

POWER IN THE FIRM AND MANAGERIAL CAREER CONCERNS

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Abstract

With more power, a manager can make more decisions or more important ones, and in this way have more impact on his firm. As a consequence, firm performance provides more information about the abilities of more powerful managers, who are more “visible”. In this paper I analyze how the allocation of power in the firm affects the managers’ career concerns when no manager’s power can be increased without reducing another manager’s. I show that, with a simple linear technology and risk-neutral managers, it is generally optimal to divide power in an unequal way, even though this may create conflicts of interest between managers. I also analyze how optimal pay-for-performance schemes should depend on the allocation of power.

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1 INTRODUCTION

The allocation of power in a firm determines how individuals affect the decisions of the organization as a whole: powerful managers are entitled to make important decisions — decisions which can potentially have a large impact on firm performance, such as approving large investment projects or designing new products and processes— while less powerful managers are left with fewer or less important decisions. Several papers in the incomplete contracting literature have recently pointed out that the allocation of power determines the employees' incentives to invest in specific human capital (Grossman and Hart, 1986; Hart and Moore, 1990) and to show initiative (Aghion and Tirole, 1997). In this paper I study the costs and benefits of different allocations of power from a different perspective: suppose a firm employs several managers, some more powerful than others, and suppose that the labor market tries to assess their abilities by looking at their firm's performance. If firm performance is poor, it would be irrational for the market to blame the powerless managers more than the powerful ones. And if performance is good a rational market would have to give more credit to the powerful ones. As a consequence powerful managers, realizing that they are more accountable, would have an incentive to work harder and build a good reputation, while less powerful managers would have less incentives to do so.

Combining Holmstrom (1982a) and Holmstrom (1982b), I use a model of team production with career concerns to analyze the costs and benefits of different allocations of power. In this model, managers are endowed with general human capital whose value cannot be perfectly evaluated by their current employer or by the labor market, and have an incentive to work hard because this increases the market's estimate of their human capital. Their employer divides power among them in order to maximize profits, taking into account that power makes managers more visible to the market, and that more visible managers work harder. As in Hart and Moore (1990) or Aghion and Tirole (1997) I also assume that there is a limited amount of power in the firm, that managers have to share. As a consequence, when the firm increases a manager's power it has to trade off the increase in this manager's incentives against the reduction in the other manager's. However, in contrast with the previous literature I point out that this trade-off is endogenously determined by labor market competition: the benefits managers get from power depend on how the market uses firm performance to re-estimate the value of their individual human capital. Thus, while other authors have emphasized that power motivates managers because it allows them to make decisions which benefit them personally and may not benefit the firm, I take the view that power motivates managers because it makes them more visible to the market. I stress that precisely because powerful managers have more opportunities to make inefficient decisions, a rational market will, in

equilibrium, consider them more accountable for their firm's performance. Hence these managers will behave more efficiently than their less powerful colleagues.

I begin by assuming that the only instrument the firm can use to motivate managers is power, and I analyze the determinants of the optimal allocation of power in that case. I show that in general it is optimal to divide power in an unequal way. This challenges the view often found in the literature on employee participation that one of the benefits of distributing power equally is that employees become more motivated: instead, I find that when the allocation of power is made more equal the reduction in one of the manager's incentives generally offsets the increase in the other manager's. This is due to two reasons. Firstly, power and managerial effort are complements: if a manager decides to work harder, it is profitable for the firm to give him more power, so that the organization as a whole benefits more from his effort; but having more power, the manager will realize he is more visible to the market and will work even harder, and it will be profitable to give him even more power. Secondly, I find that the market's learning process about the managers' human capital is convex with respect to power: as the firm increases a manager's power and reduces another manager's, the increase in the former's incentives more than offsets the reduction in the latter's.

Within this framework, I also analyze the relationship between power and performance pay when pay-for-performance schemes can be made contingent on firm performance, but not on individual managerial performance. Using assumptions similar to Gibbons and Murphy (1992) I find three reasons why optimal pay-for-performance schemes should depend on the allocation of power between managers. First of all, the larger a manager's power, the cheaper it is for him to influence firm performance, and therefore the size of his bonus. Hence if the firm offered the same incentive rate to two managers at different positions, the one with more power would exert more effort. Secondly, because power generates incentives via labor market competition, it is not necessary to give high explicit incentives to powerful managers, because such managers realize how visible they are and tend to work hard even if they are offered low bonuses. Finally, the distribution of power affects the variance of firm performance, which is minimized when all managers have equal power. If managers are risk-averse, this affects the cost of using performance pay to increase managerial effort. Thus, when managerial career concerns are not important and managers are not very risk averse it is optimal for the firm to give higher performance bonuses to more powerful managers.

2 POWER AND LEARNING

2.1 SET-UP

I extend Holmstrom's (1982b) model of managerial career concerns in two directions. First of all, I assume that firms employ two managers instead of one, and that the labor market cannot observe their individual performance: only firm performance is observable. Hence, the firm faces a particular kind of team production problem where team members' payoffs are adjusted in time through labor market competition and incentives are generated by this dynamic adjustment process. In contrast, in the standard team production problem (see Holmstrom, 1982a) the firm provides incentives by designing pay-for-performance contracts. The role of career concerns is particularly important at top levels of management since top managers' decisions easily affect company performance, which is observed by the market. In contrast, the performance of low-level units of a company is rarely observed by the market, and career concerns are relatively unimportant at that level. Hence in the model managers A and B are considered to be top managers and y_t is a measure of corporate performance observable by the labor market. By choosing how much power to give to each manager, the firm can make it easy or difficult for the market to learn about them. Thus, the importance of career concerns is endogenously determined in the model. In this sense this is also a peculiar team production problem, where power (as opposed to pay-for-performance) is used as an instrument to limit free riding.¹

Production. A risk-neutral firm (the principal) employs two managers, A and B (the agents), at periods $t = 1, 2$ and maximizes the discounted sum of expected profits using δ as a discount rate. The firm's technology at period t has the following constant returns to scale form:

$$y_t = \varphi_A(\eta_A + e_{At}) + \varphi_B(\eta_B + e_{Bt}) + \varepsilon_t \quad (1)$$

where y_t is output, e_{At} is manager A's effort, η_A is manager A's ability and η_B and e_{Bt} are similarly defined for manager B. Manager A's potential productivity is $\eta_A + e_{At}$, but once he is hired, his effective contribution to the firm depends on the amount of power he receives, characterized by φ_A . If he receives little power (low φ_A), anything he does has a smaller impact on output than it would have had, had he been given more power. Thus I define power as the degree to which a manager can affect his firm's performance: a manager may

¹In two recent papers, Meyer (1994) and Jeon (1996) have used a similar model. However, their focus is on efficient task assignment in a context where there is no managerial effort, whereas I am interested in the relationship between power and incentives.

be very talented, but his company only benefits from it to the extent that he is allowed to make relatively important decisions. Otherwise his talent is wasted.

For example, suppose two managers are in charge of launching a new product and have to decide how to use their budgets. Suppose each manager is in charge of a different aspect of the project, for example manufacturing and marketing. Assume also that the company can decide what budget is given to each manager, and let I_i (for $i \in \{A, B\}$) denote manager i 's budget. Suppose the new product generates returns measured by V , which depend on the two managers' choices, and let V_A and V_B (with $V_A + V_B = V$) denote the returns due to A and B respectively. Ideally, the firm would like to be able to decompose V into V_A and V_B , *i.e.* to know what part of the returns generated by the new product is attributable to the marketing and manufacturing decisions respectively. However, it is usually impossible to make this decomposition. With $I = I_A + I_B$, the rate of return of the project is

$$\varrho = \frac{V - I}{I} = \frac{I_A V_A - I_A}{I} + \frac{I_B V_B - I_B}{I}$$

and the company would like to infer separate rates of return ϱ_A and ϱ_B for each manager based on V , I_A , and I_B . In this example, we can define a manager's power as the relative size of his budget, $\varphi_i = I_i/I$, and write

$$\varrho = \varphi_A \varrho_A + \varphi_B \varrho_B.$$

The problem of the firm would then be to find the budget allocation that maximizes the expected rate of return of the new product.

In the incomplete contracting literature it is usually considered that power is a limited resource in the firm (see for example Hart and Moore (1990) and Aghion and Tirole (1997)). In the same spirit, I make the following assumption:

Assumption 1 $\varphi_A + \varphi_B = 1$.

As in Holmstrom's (1982b) original model, I assume that the abilities η_A and η_B are constants unknown to everyone (including the managers themselves), and that all players have identical prior beliefs with distribution $\eta_i \sim N(\eta_{i0}, \sigma_i^2)$ for $i \in \{A, B\}$ and $\text{cov}(\eta_A, \eta_B) = 0$. Finally, the random variable ε_t is a productivity shock to the firm, with $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$ for $t = 1, 2$. Such shocks are assumed to be independently distributed.

