Career Concerns in Teams[1]

Emmanuelle Auriol
ARQADE and IDEI
Toulouse

Guido Friebel[2]
SITE and IDEI, CEPR
Stockholm and Toulouse

Lambros Pechlivanos
Foundation for Economic & Industrial Research
Athens

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[2]Corresponding Author. Address: SITE, Stockholm School of Economics, P.O. Box 6501, 11383 Stockholm, Sweden, E-mail: Guido.Friebel@hhs.se

Abstract

We study the impact of changes in the commitment power of a principal on cooperation among agents, in a model in which the principal and her agents are symmetrically uncertain about the agents' innate abilities. When the principal *cannot* commit herself to long-term wage contracts, two types of implicit incentives emerge. First, agents become concerned about their perceived personal productivity. Second, agents become more reluctant to behave cooperatively - they have an incentive to 'sabotage' their colleagues. Anticipating this risk, and in order to induce the desired level of cooperation, the principal must offer more *collectively oriented* incentive schemes. We also show that temporary workers are not affected by the sabotage effect and that as a result, their incentives are more individually oriented.

Key Words: Teamwork, Career concerns, Sabotage, Commitment, Collective orientation of incentive schemes.

JEL Classification Numbers: J33, D23, M12.

1 Introduction

Many corporations aim to foster teamwork among their employees. For instance, a 1994 survey of US firms found that in 64% of the responding establishments, at least half of the core workers were involved in employee problem-solving groups, work teams, total quality management practices, job rotation or combinations of these practices.[1] At the same time, recent surveys indicate that workers distrust the commitments made by their management.[2] However, managerial commitment for long-term relationships with their workers is a prerequisite for the efficiency of teamwork as found by Ichniowski, Shaw, and Prennushi (1997).[3]

Our paper investigates how cooperation among agents is affected by managerial commitment. We show that when workers anticipate that their wage contracts will be renegotiated, their willingness to support each other decreases. They have an increased incentive to behave selfishly in order to appear more productive, and may want to sabotage their colleagues. Such behavior may be costly for a firm, which in order to reinstall cooperation, must change its incentive schemes towards more collectively-oriented wage contracts.

The argument is brought forward in the framework of Holmström's (1999) career concerns model, i.e., agents' innate abilities are neither known to themselves nor to the principal. Our model (introduced in Section 2) considers a principal who wants to induce agents to reciprocally help each other in the fulfillment of their individual tasks.[4] The only way the principal can induce her agents to support each other is by tying each team member's compensation to her colleagues' performance. Thus, the wage contracts we consider consist of a fixed wage, an individual incentive component, and a collective incentive component. It is important to notice that such a contract, in addition to the risk associated with her own unknown ability, exposes each agent to risks associated with the unknown innate abilities of her teammates. In Section 3, we show that if the principal can commit herself to a salary path, she can to some extent insulate an agent's lifetime income from the uncertainty concerning the teammates' innate abilities.

In Section 4, we show that without commitment for salary paths, the principal's ability

[1]Cf. Locke, Kochan and Piore (1995).

[2]Cf., for instance, Robinson and Rousseau (1994).

[3]In the same spirit, several studies have stressed the importance of 'lifetime' employment for the successful implementation of teamwork in Japanese corporations [e.g., Brown et al. (1997)].

[4]This setup reflects what organization sociologists [e.g., Wagemann (1995)] call a 'hybrid work design', i.e., an organization that combines elements of interdependent and independent work.

to insure agents against these risks decreases. Here, two interesting implicit incentives arise due to the fact that each agent anticipates that the second-period incentive scheme will depend on her own and her colleagues' first-period performances. First, each agent wants to influence the market's perception about her productivity, in order to cash in a reputational bonus. These are the standard *career concerns* known from the literature. Second, there is a *sabotage effect*, i.e., negative 'ratchet' incentives, that manifest themselves in a decreased willingness of each agent to help her colleagues. When an agent helps her colleagues, she increases their reputation, without being able to capitalize on this enhanced perception. Even worse, the enhanced reputation of colleagues may hurt the agent through changes in the composition of her wage: Upon observing high outputs, the principal believes that the team consists of productive agents. She thus expects to pay a large part of the salary through the collective incentive component of the salary. Since an agent's total wage is pinned down by her outside option, this is tantamount to a smaller fixed wage, and hence makes the agent worse off.

Put differently, the principal's loss of commitment for salary paths does not only induce every agent to try to look as productive as possible in absolute terms, but also relative to her teammates. In order to undo the career concerns and the sabotage effect, the principal offers first-period wage contracts leading to lower-powered individual incentives, but higher-powered collective incentives. Thus the collective orientation of the offered explicit incentive scheme increases.

