On Self-Enforcing Clawback Provisions in Executive Compensation

Ying-Ju Chen* Mingcherng Deng†

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Abstract

In this paper, we argue that clawback provisions may alleviate a manager's ex ante incentive to misreport private information, but increase her ex post incentive to conduct earnings management. Due to these two intertwined economic forces, the reported revenues are distorted by the opposite direction that an accounting signal indicates. Such revenue distortions may be exacerbated when an accounting signal becomes more informative or conservative. Nonetheless, firms may still benefit from implementing clawback provisions, although the manager can *costlessly* manipulate accounting signals ex post. This result may explain why some companies voluntarily develop policies to incorporate clawback provisions, in spite of the detrimental effect of earnings management.

Keywords: clawback provisions, dynamic incentives, information asymmetry

*University of California, 4121 Etcheverry Hall, Berkeley, CA 94720; e-mail: chen@ieor.berkeley.edu.

†Corresponding author; University of Minnesota; 321 19th Ave S 3-131, Minneapolis, MN 55455; e-mail: dengx069@umn.edu.

1 Introduction

There has been a widespread public debate over the effectiveness of corporate governance practices in firms. One of the main concerns is that managers take advantage of accounting discretion to misreport financial information and to extract excess compensation (rents) from shareholders. Due to these concerns, Section 304 of the Sarbanes-Oxley Act of 2002 (hereafter SOX) called for clawback provisions, which require public company managers to disgorge incentive-based compensation in the event of material noncompliance with financial reporting requirements.[1]

In response to Section 304 of the SOX, some companies have voluntarily developed policies to incorporate clawback provisions in compensation contracts. For example, in November 2008, UBS introduced a "bonus malus" system in which at least two-thirds of senior managers' bonuses in good years are "banked" to offset possible losses in subsequent bad years.[2] Morgan Stanley introduced a clawback feature into its bonuses for 7,000 executives and employees, in which the company could recover a portion of bonuses for employees causing "a restatement of results, a significant financial loss or other reputational harm to the firm."[3] Credit Suisse began paying bonuses in illiquid risky securities that lose value in bad years and could be forfeited if employees quit their job or were fired.[4] Equilar, an executive-compensation advisory firm, reported that nearly three-quarters of Fortune 100 companies had such rules in 2009, up from about 18% in 2006 (Lublin (2010)). In 2010, of the 100 largest public companies, 71 firms operate a clawback policy through which they can reclaim senior management's compensation under certain circumstances (Thomas (2010)).

The benefits of clawback provisions seem obvious. Indeed, Gigler and Hemmer (1998) argue that audited financial reports may serve a disciplining or confirmation role in providing credibility to an agent's more informative and more timely voluntary disclosures. In the adverse selection literature, Cremer and McLean (1988) and Riordan and Sappington (1988) show that when a principal can access an ex post accounting signal that is correlated to an agent's private information,

[1] More recently, the U.S. Securities and Exchange Commission (SEC) changed Regulation S-K Item 402 (b) to require that compensation committees disclose their policies regarding bonus recovery in the event of errant financial statements. We also note that after the financial crisis of 2008, the Emergency Economic Stabilization Act of 2008 also included a standard clawback provision for all financial institutions that sell troubled assets to the Secretary of the Treasury. Moreover, the Dodd-Frank Wall Street Reform and Consumer Protection Act signed on July 21, 2010 further expands the reach of mandatory recoupment policies. Under the Act, the SEC will direct the national securities exchanges to amend their listing standard to require that listed company disclose and adopt a compensation clawback policy. But full details of the clawback requirements are still ambiguous and no deadline for the implementation is given yet.

[2] "UBS to change to the way it pays senior managers," Associated Press Newswires (2008).

[3] Farrell and Guerra, "Top Executives at Morgan Stanley and Merrill forgo their bonuses," Financial Times (2008).

[4] Harrington, "Credit Suisse to loan cash bonuses," Sunday Telegraph (2009).

then the first best allocation can be achieved and inefficiencies are completely eliminated. Baron and Besanko (1984) shows that if a principal can observe an audited financial report, he can implement the first-best solution if ex post penalties are not bounded (the maximal punishment principle). Thus, regulators maintain that clawback provisions may mitigate the incentive of misreporting financial statements, thereby resulting in higher shareholders' value (Lucchetti (2010)).

What are potential costs of clawback provisions? The results of these studies are based on the assumption that accounting signals are ex post verifiable and cannot be manipulated by an agent. Earnings management, however, is pervasive. Intuitively, if the clawback provisions are implemented, managers have strong incentives to exploit discretion and manipulate accounting signals in order to circumvent clawback provisions. This possibility seems to be ignored by policy makers and researchers, because the extant literature has paid little attention to the detrimental effect of earnings management on clawback provisions. How would earnings management interacts with clawback provisions? Can a principal still implement the first-best solution when accounting signals are not verifiable? If not, how should a principal resolve the trade-off between clawback provisions and earnings management? If accounting signals can be easily manipulated, would firms still benefit from implementing clawback provisions and under what circumstances?

To answer these questions, we build a dynamic adverse selection model wherein a board of directors (principal) contracts with a manager (agent) to generate sales revenue for two periods. The manager privately observes uncollectible revenue and can exert costly and unobservable effort to enhance the revenue. Thus, the board faces an agency problem intertwined with adverse selection and moral hazard, which consequently allows the manager to earn additional payments as a form of information rent. In between the two periods, the board observes a soft accounting signal that is correlated to the uncollectible revenue. On one hand, this accounting signal could be used to implement possible clawback provisions, thereby mitigating the information asymmetry problem vis-a-vis the manager. If the ex post accounting signal indicates strong evidence of the manager's ex ante misreporting, the board may clawback the manager's first-period compensation and/or adjust the second-period compensation. On the other hand, the manager, at a cost, can take advantage of accounting discretion to manipulate the accounting signal in order to avoid possible punishment. Conceivably, when it is very costly for the manager to manipulate the accounting signal, the board can effectively utilize the accounting signal to implement the first-best revenue allocation. But, if the verifiability of the accounting signal is low and the manager can manipulate the signal at a small cost, then the board cannot always clawback all losses when the manager's report deviates from the actual state realization.

Beyond the standard trade-off between allocative efficiency and rent extraction, our analysis suggests that these two intertwined economic factors may lead to unintended consequences. One may conjecture that the board shall request the manager to deliver higher (lower) revenue when the accounting signal is good (bad); this conventional wisdom may not hold when the accounting signal can be manipulated. Specifically, when the manager claims to be the inefficient one but the accounting signal turns out to be good, the revenue allocation is distorted downwards. This is because in this case the board knows the manager is more likely to have misreported; thus, downward distorted revenue allocation turns out to be a severe penalty for the efficient manager than for the inefficient one. Consequently, it constitutes a very effective instrument to facilitate truth-telling. Because the accounting system is noisy, the inefficient manager may be negatively affected by the downward distortion even though reporting truthfully. If the manager's report as the inefficient one and the accounting signal is bad, the board stipulates revenue allocation upwards so as to compensate the loss due to a type I error.

Contrary to the common belief, we find that the revenue distortions are exacerbated when the accounting system is *more* accurate. As the accounting system is more accurate (informative), the conflict between the manager's report and the accounting signal is more likely due to misreporting. Hence, the board further distorts the revenue allocations, for the benefit of reducing information rent is larger the cost of allocative inefficiency. If the accounting system becomes completely uninformative, then the revenue allocations approach the classical second-best solution. This implies that the verifiability of accounting system is a *substitute* for the accounting informativeness. High accounting informativeness alleviates the ex ante incentive to misreport private information, whereas low accounting verifiability exacerbates the ex post incentive to conduct earnings manipulation. When the accounting system is accurate enough, the board can still implement the first-best allocation even though the accounting signal is manipulable ex post.

In contrast, the effect of accounting conservatism on the information rent is *ambiguous*. As the accounting system becomes more conservative, the accounting signal is more likely to report a bad signal, making a bad signal more uninformative and a good signal more informative. This consequently provokes the efficient manager's incentive to misreport, because she is more likely to receive a bad accounting signal under conservative accounting. On the other hand, the board may benefit from accounting conservatism, for it alleviates the manager's incentive to manipulate the signal ex post. The net effect of accounting conservatism is determined by the tradeoff between these two economic forces. If the accounting verifiability is high, the benefit of alleviating ex post manipulation is smaller; consequently, accounting conservatism may be detrimental. If the uncertainty about the manager's type is higher, accounting conservatism may give rise to a higher cost of information asymmetry.

This model may add insights into the widespread debate over the introduction of the clawback provisions. It is argued among practitioners that the clawback provisions can be utilized to alleviate the manager's ex ante incentive to misreport private information, but may exacerbate the incentive to manipulate the accounting signal ex post. We demonstrate that firms may still benefit from implementing clawback provisions even though the manager can *costlessly* manipulate accounting signals ex post. This result may explain why some companies voluntarily incorporated clawback provisions in compensation contracts, even though they are fully aware of the potential manipulation problem. The board benefits from these signal-contingent revenue allocations for two reasons. First, this contingency may mitigate the allocative inefficiency that results from the adverse selection. Second, even though the board has to balance the payoff for each type of manager across the accounting signals, different types of managers may still obtain different expected payoffs in the second period. This discrepancy arises because they incur heterogeneous private costs under the same revenue allocations and perceive different probabilities of the signal realizations. Thus, utilizing signal-contingent revenue allocations (clawback provisions) allows the board to better differentiate different types of managers despite the costless ex post manipulation.

Moreover, our analysis suggests several interesting predictions between the properties of the accounting system and the managerial compensation (clawback) contracts. For example, the revenue allocations are distorted by the *opposite* direction of the accounting signal. When the accounting signal is more informative, the board actually exacerbates the revenue distortions in the second period. Such revenue distortions are mitigated when the verifiability of the accounting signal is higher. In contrast, the revenue allocations are both lower when the accounting system becomes more conservative. These results provide empirical predictions for the association among the time-series variation of reported revenue and the properties of accounting system (i.e., informativeness, conservatism or verifiability) in executive compensation. These predictions, to our knowledge, have not been explored in the academic literature.

The article is organized as follows. Section 2 discusses how this paper contributes to the related literature. Section 3 describes the formal model, and Section 4 provides the equilibrium analysis. We discuss empirical implications in Section 5, present conclusions and directions for future work in Section 6, and relegate all the proofs in appendix.

2 Related Literature

As the accounting signal in our context provides valuable information to fight against an adverse selection problem, our paper is related to the vast literature on the full surplus extraction. The two seminal papers (Cremer and McLean (1985, 1988)) formally identify necessary and sufficient conditions for full surplus extraction for all instances of agents' utilities. McAfee and Reny (1992) extend the discussion to incorporate continuous uni-dimensional type spaces. Mezzetti (2007) considers an interdependent-value setting (i.e., agents' true valuations depend on other agents' private information). Due to the interdependence of valuations, the payoffs are correlated. Hence, a two-stage mechanism that requires agents to report their types as well as their payoffs can be adopted to achieve the full surplus extraction. Obara (2008) allows the agents to exert effort that affects the probability distribution over types. He shows that conditions similar to Cremer and McLean (1988) continue to be valid in the environment with moral hazard followed by adverse selection. Johnson et al. (1990) investigate whether it can be achieved among a group of agents whose actions generate externality for others.

All papers in this literature assume that ex post signals are verifiable and cannot be manipulated. We contribute to this literature by relaxing this critical assumption. We show that the first-best allocation can be implemented only if the accounting signal conveys enough information about the firm's type and/or the accounting verifiability is sufficiently large. Moreover, to analyze the effect of clawback provisions, we study a multi-period adverse selection model in which a principal can make the first-period compensation policies and/or the second-period revenue allocation contingent on the ex post realization of the accounting signal. Our analysis consequently reveals some interesting results that the revenue allocations in the second period are distorted by the opposite direction that an accounting signal indicates.

It is worth mentioning that researchers recently have examined the circumstances in which full surplus extraction is not feasible in the setting a la Cremer and McLean (1985, 1988). Gary-Bobo and Spiegel (2006) and Kessler et al. (2005) show that in the presence of limited liability constraint, the first-best allocation can be implemented if the state of nature conveys enough information about the firm's type and/or the maximal loss that the firm can sustain is sufficiently large. Our paper differs from these paper in two aspects. First, we abstract away the effect of limited liability, but rather in our context the implementation of the first-best allocation is hindered by the accounting verifiability and managerial manipulation. In our model, the manager earns rents through two channels: ex ante misreporting and ex post manipulation, resulting in another agency cost. Such strategic interactions are not modelled in Gary-Bobo and Spiegel (2006) and Kessler et al. (2005). Second, to analyze the effect of clawback provisions, we study a multi-period adverse selection model wherein a principal can utilize more screening variables (transfer payments and revenue allocations in two periods) to extract the agent's information rent. This result is not possible in a one-period model as in Gary-Bobo and Spiegel (2006) and Kessler et al. (2005), where ex ante revenue allocation cannot be contingent on the ex post realization of the accounting signal. Our analysis implies that their solution approach may be suboptimal in a two-period model. More research along this line may be promising.

Our paper is related to the literature on reporting misstatements. Most papers in the literature rely on a moral hazard model with a risk-efficiency trade-off. The accounting signal itself is served as a performance measure, but an agent can manipulate the signal in order to reduce personally costly effort. For example, Liang (2004) shows that earnings management can improve the efficiency of allocating compensation risk. Nan (2008) shows that when the hedging decision is not contractible, a strategy of discouraging hedging but allowing earnings management may be optimal, because encouraging hedging may require a more costly compensation scheme to compensate the agent for reduced earnings management. Also see Goldman and Slezak (2006) who show that linking pay to the firm's share price provides the CEO with incentives to manipulate accounting information. They analyze how an exogenous change in the level of monitoring influences the equilibrium levels of the pay-performance sensitivity and manipulation.

