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Is the Conditional Audit Policy Necessary in a Two-Period Audit Scenario?*

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ABSTRACT

It seems common sense that previous audit experience has some impact on the current audit decision. In other words, the principal tends to enhance the probability of auditing agent if the latter has a "bad" audit record, e.g. has previously concealed some truth. This paper intends to gain an insight into how previous audit experience influences the principal's audit decision in a two-period audit scenario. Under the basic assumptions and setting, the paper shows that it's not necessary for the principal to use a conditional audit in an optimal audit policy; i.e., the audit policy for the second period doesn't necessarily depend on the audit result in the first period. Although the result appears counterintuitive and even surprising, it's a reasonable choice of the principal under the assumption of self-interested and rational behavior. This paper will try to explicate the theoretical implications in the conclusion.

Key Words: Information Asymmetry, Agency Problem, Audit Policy

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1. Introduction

Information asymmetry has been a popular phenomenon in the variety of agency structures. To relieve the problem resulted from information asymmetry and to reduce the related agency costs, the principal often chooses to employ an auditor to supervise the audited agent (e.g. the manager). The audit measure becomes one of the prominent management mechanisms inducing the audited agent to either make every effort or tell the truth.

In this line of research, under various settings and assumptions, there are some results contributing to future study of the related issues. First of all, Antle (1982) considers auditor an expected utility maximizer and studies agency problems resulting from agency structure of owner-manager-auditor using game theory. Basing their study on the agency hierarchy of consumer-regulator-firm(regulated), Baron & Besanko (1984) explore how the regulator determines its optimal decision to audit the regulated firm with better information obtained by her at a cost and sets the related pricing policy to maximize the total social welfare of consumers as well as the regulated firm.

Next, under the framework that consumers (or Congress) instruct the regulator's action and the regulator supervises the monopoly firm's operation, Demski & Sappington (1987) examine the problem of regulation between the self-interested regulator and the self-interested firm. Baiman, Evans & Noel (1987) presents a principal-agent model in which the agent becomes strictly better informed than the principal after the contract agreement. They analyze how principal uses the information communicated by agent's report and hires a utility-maximizing auditor to mitigate the inefficiency caused by information asymmetry. Later, Baiman, Evans & Nagarajan (1991) also dwell on the issue of collusion between the manager and the auditor.

In the latter study of audit policy, it can be found that researchers have transferred considerable attention to the collusion between the auditor and the audited agent. There have existed a few such papers in the literature. For instance, without the possibility of adding a second supervisor, Tirole (1986) studies the phenomenon of bribes in a hierarchical contract involving a principal, a supervisor and an agent. Kofman and Lawarree (1993), by assuming the external auditor never colludes, derive the optimal contract when both internal and external auditors are available. Laffont and Martimort (1999) also investigate the simultaneous use of two collusive supervisors. They show that information per se introduces increasing returns in the benefits of side-contract. By duplicating auditors, the principal can reduce their information and their discretion, and then improve expected welfare.

As for the research on the conditional audit, there are two papers which may be closely related to our work. Among others, Landsberger and Meilijson (1982) propose a dynamic incentive generating penalty system which, they argue, may reduce the generation of undesirable externalities at a given cost. On the other hand, Greenberg (1984) further proposes an optimal auditing scheme for the tax authorities and classifies individuals into one of three groups. Each group is characterized by two parameters. It's then shown that there is a choice of these parameters so that in equilibrium the percentage of individuals that cheat is arbitrarily small. However, both of them are basically involved with some kind of specific conditional audit mechanism under the infinite periods. By our knowledge, there seems no paper involving a conditional audit policy in a finite multi-period scenario. In the consideration of the prominence of the issue concerned, this paper creates a two-period decision scenario and analyzes how a conditional audit affects the optimal audit policy of the principal. Under the basic assumptions and setting, it's found that a conditional audit is unnecessary in an optimal audit policy of the principal; i.e., the audit policy for the second period doesn't necessarily depend on the audit result in the first period. The conclusion appears counterintuitive and even surprising. However, under the assumption of self-interested and rational behavior, it should be a reasonable result.

In next section, we'll characterize the basic model used in this paper. The related analyses and results will be presented in section 3. Finally, in the concluding section, we'll discuss the theoretical implications of this research as well as its effect on the principal's policy planning.

2. The Model

This paper examines a three-tier hierarchy consisting of a principal, an auditor and a manager. The principal owns the vertical structure; the manager runs an operating unit with private information about its realized return; the auditor collects information for the principal. Following Tirole (1986), it is assumed that the principal lacks either the time or the knowledge necessary to supervise the manager, and that the auditor also lacks either the time or the resources required to run the vertical structure. It is further assumed that all players are risk neutral. Also, the auditor is considered to be independent and won't collude with the manager.

Nature is assumed to be the only one factor influencing the realized return, i.e. high return (R_H) or low return (R_L). Although the probability (p) of high return is the common information, the final realized return is the private information of the manager. That is, the principal will be unable to learn the manager's realized return unless the former takes some audit action. According to some kind of contract or regulation, it's assumed that the manager has to transfer some portion (α) of the return to the principal. In other words, the manager can reserve only the $1-\alpha$ portion of the return. That mechanism brings about an incentive that the manager would like to under-declare the return.

To deter under-declaration of return, the principal can employ the auditor at cost C to audit the return declared by the manager when the latter declares low return. If the auditor finds the under-declaration of return, the manager has to pay a penalty of $\bar{P}$.[1] In a two-period audit decision, the audit policy for the second period may be dependent on the audit result in the first period; i.e. there can exist the possibility of "conditional audit." It's assumed that the audit probability for the first period is A if the manager declares low return, but the probability for the second period will depend on the audit result in the first period. If the under-declaration of return in period one is found and revealed by the auditor, the probability for the second period will be enhanced up to $A'(\equiv A+a)$ provided the manager declares low return once again in period two. However, is the conditional audit necessary for raising the principal's expected utility? That is the key issue that this paper intends to deal with.

