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Managerial Retention Cost, Manager Specific Effort and the Use of Leading Indiactors

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Abstract

This study examines the role of leading indicators in a managerial contracting setting. For the purpose of incentive provision when the outcome of the manager's activities are in the long run, the use of leading indicators such as customer satisfaction is often observed. In the two-period contract setting in this paper, I focus on the setting where those activities are manager-specific and the firm can gain the outcome of the manager's activities only when the manager stays at the firm in the second period. Under this setting, I show the equilibrium cost to induce the manager to stay at the firm and describe the role of leading indicators. Furthermore, I show the relationship between manager-specific effort exerted in the first period and the effort incentive in the second period. I show, in equilibrium, complementarity between the two kinds of efforts above does not necessarily help improve the incentive of the manager-specific effort in the first period.

Key Words: Leading Indicators; Retention cost; Manager-specific effort; Moral hazard; Short-term contracts; Effort substitution

1 Introduction

When the owner of a firm wants to motivate a manager from the long-term perspective, use of leading indicators is often observed in practice as in Balanced Scorecard (e.g., Kaplan and Norton, 2006). The purpose of this paper is to show the roles of leading indicators and describe the equilibrium level of efforts under the sequence of short-term contracts.

Christensen, Feltham and Sabac [2003] analyzed the sequence of short-term contracts and showed that there is no pure strategy equilibrium the manager stays at the firm in the second period unless the intertemporal correlation between performance measures used in the contract for performance evaluation is zero.

In this paper, I consider the setting where the manager can access the labor market after the first period. Therefore I analyze the contract regime is the sequence of short-term contracts, where the owner offers one period contract at the beginning of each period. Under the sequence of short-term contract setting, it is natural to think that it is costly to induce the manger to work for the same company in the second period as well. In order to analyze the relevant cost and inefficiency caused by the manager's access to the labor market, I introduce the notion of retention cost, cost to induce the manager to stay at the firm in the second period.

In order to analyze the inefficiency caused by the manager's access to labor market, I introduce the retention cost, the cost to induce the manager to stay in the second period, and thereby analyze the equilibrium where the firm gains the outcome of the manager's first period activity only when the manager stays in the firm in the second period.

In classic moral hazard problems, the focus is on the tradeoff between incentive provision of the agent and imposing risk on him (e.g., Holmstrom, 1979, 1982). Indjejikian and Nanda [1999] analyzed the sequence of short-term contracts where performance measures in each period have inter-temporal correlation. Under the sequence of short-term contracts scheme, Indjejikian and Nanda [1999] showed that there is ratchet effect, a negative effect of use of nonfinancial performance measures on first period effort. Sliwka [2002] also analyzed the weight on the performance measures, especially on the leading indicators under the similar setting and showed that the weight on leading indicators can be negative. As Christensen Feltham and Sabac [2003] pointed out, Indjejikian and Nanda [1999] and Sliwka [2002] implicitly assumed the manager's commitment to stay, i.e., the manager is committed to stay at the firm in the second period even under a short-term contract setting. Christensen, Feltham and Sabac [2003] argues that there are three kinds of relevant commitment researchers should consider, commitment to the content to the contract, fairness of contract[1] and stay commitment. In this paper, I consider the setting where there is no stay commitment but the owner have the opportunity to give the manager an offer that induces the manager to stay at the firm. Kaplan and Norton [2006] emphasizes the use of nonfinancial performance measures such as leading indicators in Balanced Scorecoard. Christensen, Feltham and Sabac [2003] showed that, under the sequence of short-term contracts, the mamager stays at the firm after the first period unless intertemporal correlation equals zero.

Christensen, Feltham and Sabac [2003] analyzed a moral hazard problem in a two-period setting and showed that there is no pure strategy equilibrium where the manager stays in the owner's firm in the second period unless performance measures in two periods have non-zero correlation.

This paper is organized as follows. In the next section, I describe the basic model and characterize the retention cost. In the third section, I examine the incentive and delegation problem of pre-contract investment by adding the opportunity to make an investment decision before contracting. In the forth section, I introduce the new assumption, the complementarity of efforts, and analyze the relationship between retention cost and complementarity of efforts. In the sixth section, I make concluding remarks.

