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**Working Paper**

## Becoming "We" instead of "I". Identity management and incentives in the workplace

Discussion Papers, No. 760

**Provided in Cooperation with:**

Research Department, Statistics Norway, Oslo

*Suggested Citation:* Donze, Jocelyn; Gunnes, Trude (2013) : Becoming "We" instead of "I". Identity management and incentives in the workplace, Discussion Papers, No. 760, Statistics Norway, Research Department, Oslo

This Version is available at:

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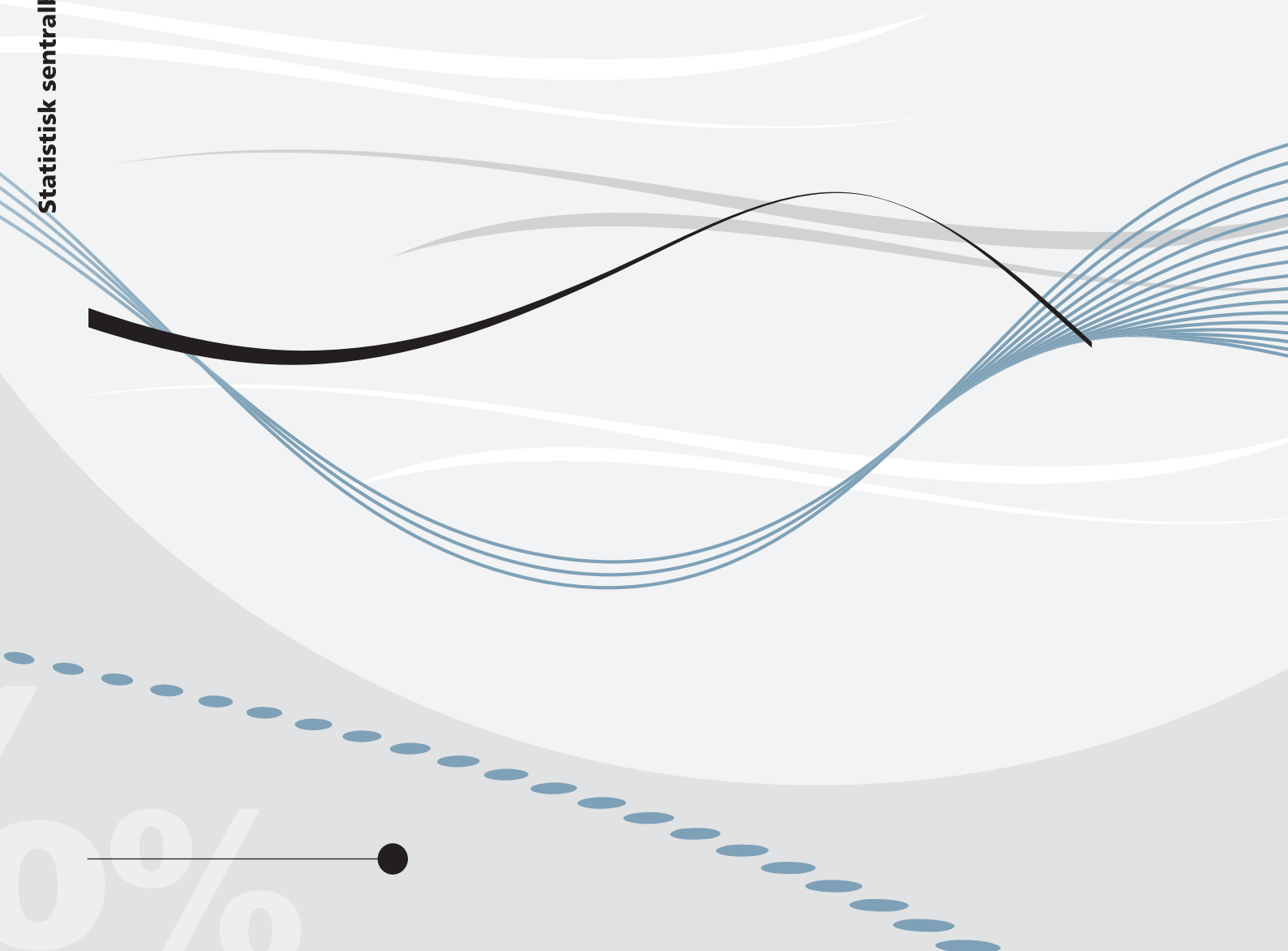
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*Jocelyn Donze and Trude Gunnes*

## **Becoming "We" instead of "I"**

Identity management and incentives in the workplace





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## **Becoming “We” instead of “I”** Identity management and incentives in the workplace

**Abstract:**

This article studies how a firm fosters formal and informal interaction among its employees to create a collective identity and positively influence their effort. We develop an agency model, in which employees have both a personal and a social ideal for effort. The firm does not observe the personal ideals, which gives rise to an adverse selection problem, but can make its workforce more sensitive to the social ideal by allocating part of working hours to social interaction. We show that there are two reasons why the firm invests in social capital. First, it reinforces the effectiveness of monetary incentives. Second, by creating a shared identity in the workforce, the firm is able to reduce the adverse selection problem. We also show that the firm allocates more time to bonding activities when employees have low personal ideals for effort or when they are more heterogeneous as regards these ideals.

**Keywords:** agency theory, social interaction, social norms, norm regulation

**JEL classification:** D2, D8, J3, M5

**Acknowledgements:** We would like to thank François Salanié, Moritz Müller, Mads Greaker and participants at ESEM 2013, the 2013 Norwegian annual meeting for economists, and the 2013 annual meeting of the French economic association for their comments. The usual disclaimer applies.

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ISSN 0809-733X

Print: Statistics Norway

## **Sammendrag**

Denne artikkelen belyser hvordan en bedrift kan fremme formelle og uformelle samhandlinger blant sine ansatte for å skape en kollektiv identitet og positivt påvirke deres innsats. Vi utvikler en Principal-Agent modell, der de ansatte både har et personlig og et sosialt ideal for innsats ("effort"). Bedriften kan ikke observere de ansattes personlige idealer, noe som gir opphav til et ugunstig utvalgsproblem ("adverse selection"). Men bedriften kan påvirke arbeidsstyrkens følsomhet for det sosiale idealet ved å fordele en del av arbeidstiden til sosial interaksjon. Vi viser at det er to grunner til at bedriften ønsker å investere i sosial kapital. For det første forsterker det effektiviteten knyttet til bruken av monetære insentiver. For det andre, ved å skape en felles identitet blant de ansatte, er bedriften i stand til å redusere problemet med ugunstig utvalg. Vi viser også at bedriften er tjent med å tildele mer tid til sosiale aktiviteter når ansatte har lave personlige idealer for innsats eller når de er mer heterogene sett i forhold til idealene.

*“Our offices and cafes are designed to encourage interactions between Googlers within and across teams, and to spark conversation about work as well as play.”*

(Google website, 2013)

*“I call it the ‘pronoun test’, I ask frontline workers a few general questions about the company. If the answers I get back describe the company in terms like ‘they’ and ‘them,’ then I know it’s one kind of company. If the answers are put in terms like ‘we’ or ‘us,’ then I know it’s a different kind of company.”*

(Former U.S. Secretary of Labor, Robert B. Reich, on visiting a company for the first time)

## 1 Introduction

United Parcel Service (hereafter UPS) is known as a company that constantly strives to improve its efficiency: packages are sorted by computers to optimize the order of delivery; delivery routes are designed to avoid left turns, so that no time is wasted waiting for a gap in oncoming traffic; and drivers have to maintain a fast pace when walking. This company, which is continuously looking to save seconds in the supply chain, has a somewhat unexpected practice: several minutes are set aside for drivers and loaders to engage in a “pre-work huddle”, a team gathering before the drivers leave the distribution center. According to UPS management, the objective of this practice is to engender a team spirit between loaders and drivers (Cohen and Prusak, 2001). Fostering a certain amount of social bonding among employees is not unique to UPS. Over the past few decades, many firms have introduced new practices to make it easier for employees to develop formal and informal interaction: new physical spaces such as open-plan offices, places to relax, and meeting points are designed to promote an environment of communication and information sharing among colleagues; workshops and brainstorming sessions are held with the aim of promoting collective creativity and mutual understanding; information technologies, such as email, intranet and chats favor exchange; and team building activities, defined as a variety of practices ranging from simple bonding exercises to complex simulations, aim to generate a sense of cohesiveness among employees.<sup>1</sup>

