Optimal Contracts with Earnings Management and Internal Control

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Abstract

This study examines two programs, which are subject to different incentive constraints. It compares and characterizes the equilibrium of each program and highlights the value of incentive constraints. It studies the role of disclosure of financial reporting and internal control reporting in a principal-agent model. The traditional model deals with the agent's moral hazard in exerting productive effort. Additionally, this study includes earnings management as a moral hazard problem. Then, it examines the optimal compensation contract to incentivize the manager for the sake of the shareholder (owner).

Keyword: agency theory, principal-agent model, earnings management, internal control

1. Introduction

Earnings management has been studied considerably in the literature, with Dye (1988) as the benchmark (Arya, Glover, & Sunder, 1998; Christensen, Demski, & Frimor, 2002; Demski, 1998; Demski & Frimor, 1999; Evans & Sridhar, 1996). Dye (1988) treated the economic earnings as a *type*, accounting earnings as a *message* of mechanism, and earnings management in communicating its true *type* using the revelation principle (R.P.). I reviewed the preceding and subsequent literature of Dye (1988), which cover accounting and other contexts beyond accounting (Baiman & Evans, 1983; Beyer, Guttman, & Marinovic, 2014; J. Christensen, 1981; Crocker & Morgan, 1998; Crocker & Slemrod, 2007; Demski, 1972; Demski & Feltham, 1978; Dutta & Gigler, 2002; Dye, 1983; Hölmstrom, 1979; Lacker & Weinberg, 1989; Maggi & Rodríguez-Clare, 1995; Melumad & Reichelstein, 1989; Morton, 1993). These overall reviews can be summarized as follows: the R.P. applies to a state of nature or characteristics, that is, the *type* (environment), such as an internal control quality[1]. Meanwhile, earnings management is treated as an *action*, related to the moral hazard problem.

This study examines two programs, which are subject to different incentive constraints. It compares and characterizes the equilibrium of each program and highlights the value of incentive constraints. It studies the role of disclosure of financial reporting and internal control reporting in a principal-agent model. The traditional model deals with the agent's moral hazard in exerting productive effort. Besides, this paper includes earnings management as a moral hazard problem. Next, this study examines the optimal compensation contract to incentivize the manager for the shareholder's sake (owner).

2. The Set-up

A risk-neutral principal (owner or the board of directors as a representative of shareholders' interests) contracts with a risk-neutral agent (manager) to implement a one-period project with four-dates.[2] The linear compensation contract is assumed as $w(y)=f+v\cdot y$ based on accounting earnings y, where f is the agent's fixed wage, v is the incentive rate for the firm's earnings report. The firm's final cash flow x cannot be observed until the compensation contract horizon expires; thus, its cash flow cannot be used as a contractible variable. Therefore, the two parties rely on the accounting earnings as a contractible variable instead of the cash flow.

At date $t=0$, a compensation contract is signed. At date $t=1$, the agent exerts an unobservable productive effort. The firm's cash flow $\tilde{x}$ and the agent's productive effort a ($a\geq 0$) have a linear relationship as $\tilde{x}=a+\tilde{\varepsilon}$. Agent's cost of effort is defined as $C_a(a)=0.5ka^2$ with the marginal cost of effort, $k\geq 0$. The noise term $\tilde{\varepsilon}$ represents the uncertainty of the firm's cash flow beyond the control of the agent (manager), having a probability density function with a zero mean.

At date $t=2$, the agent has opportunities to misreport earnings before public disclosure. It is assumed that the agent has some discretion over the accounting for the earnings report, and an earnings bias to the reported earnings is added. Subsequently, at date $t=3$, the agent issues a public accounting report on the firm's earnings, that is, $\tilde{y}=a+e+\tilde{\varepsilon}$.[3] This model regards earnings management as an *action*, a sort of moral hazard problem. The reporting bias, that is, $e(e\in\mathbb{R})$, related to earnings management results from the manager's discretionary action with his intent.[4] When e is positive (negative), the manager chooses aggressive (conservative) accounting procedures and inflates (deflates) earnings[5]. The cost of earnings management is $C_e(e)=0.5\frac{1}{\theta}e^2$, where the inverse of the internal control parameter, $\frac{1}{\theta}$ $(0<\theta<\infty)$, is the agent's marginal cost of earnings management. This study assumes that the parameter θ reflects the quality of the internal control system. The disclosure of an internal control report, which mainly targets financial reporting reliability by the Financial Instruments and Exchange Law, is mandatory for all listed companies only in Japan. If the quality of internal control is good $(\theta \to 0)$, then the cost of earnings manipulation soars up $(\frac{1}{\theta} \to \infty)$, and this leads the manager to be reluctant to manipulate accounting earnings. Likewise, setting up the internal control system makes it possible to create the earnings management cost function.

