Group vs. Individual Performance Pay in Relational Contracts when Workers are Envious

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Group vs. Individual Performance Pay in Relational Employment Contracts when Workers Are Envious*

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Abstract

I compare group to individual performance pay when workers are envious and performance is non-verifiable. Avoiding pay-off inequity, the group bonus contract is superior as long as the firm faces no credibility problem. The individual bonus contract may, however, become superior albeit introducing the prospect of unequal pay. This is due to two reasons: The group bonus scheme is subject to a free-rider problem requiring a higher incentive pay and impeding credibility of the firm. Moreover, with individual bonuses the firm benefits from the incentive-strengthening effect of envy, allowing for yet smaller incentive pay and further softening the credibility constraint.

Keywords: principal-agent, relational contract, inequity aversion, bonus, team, envy

JEL classification: D63, D82, M52, M54

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1 Introduction

The present paper investigates how agents’ concerns for fairness affect the optimal provision of incentives in a moral-hazard framework with non-verifiable performance measures. The existing literature on incentive schemes under inequity aversion has mainly analyzed explicit contracting. In these environments, employing inequity averse agents comes at a cost for the principal. An exception is the study by Kragl and Schmid (2008) which examines an infinitely repeated game where observed performance is non-verifiable. Their analysis focuses on individual performance compensation; it shows that in contrast to the situation with objective performance measures, employing inequity averse agents may become advantageous to the principal. In the present paper, I introduce in a similar framework the possibility of group compensation and compare its advantage with the individual bonus scheme.

Most employment relationships suffer from moral hazard because an employee’s effort is not observable by the firm. Nevertheless, in many cases the employee’s performance can be observed by the contracting parties. Though an incentive contract is then not court-enforceable, the observed performance may be used in an agreement that must, however, be self-enforcing. Such agreements are called relational contracts and may be sustained in long-term relationships as reputational equilibria. As employment contracts are usually long-term and employer and workers thus interact repeatedly, relational contracts exhibit realistic features of real-world incentive schemes.

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1 Compared to the first-best efficient benchmark with purely self-interested, not wealth-constrained agents, inequity aversion entails agency costs. See e.g. Neilson and Stowe (2008), Bartling and von Siemens (2007), and Grund and Sliwka (2005).

2 Third parties, as e.g. a court, are often not able to verify each piece of information that is available to the principal. Moreover, it will often be too costly or even impossible to credibly communicate the agent’s contribution to firm value to an outside party. See e.g. Milgrom and Roberts (1992) and Holmström and Milgrom (1994).

3 Reputational equilibria may exist if one party cares about her reputation in future relationships. In particular, the parties may prefer to stick to the implicit agreement if there is a credible future punishment threat in case they renege on the agreement. See e.g. Holmström (1981), Bull (1987), Baker, Gibbons, and Murphy (1994), or Baker, Gibbons, and Murphy (2002).
Moreover, individual employment relationships are typically embedded in the larger framework of the firm, thus in a social context where individual comparison may play a role. Experimental evidence suggests that workers not only care about absolute but also about relative payoffs.\(^4\) Hence, the employer must take into account that her decisions regarding one worker might affect other employment relationships within the same organization. When workers are inequity averse, i.e. when they resent being paid more or less than their co-workers, the prospect of unequal pay implies additional agency costs for the firm, the so-called inequity premium. These costs arise whenever the workers face a positive probability of receiving unequal wages as is the case with imperfect performance measures and individual performance pay.\(^5\)

In the existing literature, it is frequently argued that concerns for equity or fairness could serve as an explanation for observed wage compressions or the absence of individual performance pay.\(^6\) The implementation of joint-performance evaluation such as a group compensation scheme rules out the possibility of unequal payoffs across workers. Thus, when a firm employs more than one worker, even if there are no complementarities in production, it may choose to pay a group bonus, solely for the purpose of avoiding agency costs resulting from inequity aversion. While the present paper in a first step verifies the above intuition for contractible performance, its main purpose is to investigate whether a group bonus contract is still preferrable when performance is non-verifiable. In particular, assuming inequity averse preferences on the workers’ sides, I investigate the feasibility and profitability of relational group bonus contracts compared to the case of relational individual bonus contracts as investigated by Kragl and Schmid (2008). It turns out that, in contrast to the situation with verifiable performance, individual


\(^5\)This might not be true when workers earn rents (see Demougin and Fluet (2003), Demougin and Fluet (2006), and Bartling and von Siemens (2007)). Inequity aversion strengthens incentives and can thus be beneficial when workers are financially constrained. Assuming no financial constraint on either side, however, workers earn no rents in my setup.