In contrast, we focus on the role of earnings management with ex ante information asymmetry, where the fundamental problem is a trade-off between efficiency and rents. In this model, the accounting signal serve as a confirmation role in order to alleviate the manager's ex ante incentive to misreport private information. Earnings management does not directly affect the agent's performance, but rather hinders the principal's ability to extract rent from the agent. Mittendorf (2010) analyzes how audit thresholds may create incentive for misstatements, but the predictability of such misstatements may serve to promote efficiency. In line with this argument, Arya et al. (1998) consider an extreme form of clawback provisions: In a two-period relationship, an owner may select to dismiss the manager at the end of period 1. They show that earnings management may be beneficial, because it helps the owner commit to firing the manager less frequently. Interestingly, we illustrate that a principal may still benefit from utilizing the accounting signal even though it can be manipulated without any cost. Our analysis complements Holmstrom (1979), who shows that any signal that is informative of the agent effort should be used to condition on the agent's compensation scheme (aka the sufficient statistic theorem). Chen et al. (2011) recently shows how firms choose to commit to loose monitoring system implied by a standard agency model a la Holmstrom (1979). But to our knowledge, no research has examined the validity of Holmstrom (1979) when the signal can be manipulated costlessly.

3 The Model

We consider a principal-agent model in which a board of directors (principal) hires a risk-neutral manager (agent) for two periods. In each period $i \in \{1, 2\}$, the manager produces a net product revenue

$$R = e - \theta,$$

where $\theta \in \{\theta_l, \theta_h\}$ ($\theta_h > \theta_l > 0$) is the uncollectible revenue and $e \geq 0$ is the manager's effort. The manager privately observes the uncollectible revenue θ prior to the contracting stage, which is invariant across different periods. The board has a prior belief on θ characterized by probability $\alpha = \Pr(\theta = \theta_l)$. Upon exerting the costly effort to increase the product revenue, the manager incurs a disutility (in monetary terms) of $\psi(e) = e^2/2$, where the quadratic form is adopted to facilitate analytical expressions. At the end of each period, the board can observe product revenue R, but cannot verify the proportion of uncollectible revenue θ.

At the beginning of the second period, the board receives an accounting signal $S \in \{S_G, S_B\}$ that could be used to mitigate the information asymmetry problem vis-a-vis the manager (where the subscripts G and B denote good and bad news, respectively). This accounting signal is informative in that it is correlated to the unobservable uncollectible revenue θ. Let π_{jk} denote the conditional probability that the accounting signal S_k is realized, conditional upon the realization of θ_j. We assume the conditional probability π_{jk} exhibits the following properties:

$$\begin{aligned} \pi_{lG} &= \Pr(S_G|\theta_l) = \lambda + \delta, \text{ and } \pi_{lB} = \Pr(S_B|\theta_l) = 1 - \lambda - \delta, \\ \pi_{hG} &= \Pr(S_G|\theta_h) = \delta, \text{ and } \pi_{hB} = \Pr(S_B|\theta_h) = 1 - \delta, \end{aligned}$$

where $0 \leq \lambda \leq 1$ and $0 \leq \delta \leq 1 - \lambda$ are imposed to ensure that these conditional probabilities are well-behaved. The parameter λ serves as a proxy of the informativeness of accounting signal, as a higher λ indicates a more informative signal (see Milgrom (1981)). The specification is consistent with the strict monotone likelihood ratio property (MLRP): $\frac{\pi_{lG}}{\pi_{hG}} > \frac{\pi_{lB}}{\pi_{hB}}$. Given the binary nature of the accounting signal, MLRP is equivalent to the condition that the likelihood of obtaining the signal S_G is higher when the state is θ_l than when the state is θ_h, i.e., $\pi_{lG} > \pi_{hG}$.[5] We define

[5] We focus on the setting in which the manager exerts costly effort to increase the net sales revenue. When the uncollectible revenue is higher, the manager needs to exert more costly effort in order to achieve a level of net revenue R. To reduce the disutility of effort, the manager then has an incentive to over-report the uncollectible revenue θ. This setting thus captures the manager's incentives of over-reporting uncollectible revenue that we may observe in practice. Because of this incentive, the board considers the type-θ_l manager as an efficient one. The direction of misreporting private information may change in a different setting; see, for instance, a capital budgeting model by Antle and Eppen (1985). However, the economic tradeoffs we will document herein are not sensitive to this assumption.

$\Delta\theta \equiv \theta_h - \theta_l$ as a measure of the *type uncertainty.* In contrast, the parameter δ represents an index of accounting conservatism in the manner. When δ is lower, the accounting system is more likely to report S_B, irrespective of the state of nature. Thus, a decrease in δ makes the accounting system more conservative unconditionally. This suggests that unconditional conservatism makes the accounting system more informative at the top end (signal S_G) and less informative at the bottom end (signal S_B).

To model the possibility of accounting manipulation, suppose that the manager can manipulate the realization of the accounting signal at a commonly known cost K. That is, before the board observes the accounting signal S_k, the manager can invest in K and change the signal's realization into S_{-k}, and vice versa. The board can observe the accounting signal only after the signal is manipulated. The manipulation cost may be a bribe to an internal accountant/auditor, a possible legal penalty if being caught, or simply a disutility cost of maneuvering accounting data. The accounting signal cannot be manipulated if $K = \infty$ whereas the accounting signal is completely manipulable if $K = 0$. Thus, the parameter K can be regarded as a measure of verifiability of the accounting signal.[6] Our goal is to investigate how the possibility of manager's manipulation gives rise to a materialistic effect even if in equilibrium manipulation is never induced.[7]

We normalize the total length of the contracting period to 1; accordingly, the first period of production lasts for a time $\tau \in (0,1)$, and the second period of production lasts for the remaining time $1-\tau$. Upon observing the product revenues R_1 and R_2, the board's expected payoff is given by

$$V = \tau(v(R_1) - t_1) + (1-\tau)(v(R_2) - t_2),$$

where $v(\cdot)$ corresponds to the board's value function, and (t_1, t_2) are the compensation payments to the manager for two periods. To facilitate the analysis, we assume that $v(R)$ is increasingly concave in R (i.e., $v'(\cdot) > 0$ and $v''(\cdot) \leq 0$). On the other hand, a type-j manager's payoff given (R_1, R_2) is

$$U_j = \tau(t_1 - \psi(R_1 + \theta_j)) + (1-\tau)(t_2 - \psi(R_2 + \theta_j)).$$

Our primary goal is to examine how the accounting signal influences the revenue allocation and the clawback provisions. To this end, we first consider two benchmark cases: the first-best scenario in which the manager's uncollectible revenue is publicly known, and the second-best scenario in which the manager privately observes the uncollectible revenue and no clawback provision

[6] We assume that the verifiability K is common knowledge. See Glover et al. (2006) for an analysis where an agent knows more about the verifiability than does a principal.

[7] As K does not hinge on the manager's true type, we abstract away the countervailing incentives proposed in Maggi and Rodriguez-Clare (1995) in this manipulation context.

is implemented. Following this, we then introduce the accounting signal and see how the clawback should be designed accordingly in the next section.

3.1 First-best and second-best scenarios

In the absence of accounting signal, the game repeats for two periods; consequently, we drop the index of the period and simply use R_j to represent the revenue allocation, where the subscript j corresponds to the manager's type. Let us start with the first best scenario in which the board can observe the uncollectible revenue θ. In each period, the aggregate payoff for the board and the manager is $v(R_j) - \psi(R_j + \theta_j)$. The first-best effort, denoted by e_j^{fb}, is determined by the first-order condition $v'(R_j) - \psi'(R_j + \theta_j) = 0$, where $e_j^{fb} = R_j^{fb} + \theta_j$. Accordingly, the board's expected payoff in each period is

$$V^{fb} = \alpha[v(R_l^{fb}) - \psi(R_l^{fb} + \theta_l)] + (1 - \alpha)[v(R_h^{fb}) - \psi(R_h^{fb} + \theta_l)].$$

Next, we consider the second-best scenario in the absence of accounting signal. In such a scenario, the board faces the classical two-period adverse selection problem. The optimal contract design problem can be translated into a single-period one. According to the revelation principle, we can without loss of generality focus on the family of direct mechanisms in which the manager is requested to report her type and the board determines the product revenue and the corresponding payment. The board's objective function for both periods is to maximize

$$\max_{\{R_j, t_j\}} \qquad V^{sb} = \alpha[v(R_l) - t(\theta_l)] + (1 - \alpha)[v(R_h) - t(\theta_h)].$$

The corresponding incentive compatibility (IC) and individual rationality (IR) constraints are:

$$t(\theta_l) - \psi(R_l + \theta_l) \geq t(\theta_h) - \psi(R_h + \theta_l), \tag{IC-lh}$$

$$t(\theta_h) - \psi(R_h + \theta_h) \geq t(\theta_l) - \psi(R_l + \theta_h), \tag{IC-hl}$$

$$t(\theta_h) - \psi(R_h + \theta_h) \geq 0, \tag{IR-h}$$

$$t(\theta_l) - \psi(R_l + \theta_l) \geq 0, \tag{IR-l}$$

which ensure that the manager is willing to report her type truthfully and accept the board's contract. By the standard arguments in the literature, only the constraints (IR-h) and (IC-lh) are binding. Given that $\psi(e_j) = e_j^2/2$, the solution to the board's problem is characterized by two first-order conditions:

$$v^{'}(R_l) - R_l - \theta_l = 0,$$

and

$$v'(R_h) - R_h - \theta_h = \frac{\alpha}{1-\alpha}\Delta\theta. \tag{1}$$

We therefore observe the standard economic trade-off under information asymmetry. The board induces the efficient (type-θ_l) manager to exert the first-best effort e_l^{fb}, but the inefficient (type-θ_h) manager's effort $e_h^{sb} = R_h^{sb} + \theta_h$ is distorted downwards with $v''(\cdot) \leq 0$.

Lemma 1. *In the absence of ex post accounting signals, the optimal menu of contracts entails no revenue distortion on the efficient manager ($R_l^{sb} = R_l^{fb}$) and downward distortions on the inefficient manager ($R_h^{sb} < R_h^{fb}$).*

4 The analysis

In this section, we consider the case in which the board can observe an ex post accounting signal regarding the uncollectible revenue. Based on the realized accounting signal, the board implements clawback provisions by taking back the manager's first-period compensation and/or adjust the second-period compensation. The manager may circumvent the clawback provisions by manipulating the accounting signal. It is intuitive that the standard trade-off between allocative efficiency and rent extraction shall be moderated by the clawback provisions. But, the possibility of clawback provisions exacerbates the manager's incentive to manipulate the accounting signal ex post. These two intertwined economic forces may lead to unintended consequences as will be demonstrated below.

We first formally define a direct revelation mechanism that incorporates the manager's reports and the clawback provisions. In this mechanism, the board first asks the manager to report her type. Given the manager's report $\hat{\theta}$ (which may not necessarily equal her true type), the board requests the manager to generate the product revenue $R_1(\hat{\theta})$ in the first period and compensate the manager by $t_1(\hat{\theta})$. Then the board observes the accounting signal S at the end of period 1. The period-2 product revenue specifies the product revenue $R_2(\hat{\theta}, S)$ and the compensation pay $t_2(\hat{\theta}, S)$ to the manager. Thus, essentially the board offers a menu of contracts $\gamma = \{(\gamma_1(\hat{\theta}), \gamma_2(\hat{\theta}, S)\}$, where $\gamma_1(\hat{\theta}) = (t_1(\hat{\theta}), R_1(\hat{\theta}))$ and $\gamma_2(\hat{\theta}, S) = (t_2(\hat{\theta}, S), R_2(\hat{\theta}, S))$ for the manager's report $\hat{\theta}$ and the accounting report S.[8] Because the accounting signal S is observed after the manager's report, the contract can be made conditional on both the manager's report $\hat{\theta}$ and the observed accounting signal that provides useful information on the true state of θ. In particular, if the ex post accounting signal

[8]To demonstrate why a firm wants to voluntarily implement clawback provisions, we abstract away from imposing specific compensation structures such as stock options. But we acknowledge that such optimal compensation/clawback provisions may not be implemented by a firm for practical limitations and thus are not self-enforcing.

S indicates that the true uncollectible revenue is likely to differ from the manager's ex ante report $\hat{\theta}$, the board would adjust the second-period compensation, labelled as the clawback provisions, to the manager. The goal of this analysis to analyze the effect of the clawback provisions on the manager's incentive to misreport her private information.[9]

The timing of the game is as follows. 1) At the beginning, the manager privately observes the uncollectible revenue θ (i.e., her type). 2) The board offers a menu of contracts which stipulates $\{(\gamma_1(\hat{\theta}), \gamma_2(\hat{\theta}, S)\}$ for the manager's report $\hat{\theta}$ and the accounting report S. 3) The manager generates the product revenue $R_1(\hat{\theta})$ and receives corresponding transfer $t_1(\hat{\theta})$ in the of period 1. 4) The accounting system reports an accounting signal S. 5) The second-period revenue is realized $R_2(\hat{\theta}, S)$ and the manager is compensated by $t_2(\hat{\theta}, S)$. In Figure 1, we briefly summarize the sequence of events.

