Title
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Publication Date
2012-12-01

Undergraduate

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Working Paper # 2012 -13

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December,2012

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Abstract

A clawback provision is the right of a firm to recover from an executive's compensation as the result of triggering events, such as a financial restatement. We argue that the adoption of clawback provisions may exacerbate a manager's incentive to avoid financial restatements via earnings management. Only when the accounting verifiability is high, making earnings management very costly, can clawback provisions completely eliminate the manager's incentive to misreport ex-ante; otherwise, clawback provisions stipulate a reduction of future executive compensation in the event of a financial restatement. We show firms still benefit from implementing clawback provisions, while earnings management is costless. This result may explain why companies voluntarily adopt clawback provisions, in spite of the detrimental effect of earnings management.

Keywords: clawback provisions, dynamic incentives, information asymmetry

*We thank Tim Baldenius, Jeremy Bertomeu, Carlos Corona, Masako Darrough, Shane Dikolli, Qintao Fan, Frank Gigler, Brian Mittendorf, Volker Laux, Pierre Liang, Nahum Melumad and workshop participants at Baruch College, New York University, University of California at Berkeley, University of California at Irvine, University of Minnesota, University of Texas at Dallas, the 2011 AAA Conference at Denver, the 2011 JAFF Conference for helpful comments and suggestions. Ying-Ju Chen thanks the Coleman Fung Risk Management Research Center for financial support. All remaining errors are our own.

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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. In response to these concerns, Section 304 of the Sarbanes-Oxley Act of 2002 (hereafter, SOX) authorizes the Securities and Exchange Commission (SEC) to enforce the recovery of bonus paid to top managers (clawback provisions) in the event of financial restatements.[1] 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.

The extant literature has documented that clawback provisions may effectively reduce a manager's ex-ante incentive to misreport private information in an adverse selection setting. For example, Baron and Besanko (1984) argues that if managers know misreporting may face unbounded penalty ex-post, they have no incentive to mis-represent accounting information ex-ante (aka, the maximal punishment principle). Cremer and McLean (1988) and Riordan and Sappington (1988) show that a firm can completely reduce the ex-ante incentive to misreport private information if it can ex-post adjust the manager's compensation depending on the realization of ex-post signals (such as an audited financial reports). Gigler and Hemmer (1998) argue that audited ex-post financial reports can serve as a disciplining role such that the manager has an ex-ante incentive to provide more informative and timely voluntary disclosures. These studies provide some support for regulators' argument that clawback provisions mitigate the incentive of misreporting financial statements, thereby resulting in higher shareholders' value (Lucchetti (2010)).

What are the potential costs of implementing clawback provisions? The Corporate Library shows that clawback provisions in compensation contracts are usually either fraud-based or performance-based: fraud-based clawback provisions apply only to executives who have engaged in misconduct leading to a restatement, whereas performance-based ones pertain to any executive who received incentive compensation due to incorrect financial records. To implement clawback provisions, firms need to make managers' compensation contingent on ex-post verifiable accounting signals, which

[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.

triggers financial restatements. Nonetheless, these accounting signals are subject to earnings management that is pervasively documented in the empirical literature. This possibility creates an adverse effect on clawback provisions, because managers would then have strong incentives to avoid financial restatements and impedes clawback provisions from being triggered by exploiting discretion and manipulating accounting signals. This detrimental effect of earnings management on clawback provisions seems to have been overlooked by policy makers and researchers. This paper attempts to address the following research questions. Can a firm still implement the first-best solution when accounting signals are not verifiable? If not, how should a firm resolve the trade-off between the benefits of clawback provisions and the potential costs of 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 increase sales revenue. The manager has an incentive to over-report uncollectible revenue so that she could achieve the revenue target by less effort. 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 (audit) 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.

We argue that the effectiveness of clawback provisions critically depends on the level of accounting verifiability. When the accounting verifiability is high, making earnings management very costly, the board can effectively utilize the clawback provisions to deter the manager from misreporting her ex-ante private information and to implement the first-best revenue targets without giving up any information rent. 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 clawback all losses when the manager's report deviates from the accounting signal. In this case, we show that the board distorts the second-period revenue targets in order to induce the manager's truthfully report and to alleviate her incentive to ex-post manipulate the accounting signal.