This study assumes an ongoing firm where the contract has not expired; therefore, the final cash flow is not necessarily the same as accounting earnings at date $t=4$.[6] The timeline of this model is defined in figure 1.

Figure 1. Timeline

- $t=0$ The contract is signed.
- $t=1$ The agent exerts productive effort.
- $t=2$ The agent decides whether to manipulate reported earnings with non-productive action.
- $t=3$ The agent issues a public accounting report on the firm's earnings.
- $t=4$ The agent is compensated according to the contract.

This model assumes that only the agent can observe both the agent's productive effort and the manipulative action. However, the principal cannot distinguish the portion of earnings from the agent's manipulative or productive action. Consequently, this causes two *moral hazard* problems. The notation used in this model is summarized in Table 2.

Table 2. Notation

x	the firm's final gross cash flow, $\tilde{x}=a+\tilde{\varepsilon}$, $E(x)=a$
$\tilde{\varepsilon}$	noise term of the firm's cash flow, $\varepsilon \sim N(0,\sigma^2)$
y	the firm's accounting earnings, $\tilde{y}=a+e+\tilde{\varepsilon}$
a	the agent's effort level ($a \geq 0$)
$C_a(a)$	agent's cost of effort, $C_a(a)=0.5ka^2$
k	agent's marginal cost of effort, $k \geq 0$
e	the reporting bias, that is, the extent of earnings management
$C_e(e)$	agent's cost of earnings management, $C_e(e)=0.5\frac{1}{\theta}e^2$
$\frac{1}{\theta}$	agent's marginal cost of earnings management, $0<\theta<\infty$
$Ew(\cdot)$	agent's expected compensation, $Ew(y)=f+v[a+e]$
f	fixed-wage
v	compensation weight on the firm's reported earnings
v_θ	compensation weight on the firm's quality of internal control
$EU^A(\cdot)$	agent's expected utility, $EU^A(\cdot)=Ew(y)-C_a(a)-C_e(e)$
$EU^p(\cdot)$	expected terminal return to the principal (shareholders) net of the agent's compensation, $EU^p=E(x)-Ew(y)$ in Program 2[7]
$h(\theta)$	probability density function

3. The Model

The compensation contract is linear as $w(y)=f+v\cdot y$. Therefore, the agent's expected utility is as follows.

$$EU^A(y)=Ew(y|a,e)-C_a(a)-C_e(e)=f+v[a+e]-0.5ka^2-0.5\frac{1}{\theta}e^2$$

Shareholders are assumed to be identical and risk-neutral. Then, the agent's compensation contract is chosen to maximize the principal's payoff.

$$\max_{f,v} EU^p=E(x|a)-Ew(y|a,e)$$

The principal seeks to maximize the expected net payoff above, and induces the optimal level, using an incentive-compatible contract subject to certain constraints. The individually rational constraint (IR) and incentive compatibility constraint for productive efforts

(IC-a) are as follows.

$$EU^{A}(a, e) \geq \overline{w} \tag{IR}$$

$$a \in argmax\, EU^{A}(\tilde{a}, \tilde{e}) \tag{IC-a}$$

$$e \in argmax\, EU^{A}(\tilde{a}, \tilde{e}) \tag{IC-e}$$

The study includes the incentive compatibility constraint for manipulative action, (IC-e). It represents that the principal may allow the agent to manipulate accounting earnings as long as it brings about some payoffs to the principal.[8]

3.1 The Benchmark: Program 1

First, Program 1 is considered the first-best case, where the principal can observe a and e correctly, after contracting. Then, the principal's pay off can be expressed as follows:

$$\max_{f,v,a,e} EU^{p} = E(x) - Ew(y|a, e) = a - [f + v(a+e)]$$

$$EU^{A}(a, e) \geq \overline{w} \tag{IR}$$

If both a and e are known as common knowledge, then there is no need to incorporate y as a contracting variable. It leads to no incentive contract, that is, $v^{*} = 0$. Additionally, if the individual rationality constraint can be satisfied, the following fixed-wage can be driven as a first-best optimal contract. For convenience, this paper assumes $\overline{w} = 0$ in the calculation.

$$EU^{A}(a, e) = f + v[a+e] - C_{a}(a) - C_{e}(e) = \overline{w}$$

$$f + 0 \cdot [a+e] - C_{a}(a) - C_{e}(e) = \overline{w}$$

$$f^{*} = \overline{w} + C_{a}(a) + C_{e}(e)$$

The principal's pay off can be written as:

$$\max_{f,v,a,e} EU^{p} = a - (\overline{w} + C_{a}(a) + C_{e}(e)) = a - \overline{w} - 0.5ka^{2} - 0.5\frac{1}{\theta}e^{2} \tag{eq.1}$$