It is important to notice that in our model sabotage incentives do *not* arise because agents are remunerated according to a relative performance evaluation which makes their compensation contingent on their colleagues' performance. Neither are they subject to an implicit rank tournament as in Lazear (1989), who argues that in tournaments agents may want to destroy other people's output rather than to work hard on their own performance. The source of the sabotage incentives in our model is rather a lack of commitment of the principal. This observation is empirically important, since explicit relative performance evaluations appear to be rarely used in practice, while the importance of career concerns is indisputable. Sabotage, hence, can be a rather robust phenomenon, and as Proposition 3 shows, it should rather be expected a problem among agents who anticipate to be engaged with the same colleagues in the future than among agents whose employment relationship is of short-term nature. The intuition for this rather counterintuitive result is that temporary workers do not care about their colleagues' reputation because their future wages are not affected by it.

Our analysis relates to a number of papers on moral hazard. First, in respect to analyzing the *determinants of cooperation* between agents, our framework is closely related to Itoh (1991, 1992). Second, our model inscribes itself in the growing literature on *career concerns* based on the seminal paper by Holmström (1999).

The starting point in multi-agent analyses is that, if individual outputs are observable and correlated, incentive contracts with one agent can be made contingent on other agents' performance. Holmström (1982) and Mookherjee (1984) show that through such 'relative performance evaluations' (RPE), a principal can filter out part of the randomness agents' outputs are subject to. This reduces the risk they face, facilitating higher-powered incentive schemes.

The analysis of RPE's assumes that there are no technological interactions among agents. Itoh (1991, 1992) shows that inducing cooperation among agents and carrying out an RPE are conflicting goals.[5] As a result, the principal induces agents to cooperate only if the correlation between the agents' assignments is low, and thus the forgone benefits from an RPE are not too important. In this paper, we employ a production structure similar to the one used by Itoh. In particular, agents have task-specific cost functions, and their individual output is observable. In our model, there are however no RPE considerations, since agents' assignments are stochastically independent. Thus, we simply *presuppose the optimality of inducing cooperation* for technological reasons. We then focus on the tension between the desire of agents to affect their personal reputation and their willingness to cooperate. This tension is triggered by individuals' career concerns ensuing from changes in the principal's commitment power.

In Holmström's (1999) career concerns model an agent's innate abilities are not known, but past performance allows some statistical inference. To the extent that an agent's reputation affects her future remuneration, she would try to influence her reputation accordingly. Career concerns provide positive incentives when the agent has bargaining power vis-à-vis the market, as in Holmström (1999). Meyer and Vickers (1997), however, have shown that when the agent has no bargaining power, career concerns translate themselves into a ratchet effect.[6] By appearing to be of high innate ability, the agent creates higher

[5] For instance, the principal may want to induce cooperation between agents when their cost functions are *task-specific*.

[6] Meyer, Olsen and Torsvik (1996) argue that inducing teamwork can mitigate the ratchet effect. This perspective is somewhat orthogonal to ours where the ratchet effect itself obstructs cooperation which is desirable for technological reasons.

expectations with respect to her performance, and hence the principal becomes more demanding. The effect we highlight in this paper - the passive sabotage of colleagues' work - is actually another sort of such a ratchet effect. High performance of an agents' colleagues hurts the agent since it will be associated with a smaller fixed wage, due to the perception that she works in a productive environment.

Finally, our paper complements Gibbons and Murphy (1992) to the extent that in both papers explicit incentive schemes are crafted so that they counter the effect of implicit incentives (either positive or negative). This property is due to the additive production technology considered by most of the literature (including our work). Dewatripont, Jewitt, and Tirole (1999) show that if ability and effort enter in a multiplicative fashion in production, explicit and implicit incentives may become complements.[7]

2 The Model

There is a principal, denoted by P, and N agents, denoted by $i \in I \equiv \{1, \cdots, N\}$. N also represents the size of the production unit, referred to as 'team'. Individuals live for two periods indexed by $t = \{1, 2\}$, and they do not discount the future.

2.1 Production

Aggregate output of the production unit in period t is defined as $Y^t = \Sigma_{i \in I} y_i^t$, i.e., we assume a production structure in which each of the N agents has a clear task assignment at time t.[8] Agent i's output y_i^t represents the degree to which he has fulfilled his task, and total output is simply the sum of individual outputs each of which are assumed to be observable and verifiable. Let $y^t \equiv (y_1^t, \cdots, y_i^t, \cdots, y_N^t)$ denote the profile of the individual outputs of all agents. This setup, borrowed from Itoh (1991, 1992), presupposes that the

[7]Ortega (1999) employs the career concerns framework to analyze the allocation of power within a firm. He argues that power increases visibility to the outside world, and consequently it strengthens the importance of career concerns. It is shown that the positive incentive effects uneven allocation of authority has on more powerful managers outweigh the negative incentive effects on those managers with less power.

[8]There are two interpretations for Y^t. It can be considered as the output of a firm that only employs labor, for instance, a consulting or a law firm. Alternatively, it may represent a firm's 'labor product', which is maximized by a principal who takes her firm's capital endowment as given in the short run.

principal could deal with each agent separately. Denote individual outputs by

$$y_i^t = \theta_i + \varepsilon_i^t + e_{ii}^t + h(N) \sum_{j \neq i} e_{ji}^t.$$

The first three elements stem from the standard career concerns model. First, there is the agent's innate ability, θ_i, which is assumed to be a realization of a normally distributed random variable with mean 0 and variance σ_θ^2, and which is independently and identically distributed (i.i.d.) across agents. This variable reflects the fact that the agent's ability is subjected to some systemic variation, symmetrically unknown to everybody. The second element is the realization of some exogenous transitory shock, $\varepsilon_i^t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$, each agent's talent is subjected to. These shocks are assumed to be i.i.d. across periods and agents. We denote by $\Sigma^2 \equiv \sigma_\varepsilon^2 + \sigma_\theta^2$ the variance of the random elements of the production process. Third, the agent puts effort into her assignment, e_{ii}^t.

