



Internal sanction or external sanction?⁽¹⁾

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Abstract This work studies the relative merits of two distinct management policies by which a manager induces a worker's effort, based on the work norm. One policy is to induce the worker to experience disutility (guilt) if he shirks by making him internalize a sanction through an educational program. The other policy is to give him an incentive from the outside, by punishment. The former policy is shown to be effective when the worker has a high level of intrinsic motivation, and the latter policy is effective when the worker is sufficiently patient.

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1. Introduction

To generate higher productivity, a manager can induce workers' efforts at the workplace by providing incentives. For example, we can think of schemes based on external interventions contingent on work performance, including reward or punishment; or others that generate a sense of self-discipline through an educational program, so that workers increase their effort spontaneously. Below, regulation of the work effort of workers is defined through the work norm.

Why do people obey the established norm in spite of possible inefficiency? Elster (1989) answered this question using the concepts of internal and external sanctions. An internal sanction is a feeling of guilt, anxiety or shame. Influenced by these feelings, members of an organization obey norms even in the absence of any extrinsic motivators. Education of workers into discipline is an example of a management policy that exploits internal sanctions. An external sanction is a sanction by other members of an organization, which makes it rational for each member to choose norm-guided behaviors. The performance-based provision of rewards and punishments is an example of an external sanction. The existing literature on the work norm, as well as agency theory, mainly analyzes the roles of external sanctions in inducing workers' efforts.⁽²⁾ The underlying assumption is that workers feel the disutility of efforts.

Baron (1988) pointed out that the assumption commonly used in simple agency models might be entirely wrong. His assertion is likely to be true when workers have high initial levels of intrinsic motivation. There are various reasons for employed workers to have high intrinsic work motivation. They are motivated by feelings of competence and self-determination (Deci, 1975); or the work is performed for its own sake (Frey, 1997); or pride in their work might be high

(2) For the norm, see Kandori (1992), and Okuno-Fujiwara and Postlewaite (1995). These results are based on the Folk Theorem in the theory of repeated games that focuses on a punishment that provides players with extrinsic incentives. See also, for example, Fudenberg and Maskin (1986), and Abreu (1988). For the agency theory, see Macho-Stadler and Pérez-Castrillo (2001) and Salanié (1997). The agency theory, by contrast, focuses on a reward that provides agents with extrinsic incentives.

and the work is interesting (Kreps, 1997); or they feel sufficient satisfaction with their work; or creativity and the quality of work is important. Kreps (1997) asserted that employed workers may take sufficient pride in their work to increase their utility.

Frey (1997) has pointed out that when the agent has a sufficiently high intrinsic work motivation at the outset, the use of extrinsic incentives may crowd out intrinsic work motivation. The crowding-out effect has been discussed by many socio-psychologists (e.g., Deci, 1975; Deci and Ryan, 1985) and economists (e.g., Frey, 1997; Kreps, 1997; Leete, 2000; Bénabou and Tirole, 2003). Kreps(1997) asserted that the provision of extrinsic incentives for workers can be counterproductive, leading to reduced levels of quality-weighted effort and lower net profits for the employer. Leete (2000) suggested that wage dispersion should be less apparent in the nonprofit sector which relies on intrinsically motivated employees having continuing intrinsic motivation. Bénabou and Tirole (2003) showed that when only the principal knows the task's difficulty or the agent's suitability to the task, a reward offered by him works as a signal about it, so that an increase in the reward is interpreted negatively by the agent and always reduces his assessment of the task's attractiveness. With these points in mind, analysis should not be restricted to external sanctions in considering the worker's motivation.

The present paper studies the relative merits of management policies utilizing internal sanction and external sanction. We examine the effects of an external sanction on the conditions under which a manager can induce a worker's effort using monitoring and punishment. We consider not only the direct effect that decreases a worker's utility when he is caught shirking, but also an indirect effect through the reduction of worker's motivation that may increase a worker's utility when he shirks. When a worker has a high level of intrinsic motivation at the outset the former policy is found to be effective, and when he does not have a high level of motivation but is sufficiently patient the latter policy is effective.

