

## The effect of directors' equity incentives on earnings management

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### Abstract

This study examines the effect of allowing directors to trade in a firm's shares on the likelihood of earnings management, on the firm's value, and on the stock price. We study these issues in a stylized principal-agent game wherein the directors induce earnings management by allowing managers flexibility in reporting. In contrast to Stein [Stein, J.C., 1989. Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *Quarterly Journal of Economics* 104 (4), 655–669], we show that earnings management distorts the stock price because the market cannot undo the bias in the accounting report. Furthermore, it reduces the firm's value because of its unfavorable effect on the manager's effort. These results stand in contrast to the previous literature on insider trading and have important policy implications. They support the OECD's 2004 recommendation to prohibit insider trading.

**Keywords:** Governance; Insider trading; Compensation; Principal-agent

### Article Outline

1. [Introduction](#)
  2. [Model](#)
  3. [The equilibrium](#)
    - 3.1. [Benchmark: the shareholders' optimal contract for management](#)
    - 3.2. [Benchmark: the optimal contract designed by directors who are not awarded an equity stake](#)
    - 3.3. [The equilibrium when directors own equity](#)
  4. [Example](#)
  5. [Conclusion](#)
- [Acknowledgements](#)  
 Appendix A. [Appendix](#)  
[References](#)

### 1. Introduction

The goal of the Sarbanes-Oxley Act (SOX) was to restore investors' confidence in the capital market, which had been shaken by accounting scandals in the wake of revelations of earnings management. Some of the Act's measures have increased the burden on directors, and directors' compensation has increased with it. [Linck et al. \(2005\)](#), report that small (large) firms paid \$3.19 (\$0.32) in director fees per \$1000 of net sales in 2004, which is \$0.84 (\$0.07) more than they paid in 2001 and \$1.21 (\$0.10) more than in 1998. Furthermore, the increase in equity stakes has surpassed the increase in cash payments.<sup>1</sup> SOX thus has had unforeseen consequences: it not only caused increases in directors' total payments, it also made their compensation more equity-based. Consider, for example, the incentives of the directors of IBM as disclosed in IBM's 2005 proxy:

Effective January 1, 2005, directors who are not employed by the Company will receive an annual retainer of \$100,000, an increase of \$30,000 ... Sixty percent of the annual retainer fees is paid in Promised Fee Shares of IBM common stock under the Directors Deferred Compensation and Equity Award Plan (the "DCEAP"). ... Under the IBM Non-Employee Directors Stock Option Plan, each non-management director receives an annual grant of options to purchase 4000 shares of IBM common stock.

Directors' incentives are supposed to align the interests of directors with those of shareholders. Since the latter are averse to earnings management, SOX contributes to aligning these interests if the increase in directors' shareholdings motivates them to curb earnings management by managers. However, the increase in shareholdings also increases the importance of insider trading to directors. Since insider trading by managers motivates them to manage earnings (e.g., [Elitzur and Yaari, 1995](#)), we ask whether intensified insider trading by directors resulting from increases in shareholdings paradoxically will contribute to earnings management, too.

In this study, we examine the effect of insider trading by directors on the likelihood of earnings management (by management), on the value of the firm (through the effect of the design of management's incentives on management's actions), and on the stock price. We model the relationship between directors and management as a principal-agent game with unobservable economic earnings. The directors decide on the accounting flexibility and design management's incentives. Management prepares a draft of the financial reports for the auditor. Since the audit technology is imperfect, directors can eliminate earnings management only by allowing management no accounting flexibility.

We find that directors allow managers to manage earnings in order to engage in profitable insider trading. Of course, the fact that firms manage earnings does not, by itself, imply that earnings management is not neutral. Earnings management is neutral when the stock price is unbiased, because the market can see through the bias in the report and value the firm correctly and the manager is paid in accordance with the truth. That is, neutral earnings management has neither a cash flow effect nor a distributional effect ([Stein, 1989](#), [Elitzur, 1995](#), [Christensen and Feltham, 2002](#) and [Christensen and Feltham, 2005](#)). Since, besides the manager, only the directors know the bias, neutral earnings management requires that the directors signal the truth through a combination of the accounting reports and management's compensation.<sup>2</sup> However, the desire to make profitable insider trades leads directors to create an information asymmetry between themselves and the market. Hence, the directors prefer earnings management that conceals the truth. Shareholders, who design the directors' incentives, are implicitly willing to let the firm manage earnings because the cost of earnings management is outweighed by the benefit from inducing directors to design an efficient incentive contract for the manager.

We conclude the paper with an example that illustrates how the design of a piece-wise contract can make insider trading profitable. The point at which the contract exhibits a kink determines the manager's "target" report. The directors fix the location of the kink randomly so that the market cannot distinguish between a truthful report and a "target" report. The market responds by playing a mixed strategy as well, randomizing between believing the report and discounting it. As a result, the stock price might be a biased estimate of the true firm's value: either because the market discounts truthful reports, or because the market erroneously thinks the report is truthful.

Our paper contributes to three strands of literature: governance, earnings management, and insider trading. As [Becht et al. \(2002, p. 43\)](#), observe: "In contrast to the large empirical literature on the composition of boards, formal analysis of the role of boards of directors and how they should be regulated is almost non-existent." Broadly speaking, the papers on governance either deal with board composition between insiders and outsiders and size ([Aggarwal and Nanda, 2004](#), [Harris and Raviv, 2005](#), [Raheja, 2005](#) and [Adams and Ferreira, forthcoming](#)) or board decisions that are affected by the conflict between the board and the manager, such as turnover following poor performance ([Hermalin and Weisbach, 1998](#) and [Warther, 1998](#)). Our paper belongs to the second type, since it focuses on the role of the board in designing the incentives of work-averse CEOs. We make a contribution to this area by finding that the composition of the directors' compensation affects the directors' design of the management compensation contract and accounting flexibility. We show that self-dealing by directors can bring about the undesirable outcome of earnings management. We therefore recommend that regulators support the policy recommendation of the Organization of Economic Cooperation and Development (OECD) to prohibit insider trading in order to achieve a higher quality of corporate governance.

Our contribution to the principal-agent earnings management literature is that we shift the focus from the agent—management—to the principal—the directors. Previous studies have found that principals do not induce truth-telling from the manager because truth-telling is prohibitively costly ([Dye, 1988](#), [Evans and Sridhar, 1996](#) and [Ronen and Yaari, 2006](#)). We assume that the board can achieve the same payoffs as a truth-telling equilibrium. We show that earnings management is the outcome of a tacit collusion between management and opportunistic directors. Furthermore, in contrast to the studies that have shown that earnings management might be valuable (see, e.g., [Demski, 1998](#) and [Arya et al., 2003](#)), we find that earnings management is harmful.

Finally, our paper also contributes to the literature on insider trading. This strand of research is mostly concerned with the effect of the manager's insider trading on the conflict of interest between the owners of the firm (the principal) and the manager (the agent). Following [Manne, 1966](#) and [Easterbrook, 1985](#) argues that insider trading by managers is beneficial because it lessens the conflict of interest between owners and managers. [Dye \(1984\)](#) proves that insider trading by the manager is beneficial because it is correlated with his unobserved effort. Thus, insider trading can be used in the manager's compensation contract to reduce the cost of incentives. [Bebchuk and Fershtman, 1990](#), [Bebchuk and Fershtman, 1993](#) and [Bebchuk and Fershtman, 1994](#) show that the value of the manager's insider trading depends on the trade-off between the manager's risk-aversion and his speculative-gains motive. [Elitzur and Yaari \(1995\)](#) find that the manager times the allocation of accruals over his tenure horizon in order to maximize his profits from insider trading. [Baiman and Verrecchia \(1995\)](#) analyze the case in which the stock price contains non-contractible perfect information on the manager's unobservable effort and find that although a manager's insider trading affects the parameters of the contract, it has no effect on the stock price. [Noe \(1997\)](#) shows that prohibiting insider trading by managers could be superior to mechanisms that restrict their activities. We, however, focus on the directors who are supposed to monitor management rather than on managers themselves, and we show that insider trading by directors both distorts prices and destroys value.

The paper is organized as follows: In Section 2, we present the model. We characterize the equilibria in Section 3. In Section 4, we provide an example. Section 5 contains our conclusions.

## 2. Model

Our one-shot model contains three players: shareholders, directors, and management. The firm is a hierarchy of principal-agent relationships, between shareholders and directors, and between directors and the manager. The shareholders act as principal to the directors. The directors are an agent of the shareholders and a principal of management, and management is an agent of the directors. The manager is hired because his effort, together with nature, determines the firm's earnings,  $x, x \in [\underline{x}, \bar{x}]$ . Our model focuses on the functions of the board

of directors in designing management's incentives and fulfilling their monitoring role with respect to the financial reports.

