# Team Governance: Empowerment or Hierarchical Control

Guido Friebel[*] Wendelin Schnedler[**]

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**Abstract**

We investigate the costs and benefits of managerial interventions with a team in which workers care to different degrees about output. We show that if there are complementarities in production and if the team manager has some information about team members, interventions by the manager may have destructive effects: they can distort how workers perceive their co-workers and may lead to a reduction of effort by those workers who care most about output. Moreover, interventions may hinder the development of a cooperative organizational culture in which workers trust each other.

Keywords: team work, incentives, informed principal, intrinsic motivation

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[*]gfriebel@wiwi.uni-frankfurt.de, Frankfurt University, CEPR and IZA

[**]wendelin.schnedler@awi.uni-heidelberg.de, Heidelberg University and IZA

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# Introduction

One of the most important tasks of managers is to ensure that workers act in line with the interest of the firm or organization. Managers hence frequently intervene in production by monitoring workers, controling them, or by providing incentives to them. Psychologists have long recognized that these interventions may have negative consequences on motivation (Deci, 1971). Bénabou and Tirole (2004) pioneered the economic analysis of such 'crowding out of intrinsic motivation.' Their model and the ensuing literature are concerned with the relationship between a manager and a single worker (see, e.g., Sliwka, 2007, Herold, 2010, Falk and Kosfeld, 2006, or Schnedler, in print). In reality, however, production often takes place in teams with several workers. Moreover, industrial psychologists point out that teams are particularly prone to negative effects of intervention.[1] Here, we argue that managerial interventions reveal to committed team members that a colleague is not committed, which reduces their effort on tasks that cannot be monitored. Managerial intervention hence involves a trade-off between ensuring effort by uncommitted team members and crowding out that of committed ones.

How this trade-off plays out is illustrated in a simple static model with a manager and two workers, A and B, in Section 2. We assume that worker A is publicly known to be committed to the team. In other words, he cares about team output. B's commitment is the manager's private information. Production involves two tasks: a normal task with verifiable effort and an extra task with unverifiable effort. Efforts at the extra task are complements in the production of output, that is, any committed worker will only be willing to exert extra effort if his colleague is likely to be committed and matches this effort. So, worker A reduces extra effort when the manager's intervention signals that B is not committed.

We use this model to predict the effects of intervention in teams in Section 3. The nature of the equilibrium depends on the importance of the extra task, and the gen-

[1] See Stewart (2006) for a survey of 93 studies.

eral commitment in the workforce. When the extra task is not important, the manager empowers if and only if B is committed. The manager's information is then perfectly revealed. Compared to a self-managed team, two problems are eliminated: (i) the waste of extra effort by a committed worker who wrongly believes his colleague to be committed and (ii) the withholding of extra effort by a committed worker who wrongly believes his colleague to be uncommitted. The manager does not always intervene, which leads us to the interesting observation that the mere presence of a manager sometimes suffices to improve on the outcomes of a self-managed team. Second, when the extra task is important and the general commitment in the workforce is high (so that B is likely to be committed), the manager always empowers the team and worker A always exerts extra effort. The manager hides her information because she does not want to lose this extra effort. As the manager never intervenes, her presence makes no difference, and the team may just as well be self-managed. Third, when the extra task is important but the general commitment in the workforce is low, the manager empowers committed workers, but only occasionally intervenes with uncommitted workers. The manager's information is then partially revealed: sometimes, the manager empowers uncommitted workers. In this case, empowerment deliberately deceives committed workers in order to induce them to exert extra effort. This extra effort is partially wasted because it is not matched by the uncommitted colleague.

In Section 4, we examine three variations of the model to check for robustness. First, we relax the assumption that the manager is perfectly informed. As long as the information held by the manager is independent of that by the workers, interventions continue to be a potential signal for commitment and the essence of our results remains valid. However, since the manager's information may be wrong, sometimes she erroneously intervenes in the work of committed workers who then exert no extra effort. We call this the tragedy of committed but unmotivated workers, which is an unwanted side effect of having a manager. As another variation, we examine the case that all workers' commitment is unknown and find that results are robust. Finally, we look at the possibility that committed workers repeatedly interact, so that effort can become a credible signal for commitment. We then discuss the limits of using this signal to re-establish trust after a false intervention.

The next section relates our paper to the literature, while the last section concludes.

# 1 Literature

In the tradition of Alchian and Demsetz (1972), economists have argued that teams are crucial for modern production but that they blur individual contributions.[2] Following Holmström and Milgrom (1991), we assume that some tasks are easier to observe than others and blend this idea with a small body of literature that more closely investigates the costs and benefits (Itoh 1991, 1992) and the organization of team work (Auriol et al., 2002).

Probably closest to our paper is that by Sliwka (2007) who also considers the effects of managers' intervention on a group of workers. There are, however, important differences. First, Sliwka does not explicitly model strategic interactions between workers. He considers workers of different types: some always stick to promises, others never, while a third type adapts preferences to the prevailing social norm. This type interprets interventions as a sign that it is unusual to stick to promises and then withholds effort. In our paper, workers care about co-workers' preferences because it matters for team production. Worker A knows that his effort will be wasted if B is not committed to the outcome of work. Interventions thus crowd out effort even if people are interested in delivering a decent output. Moreover, interventions distorts the build-up of trust in a team, an effect that is not present in Sliwka's paper.

The detrimental effect of interventions on effort has also been explained by appeal-

[2]Holmström (1982) has shown that introducing a principal who is the residual claimant can solve the free-riding problem that is present in such teams.

ing to the idea that interventions are a signal about worker's preferences (Bénabou and Tirole, 2003), the principal's expectations (Schnedler and Vadovic, 2007), the principal's character (Ellingsen and Johannesson, 2008), the principal's trust in the success of a joint project (Herold, 2010) or the proportion of egoists in a population (van der Weele, in press). Seabright (2009) suggests that certain actions cease to work as a signal once they are paid for, while Schnedler (in print) explains why success bonuses may reduce effort by a perceived income effect. In contrast to our paper, none of these contributions examines interventions with teams. We abstract from the question how the team composition and hence its members' preferences may be influenced. This complementary question is studied by Besley and Ghatak (2005) as well as Kosfeld and von Siemens (2007).