We next specify the manager's payoffs. The manager observes her true type and plays the mechanism before the accounting signal is realized. Thus, the manager's payoff must be written in expectation over the realization of S. The type-θ manager's payoff given her report $\hat{\theta}$ is

$$U(\hat{\theta}|\theta, S) = \tau \left[t_1(\hat{\theta}) - \psi(R_1(\hat{\theta}) + \theta)\right] + (1-\tau)\left[t_2(\hat{\theta}, S) - \psi(R_2(\hat{\theta}, S) + \theta)\right], \tag{2}$$

where the two terms represent the period-1 and period-2 payoffs respectively. The manager incurs a disutility of effort that depends on her true type θ, her own report $\hat{\theta}$, and the realized accounting signal S (through the required product revenues $R_1(\hat{\theta})$ and $R_2(\hat{\theta}, S)$). Ex ante, a type-θ_j manager receives a good accounting report S_G with probability $\pi_{jG} = \Pr(S_G|\theta_j)$. Thus, the manager's ex ante expected payoff is specified as

$$\pi_{jG} U(\hat{\theta}|\theta_j, S_G) + (1 - \pi_{jG}) U(\hat{\theta}|\theta_j, S_B). \tag{3}$$

To simplify the notation, we define

$$\begin{aligned} U_j(\gamma_{jk}) &= \tau\left[t_1(\theta_j) - \psi(R_1(\theta_j) + \theta_j)\right] + (1-\tau)\left[t_2(\theta_j, S_k) - \psi(R_2(\theta_j, S_k) + \theta_j)\right], \\ U_j(\gamma_{-jk}) &= \tau\left[t_1(\theta_{-j}) - \psi(R_1(\theta_j) + \theta_j)\right] + (1-\tau)\left[t_2(\theta_{-j}, S_k) - \psi(R_2(\theta_{-j}, S_k) + \theta_j)\right], \end{aligned}$$

[9] Note that a firm may clawback a manager's compensation even if she does not involve any accounting misreporting. In 2010, the courts allowed the SEC to move forward in its case to disgorge bonuses and stock sale profits totaling \$4.1 million received between 2003 and 2005 from Maynard Jenkins, the former CEO of CSK Auto Corporation, despite the fact that Jenkins was not accused of being personally involved in inflating earnings of the company. More recently, the SEC announced a settlement with the CEO of Beazer Homes USA Inc., Ian J. McCarthy, who was required to reimburse the company for bonuses, other incentive-based or equity-based compensation, and profits from Beazer stock sales that he received during the 12-month period after his company filed fraudulent financial statements during fiscal year 2006. While not personally charged for the misconduct, under the settlement (which is still subject to court approval), McCarthy agreed to give back \$6.5 million.

where the subscript j denotes the manager's true type, the first subscript of γ corresponds to the manager's report, and k indicates the accounting signal S_k. In our two-type framework, the index $-j$ corresponds to the type other than j.

In line with the extant literature, the board needs to consider the following incentive compatibility and individual rationality constraints for the manager. The incentive compatibility constraints ensure that a type-θ_j manager truthfully reports her type as $\hat{\theta} = \theta_j$ and takes the offer γ_{jk}, instead of reporting θ_{-j} and taking the offer γ_{-jk}, that is, $U(\theta_j|\theta_j, S) \geq U(\theta_{-j}|\theta_j, S)$. Specifically, the incentive compatibility for a type-θ_j manager is specified by

$$\pi_{jG}U_j(\gamma_{jG}) + (1-\pi_{jG})U_j(\gamma_{jB}) \geq \pi_{jG}U_j(\gamma_{-jG}) + (1-\pi_{jG})U_j(\gamma_{-jB}). \tag{4}$$

Moreover, a type-θ_j manager's individual rationality constraints must be satisfied:

$$U(\theta_j) = \pi_{jG}U_j(\gamma_{jG}) + (1-\pi_{jG})U_j(\gamma_{jB}) \geq 0, \tag{5}$$

where the manager's reservation utility is normalized to zero.

We next consider the manager's incentive to manipulate the accounting signal. Given the realization of the accounting signal, the manager's decision on whether to manipulate the signal is straightforward. When the accounting signal is S_k, the manager j's payoff is given by $U_j(\gamma_{jk})$ if she selects not to manipulate the accounting signal. In contrast, if she chooses to manipulate the accounting signal into S_{-k}, her expected payoff is $U_j(\gamma_{j-k}) - K$.[10] Hence, the incentive compatibility constraint for no manipulation is

$$U_j(\gamma_{jk}) \geq U_j(\gamma_{j-k}) - K. \tag{IC-M}$$

This constraint should be satisfied for all $j \in \{h, l\}$ and $k \in \{G, B\}$. As the manager j's payoff in the first period is not affected by the realization of the accounting signal, we can simplify the constraint (IC-M) as

$$t_2(\theta_j, S_k) - \psi(R_2(\theta_j, S_k) + \theta_j) \geq t_2(\theta_j, S_{-k}) - \psi(R_2(\theta_j, S_{-k}) + \theta_j) - K. \tag{6}$$

The (IC-M) constraint ensures that the manager does not manipulate the accounting signal so that it remains truthful. We will analyze how the verifiability of the accounting signal K may affect the

[10] We can distinguish two types of earnings management: informed versus uninformed earnings management. Under uninformed earnings management, the manager makes manipulation decision before observing the signal. Intuitively, uninformed earnings management is more costly to the manager, because the cost of manipulation is wastefully incurred when the accounting signal turns out to be favorable. To highlight the detrimental effect of earnings management, we model informed earnings management, where earnings management is made after the manager observes the true accounting signal. The economic trade-offs herein are not affected by this assumption.

manager's incentive to misreport her private information and identify the conditions under which the board would prefer no accounting manipulation.[11]

Given the manager's truthful report θ_j and the accounting report S_k, the board's payoff for two periods is

$$V(\gamma_{jk}) \equiv \tau[v(R_1(\theta_j)) - t_1(\theta_j)] + (1-\tau)[v(R_2(\theta_j, S_k)) - t_2(\theta_j, S_k)]. \tag{7}$$

The board's maximization problem for all $\theta_j \in \{\theta_l, \theta_h\}$ and $S_k \in \{S_G, S_B\}$ is given by

$$\begin{array}{llcl} (\mathbf{P}) \ \max\limits_{\gamma_{jk}} & U_o & = & \alpha[\pi_{lG}V(\gamma_{lG}) + (1-\pi_{lG})V(\gamma_{lB})] + (1-\alpha)[\pi_{hG}V(\gamma_{hG}) + (1-\pi_{hG})V(\gamma_{hB})] \\ & \text{s.t.} & & \text{(IC), (IR), and (IC-M).} \end{array}$$

We show in Appendix that the optimal solution for the manager's compensation critically depends on the manipulation constraint (IC-M). If the level of verifiability is high, then the manger finds it too costly to manipulate the accounting signal. As a result, the board can effectively utilize the signal in order reduce the information rent. We label this as "*no-manipulation* regime." When the level of accounting verifiability is relatively lower, the board must adjust the payments and revenue allocations so as to satisfy the no-manipulation constraint (IC-M). We call this scenario "*revenue distortion* regime." In what follows, we characterize the equilibria in more detail.

4.1 No manipulation regime

In this subsection, we examine the scenario in which the board can effectively utilize the signal in order reduce the information rent, because the verifiability of the accounting report is relatively high. We now analyze the optimal contracts when the no-manipulation constraint (IC-M) is not binding. In this case, the board's problem is to design a menu of contracts $\gamma = \{(\gamma_1(\hat{\theta}), \gamma_2(\hat{\theta}, S)\}$, where $\gamma_1(\hat{\theta}) = (t_1(\hat{\theta}), R_1(\hat{\theta}))$ and $\gamma_2(\hat{\theta}, S) = (t_2(\hat{\theta}, S), R_2(\hat{\theta}, S))$, such that type-$\theta_j$ manager has no incentive to misreport as θ_{-j} and the manager's expected payoff is not smaller than the reservation utility. We first note that since the board can commit to the two-period contract, the board can always set the period-1 compensation as zero and adjust the period-2 compensation to the manager's IR constraint. More importantly, the board can effectively adjust the second-period compensation pay $t_2(\hat{\theta}, S)$ such that the manager has no incentive to misreport her private information.

The intuition is articulated as follows. Suppose that the type-θ_l manager misreports as θ_h. In this case, the board can offer the period-2 compensation pay $t_2(\theta_h, S_G) < t_2(\theta_h, S_B)$. Because

[11] This definition is consistent with Watts (2003) who argues that the lack of verifiability of many value estimates gives managers the ability to introduce bias to value estimates.

the accounting signal is informative, the type-θ_l manager may find it more costly to misreport her private information, which reduces the cost of information rent. On the other hand, the type-θ_h manager's expected payoff is negatively affected by $t_2(\theta_h, S_G)$ even when she truthfully reports her type. But as the type-θ_l manager is more likely to receive S_G than the type-θ_h, the board still benefits from imposing lower compensation pay $t_2(\theta_h, S_G)$ than $t_2(\theta_h, S_B)$. The same argument can be applied to the type-θ_h manager. When the type-θ_h manager misreports as θ_l, the board is more likely to observe S_B. Thus, to prevent the type-θ_h manager from misreporting, the board offers smaller compensation pay $t_2(\theta_l, S_G)$ than $t_2(\theta_l, S_B)$, such that she has no incentive to misreport her private information.

Indeed, we observe that for any given schedule, the system of (IC) and (IR) has as many (four) equations as unknowns $\{t_1(\hat{\theta}), t_2(\hat{\theta}, S)\}$. When the accounting signals are informative, it is possible to solve for the optimal ex post compensation pay, such that all these constraints are satisfied. In this case, the manager receives no information rent irrespective of her type. In particular, the first-best revenue allocation $\{R_1(\hat{\theta}), R_2(\hat{\theta}, S)\}$ can be implemented by this mechanism. The optimal compensation schemes that implements the first-best allocation is provided in Appendix. The following proposition summarizes the result. To distinguish the two periods and highlight the influence of the accounting signals on the second-period revenue allocations, we use R_j to represent the first-period required revenues and R_{jk} to denote the second-period revenues, where $j \in \{h, l\}$ and $k \in \{G, B\}$. This notation applies to the subsequent analysis and discussions.

Proposition 1. *When the limited liability constraint is not binding, the board can implement the first-best revenue allocations where $R_h < R_l$, $R_l = R_{lk} = R_l^{fb}$ and $R_h = R_{hk} = R_h^{fb}$, for $k \in \{G, B\}$. The optimal compensation schemes stipulate the first-period compensation $t_1^{fb}(\theta_l) = t_1^{fb}(\theta_h) = 0$ and the second-period compensation $t_2^{fb}(\theta_l, S_G) < t_2^{fb}(\theta_l, S_B)$ and $t_2^{fb}(\theta_h, S_G) < t_2^{fb}(\theta_h, S_B)$.*

We show that the accounting signal that is correlated with ex ante private information may serve as a contracting mechanism. Based on the accounting signal, the board can impose different compensation schemes by adjusting the second-period compensation pay and effectively achieve the first-best revenue allocation in both periods. This result critically depends on the assumption that the board can create a sufficient large pay differential

$$t_2(\theta_j, S_B) - t_2(\theta_j, S_G) = \frac{\psi(R_j + \theta_h) - \psi(R_j + \theta_l)}{(1-\tau)(\pi_{lG} - \pi_{hG})}, \tag{8}$$

such that the manager has no incentive to misreport her private information. But it is possible that the board cannot impose an unbounded penalty on the manager when she is caught misreporting. In such a scenario, the possibility of the manager's manipulation will prevent the board from implementing the first-best solution.

Holding the manipulation cost K constant, we observe that the implementation of the allocations in Proposition 1 requires that $\frac{\psi(R_j+\theta_h)-\psi(R_j+\theta_l)}{(1-\tau)(\pi_{lG}-\pi_{hG})} \leq K$ in order to prevent the ex post manipulation. Because the term $\pi_{lG}-\pi_{hG}=\lambda$ depends only on the nature of accounting signal, it is immediate that the distortions will not occur if and only if the accounting signal is sufficiently informative. On the other hand, the accounting conservatism does not factor into the regime switch. Thus, unlike the accounting informativeness λ, the change of accounting conservatism does not help prevent revenue distortions. We highlight this observation below.

Corollary 1. *There is no revenue distortion when the accounting signal is sufficiently informative, and the change of accounting conservatism does not influence the possibility of revenue distortion.*

Nevertheless, given that revenues are distorted, accounting conservatism does affect how distorted they are, as we demonstrate below. Specifically, in the next subsection, we examine the scenario in which the no-manipulation constraint (IC-M) is binding.

4.2 Revenue distortion regime

We have established that if the board can create a sufficiently large pay differential, then the board can implement the first-best revenue allocations. In this subsection, we examine the scenario in which the verifiability of the accounting report is relatively low, and the manager may find it beneficial to manipulation the accounting report. The board is intent on utilizing the accounting report in order to curtail the efficient (type-θ_l) manager's incentive to misreport. When the manager's report is different from the accounting signal, the board would impose a lower payment, but the board's ability to create a large pay differential is limited by the no-manipulation constraint. As a result, the board still needs to provide information rent to the efficient manager in order to induce truthful reporting.