We next introduce the time-line and the notation. We adhere to the standard notation of principal-agent games with unobservable outcome. Having a three-player game, however, naturally adds more notation on utility functions and decision variables.

*Date 1:* The shareholders vote for the nominated directors and award them an equity stake in the firm: a fraction  $\beta$  of the firm's  $N$  outstanding shares and options to purchase an additional fraction  $\gamma$  at the end of the period. The exercise price is the price per share after the firm publicizes the accounting report,  $m$ ,  $P(m)$ . For parsimony, we assume that the firm buys treasury stock if directors exercise their options so that  $N$  does not change, and we normalize  $N$  to one,  $N = 1$ .

*Date 2:* The directors choose the auditor and the quality of the internal control system. These decisions determine the manager's maximum accounting flexibility,  $q$ ,  $0 \leq q \leq \bar{q}$ . When  $q = 0$ , the manager cannot bias the report of earnings, and the firm reports the truth.

The directors design the manager's compensation schedule  $S$ , basing it on the imperfectly audited, end-of-the-period report,  $m$ ,  $S : \mathfrak{R} \rightarrow \mathfrak{R}_+$ . The contract and the accounting flexibility are private information of the directors and the manager.

The accounting flexibility implies that the imperfectly audited report can be biased. That is, denoting the bias by  $b$ ,  $b = m - x \leq q$ . Given our one-period model, it is clear that in equilibrium the manager does not have incentives to hoard reported outcome, so  $b \geq 0$ .

*Date 3:* The manager exerts unobservable production-investment effort,  $a$ ,  $a \geq 0$ .

*Date 4:* The actual outcome,  $x$ , is realized. The manager alone observes  $x$ .

*Date 5:* The manager prepares a draft of the report,  $m_1$ . The auditor examines the draft. The discussions between the auditor and the manager during the audit, and between the auditor and the audit committee after the audit, are confidential. If the manager attempts to manage earnings, directors can deduce the truth from these discussions. However, this knowledge is neither verifiable nor contractible.<sup>3</sup>

*Date 6:* After issuing the audited report,  $m$ , the manager receives compensation,  $s(m)$ , as authorized by the board of directors.<sup>4</sup> The stock price,  $P(m)$ , is set. Directors can sell their shares and exercise their options at the price  $P(m)$ .

*Date 7:* A long time later, the market receives additional information that eliminates the gap between the market's and the directors' valuations. The directors sell their remaining holdings.

[Table 1](#) summarizes the timeline of the model.

*Assumptions:*

Table 1.

Timeline

Date 1	Date 2	Date 3	Date 4
Shareholders award directors shares and options	The board designs the accounting flexibility and the contract of the manager. The manager signs the contract.	The manager exerts effort.	Nature chooses earnings, and the mana

(A1) The occurrence of earnings management depends on two parameters: the accounting flexibility,  $q$ , and the probability that an audit does not detect the truth. The flexibility parameter determines the maximum bias,  $b \leq q$ .

The audit detection technology has a one-sided error (see, e.g., [Schwartz, 1997](#), [Ronen and Yaari, 2002a](#) and [Ronen and Yaari, 2002b](#)). The audit confirms a truthful report by the manager perfectly and detects the truth when the manager submits a biased report imperfectly. In what follows, we denote the probability of detecting misrepresentation by  $\pi(b)$ ,  $\pi(b) = \text{Prob}(m = x | m_1 \neq x)$ . Because the audited report is imperfectly credible,  $\forall b$ ,  $1 > \pi(b) > 1/2$ . We assume that the probability of detection is an increasing function of the bias,  $b$ ,  $\frac{\partial \pi(b)}{\partial b} > 0$ . This assumption reflects the reality that the likelihood of noticeable accounting signals that trigger further auditing and detection of the truth increases as the draft's deviation from the truth increases.

Our modeling of the accounting flexibility is inspired by [Evans and Sridhar \(1996\)](#) and [Ronen and Yaari \(2006\)](#). Similar to the former,<sup>5</sup> we allow for zero flexibility,  $q = 0$ . In this case, the report is truthful,  $m = x$ . We differ, however, in that we assume that  $q$  is an endogenous variable. In Evans and Sridhar's study,  $q$  is chosen by nature, and in Ronen and Yaari's study,  $q$  is a known parameter of GAAP. This difference implies that in our study the directors effectively determine the bias.

(A2) All long-term considerations are captured by a value function,  $V$ , that translates economic earnings,  $x - s(m)$ , into the firm's value,  $V(x - s(m))$ ;  $V$  is a linear increasing function of  $x - s(m)$ , i.e.,  $V' > 0$ , and  $V'' = 0$ . This assumption reflects the expectation that higher current earnings produce higher future dividends.

(A3) The value of the firm after the manager is paid  $s(m)$  is split between the shareholders and the directors. The shareholders' wealth is denoted by  $W^S$ , and the directors' wealth is denoted by  $W^D$ , where  $W^S + W^D = V(x - s(m))$ .

(A3i) As residual claimants, the shareholders maximize  $E(W^S) = E(V(x - s(m))) - E(W^D)$ .

The directors' wealth,  $W^D$ , depends on their trading decision on date 6. They sell shares with conditional probability of  $\delta_\beta$  given  $m$ , to receive  $\beta P(m)$ . Alternatively, they do not sell their shares (until date 7) with conditional probability of  $1 - \delta_\beta$  given  $m$ , to be left with  $\beta V(x - s(m))$ , and exercise the options at date 6 with probability of  $\delta_\gamma$  and sell the shares obtained on date 7 to gain  $\gamma[V(x - s(m)) - P(m)]$ . Hence, their wealth is

$$W^D = \beta V(x - s(m)) + G(m), \tag{1}$$

where  $G(m) = \delta_\beta \beta [P(m) - V(x - s(m))] + \delta_\gamma \gamma [V(x - s(m)) - P(m)]$ .

The first term in  $G(m)$  is the conditional expected trading gains from selling shares given  $m$ , the second is the conditional expected trading gains from exercising the options given  $m$ . In what follows, we refer to  $\beta V(x - s(m))$  as the long-term value of directors' holdings, and to  $G(m)$  as trading gains. The directors also incur monitoring disutility,  $C$ , and their reservation utility is zero.

(A3ii) The directors maximize their expected wealth net of the monitoring disutility,  $E(W^D) - C$ .

Monitoring reduces the directors' payoff for a number of reasons. The foremost is likely to be the inherent inconsistency between effective monitoring and the pressure not to antagonize management.<sup>6</sup> We focus on two of the main functions of boards of directors that have the potential to antagonize management: the design of management's incentives, which requires effort chosen from a binary set,  $e, e \in \{0, D\}$ ,  $D \geq 0$ , and the design of the accounting flexibility,  $q$ .<sup>7</sup> We assume that a flat-salary contract requires zero effort on the part of directors,  $e = 0$ , but an incentives contract requires positive effort of  $D$ .

We assume that  $C(q, e)$  is a decreasing function of  $q$ .<sup>8</sup> The assumption that  $C$  decreases in flexibility reflects the fact that the directors' duty to make decisions with due care is easier if more options can be approved legitimately without antagonizing management. This portrayal reflects the dynamic that directors do not initiate accounting decisions; rather, they have to approve them, given management's draft and the discussions with the auditor. The more latitude they have regarding a certain menu of choices, the easier it is for them to consent to management's wishes and at the same time fulfill their *duty of care* obligation.<sup>9</sup>

Our characterization of directors' incentives assumes away the threat of litigation and the damaging impact of a firing on reputation. Until Enron and WorldCom, litigation was covered by insurance against such claims, and directors thus bore no personal financial cost. The cost associated with being fired and losing reputation are unclear since firms take measures such as having staggered boards to reduce the chance of replacing the board (Bebchuk and Cohen, 2005). In staggered boards, directors are chosen in installments. Replacing the current board requires winning proxy contests repeatedly.

The risk-averse, work-averse manager has a utility function that is separable in compensation,  $s(m)$ , and effort,  $a$ . His payoff over the former is represented by a von Neumann-Morgenstern utility  $U$ , where  $U' > 0$  and  $U'' < 0$ . His disutility over the latter equals  $a$ .<sup>10</sup> The manager can obtain a utility of  $\bar{U}$  in an alternative job.