In this paper, the audit capability (or audit quality) of the auditor is defined as the probability, r, that the under-declaration of return can be found by the auditor; i.e. the more the value of r, the better the audit capability. Meanwhile, it's assumed that there doesn't exist the possibility of blackmail or collusion between the auditor and the manager. Both C and r are assumed to be the common information of all parties involved.

1 Following Kofman and Lawarree (1993), we assume $\bar{P}$ is an exogenously given number, which can be interpreted, for instance, as a legally specified limit on liability.

To summarize, the timing on the relevant events is presented as follows:

(1) The principal and the manager achieve an agreement that the latter will transfer some portion (α) of the return to the former.

(2) Nature determines the realized return in period one; i.e. high return (R_H) or low return (R_L).

(3) The manager declares the return in period one, $\hat{R}_1$, and will transfer $\alpha \cdot \hat{R}_1$ to the principal.

(4) The principal sends the auditor at cost C with probability A if the manager declares low return in period one (i.e. $\hat{R}_1 = R_L$).

(5) The auditor presents an audit report. If the under-declaration of return is disclosed, the manager will have to pay the principal a penalty of $\bar{P}$.[2] Also, the principal will keep a dishonest record on the manager.

(6) Nature determines the realized return in period two once again; i.e. high return (R_H) or low return (R_L).

(7) The manager declares the return in period two, $\hat{R}_2$, and will transfer $\alpha \cdot \hat{R}_2$ to the principal.

(8) The principal sends the auditor at cost C with probability A if the manager was not found under-declaring the return in period one and declares low return in period two (i.e. $\hat{R}_2 = R_L$), but with probability A' if the manager was found under-declaring the return in period one and declares low return in period two.

(9) The auditor presents an audit report, and the manager will have to pay the principal a penalty of $\bar{P}$ if the under-declaration of return is disclosed.

(10) Transfer takes place.

As nature determines the realized return in each period, the manager can choose to declare either high return or low return to the principal. If the outcome is high realized return (with probability p), the manager can choose either to truthfully declare high return or to dishonestly declare low return. However, if the outcome is low realized return (with probability $1-p$), based on the self-interested and rational assumption, the manager will declare only low return to the principal.[3]

2 $\bar{P}$ is assumed to be larger than $\alpha \cdot (R_H - R_L)$ for compensation and punishment.

3 If the realized return in period one is low, the audit probability for period two will kept to be A whether the manager declared either high or low return in period one.

If the realized return in period one is high, whether manager chooses to under-declare the return or not will depend on the difference of transferring amounts ($\alpha(R_H - R_L)$), the expected penalty ($Ar\bar{P}$), and the unfavorable effect on the audit probability for period two (possibly enhanced from A to A'). In the second period, if the realized return is high, whether manager chooses to under-declare the return or not will depend on nothing but both the difference of transferring amounts ($\alpha(R_H - R_L)$) and the expected penalty ($Ar\bar{P}$ or $A'r\bar{P}$ depending on the previous audit result).

On the other hand, since the principal is unable to observe the realized return, his audit policy can only depend on the return declared by the manager. In other words, the principal will take audit action only when the manager declares low return. If the realized return is low, the audit result will be also low return;[4] but if the realized return is high, the audit result will be subject to the effect of the audit quality (r) of the auditor. Given the principal's audit action, there remains a probability of $1-r$ that the auditor won't find the under-declaration of return.

3. The Analyses

In order to analyze the variety of strategy equilibriums between the principal and the manager, it's necessary to first characterize the manager's possible strategies under some combination of parameters. First of all, as the aforementioned, if the realized return in either period one or period two is low, the manager will consistently declare low return to the principal on the basis of self-interested and rational assumption.

Furthermore, the factors influencing the manager's declaration behavior includes the transferring ratio of return declared (α), the penalty ($\bar{P}$), the audit probabilities (A and A') and the audit quality (r). According to the relative relations among those parameters, we can infer the following three possible strategies that will be taken by the manager. (To simplify the denotation, we let $\Delta R \equiv R_H - R_L$ in the following analysis.)

Lemma 1:

If $\alpha\Delta R \leq Ar\bar{P}$, the manager will honestly declare the return in either period one or period two. That is, if the realized return in either period one

4 It's assumed that the auditor has to present some evidence to support his audit report on under-declared return, and that the evidence cannot be falsified.

or period two is high (i.e. $R_1 = R_H$ or $R_2 = R_H$), the manager will consistently declare high return to the principal (i.e. $\hat{R}_1 = R_1 = R_H$ or $\hat{R}_2 = R_2 = R_H$).

[Proof] If the realized return in period two is R_H, under the condition of $a\Delta R \leq Ar\bar{P}$, the expected penalty will be too large for the manager to under-declare the return. Hence, the manager will truthfully declare high return. By the same token, if the realized return in period one is R_H, the manager will also choose to declare high return since his decision in period one won't affect his declaration decision and expected payoff in period two.

Lemma 2:

Under the condition of $Ar\bar{P} < a\Delta R < A'r\bar{P}$, if the realized return in period two is high (i.e. $R_2 = R_H$), the manager will under-declare the return provided that he has a clean record;[5] but he will declare high return provided that he was found under-declaring return in period one. Meanwhile, if the realized return in period one is high (i.e. $R_1 = R_H$), the manager will under-declare the return all the time.
[Proof] See the appendix A.