The fourth element $h(N) \sum_{j \neq i} e_{ji}^t$, represents the total output effect of the support ('help') an agent receives from her colleagues. Other agents' help efforts increase agent i's output in an additive way. We postulate the following:

Assumption 1 *The marginal rate of technical substitution between an agent's own effort satisfies* $1 \geq h(N) \geq 0$ *for all* $N \geq 2$.

We assume that providing help to others is not more productive than working on someone's own task, and that 'help' effort is not value-destroying. This rather general setup allows, through various shapes of $h(N)$, to capture costs of teamwork that may vary according to the technology used, the skills of team members, communication costs and so forth.[9] It should be noted, that if $h(N) = 0$, we are back to the standard career concerns model of Holmström's (1999).

In carrying out their own tasks and providing help to their colleagues, agents incur disutility which is *task-specific* in the way specified by Assumption 2.

Assumption 2 *Agent i's total cost is* $C(e_i) = \sum_{j \in I} c(e_{ij}) = \sum_{j \in I} \frac{e_{ij}^2}{2}$, *where* e_i *denotes the vector of efforts agent i puts into her own assignment, and those of her colleagues.*

[9]For instance, in a team consisting of N agents, the number of communication channels is $\frac{N(N-1)}{2}$, which is convex in N. Considering the function $h(N)$ as an inverse measure of these costs, $h(N)$ can hence be decreasing in N and concave. Practitioners are aware of the exponential increase in coordination costs when team size increases [e.g., Fried (1991)].

Assumption 2 captures the *benefits* of helping effort. Allocating a given total effort to more than one task involves lower disutility. Since this specification is in stark contrast to other multi-task models building on Holmström and Milgrom (1991), it may deserve some discussion. In multi-task models, negative externalities between the tasks of a given agent are introduced through his cost function. In formal terms, the cross derivatives of an agent's cost function with respect to two tasks are positive. In this spirit, helping others would be costly to an agent because it crowds out efforts spent on his own task and thus lowers his own output. A natural way to capture this intuition would be to assume that agents only care for the *sum of effort* exerted, without taking into account on which task the effort was spent. Costs would, for instance, take the functional form $C(e_i) = \left(\sum_{j\in I} e_{ij}\right)^2/2$. For matters of further discussion, we label this specification *total-effort-dependent* cost function.

For our purposes, a task-specific cost function rather than a total-effort-dependent one has some advantages. First, as will become clear in the analysis of the model, the task-specific cost function allows us to focus on the sabotage effect induced by career concerns that result from diminishing commitment power of the principal. The cost function we employ facilitates us to concentrate on this novel effect, rather than having to deal simultaneously with technologically founded externalities. Second, it is noteworthy that although the technology we consider is most favorable for cooperation, obstacles to cooperation emerge due to reputational concerns triggered by lacking managerial commitment.

Third, it is *a priori* not clear, whether a total-effort-dependent cost function should be deemed more natural than a task-specific one. Industrial psychologists argue that there is a *taste for variety,* i.e., monotonous tasks are perceived less pleasant and involve quicker exhaustion than more variable tasks. Inducing teamwork is one way to react to a taste for variety. Others are to redesign tasks according to the principles of 'job enlargement' and 'job enrichment' which cater the same needs.[10] While we believe that our task-specific cost function makes sense in the presence of a taste for variety, it has obvious limitations. For instance, working on more than one task may involve fixed costs, which depending on the production process could partially or completely outweigh the positive effects of a taste for variety. These effects can in principle be captured by different specification of $h(N)$. Ultimately, the decision about how to specify the cost function in a multi-task framework appears to be an empirical, rather than a theoretical, question.[11]

[10]For a review of the literature, which emerged as a reaction to the 'Taylorist' organisation of the workplace, see, for instance, Kelly (1981).

[11]On this account we are only aware of one empirical paper, Drago and Garvey (1998), the evidence of

2.2 Preferences

The risk-neutral principal maximizes output net of wages:

$$U_P = \sum_{t=1}^{2} \sum_{i \in I} [y_i^t - w_i^t].$$

Following the framework used in Holmström and Milgrom (1987, 1991), we assume that agent i is endowed with a constant absolute risk aversion (CARA) utility function:

$$U_i = -exp\left\{-r \sum_{t=1}^{2} [w_i^t - C(e_i^t)]\right\},$$

where r is the CARA coefficient. Notice that due to the multiplicative separability of the utility function, the agent does not value income smoothing across periods, i.e., the agent behaves as if she has access to perfect capital markets. We assume that when the agent does not enter the labor market, she receives a payoff equal to her expected innate ability.[12] Thus, given that the expected value of θ_i is normalized to 0, the agent's outside opportunity is also zero.

