

The Optimality of Power in Organizations :
Power Acquisition Process and Evaluation

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Abstract

This paper develops a moral hazard model whereby an agent exerts power to impute failure to other agents. The model is used to analyze the effect of power on organizational welfare. Our conclusion is that power is beneficial for organizations if the principal can control the power relationships between agents. These benefits disappear if strategic interaction between agents determines the power relationship. Other kinds of benefits are also shown by extending the model in two directions: (i) where there is competition for power between agents, and (ii) where the strategic interaction between agents generates a direct negative externality for the organization.

1 Introduction

Power, the ability of a person to bargain advantageously with his or her colleagues, is commonly observed in organizations. Researchers in organizational behavior have long investigated horizontal power relationships (i.e., between colleagues, divisional managers, etc.) and have confirmed the existence of power (Boeker, 1989; Crozier, 1964; Emerson, 1962; Gandz and Murray, 1980; Salancik and Pfeffer, 1974; Perrow, 1986. For a recent survey paper, see Ocasio, 2002). For example, Crozier (1964) in a case study of three French factories, found that maintenance workers (e.g., machine-setters and ordinary mechanics) exerted their power on production workers.¹ Although maintenance workers do not have (formal) authority over production workers, one of the production

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¹He inquires into politics in “The Industry Monopoly” in detail, which is granted a legal monopoly and belongs to the French State. The Industry Monopoly is a large-scale production organization for a very simple commodity.

workers reports that “we are dependent on them (maintenance workers), they are the bosses” (p.93). Salancik and Pfeffer (1974) also offer empirical evidence for the existence of power among faculty heads at the University of Illinois. Although various organizational processes are influenced by power, the evaluation process itself is the one that is most susceptible to power. Gandz and Murray (1980) asked the respondents of their survey research to give “a good example of workplace politics in action.”² Thirty-one percent of the examples given were associated with the assessment of work performance, such as those that “dealt with avoiding blame for poor work performance.”

The main purpose of this paper is to analyze the effects of power on organizational welfare when power is exerted in the evaluation processes as in Gandz and Murray (1980). One may think that as this is likely to distort performance measures, power provides only negative effects for organizations. This paper, however, argues that under some conditions, power is beneficial for organizations. To address this issue, we develop a variant of a standard moral hazard model with limited liability in which there is a risk-neutral headquarters (the principal) and two identical risk-neutral division managers (the agents). Each division manager chooses whether to take productive action, and the headquarters designs and offers each manager a compensation scheme for taking productive action. The performance of each manager is separately evaluated as either “good” or “bad”, but is correlated with that of the other manager. For convenience, the outcome where a manager’s performance is good and the other manager’s performance is bad is labeled as the former’s *relative success*. The managers also choose whether to engage in unproductive activity named “power struggle.” Their choice of power struggle determines the power relationship between the managers, and the power relationship influences their performance measures as follows. If only one of the managers engages in the power struggle, he acquires power and can impute, in part, his failure to the nonpowerful manager. In other words, the emergence of power increases the probability of the powerful manager’s relative success and decreases the nonpowerful manager’s relative success. If both or neither manager engages in the power struggle, no manager has power and the performance measures are not distorted.

We examine this model under the following alternative assumptions: (a) the power struggle is contractable (a contractable power acquisition process), or (b) the power struggle is not contractable (a noncontractable power acquisition process). The first assumption means that the headquarters can control the power relationship, while the second assumption suggests that the strategic interaction between the managers determines the power relationship. These assumptions may be interpreted as representing the following realistic cases. Suppose that the main source of power is the ability to influence the allocation of critical resources such as information, key machinery, monetary budgets, etc.³ When the critical resources are owned by the organization, assumption

²Gandz and Murray (1980) sent 590 questionnaires to the North American resident graduates and current part-time MBA students of a large metropolitan Canadian business school. The respondents were asked the extent to which political considerations influenced 11 organizational processes, including pay determination, promotion and discipline, and asked to describe an actual situation as “a good example of workplace politics in action.” They found that interdepartmental coordination, the delegation of authority, and promotion are the most politicized.

³For example, Salancik and Pfeffer (1974) find that the power of a department head in the university is most highly correlated with the outside funds that the department obtains.

(a) is reasonable, as the headquarters can usually allocate resources between the managers and this makes possible the headquarters' control over the power relationship. On the other hand, assumption (b) applies when the resources do not belong to the organization, such as outside research funding for a university. Although this paper shows the optimality of power in both cases, the benefits are quite different as briefly explained below.

Start by assuming that the power acquisition process is contractable. In this case, the benefit of power is that it reduces the rents the headquarters must pay to the managers below that where there is no emergence of power. When no manager has power, performance measures are not distorted, and hence as in the standard moral hazard model with limited liability and correlated performance, the least costly contract specifies a high compensation to a manager if and only if he is relatively successful (Che and Yoo, 2001).⁴ When the powerful manager can impute failure to the nonpowerful manager, there are two kinds of change in the probability distribution of performance measures. On the one hand, the probability of the nonpowerful manager's relative success decreases. When the compensation to the nonpowerful manager is contingent on relative success, the decrease in probability reduces the rent paid to the nonpowerful manager because his or her performance is less likely to be good. On the other hand, the powerful manager's exertion of power also increases the probability of his or her own relative success. If the compensation to the powerful manager were contingent on his or her relative success, this would increase the rent paid to the powerful manager. The headquarters, however, can avoid this increase in the rent paid by changing the pay scheme so that the powerful manager is paid high compensation if and only if both managers' performance measures are good. Therefore, the headquarters prefers the emergence of power.

When the power acquisition process is not contractable, the headquarters must design the contract in order to control both productive activities and power struggles. The optimal contract under the contractable power acquisition process then turns out to be infeasible because it cannot induce the emergence of power. We show that under the noncontractable power acquisition process, power is never optimal, and the optimal contract is either that both or neither manager engages in a power struggle, depending on the cost of the power struggle.

We thus extend the model in two directions in order to find the benefits of power under the noncontractable power acquisition process. The first extension is to introduce competition for resources between the managers. In the basic model, we implicitly assume that each manager can establish his or her influence on resources at the same cost, regardless of the other manager's behavior. This assumption may be reasonable when there are abundant resources such that resource constraints are not binding. On the other hand, if resources are scarce, and both managers attempt to establish an influence on them, the managers must engage in competition for the resources. Then it is reasonable to assume that each manager bears a greater cost in establishing his or her influence when the other manager also engages in the power struggle than when the latter does not. Under such a modified cost function, we show that power is again beneficial to the organization, because headquarters can more easily control the managers'

⁴The headquarters cannot avoid leaving the managers with rents, because the principal cannot verify their productive action and the agents are protected by limited liability.

power struggle under the emergence of power.

In the second extension, we consider the direct negative effect of the power struggle on the efficiency of organizations. This contrasts with the basic model where the power struggle only affects performance measures. Suppose that by engaging in a power struggle, each manager can establish his or her control over the use of resources, and hence the other manager has to bargain with the former in order to use these same resources. This sort of bargaining can cause negative externalities for the organization, including the delaying of decisions, the breakdown of the bargaining process, and so on. When there is a negative externality, headquarters faces a trade-off between allowing the power struggle that results in the negative externality and preventing the power struggle with some additional incentive costs. Therefore, we show that if the negative externality is not large, power is again optimal.

There is some existing literature studying nonproductive activities such as our power struggle. Milgrom and Roberts (1986) and Milgrom (1988) introduce “influence activities,” whereby managers influence the decisions of their headquarters. With this process, they claim that the headquarters’ welfare is worsened because it is more costly for the headquarters to induce the managers’ productive activities when they have incentives for engaging in influence activities. Scharfstein and Stein (2000) consider rent-seeking activities by managers and show that the possibility of such activities leads to the inefficient allocation of investment, even if the headquarters can use compensation schemes to prevent them. Power struggle in our model may be interpreted as an example of influence activity, in the sense that performance measurement is affected. Lazear (1989) and Chen (2003) analyze “sabotage” in rank-order tournament models, whereby one manager aims to hurt another manager’s performance. In that model, sabotage only distorts the performance of the other manager; in our model, the powerful manager not only decreases the nonpowerful manager’s performance, but also increases his or her own performance.

The most distinctive contribution of the current paper is to show the optimality of power. None of the extant literature identifies the case where the allowance for nonproductive activities is optimal for the principal. Indeed, the existing work argues that the principal should prohibit nonproductive activities if he or she can write a contract contingent on these activities. In contrast, we show that headquarters prefers the emergence of power, even if it can prevent managers from engaging in nonproductive activities.

The remainder of the paper is organized as follows. Section 2 develops the moral hazard model and introduces power struggle. In section 3, we show that power is beneficial for the headquarters when the power acquisition process is contractable. Section 4 analyzes the case of a noncontractable power acquisition process. We offer two extensions to explain further benefits of power in section 5. Section 6 provides some concluding remarks.