2 Basic model

There are two players in this model, the risk-neutral owner of the firm and the risk-neutral manager. The owner owns the assets to produce goods or service, but needs someone else, the manager, to gain the outcome from those assets. The owner hires the manager for this purpose for as many as two periods and the manager works for the manager. The owner's objective from the contract relationship with the manager is maximization of expected outcome net expected payment to the manager.

[1] For fairness, see Baron and Besanko [1987] for example.

The manager exerts the two kind of efforts: strategic effort in period one and operational effort in period two, respectively[2]. I assume that the outcome of strategic effort cannot be delivered to the firm unless the manager stays at the firm in the second period as well.

Now denote $e_s \in \mathbf{R}$ is the outcome of strategic effort incurring cost of effort $\frac{1}{2}e_s^2$, which the manager chooses and pays in the first period. The outcome of strategic effort e_s realizes at the end of the second period. I assume that e_s is unobservable. Importantly, strategic effort e_s is specific to the manager hired in period 1. That is, the outcome of strategic effort is not delivered to the firm when the manager leaves the firm after the first period and the owner hires another manager for the second period. Let us denote $e_o \in \mathbf{R}$ operational effort in period 2. Operational effort is unobservable and incurs cost of effort $\frac{1}{2}e_o^2$. Operational effort is chosen by the manager in the second period and realizes at the end of the second period.

The outcome of two kinds of effort, which is delivered to the firm at the end of the second period, is jointly observed as follows: $x = k \cdot e_s + e_o + \varepsilon_x$, where $k \geq 0$ is the productivity parameter of strategic effort e_s and ε_x is a random variable subject to normal distribution with mean zero and variance σ^2. The outcome x is assumed to be observable and verifiable and therefore can be contracted upon. Notice that the efficient effort levels are given by $e_s = k$, $e_o = 1$.

Additionally, the performance measure $s = e_s + \varepsilon_s$ realizes in the first period and is observable and verifiable. The term ε_s is a random variable subject to normal distribution with mean zero and variance σ^2. This performance measure conveys the information regarding the strategic effort but the outcome of strategic effort is delivered to the firm in the second period, so I call this performance measure the leading indicator. I assume that there can be correlation between the noise terms in the outcome and the leading indicator: $\tau = corr(\varepsilon_x, \varepsilon_s)$, where $-1 \leq \tau \leq 1$. The correlation between outcome and the leading indicator corresponds to the characteristics of prospective performance measures such as customer satisfaction[3].

At the beginning of each period, the owner offers the manager a one-period linear contract as a take-it-or-leave-it offer. Let $w_1 = f_1 + v_1 \cdot s$ denote the first period contract, where f_1 is fixed compensation and v_1 is the coefficient for the leading indicator s. Similarly, let $w_2 = f_2 + v_2 \cdot x$ denote the second period contract, where f_2 is fixed compensation and v_2 is the coefficient for the

[2]The terminology follows Sliwka [2002]

[3]See Kaplan and Norton [1996] for detailed description on custmer satisfaction measures.

outcome. I assume that $\underline{w}_i$ is the alternative payoff for the manager in period $i \in 1, 2$.

As I mentioned above, Christensen, Feltham and Sabac[2003] showed that the manager does not stay at the firm without a special case under the setting of sequence of short-term contracts. With production technology and short-term contracts, it is optimal for the manager to gain the payoff above the alternative payoff in the first period and leave the firm after the first period[4]. Now, I assume that the owner can commit to pay the retention cost c_s as follows. When the owner offers the first period contract, the owner offers the retention cost c_s, which is paid to the manager at the beginning of the second period if the manager accepts the second period contract [5]. On the other hand, if the manager rejects the second period contract and leaves the firm, c_s is not paid to the manager. Additionally, I assume that the second period contract must cover the manager's alternative payoff in the second period, $\underline{w}_2$. Finally, the owner can precommit to the payment of retention cost c_s[6].

Introduction of the retention cost is justified as follows. First, the strategic effort is specific to the manger. That is, the owner does not gain the outcome of the strategic effort if the manager leaves the firm. Therefore, it is natural to assume that the owner wants the opportunity to offer the retention cost c_s to induce the manager to stay at the firm in the second period. Second, I focus on the setting where the manager can access the labor market after the first period. If I analyze the long-term contract with or without commitment, it will be difficult to study the cost to induce the manager to stay at the firm in the second period. For this purpose, I need the contract regime to be the sequence of short-term contracts.