Labor Market Competition. A competitive labor market for managers observes the performance of the firm (*i.e.* of the team of managers) and makes inferences about the managers' abilities. In equilibrium, a competitive labor market should offer higher wages to the man-

agers that are thought to have a higher ability. Hence our second assumption:

Assumption 2 *When manager i is thought to have ability η_i , his value to the labor market is $\gamma\eta_i$, with $0 < \gamma < 1$.*

Thus, because of labor market competition, the market wage of a manager does not directly depend on his power: it only depends on his perceived ability. However, power does affect the manager's market wage in an indirect way, by making him more or less visible.

Utility functions. Both managers have the same strictly increasing, convex disutility of effort $c(e)$, and the same utility function. Their reservation utility is 0. I also assume that they discount the future at the same rate, δ , as the principal. Finally, I consider a risk-neutral and a risk-averse case. In the risk neutral case, the utility function is

$$U_{rn}(w_{i1}, w_{i2}; e_{i1}, e_{i2}) = \sum_{t=1}^2 \delta^{t-1} [w_{it} - c(e_{it})] \quad (2)$$

where w_{it} is the wage paid to manager $i \in \{A, B\}$ at period t . For the risk-averse case I use the following exponential utility function:

$$U_{ra}(w_{i1}, w_{i2}; e_{i1}, e_{i2}) = -\exp\left(-r\left\{\sum_{t=1}^2 \delta^{t-1} [w_{it} - c(e_{it})]\right\}\right), \quad (3)$$

which implies that managers have access to a perfect capital market. In this way I abstract from the issue of how the principal can use the labor contracts to smooth the managers' incomes over time.

Timing. There are only two periods, and decisions are made in the following order:

- The market offers each manager i a wage w_{i1}^m for period 1.
- The principal offers each manager i a position φ_i for both periods, and a wage w_{i1} for period 1.
- Managers accept or reject the principal's offers.
- First-period production takes place: the managers choose e_{A1} and e_{B1} .
- The productivity shock ε_1 is realized, and all players observe y_1 .
- The market offers each manager a second-period wage w_{i2}^m .
- The principal offers each manager a second-period wage w_{i2} .

- Managers accept or reject the principal's offers.
- Second-period production takes place.
- The productivity shock ε_2 is realized, and all players observe y_2 .

I use the assumption that the firm commits to a certain allocation of power φ_i in order to derive some basic results. After that, I relax the assumption and allow the firm to change the allocation of power once period-1 performance has been observed and the beliefs about the managers have been updated.

2.2 THE UPDATING PROCESS

Let the equilibrium levels of managerial effort be denoted by e_{it}^* (for $i \in \{A, B\}$ and $t \in \{1, 2\}$). Because of normality, the posterior beliefs at period t about i 's ability are a weighted average of today's signal and all past signals:

$$\eta_{it} = (1 - t\alpha_{it})\eta_{i0} + \alpha_{it} \sum_{s=1}^t \left(\frac{z_s}{\varphi_i} - \frac{\varphi_{-i}}{\varphi_i} \eta_{-i0} \right). \quad (4)$$

where

$$\begin{aligned} \alpha_{it} &\equiv \frac{\varphi_i^2 \sigma_i^2}{(\varphi_A^2 \sigma_A^2 + \varphi_B^2 \sigma_B^2)t + \sigma_\varepsilon^2} \\ z_t &\equiv y_t - \varphi_A e_{At}^* - \varphi_B e_{Bt}^*. \end{aligned} \quad (5)$$

In the above expression I have used η_{it} to denote the posterior beliefs about manager i 's ability after period- t performance has been observed. The coefficient α_{it} measures the rate at which the principal updates his beliefs about manager i , or, in other words, the extent to which this manager is made accountable for firm performance: the higher α_{it} , the more the principal blames this manager for a bad result or rewards him for a good one. Finally, z_t is the estimate of the team productivity that the players construct after observing period t 's output, y_t .

The characterization of the updating process provides us with the following relationship between power and accountability:

Lemma 1 (Power and Accountability)

- α_{i1} is increasing in φ_i .

- There exists a critical value of power $\hat{\varphi}_i$ such that the accountability parameter α_{i1} exhibits increasing returns to power if $\varphi_i < \hat{\varphi}_i$ and decreasing returns to power otherwise. If $\sigma_\varepsilon < \sigma_i$, then $0 < \hat{\varphi}_i < 1$.

Proof: Differentiating α_{i1} with respect to φ_i , we find $\frac{\partial \alpha_{i1}}{\partial \varphi_i} > 0$ and $\frac{\partial^2 \alpha_{i1}}{\partial \varphi_i^2} > 0$ or $\frac{\partial^2 \alpha_{i1}}{\partial \varphi_i^2} < 0$ depending (respectively) on whether φ_i is low or high. ■

The first part of the lemma states that more powerful managers are more accountable than less powerful ones. Consider A's productivity in the firm at period 1, $\varphi_A(\eta_A + e_{A1})$. When A is expected to play the pure strategy e_{A1}^* , the variance of his productivity is $\varphi_A^2 \sigma_A^2$. Note that this measures the principal's prior uncertainty about A's value to the firm, and that for a given σ_A^2 , such uncertainty increases with power, simply because the failures and successes of powerful managers affect firm performance more than those of less powerful managers. Moreover, a Bayesian player updates his beliefs more quickly the higher the prior uncertainty. Hence, the rate at which the market and the firm will change their beliefs about a manager will be higher the higher this manager's power. Equivalently, dividing the production function (1) by φ_A ,

$$y'_t = \eta_A + e_{At} + \varepsilon'_t \quad (6)$$

where

$$y'_t \equiv \frac{1}{\varphi_A} y_t$$

$$\varepsilon'_t \equiv \frac{1}{\varphi_A} [\varphi_B(\eta_B + e_{Bt}) + \varepsilon_t].$$

and the variance of the noise is

$$V(\varepsilon'_t) \equiv \frac{1}{\varphi_A^2} [\varphi_B^2 \sigma_B^2 + \sigma_\varepsilon^2].$$

Hence, an increase in A's power is equivalent to an increase in the precision of his signal, y'_t .

The second part of the lemma is illustrated in Figure 1. The marginal effect of power (φ_A) on accountability (α_{A1}) is increasing for low values of power, and decreasing for high values. I leave an intuitive explanation of this result for the next section.

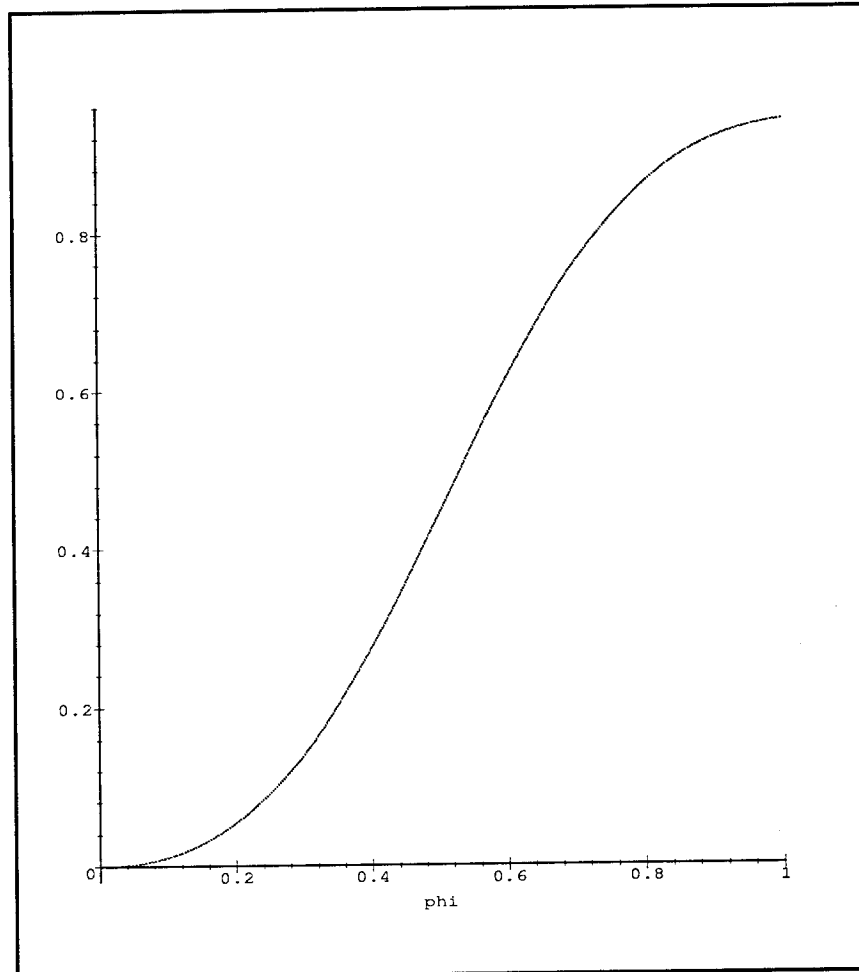


Figure 1: Updating coefficient for i (α_{i1}) as a function of manager i 's power (φ_i) when $\sigma_A = \sigma_B = 4$ and $\sigma_\epsilon = 1$

3 OPTIMAL ALLOCATION OF POWER

3.1 COMMITMENT CASE

As a first step, and in order to highlight the main relationships between managerial power and career concerns, I assume that the firm chooses how to allocate power among managers based on prior beliefs, and commits not to reallocate power after the priors have changed. In the next section I relax this assumption in order to analyze the relationship between promotions and career concerns.