In accordance with Holmström and Milgrom (1987), we concentrate on linear contracts. This allows us to build on previous work, most notably on Gibbons and Murphy (1992). Hence, agent i's salary in period t is of the following form:

$$w_i^t = \sum_{j \in I} \alpha_{ij}^t y_j^t + \zeta_i^t,$$

where α_{ij} relates agent i's remuneration to agent j's output, and ζ_i is agent i's fixed wage component. The incentive component of the remuneration can be disentangled into an individual incentive component α_{ii}, and a collective incentive component α_{ij}, $\forall j \neq i$. Making use of the fact that the equilibrium is symmetric, we can denote α_{ii} by α_{ind} and α_{ij} by α_{col}, $\forall\, i, j$. Hence, agent i's wage can be expressed as:

$$w_i^t = (\alpha_{ind}^t - \alpha_{col}^t) y_i^t + \alpha_{col}^t Y^t + \zeta_i^t. \tag{1}$$

In the first best, the principal is able to observe her agents' effort levels. This allows her to offer contracts that specify effort assignments. Clearly, the optimal contract insures completely the agents, and requires the technologically efficient levels of effort, i.e., $e_{ii}^{fb} = 1$

which does not appear to contradict our assumption of a taste for variety.

[12] This could be, for instance, the case if the agent's alternative is to work in the informal sector, that is not subject to moral hazard.

and $e_{ij}^{fb} = h(N)$, $\forall\ i, j \neq i$.[13] To provide perfect insurance, the principal chooses $\alpha_{ind}^{fb} = \alpha_{col}^{fb} = 0$, $\forall\ i, j$, and sets $\zeta_i^{fb} = C(e_i^{fb})$ in order to satisfy the agents' individual rationality constraints. Given the agents' utility function, the optimal contract is the repetition of the contract that is optimal in a static one-period framework.

3 Full Commitment to Life-Time Salary Paths

We now consider the case in which the principal can commit to life-time salary paths. For any given N, the principal offers to each agent a contract that specifies the first and the second-period incentive schemes, i.e., $\{\alpha_i^t, \zeta_i^t\}_{t=1,2}$. Her program is as follows.

$$\begin{aligned}
&\max_{\{\alpha_i^t\},\{\zeta_i^t\}} && \sum_{t=1}^{2}\sum_{i\in I} E[(1-\sum_{j\in I}\alpha_{ji}^t)y_i^t - \zeta_i^t] \\
&s.t. && CE_i \equiv \sum_{t=1}^{2}[\sum_{j\in I}\alpha_{ij}^t E y_j^t + \zeta_i^t - C(e_i^t)] - \frac{r}{2}Var(w_i^1 + w_i^2) \geq 0, \quad \forall\ i, && (IR_i) \\
& && e_i^t\ \ argmax\ \ CE_i, \quad \forall\ i, t, && (IC_i)
\end{aligned}$$

where

$$Var(w_i^1 + w_i^2) = \sum_{j\in I}[(\alpha_{ij}^1 + \alpha_{ij}^2)^2\Sigma^2 - 2\alpha_{ij}^1\alpha_{ij}^2\sigma_\varepsilon^2].$$

Notice that the definition of the certainty equivalence involves a restriction on the remuneration contract. It specifies incentive schemes that depend only on the contemporaneous outcome; i.e., the second-period wage depends only on the second-period outcome. In our framework, this restriction is without loss of generality since utility is assumed to be multiplicatively separable across time.[14] Hence, agents do not value consumption smoothing. Moreover, since production is also separable across time, the principal cannot benefit by engaging in intertemporal risk-sharing.

One should however not confuse such long-term contract with two spot contracts. By committing herself to an expected second-period salary before she observes the first period outcome, the principal succeeds in insulating her agents' expected life-time income from the uncertainty they face with respect to the true ability of all team members - their expected life-time income does not depend on any of the actual θ_is.

[13]Throughout the paper, the index 'fb' stands for first best, and it is used when we want to denote the optimal value of a variable within the first best environment. Equivalently, the indices 'fc' (for full commitment), and 'rp' (for renegotiation-proof) are employed in the same fashion.

[14]When other utility functions were considered, such a restriction could not be imposed without loss of generality, e.g., Harris and Holmström (1982).