Lemma 3:

Under the condition of $a\Delta R \geq A'r\bar{P}$, if the realized return in either period one or period two is high (i.e. $R_1 = R_H$ or $R_2 = R_H$), the manager will choose to under-declare the return to the principal (i.e. $\hat{R}_1 = R_L < R_1$ or $\hat{R}_2 = R_L < R_2$).

[Proof] See the appendix B.

After understanding the possible strategies that will be taken by the manager, it's the next step for us to analyze the optimal strategies of the principal while facing the manager's strategies. Fundamentally, there is a precondition for the principal to consider employing the auditor; that is, the expected payoff needs to be more than the audit cost (i.e. $rp\bar{P} > C$). Otherwise, the audit mechanism will never be used. In the latter analysis, $rp\bar{P} > C$ will be an implied assumption.

Since this paper focuses on the difference between A and $A'(\equiv A + a)$, i.e. the optimal value of a, we can rewrite the preconditions in the lemmas aforementioned as:

5 That implies the manager either honestly declared the return in period one or dishonestly under-declared the return in period one but was not found.

(i) $a\Delta R \leq Ar\bar{P} \Rightarrow \frac{a\Delta R}{r\bar{P}} \leq A \leq 1$ where $0 < A \leq 1$;

(ii) $Ar\bar{P} < a\Delta R < (A+a)r\bar{P} \Rightarrow 0 \leq A < \frac{a\Delta R}{r\bar{P}} < (A+a) \leq 1$ where $0 \leq A \leq 1$ and $0 \leq a \leq 1-A$;

(iii) $a\Delta R \geq (A+a)r\bar{P} \Rightarrow 0 \leq A \leq (A+a) \leq \frac{a\Delta R}{r\bar{P}}$ where $0 \leq A \leq 1$ and $0 \leq a \leq 1-A$.

Moreover, it's further assumed that the principal can obtain the expected payoff π_1, π_2 and π_3 under the situation (i), (ii) and (iii), respectively. According to the above relations among the related parameters, we can derive the following propositions.

Proposition 1:

If $a\Delta R \geq r\bar{P}$, then the optimal audit policy of the principal will be $A^* = A'^* = 1$ and $a^* = 0$. In other words, the conditional audit is useless. Meanwhile, in that situation, the principal will have a maximal expected payoff of π_3^*, where $\pi_3^* = 2aR_L + 2(rp\bar{P} - C)$.

[Proof] See the appendix C.

Proposition 1 implies that if the manager's benefit of under-declaring return is not less than the expected penalty under complete audit (i.e. $A=1$), the principal will definitely choose to take a complete audit action. That's because in that situation the manager necessarily choose to under-declare the return, and it becomes the principal's optimal audit policy for him to take a complete audit action under the incentive that the expected penalty revenue is larger than the audit cost.

On the other hand, if $a\Delta R < r\bar{P}$, then $\frac{a\Delta R}{r\bar{P}} < 1$ and there can exist the situation (i), (ii) or (iii). In the following inferences, it will be shown that the audit policy from the situation (i) will dominate that from the situation (iii), and the audit policy from the situation (iii) will also dominate that from the situation (ii). Hence, if $a\Delta R < r\bar{P}$, the audit policy from the situation (i) will be the principal's optimal strategy maximizing his expected payoff.

Lemma 4:

If $a\Delta R < r\bar{P}$, then the principal's maximal expected payoff in the situation (i), π_1^*, will be larger than that in the situation (iii), π_3^*.

[Proof] See the appendix D.

Lemma 5:

If $a\Delta R < r\bar{P}$, then the principal's maximal expected payoff in the situation (iii), π_3^*, will be larger than that in the situation (ii), π_2^*.

[Proof] See the appendix E.

According to the results of lemmas 4 and 5, we can further obtain the following result.

Proposition 2:

If $\alpha\Delta R < r\bar{P}$, then the optimal audit policy of the principal will be $A^* = \frac{\alpha\Delta R}{r\bar{P}}$, and a will have no effect on the manager's declaration of the return in period two. Meanwhile, in that situation, the principal will have a maximal expected payoff of π_1^*, where $\pi_1^* = 2\alpha R_L + 2p\alpha\Delta R - 2(1-p)\frac{\alpha\Delta R}{r\bar{P}}C$.

[Proof] By the lemmas 4 and 5, it's straightforward that the principal's expected payoff will be maximized in the audit policy from the situation (i) and a maximal expected payoff, π_1^*, will be achieved.

It can be found in proposition 2 that if the manager's benefit of under-declaring return is less than the expected penalty under complete audit, the principal will not need to take a complete audit action for deterring the manager's under-declaration behavior. Instead, the principal can take a random audit policy (i.e. $A = \frac{\alpha\Delta R}{r\bar{P}}$) to induce the manager to honestly declare the return. In that situation, since the manager necessarily chooses the honest declaration in period one, there will be no necessity of using a conditional audit probability in period two.

Finally, according to the propositions 1 and 2, we can conclude that the difference, a, between the audit probability, A, and the audit probability, A', actually doesn't play any role in the two-period audit policy. Thus, we have the following inference in proposition 3.

Proposition 3:

In a two-period audit scenario with the assumption of $C < rp\bar{P}$, it will be enough for the principal to use an uniform audit probability for low return declaration in both period one and period two.

[Proof] It can be easily derived by summarizing the results of propositions 1 and 2.

Based on a simple but reasonable assumption that the audit cost is less than the expected penalty revenue, we have obtained an impressive conclusion in proposition 3; that is, it's not necessary for the principal to take a conditional audit policy in which the audit probability in period two will be dependent on the audit result in period one. While the result may be not so intuitive, it does be the principal's optimal audit policy in consideration of the manager's self-interested and rational behavior.