Second, the optimal productive effort to maximize the objective function is $a^* = \frac{1}{k}$ by the first-order condition (F.O.C). Likewise, the optimal manipulative action will be $e^* = 0$, no earnings manipulation. By substituting these results into the payoff equation (eq.1) , the principal's objective function can be re-written as:

$$\max_{f,v,a,e} EU^{p\_p1} = \frac{1}{k} - \left(\overline{w} + \frac{1}{2k} \right) = \frac{1}{2k} - \overline{w}$$

The agent gets only the fixed salary, that is, 50% ($\frac{1}{2k}$) of the final expected cash flows ($\frac{1}{k}$), equivalent to the cost of productive action; thus, the agent's utility becomes zero[9]. The principal extracts all the surplus, that is, 50% ($\frac{1}{2k}$) of the final expected cash flows ($\frac{1}{k}$) in this first-best contract.

3.2 The Agency Model Under Moral Hazards

Now, let us consider the original assumptions, where the principal cannot observe a and e. The design of optimal (linear) compensation contracts and earnings management induced in equilibrium are studied. The equilibrium of the model is solved by backward induction. Program 2 and 3, which are subject to different incentive constraints, are analyzed, and the value of incentive compatibility constraint is examined. In Program 2, the optimal level of earnings manipulation and the manager's productive effort is incorporated. Given the manager's response functions, the optimal contract that maximizes the principal's expected payoff is determined.

Now, we consider Program 2, where the principal seeks to maximize the payoff, using (IR), (IC-a), and (IC-e) constraints for optimal earnings management. Then, the agent's optimal choices are solved as follows.

Lemma 1

(1) Given the contract, the agent's optimal productive action is characterized by

$$a^{\dagger\dagger} = \frac{1}{k} v$$

(2) Given the contract, the agent's optimal earnings management action is characterized by

$$e^{\dagger\dagger} = \theta \cdot v$$

(3) Given the contract, the fixed salary is characterized by

$$f^{\dagger\dagger} = \overline{w} - \frac{1}{2}\left(\frac{1}{k} + \theta\right) v^2$$

(4) Given the contract, the principal's optimal contract is characterized by

$$v^{\dagger\dagger} = \frac{1}{(1 + k\theta)}$$

(Proof: See Appendix)

Then, the principal's payoff can be written as:

$$\max_{f,v,a,e} EU^{p\_p2} = \frac{1}{k} v^{\dagger\dagger} - \left(\overline{w} + \frac{1}{2}\left(\frac{1}{k} + \theta\right) v^{\dagger\dagger 2} \right)$$

$$= \frac{1}{k(1 + k\theta)} - \frac{1}{2k(1 + k\theta)} - \overline{w} = \frac{1}{2k(1 + k\theta)} - \overline{w}$$

In Program 2, the agent's fixed salary increases with respect to θ ($\because f'(\theta) \geq 0$), and the incentive coefficient decreases ($\because v'(\theta) \leq 0$). The incentive coefficient becomes greater than that in Program 1 ($\because v^{\dagger\dagger} > v^* = 0$). If the quality of internal control becomes poor ($\theta \to \infty$), the bonus decreases, and the fixed-wage increases. As the diverging θ is offset by a reducing bonus coefficient ($\because e^{\dagger\dagger} = \theta \cdot v$), optimal earnings management converges to a certain amount. Thus, (IC-e) constraint to maximize the agent's utility prevents the imprudent increase of accounting earnings management, controlled by the incentive coefficient $v^{\dagger\dagger}$ to maximize the principal's payoff. Program 2 mitigates the principal's payoff, compared with the benchmark, that is, Program 1 ($\because \frac{1}{k} v^{\dagger\dagger} = \frac{1}{k(1 + k\theta)} < \frac{1}{k} v^* = \frac{1}{2k}$, *where* $k \geq 0$, $0 < \theta < \infty$), except the case of $\theta \to 0$.[10] Let's consider the case of $\theta \to 0$ in the principal's payoff of Program 2.

$$\lim_{\theta \to 0} \max_{f,v,a,e} EU^{p\_p2} = \lim_{\theta \to 0} \frac{1}{k(1 + k\theta)} - \left(\frac{1}{2k(1 + k\theta)} + \overline{w} \right) = \frac{1}{k} - \left(\frac{1}{2k} + \overline{w} \right)$$

If the quality of internal control is excellent ($\theta \to 0$), the cost of earnings management becomes extremely high ($C_e(e) = 0.5 \frac{1}{\theta} e^2 \to \infty$), then the agent would be reluctant to manage the accounting earnings. Consequently, the final gross cash flows would become equivalent to that of the benchmark.

The (IC-e) constraint represents that the principal may allow the agent to manipulate accounting earnings, as long as earnings management brings about some payoffs to the principal and within GAAP. In Program 2, the agent gets 50% ($\frac{1}{2k(1+k\theta)}$) of the final expected cash flows ($\frac{1}{k(1+k\theta)}$), required for the cost of the optimal productive action and earnings management. The principal earns 50% ($\frac{1}{2k(1+k\theta)}$) of the final expected cash flows ($\frac{1}{k(1+k\theta)}$), and extracts all the surplus.