Our analysis demonstrates that these two intertwined economic factors may lead to unintended consequences. One may conjecture that the board shall request the manager to achieve a higher (lower) revenue target when the accounting signal is good (bad); this conventional wisdom may not hold when the accounting signal can be manipulated. When the manager claims to be inefficient but the accounting signal turns out to be good, the board knows the manager is likely to have misreported and thus reduces the second-period revenue target. Because the efficient manager suffers more from downward-distorted revenue targets than the inefficient manager, they constitute an effective instrument to facilitate ex-ante truth-telling. If the manager's report as the inefficient one and the accounting signal is bad, the board actually imposes a higher revenue target, because the manager is more likely to be inefficient.

Contrary to the common belief, we find the revenue distortions are exacerbated when the accounting system is *more* informative. As the accounting system becomes more 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 targets, because the benefit of reducing information rent is larger than the cost of revenue inefficiency. If the accounting system becomes completely uninformative, the revenue targets are closer to the classical second-best solution. This implies that the accounting verifiability 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 informative 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 trade-off 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 adds insights into the widespread debate over the introduction of clawback provisions. We argue the clawback provisions can 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 potential earnings management problems. The board benefits from these signal-contingent revenue targets for two reasons. Even though the board has to balance the payoff for each type of the 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 targets and perceive different probabilities of the signal realizations. As a result, the contingency compensation contract mitigates the revenue inefficiency that results from the adverse selection. Thus, utilizing signal-contingent revenue targets (clawback provisions) allows the board to better differentiate different types of managers despite the costless ex-post manipulation.

Our analysis suggests several interesting predictions between the properties of the accounting system and the managerial compensation (clawback) contracts. For example, the revenue targets are distorted in the *opposite* direction of what the accounting signal indicates. 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 accounting verifiability is higher. In contrast, the revenue targets are 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 target contingent on the ex-post realization of the accounting signal. Our analysis consequently reveals some interesting results that the revenue targets in the second period are distorted in the opposite direction that an accounting signal indicates.

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 papers 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 targets in two periods) to extract the agent's information rent. We cannot obtain the same result in a one-period model as in Gary-Bobo and Spiegel (2006) and Kessler et al. (2005), where ex-ante revenue target 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 relates 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, Levine and Smith (2010) consider a model wherein the manager takes a first-period effort that stochastically determines a first-period signal and a second-period cash flow. They compare the optimal contracts under various circumstances (clawback versus no clawback provisions and manipulation versus no-manipulation contracts). They find that the no-clawback contract dominates the clawback contract if the cash realization is relatively noisy, earnings management is difficult, or the agent is very impatient. 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 in ex-ante information asymmetry, where the fundamental problem is a trade-off between efficiency and rents. Maggi and Rodriguez-Clare (1995) show that if the cost of earnings management is type-dependent, a principal can strategically induce an inefficient manager to conduct earnings management on the production outputs, thereby reducing the information rent given up to an efficient manager. Our paper differs from Maggi and Rodriguez-Clare (1995) in many aspects. We study a two-period model in which a principal can observe an interim noisy accounting signal and adjust the second-period compensation. Earnings management does not directly affect an agent's outputs, but rather hinders a principal's ability to extract rent from the agent. Since the cost of earnings manager does not hinge on an agent's true type, we assume away the countervailing incentives in Maggi and Rodriguez-Clare (1995). Thus, the efficient manager's information rent in our context strictly decreases in the informativeness of the accounting signal, and our analysis delivers completely different economic insights.

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) 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.

Product revenue and managerial effort. 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 a probability $\alpha = \Pr(\theta = \theta_l)$. Upon exerting the costly effort to increase the product revenue, the manager incurs a disutility (in monetary terms) $\psi(e) = e^2/2$, 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.[2]

Accounting signal. 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, because 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

[2]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.

upon the realization of θ_j. 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)). 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). This specification suggests that the likelihood ratio (π_{lG}/π_{hG}) increases when the accounting signal becomes more informative (a higher λ). But if the accounting signal is more conservative, the likelihood ratio is smaller.