4. Conclusion

It seems common sense that people can learn something from the past. Therefore, the previous experience brings about somewhat of impact on one's future action. There is no exception in the audit decision, either. In practice, such as taxation audit, the previous audit result often influences the present audit decision. That phenomenon is based on a preconception that someone doing something bad, such as concealing the truth, will tend to do the same thing again. Thus, the optimal decision will be dependent on the past experience.

If the attributes of the population concerned are certain and invariable, then the facts found from the samples do tell us something about the population. Those facts can play a prominent role in the analysis of the population and in the future decision. Under such a situation, the previous experience can be relevant to the future decision. However, in the audit decision, is the behavior of the audited agent (or the manager) certain and invariable? The answer should be negative. What we can conjecture is nothing but the audited will behave in a self-interested and rational way. Based on the behavioral assumption, the decision maker will have a wholly different strategy consideration.

In this paper, we create a two-period audit scenario and intend to dwell on whether the audit result in period one will have an effect on the audit decision in period two. It is found that if the manager's benefit of under-declaring return is larger than the expected penalty under complete audit, the manager necessarily choose to under-declare the return; and then the principal's optimal audit policy is to take a complete audit action in either period one or period two due to the incentive that the expected penalty revenue is larger than the audit cost. Thus, it's unnecessary to take the conditional audit into account.

On the contrary, if the manager's benefit of under-declaring return is less than the expected penalty under complete audit, the principal will not need to take a complete audit action for deterring the manager's under-declaration behavior. Instead, the principal can take a random audit policy to induce the manager to honestly declare the return. In that situation, since the manager definitely chooses the honest declaration in period one, there will be no necessity of using a conditional audit probability in period two, either.

Hence, we obtain a conclusion that, in an optimal two-period audit policy, it's not necessary for the principal to take a conditional audit policy. In other words, the audit policy for the second period doesn't need to depend on the audit result in the first period. While the result may be counterintuitive, it does be the principal's optimal audit policy in consideration of the manager's self-interested and rational behavior. Nevertheless, it doesn't imply we can extend the result to the other multiple-period (e.g. an infinite-period) decision situations. With respect to the audit policy in a finite multiple-period (more than two period), it may need much more researches to address the issues concerned.

Appendix A *(Proof of lemma 2)*

If the realized return in period two is R_H, under the condition of $a\Delta R > Ar\bar{P}$, the manager will choose to under-declare the return if he has a clean record; however, he won't do that if he was found under-declaring return in period one since $a\Delta R < A'r\bar{P}$.

On the other hand, if the realized return in period one is R_H, the manager will be inclined to under-declare the return since

$$E(\hat{R}_1=R_H|R_1=R_H)=(R_H-aR_H)+p(R_H-aR_L-Ar\bar{P})+(1-p)(R_L-aR_L),$$

$$\begin{aligned}E(\hat{R}_1=R_L|R_1=R_H)=&(R_H-aR_L-Ar\bar{P})+Ar[p(R_H-aR_H)\\&+(1-p)(R_L-aR_L)]+(1-Ar)[p(R_H-aR_L-Ar\bar{P})\\&+(1-p)(R_L-aR_L)],\end{aligned}$$

and

$$\begin{aligned}&E(\hat{R}_1=R_H|R_1=R_H)-E(\hat{R}_1=R_L|R_1=R_H)\\&=(R_H-aR_H)-(R_H-aR_L-Ar\bar{P})+p(R_H-aR_L-Ar\bar{P})-Arp(R_H-aR_H)\\&\quad-p(R_H-aR_L-Ar\bar{P})+Arp(R_H-aR_L-Ar\bar{P})\\&=aR_L-aR_H+Ar\bar{P}+Arp(aR_H-aR_L-Ar\bar{P})\\&=-a\Delta R+Ar\bar{P}+Arp(a\Delta R-Ar\bar{P})\\&=(a\Delta R-Ar\bar{P})(Arp-1)<0\quad(\because a\Delta R>Ar\bar{P}\text{ and }Arp<1).\end{aligned}$$

Appendix B *(Proof of lemma 3)*

Under the condition of $a\Delta R \geq A'r\bar{P}(\geq Ar\bar{P})$, if the realized return in period two is high (i.e. $R_2=R_H$), the manager will be inclined to under-declare the return whether he was found under-declaring return in period one or not.

On the other hand, if the realized return in period one is R_H, the manager will be also inclined to under-declare the return since

$$\begin{aligned}&E(\hat{R}_1=R_H|R_1=R_H)\\&=(R_H-aR_H)+p(R_H-aR_L-Ar\bar{P})+(1-p)(R_L-aR_L),\end{aligned}$$

$$\begin{aligned}&E(\hat{R}_1=R_L|R_1=R_H)\\&=(R_H-aR_L-Ar\bar{P})+Ar\{p[R_H-aR_L-(A+a)r\bar{P}]+(1-p)(R_L-aR_L)\}\\&\quad+(1-Ar)[p(R_H-aR_L-Ar\bar{P})+(1-p)(R_L-aR_L)],\end{aligned}$$

and

$$\begin{aligned}&E(\hat{R}_1=R_H|R_1=R_H)-E(\hat{R}_1=R_L|R_1=R_H)\\&=(R_H-aR_H)-(R_H-aR_L-Ar\bar{P})+p(R_H-aR_L-Ar\bar{P})-Arp[R_H-aR_L\\&\quad-(A+a)r\bar{P}]-p(R_H-aR_L-Ar\bar{P})+Arp(R_H-aR_L-Ar\bar{P})\\&=aR_L-aR_H+Ar\bar{P}-Arp[Ar\bar{P}-(A+a)r\bar{P}]\end{aligned}$$

$=-a\Delta R+Ar\bar{P}+Arp\cdot ar\bar{P}\leq 0$
$(\because a\Delta R\geq A'r\bar{P}=(A+a)r\bar{P}\quad \therefore a\Delta R-Ar\bar{P}\geq ar\bar{P}\geq ArP\cdot ar\bar{P})$.