(A3iii) The manager maximizes his payoff over compensation and effort,  $E(W^M) = E(U(S(m))) - a$ .

We do not consider the repercussions of revelation of the truth on Date 7 on management's reputation, because this issue is unclear when earnings management is not fraudulent. While it is known that CEOs are let go when a firm performs poorly and that firms hide poor performance by managing earnings, there is no convincing evidence that non-fraudulent earnings management in itself leads to separation of its CEO from a firm (Ronen and Yaari, forthcoming). Furthermore, in our study, earnings management takes place even if performance is good.

Table 2 summarizes the decisions and corresponding payoffs of our three players.

	Decisions	Payoff
Shareholders	$\beta, \gamma$	$W^S = (1 - \beta)E(V(x - S(m))) - EG(m)$
Directors	$e, S, q, \delta_\beta, \delta_\gamma$	$W^D - C(q, e) = \beta E(V(x - S(m))) + EG(m) - C(q, e)$
Manager	$a, m$	$E(U(S(m))) - a$

As Table 2 indicates, shareholders design the equity contract of the directors,  $(\beta, \gamma)$ . The directors choose whether to expend effort in designing an incentive contract for management,  $e$ , and if they do, they then determine the shape of the contract,  $S$ ; they also design the accounting flexibility,  $q$ , through the choice of an auditor. For their own trading gains, they determine the conditional probabilities of selling their shares,  $\delta_\beta$ , and exercising their options,  $\delta_\gamma$ , given the firm's report. The manager chooses production-investment effort,  $a$ , and the draft of the accounting reports submitted to the auditor.

(A4) The date-5 market price,  $P$ , is determined in a Noisy Rational Expectations Equilibrium (NREE).<sup>11</sup> The price aggregates traders' expectations regarding the firm's long-run value conditional on the firm's report,  $m$ . We assume that the market is composed of informed, uninformed, and noise traders. The informed traders expend costly resources to learn the truth known by the directors and attach to the firm the same value,  $P^D(m)$ . The uninformed rational investors value the firm at  $P^U(m)$ . The market price is a weighted average of

informed and uninformed investors' valuations:

$$P(m) = \phi P^U(m) + (1 - \phi)P^D(m) + \varepsilon, \quad 0 < \phi \leq 1, \quad (2)$$

where  $\varepsilon$  is white noise introduced by noise traders,  $E(\varepsilon) = 0$ ,  $E(\varepsilon^2) > 0$ , and is uncorrelated with both  $P^U$  and  $P^D$ , and  $E(P^U(m)\varepsilon) = E(P^D(m)\varepsilon) = 0$ .

The parameter  $\phi$  is the weight of the uninformed investors' valuation in the price. We assume that when the firm reports the truth consistently, informed traders are driven away from the market,  $\phi = 1$ , because they no longer benefit from expending costly resources to learn the truth.

We also assume that uninformed investors are rational, in that after observing the firm's report,  $m$ , they update their prior beliefs function,  $h(x)$ , by Bayes' rule, to  $h^p(x|m)$ ,

$$P^U(m) = \int V(x - S(m))h^p(x|a, m) dx. \quad (3)$$

The price is rational, since  $E_x(P(m)) = E(V(x - S(m)))$ .

In what follows, we denote the density function of the economic earnings,  $x$ , conditional on  $a$ , by  $f(x|a)$ , and the associated cumulative distribution function by  $F(x|a)$ .

The assumptions on technology are as follows:

(a) To ensure regularity, we assume that all functions are twice continuously differentiable.

(b) The following standard assumptions hold: the Monotone Likelihood Ratio Condition (MLRC) holds, i.e.,  $f_a/f$  is a non-decreasing function of  $x$ , where  $f_a$  is the derivative of  $f(x|a)$  with respect to effort of the manager; the first-order approach is valid: either the CDF condition holds—i.e.,  $F(x|a)$  is convex in the effort of the manager (Rogerson, 1985)—or the conditions of Jewitt's Theorem 1 (1988) hold; and the support of  $f(x|a)$  is independent of the manager's effort. We also assume that when  $a = 0$ , the firm generates minimal earnings  $\underline{x}$  for sure, but that  $E(x|a, a > 0) > \underline{x}$ , so that value maximization implies that it is always in the best interests of the shareholders to have the directors design a contract that induces the manager to exert effort.

Table 3 summarizes the notation.

Table 3.

Notation	
$X$	The actual economic earnings, $x \in [\underline{x}, \bar{x}]$
$a$	The manager's production-investment effort. Also, his disutility from effort, $a \geq 0$
$f(x a)$	The density function of the firm's earnings given the manager's effort
$m_1$	The manager's draft of the report that is submitted to the auditor confidentially
$m$	The firm's end-of-the-period report
$q$	The accounting flexibility, $m - x \leq q$ , $0 \leq q \leq \hat{q}$
$b$	The bias in the accounting report as chosen by the manager, $0 \leq b \leq q$
$\pi$	The probability that the auditor discovers the truth when the manager attempts to bias the report
$S$	The manager's compensation schedule as a function of $m$ , $S: \mathfrak{R} \rightarrow \mathfrak{R}$ . An actual payment is denoted by $s(m)$
$U$	The manager's von Neumann–Morgenstern utility function over compensation, $U' > 0$ and $U'' < 0$
$\beta(\gamma)$	The fraction of the firm's outstanding shares awarded to the directors (the additional fraction of shares that could be purchased by the directors by exercising their options)
$\delta_x(\delta_\beta)$	The conditional probability that the directors exercise the options (sell their shares) on date 6, given the firm's report
$G(m)$	The gains to the directors from insider trading after the release of the accounting reports
$V$	A value function that translates the firm's net earnings, $x - s(m)$ , to its long-run value
$e$	The directors' effort to design the manager's incentive contract
$W^T$	The payoff of a stakeholder: shareholders, $T = S$ ; directors, $T = D$ ; and the manager, $T = M$
$C(q, e)$	The monitoring disutility of the board of directors
$N$	The number of outstanding shares
$P^U(m)$	The uninformed investors' valuation of the firm given the firm's report
$P^D(m)$	The directors' valuation of the firm given the firm's report, $m$
$P(m)$	The date-6 market price per share given the firm's report, $m$
$h(x)$	The beliefs of uninformed traders
$\phi, (1 - \phi)$	The weight of the uninformed (informed) investors' valuation in the price

### 3. The equilibrium

#### 3.1. Benchmark: the shareholders' optimal contract for management

In this section, we solve for the equilibrium contract that would exist if the shareholders designed the manager's incentives directly.

We solve the game backwards. The last to move is the manager, who chooses the input to the auditor after observing earnings,  $x$ .

Lemma 1

Let  $S$  be a non-decreasing schedule.

(a) If the outcome falls in a flat region of the contract,  $s(x + q) = s(x)$ , the manager submits a truthful report to the auditor,  $m_1 = x$ .

(bi) If the outcome falls in an increasing region of the contract,  $s(x + q) > s(x)$ , the manager inflates the report to the auditor by  $q$ ,  $m_1 = x + q$ .

(bii) In the special case in which the contract increases up to  $x + q'$ ,  $q' < q$ , and then flattens out, the manager inflates the report to the auditor by  $q'$ ,  $m_1 = x + q' < x + q$ .

Proof

See [Appendix A](#).

Part (a) indicates that the manager reports the truth when his payment for telling the truth is the same as for any inflated message, because the contract has a flat region. Part (b) states that the manager takes full advantage of the flexibility and biases the input to the auditor by  $q$  when the message falls in a strictly increasing region. Part (c) specifies the situation when the bias is lower than  $q$ . When the outcome falls in an interval with a kink—the contract increases and then levels off, the report at the kink is the maximum biased report, because the benefit from reporting one dollar more is weighed against the expected loss arising from the increasing chance that the truth will be discovered.

[Fig. 1](#) illustrates the different cases. If  $q = q_A$ , the manager inflates the report when  $x = x_1$  and reports the truth when  $x = x_2$ . If  $x = x_1$  and  $q = q_B$ , the manager does not report more than  $x_1 + q'$ .

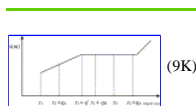


Fig. 1. Illustration of [Lemma 1](#).