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<sup>1</sup>Cohen and Prusak (*ibid.*) give several examples of firms providing “space and time” to allow their employees to interact. Notably, they describe how Alcoa, the world’s leading producer of aluminum, moved to new headquarters in

Why do firms allocate time and space to foster social interaction between their employees? Besides creating a great atmosphere and facilitating the emergence of new ideas, the literature on organizational identification, a subfield of management literature, has suggested that, by promoting interaction, a firm may be seeking to induce its workforce to identify as part of a collective (the group or the organization) and behave in ways that are normative for the collective identity (e.g., Pratt, 2000; Ellemers, De Gilder and Haslam, 2004; Van Dick, 2004; Cohen and Prusak, 2001). According to these authors, shifting the employees' identity from being personal ("I") to collective ("we") has two positive consequences. First, the group-based expectations, goals, or outcomes become a source of implicit incentives for workers, coming to supplement or even replace other explicit and implicit incentives. Second, by promoting the collective identity, the firm can keep possibly heterogeneous employees together and secure their involvement in the work environment. In this context, the rise of practices aimed at encouraging employee interaction and building collective identities could be interpreted as an attempt by firms to counter reduced loyalty (Casey, 1996) or increased diversity (Cohen and Prusak, 2001) among their workforces.<sup>2</sup>

In this article, we develop an agency model with a social norm in order to formalize the idea that a firm might find it profitable to allocate time for its employees to interact, develop social ties and create a collective identity. An employee's identity is modeled as an ideal for effort, which is a weighted combination of a personal ideal and a shared social ideal. Personal ideals can differ across employees and are not observed by the firm. This gives rise to an adverse selection problem. Employees perform independent production tasks, which means that the only externalities among workers are social. Although the existence of social interaction between employees could also foster the exchange of information, ideas and know-how, we omit introducing technological or

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1998 in which glass-walled conference rooms, meeting places, kitchens, and escalators occupy the center of each floor and are designed to encourage workers to meet, mix, and chat. According to the CEO, Paul O'Neill, the ultimate goal was to promote "a sense of connection" among employees. Conversely, Robin Dunbar (1998) explains why a TV production unit experienced reduced productivity after being moved to a new workplace. "It turned out that when the architects were designing the new building, they decided that the coffee room where everyone ate their sandwiches at lunch time was an unnecessary luxury and so dispensed with it ... If people were encouraged to eat their sandwiches at their desks, then they were more likely to get on with their work and less likely to idle time away. And with that, *they inadvertently destroyed the intimate social networks that empowered the whole organization*" (italics added).

<sup>2</sup>The literature on organizational identification is based on insights from social identity theory (Tajfel, 1972; Tajfel and Turner 1979). This theory suggests that a person's identity is composed of two different facets. Personal identity corresponds to individual attributes that are not shared with other people. Social identity corresponds to attributes that result from being a member of a social group. The literature on organizational identification goes a step further by suggesting that an organization can reinforce its employees' social identity through social bonding or training in order to create implicit group incentives.

informational spillovers in the production process in order to focus on social spillovers and their management by the firm. This enables us to obtain three main new results. First, we take the employees' sensitivity to the social ideal as given and determine the optimal payment scheme. We show that, the more employees are sensitive to the social norm, the higher will be the power of monetary incentives chosen by the firm and its profits. This result is a consequence of an effect known in the economic literature as the social multiplier effect, which, when applied to an agency context, means that the existence of the social norm reinforces the effectiveness of monetary incentives (see for example Fischer and Huddart, 2008). Second, we allow the firm to alter the employees' sensitivity to the social norm by choosing the part of working hours allocated to social interaction. For the firm there is a cost of investing in social capital because less time is left for production. There is also a benefit: by favoring social bonding the firm makes its workforce more sensitive to the social ideal. We show that the firm allocates more time for social interaction when employees have low personal ideals for effort: motivating employees through the collective identity is used as a substitute for low individual work ethics. Third, we show that investing in social capital allows the firm to alleviate the adverse selection problem. By promoting the shared social ideal, the firm is able to mitigate the effect of employees' heterogeneity on their individual behaviors and to reduce the contractual distortions resulting from incomplete information. The consequence is that the firm gives employees more time to develop social ties when the workforce is heterogeneous. These last two results are consistent with the findings from the literature on organizational identification.

There is a burgeoning theoretical literature that suggests that social norms have important effects on workers' behavior in the workplace.<sup>3</sup> Kandel and Lazear (1992) assume that members of a team suffer a utility loss when their own effort level falls short of that of their co-workers. The consequence is that workers exert more effort than if peer effects were absent. In an agency context, Fischer and Huddart (2008) show that the existence of social norms fosters the effectiveness of monetary incentives. Although they do not solve for the optimal contract, they derive some implications for the organizational boundaries of firms by distinguishing between a desirable and an undesirable action, each with its own norm. Huck, Kübler and Weibull (2012) show that a particular norm can be output-increasing, neutral, or output-decreasing, depending on the incentive scheme a firm offers. They further show that low-effort equilibria (where someone exerts a low effort because others do

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<sup>3</sup>We will discuss the growing empirical literature later in this article.

the same) can coexist with high-effort equilibria (where someone exerts a high effort because others do the same). Rob and Zemsky (2002) study the accumulation of social capital in a firm in which a continuum of workers repeatedly perform an individual task and a cooperative task. The effort devoted to cooperation is not observable, but employees have preferences for helping that depend on the degree of past cooperation. In this context, the firm can choose to limit the incentive intensity on observable individual tasks in order to induce workers to be more helpful today and therefore more pro-social tomorrow. Rob and Zemsky show that the dynamic process possibly admits several steady states with different cooperation levels, which the authors interpret as multiple corporate cultures.<sup>4</sup> In the present article, we rely on the work of Fischer and Huddart (2008) to introduce a social norm for effort in the employees' preferences. Compared to their article and the other articles cited above, we add two elements to the analysis. First, we allow the firm to invest in social capital by choosing the amount of social interaction among employees. Therefore, the firm has an instrument other than the payment scheme to regulate workers' effort. We show that a first motive for the firm to invest in social capital is to reinforce the effectiveness of monetary incentives. Second, we allow for heterogeneity among employees with regard to their personal ideals for work. This gives a second motive to invest in social capital, namely creating a shared identity, in order to mitigate the adverse selection problem. Akerlof and Kranton (2008) also consider an organization that is able to affect its workers' identity (ideal for effort) through its management style. There is a moral hazard problem regarding workers' effort and the organization can either decide to monitor its workforce closely or choose loose supervision. They assume that monitoring workers allows to detect shirking more easily. But, at the same time, it reduces workers' ideal for effort as there is less identification with the workgroup. Akerlof and Kranton characterize the circumstances under which the organization prefers loose supervision. In this article, we endogenize workers' collective identity and describe more fully how the firm is able to regulate this identity.

The article is structured as follows. In section 2, we present the theoretical model. In section 3, we derive the optimal linear contract. In section 4, we analyze how the firm regulates the social norm among its employees. Section 5 concludes.

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<sup>4</sup>Along these lines, Rotemberg (1994) and Dur and Sol (2010) consider models without social norms, but in which two workers are endowed with altruistic preferences they can affect by their choices. In Rotemberg, worker  $i$  decides the degree to which he internalizes the utility of worker  $j$ . In Dur and Sol, worker  $i$  is able, by engaging in social interaction with worker  $j$ , to increase  $j$ 's degree of altruism. Both articles show that it is rational for workers to invest in altruistic activities to some extent. In turn, the efficiency of the equilibrium is enhanced.