The board's problem is characterized by the following economic tradeoffs. If the board wants to induce truth-telling, the board's problem needs to satisfy two binding constraints: the type-θ_l manager's incentive compatibility constraint (IC-lh'), and the type-θ_h manager's individual rationality constraint (IR-h'). These two constraints imply that the type-θ_l manager's expected utility (information rent) Φ is

$$\begin{aligned}\Phi \equiv\ & \tau[\psi(R_h+\theta_h)-\psi(R_h+\theta_l)] \\ & +(1-\tau)[(\pi_{lG}-\pi_{hG})(t_2(\theta_h,S_G)-t_2(\theta_h,S_B))-\pi_{lG}\psi(R_{hG}+\theta_l)-(1-\pi_{lG})\psi(R_{hB}+\theta_l) \\ & +\pi_{hG}\psi(R_{hG}+\theta_h)+(1-\pi_{hG})\psi(R_{hB}+\theta_h)]. \end{aligned} \tag{9}$$

When the accounting signal is not available, the board can offer the same revenue allocation

($R_{hG} = R_{hB} = R_h$) to ensure truth-telling. However, provided that the accounting signal is informative ($\pi_{lG} > \pi_{hG}$), when the manager reports θ_h, but the accounting signal is S_G, the board knows that the manager's true type is more likely to be efficient (type-θ_l). In order to reduce the information rent, the board would reduce the compensation $t_2(\theta_h, S_G)$ as much as possible, but a lower $t_2(\theta_h, S_G)$ would incentivize the manager to manipulate the accounting signal as shown by the no-manipulation constraint (IC-M):

$$\psi(R_{hG}+\theta_h) - \psi(R_{hB}+\theta_h) + K \geq t_2(\theta_h, S_G) - t_2(\theta_h, S_B) \geq \psi(R_{hG}+\theta_h) - \psi(R_{hB}+\theta_h) - K.$$

Thus, the board is forced to offer a higher $t_2(\theta_h, S_G)$ in order to meet (IC-M) constraint. The optimal compensation $\{t_2^*(\theta_h, S_G), t_2^*(\theta_h, S_G)\}$ are jointly determined by (IC-M) and the inefficient manager's individual rationality constraint (IR-h'). The compensation $t_2^*(\theta_h, S_G)$ is now given by

$$t_2^*(\theta_h, S_G) = \frac{\tau\psi(R_h+\theta_h) + (1-\tau)[\psi(R_{hG}+\theta_h) - (1-\pi_{hG})K]}{1-\tau},$$

and is strictly decreasing in the level of accounting verifiability K. If the accounting verifiability K is high enough, $t_2^*(\theta_h, S_G)$ converges to the same solution as that in the no-manipulation regime. Thus, when the constraint (IC-M) binds, the board is forced to offer higher compensation $t_2^*(\theta_h, S_G)$, which leads to a smaller compensation differential

$$\Delta t_{hk} \equiv t_2^*(\theta_h, S_G) - t_2(\theta_h^*, S_B) = \psi(R_{hG}+\theta_h) - \psi(R_{hB}+\theta_h) - K,$$

and a higher information rent for the type-θ_l manager.

Given the type-θ_l manager's expected utility (information rent), the optimal product revenues (from the board's perspective in problem (**P**)) are characterized by the following first-order conditions. First, the board offers the first-best revenue allocations for the (efficient) type-θ_l manager for both periods. Second, the optimal revenue allocations for the inefficient (type-θ_h) manager are distorted and are characterized by the following first-order conditions:

$$\begin{aligned} v'(R_h) - R_h - \theta_h &= \frac{\alpha}{1-\alpha}\Delta\theta, && (10) \\ v'(R_{hG}) - R_{hG} - \theta_h &= \frac{\alpha}{1-\alpha}\frac{\pi_{lG}}{\pi_{hG}}\Delta\theta, && (11) \\ v'(R_{hB}) - R_{hB} - \theta_h &= \frac{\alpha}{1-\alpha}\frac{1-\pi_{lG}}{1-\pi_{hG}}\Delta\theta. && (12) \end{aligned}$$

In the presence of information asymmetry, the board needs to distort the revenue allocation downwards. But such downward distortion is alleviated by the ex post accounting signal. We first highlight these results in the following proposition.

Proposition 2. *When the level of verifiability K is sufficiently small, the revenue distortion regime results and the optimal menu of contracts entails*

- *No revenue distortion on the efficient type of manager ($R_l = R_{lk} = R_l^{fb}$).*
- *The optimal revenue allocations $\{R_h^*, R_{hG}^*, R_{hB}^*\}$ are characterized by (10), (11) and (12), respectively.*

In this regime, the board can still observe an accounting signal that is correlated to the manager's private information, but such an accounting signal can be manipulated ex post by the manager. This subsequently gives rise to the manager's no-manipulation constraints. As the type-θ_l manager's incentive is to misreport as θ_h, the board can utilize the accounting signal as a mechanism to alleviate such temptation. While maintaining the efficient manager's revenue allocation at the first-best level, the board will fine-tune the period-2 revenue function R_{hk} in response to the accounting report $S_k \in \{S_G, S_B\}$. Thus, the board faces the classical trade-off between rent extraction and efficiency. To understand this trade-off, let us reexamine the type-θ_l manager's information rent Φ as

$$\Phi = \tau[\psi(R_h + \theta_h) - \psi(R_h + \theta_l)] + (1-\tau)\{\pi_{lG}[\psi(R_{hG} + \theta_h) - \psi(R_{hG} + \theta_l)]$$
$$+(1-\pi_{lG})[\psi(R_{hB} + \theta_h) - \psi(R_{hB} + \theta_l)] - (\pi_{lG} - \pi_{hG})K\}.$$

This equation indicates that if the accounting system is informative ($\pi_{lG} > \pi_{hG}$), the type-θ_l manager gains information rent by misreporting as $\hat{\theta}_h$ and such information rent decreases in the verifiability K and increases in the revenue allocation R_{hk}.

To reduce the information rent, the board has an incentive to distort revenue allocations R_{hk} downwards, but such distortions reduce the allocation efficiency. If the manager reports θ_h, but the accounting signal is S_G, the board knows that the manager's true type is more likely to be efficient (type-θ_l). The board then finds it beneficial to distorts R_{hG} *downwards* in order to reduce the information rent. This result is counterintuitive, as the revenue should be adjusted higher to reflect the optimistic expectation of the manager's efficiency. On the other hand, the inefficient (type-θ_h) manager may be incorrectly penalized (a Type-I error) when the revenue R_{hG} is distorted downwards. Thus, the board needs to subsidize the type-θ_h manager for the possible losses in order to satisfy the manager's IR constraint; consequently, the revenue allocation R_{hB} is distorted upwards ($R_{hB}^* > R_h^{sb}$).

Collectively, the accounting signal can only partially mitigate the asymmetric information problem, because the accounting system still cannot perfectly identify the efficient (type-θ_l) manager's misreporting (a Type-II error) and the manager can potentially manipulate the accounting signal ex post. The board distorts R_{hG} downwards and R_{hB} upwards in order to balance between the benefit of reducing information rent and the cost of efficiency loss.

Corollary 2. *In the revenue distortion regime, the board distorts the second-period allocation upwards (downwards) when the accounting signal is bad (good), that is,* $R^*_{hG} < R^*_h = R^{sb}_h < R^*_{hB}$.

How does the board adjust the choices of revenue allocation $\{R_{hG}, R_{hB}\}$ in response to the informativeness of the accounting signal? One may conjecture that the revenue distortion would be less desired when the accounting signal is more informative. Corollary 2 shows that this conventional wisdom may not hold in this setting. As the degree of information precision λ is higher, the accounting signal is more likely to reflect the manager's true type (π_{lG} is larger). In other words, if the manager reports θ_h, but the accounting signal is S_G, the manager is more likely to have misreported her true type. As a result, the board distorts R_{hG} further lower. To satisfy the type-θ_h manager's IR constraint, the revenue allocation R_{hB} increases when the accounting system is more precise. When the accounting system becomes completely uninformative ($\lambda = 0$), then R_{hG} and R_{hB} approaches to the second-best solution.

Corollary 3. *In the revenue distortion regime, holding the level of accounting conservatism constant, if the accounting system becomes more informative, the board further distorts* R_{hG} *downwards and* R_{hB} *upwards* ($\partial R_{hG}/\partial\lambda < 0$,*and* $\partial R_{hB}/\partial\lambda > 0$).

In contrast, accounting conservatism has an asymmetric effect on the inefficient manager's revenue allocation. As the accounting system becomes more conservative (a smaller δ), it is more likely to observe the bad accounting report S_B. Consequently, the bad signal S_B becomes less informative, but the good signal S_G is very informative. When the manager reports θ_h, but the accounting signal is still S_G, the board knows that the manager's true type is very likely to be θ_l. Hence, the board further decreases R^*_{hG} ($\partial R_{hG}/\partial\delta > 0$) to reduce information rent. On the other hand, the accounting report S_B becomes less informative, for both types of managers are now mixed together. Thus, the revenue allocation R^*_{hB} is distorted more toward R^{sb}_h when the accounting system is more conservative ($\partial R^*_{hB}/\partial\delta > 0$). Interestingly, if the accounting system becomes extremely liberal ($\delta = 1 - \lambda$), then the good signal S_G is perfectly informative, but the bad signal S_B is not. Hence, the revenue allocation R_{hG} coincides with the first-best solution, but R_{hB} is still smaller than the second-best solution.

Corollary 4. *In the revenue distortion regime, holding the level of accounting informativeness constant, the revenue allocations are both lower when the accounting system becomes more conservative* ($\partial R_{hG}/\partial\delta > 0$, *and* $\partial R_{hB}/\partial\delta > 0$).

We next characterize how the accounting informativeness and accounting verifiability jointly determines the efficient manager's information rent. First, the accounting informativeness gives rise to both direct and indirect effects on the information rent:

$$\frac{d\Phi}{d\lambda} = \underbrace{\frac{\partial\Phi}{\partial\lambda}}_{\text{Direct effect }<0} + \underbrace{\frac{\partial\Phi}{\partial R_{hG}}\frac{\partial R_{hG}}{\partial\lambda} + \frac{\partial\Phi}{\partial R_{hB}}\frac{\partial R_{hB}}{\partial\lambda} + \frac{\partial\Phi}{\partial R_{h}}\frac{\partial R_{h}}{\partial\lambda}}_{\text{Indirect effect }<0}.$$

On one hand, the board offers information rent to the type-θ_l manager in order to counter the incentive to misreport as θ_h. When the accounting system becomes more precise, the accounting signal is more likely to be S_G. Thus, if misreporting as θ_h, the type-θ_l manager is more likely to be contracted with R_{hG} than with R_{hB}, which results in a negative payoff because $R_{hG} < R_{hB}$. On the other hand, the accounting informativeness gives rise to indirect effects on the revenue allocations $\{R_{hG}, R_{hB}, R_h\}$. Proposition 3 shows that as the accounting system becomes more informative, the optimal contracts entail more downward distortion on R_{hG} and upward distortion on R_{hB} ($\partial R_{hG}/\partial\lambda < 0$, and $\partial R_{hB}/\partial\lambda > 0$). But the period-1 revenue allocation is not affected by the degree of accounting conservatism ($\partial R_h/\partial\lambda = 0$), because the board cannot make the period-1 allocation contingent on the accounting report. As the manager's expected information rent increases in revenue allocation ($\partial\Phi/\partial R_{hk} > 0$), we show that the information rent decreases in the accounting informativeness.

Provided that the information rent strictly decreases in the informativeness, it is intuitive that there exists a cut-off threshold $\overline{\lambda}(K)$ at which the efficient manager earns zero information rent. This threshold $\overline{\lambda}(K)$ is jointly determined by the type uncertainty $\Delta\theta$ (a proxy for the magnitude of information asymmetry) and the level of verifiability K. When the accounting system is very difficult to be manipulated (a large K), Proposition 1 shows that the board can obtain the first-best allocation as along as the accounting system is slightly informative. But if the accounting system becomes more manipulatable, the board cannot implement the first-best solution unless the informativeness of the signal is higher. Thus, the level of verifiability may play a *substitute* role of the accounting informativeness in alleviating the cost of asymmetric information. This implies that if regulators imposes an exogenous level of accounting informativeness, the board can facilitate higher accounting verifiability of the accounting signal to subsidize the loss of informativeness when confronted with the asymmetric information problem vis-a-vis the manager.

Proposition 3. *Holding the level of accounting conservatism constant, the efficient manager's information rent strictly decreases in the informativeness of the accounting system ($d\Phi/d\lambda < 0$). There exists a cut-off point for the level of accounting informativeness $\overline{\lambda}(K)$: 1) for λ in $(0, \overline{\lambda}(K)]$, the manager receives positive information rent; 2)for $\lambda > \overline{\lambda}(K)$, the board attains the first-best allocation; 3) for $\lambda = 0$, the solution coincides with the second-best solution. The cut-off point $\overline{\lambda}(K)$ decreases in the level of accounting verification ($d\overline{\lambda}(K)/dK < 0$).*

The effect of accounting conservatism on the information rent is less straightforward. On one hand, accounting conservatism exacerbates the manager's incentive to misreport her private information. The board intends to utilize the accounting signal to alleviate the type-θ_l manager's incentive to report as θ_h. As the accounting system becomes more conservative (a smaller δ), the accounting signal is more likely to be S_B. Thus, if misreporting as θ_h, the type-θ_l manager is more likely to be contracted with R_{hB} than with R_{hG}, leading to a higher information rent. Moreover, accounting conservatism increases the information content of the good signal S_G is higher, but decreases that of the bad signal S_B. The board alleviates the downward distortion for R_{hG}, but exacerbates the upward distortion for R_{hB}. As a result the efficient manager's information rent is higher because of accounting conservatism.

On the other hand, accounting conservatism alleviates the manager's incentive to manipulate the accounting signal ex post. Recall that the no-manipulation constraint (IC-M) limits the board's ability to extract the efficient manager's information rent by decreasing the compensation scheme $t_2^*(\theta_h, S_G)$. When the accounting system becomes more conservative, the type-θ_l manager is more likely to observe S_B and thus has less incentive to manipulate the signal ex post. This consequently makes the board less costly to satisfy the (IC-M) constraint.

The net effect of accounting conservatism is determined by the magnitude of accounting verifiability K and the type uncertainty $\Delta\theta$. First, if the accounting verifiability K is small, the manager finds it less costly to manipulate the accounting signal and the cost of preventing the ex post manipulation is high. In this case, when the accounting system becomes more conservative, the benefit of alleviating ex post manipulation is larger than the cost of exacerbating ex ante misreport; thus, the information rent may decrease in the level of accounting conservatism. Second, the type uncertainty $\Delta\theta$ represents the extent of ex ante adverse selection. When the type uncertainty $\Delta\theta$ is higher, the manager has a stronger incentive to manipulate the accounting signal ex post and the board finds it becomes more costly to satisfy the no-manipulation constraint (IC-M). Thus, if the accounting system is more conservative, the board may benefit from accounting conservatism, for it reduces the incentive to do accounting manipulation.