In the presence of a competitive labor market, the updating coefficients α_{A1} and α_{B1} are an essential determinant of managerial incentives, as they measure how market beliefs about managers depend on firm performance, and therefore whether a manager's effort can have a significant effect on his market value. In order to complete lemma 1's characterization of the relationship between power and accountability, the following result will be useful:

Lemma 2 *If managers are ex-ante identical ($\eta_{A0} = \eta_{B0} = \eta_0$, and $\sigma_A^2 = \sigma_B^2 = \sigma^2$), then the value of φ_i that maximizes $\alpha_{A1} + \alpha_{B1}$ is a corner solution, $\varphi_i^* \in \{0, 1\}$. The minimizing value is $1/2$. Finally, $\alpha_{A1} + \alpha_{B1}$ is increasing in σ^2 and decreasing in σ_ε^2*

Proof: The lemma is proved by differentiation. ■

This result has a very intuitive explanation: suppose a priori the abilities of all managers are equally unknown, $\sigma_A^2 = \sigma_B^2 = \sigma^2$. Re-arranging, the sum of the updating coefficients could be expressed as

$$\alpha_{A1} + \alpha_{B1} = \frac{(\varphi_A^2 + \varphi_B^2)\sigma^2}{(\varphi_A^2 + \varphi_B^2)\sigma^2 + \sigma_\varepsilon^2} = \frac{\sigma_J^2(\varphi_A)}{\sigma_J^2(\varphi_A) + \sigma_\varepsilon^2},$$

where $\sigma_J^2(\varphi_A) \equiv (\varphi_A^2 + \varphi_B^2)\sigma^2$. Here, $\sigma_J^2(\varphi_A)$ is just the prior variance of the team's productivity. Note also that when power is equally divided between the two managers, the firm minimizes the uncertainty about the team's productivity: $\sigma_J^2(\varphi_A)$ is minimized at $\varphi_i = 1/2$. Now suppose that the principal had hired only one manager, with prior ability $\varphi_A\eta_{A0} + \varphi_B\eta_{B0}$ and prior variance $\sigma_J^2(\varphi_A)$. After observing y_1 , the updating coefficient that the principal would use to form his posterior beliefs about this imaginary manager would be precisely $\alpha_{A1} + \alpha_{B1}$, according to basic Bayesian updating.² Thus the problem where the principal chooses how to allocate power between several managers is equivalent to a problem where he chooses the prior uncertainty about the ability of a single, imaginary manager. Finally, note

²In the single-manager case, with $y_t = \eta + \varepsilon_t$, $\eta \sim N(\eta_0, \sigma^2)$, and $\varepsilon_t \sim N(0, \sigma_\varepsilon^2)$, the posterior ability is $\eta_1 = (1 - \alpha_1)\eta_0 + \alpha_1 y_1$ and the updating rate is $\alpha_1 = \frac{\sigma^2}{\sigma^2 + \sigma_\varepsilon^2}$.

that the rate of updating of a Bayesian principal is higher the higher the prior uncertainty about the manager. As a consequence, it must be the case that the rate of updating for the imaginary manager, $\alpha_{A1} + \alpha_{B1}$, is maximized at the corners ($\varphi_i^* \in \{0, 1\}$), since these values maximize the prior uncertainty about his ability.

To analyze the profit-maximizing distribution of power, let $w_{it}(\eta_{it-1}, e_{it}^*)$ be the wage that the firm offers to manager i in period t given his expected ability (η_{it-1}) and effort (e_{it}^*). Similarly, let $w_{it}^m(\eta_{it-1})$ denote the wage offered to manager i by the market in period t . Labor market competition imposes the following constraints:

$$w_{it}^m(\eta_{it-1}) = \gamma\eta_{it-1}. \quad (7)$$

$$w_{it}(\eta_{it-1}, e_{it}^*) - c(e_{it}^*) = w_{it}^m(\eta_{it-1}) \quad (8)$$

for $i \in \{A, B\}$ and $t \in \{1, 2\}$. Because of labor market competition, managers can bid up their wages every time they are believed to have a higher ability, and this creates an incentive for them to work hard. Using the above constraints, it is also possible to obtain the following testable prediction of the model:

Remark 1 *Power and firm performance are complements in the wage function of each manager: for $i \in \{A, B\}$,*

$$\frac{\partial^2 w_{i2}}{\partial y_1 \partial \varphi_i} > 0.$$

This result is easily derived from (7) and (8) above: combining these two constraints,

$$w_{i2}(\eta_{i1}, e_{i2}^*) = \gamma\eta_{i1} + c(e_{i2}^*), \quad (9)$$

and as a consequence

$$\frac{\partial w_{i2}}{\partial y_1} = \gamma\alpha_{i1},$$

which from lemma 1 is increasing in φ_i . Hence the model predicts managerial wages to be more sensitive to performance the higher the power of the manager. In equilibrium, the wages of powerful managers are more volatile than those of less powerful managers: the latter are not held very accountable by the labor market for the firm's performance, and as a result their wages are more insulated from productivity shocks. Finally, note also that

according to equation (9) above more powerful managers are paid higher wages in order to compensate for the fact that they exert more effort. But all managers receive the same payoff *net* of effort as long as their abilities are perceived to be the same.

Having determined how the labor market rewards managers for firm performance, the equilibrium levels of managerial effort follow from the IC constraints

$$e_{it}^* = \operatorname{argmax}_{e_{it}} [\delta\gamma\eta_{it} - c(e_{it})], \quad (\text{IC})$$

which lead to $c'(e_{i1}^*) = \delta\gamma\alpha_{i1}$ and $e_{i2}^* = 0$. Hence $c'(e_{A1}^*) + c'(e_{B1}^*) = \delta\gamma(\alpha_{A1} + \alpha_{B1})$: the sum of the two managers' incentives depends on the rates of updating α_{A1} and α_{B1} . In view of this expression the result of lemma 1 can be re-interpreted as follows:

Remark 2 *The sum of the two managers' incentives is maximized at the corners ($\varphi_i = 1$).*

Finally, the principal takes into account the IR constraints

$$w_{i1} + \delta E(w_{i2}) - c(e_{i1}) \geq 0. \quad (\text{IR1})$$

$$w_{i2} \geq 0. \quad (\text{IR2})$$

Defining $F(\cdot) \equiv c'^{-1}(\cdot)$, a profit-maximizing principal chooses φ_A in order to maximize

$$\sum_{i \in \{A, B\}} \left(\varphi_i [\eta_{i0}(1 + \delta) + F(\delta\gamma\alpha_{i1})] - 2\gamma\eta_{i0}(1 + \delta) - c(F(\delta\gamma\alpha_{i1})) \right)$$

subject to $\varphi_A + \varphi_B = 1$, which gives the first order condition

$$\begin{aligned} & (\eta_{A0} - \eta_{B0})(1 + \delta) + \delta\gamma \left(F'(\delta\gamma\alpha_{A1}) \frac{\partial\alpha_{A1}}{\partial\varphi_A} - F'(\delta\gamma\alpha_{B1}) \frac{\partial\alpha_{B1}}{\partial\varphi_B} \right) = \\ & = \delta^2\gamma^2\alpha_{A1}F'(\delta\gamma\alpha_{A1}) \frac{\partial\alpha_{A1}}{\partial\varphi_A} - \delta^2\gamma^2\alpha_{B1}F'(\delta\gamma\alpha_{B1}) \frac{\partial\alpha_{B1}}{\partial\varphi_B}. \end{aligned}$$

Proposition 1 *Suppose the two managers are risk-neutral and ex-ante identical. An output-maximizing firm chooses to give all the power to one of the managers: $\varphi_A^* = 1$ or $\varphi_B^* = 1$.*

Proof: Since managers are ex ante identical, they have the same prior ability, and the

distribution of power only affects output through effort. Letting

$$\alpha_{A1}(\varphi_A) \equiv \frac{\varphi_A^2 \sigma^2}{[\varphi_A^2 + (1 - \varphi_A)^2] \sigma^2 + \sigma_\varepsilon^2},$$

the firm's output at $\varphi_A = 1$ (net of the ability terms) is $F[\delta\gamma\alpha_{A1}(1)]$. At any interior point ($0 < \varphi_A < 1$), on the other hand, output is

$$\varphi_A F[\delta\gamma\alpha_{A1}(\varphi_A)] + \varphi_B F[\delta\gamma\alpha_{B1}(\varphi_B)]$$

where $F[\delta\gamma\alpha_{A1}(\varphi_A)] < F[\delta\gamma\alpha_{A1}(1)]$ and $F[\delta\gamma\alpha_{B1}(\varphi_B)] < F[\delta\gamma\alpha_{A1}(1)]$. Hence either $\varphi_A = 1$ or $\varphi_B = 1$ maximizes output. ■

It is often argued that re-distributing power from very powerful managers to less powerful ones benefits the firm because the latter become more motivated and work harder.³ If a manager is already very powerful and motivated it would be intuitive to think that the firm would gain by transferring some of his power to a very demotivated, powerless manager, who would work harder as a result. This argument frequently appears in discussions on the benefits of employee participation plans, which many US firms have recently adopted.⁴ Proposition 1 points out that this argument generally fails. First of all, its validity depends on the relationship between power and incentives: if the marginal return of effort for a manager is a concave function of power, then a re-distribution of power from the more to the less powerful manager will increase the latter's effort enough to compensate the reduction in the former's. However, we know from lemma 2 that the labor market's learning process generates a *convex* relationship between effort and incentives, and therefore the argument based on concavity does not hold.