## 2 Modeling personal and social ideals

We take a moral hazard framework *à la* Holmstrom and Milgrom (1987) and extend it in two directions. First, we include a social ideal for effort in employees' preferences, following Fischer and Huddart (2008). Second, we allow for some heterogeneity in the workforce regarding personal ideals for effort. The characteristics of employees are unobserved by the firm, which gives rise to a problem of adverse selection. As we want to focus attention on the way work ideals affect employees' incentives and productivity, we choose to exclude other positive externalities such as technological spillovers that could take place among employees when interacting or producing.

**Agents.** A risk-neutral firm employs a continuum of size one of risk-adverse employees to perform similar, but independent tasks. Each employee is characterized by his personal ideal for effort,  $t$ . Personal ideals are distributed according to the probability distribution function  $f(t)$  defined on a set  $T = [\underline{t}, \bar{t}]$ . Let  $F(t)$  denote the cumulative distribution function associated with  $f(t)$ . Each employee exerts a level of effort  $e$ , not observed by the firm, and produces a publicly observable output  $y = e + \varepsilon$ . The term  $\varepsilon$  is an idiosyncratic unobservable noise following a centered normal with variance  $\sigma^2$ . The noise terms are independent across employees.<sup>5</sup>

**Contracts.** As employees are heterogeneous, the firm may find it optimal to offer different contracts to different employees. We denote the menu of contracts by  $\{w(t)\}_{t \in T}$  where  $w(t)$  is the compensation paid by the firm to an employee with personal ideal  $t$ . As is common in contracting literature, we limit attention to linear contracts of the shape  $w(t) = \alpha(t)y + \beta(t)$  where  $\alpha(t)$  is the variable rate and  $\beta(t)$  is the base salary. We will sometimes refer to  $\alpha(\cdot)$  as the power of incentives.

**Payoffs.** Employees have a constant absolute risk aversion. The utility function of an employee of personal ideal  $t$  choosing the contract  $w$  and effort  $e$  is given by

$$U(w, e, n(t)) = -\exp[-\eta(w - C(e, n(t)))] \quad (1)$$

where  $\eta$  represents the employee's constant absolute risk aversion, and  $C(e, n(t)) = \frac{1}{2}(e - n(t))^2$

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<sup>5</sup>As personal ideals and efforts are not observed by the firm, the model features simultaneous adverse selection and moral hazard problems. See Laffont and Martimort (2002) and Theilen (2003) for a general analysis of so-called mixed models.

represents the extended cost function of the employee. The cost of effort is decreasing up to the point where the ideal  $n(t)$  is reached and increasing beyond this point. The ideal corresponds to the effort that employee  $t$  exerts when the variable rate of the compensation is zero but the base salary is sufficiently high to satisfy the participation constraint, which we define below. Following Fischer and Huddart (2008), the ideal  $n(t)$  is a weighted average of two elements: the personal ideal of the employee equal to  $t$  and a shared social ideal taken equal to the average effort across employees,  $E[e]$ .<sup>6</sup> We write

$$n(t) = \lambda t + (1 - \lambda)E[e] \quad (2)$$

where  $\lambda \in (0, 1]$ . The term  $1 - \lambda$  of expression (2) reflects the employees' sensitivity to the social ideal. When  $\lambda = 1$ , employees do not care about the social ideal of the workgroup and only take into account their personal ideals when choosing their effort levels. The standard cost function is obtained by taking  $\lambda = 1$  and  $t = 0$ . We also assume that employees have the same reservation utility level  $U(w_0) = -\exp(-\eta w_0)$ .

The risk-neutral firm's expected profit is equal to the part of the expected production accruing to the firm net of the fixed salaries paid to the employees:

$$\int_{\underline{t}}^{\bar{t}} ((1 - \alpha(t))e(t) - \beta(t)) f(t) dt \quad (3)$$

### Timing of the game

- First, the firm chooses the amount of working hours left for employees to interact. This choice alters the employees' sensitivity to the social ideal in a way we will describe precisely in section 4.
- Second, the firm proposes a menu of contracts  $\{w(t)\}_{t \in T}$ .
- Third, each employee chooses one contract or exercises his outside option.
- Fourth, employees exert effort. Outputs and payoffs are realized.

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<sup>6</sup>Hence, the social ideal is associated with a unique reference group, which is the entire workforce. Each employee takes this social ideal as given.

### 3 The optimal linear contract

In this section, we take the sensitivity of employees to the social norm as given. First, we derive the optimal level of effort for employees. Second, we solve the problem of the firm and derive the optimal menu of linear contracts.

#### 3.1 Problem of an employee

Suppose for now that any employee selects the contract designed for him. An employee of personal ideal  $t$  chooses his effort level to maximize his certainty equivalent payoff,  $\alpha(t)e + \beta(t) - \frac{1}{2}(e - n(t))^2 - \frac{1}{2}\eta\sigma^2\alpha^2(t)$ . Solving for the optimal effort gives

$$e(t) = \alpha(t) + n(t) \quad (4)$$

where  $n(t)$  is given by (2). Expression (4) characterizes the effort exerted by employee  $t$  *given* the work ideal,  $n(t)$ . If the firm does not provide any monetary incentive at all (that is, if  $\alpha(t) = 0$ ), the employee chooses a level of effort equal to his work ideal. By taking the partial derivative of expression (4) with respect to  $\alpha(t)$ , one can study how increasing the monetary incentive at the margin affects effort when the effect of the social norm is neutralized. We have

$$\frac{\partial e(t)}{\partial \alpha(t)} = 1 \quad (5)$$

Effort increases as the firm provides more monetary incentives. We now endogenize the social norm. By plugging expression (4) into  $E[e] = \int_{\underline{t}}^{\bar{t}} e(t)f(t)dt$ , we obtain the average effort exerted by employees:<sup>7</sup>

$$E[e] = E[t] + \frac{E[\alpha]}{\lambda} \quad (6)$$

where  $E[\alpha] = \int_{\underline{t}}^{\bar{t}} \alpha(t)f(t)dt$  is the average power of incentives and  $E[t] = \int_{\underline{t}}^{\bar{t}} tf(t)dt$  is the average personal ideal. Expression (6) shows that there are three sources fueling employees' effort: their personal work ideals, their social orientation, and the monetary incentives. Interestingly, the way the average effort depends on the average personal work ethic *is not* affected by the employees'

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<sup>7</sup>The fact that  $\partial e(t)/\partial E[e] = 1 - \lambda < 1$  implies that there is only one equilibrium in effort levels (see Cooper and John (1988)), as opposed to the framework of Huck, Kübler and Weibull (2012).

sensitivity to the social ideal: for the firm, having a pro-social workforce does not reduce the positive influence of personal ideals on effort. However, the way the average effort depends on the average power of monetary incentives *is* affected by the sensitivity to the social ideal: a higher sensitivity makes monetary incentives more effective. The two previous results are driven by similar social multiplier effects. We first describe the multiplier effect on monetary incentives. Analytically, it takes the following shape:

$$\frac{dE[e]}{dE[\alpha]} = \frac{1}{\lambda} = \frac{1}{\lambda} \times \frac{\partial E[e]}{\partial E[\alpha]} \quad (7)$$

with  $1/\lambda \geq 1$ . To explore the functioning of the multiplier, let us sum expression (4) over types, weighted by the probability distribution function  $f$ . We obtain

$$E[e] = E[\alpha] + \lambda E[t] + (1 - \lambda)E[e] \quad (8)$$

Let us suppose that the average power of monetary incentives  $E[\alpha]$  increases by an amount equal to  $\Delta E[\alpha]$ . In a first round, this has a direct effect on average effort: the right-hand side in expression (8) increases by  $\Delta E[\alpha]$ , which causes the left-hand side  $E[e]$  to increase by the same amount. In the second round, the change in monetary incentives has an indirect effect on effort through the social norm: the higher social work ideal that emerged in the first round induces employees to exert even more effort. Formally, the right-hand side increases by  $(1 - \lambda)\Delta E[\alpha]$ , which causes an equivalent rise in the left-hand side. Summing the successive increases, we obtain:

$$\Delta E[e] = [1 + (1 - \lambda) + (1 - \lambda)^2 + \dots] \Delta E[\alpha] = \left[1 + \frac{1 - \lambda}{\lambda}\right] \Delta E[\alpha] = \frac{1}{\lambda} \Delta E[\alpha] \quad (9)$$

The multiplier  $1/\lambda$  can therefore be understood as the sum of the direct monetary effect, 1, and the indirect social effect,  $(1 - \lambda)/\lambda$ .