Proposition 4. *Holding the level of accounting informativeness constant, the efficient manager's information rent decreases in the level of accounting conservatism* ($d\Phi/d\delta > 0$) *only if the level of accounting verifiability K is sufficiently low or the type uncertainty $\Delta\theta$ is sufficiently large.*

A number of studies argue that accounting conservatism may play a stewardship role in order to mitigate agency costs (see, e.g., Kwon et al. (2001) and Gigler and Hemmer (2001)). An implicit assumption in this literature is that the accounting signal itself is verifiable ex post and *cannot* be manipulated. Beyer et al. (2010) challenge this assumption, arguing that reporting entities may manipulate the accounting signal via privately selecting the level of accounting conservatism.

In response to the call, Proposition 4 indicates that the accounting verifiability plays a critical role in a contractual relationship: accounting conservatism is beneficial only when the accounting verifiability is low or the ex ante information asymmetry (reflected by the type uncertainty $\Delta\theta$) is high. Chen et al. (2007) also analyze the role of conservative accounting standards in alleviating rational yet dysfunctional unobservable earnings manipulation. They show that conservatism in accounting standards is effective in reducing incentives to manage earnings upwards and doing so can reduce contracting costs. In a different setting, our paper illustrates whether or not accounting conservatism may reduce the contracting costs depends on the level of accounting verifiability.

Finally, let us discuss the scenario in which the accounting verifiability K is relatively small. In this regime, because even the type-θ_l manager may have an incentive to manipulate the accounting signal, we need to consider the no-manipulation constraints, that is,

$$t_{lG} - \psi(R_{lG} + \theta_l) \geq t_{lB} - \psi(R_{lB} + \theta_l) - K, \tag{IC-M-lg}$$

$$t_{lB} - \psi(R_{lB} + \theta_l) \geq t_{lG} - \psi(R_{lG} + \theta_l) - K. \tag{IC-M-lb}$$

To incentivize truthful reporting, the board intends to compensate the manager by lowering t_{lB} and increasing t_{lG} as long as the accounting signal is informative. These constraints are satisfied when the difference between two compensation schemes (t_{lG}, t_{lB}) is relatively small. Notably, only the type-θ_l manager's (IR) constraint is affected by the compensation schemes (t_{lG}, t_{lG}). This implies that the board can fine tune the compensation schemes (t_{lG}, t_{lG}) to satisfy the no-manipulation and (IR) constraints, but still keeping the (IC) constraint satisfied. As a result, the revenue allocations as shown in Proposition 2 are intact.

When the manager can manipulate the accounting signal without any cost ($K = 0$), one may conjecture that the board would simply give up implementing the clawback provisions (i.e., not contracting with the manager contingent on the accounting signal) and stipulate the classical second-best contracts. Nevertheless, the next proposition invalidates this intuition.

Proposition 5. *Suppose that $v(R) = R - vR^2/2$ and the accounting system is informative ($\lambda > 0$). Even if the manager can manipulate the accounting signal costlessly ($K = 0$), the manager's information rent is strictly lower than the rent under the classical second-best solution.*

To understand this result, recall that in the absence of manipulation cost the no-manipulation constraints become the following:

$$t_{hG} - \psi(R_{hG} + \theta_h) \geq t_{hB} - \psi(R_{hB} + \theta_h), \text{ and } t_{hB} - \psi(R_{hB} + \theta_h) \geq t_{hG} - \psi(R_{hG} + \theta_h),$$

and therefore they must hold in equality: $t_{hG} - \psi(R_{hG} + \theta_h) = t_{hB} - \psi(R_{hB} + \theta_h)$. This implies that if the manager can costlessly manipulate the accounting signal ex post, the board is forced to give away exactly the same payoff to the manager irrespective of the signal realization. Under the classical second-best solution, we would have $R_{hG} = R_{hB} = R_h$, making both the revenue allocations and the payments independent of the accounting signals. This natural solution, however, turns out to be suboptimal. As we show in the appendix, the board extracts more surplus if the revenue allocation is made contingent on the accounting signal; accordingly, he can wisely design the appropriate payments to deter the manager's ex post manipulation.

The board strictly benefits from these signal-contingent revenue allocations for two reasons. First, in the classical second-best solution, the efficient manager earns information rent so as to induce truthfully reporting. Clearly, if the board is willing to commit the full information rent, then the manager has no incentive to manipulate the signal, even though the cost of manipulation is zero. But if the accounting signal is informative, the inherent heterogeneity between the efficient and inefficient managers reduces the information rent given up to the manager, because the efficient manager still has a slightly higher chance to observe S_G. In order to deter manipulation, the board has to balance the payoff for each type of manager across the accounting signals (R_{hG} and R_{hB}). Still, different types of managers may obtain different expected payoffs in the second period:

$$\begin{aligned} & \pi_{lG}\left[t_{hG} - \psi(R_{hG} + \theta_l)\right] + (1 - \pi_{lG})\left[t_{hB} - \psi(R_{hB} + \theta_l)\right] \\ \neq\; & \pi_{hG}\left[t_{hG} - \psi(R_{hG} + \theta_h)\right] + (1 - \pi_{hG})\left[t_{hB} - \psi(R_{hB} + \theta_h)\right], \end{aligned} \tag{13}$$

because the probabilities of $\{S_G, S_B\}$ are contingent on the manager's true type. Thus, the efficient manager expects to earn a smaller information rent than that when such an uncertainty does not exist. Second, this contingency may mitigate the allocative inefficiency that results from the adverse selection (as the ex post allocations R_{hG} and R_{hB} are allowed to deviate from the downward distorted second-best solution). We therefore conclude that the accounting signals help the board mitigate the adverse selection problem even if the accounting manipulation is costless.

5 Empirical Implications and Discussion

While it becomes increasingly common that firms adopt the clawback provisions in compensation contracts, the extant empirical literature has paid little attention on the economic consequences of the clawback provisions. In a dynamic setting, our analysis provides a number of testable empirical predictions regarding the role of the clawback provisions in corporate governance and in the design of executive compensation contracts. Below, we discuss in detail these policy and empirical implications derived directly from the propositions.

This model may add insights into the widespread debate over the introduction of the clawback provisions. Section 304 of the Sarbanes-Oxley Act of 2002 called for clawback provisions, which requires public company managers to disgorge incentive-based compensation in the event of material noncompliance with financial reporting requirements. In response, some companies have voluntarily developed policies to incorporate clawback provisions in compensation contracts. It is argued among practitioners that the clawback provisions can be utilized to alleviate the manager's ex ante incentive to misreport private information, but may exacerbate the incentive to manipulate the accounting signal ex post. We demonstrate that firms may still benefit from implementing clawback provisions even though the accounting signals can be manipulated without any cost. Thus, this result may explain why some companies voluntarily developed policies to incorporate clawback provisions in compensation contracts.

Additionally, our analysis predicts two equilibrium regimes when firms implement the clawback provisions. In the no-manipulation regime, the accounting verifiability is sufficiently high and the board can implement the first-best solution without any revenue distortion. In the revenue distortion regime, however, the board may need to distort revenue allocations from the second-best level, because the accounting verifiability is not high enough to prevent manipulation. Arguably, one may not observe the level of accounting verifiability in empirical financial data, but can observe how revenue distortions in the managerial contracts. Thus, our analysis implies that researchers can obtain an estimate of accounting verifiability via comparing the revenue allocations cross-sectionally of those firms adopting clawback provisions.

The model also has empirical implications on the time-series relation of reported accounting measures in executive compensation. It is a standard approach that most studies utilize pooling observations over time to estimate the sensitivity of pay to performance measures (Lambert and Larcker (1987)). An implicit assumption of these studies is that the pay-performance relation is stable over time. In contrast, we have shown that when the clawback provisions are implemented, the board may adjust the second-period revenue allocations so as to alleviate the cost of information asymmetry. Interestingly, the revenue allocations are distorted by the *opposite* direction of the accounting signal and exhibit the pecking order: $R^*_{hG} < R^*_h < R^*_{hB}$. As a result, a firm-specific time-series regression of compensation on performance measures may result in serially correlated residuals (also see Gaver and Gaver (1998)). When the accounting signal is more informative, the board actually exacerbates the revenue distortions in the second period. Such revenue distortions are mitigated when the verifiability of the accounting signal is higher. In contrast, the revenue allocations are both lower when the accounting system becomes more conservative. This suggests that the time-series variance of performance measures may result from both changes in optimal effort level over time and changes in the properties of accounting system (also see Sloan (1993)). These results provide empirical predictions for the association among the time-series variation of reported revenue and the properties of accounting system (i.e., informativeness, conservatism, and verifiability) in executive compensation. These predictions, to our knowledge, have not been explored in the literature.

Under the Dodd-Frank Wall Street Reform and Consumer Protection Act, the SEC will direct the national securities exchanges to amend their listing standard to require that all listed companies disclose and adopt a compensation clawback policy. The goal of this paper is to demonstrate why a firm may voluntarily implement the clawback provisions even though they may give rise to excessive earnings management. To analyze the effect of mandatory clawback provisions, one may introduce a regulator whose objective is to maximize a weighted average of the firm's and the manager's expected payoffs. It is possible that mandatory clawback provisions may not be optimal when the regulator imposes a large weight on the manager's utility. But the economic trade-offs herein are not sensitive to this modification.

6 Conclusion

In this paper, we investigate the impact of clawback provisions in a dynamic adverse selection model wherein a board of directors (principal) contracts with a manager (agent) to generate sales revenues for two periods. The manager privately observes the uncollectible revenue and can exert costly effort to enhance the revenue. In between the two periods, the board observes an accounting signal that could be used to mitigate the information asymmetry problem vis-a-vis the manager. We characterize two economic regimes when the clawback provisions are adopted. When it is very costly to the manager to manipulate the accounting signal, the board can effectively utilize the accounting signal to implement the first-best revenue allocation. In the revenue distortion regime, however, the board may need to distort revenue allocations from the second-best level, because the accounting verifiability is not high enough to prevent manipulation.

Several interesting results are obtained in the revenue distortion regime. We show that when the accounting signal can be manipulated, the board may request the manager to deliver lower revenue when the accounting signal is good. The revenue distortions actually are exacerbated when the accounting system is more accurate. In contrast, the effect of accounting conservatism on the information rent is less straightforward. If the accounting verifiability is high, the benefit of alleviating ex post manipulation is smaller and thus, accounting conservatism may be is detrimental. Finally, our analysis predicts an estimate of accounting verifiability via comparing the revenue allocations cross-sectionally of those firms adopting clawback provisions. We also provide empirical predictions for the association among the time-series variation of reported revenue and the properties of accounting system (i.e., informativeness, conservatism, and verifiability) in executive compensation. These predictions, to our knowledge, have not been explored in the literature.

Our paper can be extended as follows. In this study, we assume that the board, without any cost, can observe the unbiased accounting signals ex post. An extension would be to endogenize the accounting signals by introducing the role of accountants. In such a scenario, the accountant may not truthfully report unless she is offered appropriate incentives from the board. For example, the manager may bribe the accountant, who then will issue an audit report to the investor that the manager prefers. As a result, the clawback provisions become less effective in alleviating the cost of information asymmetry. To avoid such collusion, the accountant must be rewarded more than possible bribes from the manager so that honest reporting is preferable. This may consequently affect the choices of the clawback provisions and revenue efficiency.

Appendix

In this appendix, we provide the detailed proofs of the technical results in the paper.

Proof of Proposition 1 (the first-best solution).