We take into account the two factors mentioned above. The first is that when a worker has a high level of intrinsic motivation his utility is an increasing function of his effort level. We say that the worker has a high level of intrinsic

motivation when his marginal utility of effort is positive. Unlike the usual agency models, we assume that the worker feels not only a positive level of disutility from working hard but also a (positive or zero) level of disutility from shirking. As a result, his marginal utility of effort is defined as the disutility from shirking minus that from working. This implies that if he feels greater disutility from shirking than from working then his marginal utility of effort is positive. These observations suggest that the level of disutility from shirking that the highly motivated worker feels spontaneously is high enough to deter his own deviations. In contrast, when he feels no disutility from shirking the internal sanction cannot effectively deter his deviations.

The second factor is that the provision of extrinsic incentives crowds out the worker's intrinsic motivation. This fact is reflected by assumption 3 in section 2.3; the present results are all based on this assumption. When crowding out arises it is shown that the conflict between extrinsic incentives and intrinsic motivation may cause a trade-off between the use of punishments and their effectiveness; the probability that the manager can induce the worker's effort using punishments decreases as the punishments become more severe. This is because the crowding-out effect may cause the worker to have a negative marginal utility of effort. The external sanction should therefore be used only when no such conflict arises. Instead, as suggested by the Folk Theorem, the worker must be sufficiently patient that the future disutility caused by punishments is large enough to deter his deviations. Consequently, the external sanction can effectively induce a worker's effort only when his motivation level is low but his discount factor is high.

Below, Section 2 presents the labor contract model used, in which a worker has private information about his characteristics. The main difference from conventional agency models, in which the worker's private information, e.g. his ability, is incorporated as the difference between disutility levels for *working*, is that in our model it is reflected in the difference between disutility levels for *shirking*. Correspondingly, we consider punishment rather than reward as an extrinsic motivator. Section 3 determines a management policy to induce a worker's effort

at the minimum cost, given his characteristics. Conclusions are presented in Section 4.

2. The model

2.1 The manager-worker game

We now describe the model. A manager and a worker make a labor contract. The manager hires the worker and produces one unit of goods every period of time t ($t = 0, 1, \dots$). In period t , the worker exerts an effort e_t and receives a wage payment w_t . If the worker can be characterized by his initial level of motivation and his patience, which are assumed to be his private information, his choice of effort level depends on these as well as upon the manager's choice of policy.

The management policy we consider involves two stages: ex ante monitoring at the first stage, and interim monitoring at the second stage. The former is mainly concerned with ex ante information about the worker's characteristics. The latter is mainly concerned with ex post information about the worker's actions. We analyze the outcome of the management policy using a multi-stage game with incomplete information between the manager and the worker.

Before period 0, events take place in the following order: (1) the worker's characteristics are determined by Nature, (2) the manager offers a contract under which an initial payment is w_0 (ex ante monitoring), (3) the worker decides whether to accept the contract, (4) if the worker accepts, the manager determines how to induce the worker's effort (interim monitoring).

2.2 Manager and management policies

Here, we formalize the two policies available to the manager and consider his choice. At the first stage the initial payment w_0 is determined according to the worker's initial level of motivation, so that he accepts the proposed contract and reveals his motivation level truthfully. As discussed in the Introduction, the worker's intrinsic motivation is an important factor for the decision-making at the next stage.

At the second stage, the manager determines how to induce the worker's effort by considering the relations between the worker's optimal choice of effort and his characteristics. Two options are considered for the second stage of the management policy: one is to cause the worker to internalize sanctions; the other is to provide an external incentive using monitoring and punishment. We assume that the manager cuts the worker's wage by $\Delta w = (1 - \alpha) w_0$, $\alpha \in [0, 1]$, in the case of punishment, and that a worker's deviation is punished with probability $p \in [0, 1]$. The manager's choice of interim monitoring is described by the parameter values (α, p) .