4. The Information Value of Truth-telling

This study assumed the parameter θ as common knowledge in Program 2. Program 3 tries to restrict the parameter θ. Program 3 assumes that the parameter θ is only observed by the agent. Notably, the new setting of the parameter θ is limited to apply to the quality of the internal control system such as the manager's integrity. This leads to an adverse selection problem. Program 3 delves into the incentive compatibility constraint for truth-telling θ, that is, R.P., if θ is privately known. The principal seeks to maximize the payoff, using (IR), (IC-a), and additionally (IC-tt) constraints for optimal earnings management as follows:

$$\max_{f,v,v_\theta,a,\theta} E_\theta U^p = \int_{\underline{\theta}}^{\overline{\theta}} [E(x) - Ew(\theta,y)]h(\theta)d\theta$$

$$EU^A\ (a,e) \geq \overline{w} \tag{IR}$$

$$a \in argmax\ EU^A\ (\theta,\theta,\tilde{a},\tilde{e}) \tag{IC-a}$$

$$\theta \in argmax\ EU^A\ (\theta,\hat{\theta},a,e(\theta)) \tag{IC-tt}$$

Adverse selection problem after contracting needs to provide the incentive coefficient, v_θ of the parameter θ, to motivate the agent to provide a truthful report.[11] The compensation contract is linear as $w(\hat{\theta},y) = f(\hat{\theta}) + v(\hat{\theta})y + v_\theta(\hat{\theta})\hat{\theta}$. Then, the agent's expected utility is as follows:

$$EU^A(\theta,\hat{\theta},a) = Ew(\hat{\theta},y) - C_a(a) - C_e(e)$$

$$= f(\hat{\theta}) + v(\hat{\theta})[a+e] + v_\theta(\hat{\theta}) \cdot \theta - 0.5ka^2 - 0.5\frac{1}{\theta}e^2$$

Lemma 2

(1) Given the contract, the agent's optimal productive action is characterized by

$$a^{\ddagger} = \frac{1}{k}v(\hat{\theta}).$$

(2) Given the contract, the principal's optimal contract is characterized by

$$v^{\ddagger}(\theta) = 1.$$

$v_\theta(\theta)$ can be any function, which satisfies $\frac{\partial E_\theta U^P}{\partial v_\theta(\theta)} = 0$ and $v_\theta{}'(\theta) \geqq 0$. Note that $v_\theta(\theta)$ is not enough to satisfy the maximum principal's payoff because $E_\theta U^p(\cdot)$ is not strictly concave with respect to $v_\theta(\theta)$.

(3) Given the contract, the fixed salary is characterized by

$$f^{\ddagger}(\theta) = \overline{w} - \frac{1}{2k}v(\theta)^2 - v(\theta)e + \frac{1}{2\theta}e^2 - v_\theta(\theta)\theta + \int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2 t^{-2} dt.$$

(Proof: See Appendix)

In Program 3, the agent's fixed salary decreases with respect to θ ($\because f'(\theta) \leqq 0$)[12], and the incentive coefficients are constant. If the quality of internal control becomes poor ($\theta \to \infty$), the fixed-wage decreases; instead, the bonus for truth-telling is compensated. By substituting the optimal choices into Program 3, the principal's payoff is expressed as follows:

$$\max_{f,v,v_\theta,a,\theta} E_\theta U^{p\_p3} = \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{1}{k}v(\theta) - \frac{1}{2k}v(\theta)^2 - \overline{w} - \frac{1}{2}e^2\underline{\theta}^{-1} \right] h(\theta)d\theta$$

$$= \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{1}{2k} - \overline{w} - \frac{1}{2}e^2\underline{\theta}^{-1} \right] h(\theta)d\theta$$

The agent reports the truth on the internal control if he or she is provided with the information rent, $\frac{1}{2}e^2\underline{\theta}^{-1}$. When the quality of internal control becomes excellent ($\underline{\theta} \to 0$), the principal is expected to pay the excessively large information rent ($\because \frac{1}{2}e^2\underline{\theta}^{-1} \to \infty$). Conversely, even though the quality of internal control becomes bad ($\theta \ll \infty$, $\underline{\theta} \ll \infty$), the principal should compensate for information rent to incentivize the agent.

