Endogenous Monitoring in Multiprincipal Model
: implications for organizational design *

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Abstract

I analyze common agency games with moral hazard in which each principal can endogenously choose the level of monitoring for each agent, and derive some implications for organizational design. I show that even if a principal doesn't benefit from an agent's work, she has incentive to monitor him by drawing monitoring fee from the principal who benefits from the task via the agent in equilibrium. And I show by collecting the monitoring provisions from each principal, the multi-principals organization can create higher incentives and welfare compared with the single-principal one.

1 Introduction

In real world, we can see a variety of organizations in which multiple authorities control each agent. For example, several ministries which pursue different objectives try to influence a firm's management by regulations. And, many private firms adopt matrix structures in which a worker is supervised by several bosses.[1] Each superior would design a financial reward and try to control her subordinate. These types of situations can be modeled as common agency games between the authorities (principals) and the agent in economic theory.

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[1]See Davis and Lawrence (1977) and Galbraith (2000) for detail.

It is well known that the common agency game between risk-neutral principals and risk-averse agent leads to the *low-powered-incentive* provision for the agent and the low level of total welfare.(e.g.Dixit (1996)) This logic can be explained as follows. In this moral hazard environment, the principal faces the famous risk and incentive trade-off and has to incur risk-premium for the agent's participation.[2] Particularly, in multi-principal case, when they offer contracts non-cooperatively, each of them tries to reduce this risk cost without considering the effect of the other principals' risk reductions. As a result, the common agent bears less risk and is less incentivized, and the total welfare decreases as a result of the above negative externality.

By the way, the contract design is not the only instrument to reduce risk for the agent in real world organization. For example, in the above examples, if the regulators inspect a firm more frequently, then its management status would be assessed more precisely. And if each boss spends more time and energy in evaluating a follower, then the latter's risk for under evaluation would be mitigated. If we incorporate this kind of monitoring by principals into the model, the above contractual externality might not lead to severe consequences as long as the free-riding in monitoring among principals does not cause serious problems.

In this paper, I examine this possibility. First, I show even if a principal doesn't benefit from a task, she[3] has incentive to contribute a costly monitoring to it. There, through this information production activity, she draws monitoring fee from the principal who benefits from the task via the agent in equilibrium. And, albeit there are a lot of principals who do not find any benefit from the task at all, by collecting their monitoring, the multiprincipals situation can create higher incentive and welfare than the single principal one when the diseconomies of scope in the principals' monitoring really works.

To the best of my knowledge, this paper is the first to analyze the nature and the role of endogenous monitoring in multi-principal model with moral hazard. Bernheim and Whinston (1986) and Dixit (1996) are the main works on this field, and my analysis is based on the latter's model. Recently, Khalil, Martimort, and Parigi (2004) examined the nature of optimal contracts under various contractual and monitoring arrangements in an adverse selection framework without moral hazard. Their comparison between the centralized and decentralized monitoring is trivial in my paper since the merged principal case is free from the contractual externality and the free-riding in

[2]For example, see Laffont and Martimort (2002).

[3]Following the tradition on this literature, we refer to a principal as "she" and an agent as "he" throughout the paper.

monitoring. Costa, Ferreira and Moreira (2005) analyzed the choice between the matrix and the hierarchical structure[4] using common agency framework. In their model, the dominance of matrix form is due to the observation that the existence of another boss who benefits form the agent's task can create higher incentive. But my model can generate the trade-off independent of the level of bosses' total benefit.

The paper proceeds as follows. In the next section, I describe the model. And in section 3, I derive the optimal choices of contracts and monitoring efforts. Section 4 is devoted to make some comparisons between two organizational forms. First, I examine the nature of optimal contracts and monitoring, and then proceed to compare the agents' incentives and the total welfare. Finally, section 5 concludes.