(1) *Policy exploiting internal sanction (the IS policy)*

The first question is whether the manager provides the worker with an educational program to cause him to obey the work norm spontaneously. We call the first option *the IS policy*. The role of the IS policy is to induce a potential disutility caused by the worker's intrinsic motivation when he deviates from the work norm; no monitoring or punishment is used, i.e. $\alpha = 1$ and $p = 0$ for all t .⁽³⁾ This implies that the manager makes a commitment to pay a constant wage every period. We suppose that the cost is C_t in the first period of providing the educational program.

(2) *Policies exploiting external sanction (the ES policy)*

The manager's second option is whether or not to keep the probability of external sanction high enough to give the worker an extrinsic incentive to obey the established work norm. The option is to keep the probability p high by spending a monitoring cost $c_E(p)$ each period and to use a punishment $\Delta w > 0$ when a deviation is found, i.e. $\alpha \in (0, 1)$ and $p \gg 0$ for all t . We call this second option *the ES policy*. The last option is the maximal punishment in which the manager dis-

(3) We can formulate the educational program as a random process in the following manner: Assume that it increases the worker's disutility level by η , where η is a random variable uniformly distributed on $[0, \sigma]$ with $\sigma > 0$. In fact, this formulation does not change our main conclusion. This is because the manager would choose the IS policy only when he is sure that it can deter the worker's deviation in the worst case where the realized. $\eta = 0$

misses the worker, i.e., $\alpha = 0$. This still costs C_D .

The manager's preference is defined using the cost of each policy; obviously, he prefers the cheaper policy. Assume that if the worker deviates the manager may suffer a loss l . This is not necessarily informative as to his deviation because of imperfect monitoring. The expected present value of l in the first period is $\delta_m^t l_e$ if the deviation occurs in period t .

We make the following assumption concerning the total costs:

Assumption 1. The costs are taken to obey:

$$C_I \leq C_E(p) + L, C_E(p) \leq C_I + L, C_D \leq L \quad (1)$$

for all $p \in [0, 1]$, where $C_E(p) = \sum_{t=0}^{\infty} \delta_m^t c_E(p)$ (here $C_E(0) = 0$, $C'_E(p) \geq 0$) and $L = \sum_{t=0}^{\infty} \delta_m^t l_e$ both represent the discount sum, and $\delta_m \in [0, 1)$ is the manager's discount factor.

The first inequality in (1) implies that, if the manager judges from information about the worker's characteristics that internalization of the work norm is possible through an educational program, he will choose the IS policy to reduce the monitoring costs. The second inequality implies that if the manager judges that an external sanction can deter the worker's deviation, he will choose the ES policy. The third inequality implies that the maximum punishment is used after a finite number of deviations are observed.

2.3 The Worker

In this section we formalize the worker's possible effort levels and his preference. Suppose, for simplicity, that the effort level of the worker can only take two possible values: $e_t \in \{0, 1\}$ where $e_t = 1$ corresponds to working hard, and $e_t = 0$ to shirking. We shall often refer to $e_t = 1$ as obeying the work norm and $e_t = 0$ as deviating from it.

If we assume that the worker is risk neutral, his instantaneous utility in pe-

riod t is written as:

$$u_t = w_0 - e_t - D(e_{t-1}, e_t, \alpha, p) \quad (2)$$

where w_0 represents a wage offered by the manager, e_t represents the (physical or mental) disutility of effort, and D represents the total disutility from shirking, which depends on the worker's effort levels (e_{t-1}, e_t) and the manager's choice of interim monitoring (α, p) . The disutility function D in (2) takes the form:

$$D(e_{t-1}, e_t, \alpha, p) = (1 - e_t) d_t(\alpha) + p(1 - e_{t-1}) \Delta w, \quad (3)$$

where $\Delta w = (1 - \alpha) w_0$. This takes the values $D(1, 1, \alpha, p) = 0$ for any α and p , $D(0, 0, \alpha, p) = d_t(\alpha) + p(1 - \alpha) w_0$, and $D(0, 0, 1, 0) = d_t(1)$, where d_t represents the disutility caused by an internal sanction. (Note that $d_t(1)$ can be positive or zero).