Proposition 1

The information value of (IC-tt), defined as $\Gamma_{(IC\text{-}tt)} = \max_{f,v,v_\theta,a,\theta} E_\theta U^{p\_p3} - \max_{f,v,a} EU^{p\_p1}$, will always be

negative.
(Proof: See Appendix)

Proposition 1 states that the principal's payoff under the adverse selection problem is supposed to be reduced. Therefore, contrary to common belief, it is difficult to say that the truth-telling report always leads to a beneficial consequence to the principal. This issue traces back to the traditional adverse selection problem. This implication does not mean that the parameter θ is unnecessary to the principal. The optimal contract of Program 2 is feasible because the cost function of earnings management is indirectly controlled by $\frac{1}{\theta}$. Therefore, regarding the role of disclosure, it is essential for internal control reporting not to diverge the earnings management.

5. Concluding Remarks

This paper examines the economic consequences of optimal compensation contracts under earnings management in publicly reported earnings. A firm with the risk-neutral principal (owner) offers the risk-neutral agent (manager) a compensation contract using the agency model. Two parties rely on accounting earnings as a performance measure. This study explores two programs, which are subject to different incentive constraints. This derives the following implications.

The (IC-e) in Program 2 is valuable for blocking the diverging earnings management and making it optimal for both the agent and principal. The agent's involvement in managing the optimal level accounting earnings would be beneficial to the principal. The optimal contract of Program 2 is feasible because the cost function of earnings management is indirectly controlled by $\frac{1}{\theta}$. Therefore, regarding the role of disclosure, internal control reporting is essential not to diverge the earnings management.

Appendix. Proofs

Proof of Lemma 1 (1)

To satisfy $a \in argmax\ EU^A(\cdot)$ (IC-a) constraint, this study differentiates $EU^A(\cdot)$ with respect to a. Then, by F.O.C.,

$$EU^A(y|a,e)=f(\theta)+v[a+e]-0.5ka^2-0.5\frac{1}{\theta}e^2$$

$F.O.C.\ \frac{\partial EU^A}{\partial a}=0 \qquad \therefore a^{\dagger\dagger}=\frac{1}{k}v$

$S.O.C.\ \frac{\partial^2 EU^A}{\partial a^2}=-k\leq 0\ (\because k\geq 0)$

Thus, $EU^A(\cdot)$ is concave and is maximized at $a^{\dagger\dagger}=\frac{1}{k}v$.

Proof of Lemma 1 (2)

The proof to satisfy (IC-e) follows the same procedure as above.

$$EU^A(y|a,\ e)=f+v[a+e]-0.5ka^2-0.5\frac{1}{\theta}e^2$$

$F.O.C.\ \frac{\partial EU^A}{\partial e}=0 \qquad \therefore e^{\dagger\dagger}=\theta\cdot v$

$S.O.C.\ \frac{\partial^2 EU^A}{\partial e^2}=-\frac{1}{\theta}\leq 0\ (\because \theta\geq 0)$

Thus, $EU^A(\cdot)$ is concave and can be maximized at $e^{\dagger\dagger}=\theta\cdot v$.

Proof of Lemma 1 (3)

The agent's expected utility, $EU^A(\cdot)$ is supposed to be more than the reserved utility $\overline{w}$ and satisfy (IR). Then, $f^{\dagger\dagger}$ can be expressed as follows:

$$Ew(y|a,\ e)=f+v[a^{\dagger\dagger}+e^{\dagger\dagger}]=f+\left(\frac{1}{k}+\theta\right)v^2$$

$$EU^A(\cdot)=Ew(y|a,\ e)-\frac{1}{2k}v^2-\frac{1}{2}\theta v^2=\overline{w}$$

$$f+\left(\frac{1}{k}+\theta\right)v^2-\frac{1}{2}\left(\frac{1}{k}+\theta\right)v^2=\overline{w}$$

$$\therefore f^{\dagger\dagger}=\overline{w}-\frac{1}{2}\left(\frac{1}{k}+\theta\right)v^2$$

Proof of Lemma 1 (4)

For the optimal contract of the principal, I substitute $Ew(y|a,\ e)$ and $a^{\dagger\dagger}=\frac{1}{k}v$, $e^{\dagger\dagger}=\theta\cdot v$ in $EU^p(\cdot)$, and differentiate $EU^p(\cdot)$ with respect to v.

$$Ew(y|a,\ e)=f^{\dagger\dagger}+v[a^{\dagger\dagger}+e^{\dagger\dagger}]=\overline{w}+\frac{1}{2}\left(\frac{1}{k}+\theta\right)v^2$$

$$\max_{f,v,a,e} EU^p=E(x)-Ew(y|a,\ e)=\frac{1}{k}v-\left(\overline{w}+\frac{1}{2}\left(\frac{1}{k}+\theta\right)v^2\right)$$

Then, by F.O.C.,

F.O.C. $\frac{\partial EU^P}{\partial v}=\frac{1}{k}-\left(\frac{1}{k}+\theta\right)v=0$

$$\therefore v^{\dagger\dagger} = \frac{\frac{1}{k}}{\left(\frac{1}{k} + \theta\right)} = \frac{1}{(1 + k\theta)}$$