Appendix C *(Proof of proposition 1)*

Since $a\Delta R\geq r\bar{P}\Rightarrow\frac{a\Delta R}{r\bar{P}}\geq 1$, there can exist only the situation (iii). The principal's expected payoff in the situation (iii) is

$$\begin{aligned}\pi_3=&p\{aR_L+A(r\bar{P}-C)+p[aR_L+Ar(A+a)(r\bar{P}-C)+(1-Ar)A(r\bar{P}-C)]\\&+(1-p)[aR_L-Ar(A+a)C-(1-Ar)AC]\}\\&+(1-p)\{aR_L-AC+p[aR_L+A(r\bar{P}-C)]+(1-p)(aR_L-AC)\}\\=&2aR_L+(2A+Aarp)(rp\bar{P}-C)\quad\text{(See appendix F).}\end{aligned}$$

We have $\frac{\partial\pi_3}{\partial A}=(2+arp)(rp\bar{P}-C)$ and $\frac{\partial\pi_3}{\partial a}=Arp(rp\bar{P}-C)$.
Besides, $rp\bar{P}>C$, $0\leq Arp\leq 1$ and $0\leq arp\leq 1\Rightarrow\frac{\partial\pi_3}{\partial A}>\frac{\partial\pi_3}{\partial a}>0$;
Hence, when $A^*=1$ and $a^*=0$ in the situation (iii), the principal will have the maximal expected payoff $\pi_3^*=2aR_L+2(rp\bar{P}-C)$.

Appendix D *(Proof of lemma 4)*

In situation (i), the principal's expected payoff is

$$\begin{aligned}\pi_1=&p[aR_H+paR_H+(1-p)(aR_L-AC)]\\&+(1-p)[aR_L-AC+paR_H+(1-p)(aR_L-AC)]\\=&2aR_L+2pa\Delta R-2(1-p)AC\quad\text{(See appendix G).}\end{aligned}$$

We have $\frac{\partial\pi_1}{\partial A}=-2(1-p)C<0$ and $\frac{\partial\pi_1}{\partial a}=0$.

Also, since $\frac{a\Delta R}{r\bar{P}}\leq A\leq 1$, as $A^*=\frac{a\Delta R}{r\bar{P}}$ in the situation (i), the principal will have the maximal expected payoff $\pi_1^*=2aR_L+2pa\Delta R-2(1-p)\frac{a\Delta R}{r\bar{P}}C$. In that case, a will have no effect on π_1^*.

On the other hand, by the same token as the proof of the inference 4, when $A^*=\frac{a\Delta R}{r\bar{P}}$ and $a^*=0$ in the situation (iii), the principal will have the maximal expected payoff $\pi_3^*=2aR_L+2(rp\bar{P}-C)\frac{a\Delta R}{r\bar{P}}$.

In order to compare π_1^* with π_2^*, we need to precisely characterize the value of A^* in the situation (i) and that of A^* in the situation (iii). According to the definition of the situation (i), the A^* in the situation (i) should be larger than but very close to $\frac{a\Delta R}{r\bar{P}}$, and can be defined as $\frac{a\Delta R}{r\bar{P}}+\varepsilon$ where $\varepsilon>0$ and $\varepsilon\rightarrow 0$. On the contrary, the A^* in the situation (iii) should be less than but very close to $\frac{\alpha \Delta R}{r\bar{P}}$, and can be defined as $\frac{\alpha \Delta R}{r\bar{P}} - \varepsilon$ where $\varepsilon > 0$ and $\varepsilon \to 0$. Hence, we have

$$\pi_1 = 2\alpha R_L + 2p\alpha\Delta R - 2(1-p)\left(\frac{\alpha \Delta R}{r\bar{P}} + \varepsilon\right) C \text{ and}$$

$$\pi_3 = 2\alpha R_L + 2(rp\bar{P} - C)\left(\frac{\alpha \Delta R}{r\bar{P}} - \varepsilon\right)$$

$$= 2\alpha R_L + 2p\alpha\Delta R - 2\frac{\alpha \Delta R}{r\bar{P}} C - 2\varepsilon(rp\bar{P} - C).$$

Let $\frac{\alpha \Delta R}{r\bar{P}} = \beta$, then we obtain

$$\pi_1 = 2\alpha R_L + 2p\alpha\Delta R - 2(1-p)C\beta - 2(1-p)C\varepsilon,$$

$$\pi_3 = 2\alpha R_L + 2p\alpha\Delta R - 2C\beta - 2\varepsilon(rp\bar{P} - C),$$

and

$$\begin{aligned}\pi_1 - \pi_3 &= -2(1-p)C\beta + 2C\beta - 2C\varepsilon + 2pC\varepsilon + 2rp\varepsilon\bar{P} - 2C\varepsilon \\ &= 2pC\beta + \varepsilon(2pC + 2rp\bar{P} - 4C) \\ &\approx 2pC\beta > 0 \quad (\because \varepsilon \to 0).\end{aligned}$$