We make two assumptions concerning the disutility d_t of any internal sanction:

Assumption 2. The function d_t is non-negative: $d_t(\alpha) \geq 0$ for all α .

Assumption 3. The function d_t is concave in α : $d'_t(\alpha) \geq 0$ and $d''_t(\alpha) \leq 0$ for all $\alpha \in [0, 1]$.

This assumption implies that the disutility caused by the internal sanction decreases as the disutility caused by the external sanction increases (α decreases), and that the decrease in the disutility increases as α decreases. This reflects the crowding-out effect discussed in the Introduction and is the central assumption involved in the present results.⁽⁴⁾

(4) Our assumption is similar to Frey's (1997) explanation of the crowding-out effect: When a work activity is supported by both high work morale and external intervention, a 'psychologically' unstable situation arises in which the worker is 'over motivated'. ↗

We now characterize the worker in terms of intrinsic motivation using the disutility d_t for shirking. It can be verified that the worker's marginal utility of effort, $u(e_{t-1}, 1, \alpha, w_0) - u(e_{t-1}, 0, \alpha, w_0) = d_t(\alpha) - 1$, is positive if $d_t(\alpha) \geq 1$. From assumption 3, the marginal utility decreases as the potential punishment becomes more severe. Assumption 3 then implies that the fear of severe punishment may cause a negative marginal utility of effort. We assume that if $d_t(\alpha) \geq 1$, there exists a value $\alpha^* < 1$ such that $d_t(\alpha^*) = 1$.

For simplicity, assume that $d_t(1)$ can take only two possible values: $d_t(1) \in \{0, d\}$ where $d \geq 1$. Then $d_t(1) = d \geq 1$ corresponds to the case in which the worker's marginal utility of effort is positive even without any extrinsic motivators (a case of high motivation level). On the other hand, $d_t(1) = 0$ corresponds to the case in which the worker's marginal utility of effort is negative without extrinsic motivators (low motivation level). This, together with assumptions 2 and 3, implies that $d_t(\alpha) = 0$ for all $\alpha \in [0, 1]$. This assumption would not change the results in section 2.4 in any essential way.

The worker has an intertemporal utility function of the form:

$$U = \sum_{t=0}^{\infty} \delta^t u_t, \quad (4)$$

where u_t is an instantaneous utility of the worker in period t , and the long-run discount factor is $\delta \in [0, 1)$. The worker is characterized by an initial level of motivation d and patience δ . The worker's problem is to choose e_t , for given parameters (d, δ) and (w_0, α, p) , so that:

$$e_t = \text{Arg max}_e \left[u_t + \delta \left(\sum_{s=1}^{\infty} \delta^{s-1} u_{t+s} \right) \right]. \quad (5)$$

2.4 The worker's choice of effort

This section provides the relations between the worker's optimal choice of ef-

↘A rational response of the worker to the situation is to reduce his intrinsic work motivation insofar as it is under his control. Intrinsic motivation is partially or totally substituted by externally controlled extrinsic work motivation. The principal difference between Frey's (1997) explanation and ours is explained in footnote (5).

fort e_t and his characteristics (d, δ) , given (w_0, α, p) , based on the utility maximization given by (5).

From (2), (3), and (5), the worker's effort level is determined as follows:

$$e_t = \text{Arg max}_e \left[u_t + \delta \left(\sum_{s=1}^{\infty} \delta^{s-1} u_{t+s} \right) \right], \quad (6)$$

where $u_t = w_0 + e_t [d_I(\alpha) + p \delta \Delta w - 1] - d_I(\alpha) - p \delta \Delta w$.