2 Framework

We consider a moral hazard model with limited liability in a firm with a headquarters and two divisions. The headquarters is managed by a principal, and each division by a distinct division manager i ($i = 1, 2$). All three parties are assumed to be risk neutral.

Contract The principal designs and offers each manager a contract that consists of a compensation scheme based on each pair of the managers' performance outcomes. Each manager's performance is measured as either "good" (G) or "bad" (B). Each pair of the managers' performance outcomes belongs to the feasible outcome set denoted by $X = \{GG, GB, BG, BB\}$, where the first component of each element is manager 1's performance outcome and the second is manager 2's. For example, when the principal observes GB , manager 1's performance outcome is good and manager 2's is bad. The compensation scheme is denoted by $w = (w^i(x); x \in X, i \in \{1, 2\})$, where $w^i(x)$ is the compensation to manager i when a pair of the performance outcomes is $x \in X$. We call $w^1 = (w^1(x); x \in X)$ joint performance evaluation (JPE) if $w^1(GG) \geq w^1(GB)$ and $w^1(BG) \geq w^1(BB)$. w^1 represents relative performance evaluation (RPE) if $w^1(GG) \leq w^1(GB)$ and $w^1(BG) \leq w^1(BB)$.⁵ We restrict attention to the contract satisfying the limited liability constraints (that is, $w^i(x) \geq 0$ for any $x \in X$), which imply that the managers can leave the relationship at any time, or they are wealth constrained.

Productive Actions The managers simultaneously choose productive actions for the headquarters. Manager i 's productive action denoted by $e^i \in E = \{e_H, e_L\}$ is not verifiable. He incurs private cost $c(e_H) = c > 0$ if he takes action e_H , while action e_L costs zero ($c(e_L) = 0$).

The managers' productive action pair, (e^1, e^2) , affects the distribution function of the performance outcome as follows.⁶ There is a common circumstance that is desirable with strictly positive probability σ and undesirable with probability $1 - \sigma$. If the circumstance is desirable, the performance outcomes of both managers are good; that is, $x = GG$, regardless of the managers' action. If the circumstance is undesirable, a manager's performance outcome is good with probability q_k and bad with probability $1 - q_k$ when the manager exerts action e_k . We assume $q_H > q_L$. We also assume $q_H > 1/2$ for avoiding any unnecessary classification of the optimal compensation. Dropping this assumption does not essentially change the results. Table 1 summarizes the joint probability distribution. We interpret σ as the degree of positive correlation between two divisions, because larger σ implies more positive correlation between their performances.

Table 1: The joint distribution function at $(e^1, e^2) = (e_j, e_k)$

		M 2	
		G	B
M 1	G	$\sigma + (1 - \sigma)q_jq_k$	$(1 - \sigma)q_j(1 - q_k)$
	B	$(1 - \sigma)(1 - q_j)q_k$	$(1 - \sigma)(1 - q_j)(1 - q_k)$

⁵We can similarly define JPE and RPE about $w^2 = (w^2(x); x \in X)$.

⁶This distribution function follows Che and Yoo (2001). It has two characteristics: (i) technological independence, and (ii) positive correlation of performance measure. (ii) implies that it is easier for both managers to obtain good performance when circumstances are good (e.g., when demand in the product market is growing) than when it is bad (e.g., when product demand is shrinking).

Power Struggle Game Besides productive activities, the manager decides whether or not to engage in a power struggle. Formally he or she chooses b^i from $B = \{b_H, b_L\}$, where b_H means that he or she engages in the power struggle and b_L represents the decision of no struggle. A cost function, $d(b^i)$, satisfies $d(b_H) = d > 0$ and $d(b_L) = 0$.

As discussed earlier, the managers' struggle determines a power relationship between the managers. When only one manager engages in the power struggle, he or she can persuade the other manager to follow what the former wants. We say manager 1 (manager 2) has power if $(b^1, b^2) = (b_H, b_L)$ ($(b^1, b^2) = (b_L, b_H)$), respectively. When both or neither manager engages in the power struggle, power is not generated because the manager's relative position does not change. The power relationship is classified into three cases based on the managers' struggle decision: (i) a struggle-proof situation (SP), where neither manager engages in the power struggle; (ii) a struggle-accepted situation (SA), where both managers engage in the power struggle, and (iii) a powerful i situation (PWi), where only manager i engages in the power struggle.

Power enables the holder to manipulate performance measures in the following way. If both or neither manager struggles for power ($b^1 = b^2$), the probability function of the performance measure is the same as Table 1. If only manager 1 struggles for power ($(b^1, b^2) = (b_H, b_L)$), the probability of the powerful manager's relative success (outcome pair GB) increases by β and the probability of the nonpowerful manager's relative success (BG) decreases by β as in Table 2.⁷ We assume that β satisfies

$$0 < \beta < (1 - \sigma)q_L(1 - q_H), \quad (1)$$

so that the probability of each performance outcome is positive for all (e_j, e_k) . Intuitively, the powerful manager can impute his or her failure to the nonpowerful manager. In other words, the powerful manager manipulates his or her own performance measure at the expense of the nonpowerful manager's measure when power is generated.

Table 2: The joint distribution function at $(e^1, e^2) = (e_j, e_k)$ and $(b^1, b^2) = (b_H, b_L)$

		M 2	
		G	B
M 1	G	$\sigma + (1 - \sigma)q_j q_k$	$(1 - \sigma)q_j(1 - q_k) + \beta$
	B	$(1 - \sigma)(1 - q_j)q_k - \beta$	$(1 - \sigma)(1 - q_j)(1 - q_k)$

An interpretation of this formulation is that there is "ambiguity" about performance. Ambiguity means that the principal cannot always specify who is responsible for relative success in the project, either GB or BG . Given that true performance is GB or BG , the headquarters can verify who is the responsible manager for the relative success in the project with probability $(1 - \sigma)(1 - q_j)q_k - \beta$. However, with probability β , the headquarters cannot observe who is responsible, and thus the performance measure is open for

⁷We can similarly define the probability distribution under $(b^1, b^2) = (b_L, b_H)$.

managerial manipulation. In the latter case, the performance depends on the power relation between the managers. For example, performance may be evaluated in a formal meeting of two division managers and their headquarters. If the document submitted to the meeting affords abundant evidence, power does not matter. Otherwise, power plays an important role in evaluation. We can then interpret β as the degree of ambiguity concerning performance. Gandz and Murray (1980) offer empirical support for ambiguity in performance measures.

Payoffs and Timing Finally, we define some notation for simplicity. The probability of a pair of performance outcomes $x \in \{GG, GB, BG, BB\}$ is denoted by $p_{jk}^s(x)$, where manager 1 (manager 2) takes e_j (e_k) and s ($s \in \{S, PW1, PW2\}$) is an indicator of the power relationship, where $s = S$ represents the situation in which no manager has power; i.e., SP or SA. When manager i has power, the situation is denoted by $s = PWi$.

Each manager's payoff and the payment to the principal are defined as follows.

$$EP(w) = \sum_i EP^i(w) = \sum_{x \in X} p_{jk}^s(x) w^1(x) + \sum_{x \in X} p_{jk}^s(x) w^2(x)$$

$$U^1(e_j, e_k, b_n, b_m; w) = EP^1(w) - c(e_j) - d(b_n)$$

$$U^2(e_j, e_k, b_n, b_m; w) = EP^2(w) - c(e_k) - d(b_m)$$

Because the managers are perfectly symmetrical, without loss of generality, we call situation $s = PW1$ the emergence of power and denote it by $s = PW$: situation $s = PW2$ can be analyzed similarly. We assume that the principal's benefit with performance is so large that he or she always wishes to induce high productive action e_H for both managers and thus focuses on the minimization of $EP(w)$. The timing of the game is as follows.

1. The principal offers a contract to the managers.
2. The managers simultaneously decide whether or not to accept the contract. If both managers accept, the game continues to the next stage. Otherwise, the game ends and all parties receive zero.
3. The managers simultaneously choose productive actions and power struggles.
4. A pair of performance outcomes is realized, and the managers are paid according to the terms of the contract.