Secondly, power and effort are complements in the firm's revenue function, and this complementarity plays a crucial role. In fact, suppose power was equally distributed between A and B, and imagine that A, for some exogenous reason, decided to work harder. To take advantage of the increased effort, the firm would want to give him more power. But having more power, A would have more career concerns and would work even harder, making it

³For example Lawler (1994)

"The expected advantages of enriched jobs are many. Basically, the arguments in favor of this approach contend that enriched jobs produce greater motivation (...) than simplified jobs. The increased motivation means that the employees will be more productive and will produce higher-quality work." (p. 193)

⁴See Osterman (1994), Appelbaum and Batt (1994, 1995), and Ichniowski *et al.* (1996, 1997) for evidence on employee participation plans.

profitable for the firm to give him even more power. On the other hand, as A's power would be increased, B's would be reduced and B would exert less effort. But this would be a small loss for the firm, because the impact of B's effort on production would be smaller than that of A's. Hence it will overall benefit the firm to transfer power from B to A. Discussions on employee participation often overlook this complementarity, even though it comes directly from the standard notion of power as the ability to affect the decisions of an organization.

Clearly, proposition 1 does not imply that a profit-maximizing firm will choose a completely unequal distribution of power. From the profit-maximization problem above, the expected wage bill is

$$E\left(\sum_{i \in \{A, B\}} [w_{i1} + \delta w_{i2}]\right) = \sum_{i \in \{A, B\}} ((1 + \delta)\gamma\eta_{i0} + c[F(\delta\gamma\alpha_{i1})]).$$

Given the convexity of the cost function $c(\cdot)$, labor costs are higher for the firm when power is distributed unequally. Thus, there are cost saving reasons for distributing power equally: it is not profitable to put too much power in the hands of a particular manager because he will tend to work very hard and will have to be compensated for it. It is more costly for the firm to induce additional effort from managers that are already working very hard (*i.e.* those at high positions) than from managers that have less power and are exerting less effort.

Furthermore, when managers are risk-averse the above contract where power is concentrated in one manager is not optimal, because the manager with full power bears too much risk. In fact, before period-1 production takes place the variance of the second-period wage is

$$V(w_{i2}) = V(\gamma\eta_{i1}) = \gamma^2\sigma_i^2\alpha_{i1},$$

which is increasing in φ_i . This is so because managers at higher positions are made more accountable for the firm's performance, which is uncertain. As a consequence, a very risk-averse manager who is given a lot of power has to be compensated with a very high risk premium, and the firm will prefer to reduce his power (even if this makes incentives worse) to provide him with some insurance:

Proposition 2 *Suppose managers are risk-averse (with utility functions represented by [3]) and ex-ante identical. Then the firm chooses a more equal distribution of power than in the risk-neutral case.*

Proof. If manager i is sufficiently risk-averse, the constraint (IR1), rewritten as

$$(1 + \delta)\gamma\eta_{i0} - \frac{r}{2}\delta^2V(w_{i2}) \geq 0$$

will bind if φ_i is high. ■

Finally, it is also clear that a very unequal distribution of power will not be optimal when the managers' tasks are highly complementary. If the production function takes the form

$$y_t = \varphi_A(\eta_A + e_{At}) + \varphi_B(\eta_B + e_{Bt}) + \zeta e_{At}e_{Bt} + \varepsilon_t$$

instead of (1), and $\zeta > 0$ is high, the firm will find it optimal to divide power equally, because the lack of incentives of the less powerful manager will cause too big a reduction in the other manager's productivity.⁵

3.2 PROMOTIONS AND CAREER CONCERNS

When firm performance provides information about managers' abilities, this information will be used to reallocate power efficiently, *i.e.* to give more power to the managers who appear to be more productive. In fact, if all managers are not equally accountable, the firm will hold very different posterior beliefs about managers who are a priori identical: the firm's failures and successes will make a priori similar managers look different simply because some of them will be blamed or credited more than others, according to their power. This generates a particular kind of tournament where the identity of the winner depends both on the initial allocation of power and on the team's first-period performance. This tournament differs from Lazear and Rosen's (1981) in that the firm cannot observe a signal of performance for each manager, and is forced to use an aggregate signal (team performance) to make inferences and decide upon the winner. In order to allow for promotions, I now use φ_{it} (for $i \in \{A, B\}$ and $t \in \{1, 2\}$) to denote manager i 's position in period t .

3.2.1 THE CONFLICT OF INTEREST

Lazear (1989) first pointed out that very competitive tournaments —tournaments with very high rewards— could give rise to sabotage, since by sabotaging his competitor an employee could improve his chances of winning the contest. He found that in such cases it would be

⁵In this case, the learning process is the same as in the case we have studied before, because the effort levels are known in equilibrium and are subtracted away (as in [5]). As a consequence, the IC constraints are the same as before, but the firm has a stronger preference for dividing power equally.

optimal for the firm to reduce pay differences between winners and losers: the possibility of sabotage would lead to pay equality. However, competing managers often perform related tasks that the firm cannot measure separately: then it is only possible to assess the performance of the team and use that signal to make inferences about individuals. In such cases there are no evident gains from sabotage: a saboteur may harm himself if team performance is low. Interestingly, the analysis below shows that even in this case some managers may have an incentive to sabotage.

The principal's problem at the beginning of period 2 (after first period performance, y_1 , has been observed) is very simple. Since managers exert no effort at period 2 (the last period), the optimal decision in period 2 is to give all the power to the manager who has the highest ability, thus choosing $\varphi_{A2} = 1$ if $\eta_{A1} > \eta_{B1}$, $\varphi_{B2} = 1$ if $\eta_{A1} < \eta_{B1}$, and any $\varphi_{A2} \in [0, 1]$ if $\eta_{A1} = \eta_{B1}$. As a result when A and B make their effort choices in period 1, they take into account that their probabilities of being promoted are $Prob\{\eta_{A1} > \eta_{B1}\}$ and $Prob\{\eta_{A1} < \eta_{B1}\}$ respectively. After some manipulation,

$$\eta_{A1} \geq \eta_{B1} \Leftrightarrow \eta_{A0}(\varphi_{B1}\sigma_B^2 + \sigma_\varepsilon^2) - \eta_{B0}(\varphi_{A1}\sigma_A^2 + \sigma_\varepsilon^2) + z_1(\varphi_{A1}\sigma_A^2 - \varphi_{B1}\sigma_B^2) \geq 0. \quad (10)$$

The coefficient of z_1 in this expression determines whether a good performance in period 1 (high z_1) increases or reduces manager A's chances of being promoted. If $\varphi_{A1}\sigma_A^2 > \varphi_{B1}\sigma_B^2$, an increase in period-1 performance increases A's probability of promotion. However, if $\varphi_{A1}\sigma_A^2 < \varphi_{B1}\sigma_B^2$, a better period-1 performance can only *reduce* A's chances of promotion.

To understand why good performance might actually reduce A's chances, remember the updating formula (4), which gives

$$\eta_{A1} = (1 - \alpha_{A1})\eta_{A0} + \alpha_{A1}\left[\frac{z_1}{\varphi_{A1}} - \frac{\varphi_{B1}}{\varphi_{A1}}\eta_{B0}\right].$$

Suppose A and B are ex-ante identical, and $\eta_0 = \eta_{A0} = \eta_{B0}$. Ex post (after y_1 is observed), A's ability is a weighted average of η_0 and a measure of firm performance, and so is B's. Suppose A had initially more power than B ($\varphi_{A1} > \varphi_{B1}$). As a consequence, A is more accountable than B ($\alpha_{A1} > \alpha_{B1}$): the beliefs about A are more affected by firm performance than those about B. Therefore, if performance is better than the principal had expected ($z_1 > \eta_0$), then A gets most of the credit for it, and $\eta_{A1} > \eta_{B1}$. However, if performance is worse than expected, A gets most of the blame, and $\eta_{A1} < \eta_{B1}$. Thus if A has more power than B in the first period, then B can only hope to be promoted if the team performs poorly in period 1: in that case, the principal will think that both A and B are less able than he thought, but his opinion about A will be relatively worse than that about B, because A had

been given more power ($\varphi_{A1} > \varphi_{B1}$).