2 Model

Basically, I follow the formulation by Dixit (1996), who analyzed the common agency game using the linear-normal framework developed by Holmström and Milgrom (1987). There are K (≥ 2) risk-averse agents each of whom is to engage in a production activity. The organizational designer wants to motivate these agents by creating contractual relationships between K risk-neutral principals and them.[5] Each agent $j \in \{1, \dots, K\}$ exerts a production effort, $t_j \in \mathbb{R}_+$ with production cost, $\frac{1}{2}t_j^2$. For each j, t_j is unobservable to all the principals, but the principal(s) can design incentive contract(s) contingent on a signal, x_j which is verifiable and reflects the effort chosen by agent j. Specifically, $x^T \equiv (x_1, \dots, x_K)$ is normally distributed with mean, $t^T \equiv (t_1, \dots, t_K)$ and variance matrix, Ω whose all the off-diagonal element is zero.[6] For the j-th diagonal term of Ω, Ω_{jj}, I posit the following assumption.

Assumption For all $j \in \{1, \dots, K\}$, $\Omega_{jj} \equiv \left(\sum_{k=1}^{K} (m_j^k)^\rho \right)^{-\frac{1}{\rho}}$, where m_j^k is a monitoring effort provided by principal k to agent j, and ρ is a parameter.

This assumption states that the principals can generate more precise signal to evaluate each agent's performance by investing in monitoring efforts

[4] The "hierarchy" is defined as an organizational form in which every agent has only one boss.

[5] The designers might be some principals. For example, some firms are managed by joint partners. But as long as the designers are not any of the principals, they cannot incentivize the agents by any means other than designing organization.

[6] a^T denotes the transpose of a vector a.

more. Here, the parameter, ρ captures the different possible degrees of substitutability among principals' monitoring efforts, where $\rho < 1 + \epsilon$ in which $\epsilon > 0$ is chosen to ensure the validity of the sufficient condition for maximization.[7] The lower ρ is, the less substitutable the monitoring efforts are. Here, note that Ω_{jj} is also dependent on the other principals' monitoring efforts as well as principal j's. This reflects the intuition that principal i might monitor agent $j(\neq i)$ even if she does not enjoy any benefit from his activity as I suggested in the introduction.

Each agent j has a constant absolute risk aversion (CARA) utility function, $u(z_j) \equiv -\exp(-rz_j)$, with coefficient, $r > 0$ and the monetary measure, z_j. The monetary measure takes the form, $z_j = w_j - \frac{1}{2}t_j^2$, where w_j is the sum of incentive contracts offered by the principal(s) to him. (The contractual forms are to be specified in the next section.) Each agent's reservation wage is normalized to zero. Each principal i's benefit from each activity is summarized in a vector, $b^{iT} \equiv (b_1^i, \ldots, b_K^i)$, where b_j^i denotes her benefit from agent j's activity. Suppose $\forall j \in \{1, \ldots, K\}$, $b_j^j > 0$, and $\forall i(\neq j)$, $b_j^i = 0$, *i.e.*, the task j is beneficial only to principal j. This assumption highlights the trade-off between contractual externality and intensive monitoring, and it can be seen as an extreme case of real life situations. Moreover, define a vector $B^T \equiv (b_1^1, \ldots, b_K^K)$. I also assume each principal has a linear monitoring cost with marginal cost one [8].

The designer's alternative is the *single-authority* form or the *multi-authorities* form. In the former situation, each principal contracts only with the agent whose task is beneficial to her. And in the latter situation, each principal contracts with all the agents. (See the figure 1 for the case of $K = 2$.) The important assumption I posit is that the designer can completely enforce these authority relations for the principals.

The timing of the game is as follows.

$t = 1:$ The designer chooses an organizational form.

$t = 2:$ Each principal offers contract(s) and chooses monitoring effort(s) non-cooperatively and simultaneously to the agent(s).

$t = 3:$ Each agent accepts or rejects the contract(s) at once.[9]

If he accepts, his game goes to the next stage, but if he rejects, his game ends.

[7] I admit the possibility of the duplications of monitoring among principals.

[8] We can assume non-linear monitoring cost (e.g. quadratic form), but it involves extremely messier algebra. And we can also assume the heterogeneous monitoring costs among principals.

[9] This paper analyzes so called *intrinsic* common agency game. For an analysis of the *delegated* common agency game under moral hazard environment in which the common agent can select the subset of contractual parties, see Martimort (2004).