3 The Contractable Power Acquisition Process

In this section, we consider the benefit of power under the assumption that the managers' struggle for power is contractable. This assumption can be justified in the following two cases. The first case is where headquarters can prohibit the managers from acquiring resources outside the organization. When a source of power is influence with persons in charge of distribution chains, headquarters can prohibit managers from meeting them. The second case is where an allocation of the resources in the organization primarily changes the power relationship

between managers. If the principal can verify who controls the resources, he or she can prohibit or allow the managers' power struggle at will, because the undesired manager's control for the resources can be excluded with adequate punishment.⁸

When the struggles are contractable, the principal has two control variables for his or her optimization; that is, a compensation scheme and whether or not to allow the managers to engage in the struggle. The principal's optimization problem is given as follows.

$$\begin{aligned}
\text{[Problem 1]} \quad & \min_{w,b} EP(w) \\
& s.t \ U^i(e_H, e_H, b_m, b_n; w^i) \geq 0 \quad i = 1, 2 \quad (\text{PC}i) \\
& \quad U^1(e_H, e_H, b_m, b_n; w^1) \geq U^1(e_L, e_H, b_m, b_n; w^1) \quad (\text{IC1}) \\
& \quad U^2(e_H, e_H, b_m, b_n; w^2) \geq U^2(e_H, e_L, b_m, b_n; w^2) \quad (\text{IC2}) \\
& \quad w^i(x) \geq 0 \quad \forall x \in X, \quad i = 1, 2 \quad (\text{LLC})
\end{aligned}$$

The manager i ' participation constraint (PC i) implies that he must obtain at least his or her reservation utility, which we normalize to zero. The limited liability constraint (LLC) comes from the fact that the manager can leave the contract at any time. The manager i 's incentive compatibility constraint (IC i) is imposed on the problem in order to induce the desirable productive action (e_H).

Before fully solving the above problem, we first obtain the benchmark solution in the struggle-free situation in which no struggle is allowed and hence the principal faces only the moral hazard problem. By manipulating, (IC i) yields

$$q_H(w^1(GG) - w^1(BG)) + (1 - q_H)(w^1(GB) - w^1(BB)) \geq I_e, \quad (\text{IC1}')$$

$$q_H(w^2(GG) - w^2(GB)) + (1 - q_H)(w^2(BG) - w^2(BB)) \geq I_e, \quad (\text{IC2}')$$

where

$$I_e = \frac{c}{(1 - \sigma)(q_H - q_L)}.$$

I_e is the expected compensation difference that is required to induce the desirable productive action. Notice that the principal can use either joint performance evaluation (JPE) or relative performance evaluation (RPE) to induce the desirable productive action. In fact, by inequality (IC1'), either increment of w_{GG}^1 or increment of w_{GB}^1 gives manager 1 the incentive for taking productive action. The optimal compensation therefore depends on which evaluation process, JPE or RPE, more effectively utilizes the information of performance outcome. The following proposition claims that RPE is more informative in our model.

Proposition 1 (Struggle-Free Solution). *Suppose that there are no struggles for power. The following symmetrical compensation scheme $w_* = (w_*^1, w_*^2)$ is*

⁸Even if the principal's punishment is constrained by the limited liability of the managers, the incentive for deviation vanishes. While deviation induces zero utility for the manager, which is the maximum punishment possible under a limited liability constraint, the managers obtain positive utility by following the principal's order because of participation constraints.

uniquely optimal.

$$w^1(GB) = w^2(BG) = \frac{I_e}{1 - q_H} > 0,$$

$$w^1(x) = 0 \text{ for } x \neq GB, \quad w^2(x) = 0 \text{ for } x \neq BG.$$

The principal's expected payment is given as $EP(w_*) = 2q_H c / (q_H - q_L)$.

Proof. The principal controls only w . In an optimal compensation scheme, $w^1(BG)$ and $w^1(BB)$ should be equal to zero as positive $w^1(BG)$ and $w^1(BB)$ increase the principal's payment without relaxing (IC1). Substituting the binding (IC1) to the expected payment to manager 1, we obtain

$$EP^1(w) = \frac{q_H}{q_H - q_L} c + \sigma w^1(GG). \quad (2)$$

As σ is positive and the manager is protected by the limited liability constraints, $w^1(GG)$ should be also equal to zero. From the binding (IC1), $w^1(GB) = I_e / (1 - q_H)$. The optimal compensation for manager 2 is similarly obtained. \square

As $w^1(BB) = w^1(BG) = 0$, the optimality of RPE is easily understood by comparing a likelihood ratio of each performance; that is,

$$\frac{p_{HH}^S(GB)}{p_{LH}^S(GB)} - \frac{p_{HH}^S(GG)}{p_{LH}^S(GG)} = \frac{(q_H - q_L)\sigma}{(1 - \sigma)q_L(1 - q_H)q_L} > 0. \quad (3)$$

This means that the performance outcome GG is less informative than GB . When the principal observes the performance GB , he or she expects that it is likely for manager 1 to take e_H . However, GG does not only reflect the managers' productive actions. When he or she observes GG , there is another possibility with probability σ that the circumstance is desirable. This is why the principal should use the extreme RPE.

The business similarity among the managers (σ) plays an important role in designing compensation schemes. If the correlation is zero, RPE and JPE are indifferent. Moreover, the optimal compensation scheme does not have to depend on the other manager's performance. This result is familiar from the work of Holmstrom (1982), Mookherjee (1984) and, in particular, Che and Yoo (2001).

We next consider the moral hazard model with the managers' struggle and the claim that power benefits the principal. To show the optimality of power, all we have to do is to compare the implementation cost in PW (in which power is generated in organizations) with that in the struggle-free situation, because the principal weakly prefers the struggle-free situation to SP and SA (in which no manager has power). This is obtained by Lemma 2 in the appendix. We define an indicator as $L(\sigma, \beta)$ to compare the informativeness of GB with that of GG under PW, which is critical to our result. By the definition of the likelihood ratio, we obtain

$$\frac{p_{HH}^{PW}(GB)}{p_{LH}^{PW}(GB)} - \frac{p_{HH}^{PW}(GG)}{p_{LH}^{PW}(GG)} = \frac{q_H \beta (1 - \sigma) (q_H - q_L) [L(\sigma, \beta) - 1]}{(\sigma + (1 - \sigma) q_L q_H) (\beta + (1 - \sigma) q_L (1 - q_H))},$$

where $L(\sigma, \beta) = (1 - q_H)\sigma / q_H \beta$. As all parts in the equation, except for the $L(\sigma, \beta) - 1$, are positive, GG is more informative than GB under PW if and only if $L(\sigma, \beta) < 1$.

We begin with the explanation of the effect that the distortion of performance measure has on the informativeness of the performance outcome. GB , which is used for the powerful manager's productive activity, is noisier under PW than in the struggle-free situation, while BG , which reflects the nonpowerful manager's action, is more informative under PW. In fact, the likelihood of each performance outcome becomes

$$\frac{p_{HH}^{PW}(GB)}{p_{LH}^{PW}(GB)} < \frac{p_{HH}^S(GB)}{p_{LH}^S(GB)} = \frac{p_{HH}^S(BG)}{p_{HL}^S(BG)} < \frac{p_{HH}^{PW}(BG)}{p_{HL}^{PW}(BG)}. \quad (4)$$

Given the struggle-free solution w_* , the distortion changes only the distribution of the rent. The powerful manager obtains more rent and the nonpowerful manager obtains less rent, because under the distorted performance measure, GB is more likely to occur and BG is less likely. The implementation cost is the same as in the struggle-free situation. The principal's expected payment is rewritten as

$$EP(w) = \sum_{x \in X} P_{HH}^S(x)[w^1(x) + w^2(x)] + \beta[w^1(GB) + w^2(GB)] - \beta[w^1(BG) + w^2(BG)]. \quad (5)$$

The first term is equal to the expected payment in the struggle-free situation. The second and third terms are the additional payment due to the distorted change of performance measures. As the information gain ($\beta[w^2(BG) + w^1(BG)]$) and the information loss ($\beta[w^1(GB) + w^2(GB)]$) are exactly canceled out (i.e., $w^1(GB) = w^2(BG)$ and $w^1(BG) = w^2(GB)$), the principal achieves the same implementation cost $EP(w_*)$ as in the struggle-free situation even if the principal faces power.

Is the struggle-free solution optimal under PW? The answer is no. Generating power in organizations, the principal can design a better compensation scheme to recover part of the powerful manager's rent. Consider the compensation scheme such that the principal pays high compensation to the powerful manager 1 only if performance is GG (i.e., $w^1(GG) = I_e/q_H$, $w^1(GB) = w^1(BG) = w^1(BB) = 0$) and the nonpowerful manager is paid in the same way as the struggle-free solution. In other words, the principal imposes on the powerful manager responsibility for the nonpowerful manager's failure. In comparison with w_* , the new scheme makes the sum of the second term and the third term in (5) negative, because the principal uses more informative BG while he or she does not use less informative GB (inequality (4)). This is a benefit for the principal. However, the principal also bears the cost (the first term increases) as GG is less informative than GB in the struggle-free situation (inequality (3)). Power is thus optimal if the information gain of BG exceeds the information loss of GG . This condition is equivalent to the condition that GG is more informative than the distorted GB under PW, i.e., $L(\sigma, \beta) < 1$, as the information gain of BG is exactly canceled out by the information loss of GB under PW (equation (5)).