Suppose that the type-θ_j manager reports her type as $\theta_{j'}$. To simplify the notation, we denote the contract by $t_{j'} = t_1(\theta_{j'})$, $R_{j'} = R_1(\theta_{j'})$, $t_{jk} = t_2(\theta_{j'}, S_k)$, and $R_{jk} = R_2(\theta_{j'}, S_k)$. The manager's payoff is given by

$$U_j(\gamma_{j'k}) \equiv \tau \left[t_{j'} - \psi(R_{j'} + \theta_j)\right] + (1-\tau)\left[t_{j'k} - \psi(R_{j'k} + \theta_j)\right].$$

The type-θ_l manager's incentive compatibility constraints are:

$$\pi_{lG}U_l(\gamma_{lG}) + (1-\pi_{lG})U_l(\gamma_{lB}) \geq \pi_{lG}U_l(\gamma_{hG}) + (1-\pi_{lG})U_l(\gamma_{hB}), \tag{IC-lh'}$$

where

$$U_j(\gamma_{j'k}) \equiv \tau \left[t_{j'} - \psi(R_{j'} + \theta_j)\right] + (1-\tau)\left[t_{j'k} - \psi(R_{j'k} + \theta_j)\right].$$

Similarly, the IC constraint for the type-θ_h manager is

$$\pi_{hG}U_h(\gamma_{hG}) + (1-\pi_{hG})U_h(\gamma_{hB}) \geq \pi_{hG}U_h(\gamma_{lG}) + (1-\pi_{hG})U_h(\gamma_{lB}). \tag{IC-hl'}$$

The manager's individual rationality constraints become:

$$\pi_{lG}U_l(\gamma_{lG}) + (1-\pi_{lG})U_l(\gamma_{lB}) \geq 0, \tag{IR-l'}$$

and

$$\pi_{hG}U_h(\gamma_{hG}) + (1-\pi_{hG})U_h(\gamma_{hB}) \geq 0. \tag{IR-h'}$$

If the manager's limited liability constraint is not binding, the board can design the contract $\{t_1(\theta_j),\ t_2(\theta_j, S_k)\}$ such that the manager's constraints (IR-h'), (IR-l'), (IC-hl') and (IC-lh') are all satisfied. Because the board can commit not to negotiate the contract, we can ignore the first-period payments $t_1(\theta_j)$ and obtain the optimal $t_2(\theta_j, S_k)$ from these four binding constraints. The optimal period-2 payments $t_2(\theta_j, S_k) = t_{jk}$ for $j \in \{l, h\}$ are characterized as follows:

$$\begin{aligned} t_{jG} \;=\; & \frac{1}{\pi_{lG}-\pi_{hG}}\{\pi_{hG}\{[\psi(R_{jB}+\theta_h)-\psi(R_{jG}+\theta_h)-\psi(R_{jB}+\theta_l)] - \frac{\tau}{1-\tau}\psi(R_j+\theta_l)\} \\ & +\pi_{lG}\{[\psi(R_{jB}+\theta_h)+\psi(R_{jG}+\theta_l)-\psi(R_{jB}+\theta_l)] + \frac{\tau}{1-\tau}\psi(R_j+\theta_h)\} \\ & +\pi_{hG}\pi_{lG}\{[\psi(R_{jG}+\theta_h)+\psi(R_{jB}+\theta_l)-\psi(R_{jG}+\theta_l)-\psi(R_{jB}+\theta_h)]\}\}, \end{aligned}$$

and

$$\begin{aligned} t_{jB} \;=\; & \frac{1}{\pi_{lG}-\pi_{hG}}\{-\pi_{hG}[\psi(R_{jB}+\theta_l) + \frac{\tau}{1-\tau}\psi(R_j+\theta_l)] \\ & +\pi_{lG}\{[\psi(R_{jB}+\theta_h) + \frac{\tau}{1-\tau}\psi(R_j+\theta_h)\} \\ & +\pi_{hG}\pi_{lG}\{[\psi(R_{jG}+\theta_h)+\psi(R_{jB}+\theta_l)-\psi(R_{jG}+\theta_l)-\psi(R_{jB}+\theta_h)]\}\}. \end{aligned}$$

Substituting the optimal payments $t_2(\theta_j, S_k)$ into the board's expected payoff and letting $t_1(\theta_j) = 0$ yields

$$\begin{aligned} V = {} & \alpha\{\tau(v(R_l)-\psi(R_l+\theta_l)) \\ & + (1-\tau)[\pi_{lG}(v(R_{lG})-\psi(R_{lG}+\theta_l)) + (1-\pi_{lG})(v(R_{lB})-\psi(R_{lB}+\theta_l)) \\ & + (1-\alpha)\{\tau(v(R_h)-\psi(R_h+\theta_h)) \\ & + (1-\tau)[\pi_{hG}(v(R_{hG})-\psi(R_{hG}+\theta_h)) + (1-\pi_{hG})(v(R_{hB})-\psi(R_{hB}+\theta_h))]\}. \end{aligned}$$

Given the assumption $\psi(e_j) = e_j^2/2$, we can explicitly calculate $\psi'(R_{jk}+\theta_j) = R_{jk}+\theta_j$, $\psi'(R_{jk}+\theta_{-j}) = R_{jk}+\theta_{-j}$, and $\psi'(R_{jk}+\theta_j) - \psi'(R_{jk}+\theta_{-j}) = \theta_j - \theta_{-j}$. It is obvious that we have the following first-best solutions: for $\theta_j \in \{\theta_l, \theta_h\}$ and $S_k \in \{S_G, S_B\}$,

$$v'(R_j) - R_j - \theta_j = 0, \text{ and } v'(R_{jk}) - R_{jk} - \theta_j = 0.$$

Given $\theta_h > \theta_l$ and $v''(\cdot) \leq 0$, it is then straightforward to establish that $R_h < R_l$, $R_{hk} < R_{lk}$, $R_h = R_{hG} = R_{hB}$ and $R_l = R_{lG} = R_{lB}$.

Finally, we establish the relationship between the compensation pay across states. Because the revenue allocations are all set at the first-best level, $\psi(R_{jG}+\theta_h) = \psi(R_{jB}+\theta_h) = \psi(R_j+\theta_h)$, and $\psi(R_{jG}+\theta_l) = \psi(R_{jB}+\theta_l) = \psi(R_j+\theta_l)$. We can show the optimal compensation is given by:

$$t_{lG} = \frac{\psi(R_l+\theta_l)(1-\pi_{hG}) - \psi(R_l+\theta_h)(1-\pi_{lG})}{(1-\tau)(\pi_{lG}-\pi_{hG})};\, t_{lB} = \frac{-\psi(R_l+\theta_l)\pi_{hG} + \psi(R_l+\theta_h)\pi_{lG}}{(1-\tau)(\pi_{lG}-\pi_{hG})}$$

and

$$t_{hG} = \frac{\psi(R_h+\theta_l)(1-\pi_{hG}) - \psi(R_h+\theta_h)(1-\pi_{lG})}{(1-\tau)(\pi_{lG}-\pi_{hG})}; t_{hB} = \frac{-\psi(R_h+\theta_l)\pi_{hG} + \psi(R_h+\theta_h)\pi_{lG}}{(1-\tau)(\pi_{lG}-\pi_{hG})}.$$

It is straightforward to show that

$$t_{hB} - t_{hG} = \frac{\psi(R_h+\theta_h) - \psi(R_h+\theta_l)}{(1-\tau)(\pi_{lG}-\pi_{hG})}, \text{ and } t_{lB} - t_{lG} = \frac{\psi(R_l+\theta_h) - \psi(R_l+\theta_l)}{(1-\tau)(\pi_{lG}-\pi_{hG})}.$$

□

Proof of Corollary 1.

This comes directly from the expressions of $t_{hB} - t_{hG}$.

Proof of Proposition 2 (the characterization of the board's problem).

We now analyze the case where the no-manipulation constraint is binds. The proof proceeds with the following steps.

Step 1: Identify binding constraints.

We can express the constraints explicitly as functions of the payments (t_l and t_h). We find that the payment t_l appears on the left-hand sides only in (IC-lh') and (IR-l'):

$$\begin{aligned}
& \pi_{lG}\left\{\tau\left[t_l - \psi(R_l+\theta_l)\right] + (1-\tau)\left[t_{lG} - \psi(R_{lG}+\theta_l)\right]\right\} \\
& +(1-\pi_{lG})\left\{\tau\left[t_l - \psi(R_l+\theta_l)\right] + (1-\tau)\left[t_{lB} - \psi(R_{lB}+\theta_l)\right]\right\} \\
\geq\ & \pi_{lG}\left\{\tau\left[t_h - \psi(R_h+\theta_l)\right] + (1-\tau)\left[t_{hG} - \psi(R_{hG}+\theta_l)\right]\right\} \\
& +(1-\pi_{lG})\left\{\tau\left[t_h - \psi(R_h+\theta_l)\right] + (1-\tau)\left[t_{hB} - \psi(R_{hB}+\theta_l)\right]\right\},
\end{aligned}$$

$$\begin{aligned}
& \pi_{lG}\left\{\tau\left[t_l - \psi(R_l+\theta_l)\right] + (1-\tau)\left[t_{lG} - \psi(R_{lG}+\theta_l)\right]\right\} \\
& +(1-\pi_{lG})\left\{\tau\left[t_l - \psi(R_l+\theta_l)\right] + (1-\tau)\left[t_{lB} - \psi(R_{lB}+\theta_l)\right]\right\} \\
\geq\ & 0,
\end{aligned}$$

and t_h appears on the left-hand sides only in (IC-hl') and (IR-h'):

$$\begin{aligned}
& \pi_{hG}\left\{\tau\left[t_h - \psi(R_h+\theta_h)\right] + (1-\tau)\left[t_{hG} - \psi(R_{hG}+\theta_h)\right]\right\} \\
& +(1-\pi_{hG})\left\{\tau\left[t_h - \psi(R_h+\theta_h)\right] + (1-\tau)\left[t_{hB} - \psi(R_{hB}+\theta_h)\right]\right\} \\
\geq\ & 0,
\end{aligned}$$

$$\begin{aligned}
& \pi_{hG}\left\{\tau\left[t_h - \psi(R_h+\theta_h)\right] + (1-\tau)\left[t_{hG} - \psi(R_{hG}+\theta_h)\right]\right\} \\
& +(1-\pi_{hG})\left\{\tau\left[t_h - \psi(R_h+\theta_h)\right] + (1-\tau)\left[t_{hB} - \psi(R_{hB}+\theta_h)\right]\right\} \\
\geq\ & \pi_{hG}\left\{\tau\left[t_l - \psi(R_l+\theta_h)\right] + (1-\tau)\left[t_{lG} - \psi(R_{lG}+\theta_h)\right]\right\} \\
& +(1-\pi_{hG})\left\{\tau\left[t_l - \psi(R_l+\theta_h)\right] + (1-\tau)\left[t_{lB} - \psi(R_{lB}+\theta_h)\right]\right\}.
\end{aligned}$$

Furthermore, recalling the definition of $V(\gamma_{jk})$:

$$V(\gamma_{jk}) = \tau(v(R_j) - t_j) + (1-\tau)(v(R_{jk}) - t_{jk})$$

we can substitute $V(\gamma_{jk})$ in the board's objective and observe that the board's objective (U_o) is decreasing in both t_l and t_h. Therefore, at least one of (IC-lh') and (IR-l') must be binding, and at least one of (IC-hl') and (IR-h') must be binding. If this were not the case, the board can always reduce either the payment t_l or t_h and obtain a higher expected payoff without violating any constraint. As in the standard principal-agent problem, we will first ignore (IC-hl') and later verify that it is automatically satisfied by our candidate solutions. This leaves us with only two possible sets of binding constraints: {(IC-lh'),(IR-h')} and {(IR-l'),(IR-h')}. Below, we start with the case with {(IC-lh'),(IR-h')}; following this, we then consider the alternative set of constraints {(IR-l'),(IR-h')}.

Step 2: Rewrite the objective function.

Consider the case where the binding constraints are {(IC-lh'),(IR-h'), (IC-M)}. We first rewrite (IC-lh') as follows:

$$\begin{aligned}\pi_{lG}U_l(\gamma_{lG}) + (1-\pi_{lG})U_l(\gamma_{lB}) \quad &\geq \quad \pi_{lG}U_l(\gamma_{hG}) + (1-\pi_{lG})U_l(\gamma_{hB}) \\ &= \quad \pi_{hG}U_h(\gamma_{hG}) + (1-\pi_{hG})U_h(\gamma_{hB}) \\ &\quad\quad +\pi_{lG}U_l(\gamma_{hG}) + (1-\pi_{lG})U_l(\gamma_{hB}) \\ &\quad\quad -\pi_{hG}U_h(\gamma_{hG}) - (1-\pi_{hG})U_h(\gamma_{hB}),\end{aligned} \tag{14}$$

When the constraint (IR-h') is binding, then the type-h manager's expected payoff is zero, that is,

$$\pi_{hG}U_h(\gamma_{hG}) + (1-\pi_{hG})U_h(\gamma_{hB}) = 0.$$

Substituting $U_j(\gamma_{j'k})$ into (IC-lh') and simplifying the notation, we obtain the right-hand side of (14) as

$$\begin{aligned}&\tau[\psi(R_h+\theta_h) - \psi(R_h+\theta_l)] \\ &+(1-\tau)\left[\begin{array}{c}(\pi_{lG}-\pi_{hG})(t_{hG}-t_{hB}) - \pi_{lG}\psi(R_{hG}+\theta_l) - (1-\pi_{lG})\psi(R_{hB}+\theta_l) \\ +\pi_{hG}\psi(R_{hG}+\theta_h) + (1-\pi_{hG})\psi(R_{hB}+\theta_h)\end{array}\right],\end{aligned}$$

which represents the information rent that the board offers to the type-h manager in order to induce her truthful reporting. Two observations are as follows. First, when the accounting signal is informative, $\pi_{lG} > \pi_{hG}$, the information rent is strictly increasing in t_{hG} and decreasing in t_{hB}. Thus the board wants to reduce t_{hG} in order to reduce the manager's incentive to misreport. However, a low t_{hG} would further intensify the manager's incentive to manipulate the accounting signal. To curb such an incentive, the payment t_{hG} must satisfy the no-manipulation constraints (IC-M):

$$t_{hG} - \psi(R_{hG} + \theta_h) \geq t_{hB} - \psi(R_{hB} + \theta_h) - K, \tag{ICM-hg}$$

$$t_{hB} - \psi(R_{hB} + \theta_h) \geq t_{hG} - \psi(R_{hG} + \theta_h) - K. \tag{ICM-hb}$$

This implies that the payment t_{hG} must satisfy (ICM-hg) such that the manager does not manipulate the accounting signal. If the payment t_{hG} is not constrained, the board will obtain the first-best solution as shown in Proposition 1. In what follows, we will analyze the case where the accounting signal can be easily manipulated (a low K) and the board must offers a higher t_{hG} in order to satisfy no-manipulation constraint (ICM-hg).

Step 3: Derive the first-order conditions.