Given that the agents face the same remuneration scheme in both periods, their problem is identical in both periods. They set their effort such that $e^t_{ii} = \alpha^{t^{fc}}_{ii}$, and $e^{t^{fc}}_{ij} = h(N)\alpha^t_{ij}$, $\forall\ i, j \neq i$ and t. Taking this behavior as given, the principal can solve for the optimal incentive scheme which is given by the following expressions:

$$\alpha^{fc}_{ind} \equiv \alpha^{1^{fc}}_{ind} = \alpha^{2^{fc}}_{ind} = \frac{1}{1 + r(\Sigma^2 + \sigma^2_\theta)}, \qquad (2)$$

$$\alpha^{fc}_{col} \equiv \alpha^{1^{fc}}_{col} = \alpha^{2^{fc}}_{col} = \frac{h(N)^2}{h(N)^2 + r(\Sigma^2 + \sigma^2_\theta)}. \qquad (3)$$

The fixed components of the remuneration, $\zeta^{1^{fc}}$ and $\zeta^{2^{fc}}$, are set such that the individual rationality constraints (IR_i's) are binding.[15] The first-order conditions derived above expose a variation of the classical tradeoff in moral hazard models. The principal would want to insure her agents, but insurance involves underprovision of effort in respect to the fulfillment of the agent's own task and in respect to the help provided to others. Moreover, the larger the parameter measuring the agent's risk aversion, r, and the variance of the random elements of the production process, $\Sigma^2 + \sigma^2_\theta$, the lower powered is the incentive scheme, which again follows from the tradeoff between insurance and effort.

It is worth noticing that if we did not consider frictions in coordinating with other team members, i.e., $h(N) = 1$, (2) and (3) would become identical. In this case, agents would be given the same individual and collective incentives implying that (1) collapses into $w^t_i = \alpha_{col} Y^t + \zeta^t_i$. In this case, remuneration is a function of the total team output only - no observation of individual performance is needed. It is the technological difference between working on one's own task and helping others that makes the agents' task assignment problem rich enough to require the principal to collect disaggregate information in the full-commitment case.

[15] It should be noted that $\zeta^{1^{fc}}$ and $\zeta^{2^{fc}}$ are indeterminate; only their sum is pinned down by the optimal contract. A straightforward, but interesting, implication of this feature is that the agents' right to quit in the middle of the relationship (i.e., after the first period) is not going to affect the optimal incentive scheme. The principal by setting a very low first period fixed salary and a very large second period's fixed salary can always ensure that her workers will not find it profitable to quit. The principal, in other words, due to her ability to commit, can costlessly buy out the workers' right to quit.

4 Renegotiation-Proof Contracts

4.1 Impact of the Contractual Environment

When the principal cannot commit herself to long-term incentive schemes, the analysis is equivalent to the one in which a new contract is offered every period.[16] This implies that when the second-period contract is being negotiated all involved parties have the ability to observe first-period performances. Clearly, the second-period contract will depend on this observation. Hence, the contracts offered by the principal are $\{\alpha_i^1, \zeta_i^1\}$ for the first period and $\{\alpha_i^2(y^1), \zeta_i^2(y^1)\}$ for the second.

Suppose that at the end of the first period, the output of agent i is y_i^1, and that the conjectures about the first-period efforts that contributed to this output are $\widehat{e_{ii}^1}$ and $\widehat{e_{ji}^1}, \quad \forall\ j \neq i$. In a rational expectations framework like ours, these conjectures are in equilibrium correct. Therefore, one can compute the conditional distribution of θ_i given the first-period output, which is normal with mean

$$\tilde{\theta}_i(y_i^1) = \frac{\sigma_\theta^2(y_i^1 - \widehat{e_{ii}^1} - h(N)\sum_{j\neq i}\widehat{e_{ji}^1})}{\sigma_\varepsilon^2 + \sigma_\theta^2},$$

and variance

$$\tilde{\sigma_\theta^2} = \frac{\sigma_\varepsilon^2\sigma_\theta^2}{\sigma_\varepsilon^2 + \sigma_\theta^2}.$$

The first impact of the changed contractual environment is that the variance of agent i's second-period output is going to be smaller. Both the principal and the agent have more precise predictions about the agent's ability. For further use denote the second-period output variance by $\Sigma_1^2 \equiv \tilde{\sigma_\theta^2} + \sigma_\varepsilon^2$.

The second impact is that now, each agent can take a report of her first-period output (which can be thought as her CV) to other prospective employers. Given the agent's report y_i^1, the principal offers to the agent a reputational bonus (which may be negative) equal to $\tilde{\theta}(y_i^1)$.[17] Clearly, given the reputational bonus she has to offer, the principal is indifferent between employing a high reputation agent at a high salary or a low reputation agent at

[16]For a demonstration of the equivalence, see Gibbons and Murphy (1992).

[17]This bargaining outcome can arise as the equilibrium of an extensive-form game in which each agent picks randomly a prospective principal. Job applicants queue. After observing the report of the agent first in line, the principal makes an offer to her. The offer is either accepted or the agent queues for another job, while the principal makes an offer to the next agent in line.

a low one. Moreover, the agent knows that she cannot get a better offer from any other firm.[18]

4.2 Sabotage and Career Concerns

The second period of the renegotiation-proof environment is isomorphic to period 1 in the full-commitment environment analyzed in the previous section. The incentive components α_{ind}^{2rp} and α_{col}^{2rp} can be derived by replacing $\Sigma^2 + \sigma_\theta^2$ with Σ_1^2, in (2) and (3). The main difference is that now the outside opportunity for each agent is different depending on the reputational bonus she may claim.[19] Hence, the second-period individual rationality constraint is the following:

$$CE_i^2(y^1) \equiv E[w_i^2|y^1] - C(e_i^2) - \frac{r}{2}Var[w_i^2|y^1] \geq \tilde{\theta}(y_i^1).$$