S.O.C. $\frac{\partial^2 EU^P}{\partial v^2} = -\left(\frac{1}{k} + \theta\right) \leq 0 \; (\because k \geq 0, \theta \geq 0)$

Thus, $EU^P(\cdot)$ is concave and can be maximized at $v^{\dagger\dagger} = \frac{1}{(1+k\theta)}$. By substituting $v^{\dagger\dagger}$ in $f^{\dagger\dagger}$ of Lemma 1(3), the fixed-wage can be simplified as follows:

$$f^{\dagger\dagger} = \overline{w} - \frac{1}{2}\left(\frac{1+k\theta}{k}\right) \times \frac{1}{(1+k\theta)^2} = \overline{w} - \frac{1}{2k(1+k\theta)}$$

Proof of Lemma 2 (1)

This proof follows the same procedure as Lemma 1.

$a \in argmax\ EU^A$: *by F.O.C.* $\quad a^{\ddagger} = \frac{1}{k} v(\hat{\theta})$

Proof of Lemma 2 (2)

The agent's expected utility is as follows:

$$EU^A(\theta,\hat{\theta}) = f(\hat{\theta}) + v(\hat{\theta})a^{\ddagger} + v(\hat{\theta})e + v_\theta(\hat{\theta})\hat{\theta} - 0.5k(a^{\dagger})^2 - 0.5\frac{1}{\theta}e^2$$

$$= f(\hat{\theta}) + \frac{1}{k}v(\hat{\theta})^2 + v(\hat{\theta})e + v_\theta(\hat{\theta})\hat{\theta} - \frac{1}{2k}v(\hat{\theta})^2 - \frac{1}{2\theta}e^2$$

$$EU^A(\theta,\hat{\theta}) = f(\hat{\theta}) + \frac{1}{2k}v(\hat{\theta})^2 + v_\theta(\hat{\theta})\hat{\theta} + v(\hat{\theta})e - \frac{1}{2\theta}e^2 \qquad (eq.2)$$

The truth-telling condition is satisfied when the F.O.C. of $EU^A\ (\theta,\hat{\theta}) = 0$ and the S.O.C. of $EU^A\ (\theta,\hat{\theta}) \leq 0$. First, the F.O.C. of $EU^A\ (\theta,\hat{\theta})$ is as follows:

$$\left.\frac{\partial EU^A\left(\theta,\hat{\theta}\right)}{\partial\hat{\theta}}\right|_{\hat{\theta}=\theta} = 0$$

$$\left.\frac{\partial EU^A\left(\theta,\hat{\theta}\right)}{\partial\hat{\theta}}\right|_{\hat{\theta}=\theta} = f'\left(\hat{\theta}\right) + \frac{1}{k}v\left(\hat{\theta}\right)v'\left(\hat{\theta}\right) + v'\left(\hat{\theta}\right)e + \theta \cdot v_\theta{}'\left(\hat{\theta}\right) + + v_\theta\left(\hat{\theta}\right)\Big|_{\hat{\theta}=\theta} = 0$$

$$f'(\theta) + \frac{1}{k}v(\theta)v'(\theta) + v'(\theta)e + \theta \cdot v_\theta{}'(\theta) + + v_\theta(\theta) = 0 \qquad (eq.3)$$

Next, the S.O.C. of $EU^A(\theta,\hat{\theta})$ is as follows:

$$\left.\frac{\partial^2 EU^A\left(\theta,\hat{\theta}\right)}{\partial\hat{\theta}^2}\right|_{\hat{\theta}=\theta} = f''\left(\hat{\theta}\right) + \frac{1}{k}v\left(\hat{\theta}\right)v''\left(\hat{\theta}\right) + \frac{1}{k}(v'(\theta))^2 + v''\left(\hat{\theta}\right)e + \theta \cdot v_\theta{}''\left(\hat{\theta}\right) + v_\theta{}'\left(\hat{\theta}\right)\Big|_{\hat{\theta}=\theta} \leq 0$$

$$f''(\theta) + \frac{1}{k}v(\theta)v''(\theta) + \frac{1}{k}(v'(\theta))^2 + v''(\theta)e + \theta \cdot v_\theta{}''(\theta) + v_\theta{}'(\theta) \leq 0 \qquad (eq.4)$$

By differentiating (eq.3) with respect to θ,

$$f''(\theta) + \frac{1}{k}v(\theta)\,v''(\theta) + \frac{1}{k}(v'(\theta))^2 + v''(\theta)e + v_\theta{}'(\theta) + \theta \cdot v_\theta{}''(\theta) + v_\theta{}'(\theta) = 0 \qquad (eq.5)$$

By substituting (eq.5) into (eq.4), the truth-telling condition can be driven as follows:

$$-2v_\theta{}'(\theta) \leq 0 \Leftrightarrow \therefore v_\theta{}'(\theta) \geq 0$$