Appendix E *(Proof of lemma 5)*

In situation (ii), the principal's expected payoff is

$$\begin{aligned}\pi_2 = p\{&\alpha R_L + A(r\bar{P} - C) + p\{Ar\alpha R_H + (1-Ar)[\alpha R_L + A(r\bar{P} - C)]\} \\ &+ (1-p)\{Ar[\alpha R_L - (A+a)C] + (1-Ar)(\alpha R_L - AC)\}\} \\ &+ (1-p)\{\alpha R_L - AC + p[\alpha R_L + A(r\bar{P} - C)] + (1-p)(\alpha R_L - AC)\}\end{aligned}$$

Let $\beta \equiv \frac{\alpha \Delta R}{r\bar{P}}$ and $A + a = \beta + b$, where $b > 0$ ($\because \frac{\alpha \Delta R}{r\bar{P}} < (A+a)$). Then

$$\begin{aligned}\pi_2 = p\{&\alpha R_L + A(r\bar{P} - C) + p\{Ar\alpha R_H + (1-Ar)[\alpha R_L + A(r\bar{P} - C)]\} \\ &+ (1-p)\{Ar[\alpha R_L - (\beta+b)C] + (1-Ar)(\alpha R_L - AC)\}\} \\ &+ (1-p)\{\alpha R_L - AC + p[\alpha R_L + A(r\bar{P} - C)] + (1-p)(\alpha R_L - AC)\}\end{aligned}$$

$\because \frac{\partial \pi_2}{\partial b} < 0$ and $b > 0$ $\therefore$ as $b^* \to 0^+$, we have the maximal value of π_2^*.

If $b = 0$, then

$$\pi_2^* = 2\alpha R_L - 2AC + p^2 Ar\alpha\Delta R + 2Arp\bar{P} + A^2 rpC - A^2 r^2 p^2 \bar{P} - ArpC\beta + Arp^2 C\beta \quad \text{(See appendix H).}$$

Besides, $\because \frac{\partial^2 \pi_2}{(\partial A)^2} = 2rpC - 2r^2p^2\bar{P} = 2rp(C - rp\bar{P}) < 0 \quad (\because rp\bar{P} > C)$

$\therefore$ as $\frac{\partial \pi_2}{\partial A} = 0$, there exists a maximal value of π_2^*.

Since

$$\frac{\partial \pi_2(A=A^*)}{\partial A} = -2C + p^2 ra\Delta R + 2rp\bar{P} + 2A^* rpC - 2A^* r^2 p^2 \bar{P} - rpC\beta + rp^2 C\beta = 0,$$

we have $A^* = \dfrac{p^2 ra\Delta R + 2(rp\bar{P} - C) - rpC\beta(1-p)}{2rp(rp\bar{P} - C)}$.

In order to check if $A=A^*$ satisfies the condition of $0 \leq A < \dfrac{a\Delta R}{r\bar{P}}$, we need to analyze the possible value of A^*. First, for the part of the denominator in A^*,

$\because rp > 0$ and $rp\bar{P} > C$ $\therefore 2rp(rp\bar{P} - C) > 0$.

Next, for the part of the numerator in A^*,

$\because rpC\beta(1-p) = p\dfrac{C}{\bar{P}}a\Delta R(1-p) < prpa\Delta R(1-p)$ and

$prpa\Delta R(1-p) = p^2 ra\Delta R(1-p) < p^2 ra\Delta R$

$\therefore p^2 ra\Delta R - rpC\beta(1-p) > 0$ and $p^2 ra\Delta R + 2(rp\bar{P} - C) - rpC\beta(1-p) > 0$.

Hence, $A^* > 0$ and the condition of $0 \leq A$ is satisfied.

On the other hand, if $A^* < \dfrac{a\Delta R}{r\bar{P}} (\equiv \beta)$, then

$$A^* = \frac{p^2 ra\Delta R + 2(rp\bar{P} - C) - rpC\beta(1-p)}{2rp(rp\bar{P} - C)} < \beta$$

$$\Rightarrow p^2 ra\Delta R + 2(rp\bar{P} - C) - rpC\beta(1-p) < 2rp\beta(rp\bar{P} - C)$$

$$\Rightarrow p^2 ra\Delta R - rpC\beta(1-p) < (2rp\beta - 2)\,(rp\bar{P} - C)$$

$$\Rightarrow C < rp\bar{P} - \frac{p^2 ra\Delta R - rpC\beta(1-p)}{2rp\beta - 2}$$

$$\Rightarrow C < rp\bar{P} - \frac{p^2 r^2 \bar{P} - rpC(1-p)}{\left(2rp - \dfrac{2r\bar{P}}{a\Delta R}\right)} \quad \left(\text{by } \beta = \frac{a\Delta R}{r\bar{P}}.\right)$$

$$\Rightarrow C < rp\bar{P} - \frac{rp[rp\bar{P} - (1-p)C]a\Delta R}{2(rpa\Delta R - r\bar{P})}$$

$$\Rightarrow C < rp\bar{P} + \frac{rpa\Delta R[rp\bar{P} - (1-p)C]}{2(r\bar{P} - rpa\Delta R)}.$$

$\because \dfrac{a\Delta R}{r\bar{P}} < (A+a) \leq 1$ in the situation (ii)

$\therefore r\bar{p} > a\Delta R > rpa\Delta R$ and $2(r\bar{P} - rpa\Delta R) > 0$.

Also, $\because rp\bar{P} > C \therefore rp\bar{P} > (1-p)C$ and $rpa\Delta R[rp\bar{P} - (1-p)C] > 0$.

Thus, $\dfrac{rpa\Delta R[rp\bar{P} - (1-p)C]}{2(r\bar{P} - rpa\Delta R)} > 0$ and $C < rp\bar{P} < rp\bar{P} + \dfrac{rpa\Delta R[rp\bar{P} - (1-p)C]}{2(r\bar{P} - rpa\Delta R)}$.