The sequence of events is as follows. First, the owner offers the first period contract and retention cost to the manager. Second, the manager decides to accept or reject the owner's offer. If the manager accept, the two parties enters the contract relationship. If the manager rejects, the relationship immediately ends. Third, the manager exerts the strategic effort. Forth, the leading indicator realizes and the compensation is paid to the manager according to the first period contract. Fifth,

[4]The model of Christensen et al. [2003] corresponds to the case of $k = 0$ in this paper. In their model (especially when $\tau > 0$), the manager can gain the expected payoff $\underline{w}_1 + \frac{1}{2}v_2^2\tau^2$ by choosing the lower strategic effort than prescribed by the owner. This is due to the fact that fixed payment covers the cost of strategic effort the owner wants the manager to exert.

[5]Notice that the first period contract does not contain any portion of the second period contract, so the manager has to decide to accept or reject the first period contract without any commitment or promise regarding the second period contract.

[6]Of course, the choice of stay or leave is verifiable.

the owner offers the second period contract to the manager. Sixth, the manager decides to accept or reject the owner's offer. If the manager accept, the two parties enters the contract relationship in the second period and retention cost is paid to the manager according to the arrangement on the retention cost in the first period. If the manager rejects, the relationship ends. Seventh, the manager exerts the operational effort. Eighth, the outcome is delivered to the owner and the compensation is payed to the manager according to the second period contract and contract relationship ends.

2.1 Solution to the basic model

Solution is fulfilled by backward induction.Before solving for equilibrium retention cost c_s, I give the description of the owner's second period problem. The owner's problem at the beginning of the second period is as follows[7]:

$$\begin{aligned}
\max \quad & k \cdot \hat{e}_s + e_o^* + \tau(s - \hat{e}_s) - E[f_2 + v_2 \cdot x] \\
\text{subject to} \quad & e_o^* \in \arg\max_{e_o} \; f_2 + v_2 \cdot [k \cdot e_s + e_o + \tau(s - e_s)] - \frac{1}{2}e_o^2 && \text{(IC2)} \\
& f_2 + v_2 \cdot [k \cdot e_s + e_o^* + \tau(s - e_s)] - \frac{1}{2}[e_o^*]^2 \geq \underline{w}_2. && \text{(PC2)}
\end{aligned}$$

Note that hat means the conjecture throughout the paper. The first constraint (IC2) is the incentive compatibility constraint. This constraint means that the operational effort is chosen optimally by the manager. The second constraint (PC2) is the participation constraint. This constraint ensures the manager's expected payoff is not less than $\underline{w}_2$, his alternative payoff in the second period.

Because the manager is risk-neutral, the owner's problem above involves no other tradeoff than incentive provision of effort exertion. Therefore equilibrium effort and slope coefficient are given by $e_o^* = 1, v_2^* = 1$.

Next, I turn to the solution to retention cost. For preparation, let us focus on the manager's reaction to the first period contract (f_1, v_1). The manager's expected payoff from the contract rela-

[7]Note that, at the beginning of the second period, strategic effort e_s is the conjecture to the owner but is private information to the manager who has chosen e_s in the first period.

tionship with the owner is as follows:

$$E[f_1 + v_1 \cdot s \mid e^*_{s,stay}] - \frac{1}{2}[e^*_{s,stay}]^2 + c_s + \underline{w}_2 \qquad \text{(if stay)}$$

$$E[f_1 + v_1 \cdot s \mid e^*_{s,leave}] - \frac{1}{2}[e^*_{s,leave}]^2 + \underline{w}_2, \qquad \text{(if leave)}$$

where $e^*_{s,stay}$ and $e^*_{s,leave}$ indicates the manager's optimal choice of strategic effort if the manager stays or leaves the firm after the first period, respectively. Hence I get the optimal choice of the strategic effort in each case:

$$e^*_{s,stay} = v_1 + v^*_2(k - \tau) \qquad \text{(if stay)}$$

$$e^*_{s,leave} = v_1. \qquad \text{(if leave)}$$

Therefore, the manager optimally chooses to stay when the following inequality holds.