Nonetheless, because of the additive technology, the incentive component of the contract is independent of the agent's reputation. The reasoning is that all agents, regardless of their true ability have the same marginal product of effort. This implies that only the fixed component of the salary depends on reputation. ζ_i^2 can be computed by solving the individual rationality constraint when binding:

$$\zeta_i^2(y^1) = \tilde{\theta}(y_i^1) + C(e_i^2) + \frac{r}{2}\sum_{j\in I}(\alpha_{ij}^{2rp})^2\Sigma_1^2 - \sum_{j\in I}\alpha_{ij}^{2rp}E[y_j^2|y_j^1]. \tag{4}$$

When choosing her first-period effort levels, each agent is aware that her choice affects not only her first-period income ($w_i^1(e_i^1)$), but also, the fixed component of her second-period salary ($\zeta_i^2(e_i^1)$). Differentiating (4) with respect to the first-period effort, we can find the implicit incentives each agent considers, in addition to the standard explicit incentives given by the principal via the first-period contract.

$$\begin{aligned}\frac{\partial\zeta_i^2(y^1)}{\partial e_{ii}^1} &= (1-\alpha_{ind}^{2rp})\frac{\sigma_\theta^2}{\Sigma^2}, \\ \frac{\partial\zeta_i^2(y^1)}{\partial e_{ij}^1} &= -\alpha_{col}^{2rp}\frac{\sigma_\theta^2}{\Sigma^2}, \quad \forall\, j \neq i.\end{aligned}$$

[18]Notice that other papers in the literature [e.g., Holmström (1999) and Gibbons and Murphy (1992)] assume that the agent has all the bargaining power during the renegotiation stage. In other words, the principal maximizes subject to a zero-profit constraint. Here in contrast, due to the multiagent framework, such formulation would be problematic. The bargaining process we envision succeeds in effectively making each agent the residual claimant only to her individual output.

[19]As pointed out in footnote 15, the principal could costlessly buy out the workers' right to quit in the full-commitment case, which is, obviously, not true when she cannot commit herself to future salaries.

The first equation shows the effect of *career concerns* known from the literature. By working more, an agent wants to increase her reputation, and hence to gain by the subsequent increase in her reputational bonus ($\frac{\sigma_\theta^2}{\Sigma^2}$). However, this implicit incentive is dampened by the fact that the second-period remuneration has an 'incentive component'($-\alpha_{ind}^{2rp}\frac{\sigma_\theta^2}{\Sigma^2}$). Because the agent is going to be perceived as more productive, the principal expects that the incentive component of the salary is going to be large, and hence, she increases the salary's fixed component by less than the increase in the reputational bonus.

The second equation exposes an implicit ratchet effect that manifests itself in the form of *sabotage*. When an agent helps her colleagues, their output and their reputation increase. While this is good for her colleagues, it makes the agent worse off. An output increase makes the principal believe that the agent is teamed with productive colleagues. As a result, she anticipates that the collective incentive component of the salary is going to be large, and since the total wage is determined by the agent's outside option, the principal lowers the fixed part of the salary accordingly. Since the agent does not internalize her colleagues' reputational gains, she has a negative implicit incentive to help them.

This sabotage effect arises even though the explicit incentive scheme actually rewards agents for their colleagues' good performance. It is therefore, to the best of our knowledge, novel. It should be contrasted with the sabotage effect noted by Lazear (1989). There, sabotage arises because explicit incentives condition negatively the remuneration of one agent to her colleagues' performances.

4.3 First-Period Contract

The principal's first-period profit maximization problem can be represented by the following program:

$$\begin{aligned}
\max_{\alpha_i^1,\zeta_i^1} \quad & \sum_{i\in I} E[(1-\sum_{j\in I}\alpha_{ji}^1)y_i^1 - \zeta_i^1] \\
\text{s.t.} \quad & CE_i \equiv \sum_{j\in I}\alpha_{ji}^1 Ey_j^1 + \zeta_i^1 - C(e_i^1) + (SPNS) - \frac{r}{2}Var(w_i^1 + w_i^{2rp}) \geq 0, \ \ \forall\, i, \qquad (IR_i) \\
& e_i^1 \ \ argmax \ \ CE_i \quad \forall \ \ i. \qquad (IC_i)
\end{aligned}$$

where $SPNS$ denotes the agent's expected second-period net surplus, which is

$$SPNS = \frac{r}{2}\sum_{j\in I}(\alpha_{ij}^{2rp})^2\Sigma_1^2 + E(\tilde{\theta}_i),$$

and

$$Var(w_i^1 + w_i^{2rp}) = \left((A_{ii}^1)^2 + \sum_{j \neq i} (A_{ij}^1)^2 \right) \Sigma^2 + \sum_{j \in I} (\alpha_{ij}^{2rp})^2 \Sigma^2 + 2 \left(A_{ii}^1 \alpha_{ii}^{2rp} + \sum_{j \neq i} A_{ij}^1 \alpha_{ij}^{2rp} \right) \sigma_\theta^2,$$

where $A_{ii}^1 = \alpha_{ii}^1 + (1 - \alpha_{ii}^{2rp}) \frac{\sigma_\theta^2}{\Sigma^2}$ and $A_{ij}^1 = \alpha_{ij}^1 - \alpha_{ij}^{2rp} \frac{\sigma_\theta^2}{\Sigma^2}$ are the effective incentives (i.e., the sum of the explicit and implicit incentives) the agents are influenced by.