\(^6\)See e.g. Baker, Jensen, and Murphy (1988). In a survey study, Bewley (1999) finds that internal pay structures aim at providing internal pay equity. In recent theoretical studies, Englmaier and Wambach (2005), Goel and Thakor (2006) and Bartling (2007) show that inequity averse preferences among agents may render team incentives optimal.
Formally, I analyze an infinitely repeated game with one long-lived firm and a sequence of two short-lived workers. Workers are risk neutral, not financially constrained and consigned to work on a similar task which is valuable for the firm. Following Fehr and Schmidt (1999), I assume them to exhibit ‘self-centered inequity aversion’. The parties observe each worker’s individual output which is an imperfect and non-verifiable signal of the worker’s effort. To mitigate the moral hazard problem, the firm can offer the workers a bonus contract contingent upon either individual output or an aggregated measure of both workers’ outputs. In order to guarantee self-enforcement of the respective incentive contracts, reputation concerns have to restrain the firm from deviating. Specifically, credibility requires the firm’s gains from reneging on the bonus to fall short of the discounted gains from continuing the relational contract.

When workers are not envious, both the group bonus and the individual bonus contract implement first-best effort levels as long as the firm’s discount rate is sufficiently large. Given that workers are envious, however, the group bonus contract dominates the individual bonus contract. This is due the fact that, by adopting an individual bonus structure, the firm incurs additional expenses for inequity premiums.

Once the firm’s discount rate is sufficiently small, however, the group bonus that implements first-best efforts induces the firm to renege on its promise. Credibility then requires reducing the group bonus thereby inducing non-optimal effort levels which lead to smaller profits. In comparison, the individual bonus provides two benefits. First, a group bonus introduces a free-rider problem. Hence, it must be larger than the respective individual bonus for implementing a given level of effort. Second, using a group bonus, the firm cannot exploit the incentive-strengthening effect of inequity which allows for lowering the bonus level under individual performance pay.

Typically, workers in such a situation tend to compare their payoffs with those of their colleagues. For the importance of reference groups, see e.g. Loewenstein, Thompson, and Bazerman (1989).

I model the repeated-game structure and the self-enforcement constraint following Baker, Gibbons, and Murphy (1994) who analyze relational incentive contracts with non-inequity averse agents.

Both of these features facilitate credible commitment in the individual bonus contract.

Accordingly, there are combinations of inequity aversion and discount rates for which the relational individual bonus contract is more profitable than the group bonus contract. Moreover, there are cases where the group contract becomes yet infeasible whereas the individual bonus contract still yields positive profits.

The present paper brings together important aspects of the literature on relational contracts and that on inequity aversion. In the last decade, economists have increasingly recognized the relevance of other-regarding preferences. Alternative approaches regarding their formalization have been proposed, e.g. by Rabin (1993), Fehr and Schmidt (1999), Bolton and Ockenfels (2000), and Falk and Fischbacher (2006). By now there is a growing literature linking standard incentive theory and social preferences. Much of the work is associated with the impact of inequity aversion on individual incentive contracts under verifiable performance. Moreover, the majority of papers focuses on mutually inequity averse agents (e.g. Bartling and von Siemens (2007), Neilson and Stowe (2008), and Demougin, Fluet, and Helm (2006)).¹⁰ The effects of such preferences on tournaments are analyzed by Grund and Sliwka (2005) and Demougin and Fluet (2003). Other papers compare the efficiency of different incentive regimes when workers are concerned with relative payoffs (e.g. Bartling and von Siemens (2007), Rey-Biel (2007), Demougin and Fluet (2006), Goel and Thakor (2006), and Itoh (2004)). I complement this literature by extending the analysis of incentive provision with mutually inequity averse agents to non-verifiable performance measures which requires a dynamic relational-contract setting.

Earlier contributions on relational contracts have focused on environments with symmetric information (e.g. Bull (1987), MacLeod and Malcolmson (1989), and Levin (2002)). More recent papers analyze self-enforcing contracts under asymmetric information, in particular moral hazard in effort (e.g. Baker, Gibbons, and Murphy (1994, 2002), Levin (2003), and Schöttner (2008)). Moreover, some papers compare the efficiency of different incentive regimes for multiple agents in a dynamic setting. Che and Yoo

¹⁰Englmaier and Wambach (2005) and Dur and Glazer (2008) examine incentive contracts when agents care about inequality relative to the principal.
(2001) study the interaction of explicit and implicit incentives in teams while focusing on employee cooperation as self-enforcing behaviour. Kvaløy and Olsen (2006b) extend the latter analysis by assuming that the agents’ output is non-verifiable either. Kvaløy and Olsen (2006a) provide an explanation for the prevalence of individual performance pay in a related setting where agents possess indispensable human capital. I contribute to that strand of literature by introducing fairness concerns among agents into the analysis of two different incentive regimes under non-verifiable performance; the study offers a complementary, preference-dependent explanation as to why either individual or team incentives may be optimal in repeated employment relationships.