Then, by the envelop theorem, differentiating (eq.2) with respect to θ.

$$\left.\frac{dEU^A(\theta,\hat{\theta})}{d\theta}\right|_{\hat{\theta}=\theta} = \frac{1}{2\theta^2}e^2 \geq 0$$

$EU^A(\theta)$ increases with respect to θ ($\because \frac{1}{2\theta^2}e^2 \geq 0$); thus, $EU^A(\underline{\theta}) = \overline{w}$. If $EU^A(\theta) = EU^A(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2t^{-2}dt$ is satisfied at $\theta = \underline{\theta}$, (IR) constraint meets for all $\theta > \underline{\theta}$. Then, $EU^A(\theta)$ can be simplified as follows:

$$EU^A(\theta) = EU^A(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2t^{-2}dt = \overline{w} + \int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2t^{-2}dt$$

$$EU^A(\theta) = Ew(\theta,y) - 0.5ka^2 - 0.5\frac{1}{\theta}e^2 = Ew(\theta,y) - \frac{1}{2k}v(\theta)^2 - \frac{1}{2\theta}e^2$$

$$Ew(\theta) = EU^A(\theta) + \frac{1}{2k}v(\theta)^2 + \frac{1}{2\theta}e^2$$

$$Ew(\theta,y) = \left(\overline{w} + \int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2t^{-2}dt\right) + \frac{1}{2k}v(\theta)^2 + \frac{1}{2\theta}e^2$$

$$\max_{f,v,v_\theta,a,\theta} E_\theta U^p = \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{1}{k}v(\theta) - \left(\overline{w} + \int_{\underline{\theta}}^{\overline{\theta}} \frac{1}{2}e^2t^{-2}dt + \frac{1}{2k}v(\theta)^2 + \frac{1}{2\theta}e^2\right)\right]h(\theta)d\theta$$

Using $\int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2t^{-2}dt = \frac{1}{2}e^2(\underline{\theta}^{-1} - \theta^{-1})$, the principal's payoff can be expressed as follows:

$$\max_{f,v,v_\theta,a,\theta} E_\theta U^p = \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{1}{k}v(\theta) - \left(\overline{w} + \frac{1}{2}e^2(\underline{\theta}^{-1} - \theta^{-1}) + \frac{1}{2k}v(\theta)^2 + \frac{1}{2\theta}e^2\right)\right]h(\theta)d\theta$$

$$= \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{1}{k}v(\theta) - \overline{w} - \frac{1}{2}e^2(\underline{\theta}^{-1} - \theta^{-1}) - \frac{1}{2k}v(\theta)^2 - \frac{1}{2\theta}e^2\right]h(\theta)d\theta$$

$$= \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{1}{k}v(\theta) - \frac{1}{2k}v(\theta)^2 - \overline{w} - \frac{1}{2}e^2\underline{\theta}^{-1}\right]h(\theta)d\theta$$

By differentiating the objective function with respect to $v(\theta)$,

F.O.C., $\frac{\partial E_\theta U^P}{\partial v(\theta)} = \frac{1}{k} - \frac{1}{k}v(\theta) = 0$

$$\therefore v^{\ddagger}(\theta) = 1$$

S.O.C., $\frac{\partial^2 E_\theta U^P}{\partial v(\theta)^2} = -\frac{1}{k} \leq 0$ ($\because k \geq 0$)

Thus, $EU^P(\cdot)$ is concave with respect to $v(\theta)$ and can be maximized at $v^{\ddagger}(\theta) = 1$. Then $a^{\ddagger} = \frac{1}{k}v^{\ddagger}(\theta) = \frac{1}{k}$.

Likewise, differentiating the objective function with respect to $v_\theta(\theta)$,

F.O.C., $\frac{\partial E_\theta U^P}{\partial v_\theta(\theta)} = 0$

$E_\theta U^P$ is constant ($c \geq 0$) with respect to v_θ. This cannot derive the optimal v_θ

S.O.C., $\frac{\partial^2 E_\theta U^P}{\partial v_\theta(\theta)^2} = 0$

Thus, $v_\theta(\theta)$ is not satisfying the maximum principal's payoff, because $E_\theta U^P(\cdot)$ is not strictly concave with respect to $v_\theta(\theta)$. $v_\theta(\theta)$ can be any function, which satisfies $\frac{\partial E_\theta U^P}{\partial v_\theta(\theta)} = 0$ and $v_\theta'(\theta) \geq 0$.