[Lemma 1](#) implies that when  $q > 0$ , the distribution function of reports when the manager is given an incentive contract is different from the distribution function of outcomes. In what follows, we denote the density function of reports conditional on effort by  $k(m|a)$ .<sup>12</sup>

Outcomes

	$x_1$	$x_2$	$x_3$	$x_4$	$x_5$
Pr(x)	0.10	0.12	0.28	0.20	0.30
Pr(m)	0.08 (0.1 * 0.8)	0.096 (0.12 * 0.8)	0.244 (0.28 * 0.8 + 0.1 * 0.2)	0.144 (0.2 * 0.6 + 0.12 * 0.2)	0.436 (0.3 + 0.2 * 0.4 + 0.28 * 0.2)

Denote by  $E_z$  the expectation operator with respect to density function  $z$ . The shareholders design a contract by solving the following program:

$$\begin{aligned} \max_{S, a, (m)} & E_f(V(x)) - E_k V(S(m)) \\ \text{s.t.} & E_k(U(S(m))) - a \geq \bar{U}, \end{aligned} \tag{PC}$$

$$a = \arg \max_{a \geq 0} E_k(U(S(m))) - a, \tag{IC}$$

$$\forall x, m_1 = \arg \max_{m \leq x+q} E_k(U(S(m)|x)) - a. \tag{RC}$$

Shareholders maximize the expected long-run value of the firm net of the manager's compensation. The contract must guarantee the manager his reservation utility so that he is willing to participate in the contract (PC) and must be incentive-compatible: it provides the manager with incentives to exert effort,  $a > 0$  (IC), and to report to the auditor optimally, (RC), for each realized outcome.<sup>13</sup>

In the Nash equilibrium of this game, the manager's effort and reporting strategy are the manager's best responses to the contract, and the contract,  $S$ , is the best response to the manager's reporting strategy. That is, we have here an endogeneity problem. To address this problem, we invoke a two-stage approach to finding the equilibrium, similar to the one adopted in [Grossman and Hart \(1983\)](#). Specifically, we find the optimal contract and effort for each reporting strategy in the first stage. This yields a collection of optimal contracts and their associated effort levels and feasible reporting strategies. Next, we sift out those pairs wherein the reporting strategy is not a best response to the contract. After the second stage, we have the Nash equilibria of this setting.

Consider, then, an arbitrary distribution of reports  $k(m|a)$ . Denote by  $\lambda^S$  and  $\mu^S$  the Lagrange multipliers of (PC) and (IC), respectively. The Euler equation yields the following pointwise condition:

$$\forall m, \frac{V'}{U'} = \lambda^S + \mu^S \frac{k_a(m|a)}{k(m|a)}. \tag{4}$$

[Proposition 1](#) characterizes the equilibrium after the second stage of the analysis.

Proposition 1

(a) Shareholders design a strictly increasing schedule that induces the manager to exert a positive level of effort,  $a > 0$ .

(b) The firm does not manage earnings,  $q = 0$  (and  $k(m) = f(x|a)$ ).

(c) The stock price equals the firm's economic value,  $P(m) = V(m - s(m))$ .

Proof

See [Appendix A](#).

[Proposition 1](#) establishes that shareholders prefer an efficient incentive contract with no earnings management. The contract ensures that the manager exerts effort so that the value of the firm is maximized. Earnings management is undesirable, because a managed report hides the true outcome and thus reduces the quality of the report as a signal on the manager's unobservable effort ([Holmstrom, 1979](#)). Since the report is truthful, the rational market relies on it. Consequently, the stock price reflects the firm's true economic value.

### 3.2. Benchmark: the optimal contract designed by directors who are not awarded an equity stake

We next consider the directors' decision when they are not given stock and options.

Proposition 2

If directors are not awarded an equity stake in the firm:

(a) They design a flat-wage contract,  $S = s(\underline{x}) = U^{-1}(\bar{U})$ , and choose the maximum accounting flexibility,  $\hat{q}$ .

(b) The manager chooses zero effort, which generates earnings  $\underline{x}$ , and the firm does not manage earnings,  $m = x = \underline{x}$ .

(c) Denote the manager's effort induced by shareholders by  $a^s$ . The firm's value is lower than when the shareholders design the contract,  $V(\underline{x} - s(\underline{x})) < E(V(x - s(x))|a^s)$ .

(d) The stock price equals the firm's economic value,  $P(m) = V(\underline{x} - s(\underline{x}))$ .

Proof

See [Appendix A](#).

[Proposition 2](#) indicates that when directors are not given an equity stake in the firm they design a flat-wage contract and maximum accounting flexibility. A flat-wage contract, however, renders the choice of maximum flexibility moot. The manager reports the truth, since he gains nothing from misrepresentation. The stock price is efficient, because it reflects the firm's true value. Zero incentives to the manager are value-reducing, however, because the manager's lack of effort reduces the firm's expected value.

We note that this result is based on the stylized assumption of our model. As [Jensen et al. \(2004\)](#), observe, compensation packages for management have traditionally been designed by aggressive, experienced consultants who represent the interests of the CEOs. Hence, if the compensation committee shirks its fiduciary duty, it may well be the case that the manager designs his own package, tailoring a lucrative incentive contract. In this case, the manager is likely to have incentives to exert effort but may earn more than his reservation utility level. Hence, the shareholders' value is lower than the value characterized in [Proposition 1](#). Furthermore, unlike our finding that the firm does not manage earnings, a lucrative incentive contract with maximum accounting flexibility is an invitation to engage in earnings management.

### 3.3. The equilibrium when directors own equity

We solve the game backwards. The directors' last decision concerns their trade on date 6. The directors can either sell  $\beta$  shares or exercise options for an exercise price of  $P(m)$  and increase their holdings by additional  $\gamma$  shares.

Since directors know the truth, if the date-6 price overstates the firm's value, the date-6 decision rule of the directors is to sell their  $\beta$  shares and not exercise options,  $\delta_\beta = 1, \delta_\gamma = 0$ .

If the date-6 price understates the firm's value, the date-6 decision rule of the directors is to exercise the options and sell all holdings,  $\beta + \gamma$  shares, on date 7,  $\delta_\beta = 0, \delta_\gamma = 1$ . The trading gains and strategy are summarized in the following observation:

Observation 1

The directors' strategy on date 6 and the associated trading gains are as follows:

- Sell  $\beta$  shares if they believe that the date-6 stock price overestimates the value of the firm,  $P(m) > P^D(m)$ , to make expected trading gains of  $G(m) = \beta[P(m) - P^D(m)]$ .

- Exercise  $\gamma$  options and sell all holdings on date 7 if they believe that the date-6 stock price underestimates the value of the firm,  $P(m) < P^D(m)$ , to make expected trading gains of  $G(m) = (\gamma + \beta)[P^D(m) - P(m)]$ .

Lemma 2

Let  $S$  be a non-decreasing schedule of the report. Divide the set of reports into two mutually-exclusive subsets: truth-revealing reports and non-truth-revealing reports.

- If the report is truth-revealing, in expectation,<sup>15</sup> the stock price equals the economic value of the firm,  $P(m|P^U(m) = V(x - s(m))) = V(x - s(m))$ .

- If the report is non-truth-revealing, in expectation,

(bi) *the market discounts the firm's report, and*

(bii) *when the firm reports the truth, the price underestimates the firm's value and the directors exercise their options, and when the firm manages earnings, the price overestimates the firm's value and the directors sell their shares.*

Proof

See [Appendix A](#).

[Lemma 2](#) recognizes that some reports reveal the truth. There are two such instances: Either the report is the truth because the manager gains nothing from misrepresenting (see [Lemma 1](#)), or the report is such a low outcome that it can be explained only by the possibility that the auditor discovered an earnings management attempt. When the report reveals the truth, the price reflects the report. If, however, the market suspects that report is managed, the price discounts the report.

To illustrate the discount, suppose that the firm can earn one of five outcomes, 10, 30, 50, 100, 160, with probabilities of 0.05, 0.10, 0.20, 0.25, 0.40, and the firm reports  $m = 100$ . This report is known to be consistent with two scenarios: The truth is that  $x = 50$ , and the auditor did not discover the truth with, say, probability of 0.24, or that the truth is that  $x = 100$ , and the auditor discovered the truth with probability of, say, 0.80. Hence, the valuation of the firm by uninformed investors on date 6 is

$$P^U(m) = \frac{0.80 * 0.25}{0.80 * 0.25 + 0.24 * 0.20} V(100 - s(100)) + \frac{0.24 * 0.20}{0.80 * 0.25 + 0.24 * 0.20} V(50 - s(100)) < V(100 - s(100)).$$

Obviously, the price overestimates the value of a firm with managed earnings,  $V(50 - s(100))$ , and underestimates the value of a firm with a truthful report,  $V(100 - s(100))$ . Correspondingly, the directors' trading strategy is to sell shares with managed reports and exercise options with truthful ones.