Most closely related to the present paper is Kragl and Schmid (2008). In that paper, we show that, with individual performance pay, inequity aversion may enhance the profitability and feasibility of relational contracts. The present analysis complements the former by introducing the possibility of group bonus contracts. My findings underline that empirically observed cultural differences in social preferences should not be neglected in organizational decisions when firms rely on implicit incentives (self-enforcing agreements). In particular, the impact of other-regarding preferences on the design of incentive schemes shows to be sensitive to the verifiability of the underlying performance measures and, thus, also to the time horizon of employment.

The paper proceeds as follows. The next section describes the basic economic framework. Section 3 addresses the agency problem in the single-period game. Section 4 analyzes the reputation game. I first derive the firm’s credibility constraints under the two incentive regimes and determine the optimal relational group contract. Then I deduce conditions for the superiority of either the group or the individual compensation scheme by investigating the impact of inequity aversion on the equilibrium contracts. Section 5 discusses the implications and offers some concluding remarks.

2 The Model

I consider a repeated game between an infinitely long-lived firm, hereafter the principal, and an infinite sequence of two homogeneous short-lived work-
ers, hereafter the agents.\textsuperscript{11} All parties are risk neutral and not financially constrained. In each period, agent $i$ ($i = 1, 2$) chooses an unobservable effort level $e_i$ that causes him private cost $c(e_i)$ with $c(0) = 0$, $c'(0) = 0$, $c'(e_i) > 0$ for $e_i > 0$, and $c''(e_i) \geq 0$. This effort choice stochastically determines his contribution to firm value $Y_i$ which may be either high or low; $Y_i \in \{0, 1\}$. Albeit non-verifiable, the agent’s contribution $Y_i$ is observable by all contracting parties. By exerting effort, agent $i$ positively affects the probability of a high contribution:

$$\Pr[Y_i = 1|e_i] = p(e_i),$$

where $p(e_i) \in [0, 1)$, $p(0) = 0$, $p'(e_i) > 0$, and $p''(e_i) < 0$. The realizations of the agents’ respective contributions to firm value are stochastically independent events. Moreover, there are no complementarities in production such that the principal’s profit function is separable across agents. Altogether, the principal’s one-period profit per agent is that worker’s contribution to firm value net of wage costs $\pi_i$:

$$V(Y_i, \pi_i) = Y_i - \pi_i, \quad i \neq j. \quad (2)$$

The agents observe each other’s gross monetary payoff $\pi_i$ and exhibit inequity aversion. For convenience, I consider a simplified version of the preferences introduced by Fehr and Schmidt (1999). Specifically, I assume that in each period an agent dislikes outcomes where he is worse off than the other agent. Accordingly, agent $i$’s utility of payoff $\pi_i$ when his co-worker earns $\pi_j$ is given by

$$U_i(\pi_i, \pi_j, e_i) = \pi_i - c(e_i) - \alpha \max\{\pi_j - \pi_i, 0\}, \quad i \neq j, \quad (3)$$

where $\alpha \geq 0$ denotes his propensity for envy. Thus, the third term captures his disutility derived from disadvantageous inequity.\textsuperscript{12}

\textsuperscript{11}All workers within the infinite sequence are also homogeneous.

\textsuperscript{12}Abstracting from costs, Fehr and Schmidt (1999) propose the following utility function: $U_i = \pi_i - \alpha \max\{\pi_j - \pi_i, 0\} - \beta \max\{\pi_i - \pi_j, 0\}, \quad \alpha > \beta > 0$. Incorporating empathy via the parameter $\beta > 0$ would, however, not affect my qualitative results. Allowing for status preferences or pride as reflected by $\beta < 0$ would even strengthen my results. In contrast to my setup and that of Fehr and Schmidt (1999), Demougin and Fluet (2006) take costs into account when investigating inequity aversion: $U_i = \pi_i - c(e_i) - \alpha \max\{\pi_j - c(e_j) - \pi_i + c(e_i), 0\}$. This would also not change my results. However, an inconvenient discontinuity at the symmetric Nash-equilibrium would
Compensation contracts may be contingent either on individual contributions or the sum thereof in the respective period. In the *individual bonus scheme*, the principal pays the fixed wage $w_I$ with certainty and promises to pay a bonus $b$ to an agent whenever his individual contribution to firm value in the respective period is favorable ($Y_i = 1$):

\[
\begin{array}{ccc}
\text{Agent 1, 2} & Y_2 = 0 & Y_2 = 1 \\
Y_1 = 0 & 0, 0 & 0, b \\
Y_1 = 1 & b, 0 & b, b \\
\end{array}
\]