$$E[f_1 + v_1 \cdot s \mid e^*_{s,stay}] - \frac{1}{2}[e^*_{s,stay}]^2 + c_s \geq E[f_1 + v_1 \cdot s \mid e^*_{s,leave}] - \frac{1}{2}[e^*_{s,leave}]^2. \tag{1}$$

This inequality reduces to:

$$c_s \geq \frac{1}{2}\,[v^*_2]^2\,(k - \tau)^2. \tag{2}$$

In equilibrium, the owner wants to minimize the retention cost c_s. Therefore the optimal retention cost is written as:

$$c^*_s = \frac{1}{2}\,[v^*_2]^2\,(k - \tau)^2 \tag{3}$$

Additionally, incentive provision of strategic effort in the first period only requires effort cost. Then I get the following equilibrium strategic effort level and the first period slope coefficient:

$$v^*_1 = \tau \tag{4}$$

$$e^*_s = k \tag{5}$$

Hence I get the following proposition regarding the equilibrium retention cost and optimal slope coefficients.

Proposition 1. *Equilibrium retention cost is characterized by* $c^*_s = \frac{1}{2}\,[v^*_2]^2\,(k - \tau)^2$. *Equilibrium effort levels are efficient and the slope coefficients in the contract are given by* $v^*_1 = \tau$ *and* $v^*_2 = 1$.

2.2 Stay or leave?: the owner's optimal choice

When c_s is too large, it may be optimal not to hire the same manager in both period. Therefore, under the setting of this model where there is no other benefit to the owner from the manager's stay, it is optimal for the owner to induce the manager to stay when the following inequality holds. For simplicity, I assume that the alternative payoff of the manager is zero ($\underline{w}_1 = \underline{w}_2 = 0$) in later sections.

$$k \cdot e_s^* - \frac{1}{2}[e_s^*]^2 + e_o^* - \frac{1}{2}[e_o^*]^2 - c_s^* \geq \frac{1}{2} \tag{6}$$

The equality holds in equilibrium, so the following is given.

Corollary 1.1. *When $k \geq \frac{\tau}{2}$ holds, it is optimal for the owner to induce the manager to stay at the firm in the second period.*

The corollary says that this constraint does not matter when k is large enough. In the later section, I show that large k is not necessarily desirable.

3 Pre-contract investment

In this section, I consider the case where there is an opportunity to make an investment to the productivity of the strategic effort. When starting an new project or installing a new business unit, pre-contract investment is needed to acquire or improve productivity. In other situations, some managers study in business school by financial support by the firm in order to improve their business skills. Pre-contract investment analyzed in this section corresponds to these situations, which are common to many organizations. Additionally, argument in this section is useful to understand the equilibrium roles of retention cost and help understand the argument in the next section. In this section I show the condition the manager prefers the pre-contract investment.

I assume that there is an investment opportunity to raise the productivity from k to $k + a$, where $a > 0$ is constant and the both parties know the value of a. This investment incurs the cost $d_a \geq 0$ to the firm (the owner). This investment decision is assumed to be observable.

Before introducing the equilibrium, I examine the manager's preference over this investment decision when the investment decision right is delegated to the manager. As shown in the above proposition, the expected payoff from the contract relationship is $\underline{w}_1 + \underline{w}_2 + c_s^*$ irrespective of the productivity of strategic effort k and equilibrium effort levels are efficient independent of k. Therefore, the manager makes precontract investment when the following inequality holds.

$$\frac{1}{2}(k + a - \tau)^2 \geq \frac{1}{2}(k - \tau)^2. \tag{7}$$

This reduces to:

$$a[a + 2(k - \tau)] \geq 0. \tag{8}$$

Hence, the manager's investment decision is described in the following corollary.

Corollary 1.2. *When $k \leq \tau$, the manager prefers to make an investment in the domain $0 \leq a \leq -(k - \tau)$ and does not otherwise. On the other hand, when $k > \tau$, the manager always prefers to invest*[8].

Let us consider the implication of this corollary. When k is sufficiently large, the manager prefers to make an investment because the pre-contract investment increases the retention cost. When k is smaller than τ, however, the manager may prefer not to make an pre-coctract investment because the retention cost decreases by the investment. This corollary is useful when understanding the various functions of the retention cost in equilibrium. Recall that the strategic effort is manager-specific, say, the owner cannot acquire the outcome of the manager's strategic effort. The retention cost functions like hostage through the leaving opportunity of the manager. Additionally, pre-contract investment changes the magnitude of the retention cost in various ways. Hence, the retention cost varies with pre-contract investment, and thereby the manager does not necessarily accept the pre-contract investment even when the productivity before investment is high.