The same type of social multiplier effect also explains why the relationship between the average effort and the average work ideal is not affected by the employees' sensitivity to the social norm:  $dE[e]/dE[t] = 1$ . To understand why, let us suppose that the average personal ideal  $E[t]$  increases by  $\Delta E[t]$  in expression (8). At first, this has a direct effect on effort:  $\Delta E[e] = \lambda \Delta E[t]$ . Thereafter, there is an infinite sequence of indirect effects, through increases of the social ideal. Summing the successive effects, we obtain  $\Delta E[e] = [\lambda + \lambda(1 - \lambda) + \lambda(1 - \lambda)^2 + \dots] \Delta E[t] = \Delta E[t]$ .

Using equations (4) and (6), we can express the effort of an employee of personal ideal  $t$  as

$$e^*(t) = \lambda t + (1 - \lambda)E[t] + \frac{1}{\lambda}(\lambda\alpha(t) + (1 - \lambda)E[\alpha]) \quad (10)$$

Expression (10) states that the effort level  $e^*(t)$  is increasing in the power of incentives,  $\alpha(t)$ , and in the average power of incentives,  $E[\alpha]$ . Assume momentarily that  $\alpha(t)$  is non-decreasing in  $t$ . When employees are sensitive to the collective (that is, when  $\lambda < 1$ ), an employee with a below average personal ideal (that is,  $t < E[t]$ ) chooses an effort level higher than the one he would choose if the sensitivity to the social norm were zero (that is, when  $\lambda = 1$ ). The employee is indeed more influenced by the average work ethic,  $E[t]$ , while at the same time the effectiveness of monetary incentives is reinforced. However, an employee with an above average personal ideal (that is,  $t > E[t]$ ) may choose a higher or a lower effort level when he becomes more sensitive to the collective identity: while the employee is attracted by the lower average work ethic, monetary incentives become more effective so that the total effect is ambiguous. We summarize the main results in the following proposition.

**Proposition 1.** (1) Consider a given menu of linear contracts  $\{w(t)\}_{t \in T}$ .

(a) The relationship between the average level of effort  $E[e]$  and the average personal ideal  $E[t]$  is not affected by the employees' sensitivity to the social ideal.

(b) The average level of effort  $E[e]$  is higher when employees are more sensitive to the social ideal (that is, when  $\lambda$  is smaller). In fact, employees with a below average personal ideal exert a higher level of effort, whereas the effect on effort is ambiguous for employees with an above average personal ideal.

(2) The fact that employees' preferences incorporate a social ideal creates a social multiplier effect, defined in (7), which makes effort more responsive to a change in monetary incentives. The multiplier effect is stronger when employees are more pro-social.

In their 2008 article, Fischer and Huddart introduce a social norm in an agency context and derive the existence of a social multiplier effect: social incentives reinforce the effectiveness of monetary incentives. Point 2 in Proposition 1 echoes their result and extends it to the case of a heterogeneous workforce. Point 1(a) expresses a second social multiplier effect that is largely overlooked in the literature: having a more pro-social workforce does not weaken the positive

relationship between the average personal work ideal and the average effort. Together with point 2, this implies 1(b): the average effort is higher when employees are more sensitive to the social ideal.<sup>8</sup> Interestingly, while the effort exerted by below average workers necessarily increases when influenced by peers, the effort exerted by above average workers may decrease or increase. These theoretical results are in line with recent empirical findings. Mas and Moretti (2009) study how the productivity of cashiers in a supermarket chain is affected by the productivity of their peers. They show that workers increase their effort levels by 1% when a worker with above average productivity joins their shift. They obtain two complementary results. First, while low-productivity workers benefit from the presence of more productive workers, the productivity of high-skill workers *is not* affected by the presence of low-skill co-workers. Second, the magnitude of the spillover depends positively on the frequency of interaction in the workplace. Bandiera, Barankay, and Rasul (2010) study whether the productivity of fruit pickers is affected by the presence of co-workers with whom they share social ties. They consider a situation in which there are no externalities among workers in production, or compensation. They find that, compared to a situation without social ties, a given worker's productivity is significantly higher when working with more able friends, but significantly lower when working with less able friends.

To conclude this section, it is interesting to calculate the certainty equivalent payoff for an employee with personal ideal  $t$  when he exerts the optimal effort level (10). We have

$$u(t, \alpha(t), \beta(t)) = \beta(t) + \frac{1-\lambda}{\lambda} \alpha(t) E[\alpha] + (\lambda t + (1-\lambda) E[t]) \alpha(t) + \frac{1}{2} (1 - \eta \sigma^2) \alpha^2(t) \quad (11)$$

Note that  $\partial^2 u / \partial t \partial \alpha(t) = \lambda > 0$ : Employees with a high personal ideal are more sensitive to an increase in the power of incentives than employees with a low personal ideal. This single-crossing condition will help the firm to screen different types of employees under incomplete information.

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<sup>8</sup>In the model, the level of personal ideals is not affected by the power of incentives proposed by the firm. Accordingly, there is no crowding-out effect of intrinsic motivation by monetary incentives. The model could be extended to include a reduced form of the crowding-out mechanisms modeled in the literature (see, for example, Francois (2000) in the context of public sector motivation, Canton (2005) in a multitask environment, Bénabou and Tirole (2003) in an informed principal setting, and Bénabou and Tirole (2006) in the case of pro-social behaviors). We omit introducing such mechanisms and concentrate on the analysis of social norms and adverse selection.

### 3.2 Problem of the firm

We now turn to the problem of the firm for a given level of employee sensitivity to the social ideal. As a benchmark, we first consider the situation in which the firm knows the employees' personal ideals. We then consider the situation in which the firm cannot observe personal ideals.

#### 3.2.1 The case of complete information about personal ideals

The firm determines the menu of contracts by maximizing its expected profit

$$\max_{\{\alpha(t), \beta(t)\}} \int_{\underline{t}}^{\bar{t}} ((1 - \alpha(t))e^*(t) - \beta(t)) f(t) dt \quad (12)$$

under the participation constraints

$$\forall t \in T, u(t, \alpha(t), \beta(t)) \geq w_0 \quad (13)$$

where  $e^*(t)$  is defined in (10) and  $u(t, \alpha(t), \beta(t))$  in (11). At the optimum, the participation constraints must be binding. We show in Appendix 1 that the firm's program can be written

$$\max_{\{\alpha(t)\}} \int_{\underline{t}}^{\bar{t}} \left( \frac{\alpha(t)}{\lambda} + t - w_0 - \frac{1}{2}(1 + \eta\sigma^2)\alpha^2(t) \right) f(t) dt \quad (14)$$

Maximizing pointwise, we obtain the optimal power of incentives for each type of employee:

$$\forall t \in T, \alpha_{CI}^*(t) = \frac{1}{\lambda(1 + \eta\sigma^2)} \quad (15)$$

where CI stands for complete information. Expression (15) extends the expression of the optimal power of incentives derived in Holmstrom and Milgrom (1987) to the case in which workers have a social work ideal. As in their framework, the firm chooses low-powered incentives when the perceived risk level,  $\eta\sigma^2$ , is high. Three other points are worth noting. First, the firm chooses the same variable rate for all employees, regardless of their personal ideals. This is due to the fact that the personal ideal of an employee does not affect the way his effort responds to monetary incentives: Expression (10) implies that  $\partial^2 e^*(t)/\partial t \partial \alpha(t) = 0$ . Second, the firm chooses a higher power of incentives when

employees are more sensitive to the social ideal. In this situation, the social multiplier effect (7) is indeed strengthened, so that effort becomes more reactive to an increase in the variable rate of the compensation scheme. Third, at equilibrium, the firm has to offer a higher base salary to employees with a low personal ideal. This is because, for a menu of contracts with equal variable rates, the certainty equivalent (11) is increasing in the employees' personal ideal. This explains why, under incomplete information, the firm will have to propose a different menu of contracts in order to prevent employees with high personal ideals from switching to contracts aimed at employees with low personal ideals.