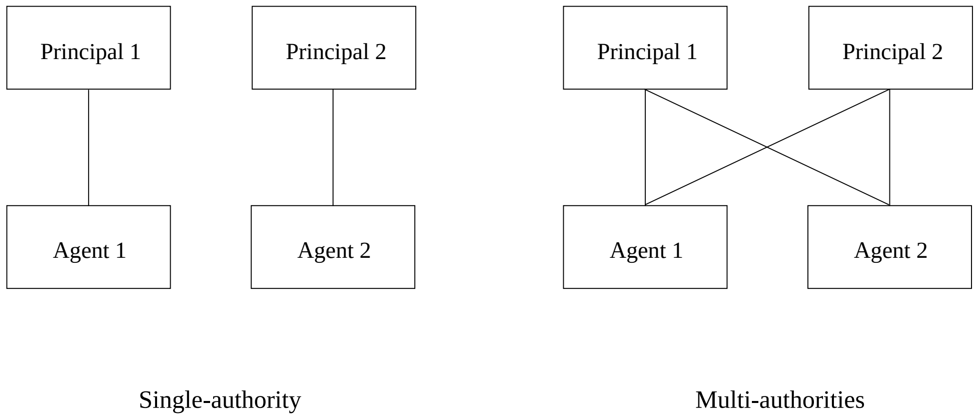

Figure 1: Organizational Chart

$t = 4$: All the agent who plays the game exerts a production effort.

$t = 5$: Some outcomes realize, and the contracts are executed.

In the above timing, I supposed the funds and the monitoring costs are small enough to ensure the principals' participation constraints never bind. Note that it is enough for us to assume only single agent case to preserve the nature of the analysis. However, there, the principals who do not benefit from the agent's output should be replaced with some outside monitors in the model as their roles are only to monitor the agent by charging fees consequently as we see in section 4. To exclude this possibility and examine the nature of monitoring in common agency game, I assumed there are K agents, and each principal is essential for the organization at least to provide incentive to one of them.

3 Optimal Contracts

3.1 Single Authority

In this subsection, I analyze the single-authority situation and obtain the optimal contracts and monitoring efforts. In this case, all the principals except i are prohibited from offering contracts to agent i, and, thus, they do not contribute costly monitoring to him at all. So, $\Omega_{jj} = 1/m_j^j$ holds for all j. (Denote m_j^j as m_j in this subsection.) A contract offered by principal i

takes the form, $\beta_i x_i + \gamma_i$ where β_i is a piece rate, and γ_i is a salary.[10]

Under this setup, each principal i's payoff is,

$$b_i^i x_i - (\beta_i x_i + \gamma_i) - m_i \ . \tag{1}$$

And each agent i's certainty equivalence is,

$$\mathrm{CE}_i \equiv \beta_i t_i + \gamma_i - \frac{1}{2}t_i^2 - \frac{r}{2}\beta_i^2 \frac{1}{m_i} \ .$$

He maximizes CE_i w.r.t. t_i, given β_i. So, the optimal effort supply is given by $t_i = \beta_i$, the incentive constraint (IC_i). And the participation constraint, (PC_i) requires $\mathrm{CE}_i = 0$. By substituting IC_i and PC_i into (1), each principal i's expected payoff can be written as,

$$b_i^i \beta_i - \frac{1}{2}\beta_i^2 - \frac{r}{2}\beta_i^2 \frac{1}{m_i} - m_i \ . \tag{2}$$

She maximizes this w.r.t. β_i and m_i. The first-order conditions for this program w.r.t. β_i and m_i are,

$$\begin{aligned} b_i^i - \beta_i - r\beta_i \frac{1}{m_i} &= 0 \\ -\frac{r}{2}\beta_i^2 \Big(- \frac{1}{m_i^2} \Big) - 1 &= 0 \end{aligned}$$

, respectively.[11]

The algebraic manipulation of these two equations yields the following result.