4 Interaction between strategic effort and operational effort

In this section, I introduce the additional assumption, the interaction between strategic effort and operational effort. I modify cost of operational effort as follows.

$$\frac{1}{2}[e_o^2 + 2p \cdot e_s \cdot e_o], \tag{9}$$

[8] In the domain of $a < 0$ it is optimal not to invest, but this possibility is precluded by the assumption $a > 0$.

where $-1 < p < 1$ is the degree of complementarity or substitutability[9] between strategic effort e_s and operational effort e_o. Generally, efforts are called substitutes when $p > 0$ and complement $p < 0$[10]. Notice that cost of operational effort above incurs in the second period. This corresponds the case the cost of operational effort varies with the strategic effort exerted in the first period. There is no other additional assumption.

Before describing the equilibrium, let us see the efficient result. Efficient effort levels maximizing the joint surplus are given as follows.

$$e_s^e = k - p \tag{10}$$

$$e_o^e = 1 - p \cdot e_s^e \tag{11}$$

Expected joint surplus is given as follows.

$$k \cdot e_s + e_o - \frac{1}{2}[e_s^2 + 2p \cdot e_s \cdot e_o + e_o^2] \tag{12}$$

$$\text{with} \qquad e_o = 1 - p \cdot e_s \tag{13}$$

In this section, the manager's optimal choice of operational effort is efficient as in the basic model. Therefore the owner's problem at the beginning of the first periodis as follows.

$$\begin{aligned}
\max_{f_1,v_1,f_2,v_2} \; & k \cdot e_s + e_o - \frac{1}{2}[e_s^2 + 2p \cdot e_s \cdot e_o + e_o^2] - c_s \\
\text{subject to} \quad & e_o^* = 1 - p \cdot e_s^* && \text{(IC2)} \\
& e_s^* \in \arg\max_{e_s} E[f_1^* + v_1^* \cdot s + f_2^* + v_2^* \cdot x] \\
& \qquad\qquad - \frac{1}{2}[e_s^*]^2 - \frac{1}{2}[\{e_o^*\}^2 + 2p \cdot e_s \cdot e_o^*] && \text{(IC1)} \\
& E[f_1^* + v_1^* \cdot s] - \frac{1}{2}[e_s^*]^2 \geq \underline{w}_1 && \text{(PC1)} \\
& E[f_1 + v_1 \cdot s \mid e_{s,stay}^*] - \frac{1}{2}[e_{s,stay}^*]^2 + c_s \\
& \geq E[f_1 + v_1 \cdot s \mid e_{s,leave}^*] - \frac{1}{2}[e_{s,leave}^*]^2 && \text{(stay)}
\end{aligned}$$

The first constraint (IC2) is incentive compatibility constraint for the choice of the manager's operational effort in the second period. (IC1) is the incentive compatibility constraint for the manager's strategic effort, optimized for the maximization of his expected payoff from the contract

[9]The similar setting appears in Dikkoli et al. [2009]

[10]See Vives [1999] for details.

relationship and cost of strategic effort and operational effort. Notice that cost of operational effort depends on the choice of strategic effort, which is chosen in the first period. The constraint (PC1) is for the manager's acceptance of the second period. As in the basic model, the owner needs to ensure the manager his alternative payoff. Thee last constraint (stay) ensures that the manager stays at the owner's firm in the second period.

The solution to the owner's problem above is similar to that of the basic model. Hence, I get the following proposition on equilibrium effort levels and slope coefficients.

Proposition 2. *Equilibrium effort levels are introduced as follows:*

$$e_s^* = \frac{v_1^* + (k - \tau - p)}{1 - p^2}, \tag{14}$$

$$e_o^* = 1 - p \cdot e_s^*. \tag{15}$$

Equilibrium slope coefficients are given as follows.

$$v_1^* = \frac{\tau - (k - p) \cdot p^2}{1 - p^2 + p^4}, \tag{16}$$

$$v_2^* = 1. \tag{17}$$

proof. The proof is by straight forward algebra as in the basic model. □

The case of $p = 0$ is equivalent to the basic model in section 2. Similar to the basic model, there is no other tradeoff than effort exertion. Therefore, equilibrium slope coefficient in the second period contract is $v_2^* = 1$. In this section, there is interaction between strategic effort and operational effort because cost of operational effort depends on the strategic effort chosen in the first period.