For most economists, teams are formed to exploit technological complementarities rather than for motivational reasons.[3] In industrial psychology, however, the starting point is often that self-governed teams have substantial motivational advantages. Evidence for the positive effects of empowered and self-managed teams abounds. Kirkman and Rosen (1999) summarize a large body of literature on the benefits of self-governed teams and analyze survey data from more than 100 teams from four firms. They find that team empowerment is correlated with high team performance. Gerwin and Moffat (1997) examine the effects of interventions, e.g., introducing evaluation and monitoring schemes, using 14 firms and 53 teams involved in 'concurrent engineering.'[4] Concurrent engineering exhibits a high degree of cross-functionality, interdependence of team members' actions and high skill complementarity. They find that interventions decrease team performance and reduce cohesion. This corresponds with our result that intervention may lower effort provision where complementarities matter and lead to 'distrust.'

Crozier (1964) gives a by now classical example of the effects of interventionist policies

[3] Che and Yoo (2001) provide an interesting theoretical exception, while Ichniowski et al. (1997) present empirical evidence that teams have motivational effects.

[4] 'Concurrent engineering' is a complicated process through which a technical innovation such as an integrated design system for a new airplane is implemented in parallel, rather than sequential steps.

in a public organization. He describes a highly interdependent work organization with a strict hierarchy that comprises supervision in case of problems and very little workplace autonomy. Crozier quotes workers: 'We are obliged not to care about the work, although we would like to' and 'Where I was before, it was sometimes possible to be proud of one's work, but here I do not see any possibility.' This notion is captured in our 'tragedy of committed but unmotivated workers.' Workers in this example cannot develop the 'psychological safety' that is a prerequisite for learning about each other and ultimately for the success of teams (Edmondson, 1999). This is reflected in the dynamic version of our model, where intervention prevents workers from learning about each others' commitment.

## 2 Model

*The team and its task.* We consider a team that consists of two workers, A and B who produce a value $v$ through their efforts. We assume that the team is supervised by a manager who wants to maximize this value. Some of the workers' tasks are verifiable and the manager can guarantee the respective effort by some intervention.[5] Denote worker $i$'s effort choice with respect to the verifiable tasks by $e_i^N$, where the $N$ stands for 'normal.' For other tasks of the workers, effort is not verifiable and the manager cannot intervene. Denote the respective effort by $e_i^E$, where the $E$ stands for 'extra.' For simplicity, suppose that the effort decision of worker $i$ at task $j$ is binary: $e_i^j \in \{0, 1\}$.

*Worker's utility.* Exerting effort at task $j$ leads to costs $c^j$. Some of the workers are interested in team output $v$. This reflects 'public service mentality' or 'public mindedness' for the public sector and 'professional attitude' in the private sector.[6] We call such workers *committed* (to the results of production). There are also workers who only care about

[5]The intervention can consist in monitoring combined with a threat to fire shirking workers or in explicit performance pay.

[6]The terminology is from Francois (2000) and Besley and Ghatak (2005) who use a similar assumption.

costs. Hence, the worker's utility takes the form:

$$\theta v - c^N e_i^N - c^E e_i^E,$$

where $\theta = 1$ if worker $i$ is committed and $\theta = 0$ if he is not committed.

*Effects of effort on team output.* Team output is not verifiable, increases in effort, is additive in the two tasks, and symmetric in efforts:

$$v = v^N(e_A^N, e_B^N) + \alpha v^E(e_A^E, e_B^E),$$

where $\alpha$ is the importance of the extra effort for the product. The extra task exhibits strong complementarities. If both workers put in extra effort, the increase in value more than outweighs the costs:

$$v^E(1,1) - v^E(0,0) > 2c^E. \qquad (1)$$

On the other hand, the increase in value due to extra effort is below the costs if this effort is not matched:

$$v^E(1,0) - v^E(0,0) < c^E \quad \text{and} \quad v^E(0,1) - v^E(0,0) < c^E. \qquad (2)$$

In order to keep the worker's decision with respect to normal effort simple, we suppose that the gains from normal effort cover the respective costs — independently of the behavior of the co-worker:

$$v^N(\cdot,1) - v^N(\cdot,0) > c^N \quad \text{and} \quad v^N(1,\cdot) - v^N(0,\cdot) > c^N. \qquad (3)$$

Normal efforts may but need not be complements. The assumptions on output and costs reflect the idea that the gains of team production are strongest where it is most difficult to identify individual efforts. Since output is additive and efforts do not interact in the cost function, the decisions to provide normal and extra effort are technologically independent. In particular, there is no reason for a worker to withdraw extra effort in order to increase normal effort. We deliberately eliminate technological dependence, so that any link between normal and extra effort in equilibrium arises from the information structure.

As an example for this setup, consider an organization that puts together a team of a programmer and a tax expert to produce a tax software. It is possible to check whether the tax expert has produced a list of program functionalities or whether the software runs, but the interface between the two experts is fraught with complementarities, and it is difficult to identify the precise contributions of the two experts. Hence, whether workers produce a superior product ultimately depends on their willingness to voluntarily exert extra effort.

*Intervention and its direct costs.* The manager's intervention $d$ is modeled in reduced form. She chooses to intervene ($d = 1$) or to empower the team ($d = 0$). If the manager intervenes, she can obtain $e^N = 1$ at a price of $k$. The manager will never intervene when the direct costs of intervention are too high. To render the analysis interesting, costs are assumed to be smaller than the gains from normal effort:

$$v^N(1,\cdot) - v^N(0,\cdot) > k \quad \text{and} \quad v^N(\cdot,1) - v^N(\cdot,0) > k. \tag{4}$$

*Information.* Worker A is not sure whether worker B is committed, while worker A is committed and his commitment is common knowledge. Let $\lambda$ be the probability that a randomly drawn worker B is committed. This probability $\lambda$ is also common knowledge and can be interpreted as the general commitment in the workforce. The manager has some independent information about worker B's commitment. In order to model this information, we assume that the manager receives a signal $S$ about the type $\theta$ of worker B, where $S = 1$ indicates that B is committed, while $S = 0$ indicates that B is uncommitted. The signal is correct with probability $p > \frac{1}{2}$. The manager then uses this signal to update her beliefs:

$$\lambda_M = \begin{cases} \overline{\lambda} := \frac{\lambda p}{p\lambda + (1-p)(1-\lambda)} & \text{if} \quad S = 1, \\ \underline{\lambda} := 1 - \frac{(1-\lambda)p}{p(1-\lambda)+(1-p)\lambda} & \text{if} \quad S = 0. \end{cases}$$

Importantly, workers cannot credibly communicate their commitment to each other neither can the manager credibly convey her information.

For most of the paper, we consider a manager who is perfectly informed ($p = 1$). Then, $\overline{\lambda} = 1$ and $\underline{\lambda} = 0$. The case of an imperfectly informed manager is dealt with in Section 4.1. Through the assumption that only B's commitment is in question, the model becomes more tractable. In reality, however, worker A's preferences are likely to be unknown as well; the main results remain valid in this case (see Section 4.2).