Accounting manipulation. 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}. 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 a proxy for the verifiability of the accounting signal.[3] Our goal is to investigate how the manager's manipulation gives rise to a materialistic effect even if manipulation is never induced in equilibrium.[4]

Payoffs. We normalize the total length of the contracting period to 1. The first period of production lasts for $\tau \in (0, 1)$, and the second period of production lasts for the remaining time $1 - \tau$. Upon observing the sales 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 in two periods, respectively. We assume that $v(R)$ is increasingly concave in R (i.e.,

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

[4]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.

$v'(\cdot) > 0$ and $v''(\cdot) \leq 0$). In contrast, a type-j manager's payoff given (R_1, R_2) is

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

Mechanism, reports, and compensation.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 the uncollectible revenue (type). Given the manager's report $\hat{\theta}$ (which may not necessarily equal her true type), the board requests the manager to achieve the revenue target $R_1(\hat{\theta})$ in period one and compensates the manager by $t_1(\hat{\theta})$. Then the board observes the accounting signal S at the end of period one. The period-two contract specifies the revenue target $R_2(\hat{\theta}, S)$ and the compensation pay $t_2(\hat{\theta}, S)$ to the manager. Thus, the board essentially 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.[5] 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 S. In particular, if the ex-post accounting signal S indicates that the true uncollectible revenue is likely to differ from the manager's ex-ante report $\hat{\theta}$, the board may adjust the second-period compensation to the manager.

We utilize this two-period compensation contract to capture the spirit of performance-based clawback provisions. While varying from firm to firm, clawback provisions in general have two components. First, the firm compensates the manager based on the performance measure $R_1(\hat{\theta})$ which is a function of the manager's action e and report $\hat{\theta}$. Second, later the long-term consequences of the manager's report $\hat{\theta}$, which was not fully captured by the performance measure $R_1(\hat{\theta})$, is revealed by an accounting (or audit) signal S. At this point, when ex-ante managerial reports are different from ex-post accounting signals (or audited evidence), firms in practice may need to restate their financial statements. The restatement subsequently triggers off clawback provisions. For example, 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 reputation harm to the firm.[6]

Timing. The sequence of events 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 sales revenue $R_1(\hat{\theta})$ and receives corresponding transfer $t_1(\hat{\theta})$ in period

[5]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.

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

one. 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.

In Appendix, we demonstrate two classical benchmark cases in which the clawback provisions are absent: 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 is implemented. In the next section, we analyze the optimal design of clawback provisions.

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. The implementation 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 we will demonstrate below.

To characterize the optimal clawback provisions, we shall first 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

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

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 revenue targets $R_1(\hat{\theta})$ and $R_2(\hat{\theta}, S)$). Ex-ante, a type-θ_j manager receives a good accounting report S_G with a probability $\pi_{jG} = \Pr(S_G|\theta_j)$. Thus, the manager's ex-ante expected payoff is specified as

$$\pi_{jG} U(\hat{\theta}|\theta_j, S_G) + (1 - \pi_{jG}) U(\hat{\theta}|\theta_j, S_B). \tag{2}$$

To simplify the notation, we define

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

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, $U(\theta_j|\theta_j, S) \geq U(\theta_{-j}|\theta_j, S)$. The incentive compatibility for a type-θ_j manager is specified by

$$\pi_{jG}U_j(\gamma_{jG}) + (1 - \pi_{jG})U_j(\gamma_{jB}) \geq \pi_{jG}U_j(\gamma_{-jG}) + (1 - \pi_{jG})U_j(\gamma_{-jB}). \tag{3}$$

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

$$U(\theta_j) = \pi_{jG}U_j(\gamma_{jG}) + (1 - \pi_{jG})U_j(\gamma_{jB}) \geq 0, \tag{4}$$