Proposition 1 *In the single authority situation, the unique equilibrium piece rates and monitoring contributions are given by* $\beta_i^S = b_i^i - \sqrt{2r}$ *and* $m_i^S = \sqrt{\frac{r}{2}}\beta_i^S$ *for all i, respectively.*

Here, $m_i^S > 0$, i.e., $\beta_i^S = b_i^i - \sqrt{2r} > 0$ needs to be satisfied. The equilibrium incentive, β_i^S is deflated proportionally to r. This is because the necessity to bear risk cost more leads the principal to incentivize the agent less. And the equilibrium monitoring, m_i^S is increasing w.r.t. r for sufficiently small r and is decreasing for sufficiently large r. This is because large level

[10]By Holmström and Milgrom (1987), these types of linear contracts are optimal in the normal model.

[11]The sufficient condition for maximization is also satisfied since (2) is strictly concave.

of monitoring is required to reduce risk cost when r is sufficiently large, and it entails fairly large monitoring cost.[12]

3.2 Multi-Authorities

Next, I analyze the multi-authorities situation by proceeding the similar steps with the previous subsection. In this situation, a contract offered by principal i to agent j is $\beta^i_j x_j + \gamma^i_j$, where β^i_j and γ^i_j denote a bonus rate and a salary for agent j, respectively.[13]

Thus, principal i's payoff becomes,

$$b^{iT} x - (\beta^{iT} x + \gamma^i) - \sum_{j=1}^{K} m^i_j \tag{3}$$

, where $\beta^{iT} \equiv (\beta^i_1, \ldots, \beta^i_K)$, and $\gamma^i \equiv \sum_{j=1}^{K} \gamma^i_j$.

Define vectors, $\beta \equiv \sum_{i=1}^{K} \beta^i$, and $\beta_j \equiv$ (the j-th element of β), and $\gamma \equiv \sum_{i=1}^{K} \gamma^i$. Then, as is the preceding subsection, agent j maximizes his certainty equivalence,

$$\mathrm{CE}_j \equiv \beta_j t_j + \gamma_j - \frac{1}{2} t_j^2 - \frac{r}{2} \beta_j^2 \Omega_{jj}$$

, given the offered contracts and the monitoring contributions, where $\gamma_j \equiv \sum_{i=1}^{K} \gamma^i_j$. By substituting IC_j, $t_j = \beta_j$, and PC_j, $\mathrm{CE}_j = 0$ for all j into (3), principal i's expected payoff becomes,

$$(b^i - \beta^i)^T \beta + \frac{1}{2} \beta^T (I - r\Omega) \beta + \gamma - \gamma^i - \sum_{j=1}^{K} m^i_j. \tag{4}$$

Principal i maximizes (4) w.r.t.β^i and m^i_j for all j, given the other principals' contract offers and monitoring provisions.

The first-order conditions for this program w.r.t. β^i and m^i_j are given by,

$$b^i - \beta^i - \beta + (I - r\Omega)\beta = 0 \tag{5}$$

$$-\frac{r}{2} \beta_j^2 \left(-\frac{1}{\rho} \Big(\sum_{k=1}^{K} (m^k_j)^\rho \Big)^{-\frac{1}{\rho}-1} \rho (m^i_j)^{\rho-1} \right) - 1 = 0 \tag{6}$$

[12]For the detailed explanation on the relationships between incentive and monitoring, see Milgrom and Roberts (1992).

[13]Again, by Holmström and Milgrom (1987), each principal finds it optimal to use a linear remuneration, given all the other principals use linear schemes.

, respectively.[14] Summing up (5) over $i = 1$ to K yields $\beta = (I + Kr\Omega)^{-1}B$.

Particularly, the j-th element of this vector is,

$$\beta_j = \frac{b_j^j}{1 + rK\Big(\sum_{k=1}^{K}(m_j^k)^\rho\Big)^{-\frac{1}{\rho}}} \ . \tag{7}$$

Here, the term, rK reflects a traditional contractual externality effect. (See Dixit (1996).) By (6), we must have $m_j^k = m_j^l$ for all $k, l \in \{1, \dots, K\}$. So, define $m_j \equiv m_j^k$ for all k. By substituting this into (6) and (7) and solving for β_j and m_j, we obtain the following. (The uniqueness of bonus rates and monitoring provisions directly follows from (5) and (6).)