The condition of $A<\frac{\alpha\Delta R}{r\bar{P}}$ is also satisfied.

Hence, there exists $A^*=\frac{p^2 r\alpha\Delta R+2(rp\bar{P}-C)-rpC\beta(1-p)}{2rp(rp\bar{P}-C)}$ to maximize the principal's expected payoff in the situation (ii) and result in π_2^*. In that case, we have

$$\pi_2^*=2\alpha R_L-2A^*C+p^2A^*r\alpha\Delta R+2A^*rp\bar{P}+A^{*2}rpC-A^{*2}r^2p^2\bar{P}$$
$$-A^*rpC\beta+A^*rp^2C\beta$$
$$=2\alpha R_L+A^{*2}rp(rp\bar{P}-C) \quad \text{(See appendix I)}$$

and

$$\pi_3^*=2\alpha R_L+2(rp\bar{P}-C)\frac{\alpha\Delta R}{r\bar{P}} \quad \text{(See the proof of Lemma 4).}$$

$$\because rp<1 \text{ and } 0<A^*<\frac{\alpha\Delta R}{r\bar{P}}<1$$

$$\therefore A^{*2}rp(rp\bar{P}-C)<\left(\frac{\alpha\Delta R}{r\bar{P}}\right)^2(rp\bar{P}-C)<2\frac{\alpha\Delta R}{r\bar{P}}(rp\bar{P}-C) \quad \left(\because 0<\frac{\alpha\Delta R}{r\bar{P}}<1\right).$$

Therefore,

$$\pi_3^*-\pi_2^*=\left[2\alpha R_L+2(rp\bar{P}-C)\frac{\alpha\Delta R}{r\bar{P}}\right]-[2\alpha R_L+A^{*2}rp(rp\bar{P}-C)]$$
$$=2\frac{\alpha\Delta R}{r\bar{P}}(rp\bar{P}-C)-A^{*2}rp(rp\bar{P}-C)>0.$$

Appendix F

$$\pi_3=p\{\alpha R_L+A(r\bar{P}-C)+p[\alpha R_L+Ar(A+a)(r\bar{P}-C)+(1-Ar)A(r\bar{P}-C)]$$
$$+(1-p)[\alpha R_L-Ar(A+a)C-(1-Ar)AC]\}$$
$$+(1-p)\{\alpha R_L-AC+p[\alpha R_L+A(r\bar{P}-C)]+(1-p)(\alpha R_L-AC)\}$$
$$=p[\alpha R_L+Ar\bar{P}-AC+\alpha R_L+p(A^2r^2\bar{P}-A^2rC+Aar^2\bar{P}-AarC+Ar\bar{P}$$
$$-AC-A^2r^2\bar{P}+A^2rC)-(1-p)(AC+AraC)]$$
$$+(1-p)[\alpha R_L-AC+\alpha R_L+p(Ar\bar{P}-AC)-(1-p)AC]$$
$$=p(\alpha R_L+\alpha R_L-2AC+Ar\bar{P}+Aar^2p\bar{P}-AarpC+Arp\bar{P}-AraC$$
$$+AarpC)+(1-p)(\alpha R_L+\alpha R_L-2AC+Arp\bar{P})$$
$$=\alpha R_L+\alpha R_L-2AC+Arp\bar{P}+Arp\bar{P}+Aar^2p^2\bar{P}-AarpC$$
$$=2\alpha R_L+rp\bar{P}(2A+Aarp)-2AC-AarpC$$
$$=2\alpha R_L+rp\bar{P}(2A+Aarp)-C(2A+Aarp)$$
$$=2\alpha R_L+(2A+Aarp)(rp\bar{P}-C)$$

Appendix G

$$\pi_1=p[\alpha R_H+p\alpha R_H+(1-p)(\alpha R_L-AC)]$$

$$
\begin{aligned}
&+(1-p)\,[\alpha R_L - AC + p\alpha R_H + (1-p)\,(\alpha R_L - AC)] \\
&= p\alpha R_H + p^2\alpha R_H + p\alpha R_L - pAC - p^2\alpha R_L + p^2AC + (1-p)\alpha R_L - (1-p)AC \\
&\quad + (1-p)p\alpha R_H + (1-p)^2(\alpha R_L - AC) \\
&= p\alpha R_H + p^2\alpha R_H + p\alpha R_L - pAC - p^2\alpha R_L + p^2AC + \alpha R_L - p\alpha R_L - AC + pAC \\
&\quad + p\alpha R_H - p^2\alpha R_H + \alpha R_L - AC - 2p\alpha R_L + 2pAC + p^2\alpha R_L - p^2AC \\
&= p\alpha R_H + \alpha R_L - AC + p\alpha R_H + \alpha R_L - AC - 2p\alpha R_L + 2pAC \\
&= 2p\alpha R_H + 2\alpha R_L - 2AC - 2p\alpha R_L + 2pAC \\
&= 2\alpha R_L + 2p\alpha(R_H - R_L) - 2(1-p)AC \\
&= 2\alpha R_L + 2p\alpha\Delta R - 2(1-p)AC
\end{aligned}
$$