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 $U_j(\gamma_{j-k}) - K$.[7] 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

$$t_2(\theta_j, S_k) - \psi(R_2(\theta_j, S_k) + \theta_j) \geq t_2(\theta_j, S_{-k}) - \psi(R_2(\theta_j, S_{-k}) + \theta_j) - K. \tag{5}$$

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

[7] 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 ex-post. 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.

may affect the manager's incentive to misreport her private information and identify the conditions under which the board would prefer no accounting manipulation.[8]

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

$$V(\gamma_{jk}) \equiv \tau[v(R_1(\theta_j)) - t_1(\theta_j)] + (1-\tau)[v(R_2(\theta_j, S_k)) - t_2(\theta_j, S_k)]. \tag{6}$$

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 accounting verifiability is high, the manger finds it too costly to manipulate the accounting signal. As a result, the board can effectively utilize the accounting signal to reduce the information rent. We label this as "*efficient schedule* regime." But when the accounting verifiability is relatively lower, the board must adjust the payments and the revenue targets so as to satisfy the no-manipulation constraint (IC-M). We call this scenario "*distorted schedule* regime." In what follows, we characterize the equilibria in more detail.

4.1 Efficient schedule 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 accounting verifiability 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. 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

[8] 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, it is more costly for the type-θ_l manager to misreport her private information, thereby reducing 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 a lower compensation pay $t_2(\theta_h, S_G)$ than $t_2(\theta_h, S_B)$. One can apply the same argument 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 a 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, 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, one can 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, this mechanism implements the first-best revenue targets $\{R_1(\hat{\theta}), R_2(\hat{\theta}, S)\}$. We characterize the optimal compensation schemes that implement the first-best revenue targets in Appendix. The following proposition summarizes the result. To simplify notations, we denote R_j by the first-period revenue targets and R_{jk} by second-period revenue targets, where $j \in \{h, l\}$ and $k \in \{G, B\}$.

Proposition 1. *When the accounting verifiability is relatively high, the board can implement the first-best revenue targets where $R_h < R_l$, $R_l = R_{lk} = R_l^{fb}$ and $R_h = R_{hk} = R_h^{fb}$, for $k \in \{G, B\}$, without paying any information rent. 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 target in both periods. This result critically depends on the assumption that the board can create a sufficient large pay differential

$$t_2(\theta_j, S_B) - t_2(\theta_j, S_G) = \frac{\psi(R_j + \theta_h) - \psi(R_j + \theta_l)}{(1 - \tau)(\pi_{lG} - \pi_{hG})}, \tag{7}$$

such that the manager has no incentive to misreport her private information.

Holding the accounting verifiability K constant, the implementation of the first-best revenue targets requires $t_2(\theta_j, S_B) - t_2(\theta_j, S_G) \leq K$ in order to prevent the ex-post manipulation. Thus, if the accounting signal is sufficiently informative (i.e., $\lambda = \pi_{lG} - \pi_{hG}$ is high), the board can implement the first-best revenue targets. But the accounting conservatism δ does not affect (7) and thus does not help to prevent revenue distortions. We highlight this observation below.

Corollary 1. *Holding the accounting verifiability K constant, the board is more likely to implement the first-best revenue targets when the accounting signal is sufficiently informative. But the level of accounting conservatism does not influence the possibility of the efficient schedule regime.*

4.2 Distorted schedule regime

In this subsection, we examine the scenario in which the accounting verifiability is relatively low, and the manager has an incentive to manipulate the accounting signal. The board intends to utilize the accounting signal 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 trade-offs. 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. Thus, the board is forced to offer a higher $t_2(\theta_h, S_G)$ in order to meet (IC-M) constraint. Given these two economic forces, the board offers the minimum compensation schemes $\{t_2^*(\theta_h, S_G), t_2^*(\theta_h, S_B)\}$ such that both the no-manipulation constraint (IC-M) and the inefficient manager's individual rationality constraint (IR-h') are satisfied.