In the case of the *IS policy* ($\alpha = 1$ and $p = 0$), we have $u_t = w_0 + e_t [d_I(1) - 1] - d_I(1)$. Thus, the worker's effort level is determined as follows:

$$e_t = \begin{cases} 0 & \text{if } d_I(1) < 1, \\ 1 & \text{if } d_I(1) \geq 1. \end{cases} \quad (7)$$

This states that a worker with a high level of motivation at the outset is willing to work hard even in the absence of external sanctions. In this case, whether he works hard does not depend on his patience.

In the case of the *ES policy* ($\alpha \in [0, 1)$ and $p \gg 0$), the worker's effort level is determined depending on the probability p of the external sanction, as follows:

$$e_t = \begin{cases} 0 & \text{if } 0 \leq p < p^*, \\ 1 & \text{if } p^* \leq p \leq 1. \end{cases} \quad (8)$$

where $p^* = (1 - d_I(\alpha)) / \delta (1 - \alpha) w_0$. Here $p^* < 1$ if and only if $\delta > \delta^*$ for given $\alpha \in [0, 1)$, where $\delta^* = (1 - d_I(\alpha)) / (1 - \alpha) w_0$. If $\delta < \delta^*$ then the worker does not work hard for all p .

The manager aims to induce the worker's effort by using a severe punishment (making α smaller) and intensive monitoring (making p larger). Since both p^* and δ^* involve d_I , the question of whether the external sanction is effective depends on the worker's motivation level. We show that a high level of intrinsic motivation reduces the effectiveness of an external sanction, and a low level of

motivation increases it.⁽⁵⁾

Proposition 1. (1) If the worker's motivation is high ($d \geq 1$), then the probability p^* and the discount factor δ^* are both monotonically decreasing in α ; (2) On the other hand, if the worker's motivation is low ($d_I(\alpha) = 0$ and $d'_I(\alpha) = 0$ for all α), both p^* and δ^* are monotonically increasing in α .

Proof. By partially differentiating p^* and δ^* with respect to α , we have:

$$\frac{\partial p^*}{\partial \alpha} = \frac{-\delta w_0[(1-\alpha)d'_I(\alpha) - (1-d_I(\alpha))]}{\{\delta(1-\alpha)w_0\}^2}, \quad (9)$$

$$\frac{\partial \delta^*}{\partial \alpha} = \frac{-w_0[(1-\alpha)d'_I(\alpha) - (1-d_I(\alpha))]}{\{\delta(1-\alpha)w_0\}^2}. \quad (10)$$

We begin with the case $d \geq 1$, such that the worker's motivation level is high. By assumption 3, $d'_I(\alpha) \geq 0$ and $\alpha < 1$, and if $1 - d_I(\alpha) < 0$ for $\alpha^* < \alpha < 1$ the right-hand sides of (9) and (10) are negative. Next, if $1 - d_I(\alpha) \geq 0$ for $\alpha \leq \alpha^*$, the inequality $(1 - \alpha) d'_I(\alpha) > 1 - d_I(\alpha)$ can be shown to hold. The tangent line of d_I at a point $(\alpha', d_I(\alpha'))$ is $d_I = d'_I(\alpha')(\alpha - \alpha') + d_I(\alpha')$, which crosses the line $\alpha = 1$ at $(1, (1 - \alpha') d'_I(\alpha') + d_I(\alpha'))$. We now show that $(1 - \alpha) d'_I(\alpha) + d_I(\alpha)$ is greater than 1 for any $\alpha \leq \alpha^*$. From $d_I(\alpha^*) = 1$ and $d'_I(\alpha^*) > 0$, we have $(1 - \alpha^*) d'_I(\alpha^*) + d_I(\alpha^*) > 1$. By the concavity of d_I (assumption 3), $d'_I(\alpha) > d'_I(\alpha^*)$ for $\alpha \leq \alpha^*$. Thus, $(1 - \alpha) d'_I(\alpha) + d_I(\alpha) > 1$ also holds.

On the other hand, if the worker's motivation is low, $d_I(\alpha) = 0$ and $d'_I(\alpha) = 0$ for all α , the right-hand sides of (9) and (10) are positive. **Q.E.D.**

As a result of proposition 1, we have the following result.