Proposition 3

*The directors design a positive level of accounting flexibility that allows for earnings management,  $q > 0$ .*

Proof

See [Appendix A](#).

[Proposition 3](#) establishes that the directors allow for flexibility in the accounting report. The reason lies in the monitoring disutility that render truth-elicitation too costly for the directors. Although accounting flexibility implies that the manager will manage earnings, we do not rush to conclude that not all reports are truth-revealing. [Stein, 1989](#) and [Elitzur, 1995](#) and others have shown that earnings management is not necessarily associated with misrepresentation. Truth revelation is possible in our setting because the directors can signal their private knowledge of the truth to the market. Proceeding with the above example, suppose that  $s(50) = 1$  and  $s(100) = 2$ . If the firm reports 100 and the directors believe it to be the truth, they pay the manager 2. The market learns that earnings of 100 reward the manager with compensation of 2, so it believes the report. If the firm reports 100 and the director believe that this report is managed, they pay the manager 1. When the market learns that earnings of 100 reward the manager with compensation of 1, it understands that the truth is that earnings are 50. We refer to this type of earnings management as neutral and define it as follows.

Definition

Earnings management is neutral if:<sup>16</sup>

(a) the stock price reflects the economic value of the firm,  $P(m) = V(x - s(m))$ , and

(b) the manager's compensation is the same as under truth-telling,  $\forall m, s(m) = s_f(x)$ .

Directors might design neutral earnings management, because non-neutral earnings management destroys value (as shown above). Hence, we next examine whether earnings management is neutral.

Proposition 4

(a) *Profitable insider trading requires information asymmetry between the market and the directors upon the release of the financial reports,  $m$ .*

(b) *Earnings management is not neutral.*

(c) *Directors design an incentive contract that brings about a lower value for shareholders than a contract designed by the shareholders would, but induces a higher value for shareholders than a contract designed by directors without an equity stake.*

[Proposition 4](#) shows that managed earnings do not reveal the truth. Part (a) provides the intuition of parts (b) and (c). It establishes that information asymmetry is needed for successful insider trading. If the market interprets the firm's report in the same way that the directors do, the directors cannot make profitable trades. The market knows enough about the technology and tastes of the manager and the directors to figure out the optimal compensation schedule, the manager's reporting strategy, and the likelihood of given outcomes upon observing the report.

Part (b) establishes that directors do not design non-neutral earnings management. The intuition of this result is that even if every other player in the game, including the directors at the time that they design the manager's incentives, were sure to play a neutral earnings-management game, the directors are better off deviating at date 6 in order to make profitable insider trades.

Part (c) shows that the directors design an incentive contract that is not as efficient as the one

favoured by the shareholders. The loss of efficiency reflects the fact that earnings management renders the reports noisy signals of outcomes, which increases the cost of the contract. The directors then design a contract that induces a lower level of effort from the manager, which thus reduces the firm’s long-run value.

We next complete the characterization of the equilibrium by solving the shareholders’ program. The shareholders design the directors’ incentives by solving the following program:

$$\begin{aligned} \max_{\beta, \gamma, S, a, q} & (1 - \beta)E_{f,x}(V(x - S(m))) - E_k(G(m)) \\ \text{s.t.} & \beta E_k(V(x - S(m))) + E_k(G(m)) - C(q, e) \geq 0, \end{aligned} \tag{DPC}$$

$$\begin{aligned} & \beta E_k(V(x - S(m))) + E(G(m)) - C(q, e) \\ & \geq \beta V(\underline{x} - s(\underline{x})) - C(q, 0), \end{aligned} \tag{DIC}$$

$$\beta \geq 0, \quad \gamma \geq 0, \quad a \geq 0, \quad q \geq 0.$$

The shareholders maximize their expected payoff subject to the contract’s guaranteeing the directors their participation constraint (DPC) and inducing them to design an incentive contract for the management (DIC). The participation constraint states that the directors’ expected payoff is at least zero, our assumed reservation utility. The incentive-compatibility constraint states that the directors prefer to exert effort and design an incentive contract rather than a flat wage that guarantees the manager his reservation utility level but yields a constant stream of the lowest earnings,  $\underline{x}$ . In the latter case there is no asymmetry of information between the directors and the market, so they cannot make trading gains, but the monitoring disutility for a given level of accounting flexibility is minimized.

Proposition 5

- (a) Shareholders award directors an equity stake in the firm,  $\beta > 0$  and  $\gamma > 0$ .
- (b) The equity stake is a decreasing function of the weight of the uninformed traders’ valuation,  $\phi$ , in the price.

Proof

See [Appendix A](#).

The shareholders award the directors an equity stake in the firm, both shares and options. Although the shareholders could prevent earnings management by not awarding the directors incentives, they prefer not to do so. The cost of the incentives is the directors’ gain from insider trading. Their trading gains, however, diminish with the informativeness of the price with respect to the true earnings,  $1 - \phi$ . Hence, the higher  $\phi$  is, the lower the equity stake. Note that [Propositions 4 and 5](#) and [Propositions 4 and 5](#) prove more than just the fact that earnings management cannot be neutral. The mechanism whereby the directors compare the manager’s input to the post-audit report also can be used to elicit the truth. The manager is instructed to report the truth, and he is penalized if the audited report does not corroborate it. Our finding that earnings management cannot be neutral also establishes that directors are not interested in truth-revelation and that the shareholders play along.<sup>17</sup> [Proposition 5](#) raises the question whether the shareholders can have their cake and eat it, too, by awarding the directors an equity stake in the firm and designing a truth-inducing mechanism. A candidate mechanism would require the directors to disclose their intentions to trade. Will it work? At first glance, the answer seems to be yes. If the directors plan to sell, the firm must be managing earnings, and if they plan to buy, the firm must be reporting the truth. A closer examination of such a mechanism, however, indicates that it eliminates the directors’ incentives to trade. No intentions will be reported, and no information transfer from the directors to shareholders on whether the report is managed will take place. Note, however, that although this mechanism does not solve the problem of how to elicit the truth, it does reduce the cost of insider trading to shareholders.

## 4. Example

We next offer an example that illustrates the difference between the contract designed by the directors and the one that is optimal for the shareholders. In the example,  $\pi$  is a scalar; i.e., the detection probability is independent of the size of the bias. The flexibility,  $q$ , is a binary variable that is either zero or  $\bar{x} - \underline{x}$ . Hence, if the manager so wishes, he might succeed in reporting  $m = \bar{x}$  even when the truth is that  $x = \underline{x}$ . The monitoring disutility is zero,  $C(q, e) = 0$ . To preserve [Lemma 1](#)’s insight, we assume that the manager reports the truth when managing earnings does not yield a higher payoff. [Proposition 6](#) characterizes the equilibrium.

Proposition 6

- (a) The directors design a piecewise contract. It first increases up to a point,  $L$ , that awards the manager the maximum payment,  $s_{\max}$ , and then it flattens off.
- (b) The manager’s reporting strategy is a report of  $L$  to the auditor for lower outcomes,  $x < L$ , and the truth for higher outcomes,  $x \geq L$ .
- (c) The kink of the contract—the position of  $L$ —is a random choice. The uninformed investors randomize between believing the report and discounting it.
- (d) In expectation, the stock price might be a biased signal of the firm’s value.

Proof

See [Appendix A](#).

[Proposition 6](#) shows that the directors create information asymmetry between the market and themselves by designing a piecewise contract. [Fig. 2](#) illustrates the manager’s compensation schedule. At first it increases; at point  $\hat{L}$  it flattens out. This schedule implies that the

manager tries to inflate the report,  $m > x$ , when the actual outcome,  $x$ , is lower than  $\hat{L}$ , and the firm reports the truth when the outcome,  $x$ , exceeds  $\hat{L}$ .

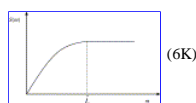


Fig. 2. The compensation schedule.

The question now is where to place the kink,  $\hat{L}$ . The Weierstrasse–Erdmann condition for a kink (see [Hadley and Kemp, 1971](#)) is

$$\pi E(G(x_-)) + (1 - \pi)EG(\hat{L}(e)) = EG(x_+). \quad (5)$$

$G(x_-)$  is the speculative gain for a truthful report when  $m < \hat{L}$ ,  $G(\hat{L})$  is the speculative gain for successfully reporting  $\hat{L}$ , and  $G(x_+)$  is the trading gain when the outcome exceeds  $\hat{L}$  and the firm reports the truth. To the left of  $\hat{L}$  (the l.h.s. of (5)), there is a probability of  $\pi$  that the firm reports the truth, so that the speculative gain is  $G(x_-)$ , and there is probability of  $1 - \pi$  that the manager successfully reports  $\hat{L}$ , which enables the directors to make trading gains of  $G(\hat{L})$ . If, on the other hand,  $x$  approaches  $\hat{L}$  from the right (the r.h.s. of (5)), the manager, who is paid  $s_{\max}$ , will report the truth, which yields gains of  $G(x_+)$ .