This creates a conflict of interest between managers which may lead to sabotage: the more powerful prefer good outcomes (high performance), while the less powerful prefer bad outcomes, as they can only expect to receive more power when the firm performs poorly and some employees at higher positions are fired. In contrast with Lazear (1989), sabotage may arise even though managers are part of the same team, simply because one of them has more responsibilities than the other. Since the tournament is based on the *relative* beliefs about the contestants, a manager can benefit from harming his own teammate as long as he is blamed less than him when performance is found to be low.

There is of course a possibility for the firm to use the initial allocation of power φ_{i1} to reduce the conflict of interest:

Remark 3 *If $\varphi_{A1} = \varphi_{A1}^{nc}$, such that*

$$\varphi_{A1}^{nc} = \frac{\sigma_B^2}{\sigma_A^2 + \sigma_B^2},$$

there is no conflict of interest in period 1.

Here, φ_{A1}^{nc} is the “no-conflict” allocation of power. From (10), when the initial power is allocated in this way the promotion decision is independent of period-1 performance, and the conflict of interest disappears. With this initial distribution of power, the principal commits not to change the employees’ positions at period 2, and to achieve this, he gives more power to the manager that he knows better *ex ante*, *i.e.* to the manager with the lower prior variance. The reason for doing this is that a Bayesian principal updates more slowly his beliefs about the managers that he has better prior information of. As a result, these managers benefit less from the firm’s good performance and are more likely to prefer bad performance. To compensate this, the principal can give them more power and in this way commit to update his beliefs at a higher rate. The better his prior information about a manager relative to the other, the more power he will have to give to the former.

3.2.2 OPTIMAL ALLOCATION OF POWER

If inequalities create conflicts of interest between managers, the firm should perhaps distribute power equally in order to maximize profits. In fact, if managers are a priori identical, then $\sigma_A^2 = \sigma_B^2$, and $\varphi_{A1}^{nc} = 1/2$: an equal distribution of power fully eliminates the conflict of interest. In this section I prove that even in the presence of conflicts it is optimal to have some inequality.

First of all, note that if the firm were to pay each manager exactly his market value w_{i2}^m (plus a compensation for the effort, according to (8)) and there was no cost for a manager to switch to another firm, then a manager's wage in period 2 would be independent of his power in that period, and would also be independent of whether he is fired or not: in any case, the manager would be certain to be paid the market wage w_{i2}^m . Hence, under such assumptions the optimal allocation of power would be exactly the same as in the commitment case, even though power would be re-allocated in the second period.

A more realistic and interesting case is the one where there is a wage premium attached to promotions, as in the tournament literature. In accordance with the fact that the labor market makes inferences about the two managers, I assume that the pay differential between the winner and the loser of the contest depends on the labor market beliefs. Specifically, suppose that when manager i is promoted ($\varphi_{i2} = 1$), he obtains full bargaining power to determine his wage: in this way, the winner of the contest earns a wage premium, as in a standard tournament. The only difference is that the premium will depend on how different the contestants are perceived by the labor market to be. Thus, suppose that period 1 performance has been such that $\eta_{A1} > \eta_{B1}$, and that the firm has accordingly chosen $\varphi_{A2} = 1$. Since the principal has no bargaining power, he has to pay

$$w_{A2} = \eta_{A1} - (1 - \gamma)\eta_{B1}.$$

Manager A's wage cannot be greater than this because it would then be profitable for the principal to set $\varphi_{A2} = 0$ instead of $\varphi_{A2} = 1$, *i.e.* to fire A instead of B: manager B would be willing to work for the principal at $w_{B2} = \gamma\eta_{B1}$ and the principal's profits would then be $(1 - \gamma)\eta_{B1}$ instead of $\eta_{A1} - w_{A2}$. Therefore, before period-1 production has taken place manager A's expected period-2 utility is

$$\begin{aligned} E(U_{A2}) &= P\{\eta_{A1} < \eta_{B1}\}E(\gamma\eta_{A1}|\eta_{A1} < \eta_{B1}) + P\{\eta_{A1} > \eta_{B1}\}E[\eta_{A1} - (1 - \gamma)\eta_{B1}|\eta_{A1} > \eta_{B1}] \\ &= \gamma E(\eta_{A1}) + (1 - \gamma)P\{\eta_{A1} > \eta_{B1}\}E(\eta_{A1} - \eta_{B1}|\eta_{A1} > \eta_{B1}). \end{aligned} \tag{11}$$

When manager A chooses his effort, he expects to earn his outside option and a promotion bonus. The size of the bonus will depend on the ability differential $\eta_{A1} - \eta_{B1}$, which in turn depends on the initial distribution of power and first-period performance. The higher this differential, the higher A's bargaining power, and the higher his wage. Thus managers take part in a tournament where the prize cannot be directly determined by the firm, but depends on the labor market's beliefs about the winner and the loser. Specifically, the winner's

prize depends on the market's perception about his ability, that the firm can influence by distributing power in one way or another. When the managers are a priori identical (with $\eta_{A0} = \eta_{B0} = \eta_0$ and $\sigma_A^2 = \sigma_B^2 = \sigma^2$), the expected ability differential is

$$E(\eta_{A1} - \eta_{B1} | \eta_{A1} > \eta_{B1}) = \begin{cases} \left(\frac{\alpha_{A1}}{\varphi_{A1}} - \frac{\alpha_{B1}}{\varphi_{B1}} \right) [E(z_1 | z_1 > \eta_0) - \eta_0] & \text{if } \varphi_{A1} > \varphi_{B1}, \\ \left(\frac{\alpha_{A1}}{\varphi_{A1}} - \frac{\alpha_{B1}}{\varphi_{B1}} \right) [E(z_1 | z_1 < \eta_0) - \eta_0] & \text{if } \varphi_{A1} < \varphi_{B1}. \end{cases}$$

Note that from (5) for a given η_0 the conditional expected value of performance, $E(z_1 | z_1 > \eta_0)$, is an increasing function of managerial effort. As a consequence, if manager A is powerful enough and in particular

$$\frac{\alpha_{A1}}{\varphi_{A1}} > \frac{\alpha_{B1}}{\varphi_{B1}},$$

the promotion premium is an increasing function of his effort. Hence when a powerful manager works harder he increases both his probability of promotion and the size of the premium.

In equilibrium, each manager chooses period-1 effort to maximize the expected second-period utility. Thus, A's first-period effort is characterized by the first-order condition

$$c'(e_{A1}) = \delta \frac{\partial E(U_{A2})}{\partial e_{A1}}$$

where, using (11),

$$\begin{aligned} \frac{\partial E(U_{A2})}{\partial e_{A1}} = & \gamma \frac{\partial E(\eta_{A1})}{\partial e_{A1}} + \frac{\partial P\{\eta_{A1} > \eta_{B1}\}}{\partial e_{A1}} (1 - \gamma) E(\eta_{A1} - \eta_{B1} | \eta_{A1} > \eta_{B1}) + \\ & + P\{\eta_{A1} > \eta_{B1}\} (1 - \gamma) \frac{\partial E(\eta_{A1} - \eta_{B1} | \eta_{A1} > \eta_{B1})}{\partial e_{A1}}. \end{aligned}$$

This is the marginal (undiscounted) return of A's first-period effort. The first term on the right-hand side is the marginal return that corresponds to the commitment case (section 3.1), and the other two terms measure the marginal effect of managerial effort on the promotion bonus. From our previous discussion, it is clear that the presence of a promotion bonus increases the incentives of the more powerful manager and reduces the other manager's.

Specifically,

$$\begin{aligned}\frac{\partial E(U_{A2})}{\partial e_{A1}} &= \gamma\alpha_{A1} + \frac{1-\gamma}{2}\varphi_{A1}\left(\frac{\alpha_{A1}}{\varphi_{A1}} - \frac{\alpha_{B1}}{\varphi_{B1}}\right) \\ \frac{\partial E(U_{B2})}{\partial e_{B1}} &= \gamma\alpha_{B1} - \frac{1-\gamma}{2}\varphi_{B1}\left(\frac{\alpha_{A1}}{\varphi_{A1}} - \frac{\alpha_{B1}}{\varphi_{B1}}\right).\end{aligned}$$

In fact, if B has little power the promotion effect could even make his incentives negative,⁶ and in that case B would try to “sabotage” the firm (*i.e.* he would exert negative effort) in order to increase his chances of promotion.

Even though sabotage is harmful to the firm and could be avoided by simply setting $\varphi_{i1} = \varphi_{i1}^{nc}$, the following results show that costs of sabotage are outweighed by the benefits of distributing power unequally.