We can confirm that the optimal compensation $t_2^*(\theta_h, S_G)$ strictly decreases in the accounting verifiability K. If the accounting verifiability K is high enough, $t_2^*(\theta_h, S_G)$ converges to the solution in Proposition 1 and the board stipulates the first-best revenue targets. But if the accounting verifiability K is low, the board is forced to offer a higher $t_2^*(\theta_h, S_G)$ in order to satisfy (IC-M), which leads to a smaller compensation differential (i.e., (7) is not satisfied) and a higher information rent for the type-θ_l manager.

Given the type-θ_l manager's expected utility (information rent), the board offers the first-best revenue targets for the (efficient) type-θ_l manager for both periods. Denote $\Delta\theta \equiv \theta_h - \theta_l$ by a measure of the type uncertainty. The optimal revenue targets for the inefficient (type-θ_h) manager are characterized by the following first-order conditions:

$$
\begin{aligned}
v^{'}(R_h) - R_h - \theta_h &= \frac{\alpha}{1-\alpha}\Delta\theta, && (8)\\
v^{'}(R_{hG}) - R_{hG} - \theta_h &= \frac{\alpha}{1-\alpha}\frac{\pi_{lG}}{\pi_{hG}}\Delta\theta, && (9)\\
v^{'}(R_{hB}) - R_{hB} - \theta_h &= \frac{\alpha}{1-\alpha}\frac{1-\pi_{lG}}{1-\pi_{hG}}\Delta\theta. && (10)
\end{aligned}
$$

In the presence of information asymmetry, the board distorts the revenue targets downwards, but such a downward distortion is alleviated by the ex-post accounting signal. We highlight these results in the following proposition.

Proposition 2. *When the accounting verifiability is sufficiently small, 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 targets $\{R_h^*, R_{hG}^*, R_{hB}^*\}$ are characterized by (8), (9) and (10), respectively.*

In the distorted schedule regime, the board cannot implement the first-best revenue targets, because the accounting verifiability is sufficiently small. To induce truthful reporting, the board offers the efficient manager a positive information rent Φ as

$$
\begin{aligned}
\Phi &= \tau[\psi(R_h+\theta_h) - \psi(R_h+\theta_l)] && (11)\\
&\quad +(1-\tau)\left\{\begin{array}{c} \pi_{lG}[\psi(R_{hG}+\theta_h) - \psi(R_{hG}+\theta_l)] \\ +(1-\pi_{lG})[\psi(R_{hB}+\theta_h) - \psi(R_{hB}+\theta_l)] - (\pi_{lG}-\pi_{hG})K \end{array}\right\}.
\end{aligned}
$$

Lowering the revenue targets R_{hk} can reduce the information rent, but also decreases the board's expected payoff. Proposition 2 shows that the board carefully 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.

To elaborate, 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 distorts R_{hG}^* lower than R_h^{sb} so as to alleviate the incentive of misreporting. But the inefficient (type-θ_h) manager may be incorrectly penalized (due to a type-I error) when the revenue R_{hG}^* is distorted downwards.[9] Thus, the board subsidizes the type-θ_h manager for the possible losses by distorting the revenue target R_{hB} upward ($R_{hB}^* > R_h^{sb}$).

[9] 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

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 revenue targets $\{R_{hG}, R_{hB}\}$ when the accounting signal becomes more informative? One may conjecture that the revenue distortion would be less desired when the accounting signal is more informative. This conventional wisdom does not hold as Corollary 2 shows. When the degree of informativeness λ is higher, the accounting signal is more likely to reflect the manager's true type and the monotone likelihood ratio (π_{lG}/π_{hG}) is higher. 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 target R_{hB} increases when the accounting signal is more informative. When the accounting system becomes completely uninformative (i.e., $\pi_{lG}/\pi_{hG} = 1$), then R_{hG} and R_{hB} approaches to the classical second-best solution ($R_{hG} = R_{hB} = R^{sb}_h$).