This program has the following interpretation: Although the principal essentially offers a one-period contract, she takes into consideration the fact that in the next period the agent will be offered the contract which is optimal from the second-period's perspective. This second-period contract gives to the agent a net surplus (net of the cost of effort). Nonetheless, the principal benefits by offering a contract to the agent that insures her against the life-time risk she faces, while taking back in return the agent's second-period net surplus. The agent's life-time risk is represented by the variance of her life-time income $Var(w_i^1 + w_i^{2rp})$. Proposition 1 presents the optimal first-period incentive scheme.

Proposition 1 *If the principal has no commitment for long-term contracts, she offers a first-period incentives scheme defined by the following first order conditions:*

$$\alpha_{ind}^{1rp} = \frac{1}{1 + r\Sigma^2} - (1 - \alpha_{ind}^{2rp}) \frac{\sigma_\theta^2}{\Sigma^2} - \frac{r \alpha_{ind}^{2rp} \sigma_\theta^2}{1 + r\Sigma^2}, \quad (5)$$

$$\alpha_{col}^{1rp} = \frac{h(N)^2}{h(N)^2 + r\Sigma^2} + \alpha_{col}^{2rp} \frac{\sigma_\theta^2}{\Sigma^2} - \frac{r \alpha_{col}^{2rp} \sigma_\theta^2}{h(N)^2 + r\Sigma^2}. \quad (6)$$

Comparing (5) and (6) with (2) and (3), we can track down the differences in the incentive scheme offered here with the one under full commitment. The principal adjusts the incentive scheme in respect to two effects. First, she undoes the effects of career concerns on her agents' decisions. The second term in both first order conditions represents a reduction of the power of the individual incentives and an increase of the power of the collective incentives. Thus, the principal perfectly offsets the implicit incentives. Second, she adjusts the contract for the additional intertemporal risks agents bear through the third term in both first order conditions. Without full commitment, the principal can no longer optimally spread the intertemporal risk-sharing across both periods. This is due to the fact that the optimal second-period contracts chosen by the principal will be fine-tuned using interim information about the agents' first-period performance. Thus the power of the second-period incentive scheme increases, involving an increase in the agents risk from their first-period perspective. The principal reduces the power of the incentive scheme in order to share part of this risk.[20]

According to the above discussion, the effects of implicit incentives can be perfectly undone by the renegotiation-proof contract. However, the contract disposes nonetheless a distortion that is due to less risk-sharing than in the full-commitment contract.[21] With some algebra one can show that $\alpha_{col}^{1fc} \geq \alpha_{col}^{1rp}$and $\alpha_{ind}^{1fc} \leq \alpha_{ind}^{1rp}$. Defining $\alpha_{col}/\alpha_{ind}$ as the degree of the *collective orientation* of the incentive scheme, we can then state the next Proposition without further proof.

Proposition 2 *The renegotiation-proof first-period incentive scheme is more collectively oriented compared to the one under full commitment.*

The linear setup of our model requires that in some cases individuals 'earn' large fixed negative payments.[22] To understand this point, consider the total variable part of the wage bill, which is defined as: $\sum_{i=1}^{N}(w_i^1 - \zeta_i^1) \equiv \left[\alpha_{ind}^{1rp} + (N-1)\alpha_{col}^{1rp}\right] Y^1$. Substituting for α_{col}^{1rp} it is easy to check that ceteris paribus it is increasing in $h(N)$. Thus, for instance, if $h(N) = 1$ and r is close to zero, in the full commitment case, each worker receives close to one dollar income for each dollar by which profits increase. Such contracts involve large negative fixed wages, something we rarely see in practice. Exceptions may be franchise relationships and cooperatives, in which individuals pay entry fees, or in former times, apprenticeships were apprentices had to pay a fee. By the same token, for smaller $h(N)$ and larger degrees of risk aversion, this problem loses its bite. Actually, one can derive a threshold level of $h(N)$ as a function of the parameters of the model such that non-negative fixed wages are feasible.

[20]It is actually possible that the intertemporal risk born by the agents is so large that there is a corner solution in the agents' effort decision, i.e., the principal induces zero effort. A sufficient condition for an interior solution is that $\sigma_\varepsilon^2 \geq \sqrt{3}\sigma_\theta^2$. This condition ensures that the principal does not learn too much about the agent's innate ability from the first-period output, and hence that the second-period contract is not going to be very powerful. An interesting implication of this is that no teamwork can be supported in the first period if the principal learns 'too' fast.