In our tax software example, the informational asymmetry could arise because the manager is informed about earlier activities of the team members, e.g., by other managers. This information is typically not accessible to workers and gives the manager some idea about workers' commitment.

*Timing.* The timing of the game is as follows:

1. Nature determines the commitment $\theta$ of worker B.

2. The manager receives signal $S$ about B's commitment.

3. The manager decides whether to intervene ($d = 1$) or not ($d = 0$).

4. Workers simultaneously[7] decide about effort provision for the two tasks ($e_i^N, e_i^E$).

5. Payoffs accrue.

Concluding the model description, we want to summarize the essential assumptions. First, we are looking at a production process in which the efforts for some of the tasks can be ensured while the efforts of other tasks cannot be ensured. There are strong complementarities for the task that cannot be monitored. Second, team members may differ in their commitment to the result of their work. Third, the manager has some pieces of information about the commitment of some team member to which other team members have no access to. Fourth, the manager can choose whether to empower the team.

[7]Letting A move first does not modify results in any interesting way.

*Equilibrium concept.* We consider Perfect Bayesian Nash equilibria, which we refine in two ways. These refinements help us to keep the analysis transparent and to focus on the main idea of the paper. First, when two committed workers interact, there can be two equilibria: one in which they exert extra effort and one in which they do not. In the latter case, the analysis becomes trivial since the decision to intervene then only depends on the gains from normal effort and the direct costs of the intervention. Therefore, we restrict attention to equilibria in which committed workers exert extra effort whenever they believe the other worker to be committed. Since committed worker's utility is larger in this type of equilibrium, we refer to them as *Pareto-refined.* Second, we appeal to the intuitive criterion by Cho and Kreps (1987) in order to establish uniqueness.

# 3 Analysis

The analysis begins with some observations about the workers' behavior. Then, we turn to the manager. Finally, the equilibrium is determined.

## 3.1 Workers' behavior

Given the assumptions, it is obvious that an uncommitted worker only exerts effort if he is forced to do so. The behavior of committed workers is described in the following lemma (the respective proof can be found with all other proofs in the appendix).

**Lemma 1** (Committed workers' behavior)**.** *(i) Committed workers always exert normal effort. (ii) It is the best response of committed workers to exert extra effort if and only if the probability* $\pi$ *that the other worker also exerts extra effort is sufficiently large:*

$$\pi \geq \frac{c^E - (v^E(1,0) - v^E(0,0))}{v^E(1,1) - v^E(0,0) - (v^E(1,0) - v^E(0,0))} =: \lambda^0. \tag{5}$$

This lemma informs us that a committed worker matches the extra effort of his colleague. Given the Pareto-refinement, the probability that worker B exerts extra effort becomes the belief that he is committed. Hence, committed workers choose extra effort if this belief is sufficiently large.

## 3.2 Manager's intervention

The manager is interested in maximizing the value of the product, $v$, and intervenes if the benefits of an intervention outweigh its costs. Benefits and costs depend on the beliefs of the manager. Intervening has the direct benefit that uncommitted workers are forced to exert normal effort. Given belief $\lambda_M$ that workers are committed, this benefit amounts to

$$B(\lambda_M) := (1-\lambda_M)(v^N(1,1) - v^N(1,0)). \tag{6}$$

The higher the belief that worker B is committed, the lower is the benefit of intervening. Apart from the direct benefit, intervening entails direct costs $k$.

In addition to the direct effects, intervening can act as a signal about the manager's information. In principle, intervention could lead to extra effort or reduce it. However, it can be shown that an intervention never leads to extra effort, so that the indirect effect of intervening is never positive. Recall that $d = 1$ is the manager's decision to intervene, while $d = 0$ is her decision to empower. Let $e^E(d)$ be the extra effort by committed workers, then the following holds.

**Lemma 2** (Hidden costs of intervention)**.** *If an intervention has any effect on workers' extra effort, it reduces this effort:* $e^E(0) \neq e^E(1) \Rightarrow e^E(0) > e^E(1)$.

Let us use this lemma to determine signaling costs $\tilde{C}(\lambda_M)$. If interventions have no effect on extra effort, these costs are zero $\tilde{C}(\lambda_M) = 0$. If interventions have an effect, they reduce effort and costs depend on the type of workers. With two committed workers, the manager loses the extra effort from both workers and costs amount to $\alpha(v^E(1,1) - v^E(0,0))$. With only one committed worker, control only reduces the extra effort of this worker and the costs are $\alpha(v^E(1,0) - v^E(0,0))$. Since the manager beliefs to face two committed workers with proabability $\lambda_M$, signaling costs in this case amount to $\tilde{C}(\lambda_M) = \alpha C(\lambda_M)$ with

$$C(\lambda_M) = \lambda_M \left(v^E(1,1) - v^E(0,0)\right) + (1-\lambda_M)(v^E(1,0) - v^E(0,0)).$$

The signaling costs due to the intervention are hence larger for a manager who believes that B is committed. At the same time, her benefit of intervening is smaller. Taken together, these observations directly imply the following lemma.

**Lemma 3** (Manager's net gains from intervening)**.** *The more a manager believes B to be committed, the lower are the net gains from intervening. This is irrespective of whether intervening reduces extra effort or not:*

$$B(\lambda_M) - \alpha C(\lambda_M) - k \text{ as well as } B(\lambda_M) - k \text{ strictly decrease in } \lambda_M.$$

This lemma reflects the natural notion that a manager who believes workers to be uncommitted has a stronger tendency to intervene. If intervening reduces extra effort, the net gains of intervening also depend on the importance of the extra task $\alpha$. In particular, a low importance renders intervening more attractive; the manager is exactly indifferent between intervening and empowerment if $B(\lambda_M) = \alpha C(\lambda_M) + k$. Solving for $\alpha$, we can define the following threshold for a manager with belief $\lambda_M$:

$$\alpha(\lambda_M) := \frac{B(\lambda_M) - k}{C(\lambda_M)} = \frac{(1-\lambda_M)(v^N(1,1) - v^N(1,0)) - k}{\lambda_M(v^E(1,1) - v^E(1,0)) + v^E(1,0) - v^E(0,0)}. \tag{7}$$

This threshold tells us for which importance of the extra task the manager with belief $\lambda_M$ intervenes. For example, the threshold for a manager who is certain that worker B is uncommitted amounts to $\alpha(0) = \frac{(v^N(1,1)-v^N(1,0))-k}{v^E(1,0)-v^E(0,0)}$. Such a manager thus intervenes if $\alpha < \alpha(0)$. More generally, the threshold $\alpha(\lambda_M)$ enables us to restrict the decision of a manager with belief $\lambda_M$.