Strategic effort e_s is motivated both by $v_1 \cdot s$, the bonus in the first period contract, and by $v_2 \cdot x$, the bonus in the second period contract. As mentioned earlier in this section, efficient level of strategic effort is $k - p$. However, conditional expected outcome after observing first period signal s is $E[x \mid s] = k \cdot e_s + e_o + \tau(s - e_s)$. Therefore v_1 is chosen to compensate for ratchet effect of portion of the second period contract $-v_2 \cdot \tau$.

From here in this section, I analyze the optimal slope coefficient v_1^*, retention cost c_s^* and expected owner's payoff.

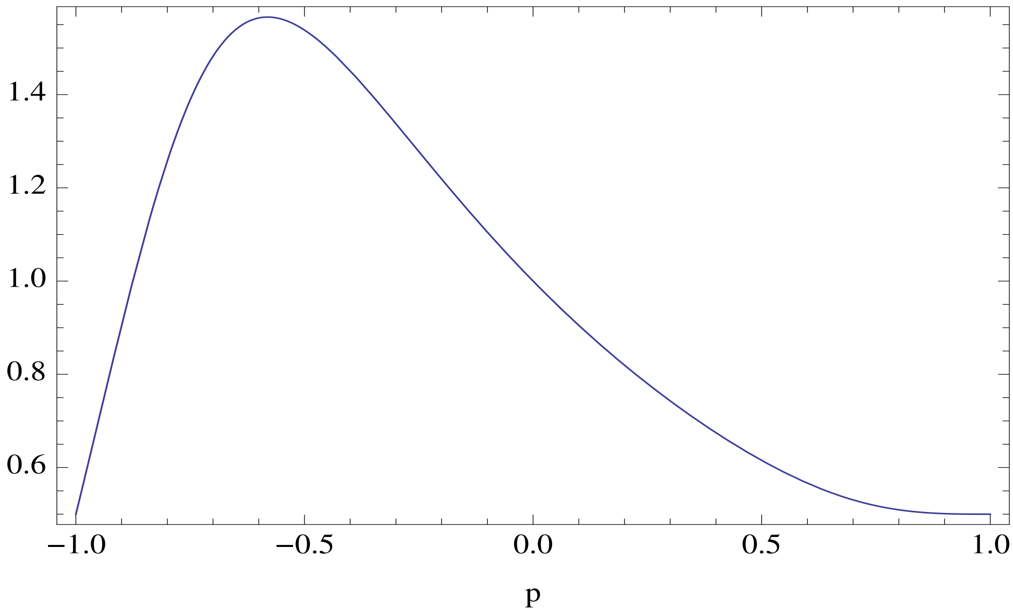

Figure 1: Equilibrium strategic effort

When $p < 0$ is negative, i.e., efforts are complementary, strategic effort reduces the cost of operational effort. On the other hand, when efforts are substitute (p is positive), strategic effort increases cost of operational effort. So it is natural to guess that equilibrium strategic effort decreases in p. However, as shown in figure 1, the optimal strategic effort in the case of $\tau = 0.5$ and $k = 1$ reaches the peak at the intermediate value between $-1 < p < 0$, and is not monotonically decreasing in p.

Observation 1. *When $\tau = 0.5, k = 1$, e_s^* takes its maximum at $-1 < p < 0$.*

This fact is in contrast to the intuition above. In order to examine the mechanism behind this observation, I analyze retention cost and the expected payoff below.

For preparation of the analysis, let us see the slope coefficient of the leading indicator, v_1^*, in the proposition above.

$$v_1^* = \frac{\tau - (k - p) \cdot p^2}{1 - p^2 + p^4}. \tag{18}$$

Straight forward algebra gives the following corollary on the sign of v_1^*.

