T = p_T(\mathbf{r}_T^2), \end{aligned}$$

which is a contradiction, for this would mean the dishonest manager is not maximizing the stock price. The first inequality holds because the dishonest manager's reporting strategy is independent of x_T, and the fact that the dishonest manager never reports a negative terminal book value, or $R_1^T > 0$. ∎

Proof of Proposition 1

Define:

$$k_T \equiv \max p_T,$$

namely, k_T is the highest price that can be induced in equilibrium—this price must clearly exist. We first argue that this number fully characterizes the support of the dishonest manager's reporting strategy β, as the following set:

$$S_T(k_T) \equiv \{\mathbf{r}_T : R_T \geq k_T\}.$$

In words, the support of the book value reported by the dishonest manager, denoted $\hat{R}_T$, must be a right-tailed interval. To establish this, three cases must be ruled out. Ruling out that the support is the entire real line or a left-tailed interval is relatively straightforward, so we omit it. Less straightforward is showing that the support of $\hat{R}_T$ is continuous. In fact, we claim that the dishonest manager assigns positive density to all the reports in the interior of $S_T(k_T)$ for some equilibrium number k_T. This can be shown by noting that the price must always be weakly smaller than the book value. Hence if two different book values R_T^*, R_T^{***} belong to the support of the reporting strategy and there exists another book value R_T^{**} satisfying:

$$\min(R_T^*, R_T^{***}) < R_T^{**} < \max(R_T^*, R_T^{***}),$$

which does not belong to the support of the reporting strategy, then R_T^{**} must induce a strictly higher price than that induced by either R_T^* or R_T^{***}. This proves that the dishonest manager never reports a book value smaller than k_T for some k_T to be determined in equilibrium. Furthermore, the reporting strategy must be atomless—otherwise, the manager would be detected. On the other hand, all trajectories in $S_T(k_T)$ must induce the same price $p_T = k_T$, or else some of the elements $S_T(k_T)$ would not maximize the price. Hence, for the price to be consistent with Bayes' Rule, the value of k_T must satisfy:

$$\frac{\gamma\mathbb{P}[x_T > k_T]}{\gamma\mathbb{P}[x_T > k_T] + 1 - \gamma}\mathbb{E}[x_T \mid x_T > k_T] + \frac{1-\gamma}{\gamma\mathbb{P}[x_T > k_T] + 1 - \gamma}\mathbb{E}[x_T] = k_T.$$

The first term in the LHS represents the probability of an honest manager conditional on the book value being above k_T multiplied by the expected value of the asset conditionally on the value truly being greater than k_T, and the second term represents the probability of a dishonest manager conditional on the book value being above k_T multiplied by the prior expected value of the asset. This latter fact simply reflects that the dishonest manager's reporting strategy is independent of x_T, hence conditional on the manager being dishonest, the entire sequence of reports is uninformative. After some rearrangements, the above equation can be rewritten more compactly as:

$$\int_{k_T}^{\infty} \theta \frac{x - k_T}{k_T} \frac{1}{\sigma\sqrt{T}} \phi\left(\frac{x}{\sigma\sqrt{T}}\right) dx = 1. \tag{9}$$

Defining the variable $y \equiv \frac{x}{\sigma\sqrt{T}}$, this equation can be written as:

$$\int_{z}^{\infty} \theta \frac{y - z}{z} \phi(y) dy = 1,$$

where $z \equiv \frac{k_T}{\sigma\sqrt{T}}$. It is easy to show that this equation has a unique solution, $z(\theta)$. ■

Proof of Proposition 2

Our purpose is to show that for $R' < R$, $\beta(r|R')$ FOSD $\beta(r|R)$. Instead of proving this directly, we prove the stronger condition that $\beta(r|R')/\beta(r|R)$ is nondecreasing (that is, we prove likelihood ratio dominance). Let $L(r) = \beta(r|R')/\beta(r|R)$ be the likelihood ratio between the two distributions, then we need to show that $L'(r) \geq 0$. Let us define $g(x) := x\Phi(x) + \phi(x)$, where $g'(x) = \Phi(x)$. We can write the likelihood ratio as:

$$L(r) = A(R)\frac{g\left(\frac{r+R-K_T}{\sigma\sqrt{T-t}} - \eta\right)}{g\left(\frac{r+R-K_T}{\sigma\sqrt{T-t}}\right)}, \tag{10}$$

where:

$$A(R) = \frac{(R-k_T)\Phi\left(\frac{R-k_T}{\sigma\sqrt{T-t+1}}\right) + \sigma\sqrt{T-t+1}\phi\left(\frac{R-k_T}{\sigma\sqrt{T-t+1}}\right)}{(R'-k_T)\Phi\left(\frac{R'-k_T}{\sigma\sqrt{T-t+1}}\right) + \sigma\sqrt{T-t+1}\phi\left(\frac{R'-k_T}{\sigma\sqrt{T-t+1}}\right)}$$

$$\eta = \frac{R-R'}{\sigma\sqrt{T-t+1}}.$$

Equation (10) is nondecreasing if and only if the function $g(x-\eta)/g(x)$ is nondecreasing for all $\eta > 0$. Letting $\lambda(x) := \varphi(x)/$

$\Phi(x)$, we can write:

$$\frac{d}{dx}\frac{g(x-\eta)}{g(x)} = \frac{g(x-\eta)}{g(x)}\left(\frac{1}{x-\eta+\lambda(x-\eta)} - \frac{1}{x+\lambda(x)}\right). \tag{11}$$

Using results for truncated normal distributions (Heckman and Honoré 1990), we can write:

$$x+\lambda(x) = x - \Big(-\phi(x)/\Phi(x)\Big) = x + E[y|y<x],$$

where y is a random variable with standard normal distribution. An implication of Proposition 1 in Heckman and Honoré (1990) is that $x+E[y|y<x]$ is increasing, which means that the right-hand side of (11) is positive. ∎

Proof of Proposition 3

First, we show that R_t is a submartingale under the measure induced by the dishonest type (that is, under β). The expected value of the report given R_{t-1} is:

$$\begin{aligned}
\mathbb{E}[r_t|R_{t-1},\tau=0] &= \int_{-\infty}^{\infty} r_t \frac{(r_t+R_{t-1}-k_T)\Phi\left(\frac{r_t+R_{t-1}-k_T}{\sigma\sqrt{T-t}}\right)+\sigma\sqrt{T-t}\phi\left(\frac{r_t+R_{t-1}-k_T}{\sigma\sqrt{T-t}}\right)}{(R_{t-1}-k_T)\Phi\left(\frac{R_{t-1}-k_T}{\sigma\sqrt{T-t+1}}\right)+\sigma\sqrt{T-t+1}\phi\left(\frac{R_{t-1}-k_T}{\sigma\sqrt{T-t+1}}\right)}\frac{1}{\sigma}\phi\left(\frac{r_t}{\sigma}\right)dr_t \\
&= \int_{-\infty}^{\infty} h(r_t)\frac{r_t}{\sigma}\phi\left(\frac{r_t}{\sigma}\right)dr_t
\end{aligned}$$

where:

$$h(r_t) := \frac{(r_t+R_{t-1}-k_T)\Phi\left(\frac{r_t+R_{t-1}-k_T}{\sigma\sqrt{T-t}}\right)+\sigma\sqrt{T-t}\phi\left(\frac{r_t+R_{t-1}-k_T}{\sigma\sqrt{T-t}}\right)}{(R_{t-1}-k_T)\Phi\left(\frac{R_{t-1}-k_T}{\sigma\sqrt{T-t+1}}\right)+\sigma\sqrt{T-t+1}\phi\left(\frac{R_{t-1}-k_T}{\sigma\sqrt{T-t+1}}\right)}.$$

The derivative of h is proportional to $\Phi(\cdot)+\cdot\,\phi(\cdot)+\phi'(\cdot)=\Phi(\cdot)$, which means that h is a positive, increasing function. Hence, we have that:

$$\begin{aligned}
\int_{-\infty}^{\infty} h(r_t)\frac{r_t}{\sigma}\phi\left(\frac{r_t}{\sigma}\right)dr_t &= \int_{-\infty}^{0} h(r_t)\frac{r_t}{\sigma}\phi\left(\frac{r_t}{\sigma}\right)dr_t + \int_{0}^{\infty} h(r_t)\frac{r_t}{\sigma}\phi\left(\frac{r_t}{\sigma}\right)dr_t \\
&> \int_{-\infty}^{0} h(0)\frac{r_t}{\sigma}\phi\left(\frac{r_t}{\sigma}\right)dr_t + \int_{0}^{\infty} h(0)\frac{r_t}{\sigma}\phi\left(\frac{r_t}{\sigma}\right)dr_t \\
&= \sigma h(0)\int_{-\infty}^{\infty} y\phi(y)dy = 0,
\end{aligned}$$