Proposition 2. *Suppose that the power acquisition process is contractable and manager 1 has power under PW.*

1. *If $0 \leq L(\sigma, \beta) < 1$ and $d \in [0, q_L c / (q_H - q_L) + \beta I_e / (1 - q_H)]$, then power is optimal. The optimal compensation scheme w_{**} is asymmetrical; that*

is,

$$\begin{aligned} w^1(GG) &= F + \frac{I_e}{q_H}, & w^2(BG) &= \frac{I_e}{1 - q_H}, \\ w^1(x) &= F \text{ for } x \neq GG, & w^2(x) &= 0 \text{ for } x \neq BG, \end{aligned}$$

where $F = \max\{0, d - q_L c / (q_H - q_L) - \sigma I_e / (1 - q_H)\}$ for satisfying (PC1). The principal's expected payment are given as

$$EP(w_{**}) = EP(w_*) - \frac{\beta}{(1 - q_H)}(1 - L(\sigma, \beta))I_e + F.$$

2. Otherwise, the principal weakly prefers no power struggle. The optimal compensation scheme and the implementation cost are the same as the struggle-freeness.

Proof. We derive an optimal compensation scheme under PW.

1. $0 \leq L(\sigma, \beta) < 1$

Suppose that $d \in (0, q_L c / (q_H - q_L) + \sigma I_e / (1 - q_H)]$ and thus $F = 0$. Substituting (ICi), the objective function yields

$$\begin{aligned} EP(w) &= \beta(1 - L(\sigma, \beta))w^1(GB) - \beta(1 + L(\sigma, \beta))w^2(BG) \\ &\quad + 2\left(\frac{\sigma}{q_H}I_e + \frac{q_H}{q_H - q_L}c\right), \end{aligned} \quad (6)$$

where $w^1(BB) = w^1(BG) = w^2(GB) = w^2(BB) = 0$ by the same reasoning as in the struggle-free situation. We can show $w^1(GB) = 0$ and $w^2(BG) > 0$ as the coefficient of $w^1(GB)$ is positive and the coefficient of $w^2(BG)$ is negative from $L(\sigma, \beta) < 1$. From (LLC) and (ICi), then the compensation scheme w_{**} is optimal. We finally check that w_{**} satisfies (PCi); i.e.,

$$\begin{aligned} U^1(e_H, e_H, b_H, b_L; w_{**}) &= \frac{q_L c}{q_H - q_L} + \frac{\sigma}{q_H}I_e - d \geq 0, \\ U^2(e_H, e_H, b_H, b_L; w_{**}) &= ((1 - \sigma)q_L(1 - q_H) - \beta)\frac{I_e}{1 - q_H} \geq 0. \end{aligned}$$

As $d \in [0, q_L c / (q_H - q_L) + \sigma I_e / (1 - q_H)]$ holds, both managers' participation constraints are not binding under w_{**} . The implementation cost is

$$EP(w_{**}) = EP(w_*) - \frac{\beta}{1 - q_H}(1 - L(\sigma, \beta))I_e.$$

This shows that the implementation cost is smaller than that in the struggle-free situation, as $0 \leq L(\sigma, \beta) < 1$.

When $d \in [q_L c / (q_H - q_L) + \sigma I_e / (1 - q_H), \infty)$, (PC1) is not satisfied and thus the principal must pay more to powerful manager 1 to satisfy (PC1). One of the optimal schemes is that the principal pays fixed compensation $F = d - q_L c / (q_H - q_L) - \sigma I_e / (1 - q_H)$ to manager 1. The implementation cost under PW is $EP(w_{**}) = EP(w_*) - \beta(1 - L(\sigma, \beta))I_e / (1 - q_H) + F$. Therefore, the implementation cost is smaller than that in the struggle-free situation if $d \in [q_L c / (q_H - q_L) + \sigma I_e / (1 - q_H), q_L c / (q_H - q_L) + \beta I_e / (1 - q_H)]$.

2. $1 \leq L(\sigma, \beta)$

As the coefficients of both $w^1(GB)$ and $w^2(BG)$ in (6) are positive, we can show that when we ignore (PCi), w_* is an optimal compensation scheme and the implementation cost under PW is the same as that in struggle-freeness. Furthermore, when $d \in (q_L c / (q_H - q_L) + \beta I_e / (1 - q_H), \infty)$ holds, the principal must pay more compensation to the powerful manager 1 to satisfy (PC1) and thus the principal weakly prefers no power.

□

Corollary 1. *Suppose that the power acquisition process is contractable. As β becomes larger, the implementation cost $EP(w_{**})$ becomes smaller.*

The more ambiguous the performance measure (the larger β is), the greater the rent-reduction. (5) implies that BG becomes more informative as the performance measure is more ambiguous, as BG is less likely to occur in PW. This enhances the benefit of power.

Corollary 2. *Suppose that the power acquisition process is contractable. As σ becomes smaller, the implementation cost $EP(w_{**})$ also becomes smaller.*

As the business becomes less similar (σ is smaller), the principal reduces rent more as GG becomes more informative and the cost of power decreases. If $\sigma = 0$, the first condition in the proposition is always satisfied, i.e., $L(0, \beta) = 0$, and hence power is optimal.

4 Noncontractable Power Acquisition Process

When the manager's struggles for power are not contractable, the principal cannot indirectly control the power relationship between managers. The principal, however, can adjust the incentive for power struggle through the compensation scheme and thus indirectly controls the power relationship.

The struggle-proof situation (namely, SP), where no manager is induced to engage in power struggle on equilibrium, can be achieved by the scheme satisfying the following conditions in addition to (PCi), (ICi), and (LLC).

$$U^1(e^1, e^2, b_L, b_L) \geq U^1(e^1, e^2, b_H, b_L)$$

$$U^2(e^1, e^2, b_L, b_L) \geq U^2(e^1, e^2, b_L, b_H)$$

The condition implies that each manager's utility is lower when he or she engages in the power struggle than when he or she does not, given that the other manager does not engage. The conditions are rewritten as

$$\beta(w^1(GB) - w^1(BG)) \leq d, \quad (\text{SPC1})$$

$$\beta(w^2(BG) - w^2(GB)) \leq d. \quad (\text{SPC2})$$

The left-hand side is the benefit of struggle for power, which stems from the fact that the powerful manager can impute his failure to the nonpowerful manager and the right-hand side is its cost. The conditions for the struggle-accepted situation (namely, SA), where both managers engage in power struggle, are

$$\beta(w^1(GB) - w^1(BG)) \geq d, \quad (\text{SAC1})$$

$$\beta(w^2(BG) - w^2(GB)) \geq d, \quad (\text{SAC2})$$

and the conditions for the emergence of power (namely, PW) are

$$\beta(w^1(GB) - w^1(BG)) \geq d, \quad (\text{PWC1})$$

$$\beta(w^2(BG) - w^2(GB)) \leq d. \quad (\text{PWC2})$$

The principal chooses the power relationship, anticipating the implementation cost in each situation. Let w_{SP} , w_{SA} , and w_{PW} be the optimal compensation scheme conditioned on SP, SA, and PW, respectively. For example, w_{SP} is the solution to [problem 1] with struggle-proof conditions, (SPC1) and (SPC2), added.

When the power acquisition process is noncontractable, these constraints for the indirect control of the power relationship make the compensation scheme in proposition 2 infeasible. Furthermore, it turns out that the principal will not prefer power in organizations as shown below. Suppose $0 \leq L(\sigma, \beta) \leq 1$, in which under the contractable power acquisition process the emergence of power is optimal and the optimal compensation scheme is w_{**} . Under the optimal compensation scheme w_{**} , $\beta[w^1(GB) + w^2(GB)] - \beta[w^1(BG) + w^2(BG)]$ in equation (5) must be strictly negative. However, it must be nonnegative as (PWC1) and (PWC2) imply

$$w^1(GB) - w^1(BG) \geq \frac{d}{\beta} \geq w^2(BG) - w^2(GB).$$

Hence w_{**} is infeasible. Moreover, the implementation cost in PW is larger than that in struggle-free situation, except at $d = \beta I_e / (1 - q_H)$, because w_* , under which the principal achieves the same implementation cost as that in the struggle-free situation, is also infeasible. Substituting w_* , (PWC1) and (PWC2) yield

$$U^1(e^1, e^2, b_H, b_L; w_*) - U^1(e^1, e^2, b_L, b_L; w_*) = \beta \frac{I_e}{(1 - q_H)} - d \geq 0,$$

$$U^2(e^1, e^2, b_H, b_H; w_*) - U^2(e^1, e^2, b_H, b_L; w_*) = \beta \frac{I_e}{(1 - q_H)} - d \leq 0.$$

These inequalities show that either (PWC1) or (PWC2) is not satisfied, except at $d = \beta I_e / (1 - q_H)$, and hence the principal cannot effectively use the information of performance measure.