Lemma 3 *Suppose managers are ex-ante identical. Then $\frac{\partial E(U_{A2})}{\partial e_{A1}} + \frac{\partial E(U_{B2})}{\partial e_{B1}}$ is maximized at $\varphi_{i1} = 1$ and minimized at $\varphi_{i1} = 1/2$.*

Proof. After some manipulation, the sum of the two managers’ marginal returns to effort can be conveniently expressed as

$$\frac{\partial E(U_{A2})}{\partial e_{A1}} + \frac{\partial E(U_{B2})}{\partial e_{B1}} = \gamma(\alpha_{A1} + \alpha_{B1}) + (1-\gamma)\frac{1}{2}(\sqrt{\alpha_{A1}} - \sqrt{\alpha_{B1}})^2,$$

where $\alpha_{A1} + \alpha_{B1}$, from lemma 2, is maximized at the corners. ■

Despite the similarity with lemma 2, this result is stronger because when power can be reallocated ex post the ex ante (period 1) misalignment of incentives becomes larger, and it is less evident that it should still be profitable to distribute power in an unequal way. But the result is intuitive: suppose the principal decides to make the initial distribution of power more unequal by giving more power to A. As a consequence B exerts less and less effort, because by doing so he increases his chances of promotion. However, B has also less and less power to affect the firm’s output and, therefore, his probability of promotion. Hence, the reduction in his effort is relatively small compared to the increase in A’s effort: as φ_{A1}

⁶With ex-ante identical managers, further manipulation yields

$$\frac{\partial E(U_{B2})}{\partial e_{B1}} = \frac{1}{2}\frac{\alpha_{B1}}{\varphi_{B1}}[\gamma - (\varphi_{A1} - \varphi_{B1})].$$

Therefore, B’s incentives are negative if $\gamma < \varphi_{A1} - \varphi_{B1}$, *i.e.* if the principal faces little labor market competition. The reason for this is clear from (11): period-2 utility is a weighted average of the outside option and the promotion bonus. If labor market competition is very weak in period 2, the promotion bonus is relatively more important.

increases, A not only benefits more from any good period-1 performance, but also has more power to affect performance. As a consequence he will increase his effort more than B will reduce his.

Finally, a result similar to proposition 1 can be derived by simply replacing α_{A1} and α_{B1} with $\tilde{\alpha}_{A1}$ and $\tilde{\alpha}_{B1}$, given by

$$\begin{aligned}\tilde{\alpha}_{A1} &= \alpha_{A1} + \frac{1-\gamma}{2\gamma}\varphi_{A1}\left(\frac{\alpha_{A1}}{\varphi_{A1}} - \frac{\alpha_{B1}}{\varphi_{B1}}\right) \\ \tilde{\alpha}_{B1} &= \alpha_{B1} - \frac{1-\gamma}{2\gamma}\varphi_{B1}\left(\frac{\alpha_{A1}}{\varphi_{A1}} - \frac{\alpha_{B1}}{\varphi_{B1}}\right),\end{aligned}$$

in the proof of proposition 1.

Proposition 3 *Suppose managers are risk-neutral and ex-ante identical. Suppose also that the allocation of power is changed after first-period performance (y_1) is observed. Then an output-maximizing firm chooses to give all the power to one of the managers at the beginning of period 1: $\varphi_{A1}^* = 1$ or $\varphi_{B1}^* = 1$.*

Proof. The proof of proposition 1 can be reproduced because $\tilde{\alpha}_{A1}$ and $\tilde{\alpha}_{B1}$ are respectively increasing and decreasing in φ_{A1} . ■

This result is also stronger than proposition 1, because in this case there is a conflict of interest between the powerful manager and the less powerful one where the latter chooses to sabotage, and despite the conflict the firm optimally chooses to have some inequality.

3.2.3 REPLACING MANAGEMENT TO REDUCE CONFLICTS

A natural way to eliminate the conflict of interest is to fire all managers when firm performance is too low. In this way, none of the managers can hope to gain more power by sabotaging the team. Hence, suppose that after period 1 the firm can hire new managers who are exactly identical to the ones that had been hired at the beginning of the game: in particular, suppose the expected ability of outside managers is η_0 . Assume that in period 1 manager A has been given more power than B. If firm performance is high ($z_1 > \eta_0$), the firm's optimal choice in period 2 is to promote manager A and fire manager B ($\varphi_{A2} = 1$), as in the case where no new managers could be hired. On the other hand, if performance is low it is now optimal to fire both managers and replace them with new ones (see figure 2). We therefore get the following result:

Proposition 4 *Suppose the firm can hire new managers at the end of period 1. Then the equilibrium satisfies the following properties:*

- *The period-1 allocation of power is unequal.*
- *The less powerful manager is offered a one-period contract which is never renewed. The more powerful manager is offered a two-period contract contingent on firm performance.*
- *There is no sabotage.*

Proof. Without loss of generality, suppose that $\varphi_{A1} > \varphi_{B1}$. First of all, it is clear that manager B will always be fired at the end of period 2: if $z_1 > \eta_0$ then $\eta_{B1} < \eta_{A1}$ and it is optimal to give B's power to A. On the other hand, if $z_1 < \eta_0$ then $\eta_{B1} < \eta_0$ and it will be optimal to fire both A and B and give all the power to a new manager. Hence B's second period expected utility is $E(U_{B2}) = \gamma\eta_{B1}$, and B will never sabotage. Consider now manager A. If $z_1 > \eta_0$ he will remain in the firm and will be promoted, whereas if $z_1 < \eta_0$ he will be fired and will be substituted by a new manager. Hence $E(U_{A2})$ is still defined by equation (11).■

On one hand, the more powerful manager gets most of the credit when performance is high, and as a consequence the firm views him as more valuable than the less powerful one. On the other hand, in case of low performance outside managers appear as better replacements for the powerful manager than any insider, because they have had no part in the poor performance of the firm, while insiders have. Hence the less powerful manager never keeps his job for two periods: independently of how the firm performs in the first period, there is always a candidate (either the other manager or an outsider) that is thought to be more able than him.

Of course, inside managers generally have some specific human capital that outsiders lack, and in this case there will be states of the world in which the less powerful manager will be able to keep his job. For instance, suppose that any new manager hired after period 2 has an expected ability $\eta'_0 < \eta_0$, *i.e.* such that if performance just meets the prior expectations ($z_1 = \eta_0$), the firm gets a positive profit from not hiring any outsider. Then, as shown in figure 3, management will be restructured in three different ways depending on firm performance: if performance is very low, the whole team of managers will be replaced by a new team (outside succession); if performance is very high, the team of managers will remain but the managers who were already powerful will become more powerful; and for a range of intermediate values of performance the old team will remain, but power will shift from the more to the less powerful (inside succession). This is consistent with the evidence found by Parrino (1997) for the US. He classifies 977 CEO departures which took place

in 1969-1989 according to three criteria: forced versus voluntary successions, successions by insiders (lower-level managers from the same company) versus successions by outsiders, and successions by outsiders from the same industry versus successions by outsiders from another industry. He finds that the probability that a fired CEO is replaced by an outsider is more sensitive to firm performance, measured by industry-adjusted return on assets, than the probability that a fired CEO is replaced by an insider. Thus, when firm performance is not substantially below industry performance, fired CEO's are more likely to be replaced by insiders, and when firm performance is substantially lower than the industry average it is more likely that fired CEO's will be replaced by outsiders. Boards appoint insiders unless performance is very low.

Note also that power will be reallocated differently in industries subject to different degrees of uncertainty: in industries where uncertainty is low, new managers will rarely be hired, but in highly risky industries firms will tend to replace old managers with new ones more often.

4 POWER AND EXPLICIT MANAGERIAL INCENTIVES

Ideally, pay-for-performance schemes would be most effective if the bonus of each manager could depend on individual measures of (his and possibly other managers') performance. But individual performance often cannot be measured, and firms have to rely on aggregates. Since the precision of the information that aggregate measures provide about individual managers depends on the allocation of power among managers, it would not be optimal to offer identical pay-for-performance schemes to managers who do not have the same power.

Suppose, following Gibbons and Murphy (1992), that managers are risk-averse with utility functions given by (4), and assume that the firm offers a linear incentive contract

$$w_{it} = a_{it} + b_{it}y_t$$

at the beginning of each period $t \in \{1, 2\}$ for $i \in \{A, B\}$. Because of the dynamics of learning on one hand and the existence of a bonus $b_{it}y_t$ on the other, managerial incentives have two sources: career concerns and the above pay-for-performance scheme.