**Lemma 4** (Manager's decision to intervene)**.** *Consider a manager with belief $\lambda_M$. Then, the following holds. (i) If $\alpha < \alpha(\lambda_M)$, the manager intervenes. (ii) If $\alpha > \alpha(\lambda_M)$ and there are signaling costs, the manager empowers. (iii) If $\alpha > \alpha(\lambda_M)$ and there are no signaling costs, the manager empowers if and only if $B(\lambda_M) < k$.*

| | | Actual type of worker B | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | committed ($\theta = 1$) | | | | uncommitted ($\theta = 0$) | | | |
| | | $e_A^N$ | $e_B^N$ | $e_A^E$ | $e_B^E$ | $e_A^N$ | $e_B^N$ | $e_A^E$ | $e_B^E$ |
| commitment in workforce | high ($\lambda > \lambda^0$) | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 |
| | low ($\lambda < \lambda^0$) | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |

Table 1: Effort choices in a self-managed team

Since a manager who believes a worker to be uncommitted ($S = 0$) gains more from intervention than a manager who believes the worker to be committed ($S = 1$) by Lemma 3, she intervenes at lower levels of importance. Thresholds can thus be ordered:

$$\alpha(\overline{\lambda}) < \alpha(\underline{\lambda}).$$

This suggests that the importance of the extra task plays a crucial role for equilibrium behavior. We examine this role in more detail in the next section.

### 3.3 Equilibrium

If effort on both tasks as well as commitment were verifiable, then, workers would agree to exert effort on all tasks and uncommitted workers would be reimbursed for their effort. The informational asymmetries prevent this efficient solution from being reached.

As a feasible benchmark let us establish how the team fares in the absence of a manager. Using Lemma 1, we can describe workers' behavior depending on the general commitment in the workforce, $\lambda$, and the type of worker B, $\theta$ (see Table 1). The self-managed team only achieves the efficient solution if both workers are committed and the workforce is rather committed (top left corner). In the following, we examine how the manager's presence and her decision (empowerment or intervention) influence workers' behavior.

In the presence of a manager, two parameters affect equilibrium behavior: the importance of the extra task, $\alpha$, in relation to threshold $\alpha(0)$ (as defined in equation (7)) and the general commitment of the workforce, $\lambda$, in relation to $\lambda^0$ (as defined in equation (5)). We will first examine the case when the extra task is unimportant. Then, we examine the case that the extra task is important and the general workforce is committed. Finally, we deal with the case that the extra task is important and the workforce is uncommitted.

**Proposition 1** (Unimportant extra task)**.** *Suppose the extra task is unimportant,* $\alpha < \alpha(0)$*. Then, there is a Perfect Bayesian Nash equilibrium with the following properties: (i) The manager empowers worker B if and only if she believes B to be committed, (ii) worker A believes worker B to be committed if and only if B is empowered, and (iii) committed workers exert extra effort if and only if B is empowered. Given Pareto refinement and intuitive criterion, this equilibrium is unique.*

The manager's information is perfectly revealed to worker A . The presence of the manager eliminates three problems that are present without a manager. First in a self-managed team put together from a rather committed workforce, worker A may wrongly believe that an uncommitted worker B is committed and waste extra effort. Second in a self-managed team composed from a rather uncommitted workforce, worker A may wrongly presume that a committed worker B is uncommitted and refrain from exerting extra effort; consequently, no extra effort is exerted although both workers are committed. Since worker A learns worker B's type from the manager's decision, these two problems no longer arise with the manager. Notice that in the presence of a committed B, the mere presence of the manager has a beneficial effect although the manager is inactive.[8] Finally, managerial supervision in this situation increases normal effort because uncommitted B's are forced to exert normal effort.

Next, we move to the case of a relatively important extra task. In this case, it becomes more attractive for the manager who knows B to be uncommitted to conceal her information. The consequences are somewhat different depending on whether the workforce is rather committed or not. Let us first consider a high general commitment in the

[8] We are grateful to an anonymous referee for pointing out this beneficial effect of a passive manager.

workforce.

**Proposition 2** (Important extra task, committed workforce)**.** *Suppose the extra task is important,* $\alpha > \alpha(0)$*, and workers are likely to be committed,* $\lambda > \lambda^0$*. Then, there is a Perfect Bayesian Nash equilibrium with the following properties: (i) The manager empowers regardless of her information. (ii) Worker A believes B to be uncommitted if the manager intervenes in B's work and to be committed with probability* $\lambda$ *(a-priori belief) if B is empowered. (iii) Committed workers exert extra effort if and only if B is empowered. Given Pareto refinement and intuitive criterion, this equilibrium is unique.*

We can, once more, compare behavior with that of a self-managed team. Since the manager conceals her information, she does not affect behavior; workers behave exactly as in a self-managed team (see Table 1). This is no longer true if the workforce is rather uncommitted.

**Proposition 3** (Important extra task, uncommitted workforce)**.** *Suppose the extra task is important,* $\alpha > \alpha(0)$*, and workers are unlikely to be committed,* $\lambda < \lambda^0$*. Then, there is a Perfect Bayesian Nash equilibrium with the following properties: (i) The manager empowers if her signal indicates that B is committed and she empowers with some probability* $\tilde{d} \in (0, 1)$*, otherwise. (ii) Worker A's belief that B is committed is* $\lambda^0$ *if B is empowered and zero, otherwise. (iii) Committed worker's exert extra effort with probability* $\tilde{e} \in (0, 1)$ *if B is empowered and no extra effort, otherwise. Given the Pareto refinement, this equilibrium is unique.*

When the commitment in the workforce is low, the manager's presence alters behavior, which can be seen by comparing the second line in Table 1 with Table 2. Occasionally, there will be a direct beneficial effect because uncommitted workers are forced to exert normal effort (right area). In addition, committed workers are now exerting extra effort when the manager empowers. While this behavior is beneficial in case that the other worker is indeed committed (left area), it leads to wasted effort if the other worker is not committed (middle area). Empowerment can thus be deceptive: the committed worker exerts extra effort that benefits the manager but is not matched.

| Type of worker B | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| committed ($\theta = 1$) | | | | uncommitted ($\theta = 0$) | | | | | | | |
| no intervention | | | | no intervention | | | | intervention | | | |
| $e_A^N$ | $e_B^N$ | $e_A^E$ | $e_B^E$ | $e_A^N$ | $e_B^N$ | $e_A^E$ | $e_B^E$ | $e_A^N$ | $e_B^N$ | $e_A^E$ | $e_B^E$ |
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |

Table 2: Effort choices in a managed team if extra task is important, $\alpha > \alpha(0)$, and the workforce is uncommitted, $\lambda < \lambda^0$.