Proposition 3. *Suppose that the power acquisition process is not contractable. Power is not optimal for the principal. The optimal solution is given as follows.*

1. For $d \in [0, \beta I_e / (1 - q_H))$, the principal strictly prefers SA (struggle-accepted situation).
2. For $d = \beta I_e / (1 - q_H)$, all situations are indifferent to the principal.
3. For $d \in (\beta I_e / (1 - q_H), \infty)$, the principal strictly prefers SP (struggle-proof situation).

In every case, the optimal compensation scheme is w_* and the implementation cost is $EP(w_*) = 2q_H c / (q_H - q_L)$.

Proof. We prove here that

$$EP(w_{SA}) = EP(w_*) < EP(w_{SP}) \quad \text{for } d \in [0, \beta I_e / (1 - q_H)), \quad (7)$$

$$EP(w_{SA}) = EP(w_*) = EP(w_{SP}) \quad \text{for } d = \beta I_e / (1 - q_H), \quad (8)$$

$$EP(w_{SA}) > EP(w_*) = EP(w_{SP}) \quad \text{for } d \in (\beta I_e / (1 - q_H), \infty). \quad (9)$$

We have already shown that $EP(w_*) < EP(w_{PW})$ when $d \neq \beta I_e / (1 - q_H)$. Combining these inequalities, we complete the proof.

Suppose $d \in [0, \beta I_e / (1 - q_H))$. Recall that the unique optimal compensation in the struggle-free situation, which is the solution to problem 1, is w_* . This w_* satisfies (SAC1) and (SAC2) for $d \in [0, \beta I_e / (1 - q_H))$; i.e.,

$$\frac{\beta I_e}{(1 - q_H)} \geq d.$$

$EP(w_{SA}) = EP(w_*)$ thus holds. However, $EP(w_{SP}) > EP(w_*)$ as w_* is a unique solution in the optimization problem and w_* does not satisfy (SPC1) and (SPC2). Therefore, $EP(w_{SA}) = EP(w_*) < EP(w_{SP})$. For $d \in [\beta I_e / (1 - q_H), \infty]$, it is similarly obtained that $EP(w_{SA}) > EP(w_*) = EP(w_{SA})$. At $d = \beta I_e / (1 - q_H)$, $EP(w_{SA}) = EP(w_*) = EP(w_{SA})$ as w_* satisfies (SPC1), (SPC2), (SAC1), and (SAC2). \square

The above represents the trade-off between the effective use of information on productive activity and an adjustment for the manager's incentive to struggle for power. In SP and SA, w_* is the compensation scheme by which the principal makes the most of information on the managers' productive activities. If the power struggle cost is small ($d \in [0, \beta I_e / (1 - q_H))$), the principal cannot effectively use information on the performance measure under SP, as w_* induces the agents to engage in the power struggle (w_* violates (SPC1) and (SPC2)). On the other hand, the principal can effectively use the information, as w_* satisfies (SAC1) and (SAC2). SA is thus optimal. If the power struggle cost is large ($d \in (\beta I_e / (1 - q_H), \infty)$), SP is optimal, as the managers are not sufficiently given the incentive for a power struggle under w_* .

5 Extensions

In the previous section, we have shown that the benefits described in proposition 2 become infeasible under the noncontractable power acquisition process. By extending the model, however, we find other benefits of power. In this section, we assume $1 < L(\sigma, \beta)$ so as to focus on the other benefits of power.⁹ For convenience, we denote the manager's incentive for the power struggle under the struggle-free solution, w_* , by

$$I_p(\sigma, \beta) = \beta w_* - d = \beta \frac{I_e}{(1 - q_H)} - d.$$

⁹When this condition does not hold, the principal again obtains the benefit from distortion of performance under the extended model. This assumption thus excludes the benefit from the distortion of performance discussed in section 3.

5.1 Resource Competition

The first extension considers the resource competition between the managers. So far, we have assumed that a manager can establish his or her influence on resources at the same cost, regardless of the other manager's behavior. This assumption applies when there are sufficient or plentiful resources. If resources are scarce, and both managers attempt to establish an influence on them, the managers engage in competition for the resources. A manager then bears a greater cost to establish his or her influence on the resources when both managers engage in the power struggle. Formally, we modify the cost function

$$d^1(b^1, b^2) = \begin{cases} d + h & \text{if } (b^1, b^2) = (b_H, b_H) \\ d & \text{if } (b^1, b^2) = (b_H, b_L) \\ 0 & \text{otherwise} \end{cases}, \quad (10)$$

$$d^2(b^1, b^2) = \begin{cases} d + h & \text{if } (b^1, b^2) = (b_H, b_H) \\ d & \text{if } (b^1, b^2) = (b_L, b_H) \\ 0 & \text{otherwise} \end{cases}, \quad (11)$$

where $h (> 0)$ is the additional cost from the competition and $d^1(b^1, b^2)$ and $d^2(b^1, b^2)$ are manager 1's cost and manager 2's cost, respectively.

Given the managers' struggle situation (i.e., SP, SA or PW), the optimal compensation scheme and the expected payment are obtained by a standard procedure (see Appendix B). Let $d_1 = \frac{\beta I_e}{1-q_H} - h$ and $d_2 = \frac{\beta I_e}{1-q_H}$.

Lemma 1. *Suppose that the power acquisition process is noncontractable, manager 1 has power under PW, there is competition for resources, and $1 < L(\sigma, \beta)$. Given the managers' struggle situation, the optimal compensation scheme and expected payment are given as follows.*

1. Given SP (struggle proof situation),

$$w_{SP} = \begin{cases} \left(\left(\frac{1-q_H}{q_H\beta} I_p, \frac{d}{\beta}, 0, 0 \right), \left(\frac{1-q_H}{q_H\beta} I_p, 0, \frac{d}{\beta}, 0 \right) \right) & \text{if } d \in (0, d_2) \\ w_* & \text{if } d \in [d_2, \infty) \end{cases}, \quad (12)$$

$$EP(w_{SP}) = \begin{cases} EP(w_*) + 2L(\sigma, \beta)I_p & \text{if } d \in (0, d_2) \\ EP(w_*) & \text{if } d \in [d_2, \infty) \end{cases}. \quad (13)$$

2. Given SA (struggle-accepted situation),

$$w_{SA} = \begin{cases} w_* & \text{if } d \in (0, d_1) \\ \left(\left(0, \frac{d+h}{\beta}, 0, 0 \right), \left(0, 0, \frac{d+h}{\beta}, 0, 0 \right) \right) & \text{if } d \in [d_1, \infty) \end{cases}, \quad (14)$$

$$EP(w_{SA}) = \begin{cases} EP(w_*) & \text{if } d \in (0, d_1) \\ 2 \frac{(1-\sigma)q_H(1-q_H)(d+h)}{\beta} & \text{if } d \in [d_1, \infty) \end{cases}. \quad (15)$$

3. Given PW (the emergence of power),

$$w_{PW} = \begin{cases} \left(w_*^1, \left(\frac{1-q_H}{q_H\beta} (I_p - h), \frac{d+h}{\beta}, 0, 0 \right) \right) & \text{if } d \in (0, d_1) \\ w_* & \text{if } d \in [d_1, d_2) \\ \left(\left(0, \frac{d}{\beta}, 0, 0 \right), w_*^2 \right) & \text{if } d \in [d_2, \infty) \end{cases}, \quad (16)$$

$$EP(w_{PW}) = \begin{cases} EP(w_*) + (L(\sigma, \beta) + 1)(I_p - h) & \text{if } d \in (0, d_1) \\ EP(w_*) & \text{if } d \in [d_1, d_2) \\ EP(w_*) + \left(\frac{(1-\sigma)q_H(1-q_H)}{\beta} + 1 \right) (-I_p) & \text{if } d \in [d_2, \infty) \end{cases}. \quad (17)$$

Lemma 1 at $h = 0$ shows the optimal implementation cost in each situation before modification of the cost function. The implementation cost is drawn in the following figure 1. Power is not optimal, except at $d = d_2$. SA is optimal if $d \in (0, d_2)$, and SP is optimal if $d \in (d_2, \infty)$ (see Proposition 3).