In period 2, managers have no career concerns and effort is determined by the explicit incentives only:

$$c'(e_{A2}) = \frac{\partial w_{A2}}{\partial e_{A2}} \Leftrightarrow c'(e_{A2}) = b_{A2}\varphi_A.$$

According to this formula, a bonus scheme based on the company's performance is a better motivator for a powerful manager than for a less powerful one, because the effort of the former has less impact on firm performance and therefore on his wage. On the other hand, labor market competition imposes the following individual rationality constraint:

$$a_{A2} + b_{A2}E(y_2|y_1) - c(e_{A2}) - \frac{r}{2}b_{A2}^2V(y_2|y_1) \geq \gamma\eta_{A1}.$$

where $V(y_2|y_1)$ is the variance of second-period output conditional on first-period output. The firm chooses the incentive rates b_{A2} and b_{B2} in order to maximize expected profits subject to the incentive compatibility and individual rationality constraints, and the resulting optimal incentive rate is

$$b_{A2} = \frac{\varphi_A^2}{\varphi_A^2 + rc''(e_{A2})V(y_2|y_1)}. \quad (12)$$

Hence an increase in A's power has two effects on the optimal second-period incentive rate. First of all, holding the posterior variance of output, $V(y_2|y_1)$, constant, it reduces the cost of motivating A: the more powerful A, the larger the impact of any additional unit of his effort on firm performance, and the larger the increase in his bonus. In this way, power increases the marginal return of A's effort. The second effect is on the posterior variance of output: after some manipulation,

$$V(y_2|y_1) = \sigma_\varepsilon^2(\alpha_{A1} + \alpha_{B1} + 1) \quad (13)$$

which, by lemma 2, is minimized at $\varphi_A = \varphi_B = 1/2$. Hence the more equally power is divided, the lower $V(y_2|y_1)$, and the cheaper it is to give incentives to A. As a consequence, when $\varphi_A < 1/2$ the two effects reinforce each other, and the explicit incentive rate is an increasing function of power; and for $\varphi_A > 1/2$ they compensate each other: giving more responsibility to A partly reduces the cost of incentives by increasing A's influence on the performance signal, but at the same time it increases the cost of incentives by increasing the variance of the signal.

Proposition 5 *For $i \in \{A, B\}$, if $c''' = 0$ the incentive rate b_{i2} is increasing in φ_i .*

Proof: Let $0 < \varphi_A < 1$. Using (13) to substitute in (12), and dividing numerator and

denominator in (12) by φ_A^2 ,

$$b_{A2} = \frac{1}{1 + rc\sigma_\varepsilon^2 \left(\frac{\sigma^2}{\sigma^2\varphi_A^2 + \frac{\sigma_\varepsilon^2}{1 + \frac{\varphi_B^2}{\varphi_A^2}}} + 1 \right)}$$

where $c \equiv c''(e_{it})$. ■

With a quadratic cost function, the first effect dominates, and second-period incentives and power are complements: it is optimal for the firm to offer higher explicit incentives to more powerful managers, because such managers find it easier to influence firm performance, on which the incentive scheme is based. Modelling the firm as a hierarchy where efficiency wages are used to motivate employees, Williamson (1967) also found a complementarity between power and incentives at the optimum. Later on Calvo and Wellisz (1978) and Qian (1994) obtained a similar result. In these papers it is argued that if a top manager is well motivated he will monitor his subordinates more closely; and his subordinates will in turn work harder and will make their respective subordinates work harder. In this way, incentives spill over from the top to the bottom of the hierarchy, making it more profitable to motivate top managers than lower level managers. Proposition 5 points out that the argument based on the chain of monitoring is not essential to Williamson's (1967) original intuition that more powerful managers should be given more incentives: suppose several managers are not hierarchically related but have nonetheless different degrees of power —*e.g.* division managers in a large corporation. Then it will still be optimal for the firm to give higher explicit incentives to more powerful managers, even if these managers have less subordinates.

In period 1, incentives are determined both by the pay-for-performance scheme and by the managers' career concerns: maximizing A's expected utility with respect to e_{A1} ,

$$c'(e_{A1}) = b_{A1}\varphi_A + \delta \frac{\partial a_{A2}}{\partial e_{A1}} = b_{A1}\varphi_A + \delta[\gamma\alpha_{A1} - b_{A2}\varphi_A(\alpha_{A1} + \alpha_{B1})]. \quad (14)$$

The first term on the right-hand side measures the effect of pay for performance on manager A's first-period effort, and the second term measures the effect of career concerns. Interestingly, career concerns do not always increase effort: developing the second term on the right hand side, if

$$rc''(e_{A2})V(y_2|y_1) < \frac{\varphi_A}{\gamma}(\varphi_A^2 + \varphi_B^2 - \gamma\varphi_A) \quad (15)$$

then career concerns *reduce* the manager's incentives. The reason for this reduction is that the firm's revision of the incentive scheme (salary and bonus) at the end of period 1 has a

ratchet effect on the level of compensation: consider manager A's choice of effort in the first period, characterized by the first order condition (14). By exerting more effort in period 1, A tries to make the firm and the market believe that his ability is higher than it really is. Because of this high level of effort, period 1 performance, y_1 , turns out to be high (on average), and the firm and the market tend to believe that the manager (and his colleague) is more able than it seemed a priori. This has two consequences. First of all, the manager's market value will increase and his second-period wage will be higher. This effect is captured by the term $\gamma\alpha_{A1}$ on the right hand side of expression (14), and is the standard effect of career concerns on incentives, as in Holmstrom (1982b). But there is also a second effect: if managers are thought to be more able, the firm will expect future performance to be higher too: $E[y_2|y_1] > E[y_2]$; and for any given rate b_{i2} future bonuses ($b_{i2}y_2$) will also be expected to be larger. As a consequence, the firm will think that if the salaries a_{i2} are not reduced managers are going to be overpaid in period 2 in comparison to the market. In order to adjust their wages back to the minimum level (the market value) it will reduce the salaries. However, if this reduction is large it will create "negative" career concerns: anticipating that by trying to fool the firm they may actually cause a reduction in their salaries, managers will reconsider their intention to work so hard. This effect is measured by the term $b_{A2}\varphi_A(\alpha_{A1} + \alpha_{B1})$ on the right hand side of (14). The size of this perverse effect on incentives will depend on the size of the incentive rate b_{A2} : if the firm is offering high-powered incentives, the change in the firm's beliefs that is caused by the increase in A's effort will have a large effect on the expected bonus ($E[b_{A2}y_2|y_1]$), and the firm will reduce the future salary a_{A2} by a large amount.

Proposition 6 (Ratchet Effect) *Assume that $c''' = 0$. For $i \in \{A, B\}$, the ratchet effect*

$$R_i(\varphi_i) = b_{i2}\varphi_i(\alpha_{A1} + \alpha_{B1}) \quad (16)$$

is decreasing in r and σ_ε^2 , and increasing in σ^2 and φ_i .

Proof: After some manipulation,

$$R_i(\varphi_i) = \frac{\varphi_i^3}{\frac{\varphi_i^2}{\alpha_{A1} + \alpha_{B1}} + r c \sigma_\varepsilon^2 \left(\frac{1}{\alpha_{A1} + \alpha_{B1}} + 1 \right)},$$

where $c \equiv c''(e_{it})$. Using this result together with lemma 2, the comparative statics with respect to r , σ_ε^2 and σ^2 are straightforward. The comparative statics with respect to φ_i can be derived from (16) after some manipulation which I sketch in the appendix. ■

By (13), an increase in either σ^2 or σ_ε^2 increases the posterior variance of output, $V(y_2|y_1)$,

therefore reducing the optimal period-2 incentive rate, b_{A2} . The reduction in b_{A2} causes the reduction in the ratchet effect. Similarly, an increase in the coefficient of absolute risk-aversion r reduces the incentive rate and the ratchet effect. Finally, when $\varphi_i \geq 1/2$ an increase in manager i 's power increases his second-period bonus rate, b_{i2} , and the rate ($\alpha_{A1} + \alpha_{B1}$) at which the beliefs about team performance are updated, thus increasing the ratchet effect.

Results for Gibbons and Murphy's (1992) one-manager model can be derived by setting $\varphi_A = 1$ and $\gamma = 1$. It is then easily verified that career concerns never reduce managerial incentives: condition (15) is never satisfied. In that case, there are two reasons why career concerns unambiguously generate positive incentives. First of all, labor market competition is strong. As a consequence, if a manager works harder and causes performance to be higher (on average), his market value increases by a large amount. This partially compensates the ratchet effect: on one hand the firm would like to reduce his salary because the bonus is expected to be high, but on the other hand the manager's market value is higher, and the firm has to increase total compensation (salary plus bonus). Secondly, notice that a manager's market value depends only on the beliefs about his ability, whereas his bonus depends on the beliefs about the *team's* ability. Hence in general the rate at which the firm updates its estimate of the bonus ($\alpha_{A1} + \alpha_{B1}$) is higher than the rate at which the manager's market value is updated (α_{A1}). This worsens the ratchet effect in the two-manager case compared with the one-manager case: with two managers, when a manager works harder, causing performance to be high, the bonus is likely to increase more than the manager's market value, and the firm will adjust his compensation down by reducing the salary. However, when there is only one manager the bonus and the market value are updated at the same rate, and this reduces the ratchet effect. Formally, substituting $\gamma = 1$ in (15), the right-hand side becomes $\varphi_A \varphi_B (\varphi_B - \varphi_A)$, which is negative if $1/2 < \varphi_A < 1$ and is zero if $\varphi_A = 1$.