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 targets $\{R_{hG}, R_{hB}\}$. As the accounting system becomes more conservative (a smaller δ), the board 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 target 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 ($\delta = 1 - \lambda$), the good signal S_G is perfectly informative, but the bad signal S_B is not. Hence, the revenue target R_{hG} coincides with the first-best solution ($R^*_{hG} = R^{fb}_h$), but R^*_{hB} is still smaller than the second-best solution ($R^*_{hB} < R^{sb}_h$).

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.

Corollary 4. *In the revenue distortion regime, holding the level of accounting informativeness constant, the revenue targets 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. 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 the one hand, the board offers the information rent to the type-θ_l manager in order to counter the incentive to misreport as θ_h. When the accounting signal becomes more informative, 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 targets $\{R_{hG}, R_{hB}, R_h\}$. 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 target 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 signal. As the manager's expected information rent increases in revenue target ($\partial\Phi/\partial R_{hk} > 0$), we show that the information rent decreases in the accounting informativeness.

Because the information rent strictly decreases in the informativeness, a cut-off threshold $\overline{\lambda}(K)$ exits such that 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 verifiability is relatively high (a large K), the board can obtain the first-best revenue targets 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 accounting informativeness is higher. Thus, the accounting verifiability may play a *substitute* role of the accounting informativeness in alleviating the cost of asymmetric information.

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

3) for $\lambda = 0$, the solution coincides with the classical second-best solution. The cut-off point $\overline{\lambda}(K)$ decreases in the accounting verification ($d\overline{\lambda}(K)/dK < 0$).

Earlier research has found information rent to be non-monotonic in the manager's ex-ante information advantage. For example, Lewis and Sappington (1991) show that if a principal can choose the probability with which the manager ex-ante receives perfect private information, the principal may not always set the probability at zero or at unity. In contrast, Proposition 3 shows that the information rent strictly decreases in the informativeness of the accounting signal. Thus, the principal always prefers to have the most informative accounting signal ex-post. Our results differ from the extant literature (i.e., Lewis and Sappington (1991)), because our analysis explores the informational advantage of the ex-post accounting signal, that is, after the manager has perfectly learned the private information ex-ante.

Another line of research has shown that a principal may benefit from earnings management. For example, Maggi and Rodriguez-Clare (1995) show that if the cost of earnings management is type-dependent, a principal can strategically induce an inefficient manager to conduct earnings management on the production outputs, thereby reducing the information rent given up to an efficient manager. Our paper differs from Maggi and Rodriguez-Clare (1995) in many aspects. We study a two-period model in which a principal can observe an interim noisy accounting signal and adjust the second-period compensation. Earnings management does *not* affect an agent's performance, but rather hinders a principal's ability to extract rent from the agent. The cost of earnings manager does not hinge on an agent's true type, so we abstract away the countervailing incentives in Maggi and Rodriguez-Clare (1995). As a result, the efficient manager's information rent strictly decreases in the informativeness of the accounting signal and the principal does not benefit from earnings management.

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. 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, 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 decreases 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 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 agency 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, $t_2(\theta_l, S_G)$ than

$$t_2(\theta_l, S_G) - \psi(R_{lG} + \theta_l) \geq t_2(\theta_l, S_B) - \psi(R_{lB} + \theta_l) - K, \tag{IC-M-lg}$$

$$t_2(\theta_l, S_B) - \psi(R_{lB} + \theta_l) \geq t_2(\theta_l, S_G) - \psi(R_{lG} + \theta_l) - K. \quad \text{(IC-M-lb)}$$

To incentivize truthful reporting, the board intends to compensate the manager by lowering $t_2(\theta_l, S_B)$ and increasing $t_2(\theta_l, S_G)$ as long as the accounting signal is informative. These constraints are satisfied when the difference between two compensation schemes $\{t_2(\theta_l, S_G), t_2(\theta_l, S_B)\}$ is relatively small. Notably, only the type-θ_l manager's (IR) constraint is affected by the compensation schemes $\{t_2(\theta_l, S_G), t_2(\theta_l, S_B)\}$. This implies that the board can fine tune the compensation schemes $\{t_2(\theta_l, S_G), t_2(\theta_l, S_B)\}$ to satisfy the no-manipulation and (IR) constraints, but still keeping the (IC) constraint satisfied. As a result, the revenue targets 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 signal is informative ($\pi_{lG}/\pi_{hG} > 1$). Even if the manager can manipulate the accounting signal at no cost ($K = 0$), the manager's information rent is strictly lower than the rent under the classical second-best solution.*