The rationality of the market implies that the kink of the contract cannot be designed in pure strategy (in expectation over the noise in the market price), because the market then can undo this decision and correctly estimate when the firm reports the truth and when the firm manages earnings. Hence, the directors choose  $L$  in mixed strategy. This implies that the market's valuation must be a random strategy choice as well.

The game between the directors and the market implies that although, on average, the stock price reflects the expected value of the firm, for each message there is some chance that the market misinterprets the report: the firm reports the truth, and the market discounts it, or the firm manages earnings, and the market believes the report.

The interesting twist of [Proposition 6](#) is that although capped compensation contracts are a quite common phenomenon, they present a puzzle, because the principal-agent paradigm predicts a monotone-increasing sharing rule ([Holmstrom, 1979](#) and [Harris and Raviv, 1979](#); and others). [Proposition 6](#) establishes that such a contract is the equilibrium outcome of the principal-agent relationship between the firm's manager and its directors, when the latter benefit from insider-trading gains.

## 5. Conclusion

In the US, outside directors receive incentive packages that include shares and options of the company they serve, and directors are allowed to trade in those shares. In this study, we have shown that such packages contribute to motivating directors to tailor incentives for effort-averse managers. At the same time, they also induce directors to tacitly collude with managers in pernicious earnings management. The market therefore gets biased information about a company's true earnings and thus discounts the reported earnings. Furthermore, the firm's value is decreased by the unfavorable effect of earnings management on the cost of the manager's contract, and hence on the manager's level of effort.

Our study has substantial policy implications. It supports the OECD's 2004 recommendation that insider trading be prohibited. In addition, our example prompts consideration of another, intermediate remedy: publicization of managers' compensation schedules, so that the market will be able to identify the existence of pernicious earnings management. Since managers' actual compensation is already being disclosed, regulators need not be too reluctant to require the disclosure of the function relating performance measures to compensation.

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## Appendix A.

Proof of Lemma 1

*Part (a):* The manager chooses  $m$  by maximizing  $\pi(m-x)U(S(x)) + (1-\pi(m-x))U(S(m))$ . The first-order condition with respect to  $m$  is

$$\frac{\partial \pi}{\partial m} [U(S(x)) - U(S(m))] + [1 - \pi(m-x)]U' \frac{\partial S}{\partial m} = 0. \quad (A.1)$$

In a flat region,  $S(x) = S(m)$ , and  $\frac{\partial S}{\partial m} = 0$ . The manager cannot gain from misrepresentation, so he may as well communicate the truth,  $m = x$ .<sup>18</sup>

*Part (bi):* The proof that the manager inflates the report is immediate from the fact that when  $S$  is increasing in the feasible reporting interval, for a given  $m$ ,  $q + x \geq m > x$ ,  $\pi(m-x)U(S(x)) + [1 - \pi(m-x)]U(S(m)) > U(S(x))$ .

*Part (bii):* To prove part (bii), compare the manager's payoff when the bias is  $q'$  with his payoff when the bias is  $q' + \varepsilon$ ,  $\varepsilon > 0$

$$\begin{aligned} \text{If } b = q', \pi(q')U(s(x)) + [1 - \pi(q')]U(s(x+q')) \\ = \pi(q')[U(s(x)) - U(s(x+q'))] + U(s(x+q')). \end{aligned} \quad (A.2)$$

$$\begin{aligned} \text{If } b = q' + \varepsilon, \pi(q' + \varepsilon)U(s(x)) + [1 - \pi(q' + \varepsilon)]U(s(x+q' + \varepsilon)) \\ = \pi(q' + \varepsilon)[U(s(x)) - U(s(x+q' + \varepsilon))] + U(s(x+q' + \varepsilon)). \end{aligned} \quad (A.3)$$

Since the contract is flat to the right of the kink,  $s(x+q') = s(x+q'+\varepsilon)$ . Upon subtracting (A.2) from (A.3), the difference in payoff equals  $[\pi(q') - \pi(q'+\varepsilon)] [U(s(x)) - U(s(x+q'))] > 0$ . The positive inequality obtains because  $\pi(q') < \pi(q'+\varepsilon)$  and  $s(x) < s(x+q')$ .  $\square$

Proof of Proposition 1

Our assumption that positive effort increases the shareholders' residual share implies that the contract is designed to induce a positive level of effort.<sup>19</sup> Hence, Eq. (4) characterizes the contract.

If the shareholders are willing to let the manager have flexibility,  $q > 0$ , then the accounting report is a noisy signal of the outcome. By the informativeness criterion of [Holmstrom \(1979\)](#), such a contract is dominated by a contract with  $q = 0$ . When  $q = 0$ , the firm does not manage earnings, and  $k(m|a)$  coincides with  $f(x|a)$ . By the MLRC, the contract then is a strictly increasing schedule.

Finally, since the flexibility is zero, it is rational to believe the report, and the stock price coincides with the corresponding true long-run value of the firm.  $\square$

Proof of Proposition 2

When directors receive a flat-cash retainer, i.e.,  $\beta = \gamma = 0$ , their objective is to minimize the monitoring disutility. They can do this by designing a flat-wage contract that induces zero effort and accords the maximum flexibility,  $\hat{q}$ . By [Lemma 1](#), a flat-wage contract induces the manager to report the truth. Hence, the firm does not manage earnings. The rational market believes the reports, and the stock price reflects the firm's true value. Zero effort produces the minimal earnings,  $\underline{x}$ , which thus yield a lower value for the firm.  $\square$

Proof of Lemma 2

*Part (a):* Some reports, such as very low ones, are truth-revealing in that the only explanation for such a report is that an attempt to misrepresent failed (because the market is aware that the manager is given an incentive contract that induces him to inflate earnings). When reports are not truth-revealing, the market's posterior belief function is the following:

$$h^p(x|m, a) = \frac{\pi(b(m))\mathbf{1}f(x|a) + [1 - \pi(m-x)]k(x, m|a)}{\pi(b(m))f(m|a) + \int [1 - \pi(m-x)]k(x, m|a) dx}, \quad (A.4)$$

where  $\mathbf{1}$  is an indicator function, taking the value of 1 when  $m = x$  and zero otherwise. Since the support of  $k$  contains only outcomes that are lower than the report,  $m$ , the market discounts the report, putting positive weight on the possibility that the true outcome could be lower than the report.

*Part (b):* The valuation of the uninformed traders is given in (A.4). The valuation by the directors is as follows: if the firm reports the truth, the directors believe it,  $P^D = V(m - s(m))$ . If the firm manages earnings, then the truth is that  $x \in \text{supp}[k(m, x)] < m$ .<sup>20</sup> Hence, the directors' posterior beliefs are

$$f^p(x|m, a) = \frac{[1 - \pi(m-x)]k(x, m|a)}{\int [1 - \pi(m-x)]k(x, m|a) dx}. \quad (A.5)$$

That is, the directors put no weight on the event that the report is truthful and thus discount the firm more than the market does.

In the former case, the stock price understates the true value of the firm, and in the latter case the price overstates the value. The directors therefore sell their shares (exercise their options) when the firm reports the truth (manages earnings).  $\square$

Proof of Proposition 3

Denote the Lagrangian of the directors' program by  $L$ . By the envelope theorem, the first-order condition with respect to  $q$  is  $\frac{\partial L}{\partial q} = -\frac{\partial C(q, x)}{\partial q} > 0$ . That is, the directors prefer to maximize  $q$ .  $\square$

Proof of Proposition 4

*Part (a):* The proof is immediate from the discussion in the text.

*Part (b):* Suppose, by contradiction, that the shareholders design the directors' incentives to induce a truth-revealing equilibrium, the directors design a contract with truth-revealing reports, and the market believes the reports. This contract maximizes the expected long-run value of the firm. The proof that the directors do not induce neutral earnings management is based on showing that the directors have incentives to deviate on date 6 and not reveal the truth in order to make a speculative gain. If the manager attempts to manage earnings, and the contract is not adapted, the directors have a loss of long-term value of  $\beta[V(s(m-b)) - V(s(m))]$ , because the manager is overpaid. By Taylor expansion,  $s(m-b) - s(m) \approx \frac{\partial s}{\partial m} b$ . Hence, by the linearity of  $V$ , the loss is approximately  $\beta V(\frac{\partial s}{\partial m} b)$ .