Appendix H

$$
\begin{aligned}
\pi_2 &= p\{\alpha R_L + A(r\bar{P} - C) + p\{Ar\alpha R_H + (1-Ar)\,[\alpha R_L + A(r\bar{P} - C)]\} \\
&\quad + (1-p)\,[Ar(\alpha R_L - \beta C) + (1-Ar)\,(\alpha R_L - AC)]\} \\
&\quad + (1-p)\,\{\alpha R_L - AC + p[\alpha R_L + A(r\bar{P} - C)] + (1-p)\,(\alpha R_L - AC)\} \\
&= p\{\alpha R_L + Ar\bar{P} - AC + p[Ar\alpha R_H + (1-Ar)\,(\alpha R_L + Ar\bar{P} - AC)] \\
&\quad + (1-p)\,(\alpha R_L - AC + A^2rC - ArC\beta)\} \\
&\quad + (1-p)\,(\alpha R_L + \alpha R_L - AC + Arp\bar{P} - AC) \\
&= p\alpha R_L + Arp\bar{P} - ApC + p^2Ar\alpha R_H + p^2(1-Ar)\,(\alpha R_L + Ar\bar{P} - AC) \\
&\quad + p\alpha R_L - p^2\alpha R_L - p(1-p)AC + p(1-p)A^2rC - p(1-p)ArC\beta \\
&\quad + 2(1-p)\alpha R_L - (1-p)AC + (1-p)Arp\bar{P} - (1-p)AC \\
&= 2\alpha R_L - 2AC + p^2AC + 2Arp\bar{P} - Arp^2\bar{P} + p^2Ar\alpha R_H + p^2\alpha R_L + Arp^2\bar{P} \\
&\quad - p^2AC - p^2Ar\alpha R_L - A^2r^2p^2\bar{P} + A^2rp^2C - p^2\alpha R_L + A^2rpC - A^2rp^2C \\
&\quad - ArpC\beta + Arp^2C\beta \\
&= 2\alpha R_L - 2AC + p^2Ar\alpha\Delta R + 2Arp\bar{P} + A^2rpC - A^2r^2p^2\bar{P} - ArpC\beta \\
&\quad + Arp^2C\beta
\end{aligned}
$$

Appendix I

$$
\begin{aligned}
\pi_2^* &= 2\alpha R_L - 2A^*C + p^2A^*r\alpha\Delta R + 2A^*rp\bar{P} + A^{*2}rpC - A^{*2}r^2p^2\bar{P} - A^*rpC\beta \\
&\quad + A^*rp^2C\beta \\
&= 2\alpha R_L + A^*(-2C + p^2r\alpha\Delta R + 2rp\bar{P} + A^*rpC - A^*r^2p^2\bar{P} - rpC\beta + rp^2C\beta) \\
&= 2\alpha R_L + A^*(-2C + p^2r\alpha\Delta R + 2rp\bar{P} + 2A^*rpC - 2A^*r^2p^2\bar{P} - rpC\beta \\
&\quad + rp^2C\beta) - A^{*2}rpC + A^{*2}r^2p^2\bar{P} \\
&= 2\alpha R_L - A^{*2}rpC + A^{*2}r^2p^2\bar{P} \\
&= 2\alpha R_L + A^{*2}rp(rp\bar{P} - C)
\end{aligned}
$$

where we use the result that

$$
\begin{aligned}
\frac{\partial\pi_2(A=A^*)}{\partial A} &= -2C + p^2r\alpha\Delta R + 2rp\bar{P} + 2A^*rpC - 2A^*r^2p^2\bar{P} - rpC\beta + rp^2C\beta \\
&= 0
\end{aligned}
$$

References

Antle, R.

1982 "The Auditor as an Economic Agent," *Journal of Accounting Research* 20: 503-527.

Baiman, S., J. Evans and N. Nagarajan

1991 "Collusion in Auditing," *Journal of Accounting Research* 29:1-18.

Baiman, S., J. Evans and J. Noel

1987 "Optimal Contracts with a Utility-Maximizing Auditor," *Journal of Accounting Research* 25:217-244.

Baron, D. and D. Besanko

1984 "Regulation, Asymmetric Information and Auditing," *Rand Journal of Economics* 15:447-470.

Demski, J. and D. Sappington

1987 "Hierarchical Regulatory Control," *Rand Journal of Economics* 18:369-383.

Greenberg, J.

1984 "Avoiding Tax Avoidance: A (Repeated) Game-Theoretic Approach," *Journal of Economic Theory* 32:1-13.

Kofman, F. and J. Lawarree

1993 "Collusion in Hierarchical Agency," *Econometrica* 61:629-656.

Laffont, J. and D. Martimort

1999 "Separation of Regulators against Collusive Behavior," *Rand Journal of Economics* 30:232-262.

Landsberger, M. and I. Meilijson

1982 "Incentive Generating State Dependent Penalty System: The Case of Income Tax Evasion," *Journal of Public Economics* 19:333-352.

Tirole, J.

1986 "Hierarchies and Bureaucracies: On the Role of Collusion in Organizations," *Journal of Law, Economics and Organizations* 2:181-214.

兩期最適稽核政策之分析*

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摘　要

一般的直覺認爲，過去的稽核經驗應該會對目前的稽核決策產生一些影響。亦即，受稽核的單位（或代理人）如果在過去曾經有過不誠實的記錄（如：謊報、懈怠等），則執行稽核的單位（或稽核人員）似乎即應對其提高稽核的頻率，以減輕相關的損失。此一直覺與作法是否眞的符合委託稽核者（或主理人）的利益？在一些假設與設定下，本研究透過兩期稽核模式的建立與分析，試圖對此一問題尋找適當的答案。研究結果顯示，在兩期的稽核情境中，條件稽核的使用並無必要。換言之，在兩期的最適稽核政策中，第二期的稽核決策並不需取決於第一期的稽核結果。此一結論雖然不是那麼符合直覺，甚至有些令人意外，惟在代理人自利與理性的行爲假設下，其實並不難理解其隱含的經濟意涵。關於此點，本文將在結論中作適當的說明。

關鍵詞：資訊不對稱、代理問題、稽核政策

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