The intuition of Proposition 5 is as follows. First, in the classical second-best solution, the efficient manager earns information rent so as to induce truthfully reporting. Clearly, the board can always commit to a non-signal-contingent contract (or the classical second-best contract) and offers the efficient manager full information rent. In this case, the manager has no incentive to manipulate the accounting signal, even though the cost of manipulation is zero. Thus the board is always weakly better off with the implementation of the clawback provisions.

Second, 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. While the optimal compensation schemes must hold in equality:

$$t_2(\theta_h, S_G) - \psi(R_{hG} + \theta_h) = t_2(\theta_h, S_B) - \psi(R_{hB} + \theta_h), \quad (12)$$

the board can still make the revenue targets contingent on the realization of the accounting signal ($R_{hG} < R_{hB}$). When the condition (12) is satisfied, the manager does not have any incentive to manipulate the signal ex-post (even with no cost), even though the revenue targets R_{hG} and R_{hB} deviates from the second-best solution. Consequently, if the accounting signal is informative, the allocation efficiency is improved and the board still benefits from the signal-contingent revenue targets.

Thirdly, to induce truthful reporting, the board at the ex-ante stage offers the efficient manager the information rent. If the accounting signal is informative, the efficient manager has a slightly higher chance to observe S_G than the inefficient one, because the probabilities of $\{S_G, S_B\}$ are contingent on the manager's true type. And even the inefficient manager has a chance (albeit small) to observe S_G. Given the signal-contingent contracts, the manager has no incentive to manipulate the signal when the condition (12) is satisfied. But, the efficient manager at the ex-ante stage may obtain different expected payoffs in the second-period than the inefficient manager:

$$\begin{aligned} & \pi_{lG}\left[t_2(\theta_h, S_G) - \psi(R_{hG} + \theta_l)\right] + (1 - \pi_{lG})\left[t_2(\theta_h, S_B) - \psi(R_{hB} + \theta_l)\right] \\ \neq \quad & \pi_{hG}\left[t_2(\theta_h, S_G) - \psi(R_{hG} + \theta_h)\right] + (1 - \pi_{hG})\left[t_2(\theta_h, S_B) - \psi(R_{hB} + \theta_h)\right]. \end{aligned}$$

Thus, the efficient manager expects to earn a smaller information rent when such an uncertainty does not exist. Taken together, we therefore conclude that the accounting signal helps the board mitigate the information asymmetry problem even if the accounting manipulation is costless.

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. 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.

This conclusion may not be directly applicable to alternative situations. First, when the manager is risk-averse, adopting clawback provisions may increase the risk borne by the manager, thereby raising the cost of providing adequate incentives for effort. Firms may not want to adopt clawback provisions when the cost of providing incentives is higher than the benefit of reducing misreporting. Second, firms may use clawback provisions as a costly signal to demonstrate its strength of corporate governance to investors or other interested parties. Thus, only firms with low risk of financial misstatement are likely to adopt clawback provision (see Chan et al. (2011)). Thirdly, we assume the board can implement clawback provisions and recoup managers' compensation without any legal frictions. In practice, there is uncertainty about whether a firm's board can win a lawsuit against an manager to recoup compensation. When such an uncertainty is likely and the cost of legal friction is high, firms may be reluctant to implement clawback provisions (Lublin (2010)).

5 Empirical Implications

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 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.

Our analysis predicts two equilibrium regimes when firms implement the clawback provisions. In the efficient schedule regime, the accounting verifiability is sufficiently high and the board can implement the first-best solution without any distortion on revenue targets. In the distorted schedule regime, however, the board may need to distort the revenue targets from the second-best level, because the accounting verifiability is not high enough to prevent manipulation. Holding other agency costs constant, Propositions 1 and 2 collectively suggest that a firm is more likely to implement clawback provisions when the accounting verifiability is higher. Proposition 3 shows that a firm benefits more from clawback provisions when the accounting signal is more informative or when the type uncertainty (a proxy for information asymmetry) is higher. We can thus summarize our predictions as follows.