The three propositions can be seen as a comparative static exercise in which the type of equilibrium changes with the importance of the extra task and the commitment in the pool of workers (see Figure 1). If the extra task is unimportant, the presence of a manager is beneficial because her information helps committed workers to coordinate on extra effort.[9] If the extra task is important and workers are likely to be uncommitted, the manager's presence sometimes reveals information and is thus helpful. If the extra task is important and workers are likely to be committed, the presence of the manager does not help. Small costs of having a manager thus suffice for a self-managed team to be optimal.

# 4 Model variations

In this section, we discuss three variations of the model: (i) an imperfectly informed manager, (ii) a situation when neither worker's commitment is known, (iii) a dynamic setting, where effort can be used as a commitment signal.

[9]In a recent experiment, Galbiati et al. (2009) show that sanctions imposed by an informed authority lead to coordination on lower effort.

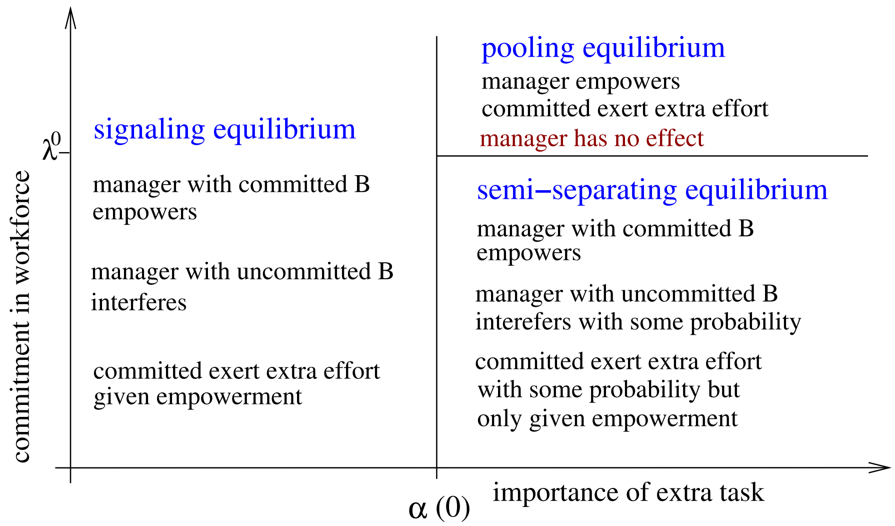


Figure 1: Comparative statics with perfectly informed manager

## 4.1 Imperfectly informed manager

Consider a manager who is imperfectly informed about worker B's commitment, i.e., $p < 1$. This manager's information is useful to committed workers as long as it is independent of their information. This holds even if the manager's signal is very noisy (see Lemma 5 in the appendix). Imperfect information has two effects. First, new behavior emerges when the extra task is unimportant (see Figure 2). Second, existing equilibria change and generate new effects. We briefly discuss both points.

First, consider an unimportant extra task, $\alpha < \alpha(\bar{\lambda})$. Then, a manager intervenes even if she receives the information that B is committed. Intervention is optimal because this information may be incorrect and losses are small since the extra task is unimportant. For the same reason, managers whose signal indicates an uncommitted B also intervene. So, workers cannot learn from managers' behavior and base extra effort on the general commitment in the workforce (see Proposition 4 in the appendix). The manager here plays a classic role: she simply assures that uncommitted workers exert normal effort (compare Table 1 with Table 3 in the appendix).

Second, suppose that the extra task is somewhat important: $\alpha(\bar{\lambda}) < \alpha < \alpha(\underline{\lambda})$.

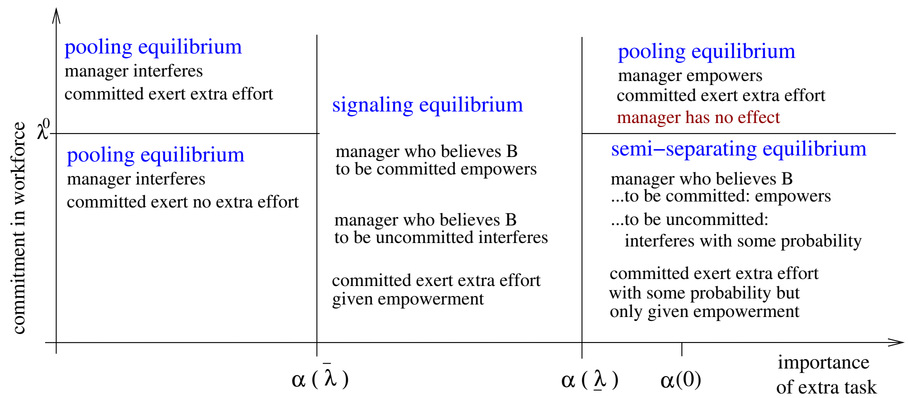


Figure 2: Comparative statics with imperfectly informed manager

Then, signaling and direct costs outweigh the benefits from intervening but only for a manager who received a signal that worker B is committed ($S = 1$). As result a signaling equilibrium emerges (see Proposition 5 in the appendix) which seems similar to that in case of a perfectly informed manager (see Proposition 1). The possibility that the manager can be wrong, however, creates two subtle differences. These differences unfold in two situations.

In the first situation, an uncommitted worker B is mistaken to be committed by the manager. Consequently, the manager empowers and if there are few committed workers, the empowerment induces extra effort from worker A (that will be wasted). In contrast to the earlier case of deceptive empowerment (Proposition 3), the misleading empowerment is not intentional, here. The manager simply makes a mistake.

In the second situation, commitment in the workforce is high, both workers in the team are indeed committed, but the manager wrongly intervenes. Since the manager intervenes, workers exert no extra effort although they are committed. The manager's imperfect information thus creates what we call a 'tragedy of committed but unmotivated workers.' Observe that worker B in this case is painfully aware of the fact that both workers are committed and willing to exert extra effort. The same tragedy of committed but unmotivated workers also occurs if the workforce from which the team is formed is uncommitted and the extra task is important. Again, empowerment is an (albeit weaker) signal for commitment and a mis-informed manager who wrongly intervenes with committed workers destroys incentives to exert extra effort (see Proposition 7 in the appendix).