Using the results for the optimal second-period contract, the optimal first-period incentive rate can be obtained by maximizing the firm's expected profits subject to the incentive compatibility and individual rationality constraints:

$$b_{A1} = \frac{\varphi_A^2}{\varphi_A^2 + rc''(e_{A1})V(y_1)} - \delta \left[\frac{\gamma - b_{A2}\varphi_A}{\varphi_A} \alpha_{A1} - b_{A2}\alpha_{B1} \right] - \frac{r\delta b_{A2}[\varphi_A^2 + (1 - \varphi_A)^2]\sigma^2}{\varphi_A^2 + rc''(e_{A1})V(y_1)}$$

For clarity it is useful to look at the case where the cost of effort is a quadratic function ($c''' = 0$). In that case, with $c \equiv c''(e)$ we can define

$$b(\varphi, V) = \frac{\varphi^2}{\varphi^2 + rcV},$$

which is simply the bonus rate that the firm would offer to a manager with power φ when there are no career concerns and the variance of firm performance is V . We can then write

$$b_{A1} = b(\varphi_A, V(y_1)) - \frac{\delta}{\varphi_A} [\gamma\alpha_{A1} - R_A(\varphi_A)] - \delta r\sigma^2 b(\varphi_A, V(y_2|y_1)) [b(\varphi_A, V(y_1)) + b(1 - \varphi_A, V(y_1))].$$

The optimal linear incentive rate is equal to the rate that would be optimal if there were no career concerns, $b(\varphi_A, V(y_1))$, minus two corrections. The first one is a career concerns correction: when the manager has positive career concerns, there is no need for the firm to offer him high-powered explicit incentives, because implicit dynamic incentives already guarantee that the manager is going to choose a high level of effort: the higher the manager's career concerns, the lower the need for the firm to give him formal incentives. The second one is an insurance correction which takes into account that, in period 1, managers are averse to period-2 uncertainty. When career concerns are not important (δ is small), the last two terms are small and the distribution of power has only two effects on the design of the explicit incentive rate: first of all, it affects the variance of the firm's performance: the more equal the distribution of power, the lower the variance of the firm's performance, and the higher the optimal explicit incentive rate for *every* manager. Secondly, an increase in a manager's power increases the effect of his effort on firm performance, and therefore on his wage. As a consequence, it is profitable to increase that manager's incentive rate and reduce the other manager's. In some cases the latter effect dominates and it is optimal to give higher explicit incentives to more powerful managers. On the other hand, when career concerns are important, the interaction between power and explicit incentives is more complicated, because more powerful managers have more career concerns. In this case, the costs of giving explicit incentives to these managers might be low, but so will the benefits: if managers with more power have stronger career concerns, the benefits from inducing more effort from them (through an explicit incentive scheme) will be smaller.

5 CONCLUSIONS

Consider a team of two top managers, and suppose that one of them is more powerful than the other —assume that the former can make important decisions, while the latter is left with relatively less important ones. One way to motivate the latter would be to give him more power, as suggested by some of the literature on motivation (*e.g.* Lawler, 1994). But this requires to transfer some of his colleague's power, who as a result will be less motivated. I analyze this trade-off and I show that even if managers are identical there is generally some degree of inequality at the optimum. I identify two reasons for this result. First of all, there exists a complementarity between power and managerial effort. More powerful managers not only tend to work harder: their effort is also more valuable to the firm, because it affects more important decisions. I argue that more powerful managers work harder because their decisions, being more important, are more visible to the outside labor market. Thus, more powerful managers have stronger career concerns. But if a manager is given more power and as a consequence starts to work harder, it will be profitable for the firm to increase his power even more so as to better benefit from his higher effort. Secondly, I show that the implicit incentives generated by the labor market via career concerns are convex with respect to power: as power is transferred from a powerful manager to a less powerful one, the incentives of the latter do not increase enough to compensate for the reduction in the former's.

I also point out that when promotion decisions are based on internal tournaments an unequal distribution of power may create conflicts of interest between competing managers. Since more powerful managers are given more blame in case of poor performance, their less powerful competitors may have an incentive to sabotage in order to discredit them. I show that despite such conflicts some inequality is still optimal because potential saboteurs, having less power, will have a lower impact on the firm than the more powerful managers, who have strong incentives to work hard. I also show that outside successions (hiring top managers from other firms when performance is low) play an important role in this case as an instrument to limit internal conflicts of interest. This is consistent with recent evidence from US companies (Parrino, 1997).

Finally, I analyze how an optimal pay-for-performance scheme based on team performance should depend on each manager's power. I show that the use of explicit incentives can give rise to negative career concerns: if a manager works very hard and makes the firm believe that his ability is very high, the firm will revise its expectations of future performance upwards. As a consequence, it will reduce his salary because it will now expect future bonuses, which are based on performance, to be higher. But this will reduce the manager's career concerns.

The magnitude of the problem will depend on the degree of labor market competition and the level of explicit incentives: with strong competition and low-powered incentives, an increase in the manager's perceived ability produces a large increase in his market value and a relatively small increase in the perceived level of his future bonuses. Hence the problem will be small in this case.

A APPENDIX

A.1 PROOF OF PROPOSITION 6:

I only sketch the proof of the relationship between power and the ratchet effect, which is the most tedious part of proposition 6. The other claims of the proposition require little manipulation.

Without loss of generality, consider the ratchet effect for A, $R_A(\varphi_A)$. We have

$$R_A(\varphi_A) = \frac{\varphi_A}{\frac{1}{\alpha_{A1} + \alpha_{B1}} \left(1 + \frac{rc\sigma_\varepsilon^2}{\varphi_A^2}\right) + \frac{rc\sigma_\varepsilon^2}{\varphi_A^2}}.$$

After some manipulation,

$$\begin{aligned} \text{sign}\left\{\frac{\partial R_A(\varphi_A)}{\partial \varphi_A}\right\} &= \text{sign}\{\varphi_A^2[2\varphi_A^2(1+4\rho) - 2\varphi_A(1+2\rho) + 1 + \rho] + \\ &+ rc\sigma_\varepsilon^2[8\varphi_A^2(1+\rho) - 2\varphi_A(3\rho-4) + 3\rho+4] + 2\rho rc\sigma^2[4\varphi_A^4 - 8\varphi_A^3 + 8\varphi_A^2 - 4\varphi_A + 1]\}, \end{aligned}$$

where $\rho \equiv \sigma_\varepsilon^2/\sigma^2$. It is easily verified that the three polynomials in φ_A which are shown in square brackets are strictly positive for $\varphi_A \in [0, 1]$.

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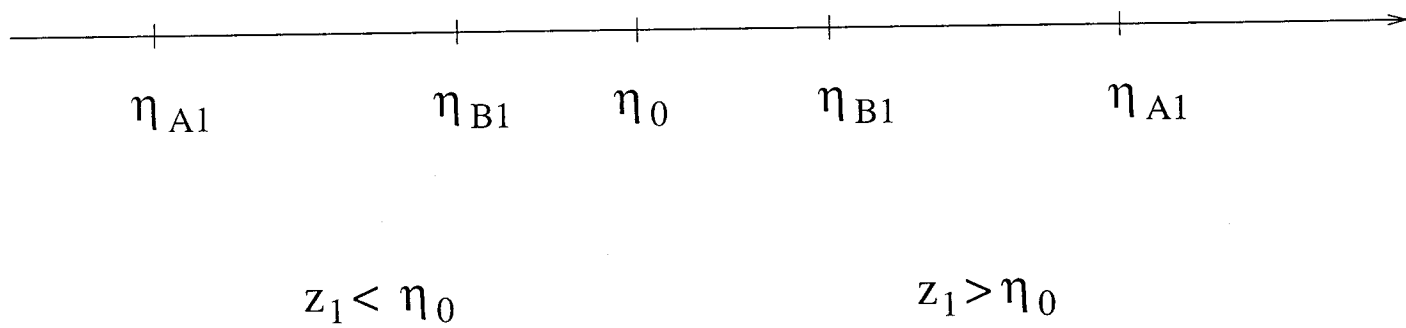
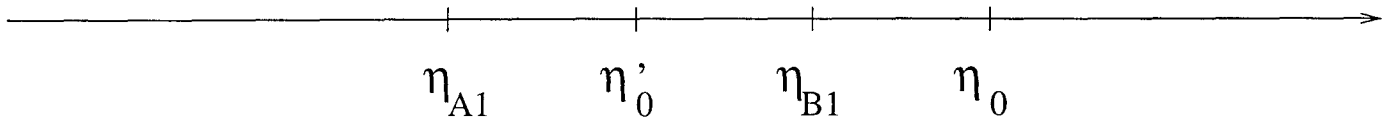
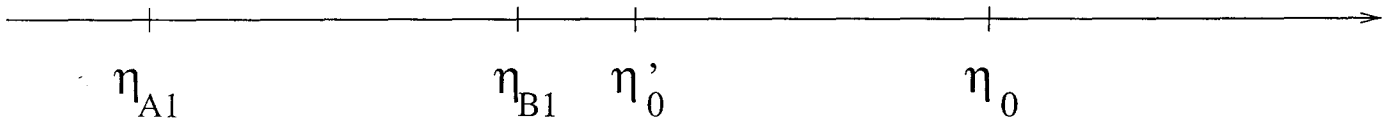


Figure 2



Inside succession



Outside succession

Figure 3