Corollary. Define $p(\alpha)$ as the function that assigns the minimum level of p sat-

(5) Frey (1997) showed that the crowding-out effect arises in a principal-agent situation because the agent's marginal benefit from performing decreases as the degree of external intervention increases. However, we show that a negative effect arises because the probability that the manager can induce the worker's effort decreases as the punishments become more severe. In our model the worker's marginal benefit from effort, which is a decrease in the disutility from shirking, does not necessarily decrease in total, because $d_I(\alpha)$ decreases but $p \delta (1 - \alpha) w_0$ increases as α decreases.

isfying $p > p^*(\alpha)$ for given α . Then (1) if the worker's motivation is high, $p(\alpha)$ and monitoring cost $C_E(p(\alpha))$ are monotonically decreasing in α when $0 \leq \alpha \leq \alpha^*$, and are zero when $\alpha^* < \alpha \leq 1$. (2) On the other hand, if the worker's motivation is low, $p(\alpha)$ and $C_E(p(\alpha))$ are monotonically increasing for all $\alpha \in [0, 1]$.

Proof. If the worker's motivation level is high, then $d_l(1) = d \geq 1$. By the continuity of d_l , for α sufficiently close to 1, $d_l(\alpha) \geq 1$ and then $p^*(\alpha) \leq 0$. Since p^* is monotonically decreasing in α and $\alpha^* < 1$ exists such that $d_l(\alpha^*) = 1$ and then $p^*(\alpha) = 0$, it follows that $d_l(\alpha) < 1$ and $p^*(\alpha) > 0$ for $\alpha < \alpha^*$.

On the other hand, if the worker's motivation is low, we obtain $p^*(\alpha) > 0$, and $\delta^*(\alpha) > 0$ for all α . From proposition 1, p^* is monotonically increasing in α . The monitoring cost $C_E(p(\alpha))$ is monotonically increasing function of p . **Q.E.D.**

The manager's problem at the second stage is to choose (α, p) for given response rules (7) and (8) and parameters (d, δ) so as to minimize the total cost. We now present a related result.

Proposition 2. Suppose the worker is characterized by his initial level of intrinsic motivation d and his patience δ . In the determination of interim monitoring (α, p) , the manager first determines α and then determines p .

1. When $\alpha = 1$, the worker with high intrinsic motivation ($d \geq 1$) works hard irrespective of his patience, whereas the worker with low motivation ($d_l(\alpha) = 0$ for all α) does not work hard. Whether the worker works hard does not depend on p and δ . In this case, the manager does not need to know the worker's patience.

2. When $\alpha \in [0, 1)$, the worker works hard if his discount factor satisfies $\delta \geq \delta^*(d, \alpha, w_0)$ and the probability of punishment satisfies $p \geq p^*(d, \delta, \alpha, w_0)$ for d, w_0 , and the given α . The discount factor is $\delta^*(d, \alpha, w_0) < 0$ for $\alpha \in [\alpha^*, 1]$ and $\delta^*(d, \alpha, w_0) > 0$ for $\alpha \in [0, \alpha^*]$, when the worker's motivation is high. On the other hand, $\delta^*(d, \alpha, w_0) > 0$ for all α , if the worker's motivation is low.

3. Determination of management policies: two-stage monitoring

3.1 Ex ante monitoring: wage determination

We now discuss how the manager determines the initial payment w_0 at the first stage. Suppose that he learns from past experiences the relations (7) and (8), but does not know the parameter values (d, δ) of an individual worker he meets. From proposition 2, the aim of the manager at the first stage is to find a worker's motivation level. Below, the wage is determined such that a worker signs the contract, and honestly reports his disutility level d . Denote the reservation level of utility of the worker by U , then the wage w_0 is determined as follows:

Proposition 3. The wage payment w_0 offered in the contract is:

$$w_0 = \begin{cases} U+1-y & \text{if } 0 \leq y < 1 \\ U+1 & \text{if } y \geq 1 \end{cases} \quad (11)$$

where y is the reported disutility level, and plays the role of a cost or penalty for cheating. If the wage is set as above then the worker with high motivation reports $y = d$. The worker with low motivation reports $y = 0$. All workers therefore receive the same wage $w_0 = U+1$ in the first period, which exactly compensates them for their effort.