[21]To see this, consider the case of no risk aversion (i.e., if $r = 0$). Here the principal is able to implement the first best effort levels by offering $\alpha_{ind}^{1^{rp}} = 1$ and $\alpha_{col}^{1^{rp}} = 1 + \frac{\sigma_\theta^2}{\Sigma^2}$. In other words, any effort distortions can be exclusively ascribed to risk-sharing considerations.

[22]We thank the referee for bringing this point to our attention.

4.4 Long-term versus Temporary Workers

The preceding analysis has implicitly assumed that agents differ only with respect to their innate ability. However, labor markets are usually segmented [cf. Doeringer and Piore (1971)]. There are employees who participate in a firm's internal labor market and see their employment in this firm as life-time career, as well as those who mainly participate in the external labor market and whose tenure in firms tends to be short. To what extent does tenure affect the sabotage incentive?

Consider that the principal hires her agents on a temporary basis. That is, the agents know that in the second period they will be members of another team in another firm. This change does not affect the analysis of the agents' incentives to provide their own effort. A good reputation affects the reputational bonus they will be able to secure, no matter in which firm they will end up being employed. Put differently, $\alpha_{ind}^{1^{temp}} = \alpha_{ind}^{1^{rp}}$.

Agents' incentives to help their colleagues are, however, affected. Given that the first-period colleagues are not going to be the same with the second-period ones, an agent does not have to take any implicit incentives under consideration. She does not even know tomorrow's colleagues, let alone influencing their reputations. This means that the sabotage effect disappears in the case of temporary workers, and the collective first-period explicit incentive offered to temporary workers is defined as:

$$\alpha_{col}^{1^{temp}} = \frac{h(N)^2}{h(N)^2 + r\Sigma^2}.$$

Comparing this expression to the collective incentives given to a long-term worker ($\alpha_{col}^{1^{rp}}$), we see that the last two terms of the long-term worker incentives are missing. Thus, as already explained, there is no sabotage effect to take into consideration, and moreover, the temporary worker does not bear any intertemporal risk with respect to her colleagues' human capital (i.e., she draws a new set of colleagues every period). We can thus state the following proposition without further proof.

Proposition 3 *The incentive scheme given to temporary workers is more individually oriented than the one given to long-term workers.*

Proposition 3 suggests that by reshuffling teams after one period, the principal could undo the distortions due to the unknown abilities of teammates. However, it may not be possible to do so for technological reasons. Indeed, if agents incur costs in getting acquainted with each other - even very small ones - a reshuffling will not be renegotiation-proof. Thus, while in a full-commitment environment reshuffling is not needed, it is not possible in a non-commitment environment.

5 Concluding Remarks

This paper shows that the presence of implicit incentives makes the agents more reluctant to behave cooperatively. The risk of sabotage forces the principal to offer more collectively oriented incentive schemes compared to a situation in which the principal has the ability to commit herself to salary paths. These results are in line with a survey among Fortune 1000 firms, carried out by Lawler et al. (1995). They find that firms increasingly seek to base their employees' wages on team efforts and outputs.[23] It is particularly interesting is that managers of downsizing firms, who can be assumed to have particularly low commitment power vis-à-vis their employees, are more likely to rely on work-group or team incentives than their colleagues in growing firms.

Moreover, we find the surprising result that it may be harder to induce cooperation among workers in internal labor markets than among temporary workers. In addition to the results presented here, Auriol, Friebel and Pechlivanos (1999) also discusses the issue of the optimal team size. There, we show that team size is constrained due to agents' risk considerations - a variation of the tradeoff between insurance and efficiency. Moreover, teams in environments where managers have less commitment are smaller than teams the managers of which are able to make long-term commitments.

Our model highlights that in the absence of commitment for long-term wage contracts, there are important constraints on the restructuring of firms towards more 'empowerment' and teamwork even if the individual can be made accountable for his or her performance. It also sheds some light on the risks associated with policies that aim at developing the individual's skills and increase his or her visibility as a substitute for job security for junior workers.[24] Unless they are accompanied by higher-powered team-oriented incentives, such efforts to increase 'employability' may have a serious drawback in exacerbating the tendency

[23]While in 1987, only 7% of the respondents employed gain-sharing plans as an incentive device covering at least 20% of their workforce, this number rose to 16% in 1993. Moreover, in 1993 close to a third of the respondents utilized team-based incentive schemes for at least a fifth of their workers and employees.

[24]Cf., for instance, Kanter (1992).

for selfish behavior within the firm. This corroborates Ichniowski, Shaw, and Prennushi (1997) findings about complementarities in Human Resource Practices.

The model suggests that exogenous factors have an important impact on the efficacy of human resource practices. Notice that the environment we consider is one in which turbulences are not even very dramatic: in particular, workers do not face income risks when fired. Nevertheless, the fact of diminishing commitment affects the workplace substantially, and the firm has to intensify its efforts to induce workers' cooperation. Clearly, considering more severe risks than the loss of wage security may enforce our predictions. Extreme examples of the effect non-commitment has on employees' behavior can be traced in studies that relate organizational changes, such as downsizing or restructuring, to increased aggression among employees [e.g., Brockner et al (1992)].

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