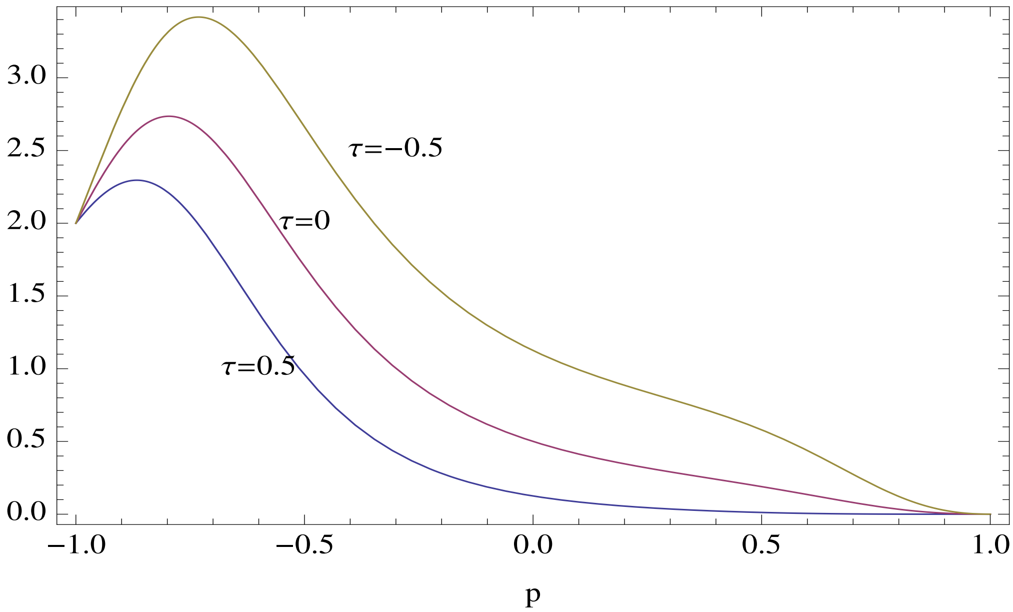

Figure 2: Equilibrium retention cost

Corollary 2.1. *The sign of the equilibrium slope coefficient in the first period contract is:*

$$v_1^* < 0 \qquad if \qquad \tau < (k-p)\cdot p^2 \tag{19}$$

$$v_1^* \geq 0 \qquad if \qquad \tau \geq (k-p)\cdot p^2. \tag{20}$$

It can be said that v_1^* is negative when k is sufficiently large. Similar to Sliwka [2002], the slope coefficient in the first period contract can be negative. Second period contract faces no tradeoff, so the second period slope coefficient v_2^* is set to induce the efficient strategic effort incentive minus ratchet effect accompanied. The first period bonus functions to compensate for this ratchet effect. This corollary is not enough to explain the non-monotonicity of optimal strategic effort in p in figure 1. Now I turn to the examination of retention cost.

In equilibrium, retention cost is given as follows:

$$c_s^* = \frac{1}{2}[v_1^*]^2 + \frac{1}{2}[e_s^*]^2 - v_1^* \cdot e_s^*, \tag{21}$$

$$\text{with} \quad e_s^* = \frac{v_1^* + (k - \tau - p)}{1 - p^2} \tag{22}$$

$$\text{and} \quad v_1^* = \frac{\tau - (k-p)\cdot p^2}{1 - p^2 + p^4}. \tag{23}$$

Now look at figure 2, an example of retention cost ($k = 1$).

Observation 2. *Equilibrium retention cost takes its maximum at some intermediate value* $-1 < p < 0$*.*

Observation of figure 2 tells that retention cost is maximized at some point in $-1 < p < 0$. This corresponds to the fact that strategic effort takes its maximum at some point in $-1 < p < 0$. Basically, strategic effort is magnified by the degree of complementarity, say $-p$. However, when p is sufficiently close to -1, motivating strategic effort is too costly in the sense that retention cost is too large. Therefore, when the degree of complementarity is extremely large, the owner refrains from fully motivating the strategic effort.

Next turn to the consideration on the relationship between retention cost and intertemporal correlation τ. The figure 2 shows that equilibrium retention cost is decreasing in intertemporal correlation τ. General result on this fact is the following corollary.