### 3.2.2 The case of incomplete information about personal ideals

We now assume that the firm does not observe the employees' personal ideals. The firm has to make sure that each type of employee chooses the contract designed for him. The profit maximizing program becomes

$$\max_{\{\alpha(t), \beta(t)\}} \int_{\underline{t}}^{\bar{t}} ((1 - \alpha(t))e^*(t) - \beta(t)) f(t) dt \quad (16)$$

under the participation constraints

$$\forall t \in T, u(t, \alpha(t), \beta(t)) \geq w_0 \quad (17)$$

and the incentive constraints

$$\forall t, t' \in T, u(t, \alpha(t), \beta(t)) \geq u(t, \alpha(t'), \beta(t')) \quad (18)$$

Let us consider two employees whose personal ideals  $t$  and  $t'$  satisfy  $t' > t$ . Summing the two incentive constraints  $u(t, \alpha(t), \beta(t)) \geq u(t, \alpha(t'), \beta(t'))$  and  $u(t', \alpha(t'), \beta(t')) \geq u(t', \alpha(t), \beta(t))$  gives  $\alpha(t') \geq \alpha(t)$ : Incentive compatibility implies that the power of incentives  $\alpha(\cdot)$  has to be non-decreasing. Using standard arguments, we show in Appendix 2 that the optimization problem of

the firm can be simplified to

$$\max_{\{\alpha(t)\}} \int_{\underline{t}}^{\bar{t}} \left( \frac{\alpha(t)}{\lambda} + t - w_0 - \frac{\lambda \alpha(t) (1 - F(t))}{f(t)} - \frac{1}{2} (1 + \eta \sigma^2) \alpha^2(t) \right) f(t) dt \quad (19)$$

under the constraints

$$\forall t \in T, \frac{d\alpha(t)}{dt} \geq 0 \quad (20)$$

Expressions (14) and (19) differ because of the term  $\int_{\underline{t}}^t \frac{\lambda \alpha(t) (1 - F(t))}{f(t)} f(t) dt$  reflecting the informational rent the firm has to give to types  $t > \underline{t}$  for them not to deviate from their specified contracts. This rent is increasing in  $\lambda$ : The adverse selection problem is more severe when employees are less concerned with the collective identity. To solve the maximization problem, we ignore momentarily the constraints (20) and maximize expression (19) pointwise. We obtain

$$\forall t \in T, \alpha_{II}^*(t) = \frac{1}{\lambda(1 + \eta \sigma^2)} - \lambda \frac{1 - F(t)}{f(t)} \frac{1}{1 + \eta \sigma^2} \quad (21)$$

where  $II$  stands for incomplete information. To guarantee that the neglected constraints (20) are verified, we make the following assumption, which is common in an agency context, regarding the hazard rate:

**Assumption 1.** The hazard rate  $\frac{f(t)}{1 - F(t)}$  is increasing in  $t$ .<sup>9</sup>

Under Assumption 1, the firm is able to screen employees according to their personal ideals. The properties of  $\alpha_{II}^*(t)$  are described in the following proposition.

**Proposition 2.**

1. *The power of incentives  $\alpha_{II}^*(t)$  is increasing in  $t$ . There is no distortion in the contract designed for the highest personal ideal:  $\alpha_{II}^*(\bar{t}) = \alpha_{CI}^*(\bar{t})$  and there is a downward distortion for the other personal ideals:  $\alpha_{CI}^*(t) - \alpha_{II}^*(t) = \lambda \frac{1 - F(t)}{f(t)} \frac{1}{1 + \eta \sigma^2}$  increases as  $t$  approaches  $\underline{t}$ .*
2. *The firm provides stronger monetary incentives when employees are more sensitive to the social norm:  $\alpha_{II}^*(t)$  increases when  $\lambda$  decreases. Furthermore, the distortion measured by  $\alpha_{CI}^*(t) - \alpha_{II}^*(t)$  decreases when employees are more sensitive to the social norm.*

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<sup>9</sup>This assumption is verified for distributions such as the uniform, the normal, the exponential, the logistic and the Laplace, among others.

3. *The power of incentives  $\alpha_{II}^*(t)$  is decreasing in the perceived risk level,  $\eta\sigma^2$ .*

Point 1 of Proposition 2 is a result typical of adverse selection problems. To prevent employees with a high personal ideal from deviating, the firm has to give employees with smaller personal ideals a contract in which the power of incentives is lower than under complete information, but in which the fixed part of the compensation is larger (to satisfy the participation constraint). As a consequence, there is a downward distortion compared with the case of complete information. Point 2 conveys two important new results. First, the firm chooses a higher power of monetary incentives when employees are more sensitive to the social ideal. As employees become more oriented toward the collective, the social multiplier stated in Proposition 1 has a stronger effect on the average effort:  $dE[e]/dE[\alpha] = 1/\lambda$  increases as  $\lambda$  decreases. Second, the distortion between the complete information case and the incomplete information case,  $\alpha_{CI}^*(t) - \alpha_{II}^*(t)$ , is reduced when employees are more sensitive to the social norm. In fact, the influence of heterogeneous personal ideals on individual behaviors diminishes when employees become more concerned with the group environment. In this case the firm proposes less differentiated monetary incentives.<sup>10</sup> In point 3, we retrieve a standard result of moral hazard models that the firm chooses a lower power of monetary incentives when employees are more risk adverse (higher  $\eta$ ) or when output is less linked to effort (higher  $\sigma$ ). At equilibrium the profit of the firm is

$$\pi^*(\lambda) = E[t] - w_0 + \frac{1}{2(1 + \eta\sigma^2)} \int_{\hat{t}}^{\bar{t}} \frac{1}{\lambda^2} \left( 1 - \frac{\lambda^2 (1 - F(t))}{f(t)} \right)^2 f(t) dt \quad (22)$$

Not surprisingly, the profit is increasing in the average personal ideal,  $E[t]$ , and increasing when employees become more sensitive to the social ideal.

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<sup>10</sup>If all employees have the same personal ideal  $\hat{t}$  (that is,  $T = \{\hat{t}\}$ ), then  $\frac{1-F(\hat{t})}{f(\hat{t})} = 0$  and we have:

$$\alpha^*(\hat{t}) = \frac{1}{\lambda(1 + \eta\sigma^2)}.$$

We retrieve the result of section 3.2.1 concerning the case of complete information about personal ideals.

## 4 Regulating employees' ideals through social interaction.

We now assume that the firm is able to affect the social orientation of its workforce by choosing the amount of time during which employees can interact. Social interaction can, for example, be fostered and to some extent controlled by the firm through the design of the workplace, through the holding of workshops and team-building activities, or by facilitating recreational breaks. There is a large amount of empirical evidence in sociology, management science, political science, and economics suggesting that individuals are more sensitive to a group norm when they have frequent interaction with the other individuals belonging to the group (e.g., Cialdini and Trost, 2008, for sociology; Cohen and Prusak, 2001, for management science; Putnam, 1995, for political science; Mas and Moretti, 2009, and Bandieri, Barankay, and Rasul, 2008 and 2010, for economics). Cohen and Prusak note, for example, that “if you want people to connect, to talk, to begin to understand and depend on one another, give them places and occasions for meeting, and enough time to develop networks and communities. Social capital needs breathing room - social space and time - within work and surrounding work”.<sup>11</sup> Sociologists emphasize the fact that people learn and internalize the values embodied in the norms through repeated interaction with others (Bicchieri and Muldoon, 2011). The act of matching behaviors and beliefs to a group norm is referred to as conformity and is seen as the result of unconscious influences, social pressure, or rewards and punishments inflicted by the group for following or not following the norm. Individuals become more affected by these stimuli when they interact frequently, and they are more willing to bear the emotional investment initially required to conform: their sensitivity to the group norm increases.