No new effects arise if the workforce is committed and the extra task is important (see Proposition 6 in the appendix). In this case, intervention remains an uninformative signal and is ignored by workers so that wrong signals have no consequence.

## 4.2 Commitment of all workers unknown

We have assumed that worker B knows worker A to be committed. More realistically, one could assume that neither worker knows his co-worker's commitment, the manager has information about both workers, and the decision is to either empower or intervene with both workers. Two additional complications arise in this setting. First, the benchmark for committed workers to exert extra effort is no longer the belief that their colleague is committed. Second, the manager can now hold three different types of information: both workers are committed, only one worker is committed, both workers are uncommitted. Still, the main insights carry over to this setting. The argument is based on three steps.

First, committed workers' behavior remains essentially the same: they always exert normal effort and engage in extra effort if the probability that the other exerts extra effort is sufficiently high; in short, Lemma 1 continues to hold. Differently, the extra effort of a committed worker A now depends not only on A's belief about B, but also on B's belief about A. For extra effort to be a best response, *both* workers must be sufficiently likely to be committed. If the belief about one worker's commitment is not large enough, committed workers exert no extra effort.

Second, observe that only two of the three possible cases are relevant: when both workers are committed and when only one worker is committed. When both workers are uncommitted, intervention has no signaling costs because uncommitted workers never exert extra effort. The direct benefits for the manager in the two relevant cases are the same as when only B's commitment was in question. For the manager with two committed workers (before: manager with $S = 1$), intervening has no direct benefit. For the manager with one committed worker (before: manager with $S = 0$), intervening forces the uncommitted worker to exert normal effort. Consequently, intervention either conveys no information or signals that at least one worker is uncommitted, i.e., Lemma 2 remains valid.

Third, the manager in the two relevant cases has the same signaling costs as before. Committed workers continue to coordinate extra effort on the basis of the manager's behavior. In the case of two committed workers, the potential signaling costs amount to the loss in value because both committed workers reduce extra effort. In the case of one committed worker, only the extra effort of this worker is lost. This is exactly what happened when worker A's commitment was common knowledge.

Summarizing, we find that committed workers behave as before. In addition, benefits, direct costs, and signaling costs for a manager in the case that both workers are committed and that only one worker is committed are the same as before. Accordingly, the manager's decision to intervene is not different from the situation when worker A was known to be committed and results are robust.

### 4.3 Repeated interactions

We have assumed that worker B cannot credibly communicate his type to worker A. One reason for this assumption may be that worker B also benefits from A's extra effort if B is uncommitted. Then, A cannot trust B's declaration to be committed. An important consequence is that a committed B who perfectly knows that A is committed cannot convince A to engage in extra effort— a problem which plays out if the manager has by mistake stifled extra effort through intervening. Below, we briefly discuss a specific channel through which B could signal his commitment and establish worker A's trust: by exerting effort.

Suppose the same team interacts again in the future to produce another good using the same production technology. This can be modeled by a simple repetition of the game between manager and workers in a second period. In the repeated game, a committed B can exert effort during the first period to convince A to engage in extra effort in the second period. If the committed B is empowered in the first period, he can use normal effort to costlessly signal his commitment. This signal can be credible because an uncommitted B incurs costs when exerting normal effort. If the committed B is not empowered in the first period, as in the tragedy of committed but unmotivated workers, B exerts normal effort regardless of his type, and normal effort is no longer a credible signal for commitment. The manager who wrongly intervenes thus not only stops committed workers from exerting extra effort but also eliminates a simple remedy to this problem. Now, a committed B has to use extra effort in the first period to signal commitment. Since A believes B to be uncommitted this effort will not be matched and is wasted. Still, B may be willing to engage in first period extra effort if the future gains from signaling commitment to A, i.e., the gains from A's extra effort in the second period, outweigh B's losses from extra effort in the first period. B thus needs to be sufficiently patient to overcome the problem. If B is impatient, extra effort does not work as a trust building measure and the erroneous intervention by the manager has lasting damaging effects on the extra effort of committed workers.

# 5 Concluding remarks

We have presented a first step toward an economic theory of team governance. A manager, who decides whether to empower the team or to intervene, faces a simple trade-off. While intervening increases effort for tasks that can be monitored easily, it may distort the effort incentives for tasks that cannot be monitored. The reason is that it affects team members' beliefs about the commitment of their colleagues to the joint output. It follows that the optimality of intervention vs. empowerment depends on both prior beliefs about team members' commitment and the importance of tasks that cannot be monitored. In a dynamic perspective, interventions may destroy the trusting atmosphere that is required for voluntary effort.

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# Proofs

*Proof of Lemma 1.* Part (i) follows directly from inequality (3). In order to prove part (ii), we first examine a committed worker who is certain about his colleague's behavior. Then, we proceed to the case in which he is not certain. First, consider a committed worker knows that his colleague exerts no extra effort, $\pi = 0$. In this case, the best response is to also exert no extra effort due to the complementary expressed in inequality (2). Second, take a worker who knows his colleague to exert extra effort, $\pi = 1$. Then, the worker's net gain from extra effort amounts to $v^E(1,1) - v^E(1,0) - c^E$. In order to see that this gain is positive, recall that $v^E(1,1) - v^E(0,0) > 2c^E$ by equation (1). Rewriting yields: $v^E(1,1) - v^E(1,0) + v^E(0,1) - v^E(0,0) > 2c^E$ or $v^E(1,1) - v^E(1,0) > c^E + (c^E - (v^E(0,1) - v^E(0,0)))$. Then, it follows directly from (2) that $v^E(1,1) - v^E(1,0) > c^E$. So, a committed worker who knows that his colleague exerts extra effort will match this effort. Finally, if the co-worker exerts extra effort with probability $\pi \in (0,1)$, the net gain from extra effort is $\pi(v^E(1,1) - v^E(0,1) - c^E) + (1-\pi)(v^E(1,0) - v^E(0,0) - c^E)$. From the preceding argument, we know that this quantity is positive for $\pi = 1$ and negative for $\pi = 0$. The gain is thus positive whenever there is sufficient weight on the first term:

$$\pi \geq \frac{c^E - (v^E(1,0) - v^E(0,0))}{v^E(1,1) - v^E(0,0) - (v^E(1,0) - v^E(0,0))}.$$

In this case and only in this case, extra effort is a best-response to extra effort. □