Proof of Lemma 2 (3)

As shown above, $EU^A(\theta) = EU^A(\underline{\theta}) + \int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2t^{-2}dt = \overline{w} + \int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2t^{-2}dt$, using (IR) for all θ. Then,

$$EU^A(\theta) = f(\theta) + \frac{1}{2k}v(\theta)^2 + v(\theta)e - \frac{1}{2\theta}e^2 + v_\theta(\theta)\theta = \overline{w} + \int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2t^{-2}dt$$

$$\therefore f^{\ddagger}(\theta) = \overline{w} - \frac{1}{2k}v(\theta)^2 - v(\theta)e + \frac{1}{2\theta}e^2 - v_\theta(\theta)\theta + \int_{\underline{\theta}}^{\theta} \frac{1}{2}e^2t^{-2}dt$$

$$f(\underline{\theta}) = \overline{w} - \frac{1}{2k}v(\underline{\theta})^2 - v(\underline{\theta})e + \frac{1}{2\underline{\theta}}e^2 - v_\theta(\underline{\theta})\underline{\theta}$$

Proof of Proposition 1

$$\max_{f,v,v_\theta,a,\theta} E_\theta U^{p\_p3} = \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{1}{2k} - \overline{w} - \frac{1}{2} e^2 \underline{\theta}^{-1}\right] h(\theta)\, d\theta = \frac{1}{2k} - \overline{w} - \frac{1}{2} e^2 \underline{\theta}^{-1}$$

Then, the information value of (IC-tt) can be expressed as follows:

$$\Gamma_{(\text{IC-tt})} = \max_{f,v,v_\theta,a,\theta} E_\theta U^{p\_p3} - \max_{f,v,a,e} EU^{p\_p1}$$

$$= \left(\frac{1}{2k} - \overline{w} - \frac{1}{2} e^2 \underline{\theta}^{-1}\right) - \left(\frac{1}{2k} - \overline{w}\right)$$

$$= -\frac{1}{2} e^2 \underline{\theta}^{-1} \leq 0 \ (\because 0 < \underline{\theta} < \theta)$$

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Notes

[1] The Japanese internal control report system has been designed less strictly than the Sarbanes-Oxley (SOX) Act in the United States.The disclosure of an internal control report, which mainly targets the reliability of financial reporting by Financial Instruments and Exchange Law, is mandatory to all listed companies.

[2] If the agent is more risk-averse than the principal, the risk-premium of an agent in the model is incorporated.

[3] This study focuses on accounting earnings management, not real earnings management, which affects the cash flow directly.

[4] In general, the term of *earnings management* represents a broad spectrum of accounting choices, such as "conservative accounting or aggressive accounting within GAAP (Generally Acceptable Accounting Principles), and fraudulent accounting to violate GAAP" (Dechow & Skinner, 2000, p. 239). As Dechow and Skinner (2000, p. 247) stated, the manager's *intent*, the key criterion to judge earnings management in the accounting procedures exists.

[5] Under this assumption, this study explains that *no earnings management* is a state at $e=0$; however, a state of earnings management means a state at $e \neq 0$.

[6] Nevertheless, the total sum of cash flow and the total amount of accounting earnings will be the same at the time of the firm's liquidation.

[7] It can be defined as $E_\theta U^p = \int_{\underline{\theta}}^{\overline{\theta}} [E(x) - Ew(y)]h(\theta)d\theta$, in Program 3, where this study supposes θ as a random variable, rather than an exogenous variable.

[8] This implication of (IC-e) constraint may bring issues to the side where the principal's interest is well accorded with the social welfare. As long as the agent bears the cost of earnings management and there exists no requirement of audit, the rational principal to pursue his or her interest and payoff will leave it undone. The principal in this paper has no concern for social justice or social welfare.

[9] For convenience, this paper follows $\overline{w}=0$, which is generally assumed in the context of contracting theory.

[10] When the quality of internal control becomes good ($\theta \rightarrow 0$), the principal pays 50% ($\frac{1}{2k}$) of the total payoff, which is equivalent to the payoff in the benchmark.

[11] If the incentive coefficient of the parameter θ is not considered (i.e., $w(y) = f(\hat{\theta}) + v(\hat{\theta})y$), $EU^A(\theta, \hat{\theta})$ becomes constant with respect to θ, that is, not being concave with F.O.C. $=0$, S.O.C. $=0$. In this case, $\hat{\theta} = \theta$ cannot optimize the agent's utility.

[12]
$$\frac{df(\theta)}{d\theta} = -\frac{1}{k}v(\theta)v'(\theta) - v'(\theta)e - \frac{1}{2\theta^2}e^2 - v_\theta(\theta) - v_\theta'(\theta)\theta + \frac{1}{2\theta^2}e^2 + v_\theta(\theta)$$
$$= -\frac{1}{k}v(\theta)v'(\theta) - v'(\theta)e - v_\theta(\theta) - v_\theta'(\theta)\theta = -v_\theta(\theta) \leq 0 \ (\because v(\theta)>0,\ v'(\theta)=0,\ v_\theta(\theta) \geq 0,\ v_\theta'(\theta)=0)$$

Thus, $f^{\ddagger}(\theta)$ decreases with respect to θ.