We consider the case where the no-manipulation constraints (ICM-hg) and (ICM-hb) are both binding. In this case, the accounting signal can be easily manipulated (a low K). In this case, the board must offer a higher t_{hG} in order to satisfy the no-manipulation constraint (ICM-hg) and (ICM-hb). Thus the binding constraints are {(IC-lh'),(IR-h'), (ICM-hg) and (ICM-hb)}. The no-manipulation constraints implies that

$$\psi(R_{hG} + \theta_h) - \psi(R_{hB} + \theta_h) + K \geq t_{hG} - t_{hB} \geq \psi(R_{hG} + \theta_h) - \psi(R_{hB} + \theta_h) - K$$

Because the board's incentive is to decrease t_{hG} as low as possible, the board can set the minimal t_{hG} that satisfies the no-manipulation constraint (ICM-hg) is given by

$$t^*_{hG} = t_{hB} + \psi(R_{hG} + \theta_h) - \psi(R_{hB} + \theta_h) - K.$$

The optimal t_{hB} is obtained such that the constraint (IR-h') is satisfied:

$$\begin{aligned}
&\pi_{hG} \left\{\tau \left[t_h - \psi(R_h + \theta_h)\right] + (1-\tau) \left[t_{hG} - \psi(R_{hG} + \theta_h)\right]\right\} \\
&+(1-\pi_{hG}) \left\{\tau \left[t_h - \psi(R_h + \theta_h)\right] + (1-\tau) \left[t_{hB} - \psi(R_{hB} + \theta_h)\right]\right\} = 0
\end{aligned}$$

The optimal compensations $\{t^*_{hG}, t^*_{hB}\}$ can be obtained from these two equations as

$$\begin{aligned}
t^*_{hB} &= \frac{\tau\psi(R_h + \theta_h) + (1-\tau)[\psi(R_{hB} + \theta_h) + \pi_{hG}K]}{(1-\tau)}, \\
t^*_{hG} &= \frac{\tau\psi(R_h + \theta_h) + (1-\tau)[\psi(R_{hG} + \theta_h) - (1-\pi_{hG})K]}{(1-\tau)}.
\end{aligned}$$

After substituting Δt_{hk} into (9) and simplifying notations, we obtain the manager's information rent Φ as

$$\begin{aligned}
\Phi \equiv\ & \tau[\psi(R_h + \theta_h) - \psi(R_h + \theta_l)] + (1-\tau)\{\pi_{lG}[\psi(R_{hG} + \theta_h) - \psi(R_{hG} + \theta_l)] \\
&+(1-\pi_{lG})[\psi(R_{hB} + \theta_h) - \psi(R_{hB} + \theta_l)] - (\pi_{lG} - \pi_{hG})K\}.
\end{aligned}$$

This equation indicates that if the accounting system is informative ($\pi_{lG} > \pi_{hG}$), the type-θ_l manager gains information rent by misreporting as $\hat{\theta}_h$ and such information rent decreases in the verifiability K and increases in the differentials of the revenue allocation ($\psi(R_{hk}+\theta_h)-\psi(R_{hk}+\theta_l)$).

Because the board can commit not to renegotiate the contract, the board can simply set the optimal period-1 payments $\{t_h, t_l\}$ to zero and adjust the second-period payments to satisfy the binding constraints. Given that (IC-lh'), (IR-h') and (ICM-hg) are binding, we then substitute t^*_{hG} and t^*_{hB} into the board's problem as follows:

$$V = \alpha \left\{ \begin{array}{c} \tau[v(R_l) - \psi(R_l + \theta_l)] \\ +(1-\tau)[\pi_{lG}(v(R_{lG}) - \psi(R_{lG}+\theta_l)) + (1-\pi_{lG})(v(R_{lB}) - \psi(R_{lB}+\theta_l))] \end{array} \right\}$$

$$+ (1-\alpha) \left\{ \begin{array}{c} \tau(v(R_h) - \psi(R_h + \theta_h)) \\ +(1-\tau)[\pi_{hG}(v(R_{hG}) - \psi(R_{hG}+\theta_h)) + (1-\pi_{hG})(v(R_{hB}) - \psi(R_{hB}+\theta_h))]\} \end{array} \right\}$$

$$- \alpha \left\{ \begin{array}{c} \tau[\psi(R_h + \theta_h) - \psi(R_h + \theta_l)] \\ +(1-\tau) \left[\begin{array}{c} (\pi_{lG} - \pi_{hG})[\psi(R_{hG}+\theta_h) - \psi(R_{hB}+\theta_h) - K] \\ -\pi_{lG}\psi(R_{hG}+\theta_l) - (1-\pi_{lG})\psi(R_{hB}+\theta_l) \\ +\pi_{hG}\psi(R_{hG}+\theta_h) + (1-\pi_{hG})\psi(R_{hB}+\theta_h) \end{array} \right] \end{array} \right\}.$$

The optimal solutions are characterized by the following first-order conditions. The optimal revenue for the type-l manager is characterized by the following first-order conditions for $S_k \in \{S_G, S_B\}$,

$$v'(R_l) - R_l - \theta_l = 0, \text{ and } v'(R_{lk}) - R_{lk} - \theta_l = 0.$$

In contrast, the net revenues for the type-h manager are characterized via the following first-order conditions:

$$v'(R_h) - R_h - \theta_h = \frac{\alpha}{1-\alpha}\Delta\theta, \tag{15}$$

$$v'(R_{hG}) - R_{hG} - \theta_h = \frac{\alpha}{1-\alpha}\frac{\pi_{lG}}{\pi_{hG}}\Delta\theta, \tag{16}$$

$$v'(R_{hB}) - R_{hB} - \theta_h = \frac{\alpha}{1-\alpha}\frac{1-\pi_{lG}}{1-\pi_{hG}}\Delta\theta, \tag{17}$$

where $\Delta\theta \equiv \theta_h - \theta_l$. The second-order conditions are all satisfied for $v''(\cdot) - 1 \leq 0$. Finally, in the absence of the accounting signal, the type-h firm's revenue allocation is distorted downwards as characterized by

$$v'(R_h^{sb}) - R_h^{sb} - \theta_h = \frac{\alpha}{1-\alpha}\Delta\theta.$$

If the accounting signal is informative ($\pi_{lG} > \pi_{hG}$), then one can verify that $R_{hG} < R_h = R_h^{sb} < R_{hB}$. The optimal compensation $\{t^*_{lG}, t^*_{lB}\}$ is determined by satisfying the (IC-hl') constraint as

$$-\psi(R_l + \theta_l) + (1-\tau)\left[\pi_{lG}(t_{lG} - t_{lB}) + t_{lB}\right] \geq \Phi$$

where Φ is the type-θ_l manager's information rent. Because we have one equation and two unknowns, this implies that the optimal compensation $\{t_{lG}^*, t_{lB}^*\}$ are

$$t_{lG}^* = \frac{\Phi + \psi(R_l + \theta_l)}{(1-\tau)\pi_{lG}} - \frac{1-\pi_{lG}}{\pi_{lG}} t_{lB}^*.$$

The verification of (IC-hl') follows directly (because the single-crossing condition is satisfied in our context).

Proof of Corollary 2 (the levels of the revenue distortions).

First, by equating (15) and (16), we obtain

$$\begin{aligned} & v^{'}(R_h) - R_h - \theta_h - \frac{\alpha}{1-\alpha}\Delta\theta \\ = & \; v^{'}(R_{hG}) - R_{hG} - \theta_h - \frac{\alpha}{1-\alpha}\frac{\pi_{lG}}{\pi_{hG}}\Delta\theta. \end{aligned}$$

Rearranging the terms yields

$$(R_{hG} - R_h) - (v^{'}(R_{hG}) - v^{'}(R_h)) = \frac{\alpha\Delta\theta}{1-\alpha}\left(1 - \frac{\pi_{lG}}{\pi_{hG}}\right).$$

Suppose that $R_{hG} > R_h$. When the accounting system is informative, the right-hand side of the equality is strictly negative. This implies that $v^{'}(R_{hG}) > v^{'}(R_h)$. But the concavity of $v''(\cdot) \leq 0$ implies that $v^{'}(R_{hG}) < v^{'}(R_h)$, a contradiction. Thus, we obtain that $R_{hG} < R_h$. Following the same method, we equate (15) and (17):

$$(R_{hB} - R_h) - (v'(R_{hB}) - v'(R_h)) = \frac{\alpha\Delta\theta}{1-\alpha}\left(1 - \frac{1-\pi_{lG}}{1-\pi_{hG}}\right).$$

which suggests $R_{hB} > R_h$, because the right-hand side of the equation is positive. Collectively, we conclude that $R_{hG} < R_h < R_{hB}$. □

Proof of Corollary 3 (the effect of accounting informativeness on the revenue distortions).

Recall that the conditional probabilities are given by

$$\begin{aligned} \pi_{lG} &= \Pr(S_G|\theta_l) = \lambda + \delta, \text{ and } \pi_{lB} = \Pr(S_B|\theta_l) = 1 - \lambda - \delta, \\ \pi_{hG} &= \Pr(S_G|\theta_h) = \delta, \text{ and } \pi_{hB} = \Pr(S_B|\theta_h) = 1 - \delta. \end{aligned}$$

We now turn to examine the effect of the informativeness of accounting signals λ. This effect can be illustrated by taking partial derivatives

$$\begin{aligned} \frac{\partial R_{hG}}{\partial \lambda} &= \frac{\frac{\alpha}{1-\alpha}\frac{\partial}{\partial\lambda}\left(\frac{\pi_{lG}}{\pi_{hG}}\right)\Delta\theta}{v''(R_{hG}) - 1} = \frac{\frac{\alpha}{1-\alpha}\frac{1}{\delta}\Delta\theta}{v''(R_{hG}) - 1} > 0, \\ \frac{\partial R_{hB}}{\partial \lambda} &= \frac{\frac{\alpha}{1-\alpha}\frac{\partial}{\partial\lambda}\left(\frac{1-\pi_{lG}}{1-\pi_{hG}}\right)\Delta\theta}{v''(R_{hB}) - 1} = \frac{\frac{\alpha}{1-\alpha}\frac{1}{\delta-1}\Delta\theta}{v''(R_{hG}) - 1} < 0. \end{aligned}$$

Because the second-order conditions are satisfied, we conclude that $\partial R_{hG}/\partial\lambda < 0$, $\partial R_{hB}/\partial\lambda > 0$ and $\partial R_h/\partial\lambda = 0$. If the accounting system becomes completely uninformative ($\lambda = 0$), then both R_{hG} and R_{hB} approaches the second best solution R_h; that is,

$$\lim_{\lambda\to 0} R_h = \lim_{\lambda\to 0} R_{hG} = \lim_{\lambda\to 0} R_{hB},$$

where

$$R_h = v'(R_h) - \theta_h - \frac{\alpha}{1-\alpha}\Delta\theta.$$

Proof of Corollary 4 (the effect of accounting conservatism on the revenue distortions).

The parameter δ represents the level of accounting conservatism; the smaller δ, the more conservative the accounting system is. The effects of accounting conservatism can be shown by a similar method.

$$\begin{aligned}
\frac{\partial R_{hG}}{\partial\delta} &= \frac{\frac{\alpha}{1-\alpha}\frac{\partial}{\partial\lambda}\left(\frac{\pi_{lG}}{\pi_{hG}}\right)\Delta\theta}{v''(R_{hG})-1} = \frac{\frac{\alpha}{1-\alpha}\frac{-\lambda}{\delta^2}\Delta\theta}{v''(R_{hG})-1} > 0,\\
\frac{\partial R_{hB}}{\partial\delta} &= \frac{\frac{\alpha}{1-\alpha}\frac{\partial}{\partial\lambda}\left(\frac{1-\pi_{lG}}{1-\pi_{hG}}\right)\Delta\theta}{v''(R_{hB})-1} = \frac{\frac{\alpha}{1-\alpha}\frac{-\lambda}{(\delta-1)^2}\Delta\theta}{v''(R_{hG})-1} > 0.
\end{aligned}$$

We can show that $\partial R_{hG}/\partial\delta > 0$, $\partial R_{hB}/\partial\delta > 0$ and $\partial R_h/\partial\delta = 0$. If the accounting system becomes extremely liberal ($\delta = 1-\lambda$), then it can be shown that R_{hB} approaches the first-best solution R_l and R_{hG} is always below the second-best allocation R_h. $\square$

Proof of Proposition 3 (the effect of accounting informativeness on the information rent).

The type-θ_l manager's expected payoff (information rent) is given by

$$\begin{aligned}
\Phi &= \tau[\psi(R_h+\theta_h) - \psi(R_h+\theta_l)] + (1-\tau)\{\pi_{lG}[\psi(R_{hG}+\theta_h) - \psi(R_{hG}+\theta_l)]\\
&\quad +(1-\pi_{lG})[\psi(R_{hB}+\theta_h) - \psi(R_{hB}+\theta_l)] - (\pi_{lG}-\pi_{hG})K\}.
\end{aligned}$$

To examine the effect of accounting informativeness, we take a derivative with respect to λ and find that

$$\frac{d\Phi}{d\lambda} = \underbrace{\frac{\partial\Phi}{\partial\lambda}}_{\text{Direct effect}} \underbrace{+\frac{\partial\Phi}{\partial R_h}\frac{\partial R_h}{\partial\lambda} + \frac{\partial\Phi}{\partial R_{hG}}\frac{\partial R_{hG}}{\partial\lambda} + \frac{\partial\Phi}{\partial R_{hB}}\frac{\partial R_{hB}}{\partial\lambda}}_{\text{Indirect effects}}$$

First, we show the direct effect of accounting informativeness on the high-type manager's utility:

$$\begin{aligned}
\frac{\partial\Phi}{\partial\lambda} &= (1-\tau)\{\psi(R_{hG}+\theta_h) - \psi(R_{hG}+\theta_l) - [\psi(R_{hB}+\theta_h) - \psi(R_{hB}+\theta_l)] - K\}\\
&= (1-\tau)[(R_{hG}-R_{hB})\Delta\theta - K] < 0,
\end{aligned}$$

which is negative because $R_{hG} < R_{hB}$, $\partial \pi_{lG}/\partial \lambda > 0$ and $\partial \pi_{hG}/\partial \lambda = 0$. The strategic (indirect) effects on U_l are given by (utilizing the first-order conditions from (15), (16) and (17)):

$$\begin{aligned}
\frac{\partial \Phi}{\partial R_h} &= \tau \Delta\theta, \\
\frac{\partial \Phi}{\partial R_{hG}} &= (1-\tau)\pi_{lG}\Delta\theta, \\
\frac{\partial \Phi}{\partial R_{hB}} &= (1-\tau)(1-\pi_{lG})\Delta\theta.
\end{aligned}$$

Substituting these terms into $d\Phi/d\lambda$ yeilds the strategic effects:

$$\begin{aligned}
& \frac{\partial \Phi}{\partial R_h}\frac{\partial R_h}{\partial \lambda} + \frac{\partial \Phi}{\partial R_{hG}}\frac{\partial R_{hG}}{\partial \lambda} + \frac{\partial \Phi}{\partial R_{hB}}\frac{\partial R_{hB}}{\partial \lambda} \\
= \;& (1-\tau)\left[\pi_{lG}\Delta\theta \frac{\frac{\alpha}{1-\alpha}\frac{1}{\delta}\Delta\theta}{v''(R_{hG})-1} - (1-\pi_{lG})\Delta\theta \frac{\frac{\alpha}{1-\alpha}\frac{1}{1-\delta}\Delta\theta}{v''(R_{hG})-1}\right] \\
= \;& \frac{(1-\tau)\frac{\alpha}{1-\alpha}(\Delta\theta)^2}{v''(R_{hG})-1}\frac{\lambda}{\delta(1-\delta)} < 0,
\end{aligned}$$

where $\partial R_{hB}/\partial \lambda = 0$. Thus we can conclude that both the direct and indirect effects are negative, suggesting that $d\Phi/d\lambda < 0$.