Because the market trusts the inflated report,  $P^U(m) = V(m - s(m))$  and  $\phi = 1$ , the directors can make trading gains by selling  $\beta$  shares (and not exercise the options). Their expected gain is:  $\beta[P(m) - P^D] = \beta[P^U(m) - P^D(m)] = \beta[V(m - s(m)) - V(m - b - s(m))] = \beta V(b)$ . The gain exceeds the since  $1 > \frac{\partial s}{\partial m}$  for some reports (the formal proof that  $1 > \frac{\partial s}{\partial m}$  is given in Rogerson (1985)), the directors are better off deviating from neutral earnings management.

*Part (c):* We first show that the insider-trading motivation has no direct effect on the shape of the contract,  $S$ . We prove it for the case in which the directors alone believe the firm's report. The proof for the case in which the directors alone ignore the firm's report entirely is the same.

When the directors believe the report,  $P^D = V(m - s(m))$ . The valuation of the uninformed traders is  $P^U = \int V(x - S(m)) h^p(x|a, m) dx$ . Taking the derivative of the difference, we obtain

$$\begin{aligned} \frac{\partial(P^D - P^U)}{\partial S} &= -V' + \int V' h^p(x|a) dx = -V' + V' \int h^p(x|a, m) dx \\ &= -V' + V' = 0. \end{aligned} \tag{A.6}$$

This result implies that the contract is determined by the principal-agent relationship part of the directors' objective function. Specifically, denoting the Lagrange multipliers of the directors' program with superscript, D,

$$\beta \left[ - \int V' k(m|a) dm + \lambda^D \int U' k(m|a) dm + \mu^D \int U' k_a(m|a) dm \right] = 0.$$

Upon rearranging, the Euler equation for the optimal contract is

$$\int \left[ -V'(x - S(x)) + \lambda^D U' + \mu^D U' \frac{k_a(m|a)}{k(m|a)} \right] k(m|a) dm = 0. \tag{A.7}$$

The proof is complete, because when the shareholders design a contract, they induce zero flexibility, and as they own 100% of the firm's value, their program yields

$$- \int \left[ V'(x - S(x)) + \lambda^S U' + \mu^S U' \frac{f_a(x|a)}{f(x|a)} \right] f(x|a) dx = 0. \tag{A.8}$$

(A.7) yields a pointwise condition. Since the manager bears risk, by (IC) and our assumption that the expected value of the firm is higher when  $a > 0$ , the firm's value is higher than when the directors have no stake in the firm.

As we cannot use the MLRC to show that (A.7) implies a strictly increasing schedule, we note that if it were optimal to induce zero effort,  $a = 0$ , the firm's value would be minimized (the principal-agent portion of the directors' program), and the trading gains would be zero, because the rational market would know the truth (the speculative portion of the directors' program). The monitoring disutility is minimized, but shareholders award  $\beta$  shares and  $\gamma$  options to guarantee that the directors are better off inducing effort.  $\square$

Proof of Proposition 5

*Part (a):* Our assumption on the negative effect of a lack of incentives on the manager's effort and Proposition 2 imply that the shareholders provide the directors with an equity stake. The difference in payoff is  $(1 - \beta)E(V(x - S(m))) - G(m) - V(x - s(x))$ . That is, either  $\beta > 0$  or  $\gamma > 0$ , or both.

We now prove that the directors get both shares and options. Denote the Lagrange multiplier of (DPC) and (DIC) by  $\lambda^D$  and  $\mu^D$ , respectively. The Kuhn-Tucker conditions of the shareholders' program for  $\beta$  and  $\gamma$  are

$$[-1 + \lambda^D + \mu^D] \xi_\beta \leq 0 \quad \text{and} \quad \beta[-1 + \lambda^D + \mu^D] \xi_\beta = 0, \tag{A.9}$$

$$[-1 + \lambda^D + \mu^D] \xi_\gamma \leq 0 \quad \text{and} \quad \gamma[-1 + \lambda^D + \mu^D] \xi_\gamma = 0, \tag{A.10}$$

where

$$\xi_\beta = E(V(x - S(m))) + \frac{\partial EG}{\partial \beta} > 0; \quad \xi_\gamma = \frac{\partial EG}{\partial \gamma} > 0.$$

At least one inequality in (A.9) and (A.10) must be binding,  $-1 + \lambda^D + \mu^D = 0$ . Hence, the other inequality holds as a strict equality as well.

*Part (b):* We prove for  $\beta$ ; the proof for  $\gamma$  is similar. Take a total derivative of (DPC) with respect to  $\beta$ .

$$\frac{\partial}{\partial \beta} [\beta E(V(x - S(m))) + E(G(m))] d\beta + \frac{\partial}{\partial \phi} [E(G(m))] d\phi = 0. \quad (A.11)$$

The argument in the first set of brackets is positive because

$$\begin{aligned} & \frac{\partial}{\partial \beta} [\beta E(V(x - S(m))) + E_k(G(m))] = E(V(x - S(m))) \\ & + \beta \int_{m, P(m) > P^D} [P(m) - P^D] k(m|x, a) dm > 0. \end{aligned}$$

Since  $\frac{\partial EG}{\partial \phi} = \int_{m, P(m) > P^D} [P(m) - P^D] k(m|x, a) dm > 0$ , the last argument in (A.11) is positive. Hence,  $d\phi/d\beta < 0$ .  $\square$

Proof of Proposition 6

*Part (a):* We start with a general compensation function. Since the manager is not paid more than the maximum level,  $s_{\max}$ , we partition the interval  $[x, \bar{x}]$  of possible messages into two types of connected subsets: sets of messages that reward the manager less than the maximum,  $s_{\max}$ ,  $m \in \hat{m}_i = \{m | m \in (x_i, x_{i+1}) \text{ and } s(m) < s_{\max}\}$ ,  $i = 1, 2, 3, \dots$  and the set of messages that reward the manager with the maximum,  $s_{\max}$ ,  $m \in \hat{m}_j^c = \{m | m \in [x_j, x_{j+1}] \text{ and } s(m) = s_{\max}\}$ ,  $j = 1, 2, 3, \dots$

The thrust of the proof is that there is only one subset of each type, and because the compensation schedule is a strictly increasing, strictly continuous function on  $\hat{m}_i$ , it must be the case that  $\hat{m}_1$  lies to the left of  $\hat{m}_1^c$ .

**Characterization of the contract on  $\hat{m}_i$**

*Preliminary:*

Since the trading-gains motivation does not affect the design of the contract, we ignore it. [See the proof of Proposition 4.] Denote the equilibrium contract by  $*$ . Define a perturbation of  $S^*$  on an arbitrary subset,  $\hat{m}_i$ , as follows:

$$S = \left\{ \begin{array}{l} S = S^* \\ S_i = S_i^* + \theta t(\cdot) \text{ where } t(x_i) = t(x_{i+1}) = 0 \end{array} \quad \forall m \notin \hat{m}_i \right\},$$

Given our assumptions that the audit technology is independent of the bias and that the accounting flexibility is maximized, the optimal contract is the solution of the following Lagrangian:

$$\begin{aligned} L = & (1 - \beta)\pi \int_{x_i}^{x_{i+1}} V(x - S^*(x) - \theta t(x)) f(x|a, e) dx \\ & + \lambda \pi \int_{x_i}^{x_{i+1}} U(S^*(x) + \theta t(x)) f(x|a, e) dx \\ & + \mu \pi \int_{x_i}^{x_{i+1}} U(S^*(x) + \theta t(x)) f_a(x|a, e) dx. \end{aligned}$$

Taking the derivative with respect to  $t$ , evaluating it at  $\theta = 0$ , and setting it to zero yield the following pointwise equilibrium conditions:  $\forall x \in \hat{m}_i$ ,

$$\frac{(1 - \beta)V'}{U'} = \lambda^D + \mu^D \frac{f_a}{f}. \quad (A.12)$$

By the MLRC, the contract is a strictly increasing function on this subset.

Since  $S(\cdot)$  is a continuous function over a closed interval, all sets of maximum payments must be to the right of the sets with lower payments, or else the compensation were a decreasing function, which contradicts our result that the compensation is a non-decreasing function. All subsets of messages that yield payments lower than the maximum belong to a single subset.  $S(m)$  then is a piecewise function: it increases up to a cap,  $\hat{L}$ , and then it flattens.