Thus, agent $i$’s gross monetary payoff is

\[
\pi_i = w_I + bY_i. \tag{4}
\]

In the *group bonus scheme*, the principal offers each agent an identical compensation contract consisting of a guaranteed fixed wage $w_G$ and a (per-agent) group bonus $B_Y Y_j$ which is paid contingent upon both agents’ contributions $Y_i$ and $Y_j$ in the respective period. Whenever paid out, the group bonus is paid to both agents. Depending on the contributions’ realizations, that contracts allows for the implementation of the following group bonus payments:

\[
\begin{array}{ccc}
\text{Agent 1, 2} & Y_2 = 0 & Y_2 = 1 \\
Y_1 = 0 & 0, 0 & B_{01}, B_{01} \\
Y_1 = 1 & B_{10}, B_{10} & B_{11}, B_{11} \\
\end{array}
\]

Hence, the gross monetary payoff of agent $i$, $i = 1, 2$, becomes

\[
\pi_i = w_G + B_{11} Y_1 Y_2 + B_{10} Y_1 (1 - Y_2) + B_{01} (1 - Y_1) Y_2. \tag{5}
\]

The timing of events in each period is as follows. At the beginning of the period, the principal offers each agent one of the above specified compensation contracts. Second, each agent decides whether to accept the contract or reject it in favor of an alternative employment opportunity that provides utility $U_0$. Third, if the agents accept the contract, they simultaneously be introduced.

\[13\text{That is, I focus on the extreme cases of either a group or an individual incentive scheme without memory.}\]
choose their respective effort levels \( e_i \). Fourth, the contributions to firm value \( Y_i \) and \( Y_j \) are realized and observed by all parties. Finally, the agents receive the explicit fixed wage, and if the contributions to firm value are favorable, the principal decides whether to pay the promised bonuses.

3 The Contracts under Verifiable Performance

In this section, I analyze the benchmark case where the agents’ contributions to firm value are verifiable. As credibility issues do not arise in this case, I only consider the single-period game.

3.1 The Individual Bonus Scheme Revisited

In the following, I briefly characterize the principal-agent problem as analyzed by Kragl and Schmid (2008).\(^{14}\) Under an individual bonus scheme, from the point of view of one agent, disadvantageous inequity occurs when only the other agent obtains a bonus. As a result, given that his co-worker exerts effort \( e_j \), agent \( i \)’s expected utility becomes

\[
E[U_i|e_i, e_j] = w_I + p(e_i) b - c(e_i) - \alpha(1 - p(e_i))p(e_j) b, \quad i \neq j. \tag{6}
\]

In such an environment there is a unique symmetric Nash-equilibrium in effort, in the following denoted by \( e \). The shape of \( p(e) \) and \( c(e) \) imply a concave payoff function for the agents such that the Nash-equilibrium in effort directly follows from the first-order condition of (6):

\[
p'(e)b - c'(e) + \alpha p'(e) p(e) b = 0 \tag{7}
\]

As a result, the principal’s sets \( b, w_I \), and \( e \) to maximize expected profits per agent subject to participation and incentive compatibility constraints:

\[
\max_{b,w_I,e} \quad (1 - b) p(e) - w_I \quad \text{s.t.} \quad \begin{cases} (IC) & b = \frac{c'(e)}{(1 + \alpha p(e)) p'(e)} \quad \text{(I)} \\ (PC) & w_I + p(e) b - \alpha(1 - p(e))p(e) b \geq c(e) + U_0. \end{cases}
\]

\(^{14}\)For the formal derivation of all results in this subsection see Kragl and Schmid (2008).
where (IC₁) directly follows from (7). The equality defines the bonus \( b \) which the principal has to offer if she wants to induce effort \( e \). Differentiating with respect to \( \alpha \) yields the following result.

**Proposition 1** Suppose that performance is verifiable. Then under the individual bonus scheme, holding the agent’s effort level constant, the required bonus is decreasing in the agent’s propensity for envy.

Intuitively, as envious agents suffer from being worse off than their co-workers in contrast to non-envious agents, they exert relatively higher levels of effort in order to decrease the probability of not obtaining the bonus. As a result, holding effort constant requires reducing the bonus. This incentive-strengthening impact of envy is in line with the literature.¹⁵ In the remainder of the paper, I will refer to this effect as the incentive effect.

The fixed wage \( w_I \) negatively enters the principal’s objective function such that the participation constraint becomes binding in the optimal contract, leading to zero rent for the agents. Using (IC₁) and (PC₁) in order to substitute \( w_I \) and \( b \) in the principal’s objective function, her problem simplifies to:

\[
\max_e \left[ V_I (e; \alpha) = p(e) - c(e) - \alpha p(e) (1 - p(e)) \frac{d'(e)}{(1 + \alpha p(e)) p'(e)} - U_0 \right] \tag{II}
\]

Denote the effort level that maximizes \( V_I (e; \alpha) \) by \( e^* (\alpha) \). Differentiating \( V_I (e; \alpha) \) with respect to \( \alpha \) by using the envelope theorem yields the following result regarding the agency costs associated with envy.