Prediction 1. *The likelihood of adopting a clawback provision increases, when*

1. *the accounting verifiability is higher;*
2. *the accounting signal becomes more informative;*
3. *the magnitude of the agency problem (information asymmetry) is higher.*

The model provides empirical implications on the time-series relation of reported accounting measures in executive compensation for those firms adopting clawback provisions. 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. We identify two necessary conditions for this empirical prediction to be valid. First, a firm does not implement clawback provisions in managerial compensation, in which case a firm stipulates the same revenue targets across two periods. Second, the accounting verifiability shall be high such that a firm stipulates the first-best revenue targets across two periods. When the accounting verifiability is low, a firm may adjust the second-period revenue targets via clawback provisions so as to alleviate the cost of information asymmetry. Interestingly, the revenue targets are distorted in the opposite direction of what the accounting signal indicates. That is, if the manager reports to be inefficient but the accounting signal is good, a firm may reduce the second-period revenue targets. This suggests that after restating its financial statements, a firm may subsequently reduce its revenue targets in period two and pay less compensation to the manager. Hence, we can state the following empirical prediction.

Prediction 2. *Suppose a firm adopts clawback provisions. When the accounting verifiability decreases, the firm is more likely to reduce subsequent managerial compensation after restating its financial statements.*

We document how a firm may adjust the distortions in revenue targets depending on the properties of accounting signals. When the accounting signal becomes more informative, the board actually exacerbates the revenue distortions in the second period. Provided that clawback provisions are adopted, a firm reduces managerial compensation even lower when its financial statements are restated. Thus, the sensitivity of incentive pay to financial restatement is higher when accounting signal is more informative. In contrast, when the accounting system becomes more conservative, the revenue targets are both lower ($\partial R^*_{hG}/\partial\delta > 0$, and $\partial R^*_{hB}/\partial\delta > 0$), suggesting that the sensitivity of incentive pay to financial restatement is lower. 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.

Prediction 3. *After adoption of a clawback policy, the sensitivity of incentive pay to financial restatements will be higher. The sensitivity increases in the informativeness of accounting signals, but decreases in the level of accounting conservatism.*

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 target. In the revenue distortion regime, however, the board may need to distort revenue targets 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. When the accounting signal can be manipulated, the board may request the manager to deliver a lower revenue target when the accounting signal is good. The revenue distortions actually are exacerbated when the accounting system is more informative. 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 targets cross-sectionally of those firms adopting clawback provisions. We also provide empirical predictions for the association among the time-series variation of reported revenue targets 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 A: Benchmark cases

In this appendix, we demonstrate 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 is implemented.

The first-best scenario. 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 target, 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

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

The second-best scenario. 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:

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

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

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

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

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 $\psi(e_j) = e_j^2/2$, the solution to the board's problem is characterized by two first-order conditions:

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

and

$$v^{'}(R_h) - R_h - \theta_h = \frac{\alpha}{1-\alpha}\Delta\theta. \qquad (13)$$

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 ($R_h^{sb} < R_h^{fb}$).*

Appendix B: Proofs of the analysis

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

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

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 targets 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:

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

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). 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 (11) 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 target $(\psi(R_{hk}+\theta_h)-\psi(R_{hk}+\theta_l))$.

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 target 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 classical 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 classical second-best allocation R_h. □

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 $d\Phi/d\lambda$ yields 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 $\partial R_h/\partial\lambda = 0$. 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 targets approach the classical 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 accounting verifiability K. For any $\lambda > \bar{\lambda}(K)$, the board can obtain the first-best solution as we have shown in Proposition 1. □

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 $\partial R_h/\partial\delta = 0$. 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,

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

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

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 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 is not changed by (ICM-lb), the revenue targets 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 contrast, 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 targets 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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