When the accounting system becomes uninformative (i.e., approaches the neighborhood $\lambda = 0$), the revenue allocations approach the second-best solution as shown by the first-order conditions (15), (16) and (17), that is

$$\lim_{\lambda \to 0} R_h = \lim_{\lambda \to 0} R_{hG} = \lim_{\lambda \to 0} R_{hB},$$

where

$$R_h = v'(R_h) - \theta_h - \frac{\alpha}{1-\alpha}\Delta\theta.$$

In this case, the type-θ_l manager's information rent is

$$\lim_{\lambda \to 0} \Phi = [\psi(R_h + \theta_h) - \psi(R_h + \theta_l)] > 0.$$

This implies that the manager earns positive rent when the accounting signal is completely uninformative and such rent decreases in the precision of the signal. Thus, there exists a level of informativeness $\bar{\lambda}(K)$ such that $U_l(\bar{\lambda}(K)) = 0$. Solving for $\bar{\lambda}(K)$ and differentiating with respect to K yields

$$\frac{d\bar{\lambda}(K)}{dK} = \frac{(\pi_{lG} - \pi_{hG})K}{(R_{hG} - R_{hB})\Delta\theta - K} < 0.$$

Thus, the critical level of informativeness $\bar{\lambda}(K)$ decreasing in the level of verifiability K. For any $\lambda > \bar{\lambda}(K)$, the board can obtain the first-best solution as we have shown in Proposition 1. $\square$

Proof of Proposition 4 (the effect of accounting conservatism on the information rent).

By the similar method, to examine the effect of accounting conservatism, we take a derivative with respect to δ and find that

$$\frac{d\Phi}{d\delta} = \underbrace{\frac{\partial\Phi}{\partial\delta}}_{\text{Direct effect}} \underbrace{+\frac{\partial\Phi}{\partial R_h}\frac{\partial R_h}{\partial\delta} + \frac{\partial\Phi}{\partial R_{hG}}\frac{\partial R_{hG}}{\partial\delta} + \frac{\partial\Phi}{\partial R_{hB}}\frac{\partial R_{hB}}{\partial\delta}}_{\text{Indirect effects}}$$

First, we show the direct effect of accounting informativeness on the high-type manager's utility:

$$\frac{\partial\Phi}{\partial\delta} = (1-\tau)[(R_{hG} - R_{hB})\Delta\theta - K] < 0,$$

which is negative because $R_{hG} < R_{hB}$, $\partial\pi_{lG}/\partial\delta > 0$ and $\partial\pi_{hG}/\partial\delta = 0$. Substituting these terms into $d\Phi/d\delta$ yields the indirect effects:

$$\begin{aligned}
& \frac{\partial\Phi}{\partial R_h}\frac{\partial R_h}{\partial\delta} + \frac{\partial\Phi}{\partial R_{hG}}\frac{\partial R_{hG}}{\partial\delta} + \frac{\partial\Phi}{\partial R_{hB}}\frac{\partial R_{hB}}{\partial\delta} \\
= \; & (1-\tau)\left[\pi_{lG}\Delta\theta\frac{\frac{\alpha}{1-\alpha}\frac{-\lambda}{\delta^2}\Delta\theta}{v''(R_{hG})-1} + (1-\pi_{lG})\Delta\theta\frac{\frac{\alpha}{1-\alpha}\frac{-\lambda}{(\delta-1)^2}\Delta\theta}{v''(R_{hG})-1}\right] \\
= \; & \frac{-\lambda(1-\tau)\frac{\alpha}{1-\alpha}(\Delta\theta)^2}{v''(R_{hG})-1}\left(\frac{\lambda+\delta}{\delta^2} + \frac{1-\lambda-\delta}{(\delta-1)^2}\right) > 0,
\end{aligned}$$

where $\partial R_{hB}/\partial\delta = 0$. Thus, collectively, we can show

$$\frac{d\Phi}{d\delta} = (1-\tau)\Delta\theta\left[\underbrace{(R_{hG} - R_{hB}) - K}_{<0} + \underbrace{\frac{-\lambda(1-\tau)\frac{\alpha}{1-\alpha}\Delta\theta}{v''(R_{hG})-1}\left(\frac{\lambda+\delta}{\delta^2} + \frac{1-\lambda-\delta}{(\delta-1)^2}\right)}_{>0}\right].$$

Given that, we conclude that the sign of $d\Phi/d\delta$ depends on the level of verifiability K. Because $d\Phi/d\delta$ is strictly decreasing in K, there exists a cut-off point $\hat{K}$, such that for $K < \hat{K}$, the type-θ_l manager's information rent decreases in the level of conservatism ($d\Phi/d\delta > 0$), where $\hat{K}$ is the solution for $d\Phi/d\delta = 0$. By the same argument, as $d\Phi/d\delta$ is strictly increasing in $\Delta\theta$, it is shown that when the type uncertainty $\Delta\theta$ is large, then the information rent decreases in the level of conservatism ($d\Phi/d\delta > 0$). □

Proof of Proposition 5 (the effect of accounting verifiability on the information rent).

We consider the case where all no manipulation constraints (ICM-hg), (ICM-hb), (ICM-lg) and (ICM-lb) are all binding. In this case, the level of accounting verifiability K is very small. The type-θ_l manager may have an incentive to manipulate the accounting signal. To ensure that the type-θ_l

manager does not have an incentive to manipulate the accounting signal, the no-manipulation constraint must be satisfied, that is,

$$t_{lG} - \psi(R_{lG} + \theta_l) \geq t_{lB} - \psi(R_{lB} + \theta_l) - K, \tag{ICM-lg}$$

$$t_{lB} - \psi(R_{lB} + \theta_l) \geq t_{lG} - \psi(R_{lG} + \theta_l) - K. \tag{ICM-lb}$$

To incentivize truthful reporting, the board intends to compensate the manager by lowering t_{lB} and increasing t_{lG} when the accounting signal is informative. This implies that the binding constraint is (ICM-lb): $t_{lB} \geq t_{lG} + \psi(R_{lB} + \theta_l) - \psi(R_{lG} + \theta_l) - K$.

In this equilibrium, the board's problem is characterized by four binding constraints (IC-lh'), (IR-h), (ICM-hg), and (ICM-lb). To solve the board's maximization problem, we first obtain t_{lB} from (ICM-lb) and t_{hG} from (ICM-hg); afterwards, we then substitute $\{t_{lB}, t_{hG}\}$ into (IR-h') and solve for (t_{hG}, t_{lG}) from (IR-h') and (IC-lh') jointly. The optimal compensation schemes are given by

$$\begin{aligned}
t_{lk} &= \frac{1}{1-\tau}[\tau(\psi(R_h + \theta_h) - \psi(R_h + \theta_l) + \psi(R_l + \theta_l)) \\
&\quad +(1-\tau)\{(1-\pi_{hG})[\psi(R_{hB} + \theta_h) - \psi(R_{hB} + \theta_l) + \psi(R_{lG} + \theta_l)] + \\
&\quad \pi_{hG}[\psi(R_{lk} + \theta_l) - \psi(R_{hG} + \theta_l)] + K(1 + \pi_{hG} - 2\pi_{lG})\}, \\
t_{hG} &= \frac{1}{1-\tau}\{\tau\psi(R_h + \theta_h) + (1-\tau)[\psi(R_{hG} + \theta_h) - K(1 - \pi_{hG})]\}, \\
t_{hB} &= \frac{1}{1-\tau}\{\tau\psi(R_h + \theta_h) + (1-\tau)[\psi(R_{hB} + \theta_h) + K\pi_{hG}]\}.
\end{aligned}$$

Note that under this case, the type-θ_l manager's information rent is the same as that when the constraint (ICM-lb) is not binding. This is because the the compensation schemes $\{t_{lG}, t_{lB}\}$ do not enter the (IC-lh') constraint. The constraint (ICM-lb) only affects how the board adjusts the $\{t_{lG}, t_{lB}\}$ in order to satisfy (IR-l) constraint. As the board's expected payoff does not change by (ICM-lb), the revenue allocations are the same as those given by Proposition 2.

We now prove that the manager's information rent is strictly lower even when the manager can manipulate the accounting signal without a cost (i.e., $K = 0$). If the accounting signal is available, the type-θ_l manager's information rent is given by

$$\begin{aligned}
\Phi &= \tau[\psi(R_h + \theta_h) - \psi(R_h + \theta_l)] + (1-\tau)\left\{\begin{array}{c} \pi_{lG}[\psi(R_{hG} + \theta_h) - \psi(R_{hG} + \theta_l)] \\ +(1-\pi_{lG})[\psi(R_{hB} + \theta_h) - \psi(R_{hB} + \theta_l)] - (\pi_{lG} - \pi_{hG})K \end{array}\right\} \\
&= \tau[\psi(R_h + \theta_h) - \psi(R_h + \theta_l)] \\
&\quad +(1-\tau)\left\{\frac{\Delta\theta}{2}\{-\Delta\theta + 2[\pi_{lG}(R_{hG} + \theta_h) + (1-\pi_{lG})(R_{hB} + \theta_l)]\} - (\pi_{lG} - \pi_{hG})K\right\}.
\end{aligned}$$

In constrast, under the standard second-best solution, the type-θ_l manager's information rent is

$$\begin{aligned}\Phi^{sb} &= \tau[\psi(R_h+\theta_h)-\psi(R_h+\theta_l)]+(1-\tau)\left(\psi(R_h+\theta_h)-\psi(R_h+\theta_l)\right) \\ &= \tau[\psi(R_h+\theta_h)-\psi(R_h+\theta_l)]+(1-\tau)\frac{\Delta\theta}{2}[-\Delta\theta+2(R_h+\theta_h)].\end{aligned}$$

This suggests that the change in the manager's information rent due to the clawback provisions is

$$\Phi^{sb}-\Phi=(1-\tau)\Delta\theta\{(R_h+\theta_h)-[\pi_{lG}(R_{hG}+\theta_h)+(1-\pi_{lG})(R_{hB}+\theta_l)-(\pi_{lG}-\pi_{hG})K]\}.$$

Substituting the first order conditions and simplifying notation yields

$$\Phi^{sb}-\Phi=(1-\tau)\Delta\theta\left\{\begin{array}{c}\left[v^{'}(R_h)-\frac{\alpha}{1-\alpha}\Delta\theta\right]-\pi_{lG}\left[v^{'}(R_{hG})-\frac{\alpha}{1-\alpha}\frac{\pi_{lG}}{\pi_{hG}}\Delta\theta\right] \\ -(1-\pi_{lG})\left[v^{'}(R_{hB})-\frac{\alpha}{1-\alpha}\frac{1-\pi_{lG}}{1-\pi_{hG}}\Delta\theta\right]+(\pi_{lG}-\pi_{hG})K\end{array}\right\}.$$

Because $R_{hG}<R_h<R_{hB}$, $v^{'}(R_{hG})>v^{'}(R_h)>v^{'}(R_{hB})$ and $\pi_{lG}>\pi_{lG}$, there exists a cut-off K such that $\Phi^{sb}=\Phi$. To gain more insights into the cut-off point K, let us assume that $v(R)=R-\frac{1}{2}vR^2$. Under this assumption, it can be shown that the revenue allocations are as follows:

$$\begin{aligned}R_h &= \frac{1}{1+v}\left(1-\theta_h-\frac{\alpha}{1-\alpha}\Delta\theta\right), \\ R_{hG} &= \frac{1}{1+v}\left(1-\theta_h-\frac{\pi_{lG}}{\pi_{hG}}\frac{\alpha}{1-\alpha}\Delta\theta\right), \\ R_{hB} &= \frac{1}{1+v}\left(1-\theta_h-\frac{1-\pi_{lG}}{1-\pi_{hG}}\frac{\alpha}{1-\alpha}\Delta\theta\right).\end{aligned}$$

Given that, the cut-off point K that makes $\Phi^{sb}=\Phi$ is

$$K=-\frac{\frac{\alpha}{1-\alpha}\Delta\theta(\pi_{lG}-\pi_{hG})}{(1+v)\pi_{hG}(1-\pi_{hG})},$$

which is negative as long as $\pi_{lG}>\pi_{hG}$. This implies that when the accounting verifiability K is zero, the type-θ_l manager's information rent is still strictly lower than that when the clawback provisions are not adopted. □

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