**Proposition 2** Suppose that performance is verifiable. Then under the individual bonus scheme,

(i) the first-best solution is obtained if agents are not envious, \( \alpha = 0 \).

(ii) the first-best solution can never be obtained if agents exhibit a propensity for envy, \( \alpha > 0 \).

(iii) total agency costs increase as agents become more envious.

In order to ensure participation, the principal needs to compensate envious agents for the expected disutility from payoff inequity. I will refer to this wage cost-augmenting effect of envy as *inequity premium effect*. Again, this result is in line with the agency literature, see e.g. Bartling and von Siemens (2007), Grund and Sliwka (2005), and Neilson and Stowe (2008).

### 3.2 The Group Bonus Scheme

In the group scheme, when exerting effort $e_1$ while his co-worker exerts effort $e_2$, agent 1’s expected utility is

$$ E[U_1|e_1, e_2] = w_G + p(e_1)(1-p(e_2))B_{10} + p(e_2)(1-p(e_1))B_{01} \quad (8) $$

$$ + p(e_1)p(e_2)B_{11} - c(e_1), $$

and for agent 2 accordingly. Under the group bonus scheme inequity in payoffs can never occur such that the agents’ inequity-averse preference structure has no effect on their respective utilities. Taking the first-order condition of (8) and rearranging terms yields

$$ p'(e_1)B_{10} + p'(e_1)p(e_2)(B_{11} - B_{10} - B_{01}) = c'(e_1), \quad (IC) $$

with a similar equality for agent 2. Initially, I focus on the symmetric Nash-equilibrium regarding the agents’ effort choice. Implicitly, this restricts the bonus scheme such that $B_{10} = B_{01} = B$. I also define $\Delta := B_{11} - B$. Intuitively, redefining the group bonus scheme in terms of $\{B, \Delta\}$ has a natural interpretation. An agent receives $B$ if at least one agent’s contribution to firm value is favorable. That payment differs from the bonus paid if and only if both agents are successful in the amount of $\Delta$. Taking this into account, the incentive-compatibility and participation constraints are for both agents given by:

$$ p'(e)B + p'(e)p(e)(\Delta - B) = c'(e) \quad (IC_G) $$

$$ w_G + 2p(e)B + p(e)^2(\Delta - B) \geq c(e) + U_0 \quad (PC_G) $$

Just as in the case of individual bonuses, the fixed wage negatively enters the principal’s objective function. Consequently, the participation constraint becomes binding in the optimum. Altogether, the principal has three vari-
ables to choose, $w_G, \Delta, B$, and two equations to satisfy, $(IC_G)$ and $(PC_G)$, such that the following result obtains.

**Lemma 1** Suppose that performance is verifiable. Then the principal can implement an arbitrary effort level using any bonus scheme $\{B, \Delta\}$ that satisfies the incentive-compatibility constraint $(IC_G)$ for the desired effort level.

A group incentive scheme then implements the following bonus payments depending on the realizations of the agents’ respective contributions to firm value:

<table>
<thead>
<tr>
<th>Agent 1, 2</th>
<th>$Y_2 = 0$</th>
<th>$Y_2 = 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y_1 = 0$</td>
<td>0, 0</td>
<td>$B, B$</td>
</tr>
<tr>
<td>$Y_1 = 1$</td>
<td>$B, B$</td>
<td>$B + \Delta, B + \Delta$</td>
</tr>
</tbody>
</table>

Taking this into account, the principal’s per-agent profit becomes:

$$\Pi = p(e)(1 - 2B) - p(e)^2(\Delta - B) - w_G$$  \hspace{1cm} (9)

Substituting $w_G$ from $(PC_G)$, the principal’s objective under a group bonus scheme simplifies to:

$$\max_{e, B, \Delta} \left[ V_G(e) = p(e) - c(e) - U_0 \right]$$ \hspace{1cm} (III)

s.t. \hspace{0.5cm} $(IC_G)$

Since, by Lemma 1, the incentive-compatibility constraint can be satisfied for any effort level, the firm implements the first-best solution, $e^{FB}$:

$$p'(e^{FB}) = c'(e^{FB})$$  \hspace{1cm} (10)

**Proposition 3** Suppose that performance is verifiable. Then the first-best solution is obtained for any group bonus scheme $\{B, \Delta\}$ that satisfies $(IC_G)$ for $e = e^{FB}$, regardless of the agents’ propensity for envy $\alpha$.