*Proof of Lemma 2.* The proof works by contradiction. Denote worker A's belief that B is committed by $\lambda_A(d)$, where $d = 1$ was the manager's decision to intervene and $d = 0$ to empower. Suppose, the effect would be positive, so that only intervention leads to extra effort: $e^E(1) = 1$ and $e^E(0) = 0$. By Lemma 1 only the following beliefs are consistent with this effort choice: $\lambda_A(1) > \lambda_A(0)$. Since these beliefs must be consistent with the manager's action, she must empower whenever she believes that worker B is uncommitted. Deviating from empowerment to intervention yields $\left[(1-\lambda_M)(v^N(1,1) - v^N(1,0)) - k\right] + \left[\lambda_M(v^E(1,1) - v^E(0,0)) + (1-\lambda_M)(v^E(1,0) - v^E(0,0))\right]$. By inequality (3), the direct gain of intervention (the first term in square brackets) exceeds the direct costs for $\lambda_M = 0$. In addition, intervening leads to more extra effort (the second term in square brackets). Deviating to an intervention is hence profitable for the manager with $S = 0$. Accordingly, $\lambda_A(1) > \lambda_A(0)$ cannot be consistent with manager's behavior. This implies for extra effort that $e^E(1) \leq e^E(0)$. By assumption intervening has an effect, so $e^E(1) < e^E(0)$. □

*Proof of Lemma 3.* The lemma follows directly from the observations that $B(\lambda_M)$ falls in $\lambda_M$ and that signaling costs weakly increase in $\lambda_M$ by Lemma 2. □

*Proof of Lemma 4.* Let us first prove part (i). If $\alpha < \alpha(\lambda_M)$, it follows that $B(\lambda_M) - \alpha C(\lambda_M) - k > 0$ by the definition of $\alpha(\lambda_M)$. Consequently, the manager intervenes if this entails signaling costs. In the absence of signal costs, she will have even more reason to intervene. To prove part (ii), observe that $\alpha(\lambda_M)$ describes the lowest importance of the extra task such that $B(\lambda_M) - \alpha C(\lambda_M) - k < 0$ given signaling cost. Thus, the manager empowers for $\alpha > \alpha(\lambda_M)$. Part (iii) follows directly from the observation that without signaling costs, empowerment occurs whenever the direct costs of intervening exceed the direct benefit. □

*Proof of Proposition 1 (Existence).* A manager who believes worker B to be committed has no incentive to intervene since this entails signaling and direct costs but yields no gains. A manager who believes worker B to be uncommitted has not incentive to empower: the net gains of empowerment are negative since $\alpha < \alpha(0)$. Given this behavior, worker A's beliefs are correct. Finally, we check whether committed workers have an incentive to deviate. (The behavior of uncommitted workers does not depend on their beliefs and is hence independent from the manager's choice). Worker A believes that B is committed only if B is empowered. Given this belief, it is optimal for worker A to exert extra effort only if B is empowered by Lemma 1. Worker B is aware of this and it is optimal for him to match the effort of worker A again by Lemma 1.

*Proof of Proposition 1 (Uniqueness).* Since $\alpha < \alpha(0)$, a manager who believes worker B to be uncommitted will always intervene by Lemma 4. So, the only alternative candidate is a pooling equilibrium in which the manager with $S = 1$ also intervenes. A manager with $S = 1$ has no benefits from intervening and can save on the direct costs of intervening. Such a manager thus has an incentive to empower unless workers exert lower effort when they are empowered. This requires that worker A beliefs worker B to be uncommitted when the manager empowers. This restriction on the off-equilibrium belief, however, violates the intuitive criterion because only managers with $S = 1$ gain from empowering. So, there is no other Perfect Bayesian Nash Equilibrium that fulfills the intuitive criterion. □

*Proof of Proposition 2 (Existence).* Beliefs are such that intervening entails signaling costs. Thus, it is optimal for both managers to empower since $\alpha > \alpha(0) > \alpha(1)$. Beliefs in equilibrium are correct, because workers cannot deduce the manager's information from her action. Moreover, the off-equilibrium belief fulfills the intuitive criterion since a manager with $S = 0$ has a larger incentive to intervene by Lemma 3. Given the equilibrium belief, it is once more optimal for committed workers to exert extra effort (again using Lemma 1). Given the off-equilibrium belief, it is optimal for workers not to exert extra effort after an intervention.

*Proof of Proposition 2 (Uniqueness).* Let us first rule out separating equilibria then the pooling equilibrium in which all managers intervene. In any separating equilibrium, the manager with $S = 0$ would have to intervene by Lemma 3. In such an equilibrium, there would hence be signaling costs. Since $\alpha > \alpha(0)$, the manager with $S = 0$ would then have an incentive to empower. Thus, there are no separating equilibria. It remains to be shown that there is no pooling equilibrium in which the manager intervenes irrespective of her information. As in the proof of the uniqueness-part in Proposition 1, a manager with $S = 1$ can profitably deviate to empowerment unless empowerment is seen as a signal for $S = 0$. Since the manager with $S = 1$ benefits more from empowerment, such beliefs are not consistent with the intuitive criterion. □

*Proof of Proposition 3 (Existence).* Suppose committed workers exert extra effort with probability $\tilde{e}$ whenever they are empowered and exert no extra effort otherwise. Then, signaling costs of intervening only occur with probability $\tilde{e}$ and amount to $\alpha \cdot \tilde{e} \cdot C(\lambda_M)$. Now, choose $\tilde{e}$ such that the manager with $S = 0$ is indifferent between intervening and empowerment: $B(0) - \alpha \cdot \tilde{e} \cdot \tilde{C}(0) - k = 0$. Such an $\tilde{e}$ exists by the continuity theorem because $B(0) - \alpha \cdot 1 \cdot C(0) - k < 0$ due to $\alpha > \alpha(0)$ and $B(0) - \alpha \cdot 0 \cdot C(0) - k > 0$ due to (4). Given this choice, the manager with $S = 0$ is indifferent and has no incentive to deviate from any $\tilde{d} \in [0, 1]$. Take $\tilde{d}$ such that committed workers are indifferent between exerting extra effort or exerting no extra effort given that worker B is empowered: $\tilde{\lambda} = \lambda^0$. Then, these workers have no incentive to deviate from $\tilde{e}$ and their beliefs in this case are correct by construction. If a committed worker A observes an intervention, they believe worker B to be uncommitted. Accordingly, it is optimal for them not to exert extra effort. The manager with $S = 1$ has no reason to deviate from empowerment because intervening would only lead to additional direct and signaling costs. Thus, worker A's belief that intervening indicates $S = 0$ is also correct and there are no profitable deviations neither for the workers nor for the manager.