Proposition 2 *In the multi-authorities situation, there is an equilibrium in which the piece rates, $(\beta_j^{jM}, \beta_i^{jM})$ and the monitoring provisions, m_j^M are given by $(\beta_j^{jM}, \beta_i^{jM}) = (b_j^j - \sqrt{2r}K^{\frac{1}{2}(1-\frac{1}{\rho})}, \ -\sqrt{2r}K^{\frac{1}{2}(1-\frac{1}{\rho})})$ and $m_j^M = \sqrt{\frac{r}{2}}K^{\frac{1}{2}(-\frac{1}{\rho}-1)}\beta_j^M$ respectively, where $\beta_j^M = b_j^j - \sqrt{2r}K^{\frac{1}{2}(3-\frac{1}{\rho})}$ is the equilibrium incentive for all j and i $(\neq j)$. And when $\rho < 1$, the piece rates and the monitoring provisions in all equilibria are given by the above ones.*[15] [16] [17]

Denote $\bar{\rho}$ as the ρ which satisfies $\beta_j^M = 0$. Since $m_j^M > 0$, i.e., $\beta_j^M > 0$ needs to be satisfied, we implicitly assume $\frac{1}{\rho} > \frac{1}{\bar{\rho}}$ in the following analysis. For the total monitoring intensity, $K^{\frac{1}{\rho}}m_j^M$, we can see $\partial K^{\frac{1}{\rho}}m_j^M/\partial K < 0$ and $\partial m_j^M/\partial K < 0$ for sufficiently small $\frac{1}{\rho}$.[18] This occurs because the free-riding effect in monitoring cannot be canceled for sufficiently small $\frac{1}{\rho}$. However,

[14] As I suggested in the section 2, the sufficient condition for maximization holds when $\rho < 1 + \epsilon$ for some $\epsilon > 0$. Though I do not present the proof here, the validity of this condition can be checked by examining the Hessian using mathematical induction.

[15] This is because of the complementarity among monitoring. However, it is possible that there are asymmetric equilibria in which some principals do not monitor an agent whose task is not beneficial to them when $\rho \geq 1$ (i.e. the case the substitutability among monitoring is pretty high).

[16] This result holds even when the setting is delegated common agency game as long as we limit our attention to the equilibria in which all the principals are active. Martimort (2004) showed all equilibria are such that all principals are active.

[17] This result preserves in the setting an agent produces K goods with no effort substitutability among them and each principal i finds benefit only from task i. (Dixit (1996)) There, whether each principal controls the agent's incentive only for her beneficial task or for all the tasks corresponds to the single authority form or the multi-authorities form in this paper, respectively.

[18] Here, the number of monitors are continuously approximated.

when $\frac{1}{\rho}$ is sufficiently large, such a free-riding effect is dominated by the size effect. (We can observe $\partial K^{\frac{1}{\rho}} m_j^M / \partial K > 0$ and $\partial m_j^M / \partial K < 0$ for sufficiently large $\frac{1}{\rho}$.) The comparative statics for β_j^M is presented in the next section.

4 Organizational Comparison

4.1 Optimal Contract and Incentive

In the single-authority case, the principal did not have incentive to monitor the agent whose task is not beneficial to her. But now, in the multi-authorities form, she tries to contribute a costly monitoring. She wastes her resource for such a seemingly unprofitable activity. Let me explain what is happening here. First, we can easily observe $\beta_j^{jM} > \beta_j^S$ if $\frac{1}{\rho} > 1$, and $\beta_j^{iM} < 0$ $(\equiv \beta_j^{iS})$ for all $i \neq j$. When principal $i(\neq j)$ posts the above (β_j^{iM}, m_j^M) instead of (β_j^{iS}, m_j^S), more precise performance signal is generated since $K^{\frac{1}{\rho}} m_j^M > m_j^S$ for sufficiently large $\frac{1}{\rho} > 1$. Then, principal j tries to incentivize agent j more, and agent j exerts more production effort for $\frac{1}{\rho} > 3$, the case the diseconomies of scope in monitoring fairly works. As a result, an information producer, principal i can earn more money. $(\beta_j^{iM} < 0)$