Consequently, the initial restriction to a symmetric Nash-equilibrium is without loss of generality.
3.3 Comparison of Group and Individual Bonus Scheme

Proposition 2 and 3 allow for a comparison of the efficiency of the group and the individual scheme in the one-shot game.

Proposition 4 Suppose that performance is verifiable.
(i) When agents are not envious, $\alpha = 0$, the individual and the group bonus scheme both lead to identical (first-best) profits for the principal.
(ii) When agents are envious, $\alpha > 0$, the principal favors the group scheme over the individual scheme as only the former yields the first-best solution.

With verifiable performance, employing envious agents using an individual bonus scheme comes at a cost for the principal. In contrast, introducing a group bonus resolves the problem as it rules out unequal payoffs; it avoids inequity-premium costs and thus yields the first-best outcome.\textsuperscript{16} As I will show in the following, the group incentive scheme, however, requires larger bonus payments. This obtains because a group bonus introduces a free-rider problem with respect to individual effort. As a result, the advantage of the group bonus scheme is weakened once performance is not verifiable.

4 The Relational Contracts

In the following, I analyze the moral hazard problem under non-verifiable performance. This requires introducing a credibility constraint for the principal under both incentive schemes. Next I characterize the optimal group contract in the repeated game and compare the results to the individual relational bonus contract.

\textsuperscript{16}As also noted by Englmaier and Wambach (2005), Goel and Thakor (2006), and Bartling (2007), this finding violates the sufficient-statistics result by Holmström (1979). According to that ‘informativeness principle’, an agent’s compensation must depend (only) on those performance indicators that provide incremental information about his action choice. With envious agents and verifiable performance, however, conditioning an agent’s incentive pay on his co-worker’s performance can be optimal even when the latter provides no information about his effort choice, as is the case in my model.
4.1 The Credibility Constraints

To model the relational contract, I embed the foregoing model into an infinitely repeated game between the firm and an infinite sequence of workers, considering trigger strategy equilibria. Specifically, if the principal reneges once on the promised bonus, no agent will ever again believe her to fulfill the contract.\footnote{In deriving the principal’s credibility constraint I follow Baker, Gibbons, and Murphy (1994). Implicitly, I assume the information on a principal’s deviation from the relational contract to be rapidly transmitted to the labor market. Alternatively, as Baker, Gibbons, and Murphy (1994) note, each period’s agent learns the history of play before the period begins. See also Bull (1987) for the role of reputation in relational contracts.} Hence, the principal’s reputation is decisive for her ability to implement relational contracts. In contrast, since workers are short-lived, reputation effects on their side are not feasible.\footnote{Specifically, allowing for negative bonus payments would create a temptation for the workers to renege on the agreement. When agents live for a bounded number of periods which is known by all parties, however, the principal can never punish the workers in the last period of the play. As a result, the workers have no reason to resist temptation in that period as withholding the bonus provides them with a payoff larger than their alternative utility. By backward induction, an unraveling effect arises; a negative incentive payment is not credible in any period of the game. Thus, according to observed practice, bonus payments cannot be negative in my setup. For a similar assumption see Baker, Gibbons, and Murphy (1994).}

As effort is not observable, agents will exert zero effort if relational contracts are infeasible, corresponding to a closure of the firm and resulting in a fallback profit of zero. If relational contracts are feasible, the principal realizes a continuation profit from each long-term relationship corresponding to the present value of the respective expected one-period profits. Hence, for the relational contract to be self-enforcing, the principal’s gains from reneging must fall short of the gains from fulfilling her promise. Specifically, suppose the group scheme \( \{ B, \Delta \} \) implements effort \( e \) in the stage game. Credibility in the repeated game then requires

\[
\max \{ B, B + \Delta \} \leq \frac{V_G(e)}{r},
\]

where \( r \) is the firm’s interest rate.\footnote{Note that the interest rate \( r \) may be interpreted in terms of the firm’s discount rate \( \delta \). Then \( r = (1 - \delta) / \delta \), where \( \delta \) measures e.g. the firm’s patience. Hart (2001) emphasizes the discount rate’s interpretation as a measure for dependency or trust between the transacting parties. Alternatively, \( r \) can be reinterpreted in terms of the likelihood that the firm disappears from the market, \( \rho \). In that case \( r = \rho / (1 - \rho) \).} By contrast, in the individual bonus scheme, for the contracts to be self-enforcing the following condition must
hold:
\[ b(e; \alpha) \leq \frac{V_I(e; \alpha)}{r} \]  

(\text{CC}_I)

Both credibility constraints reveal that, c.p., a small absolute bonus payment and a large expected one-period profit facilitate credible commitment by the principal. In addition, in the individual scheme credibility also depends on the agents’ propensity for envy.