*Proof of Proposition 3 (Uniqueness).* Separating equilibria can be excluded by the same arguments as in the uniqueness-part of the proof of Proposition 2. It remains to be shown that there are no pooling equilibria. Let us begin with the candidate in which the manager always intervenes. In this case, workers cannot learn from the manager's intervention and exert no extra effort. Now consider a deviation by a manager with $S = 1$ to empowerment. This deviation allows the manager to save on intervention costs and cannot lead to a lower level of extra effort. The deviation is thus profitable and intervening irrespectively of the signal received is no equilibrium. The other candidate is an equilibrium in which the manager always empowers. In such an equilibrium, a manager with $S = 0$ only empowers if committed workers put in extra effort. This requires worker A's belief to be sufficiently large: $\lambda > \lambda^0$. If the manager always empowers, worker A cannot update and his belief remains the a-priori belief $\lambda$. However, by assumption this belief is below the critical threshold $\lambda < \lambda^0$. Beliefs are hence not consistent with behavior and always empowering cannot be an equilibrium. □

# Additional results

**Lemma 5.** *There is always some initial belief for which the information of the manager matters to committed workers.*

*Proof.* Note that $\bar{\lambda}$ and $\underline{\lambda}$ are increasing continuous functions of the initial belief $\lambda$ which approach one as $\lambda$ approaches one and zero as $\lambda$ approaches zero. In addition, $\bar{\lambda} > \underline{\lambda}$. By continuity, there is hence always some $\lambda$ such that $\bar{\lambda} > \lambda^0 > \underline{\lambda}$. By Lemma 1, this means that the information held by the manager affects the extra effort of committed workers and hence matters to them. □

**Proposition 4** (Unimportant extra task, imperfect manager)**.** *Suppose the extra task is of low importance, $\alpha < \alpha(\overline{\lambda})$. Then, there is a Perfect Bayesian equilibrium with the following properties: (i) The manager intervenes irrespective of her information, (ii) worker A believes worker B to be committed with probability $\lambda$ (a-priori belief), and (iii) committed workers exert extra effort if and only if the general commitment in the workforce is high, $\lambda > \lambda^0$. Given Pareto-refinement, this equilibrium is unique.*

*Proof.* Since $\alpha < \alpha(\overline{\lambda}) < \alpha(\underline{\lambda})$, the manager intervenes irrespective of her information by Lemma 4. Accordingly, committed workers cannot update and believe worker B to be committed with probability $\lambda$. Given this belief and the Pareto-refinement, it is optimal for them to exert effort if and only if the general commitment in the workforce is high, $\lambda > \lambda^0$, by Lemma 1. □

| | | Type of worker B | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | committed | | | | uncommitted | | | |
| | | intervention | | | | intervention | | | |
| | | $e_A^N$ | $e_B^N$ | $e_A^E$ | $e_B^E$ | $e_A^N$ | $e_B^N$ | $e_A^E$ | $e_B^E$ |
| commitment in workforce | high ($\lambda > \lambda^0$) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | low ($\lambda < \lambda^0$) | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |

Table 3: Workers' effort with an imperfect manager, $\alpha < \alpha(\overline{\lambda})$ (pooling)

**Proposition 5** (Somewhat important extra task, imperfect manager)**.** *Suppose the extra task is somewhat important,* $\alpha(\overline{\lambda}) < \alpha < \alpha(\underline{\lambda})$*. Then, there is a Perfect Bayesian-Nash equilibrium with the following properties: (i) The manager empowers if and only if she believes worker B to be committed, (ii) worker A believes worker B to be committed if and only if B is empowered, and (iii) committed workers exert extra effort if and only if they are empowered. Given Pareto-refinement, intuitive criterion, and* $B(\underline{\lambda}) < k$*, this equilibrium is unique.*

*Proof.* The proof of existence is analogue to Proposition 1, where $\alpha(\underline{\lambda})$ replaces $\alpha(0)$. The proof of uniqueness also follows that of Proposition 1, with the difference that $B(\underline{\lambda}) < k$ ensures that empowerment is a profitable deviation for the manager with $S = 1$, so that a pooling equilibrium in which the manager always intervenes does not exist. □

**Proposition 6** (Important extra task, committed workforce, imperfect manager)**.** *Suppose the extra task is important,* $\alpha > \alpha(\underline{\lambda})$*, and workers are likely to be committed,* $\lambda > \lambda^0$*. Then, there is a Perfect Bayesian Nash equilibrium with the following properties: (i) The manager empowers regardless of her information, (ii) worker A believes B to be uncommitted if the manager intervenes with B and to be committed with probability* $\lambda$ *(a-priori belief) if B is empowered, and (iii) committed workers exert extra effort. Given Pareto-refinement, intuitive criterion, and* $B(\underline{\lambda}) < k$*, this equilibrium is unique.*

*Proof.* The proof of existence is analogue to that of Proposition 2, where $\alpha(0)$ is replaced by $\alpha(\underline{\lambda})$ and $\alpha(1)$ by $\alpha(\bar{\lambda})$. The proof of uniqueness also follows that of Proposition 2, with the difference that $B(\underline{\lambda}) < k$ ensures that empowerment is a profitable deviation for the manager with $S = 1$, so that a pooling equilibrium in which the manager always intervenes does not exist. □

**Proposition 7** (Important extra task, uncommitted workforce, imperfect manager)**.** *Suppose the extra task is important, $\alpha(\overline{\lambda}) < \alpha < \alpha(\underline{\lambda})$ and that workers are unlikely to be committed, $\lambda < \lambda^0$. Then, there is a Perfect Bayesian Nash equilibrium with the following properties: (i) The manager empowers if she received a signal that B is committed and she empowers with some probability $\tilde{d}$ otherwise, (ii) worker A believes B to be uncommitted if the manager intervenes with B and to be committed with probability $\lambda^0$ if B is empowered, and (iii) committed worker's exert no extra effort if the manager intervenes with worker B and they exert extra effort with some probability $\tilde{e}$, else. Given Pareto refinement and $B(\underline{\lambda}) < k$, this equilibrium is unique.*

*Proof.* The proof of existence is analogue to that of Proposition 3, where $\alpha(0)$ is replaced by $\alpha(\underline{\lambda})$, $\alpha(1)$ by $\alpha(\bar{\lambda})$, $B(0)$ by $B(\underline{\lambda})$, and $C(0)$ by $C(\underline{\lambda})$. The proof of uniqueness also follows that of Proposition 3, with the difference that $B(\underline{\lambda}) < k$ ensures that empowerment is a profitable deviation for the manager with $S = 1$, so that a pooling equilibrium in which the manager always intervenes does not exist. □