Proof. Set $w_0 = w + w(y)$ and $\alpha = 1$ in period 0. The worker's instantaneous utility in period 0 is then written as $u(e_0, w, y, d_I(1)) = w + w(y) - e_0 - (1 - e_0) d_I(1)$.

For the worker to accept the proposed contract, the individual rationality (IR) constraints must be satisfied. The conditions are

$$u(1, w, d, d) \geq U, \quad (12)$$

$$u(1, w, 0, 0) \geq U \quad (13)$$

for $d \geq 1$. From (12) and (13) we obtain $w + w(d) \geq U + 1$ and $w + w(0) \geq U + 1$.

For the worker to report his disutility level honestly, the following conditions must be satisfied:

$$u(e_0, w, d, d) \geq u(e_0, w, 0, d) \tag{14}$$

$$u(e_0, w, d, d) \geq u(e_0, w, y, d) \tag{15}$$

$$u(e_0, w, 0, 0) \geq u(e_0, w, d, 0) \tag{16}$$

and

$$u(e_0, w, 0, 0) \geq u(e_0, w, y, 0) \tag{17}$$

for $y \in (0, 1)$ and $d \geq 1$. From (14) and (16), we obtain $w(d) = w(0)$. From (15) and (17), we obtain $w(d) \geq w(y)$ and $w(0) \geq w(y)$.

As a simple wage scheme that satisfies the above conditions, we quote $w(y) = 0$ for $y \geq 1$ and $w(y) = -y$ for $0 \leq y < 1$, and the IR conditions are satisfied with equality. Therefore it follows that $w(0) = w(d) = 0$ and $w = U + 1$. This completes the proof. Q.E.D.

If the initial payment w_0 is set as in proposition 3, the discount factor δ^* does not exceed one for any α when $d > 1$. This will be shown by contradiction. Assume that there exists some $\alpha_0 \in (0, 1)$ such that $\delta^*(d, \alpha_0, U + 1) > 1$ or, equivalently, $1 - d_t(\alpha_0) > (1 - \alpha_0)(U + 1)$. However, the inequalities $1 - d_t(1) < 0$ and $1 - d_t(0) < U + 1$ (assumption 2) imply that for this inequality to hold there must exist some α_1 and α_2 with $\alpha_2 < \alpha_0 < \alpha_1$ such that $d'_t(\alpha_2) < U + 1$ and $d'_t(\alpha_1) > U + 1$. This contradicts the concavity of d_t (assumption 3). Therefore $\delta^* < 1$ for any α .

3.2 Interim monitoring: high level of motivation

This section shows that if the worker's motivation level is high, the IS policy is the manager's optimal choice and the work norm is the worker's equilibrium

strategy. From proposition 3, the worker reports a true disutility level $y = d$, and receives the initial payment $w_0 = U + 1$ when signing the contract. From proposition 2, the worker works hard under the IS policy ($\alpha = 1$ and $p = 0$) irrespective of his discount factor δ . On the other hand, he works hard under the ES policy if $p \geq 0$ and $\delta \geq 0$. From the corollary, the monitoring cost $C_E(p(\alpha))$ is decreasing in α .

The result for this case is stated as follows.

Proposition 4. Let assumptions 1, 2, and 3 hold. If the worker reports a disutility level y is greater than one when signing the contract, then the manager chooses the IS policy, and $\alpha = 1$ and $p = 0$ for all $t \geq 1$.⁽⁶⁾ In this case the actual work norm is the worker's equilibrium strategy.