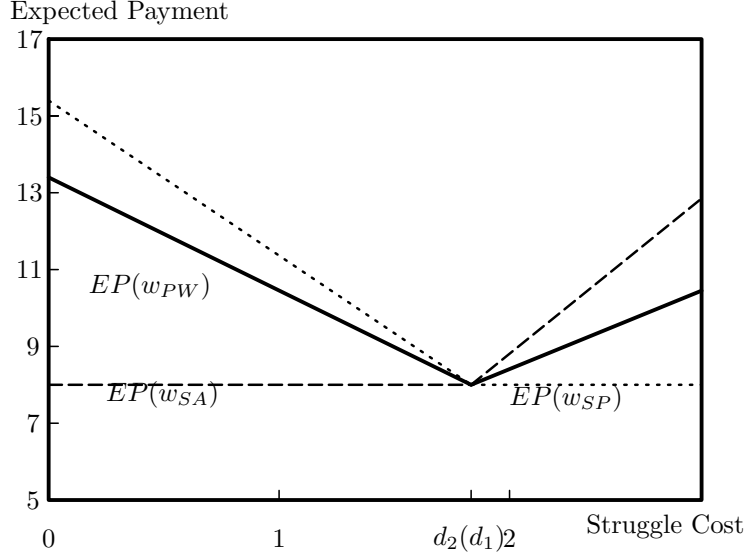


Figure 1: The implementation cost in each situation when $h = 0$ ($\beta = 0.1$, $\sigma = 0.03$, $q_H = 0.6$, $q_L = 0.3$, and $c = 2$)

The following figure 2 shows the implementation cost if there is competition for resources ($h > 0$). For the same reason as proposition 3, the principal accepts the information loss for $d \in (0, d_1)$ and $d \in (d_2, \infty)$ under PW, while SA is optimal if $d \in [0, d_1)$ and SP is optimal if $d \in (d_2, \infty)$. If the cost lies in the middle of the range ($d \in (d_1, d_2)$), power is optimal again. In contrast to the no-competition cases, the nonpowerful manager has less incentive for power struggle, as the nonpowerful manager faces the fear of competition over resources if he or she engages in the power struggle; i.e.,

$$U^2(e^1, e^2, b_H, b_H; w_*) - U^1(e^1, e^2, b_H, b_L; w_*) = I_p - h. \quad (18)$$

As w_* satisfies both (PWC1) and (PWC2) for $d \in (d_1, d_2)$, the principal can make the most of information on performance under PW,

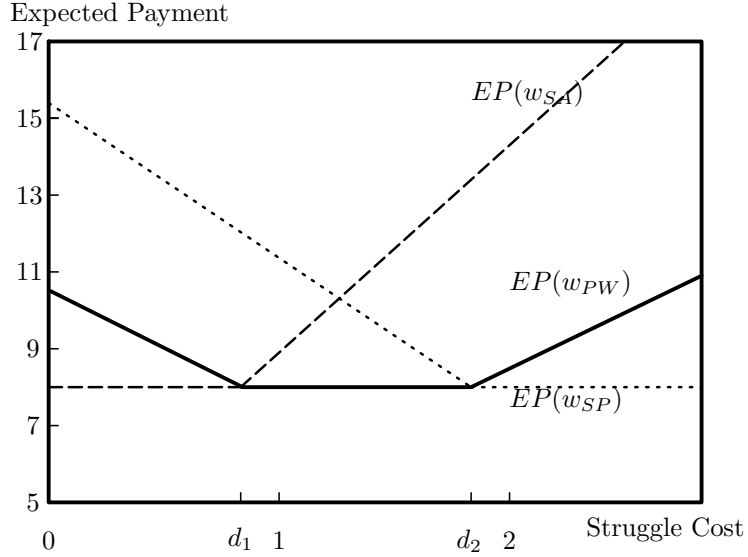


Figure 2: The implementation cost in each situation when $h = 1$
 $(\beta = 0.1, \sigma = 0.03, q_H = 0.6, q_L = 0.3, \text{ and } c = 2)$

Proposition 4. *Suppose that power acquisition process is noncontractable and competitive, and $1 < L(\sigma, \beta)$. If $h > 0$ and $d \in (d_1, d_2)$, then power is optimal for organizations.*

Proof. Straightforward. □

This benefit is particularly important if there are many managers, as allowing one manager's struggle weakens all the other managers' incentives for a power struggle.

5.2 Negative Externality

Secondly, the principal's negative externality is considered. The basic model focuses on the distortion of performance measures as the effect of power. However, the power struggle game can also affect the efficiency of organizations directly. Suppose that each manager has some influence on resources. The managers then have to negotiate for the use of these resources. In SA, both managers establish influence over different resources and thus have to bargain for the mutual use of the resource. In PW, the nonpowerful manager bargains for the use of the powerful manager's resources. This bargaining can cause a negative externality for the principal in the form of a delay in decisions, the breakdown of bargaining, and so on. Let $K(l)$ be a negative externality for the principal, where

$$K(l) = \begin{cases} K & \text{if } l = SA \quad ((b^1, b^2) = (b_H, b_H)) \\ \alpha K & \text{if } l = PW \quad ((b^1, b^2) = (b_H, b_L) \text{ or } (b_L, b_H)) \\ 0 & \text{if } l = SP \quad ((b^1, b^2) = (b_L, b_L)) \end{cases}, \quad (19)$$

where the negative externality $K > 0$ in SA and α ($1 > \alpha \geq 0$) represents the difference of the negative externality between SA and PW. We assume that the

resources are rich (Figure 1) and $d \leq d_1$, and hence the principal bears the information loss to prevent the manager from undertaking the power struggle. The principal's payoff in each struggle situation is defined by $V(l) = EP(w_l) + K(l)$ for $l \in \{SP, SA, PW\}$; i.e.,

$$\begin{aligned} V(SP) &= EP(w_{SP}) + K(SP) = EP(w_*) + K, \\ V(PW) &= EP(w_{PW}) + K(PW) = EP(w_*) + (L(\sigma, \beta) + 1)I_p + \alpha K, \\ V(SA) &= EP(w_{SA}) + K(SA) = EP(w_*) + 2L(\sigma, \beta)I_p. \end{aligned}$$

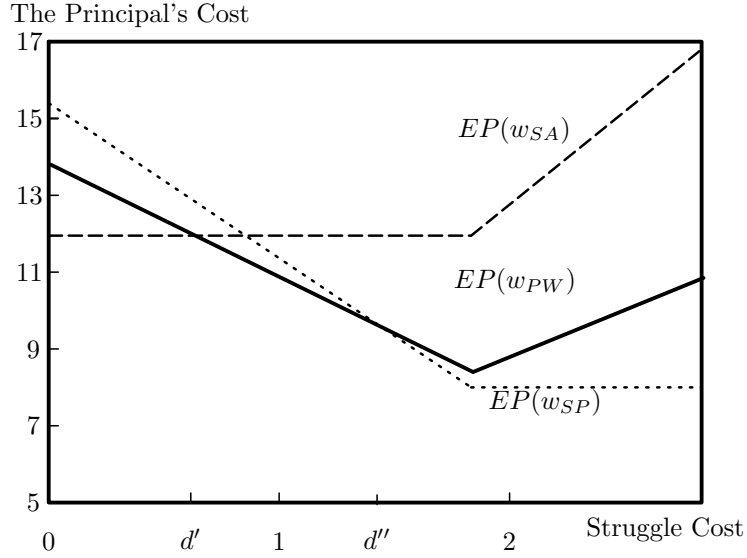


Figure 3: The implementation cost in each situation when $K = 4$ ($\beta = 0.1$, $\sigma = 0.03$, $q_H = 0.6$, $q_L = 0.3$, $c = 2$, and $\alpha = 0.25$)

$V(l)$ is drawn in Figure 3. With the negative externality, the principal again prefers power. Choosing the power relationship indirectly, the principal faces a trade-off between the implementation cost and the negative externality; i.e.,

$$K(SA) > K(PW) \geq K(SP), \quad (20)$$

$$EP(w_{SA}) \leq EP(w_{PW}) \leq EP(w_{SP}). \quad (21)$$

PW is inferior to SA in respect of the implementation cost, as under PW, the principal prevents one manager from undertaking the power struggle. However, it is superior to the struggle-accepted situation in respect of the negative externality, as the resources with which they bargain are less with the emergence of power. With SP, the emergence of power is superior in respect to the implementation cost; i.e.,

$$EP(w_{SP}) - EP(w_{PW}) = (L(\sigma, \beta) - 1)I_p,$$

because under PW the principal allows one manager to engage in the power struggle, while SP requires the prevention of both managers' struggle. On the other hand, the emergence of power is inferior in respect to the negative externality. Therefore, power is optimal if the cost of controlling both the power relationship and the negative externality are moderate under PW.

Proposition 5. *Suppose that the power acquisition process is noncontractable, $d \leq d_1$ and $1 < L(\sigma, \beta)$. If $K \in (0, \beta(L(\sigma, \beta) - 1)I_e/\alpha(1 - q_H)]$ and $\alpha \in [0, (L(\sigma, \beta) - 1)/2L(\sigma, \beta)]$, then there exists d such that the power is optimal.*

Proof. Suppose that $d' \in \{d \mid V(SP) = V(PW)\}$ and $d'' \in \{d \mid V(SA) = V(PW)\}$. If $d' < d$, $V(PW) < V(SP)$ as $V(PW)$ is decreasing with respect to d . Similarly, if $d < d''$, $V(PW) < V(SA)$ as $dV(PW)/d(d) \neq dV(SA)/d(d)$. Therefore, the conditions that there exists d such that the power is optimal are that $0 < d'' < d_1$ and $d' < d''$. By some computation, we obtain $K \in (0, \beta(L - 1)I_e/\alpha(1 - q_H)]$ and $\alpha \in [0, (L(\sigma, \beta) - 1)/2L(\sigma, \beta)]$. \square

Finally, we note a comparative analysis over β .