We normalize the length of employees' working time to 1. The firm divides the time between a productive period of length  $p$  where the instantaneous production problem is described in the two previous sections, and a period of length  $b = 1 - p$  during which social bonding takes place. The firm is able to announce and commit to the allocation of working hours before proposing the menu of contracts. As explained above, we assume that the employees' sensitivity to the social ideal is affected by the firm's choice. The more time is allocated to social interaction, the more employees

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<sup>11</sup>Friedley and Manchester (2005) make a similar point to explain what determines team cohesion in speech teams in high schools and colleges: “It is communication in the human moment that most powerfully creates team cohesion - a strong sense of loyalty and commitment to the team vision as one's own ... Whether a room or lounge where team members can congregate between classes and the end of the day, practice space for formal and informal coaching sessions, travel time in cars and vans, or social time to enjoy pizza and a movie, both quantity and quality of communication are necessary to build a cohesive team climate of openness and trust.”

become sensitive to the social norm. Formally,  $\lambda(p)$  is increasing in  $p$ .<sup>12</sup> We assume that during the period in which social bonding takes place, the employees receive their reservation wage,  $w_0$ , at each instant of time. The firm solves

$$\max_p p\pi^*(\lambda(p)) + (1-p)(-w_0)$$

where  $\pi^*(\lambda)$  is given by expression (22). Let  $\varepsilon_\lambda(p)$  denote the elasticity of  $\lambda$  with respect to  $p$ :  $\varepsilon_\lambda(p) = \frac{p\lambda'(p)}{\lambda(p)}$ . We make the following assumption.

**Assumption 2.** (a) The function  $\varepsilon_\lambda$  is increasing in  $p$ . (b) There is a level  $\hat{p} \in (0, 1)$  satisfying  $\varepsilon_\lambda(\hat{p}) = 1/2$ . Let  $\hat{b} = 1 - \hat{p}$ .

The first part of Assumption 2 means that investing in social capital has decreasing returns: when the initial level of interaction is low (respectively, high), allowing for more interaction among employees has a strong positive impact (respectively, a low impact) on their sensitivity to the social norm. The second part of the assumption guarantees that the effect of increasing interaction on employees' sensitivity to the group is sufficiently high to ensure that the firm will find it profitable to invest in social capital. We determine the optimal length of social interaction in Appendix 3. The properties are stated in the following proposition.

**Proposition 3.** *Suppose the average personal ideal of employees is  $E(t) = \hat{t}$ .*

1. *When employees are homogeneous with regard to their personal ideals ( $T = \{\hat{t}\}$ ), the firm chooses to devote a proportion  $b^*$  of working time to social interaction. We have  $b^* = \hat{b}$  if  $\hat{t} = 0$ , where  $\hat{b}$  is defined in Assumption 2. Furthermore,  $b^*$  is decreasing in  $\hat{t}$ .*

2. *When employees are heterogeneous with regard to their personal ideals, the firm chooses to devote a share  $b^{**}$  of working time to social interaction. We have  $b^{**} > b^*$ . Furthermore  $b^{**}$  is decreasing in  $\hat{t}$ .*

Proposition 3 expresses two results. First, it is more profitable for the firm to devote time to developing the employees' social ideal when their average personal ideal is low. In this case, effort is less fueled by personal work ethics and it is therefore less costly for the firm to replace productive activities with bonding activities. Second, for a given average personal ideal, the firm devotes more

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<sup>12</sup>It is convenient to express the analytical problem in  $p$  rather than in  $b$ .

time to developing social interaction for heterogeneous employees than for homogeneous employees. When employees are heterogeneous, the firm faces an adverse selection problem when designing the contracts, and it has to give a rent to the employees with a high personal ideal for effort to make them choose the right contract. By fostering the social orientation of the workforce, the firm is able to reduce the effect of heterogeneity on individual behaviors and reduce the adverse selection problem. Its profit therefore increases.<sup>13</sup>

The past few decades have seen a surge in the number of firms using bonding activities. What has driven such a change? Some researchers suggest that, in times when job security and employees' attachment to firms are diminishing, firms could use soft management policies to shift employees' identity from being personal to being collective (Casey, 1996 or Pratt, 2000). Casey (1996) notes, for example, that "the devices of workplace family and team manifest a corporate effort to provide emotional gratifications at work to counter the attractions of rampant individualism". Nevertheless there is still a lively debate about the real trend in work ethics in recent decades, with some authors suggesting a declining trend and others suggesting stability or even an increasing trend (Twenge, 2010). Other researchers highlight the dramatic changes that have occurred in the demographics of the workforce in developed countries in recent decades. These changes include increases in gender, age, ethnic and cultural diversity.<sup>14</sup> This shift in workforce demographics suggests that work ethos have become more and more diverse and contrasting among employees. Cohen and Prusak (2001) explain that nurturing professional and personal connections among workers is a way for firms to deal with their growing diversity: The collective identity that emerges from the interaction serves as glue for a heterogeneous group of people. Proposition 3 shows that our model is consistent with these two types of explanations: a decrease in the average personal work ideal of employees or a greater heterogeneity of the workforce leads the firm to allocate more time to bonding activities.

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<sup>13</sup>Note that, if Assumption 2(b) was not satisfied, the firm would not allocate time for social interaction, if faced with homogeneous employees.

<sup>14</sup>For example, according to the U.S. Bureau of Labor Statistics, the median age of the American workforce was about 41 years in 2008, compared to about 36 twenty years earlier. For the first time in American history, there are four generations in the workplace. As regards the participation of women in the workforce, women hold 51.4 percent of managerial and professional jobs in 2010, up from 26.1 percent in 1980.

## 5 Concluding remarks

The literature on economics and management theory has recently emphasized that workers are not driven solely by personal considerations but are also concerned with the goals and beliefs of the group or organization in which they work. This observation has led some authors to suggest that firm could regulate workers' sensitivity to this social identity in order to foster performance. In their textbook *Economics, Organizations and Management*, Milgrom and Roberts (1992) note, for example, that "important features of many organizations can best be understood in terms of deliberate attempts to change preferences of individual participants". One way for firms to shape and change the identities of their employees is to provide them with time and space to meet and interact. The firm plays the role of a socialization device, fostering the emergence of a collective identity within the workforce. In this article, we develop a model to study the circumstances under which a firm invests in social capital in order to strengthen the social orientation of its employees and provide extra incentives to exert effort. While there is an opportunity cost associated with bonding activities, namely that less time is available for production, there are also two benefits. First, a social multiplier effect makes monetary incentives more effective and the average effort increases. Second, the distortive effect of adverse selection on contracts is reduced as the shared social ideal becomes more important to employees than their heterogeneous personal ideals. We show that motivating employees through the collective identity acts as a substitute for declining individual work ethics and constitutes a solution for dealing with a greater heterogeneity in the workforce.

Several extensions of the model could be of interest. First, we have focused on a case where the only externalities amongst employees are social. This allows us to isolate the effect of the social ideal on incentives. Nevertheless, it is reasonable to believe that the social interaction taking place in the workplace also facilitates the exchange of information between employees and the development of new ideas. Therefore, it could be interesting to modify the model so that, in addition to their effects on work ideals, interactions also engender technological spillovers between workers and improvements in the productive process. This should reinforce the incentives of the firm to invest in social capital and use high powered incentives. Second, there is only one reference group in our framework, namely the entire workforce, relative to which the social ideal of effort is

defined. It could be interesting to make the number of reference groups endogenous and assume that employees choose the group they wish to conform to. Third, we assume that employees have the same sensitivity to the social norm. Another possible extension could therefore be to allow for different degrees of sensitivity.