Proof. From proposition 3, the signal $y \geq 1$ implies that the worker has a high level of motivation. From the corollary, the manager chooses $\alpha = 1$ and $p = 0$ to save the monitoring cost $C_E(p(\alpha))$. In this case, the worker's effort level is determined according to (7). Therefore, the work norm becomes the worker's equilibrium strategy.

If, however, the manager deviates to a positive $\alpha' < 1$, the worker's effort level is determined according to (8). The worker's high motivation implies that $\partial p^*/\partial \alpha < 0$. Thus, if $\alpha' < \alpha^*$, then $p^*(d, \alpha', \delta, U + 1) > 0$. This means that the manager suffers a loss l with positive probability every period. Therefore, he has no incentive for such a deviation. Q.E.D.

This result states that the disutility caused by the worker's intrinsic motivation can effectively induce a proper level of effort. On the other hand, the disutility caused by the external sanction is not necessarily effective, even if its level is greater than one.

(6) This result is consistent with the findings of Leete's (2000) empirical study.

3.3 Interim monitoring: low level of motivation

From proposition 3, the worker reports disutility level $y = 0$, and receives initial payment $w_0 = U + 1$ when signing the contract. From proposition 2, the worker works hard under the ES policy if $p \geq p^*(0, \delta, \alpha, U + 1)$ and $\delta \geq \delta^*(0, \alpha, U + 1)$ with $\partial p^*/\partial \alpha > 0$ and $\partial \delta^*/\partial \alpha > 0$. On the other hand, he does not work hard with certainty under the IS policy. From assumption 1 and these results, it is clear that the ES policy is chosen. The intuitive meaning of this result is that when the worker reports $y = 0$, meaning that his utility function does not have term d_t , the manager would impose an external sanction Δw to induce the worker's effort.

However, a difficult problem remains: How can the manager obtain information about the worker's patience? We show that the manager can learn the worker's patience without spending an additional monitoring cost, i.e. keeping p constant. Assume that the manager knows the relation $p^* = 1/\delta \Delta w$, but not the value of δ or p^* . He believes that the worker deviates from the work norm with probability $q = (\delta < 1/\Delta w \mid \delta < 1/p\Delta w, p, \Delta w)^{(7)}$. That is, if the manager finds a deviation he would believe that he chose $p < p^*$, thus he knows that $\delta < 1/p\Delta w$. After that the manager tries a more severe punishment $\Delta w' > \Delta w$. If he again finds a deviation he would believe that $\delta < 1/p\Delta w'$. The more he finds deviations, the more severe the punishment he uses. When he has to use the severest punishment, i.e. $\alpha = 0$ and $\Delta w = w_0$, he dismisses the worker. The result for this case is stated as follows.

Proposition 5. Let assumptions 1, 2, and 3 hold. If the worker reports a disutility level zero when signing the contract, then the manager chooses the ES policy, so that $\alpha \in [0, 1)$ and $p \gg 0$ for all $t \geq 1$. In this case the work norm becomes a patient worker's equilibrium strategy, i.e. if $\delta \geq 1/\Delta w$. On the other hand, if the worker is not patient, i.e. if $\delta \leq 1/p(U + 1)$, the manager dismisses him, and

(7) If we suppose that the unknown parameter δ is distributed according to the uniform distribution, we obtain $q = p$ for all t . This simplifies the analysis and implies that the manager believes a deviation occurred only when he finds it.

$\alpha = 0$.

From the last part of assumption 1, $C_D \leq L$, the maximal punishment is used within a finite number of periods.

4. Conclusions

This work has compared two distinct management policies by which a manager can induce workers' effort. One is called the IS (internal sanction) policy, which induces workers to experience disutility (guilt) and causes them to obey the work norm spontaneously. The other is called the ES (external sanction) policy, and gives workers an extrinsic incentive to work hard for the firm. Which policy is effective depends on the worker's motivation level. Our results suggest that when the work requires a high intrinsic work motivation (e.g. scientists, artists, or work for non-profit organizations) the IS policy should be chosen; otherwise (e.g. manual labors, salespersons, or taxi drivers) the ES policy should be chosen.

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