Corollary 3. *Suppose that the power acquisition process is noncontractable, $d \leq d_1$ and $1 < L(\sigma, \beta)$. As β is larger, the principal is less likely to prefer power.*

This means that the larger β is a poor outcome for the principal, as the information loss from the distortion of the evaluation process is more serious. In fact, the upper bound on K and α for the optimality of power is decreasing with respect to β . In contrast, the principal prefers power, as β is larger when the power acquisition process is contractable. This provides the significant difference between the contractable and noncontractable power acquisition processes.

6 Concluding remarks

We have specified the effect of power on the evaluational process and examined when power is preferable for the principal. Our analysis provides three cases: (1) when the power acquisition process is contractable, (2) when the power acquisition process is noncontractable and competitive, and (3) when the power acquisition process is noncontractable and causes a negative externality to the principal from bargaining for the use of resources.

We close this paper with a discussion of some possible extensions. In our model, we assumed that managers are identical in that managers have an equal ability in acquiring a source of power and performing productive action. It is, however, also important to ask what kind of divisions are more likely to obtain power. As divisions in an organization usually work on different tasks, they will differ in their abilities in acquiring resources and engaging in productive action, and in the relative importance of each division to the organization. How these factors affect the optimal power distribution in an organization is an interesting future direction for our research.

Appendix

A Lemma 2

Let w_{SP_v} , w_{SA_v} , w_{PW_v} be an optimal compensation scheme under SP, SA, and PW, respectively.

Lemma 2. *Suppose that the power acquisition process is contractable. The optimal implementation cost in no emergence of power weakly exceeds that in the struggle-free situation; i.e.,*

$$EP(w_*) = EP(w_{SPv}) \leq EP(w_{SAv}).$$

Proof. The implementation cost under SP is equal to that in the struggle-free situation as the optimization problems are the same. The optimization problem under SA differs from that under SP in that the managers engage in a power struggle. This presents the possibility that (PC*i*) is binding. Substituting the struggle-free solution w_* into each manager's utility function in the power struggle situation, we obtain

$$U^1(e_H, e_H, b_H, b_H; w_*) = U^2(e_H, e_H, b_H, b_H; w_*) = \frac{q_L c}{q_H - q_L} - d.$$

These show that the principal must pay for the manager's negative utility if $d \in (\frac{q_L c}{q_H - q_L}, \infty)$. Therefore, $EP(w_*) \leq EP(w_{SAv})$. \square

B The Optimal Contracts Under A Noncontractual Power Acquisition Process

In this appendix, we derive an optimal contract and the implementation cost in each struggle situation when the power acquisition process is noncontractable. As the power struggle cost is modified, (SAC1) and (SAC2) become

$$\beta(w^1(GB) - w^1(BG)) \geq d + h, \quad (\text{SAC1}')$$

$$\beta(w^2(BG) - w^2(GB)) \geq d + h. \quad (\text{SAC2}')$$

Similarly, (PWC1) and (PWC2) becomes

$$\beta(w^1(GB) - w^1(BG)) \geq d, \quad (\text{PWC1}')$$

$$\beta(w^2(BG) - w^2(GB)) \leq d + h. \quad (\text{PWC2}')$$

The principal's optimization problem is given as follows.

$$\min_{w, b} EP(w)$$

$$s.t \quad U^i(e_H, e_H, b_L, b_L; w^i) \geq 0 \quad \text{for } \forall i \quad (\text{PC } i)$$

$$U^1(e_H, e_H, b_L, b_L; w^1) \geq U^1(e_L, e_H, b_L, b_L; w^1) \quad (\text{IC } 1)$$

$$U^2(e_H, e_H, b_L, b_L; w^2) \geq U^2(e_H, e_L, b_L, b_L; w^2) \quad (\text{IC } 2)$$

$$w^i(x) \geq 0 \quad \text{for } \forall x \in M, \quad i = 1, 2 \quad (\text{LLC})$$

$$(\text{SPC1}) \text{ and } (\text{SPC2}),$$

$$\text{or } (\text{SAC1}') \text{ and } (\text{SAC2}'),$$

$$\text{or } (\text{PWC1}') \text{ and } (\text{PWC2}')$$

For convenience, we denote each point of power struggle cost by

$$d_1 = \frac{\beta I_e}{1 - q_H} - h \text{ and } d_2 = \beta \frac{I_e}{1 - q_H}.$$

B.1 Struggle-Proof Situation

Contract 1 (Struggle-Proof Situation). *Given a struggle-proof situation, the optimal compensation scheme is $w_{SP} = (w_{SP}^1, w_{SP}^2)$, where*

$$w_{SP} = \begin{cases} \left(\left(\frac{1-q_H}{q_H\beta} I_p, \frac{d}{\beta}, 0, 0 \right), \left(\frac{1-q_H}{q_H\beta} I_p, 0, \frac{d}{\beta}, 0 \right) \right) & \text{if } d \in (0, d_2) \\ w_* & \text{if } d \in [d_2, \infty) \end{cases}.$$

The implementation cost increases in comparison with the benchmark.

$$EP(w_{SP}) = \begin{cases} EP(w_*) + 2L(\sigma, \beta)I_p & \text{if } d \in (0, d_2) \\ EP(w_*) & \text{if } d \in [d_2, \infty) \end{cases}$$

Proof. For $d \in (d_2, \infty)$, w_* is optimal as it satisfies (SPC1) and (SPC2). We thus consider $d \in [0, d_2]$. In this case, as w_* violates (SPC1) and (SPC2), the binding constraints are (IC1), (IC2), (SPC1) and (SPC2). Substituting (IC1) and (SPC1) into the objective function with respect to manager 1, we obtain

$$EP^1(w) = \frac{q_H c}{q_H - q_L} + \sigma \frac{I_e}{q_H} - \frac{\sigma(1 - q_H)d}{q_H\beta} + \left(\frac{(q_H)^2 - \sigma(1 - q_H)^2}{q_H} \right) w^1(BG),$$

where ${}^1w(BB) = 0$ by the same reasoning as in the struggle-free situation. As we can show that the coefficient of $w^1(BG)$ is positive from $q_H > 1/2$ and $\sigma \leq 1$, $w^1(BG) = 0$. From (IC1) and (SPC1), the optimal compensation to manager 1 is w_{SP}^1 . The optimal compensation to manager 2 is derived in the same way. The implementation cost is obtained by substituting the optimal compensation scheme into the objective function. \square

B.2 Struggle-Accepted Situation

Contract 2 (Struggle-Accepted Situation). *Given a struggle-accepted situation, the optimal contract is $w_{SA} = (w_{SA}^1, w_{SA}^2)$, where*

$$w_{SA} = \begin{cases} w_* & \text{if } d \in (0, d_1) \\ \left(\left(0, \frac{d+h}{\beta}, 0, 0 \right), \left(0, 0, \frac{d+h}{\beta}, 0, 0 \right) \right) & \text{if } d \in [d_1, \infty) \end{cases}.$$

The implementation cost increases in comparison with the benchmark; i.e.,

$$EP(w_{SA}) = \begin{cases} EP(w_*) & \text{if } d \in (0, d_1) \\ 2 \frac{(1-\sigma)q_H(1-q_H)(d+h)}{\beta} & \text{if } d \in [d_1, \infty) \end{cases}.$$

Proof. For $d \in (0, d_1)$, w_* is optimal as it satisfies (PC1), (PC2), (SAC1') and (SAC2'). We thus consider $d \in [d_1, \infty)$. In this case, (SAC1') and (SAC2') are binding as w_* violates (SAC1') and (SAC2'). After finding an optimal compensation scheme satisfying (SAC1') and (SAC2'), we show that the compensation scheme satisfies (PC1), (PC2), (IC1), and (IC2). Substituting (SAC1') into the principal's payment function to manager 1, we obtain

$$\begin{aligned} EP^1(w) = & (\sigma + (1 - \sigma)q_H q_H) w^1(GG) + 2(1 - \sigma)q_H(1 - q_H) w^1(BG) \\ & + (1 - \sigma)q_H(1 - q_H) \frac{d + h}{\beta}, \end{aligned}$$

where $w^1(BB) = 0$ by the same reasoning as in the struggle-free situation. As the coefficients of $w^1(BG)$ and $w^1(GG)$ are positive, we can show that $w^1(BG) = 0$, $w^1(GG) = 0$ and $w^1(GB) = (d+h)/\beta$ from (SAC1'). We check (IC1) and (PC1). Substituting w_{PW} into (IC1), we obtain

$$\begin{aligned} & U^1(e_H, e_H, b_H, b_H; w^1) - U^1(e_L, e_H, b_H, b_H; w^1) \\ &= \frac{(1-\sigma)(q_H - q_L)(1 - q_H)}{\beta} (d - d_1) \geq 0. \end{aligned}$$