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## Appendices

### Appendix 1. Derivation of the optimal contract under complete information

Using expressions (4) and (10) and setting  $\alpha(t)e^*(t) + \beta(t) - \frac{1}{2}(e^*(t) - n(t))^2 - \frac{1}{2}\eta\sigma^2\alpha^2(t) = w_0$ ,

we can write

$$\begin{aligned}
 \int_{\underline{t}}^{\bar{t}} ((1 - \alpha(t))e^*(t) - \beta(t)) f(t)dt &= \int_{\underline{t}}^{\bar{t}} \left( e^*(t) - w_0 - \frac{1}{2}(1 + \eta\sigma^2)\alpha^2(t) \right) f(t)dt \\
 &= \int_{\underline{t}}^{\bar{t}} \left( \lambda t + (1 - \lambda)E[t] + \frac{\lambda\alpha(t) + (1 - \lambda)E[\alpha]}{\lambda} - w_0 - \frac{\alpha^2(t)}{2}(1 + \eta\sigma^2) \right) f(t)dt \\
 &= \int_{\underline{t}}^{\bar{t}} \left( \frac{\alpha(t)}{\lambda} + t - w_0 - \frac{1}{2}(1 + \eta\sigma^2)\alpha^2(t) \right) f(t)dt
 \end{aligned}$$

### Appendix 2. Derivation of the optimal contract under incomplete information

We want to show that the program

$$\max_{\{\alpha(t), \beta(t)\}} \int_{\underline{t}}^{\bar{t}} ((1 - \alpha(t))e^*(t) - \beta(t)) f(t)dt \quad (23)$$

subject to

$$\forall t \in T, u(t, \alpha(t), \beta(t)) \geq w_0 \quad (24)$$

and

$$\forall t, t' \in T, u(t, \alpha(t), \beta(t)) \geq u(t, \alpha(t'), \beta(t')) \quad (25)$$

can be simplified to

$$\max_{\{\alpha(t)\}} \int_{\underline{t}}^{\bar{t}} \left( \frac{\alpha(t)}{\lambda} + t - w_0 - \frac{\lambda\alpha(t)(1 - F(t))}{f(t)} - \frac{1}{2}(1 + \eta\sigma^2)\alpha^2(t) \right) f(t)dt \quad (26)$$

subject to the constraints

$$\forall t \in T, \frac{d\alpha(t)}{dt} \geq 0 \quad (27)$$

We roughly follow the method of Laffont and Martimort (2002). For convenience, let us define

$u(t, \tilde{t}) = u(t, \alpha(\tilde{t}), \beta(\tilde{t}))$  where

$$u(t, \alpha(\tilde{t}), \beta(\tilde{t})) = \beta(\tilde{t}) + \frac{1-\lambda}{\lambda} \alpha(\tilde{t}) E[\alpha] + (\lambda t + (1-\lambda) E[t]) \alpha(\tilde{t}) + \frac{1}{2} (1-\eta\sigma^2) \alpha^2(\tilde{t}) \quad (28)$$

is the certainty equivalent payoff for an employee with personal ideal  $t$  when he has chosen the contract  $\{\alpha(\tilde{t}), \beta(\tilde{t})\}$  (see equation (11)). Let  $u(t) = u(t, t)$ . Condition (25) implies the following local first-order condition for type  $t$ :  $\left. \frac{\partial u(t, \tilde{t})}{\partial \tilde{t}} \right|_{\tilde{t}=t} = 0$  or

$$\frac{d\beta(t)}{dt} + \frac{1-\lambda}{\lambda} \frac{d\alpha(t)}{dt} E[\alpha] + (\lambda t + (1-\lambda) E[t]) \frac{d\alpha(t)}{dt} + (1-\eta\sigma^2) \alpha(t) \frac{d\alpha(t)}{dt} = 0 \quad (29)$$

The local second-order condition for  $t$  is  $\left. \frac{\partial^2 u(t, \tilde{t})}{\partial \tilde{t}^2} \right|_{\tilde{t}=t} \leq 0$  or

$$\frac{d^2\beta(t)}{dt^2} + \frac{1-\lambda}{\lambda} \frac{d^2\alpha(t)}{dt^2} E[\alpha] + (\lambda t + (1-\lambda) E[t]) \frac{d^2\alpha(t)}{dt^2} + (1-\eta\sigma^2) \left( \left( \frac{d\alpha(t)}{dt} \right)^2 + \alpha(t) \frac{d^2\alpha(t)}{dt^2} \right) \leq 0 \quad (30)$$

By differentiating (29) with respect to  $t$ , we find

$$\frac{d^2\beta(t)}{dt^2} + \frac{1-\lambda}{\lambda} \frac{d^2\alpha(t)}{dt^2} E[\alpha] + \lambda \frac{d\alpha(t)}{dt} + (\lambda t + (1-\lambda) E[t]) \frac{d^2\alpha(t)}{dt^2} + (1-\eta\sigma^2) \left( \left( \frac{d\alpha(t)}{dt} \right)^2 + \alpha(t) \frac{d^2\alpha(t)}{dt^2} \right) = 0 \quad (31)$$

By using (30), (31) can be written more simply as  $\frac{d\alpha(t)}{dt} \geq 0$ . Note that the local incentive constraint for employee  $t$  (expression (29)) implies the global incentive constraint for  $t$  (expression (25)). To prove it, let us consider  $t' \neq t$ . Using (29), we can write

$$\begin{aligned} \beta(t) - \beta(t') &= \int_{t'}^t \dot{\beta}(\tau) d\tau \\ &= - \int_{t'}^t \left( \frac{1-\lambda}{\lambda} \dot{\alpha}(\tau) E[\alpha] + (\lambda \tau + (1-\lambda) E[t]) \dot{\alpha}(\tau) + (1-\eta\sigma^2) \alpha(\tau) \dot{\alpha}(\tau) \right) d\tau \\ &= - \int_{t'}^t \frac{\partial}{\partial \tau} \left( \frac{1-\lambda}{\lambda} \alpha(\tau) E[\alpha] + (\lambda \tau + (1-\lambda) E[t]) \alpha(\tau) + \frac{1}{2} (1-\eta\sigma^2) \alpha^2(\tau) - \lambda A(\tau) \right) d\tau \end{aligned} \quad (32)$$

where  $A(\tau)$  is a primitive of  $\alpha(\tau)$ . We have

$$\begin{aligned}
\beta(t) - \beta(t') &= - \left[ \frac{1-\lambda}{\lambda} \alpha(\tau) E[\alpha] + (\lambda\tau + (1-\lambda)E[t])\alpha(\tau) + \frac{1}{2}(1-\eta\sigma^2)\alpha^2(\tau) \right]_{t'}^t + \int_{t'}^t \lambda\alpha(\tau)d\tau \\
&= - \frac{1-\lambda}{\lambda} \alpha(t) E[\alpha] - (\lambda t + (1-\lambda)E[t])\alpha(t) - \frac{1}{2}(1-\eta\sigma^2)\alpha^2(t) + \frac{1-\lambda}{\lambda} \alpha(t') E[\alpha] \\
&\quad + (\lambda t' + (1-\lambda)E[t])\alpha(t') + \frac{1}{2}(1-\eta\sigma^2)\alpha^2(t') + \int_{t'}^t \lambda\alpha(\tau)d\tau
\end{aligned} \tag{33}$$

Hence

$$\begin{aligned}
&\beta(t) + \frac{1-\lambda}{\lambda} \alpha(t) E[\alpha] + (\lambda t + (1-\lambda)E[t])\alpha(t) + \frac{1}{2}(1-\eta\sigma^2)\alpha^2(t) \\
&= \beta(t') + \frac{1-\lambda}{\lambda} \alpha(t') E[\alpha] + (\lambda t' + (1-\lambda)E[t])\alpha(t') + \frac{1}{2}(1-\eta\sigma^2)\alpha^2(t') + \int_{t'}^t \lambda\alpha(\tau)d\tau \\
&= \beta(t') + \frac{1-\lambda}{\lambda} \alpha(t') E[\alpha] + (\lambda t + (1-\lambda)E[t])\alpha(t') + \frac{1}{2}(1-\eta\sigma^2)\alpha^2(t') - \lambda(t-t')\alpha(t') + \int_{t'}^t \lambda\alpha(\tau)d\tau
\end{aligned} \tag{34}$$

Therefore  $u(t, t) = u(t, t') - \lambda(t-t')\alpha(t') + \int_{t'}^t \lambda\alpha(\tau)d\tau$ . However  $-\lambda(t-t')\alpha(t') + \int_{t'}^t \lambda\alpha(\tau)d\tau$  is positive because we know from above that  $\alpha(t)$  is non-decreasing. Hence, for any  $t' \neq t$ ,  $u(t, t) \geq u(t, t')$ : the global incentive constraint is satisfied for type  $t$ .