### 4.2 The Credibility-constrained Group Bonus Scheme

According to Lemma 1, there are many \( \{B, \Delta\} \)-combinations which implement a desired effort level \( e \). Denote the set of such bonus combinations by \( A := \{B, \Delta : p'(e)B + p(e)(\Delta - B) = c'(e)\} \). Due to the credibility requirement, however, I focus on that particular scheme \( \{B, \Delta\} \) that exhibits the smallest possible bonus payments across all states. In other words, I look for the combination \( \{B^*, \Delta^*\} \) implementing effort \( e \) such that

\[
\{B^*, B^* + \Delta^*\} = \min_{B, B + \Delta \in A} \max \{B, B + \Delta\}.
\]

**Proposition 5** Suppose that performance is non-verifiable. Then the group bonus scheme that maximizes the range of interest rates \( r \) where a given effort level \( e \) can credibly be implemented is either \( \{B^*, 0\} \) or \( \{0, \Delta^*\} \), depending on the value of \( p(e) \). Specifically, the principal should choose

\[
\Delta = 0 \text{ and } B^*(e) = \frac{c'(e)}{(1 - p(e))p'(e)} \quad \text{if} \quad p(e) < \frac{1}{2},
\]

\[
B = 0 \text{ and } \Delta^*(e) = \frac{c'(e)}{p(e)p'(e)} \quad \text{otherwise}.
\]

**Proof.** The incentive-compatibility constraint for each agent can be written as

\[
(1 - 2p(e))B + p(e)(B + \Delta) = \frac{c'(e)}{p'(e)}.
\]

Holding \( e \) constant, we obtain

\[
\frac{d[B + \Delta(B)]}{dB} = -\frac{1 - 2p(e)}{p(e)},
\]

Taking \( e \) as given, depending on the value of \( p(e) \) we can distinguish two possible cases.
(i) \( p(e) < \frac{1}{2} \). Then \( d[B + \Delta(B)]/dB < 0 \). For implementing \( e \), any increase in \( B \) thus implies a reduction of \( [B + \Delta(B)] \) and vice versa. As can be seen from Figure 1a, solving for \( \min \max \{B, B + \Delta(B)\} \) requires \( B = B + \Delta(B) \) or \( \Delta = 0 \). Finally, \( B^* \) follows from (12):

\[
B^*(e) = \frac{c'(e)}{(1 - p(e))p'(e)}
\]  

(14)

Figure 1: The incentive-compatibility constraint under a group bonus scheme with (a) \( p(e) < 0.5 \) and (b) \( p(e) < 0.5 \).

(ii) \( p(e) \geq \frac{1}{2} \). Then \( d[B + \Delta(B)]/dB \geq 0 \). Thus, for implementing \( e \), any reduction of \( B \) implies a reduction in \( [B + \Delta(B)] \) and vice versa (see Figure 1b). Hence, the principal should set \( B \) as small as possible s.t. \( B \geq 0 \), yielding \( B = 0 \) and \( B^* \) follows from (12):

\[
\Delta^*(e) = \frac{c'(e)}{p(e)p'(e)}.
\]  

(15)

The foregoing suggests an interesting observation regarding the group scheme. Suppose under verifiability the first-best effort level yields a success probability \( p(e^{FB}) \geq \frac{1}{2} \). Under non-verifiability, the principal would want to maximize the range of interest rates where \( e^{FB} \) can be credibly implemented. Accordingly, she would choose to pay a group bonus only if both agents are successful; \( \Delta^* \). However, if her interest rate is large, she may be forced to lower the effort level in order to satisfy the credibility constraint.
Now suppose that the constraint requires such a strong reduction in effort that \( p(e) < \frac{1}{2} \). Then the principal would switch from the reward that is paid only if both are successful to the bonus paid if at least one agent is successful; \( B^* \).

### 4.3 Comparison of Group and Individual Bonus Scheme

#### 4.3.1 Group vs. Individual Bonus

According to Proposition 5, when implementing effort \( e \) under a group bonus scheme, the principal pays a group bonus \( B = B^* (e) \) whenever at least one of the agents is successful \( (p(e) < \frac{1}{2}) \), or she pays \( \Delta = \Delta^* (e) \) only in the case where both agents are successful \( (p(e) \geq \frac{1}{2}) \). I summarize this result in the following tables:

<table>
<thead>
<tr>
<th>Agent ( i, j )</th>
<th>( Y_j = 1 )</th>
<th>( Y_j = 1 )</th>
<th>( Y_j = 0 )</th>
<th>( Y_j = 1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_i = 0 )</td>
<td>0, 0</td>
<td>( B, B )</td>
<td>0, 0</td>
<td>0, 0</td>
</tr>
<tr>
<td>( Y_i = 1 )</td>
<td>( B, B )</td>
<td>( B, B )</td>
<td>( 0, 0 )</td>
<td>( \Delta, \Delta )</td>
</tr>
</tbody>
</table>