Corollary 2.2. *Equilibrium retention cost is decreasing in intertemporal correlation* τ $\forall k$*.*

proof. Proof is by straightforward algebra. □

Before concluding this section, let us see owner's expected payoff in the case of positive intertemporal correlation $\tau = 0.5$. Positive correlation corresponds to usual cases such as customer satisfaction, where it is often said that there is positive correlation between future performance and a current customer satisfaction measure.

Next observation describes the owner's expected payoff under positive intertemporal correlation.

Observation 3. *When* $k = 1$ *and* $\tau = 0.5 > 0$*, the owner's expected payoff is largest at negative degree of complementarity or substitution,* p*.*

As I have described above, equilibrium retention cost is larger when efforts are more complement. Additionally, when efforts are sufficiently complement, the owner does not provide the manager with much incentive of strategic effort, because retention cost is too large if she is to do so. This tendency of low powered incentive of strategic effort is greater the degree of complementarity is the greater, i.e., p is the more close to -1.

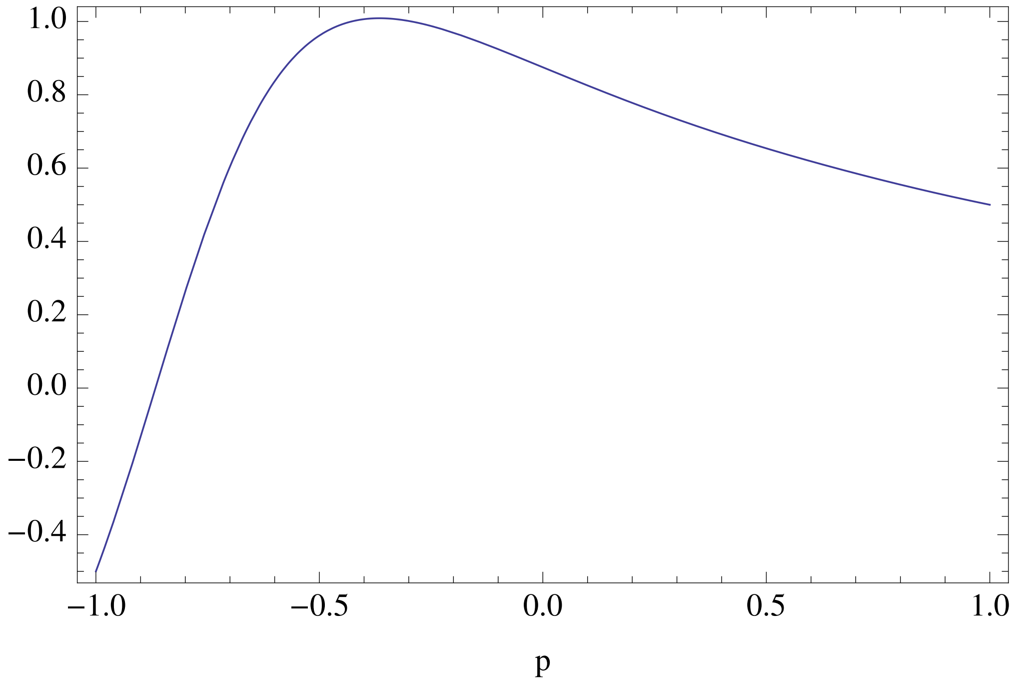

Figure 3: Owner's expected payoff

5 Conclusion

In this paper I have described the equilibrium managerial retention cost when the stay commitment mentioned in Christensen, Feltham and Sabac [2003] is absent and the owner can commit to the payment of the managerial retention cost, which is payed to the manager if the manager stays at the firm in the second period. Prior research treated the intertemporal correlation between the first period performance measures and the second period performance measures/outcome and analyzed the equilibrium effort incentives under the existence of what is called ratchet effect. I introduced into the prior models the complementarity or substitutability between efforts, especially strategic effort exerted in the first period and operational effort exerted in the second period.

The main result of this paper is that the complementarity of efforts does not necessarily improves the expected payoff of the owner of the firm. This result is in clear contrast to the intuition that effort complementarity improves the effort incentives.

There may be some obstacles to the future research. The description in this model is too complex to mathematically treat and apply to other settings. However, the function of the retention cost in this model is significant and seems to have many fruitful extensions in the future. Therefore one of the future objectives in this line of this research contains the construction of the foundation of applied models using the notion of retention cost.

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