The last inequality holds when $d \in [d_1, \infty)$. Then w_{PW} satisfies (IC1). Substituting w_{PW} into manager 1's utility function, we obtain

$$\begin{aligned} & \frac{(1-\sigma)q_H(1 - q_H)}{\beta} (d + h) - d - h - c \\ & \geq \frac{(1-\sigma)q_H(1 - q_H) - \beta}{\beta} \left(\frac{\beta I_e}{1 - q_H} \right) - c \\ & = \left(\frac{(1-\sigma)q_H(1 - q_H) - \beta}{(1-\sigma)(1 - q_H)(q_H - q_L)} - 1 \right) c \geq 0 \end{aligned}$$

Thus, (PC1) is satisfied. The optimal compensation to manager 2 is found in the same way. The implementation cost in each case is obtained by substituting the optimal compensation scheme into the objective function. \square

B.3 The Emergence of Power

Contract 3. Suppose that $1 < L(\sigma, \beta)$. Given the emergence of power, the optimal compensation scheme is $w_{PW} = (w_{PW}^1, w_{PW}^2)$, where

$$w_{PW} = \begin{cases} \left(w_*^1, \left(\frac{1-q_H}{q_H\beta} (I_p - h), \frac{d+h}{\beta}, 0, 0 \right) \right) & \text{if } d \in (0, d_1) \\ w_* & \text{if } d \in [d_1, d_2) \\ \left(\left(0, \frac{d}{\beta}, 0, 0 \right), w_*^2 \right) & \text{if } d \in [d_2, \infty) \end{cases}.$$

The implementation cost increases in comparison with the benchmark.

$$EP(w_{PW}) = \begin{cases} EP(w_*) + (L(\sigma, \beta) + 1)(I_p - h) & \text{if } d \in (0, d_1) \\ EP(w_*) & \text{if } d \in [d_1, d_2) \\ EP(w_*) + \left(\frac{(1-\sigma)q_H(1 - q_H)}{\beta} + 1 \right) (-I_p) & \text{if } d \in [d_2, \infty) \end{cases}$$

Proof. A solution in the optimization problem without (PWC1') and (PWC2') is w_* . By substituting w_* , (PWC1') and (PWC2') become

$$\begin{aligned} \beta \frac{I_e}{1 - q_H} & \geq d, \\ \beta \frac{I_e}{1 - q_H} & \leq (d + h). \end{aligned}$$

This implies that (PWC1') is binding for $d \in (0, d_1]$ and (PWC2') is binding for $d \in [d_2, \infty)$. We consider three cases according to d .

- $d \leq d_1$

When $d \leq d_1$, w_*^1 is optimal as it satisfies (PWC1') and (PC1). We thus find the optimal compensation to manager 2. Substituting (IC2) and (PWC2') into the principal's expected payment to manager 1, we obtain

$$EP^1(w) = \left(\sigma \frac{I_e}{q_H} + (1 - \sigma)q_H I_e \right) - (L(\sigma, \beta) + 1)(d + h) + \frac{(q_H)^2 - \sigma(1 - q_H)^2}{q_H} w_{GB}^2,$$

where $w_{BB}^2 = 0$ by the same reasoning as in the struggle-free situation. As the coefficient of w_{GB}^2 is positive, we can show $w_{GG}^2 = (1 - q_H)(I_p - h)/q_H \beta$, $w_{GB}^2 = 0$, and $w_{BG}^2 = (d + h)/\beta$. This compensation also satisfies (PCi); i.e.,

$$\begin{aligned} U^2(e_H, e_H, b_H, b_L; w_{PW}^2) &= \frac{q_L c}{q_H - q_L} + L(\sigma, \beta)(I_p - h) - (d + h) - c \\ &\geq \frac{(1 - \sigma)q_L(1 - q_H) - \beta}{(1 - \sigma)(1 - q_H)(q_H - q_L)} \geq 0. \end{aligned}$$

Therefore, w_{PW} is optimal.

- $d_1 \leq d \leq d_2$

In this case, (PWC1') and (PWC2') are not binding. Therefore, w_* is optimal.

- $d_2 \leq d$

When $d_2 \leq d$, w_*^2 is optimal, as (PWC2') and (PC2) are not binding. We thus find the optimal compensation to manager 1. Substituting (PWC1') into the objective function with respect to manager 1, we obtain

$$EP^1(w) = (\sigma + (1 - \sigma)q_H q_H)w^1(GG) + 2(1 - \sigma)q_H(1 - q_H)w^1(BG) + [(1 - \sigma)q_H(1 - q_H) + \beta] \frac{d}{\beta},$$

where $w^1(BB) = 0$ by the same reasoning as in the struggle-free situation. From the signs of the coefficient of w_{GG}^1 , and w_{BG}^1 , we can show $w^1(GB) = \frac{d}{\beta}$ and $w^1(GG) = w^1(BG) = w^1(BB) = 0$. The scheme also satisfies (IC1) and (PC1); i.e.,

$$\begin{aligned} U^1(e_H, e_H, b_H, b_L; w_{PW}^1) - U^1(e_H, e_L, b_H, b_L; w_{PW}^2) \\ = \frac{(1 - q_H)}{\beta} \left(d - \frac{\beta I_e}{1 - q_H} \right) \geq 0. \end{aligned}$$

$$\begin{aligned} U^1(e_H, e_H, b_H, b_L; w_{PW}^1) &= ((1 - \sigma)q_H(1 - q_H) + \beta) \frac{d}{\beta} - c - d \\ &\geq \frac{q_H c}{q_H - q_L} - c \geq 0. \end{aligned}$$

Therefore, w_{PW}^1 is optimal.

The implementation cost in each case is obtained by substituting the optimal compensation scheme into the objective function. \square

References

- [1] Boeker, Warren, 1989, "The Development and Institutionalization of Subunit Power in Organizations," *Administrative Science Quarterly*, 34-3:388-410
- [2] Che, Yeon-Koo and Seung-Weon Yoo , 2001, "Optimal Incentives for Teams," *The American Economic Review*, 91-3:525-541
- [3] Chen, Kong-Pin, 2003, "Sabotage in Promotion Tournaments," *Journal of Law, Economics, and Organization*, 19-1:119-140
- [4] Crozier, Michel, 1964, "The Bureaucratic Phenomenon," The University of Chicago Press
- [5] Emerson, Richard M., 1962, "Power-Dependence Relations," *American Sociological Review*, 27-1:31-41
- [6] Gandz, Jeffrey and Victor V. Murray, 1980, "The Experience of Workplace Politics," *The Academy of Management Journal*, 23-2:237-251
- [7] Holmstrom, Bengt, 1979, "Moral Hazard and Observability," *The Bell Journal of Economics*, 10-1:74-91
- [8] Milgrom, Paul and John Roberts, 1986, "Relying on the Information of Interested Parties," *Rand Journal of Economics*, 17-1:18-32
- [9] Milgrom, Paul R., 1988, "Employment Contracts, Influence Activities, and Efficient Organization Design," *The Journal of Political Economy*, 96-1:42-60
- [10] Ocasio, William, 2002, "Organizational Power and Dependence," in Baum, Joel A.C. ed., *Companion to Organizations*, Blackwll Publishing, pp.138-157
- [11] Perrow, Charles, 1986, "Complex Organizations: A Critical Essay," 3rd edn., New York: McGraw Hill
- [12] Rajan, Raghuram G., Henri Servaes and Luigi Zingales, 2000, "The Cost of Diversity: The Diversification Discount and Inefficient Investment," *The Journal of Finance*, 55-1:35-80
- [13] Rajan, Raghuram G. and Luigi Zingales, 1998, "Power in a Theory of Firm," *The Quarterly Journal of Economics*, 113-2:387-432
- [14] Rotemberg, Julio J., 1993, "Power in Profit-Maximizing Organizations," *Journal of Economics and Management Strategy*, 2-2:165-198
- [15] Rotemberg, Julio J. and Garth Saloner, 1995, "Overt Interfunctional Conflict (and Its Reduction through Business Strategy)," *The Rand Journal of Economics*, 26-4:630-653
- [16] Salancik, Gerald R. and Pfeffer, Jeffrey, 1974, "The Bases and Use of Power in Organizational Decision Making: The Case of a University," *Administrative Science Quarterly*, 19-4:453-473

- [17] Scharfstein, David and Jeremy C. Stein, 2000, “The Dark Side of Internal Capital Markets: Divisional Rent-Seeking and Inefficient Investment,” *The Journal of Finance*, 55-6:2537–2564
- [18] Stole, Lars A. and Jeffrey Zwiebel, 1996, “Intra-Firm Bargaining under Non-Binding Contracts,” *The Review of Economic Studies*, 63-3:375–410