where in the last line, we have made the change of variables $y = r_t/\sigma$. Thus, we have that $\mathbb{E}[R_t|R_{t-1}] = R_{t-1} + \mathbb{E}[r_t|R_{t-1}] > R_{t-1}$ so the process R_t is a submartingale. Finally, we want to show that the previous property is satisfied unconditionally. It is a straightforward computation that:

$$\begin{aligned}
\mathbb{E}[R_t|R_{t-1}] &= \rho_t\mathbb{E}[R_t|R_{t-1},\tau=1] + (1-\rho_t)\mathbb{E}[R_t|R_{t-1},\tau=0] \\
&= \rho_t R_{t-1} + (1-\rho_t)\mathbb{E}[R_t|R_{t-1},\tau=0] \\
&> \rho_t R_{t-1} + (1-\rho t)R_{t-1} = R_{t-1}.
\end{aligned}$$

Similarly:

$$\begin{aligned}
\mathbb{E}[r_t|R_{t-1}] &= \rho_t\mathbb{E}[r_t|R_{t-1},\tau=1] + (1-\rho_t)\mathbb{E}[r_t|R_{t-1},\tau=0] \\
&= (1-\rho_t)\mathbb{E}[r_t|R_{t-1},\tau=0] > 0.
\end{aligned}$$

∎

Proof of Corollary 2

The only claims that remain to be proven are that $p_t(R_t)$ is bounded above by k_T and that $\rho_t(R_t)$ is a decreasing function of R_t. First, the price $p_t(R_t) = \rho_t(R_t)R_t$ is bounded above by k_T for all t is true if and only if:

$$p_t(R_t) = \frac{R_t}{1 + \left(\frac{R_t}{k_T} - 1\right)\Phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right) + \frac{\sigma\sqrt{T-t}}{k_T}\phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right)} < k_T.$$

Rearranging terms, we can write the previous inequality as:

$$\frac{R_t - k_T}{\sigma\sqrt{T-t}} < \frac{\phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right)}{1 - \Phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right)}. \tag{12}$$

Finally, we note that inequality (12) is always satisfied, as the right-hand side in (12) is the expected value of a standard normal distribution truncated below at $(R_t - k_T)/\sigma\sqrt{T-t}$. This inequality is standard in the econometrics literature (see, e.g., Heckman and Honoré 1990).

Second, $\rho_t(R_t)$ is a decreasing function if and only if:

$$1 + \left(\frac{R_t}{k_T} - 1\right)\Phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right) + \frac{\sigma\sqrt{T-t}}{k_T}\phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right) \tag{13}$$

is an increasing function of R_t. Differentiating (13), we find that the derivative is proportional to:

$$\Phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right) + \frac{R_t - k_T}{\sigma\sqrt{T-t}}\phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right) + \phi'\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right).$$

Using the fact that $\phi'(z) = -z\phi(z)$, we get that the previous expression is equal to $\Phi\left(\frac{R_t - k_T}{\sigma\sqrt{T-t}}\right)$, which is always positive. ■

APPENDIX B
Data

We focus on CEOs who retired from Fortune 500 firms. The main reason to use CEO retirement data is to ensure that the CEO turnover is voluntary. Fortune 500 lists are obtained from MSCI GMI Ratings, which provides companies' Fortune rankings from 2001 to 2014. CEO retirement data are collected from Execucomp. CEO tenure data are merged with the CEO tenure with financial data from Compustat and analyst forecast data from I/B/E/S. For CEOs whose tenure started after 1988, we keep all firm-year financial data. For those who started as CEO before 1988, we consider their starting year 1988. We also require that CEOs in our sample remain in office for at least three years. From 2002 to 2012, there are 96 CEO retirement cases. The average tenure is 10.5 years and the average retirement age is 61, which are similar to the data used in Huson, Tian, Wiedman, and Wier (2012). In total, we have 768 firm-year observations from 92 unique CEOs/firms.

We use earnings per share (EPS) to measure earnings. The summary statistics are shown in Table 1. *Age* is the age when CEOs retired; *Tenure* is the total number of years as CEO of the firm; *Total Asset* (in millions) is the book value of asset per firm-year observation; *Mkt Cap* (in millions) is the market capitalization per firm-year observation; *Actual EPS* is the earnings per share for the firm; *EPS Forecast* is the median earnings per share forecast for the firm during the fiscal year; and *EPS Surprise* is the difference between actual EPS and EPS forecast.