We now rewrite the maximization problem of the firm as a function of  $\alpha(t)$  and  $u(t)$  instead of  $\alpha(t)$  and  $\beta(t)$ . We know that  $u(t) = \beta(t) + \frac{1-\lambda}{\lambda} \alpha(t) E[\alpha] + (\lambda t + (1-\lambda)E[t])\alpha(t) + \frac{1}{2}(1-\eta\sigma^2)\alpha^2(t)$ . The incentive constraints (29) are replaced by the constraints  $\frac{du(t)}{dt} = \lambda\alpha(t)$  and  $\frac{d\alpha(t)}{dt} \geq 0$ .<sup>15</sup> Using the fact that  $\frac{du(t)}{dt} > 0$  allows the participation constraints (24) to be simplified to  $u(\underline{t}) = w_0$ . The maximization program of the firm becomes

$$\max_{\{\alpha(t), u(t)\}} \int_{\underline{t}}^{\bar{t}} \left( \frac{\lambda\alpha(t) + (1-\lambda)E[\alpha]}{\lambda} + \lambda t + (1-\lambda)E[t] - u(t) - \frac{1}{2}(1+\eta\sigma^2)\alpha^2(t) \right) f(t)dt \tag{35}$$

under the constraints:

$$\forall t \in T, \frac{du(t)}{dt} = \lambda\alpha(t) \tag{36}$$

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<sup>15</sup>Indeed  $\frac{du(t)}{dt} = \lambda\alpha(t) + \left( \frac{d\beta(t)}{dt} + \frac{1-\lambda}{\lambda} \frac{d\alpha(t)}{dt} E[\alpha] + (\lambda t + (1-\lambda)E[t]) \frac{d\alpha(t)}{dt} + (1-\eta\sigma^2)\alpha(t) \frac{d\alpha(t)}{dt} \right)$ , but the term in parentheses is zero from the first-order condition (29).

$$\forall t \in T, \frac{d\alpha(t)}{dt} \geq 0 \quad (37)$$

$$u(\underline{t}) = w_0 \quad (38)$$

Using (36) and (38), we have  $u(t) = u(\underline{t}) + \int_{\underline{t}}^t \lambda \alpha(\tau) d\tau = w_0 + \int_{\underline{t}}^t \lambda \alpha(\tau) d\tau$ . Therefore, we can rewrite (35) as

$$\max_{\{\alpha(t)\}} \int_{\underline{t}}^{\bar{t}} \left( \frac{\lambda \alpha(t) + (1 - \lambda) E[\alpha]}{\lambda} + \lambda t + (1 - \lambda) E[t] - \int_{\underline{t}}^t \lambda \alpha(\tau) d\tau - w_0 - \frac{1}{2} (1 + \eta \sigma^2) \alpha^2(t) \right) f(t) dt \quad (39)$$

However

$$\begin{aligned} \int_{\underline{t}}^{\bar{t}} \left( \int_{\underline{t}}^t \lambda \alpha(\tau) d\tau \right) f(t) dt &= \left[ F(t) \int_{\underline{t}}^t \lambda \alpha(\tau) d\tau \right]_{\underline{t}}^{\bar{t}} - \int_{\underline{t}}^{\bar{t}} (\lambda \alpha(t)) F(t) dt \\ &= \int_{\underline{t}}^{\bar{t}} \lambda \alpha(t) dt - \int_{\underline{t}}^{\bar{t}} \lambda \alpha(t) F(t) dt = \int_{\underline{t}}^{\bar{t}} \lambda \alpha(t) (1 - F(t)) dt \end{aligned} \quad (40)$$

As a consequence the maximization problem of the firm becomes

$$\max_{\{\alpha(t)\}} \int_{\underline{t}}^{\bar{t}} \left( \frac{\lambda \alpha(t) + (1 - \lambda) E[\alpha]}{\lambda} + \lambda t + (1 - \lambda) E[t] - w_0 - \frac{\lambda \alpha(t) (1 - F(t))}{f(t)} - \frac{1}{2} (1 + \eta \sigma^2) \alpha^2(t) \right) f(t) dt \quad (41)$$

subject to the constraints (37), or

$$\max_{\{\alpha(t)\}} \int_{\underline{t}}^{\bar{t}} \left( \frac{\alpha(t)}{\lambda} + t - w_0 - \frac{\lambda \alpha(t) (1 - F(t))}{f(t)} - \frac{1}{2} (1 + \eta \sigma^2) \alpha^2(t) \right) f(t) dt \quad (42)$$

subject to (37).

### Appendix 3. Proof of Proposition 3.

We solve

$$\max_p \left( E[t] - w_0 + \frac{1}{2(1 + \eta\sigma^2)\lambda^2(p)} \int_{\underline{t}}^{\bar{t}} \left( 1 - \frac{\lambda^2(p)(1 - F(t))}{f(t)} \right)^2 f(t) dt \right) + (1 - p)(-w_0) \quad (43)$$

Let  $X(t, p) = 1 - \frac{\lambda^2(p)(1 - F(t))}{f(t)}$ . The first-order condition is

$$\begin{aligned} E[t] + \frac{1}{2(1 + \eta\sigma^2)\lambda^2(p)} \int_{\underline{t}}^{\bar{t}} X^2(t, p) f(t) dt \\ - p \left( \frac{\lambda'(p)}{(1 + \eta\sigma^2)\lambda^3(p)} \int_{\underline{t}}^{\bar{t}} X^2(t, p) f(t) dt + \frac{2}{(1 + \eta\sigma^2)\lambda^2(p)} \int_{\underline{t}}^{\bar{t}} \frac{\lambda(p)\lambda'(p)(1 - F(t))}{f(t)} X(t, p) f(t) dt \right) = 0 \end{aligned} \quad (44)$$

or

$$\begin{aligned} E[t] + \frac{1}{(1 + \eta\sigma^2)\lambda^2(p)} \left( \frac{1}{2} - \varepsilon_\lambda(p) \right) \int_{\underline{t}}^{\bar{t}} X^2(t, p) f(t) dt \\ - \frac{2p}{(1 + \eta\sigma^2)\lambda^2(p)} \int_{\underline{t}}^{\bar{t}} \frac{\lambda(p)\lambda'(p)(1 - F(t))}{f(t)} X(t, p) f(t) dt = 0 \end{aligned} \quad (45)$$

where  $\varepsilon_\lambda(p) = \frac{p\lambda'(p)}{\lambda(p)}$ .

Let  $E(t) = \hat{t}$ . Suppose that employees are identical. Expression (45) reduces to

$$\hat{t} + \frac{1}{(1 + \eta\sigma^2)\lambda^2(p)} \left( \frac{1}{2} - \varepsilon_\lambda(p) \right) = 0 \quad (46)$$

If  $\hat{t} = 0$  then the solution of (46) is  $p^* = \hat{p}$  with  $\varepsilon_\lambda(\hat{p}) = 1/2$ . If  $\hat{t} > 0$  then the solution of (46) is  $p^* > \hat{p}$ . It is easily verified that  $p^*$  is increasing in  $\hat{t}$ . Suppose employees are not identical (and hence necessarily  $\hat{t} > 0$ ) then  $\int_{\underline{t}}^{\bar{t}} X^2(t, p) f(t) dt < 1$ . The solution of (45) is therefore  $p^{**} < p^*$ .





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ISSN 0809-733X



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