Corollary 1 *When $1/\rho > 1$, in all the equilibria of the multi-authorities case, the principals who don't benefit from a task charge commissions from the principal who benefits from the task via the agent by engaging in costly information production.*

This type of situation can be observed in global firms. (e.g. investment banks) Each manager's remuneration is completely based on the performance of her divisional unit. So, she doesn't care about the other departments' performances. But in a global firm, it is difficult for each divisional manager to observe the performances of her subordinates in foreign offices. So, the other division's manager in local office monitors and evaluates their performances. As a compensation for such a supervision, she receives a fraction of the profit they have generated.[19]

Next, by comparing the equilibrium incentives between the single and the multiple authorities situation, we obtain the following result.

[19]Since our concern is the intrinsic common agency, each principal needs not to demand such a compensation from each agent directly.

Proposition 3 *In the optimal contracts,*

if $\frac{1}{\rho} > 3$*, the multi-authorities form gives higher incentive than the single-authority form ;*
if $\frac{1}{\rho} = 3$*, both the single and the multi-authorities give identical incentives ;*
if $\frac{1}{\rho} < 3$*, the single-authority form gives higher incentive than the multi-authorities form.*

The above result contrasts with that of Dixit (1996) in which multiprincipal situation entails the low-powered incentive. The intuitive logic for the above result is as follows. Focus on a task j. In the multi-authorities case, when $\frac{1}{\rho}$ is sufficiently large, principal j incentivizes agent j more since more precise performance signal can be generated, (We can easily see $K^{\frac{1}{\rho}} m_j^M$ is increasing w.r.t. $\frac{1}{\rho}$.) and principal $i (\neq j)$ charges less fee to reduce risk for him. So, as a result, he is more incentivized. [20]

4.2 Welfare

Next, we turn our attention to the organizational design problem. Here, first, I assume the organizational performance is measured by the equilibrium total certainty equivalence so as to focus simply on the interaction between contractual externality and monitoring intensity. And I suppose the designer cares about the monitoring costs. This might be justified by regarding the monitoring costs as administrative costs in public organizations or salaries for managers in business firms. Now, the organizational objective corresponding to the single-authority situation can be written as,

$$\begin{aligned} \mathrm{TCE_S} &\equiv \sum_{j=1}^{K} \left(b_j^j \beta_j - \frac{1}{2}\beta_j^2 - \frac{r}{2}\beta_j^2 \frac{1}{m_j} - m_j \right) \\ &= \sum_{j=1}^{K} \left\{ b_j^j \beta_j^S - \frac{1}{2}(\beta_j^S)^2 - \sqrt{2r}\beta_j^S \right\}. \end{aligned} \tag{8}$$

And the organizational objective corresponding to the multi-authorities

[20] High $1/\rho$ corresponds to the situations like strictly convex monitoring cost though I assumed the linear monitoring cost. We can show the diseconomies of scope in monitoring works even for rather small $1/\rho$ when the marginal cost of monitoring for a principal who benefits from the task is far larger than that of a principal who does not benefit from it.

situation becomes,

$$\begin{aligned}
\mathrm{TCE_M} &\equiv (b^1+\cdots+b^K)^T\beta - \frac{1}{2}\beta^T\beta - \frac{r}{2}\beta^T\Omega\beta - \sum_{i=1}^K\sum_{j=1}^K m_j^i \\
&= \sum_{j=1}^K \left\{ b_j^j\beta_j^M - \frac{1}{2}(\beta_j^M)^2 - \sqrt{2r}K^{\frac{1}{2}(1-\frac{1}{\rho})}\beta_j^M \right\}. \qquad (9)
\end{aligned}$$

The difference between the above two equilibrium TCEs can be calculated as,

$$\begin{aligned}
L(\tfrac{1}{\rho},K) &\equiv \mathrm{TCE_M} - \mathrm{TCE_S} \\
&= \sqrt{2r}\big(\sum_{j=1}^K b_j^j\big)(1-K^{\frac{1}{2}(1-\frac{1}{\rho})}) + rK^{3-\frac{1}{\rho}}(2-K) - rK.
\end{aligned}$$

A slight observation implies the followings.