To prove the existence of the corner requires establishing that the maximum payment is obtained at an outcome that is lower than the maximum,  $\bar{x}$ . Denote by  $G(x)$  and  $G(L)$  the trading gains when the directors believe and do not believe the report, respectively. To prove that  $\hat{L} < \bar{x}$ , we invoke the Erdmann–Wierstrasse continuity condition. The math indicates that all the expressions from the principal-agent component of the directors' program cancel each other out.<sup>22</sup> Hence, at the kink, the following condition must be met:

$$\pi EG(x|x = \hat{L}_-) + (1 - \pi)EG(L|L = \hat{L}) = EG(x|x = \hat{L}_+). \quad (A.13)$$

Rearranging, at  $\hat{L}$ ,  $EG(x) = EG(L)$ . If the maximum payment were paid for  $m = \bar{x}$ , the market would share the same beliefs as the directors, and because none believes the report,  $EG(\bar{x}) = 0$ . Shifting the target report to the left infinitesimally has a negligible effect on the manager's effort, but the directors can make trading gains and increase their welfare.

The proof that the directors play a mixed strategy follows from Proposition 4, part (a). The market would be able to “undo” their decision if they were to play a pure strategy, which would erase their expected trading gains. Hence, the choice of the kink is random.

*Part (b):* The directors play a mixed strategy because they are indifferent between the different locations of the target report. The market makes the directors indifferent to the exact location of the target report by randomizing between believing and discounting the report.  $\square$

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<sup>1</sup> This change is consistent with earlier findings that equity compensation is preferred to cash payment as a mechanism to align the directors' interests with shareholders' interests (e.g., Bryan et al., 2000 and Fich and Shivdasani, 2005).

<sup>2</sup> To illustrate the argument, if the firm reports high earnings but the directors approve a low bonus, the market correctly deducts that the true earnings are disappointing and the report is inflated. This contrasts with the case in which the firm reports the same high earnings but the manager receives a large bonus.

<sup>3</sup> For a valuable discussion of the unenforceability of contracts based on unverifiable information (see, e.g., [Hermalin and Katz, 1991](#) and [Evans and Sridhar, 1996](#)). This assumption is common in the principal-agent models of earnings management ([Evans and Sridhar, 1996](#)). A weaker assumption that the directors learn the truth only when the auditors' findings differ from the manager's draft does not affect our results qualitatively.

<sup>4</sup> We assume that the manager's compensation comprises a bonus scheme only. When the directors represent the shareholders' interests faithfully, a bonus scheme is superior to a grant of equity. The directors can filter the truth from the accounting report and pay the manager for the true performance,  $x$ . The stock price, however, is a noisy signal of the true earnings,  $x$ , because the price is set in a Noisy Rational Expectations Equilibrium (see Eq. (1) below). Studies that have shown that both earnings and stock price are valuable for contracting with the manager assume that the price contains marginal information on effort that is missing from the earnings signal (e.g., [Bushman and Indjejkian, 1993](#) and [Kim and Suh, 1993](#)). In our study, the stock price has a lower quality than earnings as a performance metric on which to base the manager's compensation, which increases the cost of incentives and reduces the shareholders' equity value.

<sup>5</sup> In the first part of the paper we equate truth-telling with  $q = 0$ . If  $q$  is transparent, however, a managed report could be truth-revealing, because the reader of the report can undo the bias. Studies by [Hirst and Hopkins, 1998](#), [Maines and McDaniel, 2000](#), [Hirst et al., 2004](#) and [Hunton et al., 2006](#), establish the positive association between truth revelation and the transparency of the presentation of the information in the financial reports. We consider the possibility of truth-revealing earnings management in the second part of this study.

<sup>6</sup> In an interview, Robert Monk, a known authority on governance, states: "Independent directors are an oxymoron because they are a group of self-selecting people. Having the status of a director is important to people. They are loyal to the rules of the club rather than to shareholders. If an independent director is bumptious or truly independent then they won't get work." ([Crainer, 2004](#)).

<sup>7</sup> These two functions are the only ones that are relevant to our analysis. One interpretation of our model is that we describe the representative outside director, since new regulations by NYSE and Nasdaq require the compensation and audit committees to be composed solely of outside directors. In this regard, our study is a contribution to governance literature, which emphasizes the role of outside directors as monitors. We show that they have incentives to compromise monitoring through implicit collusion with the firm's officers in earnings management.

<sup>8</sup> Note that  $C$  is independent of  $\pi$ , the parameter of the audit technology. If  $\pi = 1$ , i.e., the firm always reports the truth, then  $C$  indeed would be lower, because the equilibrium obtains as if accounting flexibility were non-existent, i.e.,  $q = 0$ . But  $\pi < 1$ . Hence, any richness added to the model by linking  $C$  to  $\pi$  is already obtained by linking  $C$  to  $q$ .

<sup>9</sup> "Duty of care means that a director must exercise due diligence in making decisions" ([Monk and Minow, 2004, p. 200](#)).

<sup>10</sup> Our assumption on the manager's disutility over effort entails no loss of generality, as our results generalize to any strictly convex function of effort, which is the standard assumption in the principal-agent literature ([Christensen and Feltham, 2005](#)).

<sup>11</sup> The NREE literature solves the equilibrium in closed form, assuming specific technology and preferences. Our characterization is more general. Along with this literature, we assume that the price is a linear function of the signals (see, e.g., [Verrecchia, 2001](#)).

<sup>12</sup> To illustrate, consider an example with five outcomes,  $x_1 < x_2 < x_3 < x_4 < x_5$ ;  $q = 2$ , and  $\pi(1) = 0.6$ ,  $\pi(2) = 0.8$ . The table that follows in the main text characterizes the probabilities of outcomes and reports. Suppose that the manager attempts to report  $x_3, x_4, x_5$ , and  $x_5$ , when the outcomes are  $x_1, x_2, x_3$  and  $x_4$ , respectively. The probabilities of the reports are calculated from Bayes' rule.  $\Pr(m=x_i) = \sum_j \Pr(m=x_i | x=x_j) \Pr(x_j)$ . The report of  $x_3$ , for example, has a probability of 0.244 because either the true outcome is  $x_3$  and the auditor discovered the truth (with probability of  $0.28 * 0.8$ ) or the manager successfully misrepresented  $x_1$  (with probability of  $0.10 * 0.2$ ).

<sup>13</sup> By the linearity of  $V$ , we can separate the owners' objective function into utility over outcome and disutility over payment to the manager.

<sup>14</sup> (RC) affects the pointwise equilibrium conditions. They depend on  $k$ , which is determined by the manager's reporting strategy, and is different from the density function of the economic earnings,  $f$ .

<sup>15</sup> We focus on the expected price because the unpredictable noise in the market price might reverse the ordering of the market's and directors' valuations. For example, high demand by noise traders may cause the market price to exceed the firm's true value. By describing the equilibrium in terms of expectations, we rely on the assumption that the noise,  $\varepsilon$ , is white noise,  $E(\varepsilon) = 0$ .

<sup>16</sup> Alternatively, earnings management can be valuable, because it signals value ([Ronen and Sadan, 1981](#)), or pernicious, because it distorts the truth ([Schipper, 1989](#)).

<sup>17</sup> This insight could be puzzling in light of the revelation principle. The underlying assumption of this principle is that there is demand for the truth, because if the receiver does not want to learn the truth, he can ignore it. In three-party games, however, this result might not hold (see, e.g., [Fudenberg and Tirole, 1991](#), [Ronen and Yaari, 2002a](#) and [Ronen and Yaari, 2002b](#)) because of the impact of the additional player on the receiver's payoff.

<sup>18</sup> The mode of proof that a player reports the truth when he cannot gain from misrepresentation is quite prevalent in the mechanism design literature.

<sup>19</sup> For a rigorous proof of this statement, consult [Dye \(1988\)](#). When effort approximates zero, the increase in output outweighs the increase in the cost of paying the manager for exerting effort.

<sup>20</sup> Support of a distribution function,  $\text{supp}$ , is the range of all values in its domain for which the density is not zero.

<sup>21</sup>  $V$  is taken out of the integral because  $V$  is a scalar by our assumption on the linearity of  $V$ , and, by definition,  $\int h^p(x|a, m) dx = 1$ .

<sup>22</sup> To illustrate, consider (PC). Under the piecewise contract it is as follows: To the left:  $\pi U(S(L)) + (1 - \pi)U(S(L))$ . To the right:  $U(S(L))$ .

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