Lemma 1 *If $\frac{1}{\rho}\le 1$, then $L(\frac{1}{\rho},K)<0$ for all $K\ge 2$*

Lemma 2 *$L(\frac{1}{\rho},K)$ is increasing w.r.t. $\frac{1}{\rho}$ for all $K\ge 2$.*

The higher $\frac{1}{\rho}$ is, the more diseconomies of scope in monitoring works (the duplication and the free-riding in monitoring don't matter), and this positive externality effect creates the above two results.

Using these lemmas, we can characterize the optimal organizational structure as follows.

Proposition 4 *Given $K\ge 2$, there is a unique ρ^* such that :*

if $\frac{1}{\rho}>\frac{1}{\rho^*}$, the multiple authorities form is optimal ;
if $\frac{1}{\rho}=\frac{1}{\rho^*}$, both the single and the multiple authorities form are optimal ;
if $\frac{1}{\rho}<\frac{1}{\rho^*}$, the single authority form is optimal.[21]

[21] Costa, Ferreira and Moreira (2005) defined the organizational objective as, "$\mathbb{E}(x_1+\cdots+x_K-$ *total wage*$)-$ *total monitoring cost*". In this case, the opposite result with proposition 4 holds when $b_j^j>2\ \forall j$, i.e., the single authority (the multi-authorities) is better when $1/\rho$ is sufficiently large (small). This is because the situation $1/\rho$ is sufficiently large corresponds to the one each principal gives too much incentive to the agent for the organizational designer's view.

Proof As we have seen in subsection 3-1, $b_j^j - \sqrt{2r} > 0$ $(\forall j)$ must hold. So, $L(3, K) = \sqrt{2r}(\frac{K-1}{K})\sum_{j=1}^{K}(b_j^j - \sqrt{2r}) > 0$ for all $K \geq 2$.

So, by lemma 1 and 2, the intermediate value theorem ensures the existence of the desired ρ^*. ■

By this proposition, we can focus more on the interaction between contractual externality and monitoring intensity.

Corollary 2 *For $\frac{1}{\rho} \in \left(\frac{1}{\rho^*}, 3\right)$, the optimal organization is not the one which incentivizes the agent more. And if b_j^j increases for some j, then $\frac{1}{\rho^*}$ decreases. Moreover, if K increases, then $\frac{1}{\rho^*}$ increases when b_j^js are small enough.*

The first part of the corollary holds because the diseconomies of scope above a certain level can bring down the risk costs enough in spite of lower incentives and individual monitoring. In other words, so as to give the same level of incentive with the single principal case, the size effect must work enough to negate the contractual externality in the multi-authorities situation. This leads to lower risk cost. And the second part holds since increased b_j^j enhances larger total monitoring intensity in the multi-authorities case than in the single authority one and reduces the risk-premium term further. The last part states more free-riding in monitoring makes the multi-authorities structure less attractive.

5 Concluding Remarks

In this paper, I analyzed the multi-principals model with moral hazard in which each principal can invest for the realization of more informative signals about the agents' performances. Main findings are summarized as follows. First, we observed that even the principal who does not benefit from an agent's work at all bothers to spend cost to monitor him. There, she charges monitoring fee from the agent as if the principals who care about the task pay her. (In other words, in the single authority case, she does not monitor him because there is no one from whom she can draw commission.) And I show by collecting these monitoring, the incentive and the total welfare might be higher than the single-authority form, which contrasts with the previous works. Lastly, I conclude this paper by mentioning some unresolved issues for future research. First, in this paper, the size effect of monitoring is exogenously determined. But in some situations, the existence of multiple principals itself might endogenously create the diseconomies of scope in monitoring. If those situations are plausible, the dominance of the multi-authorities structure would be more justified. And, we should be able to say more about the organizational structure. For example, each principal itself could be regarded as an organization which consists of monitors. (a bureau, stakeholders for a firm etc.) Some should be said about the nature of these sub-organizations. (size, monitoring intensities etc.) Furthermore, although I considered an ex ante monitoring, for the ex post monitoring after a signal has realized, whether the less beneficial principal would monitor and why she does if so should be pursued.

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