From the optimization problem (I) derived in section 3.1 we know that, in order to induce effort level \( e \) under the individual incentive scheme, the required bonus depends on the agents’ propensity for envy and is given by

\[
b(e; \alpha) = \frac{e'(e)}{(1 + \alpha p(e)) p'(e)}. \tag{16}
\]

Comparing equations (11) and (16) yields the following result.
Proposition 6 For any given effort level $e$ and any propensity for envy $\alpha \geq 0$, the size of the incentive-compatible group bonus exceeds the size of the individual bonus. Moreover, the relative difference between the two incentive payments is increasing in $\alpha$.

Proof. Consider the case $p(e) \geq \frac{1}{2}$. Equations (11) and (16) imply:

$$\Delta^*(e) \frac{p(e)}{1 + \alpha p(e)} = b(e; \alpha) \implies \Delta^*(e) > b(e; \alpha) \quad (17)$$

Moreover, the difference is

$$\Delta^*(e) - b(e; \alpha) = \Delta^*(e) \left(1 - \frac{p(e)}{1 + \alpha p(e)}\right), \quad (18)$$

which is decreasing in $\alpha$. Similarly, for the case $p(e) < \frac{1}{2}$ the equations yield:

$$B^*(e) \frac{1 - p(e)}{1 + \alpha p(e)} = b(e; \alpha) \implies B^*(e) > b(e; \alpha) \quad (19)$$

Again, solving for the difference verifies that it is decreasing in $\alpha$. $\blacksquare$

Intuitively, the group bonus introduces a positive externality effect of an agent’s effort on his co-worker’s expected payoff. As a result, for the group scheme the probability of obtaining the bonus is less responsive to changes in one’s effort than in the individual contract. Hence, the group bonus must be larger in order to elicit the same effort level. Moreover, due to the incentive effect of envy identified above, the individual bonus becomes smaller the more envious the agents. In contrast, the group bonus is not affected by variations in $\alpha$, so that the difference between the two is increasing.

4.3.2 Profitability

By Proposition 4, as long as the principal faces no credibility problem, the group bonus contract (weakly) dominates the individual bonus scheme. In this subsection, I reexamine the conclusion when credibility plays a role. In order to do so, I study the effects of envy on the principal’s profits in the repeated game.

In the repeated framework, an optimal relational contract implements the effort level that maximizes the principal’s expected profit per period and
agent, subject to her credibility constraint. Hence, the optimal profit in the individual scheme is

\[ V_I^*(r, \alpha) := \max_e V_I(e; \alpha) \quad \text{s.t.} \quad b(e; \alpha) \leq V_I(e; \alpha) / r. \]  

(20)

Accordingly, optimal profit in the group scheme is given by\(^{20}\)

\[ V_G^*(r) := \max_e V_G(e) \quad \text{s.t.} \quad \min \{ B^*(e), \Delta^*(e) \} \leq V_G(e) / r, \quad \text{(IC}_G). \]  

(21)

Next I define the critical interest rates for which the principal can just implement the same contract as under verifiability. Specifically, for the group bonus scheme with verifiable performance, the principal implements the first-best effort level, \(e^{FB}\). Thus, I define \(r_G\) s.t. \(\min \{ B^*(e^{FB}), \Delta^*(e^{FB}) \} = V_G(e^{FB}) / r_G\). Similarly, under an individual bonus scheme, under verifiability the principal implements effort \(e^*(\alpha)\). Denote with \(r_I(\alpha)\) the interest rate where \(b(e^*(\alpha); \alpha) = V_I(e^*(\alpha); \alpha) / r_I(\alpha)\).

Under both incentive schemes, adapting the implemented effort level \(e\) in order to satisfy the respective credibility constraints allows the principal to stay credible for a range of interest rates \(r > r_G\) and \(r > r_I(\alpha)\), respectively. For sufficiently high interest rates, however, the credibility constraint can no longer be satisfied; relational contracts become infeasible. Denote the interest rates for which this is the case under the two incentive regimes \(\tilde{r}_G\) and \(\tilde{r}_I(\alpha)\), respectively. Moreover, I designate the effort level just implementable in an individual bonus scheme for \(\tilde{r}_I(\alpha)\) by \(\tilde{e}_I\).

**Non-envious Agents**

For expository purposes, I first consider the case \(\alpha = 0\). If so, there are no inequity-premium costs under either incentive scheme. Consequently, expected one-period profits coincide for any effort level \(e\); \(V_G(e) = V_I(e; 0)\). However, the group bonus exceeds the individual bonus for any \(e\); \(b(e; 0) < \min \{ B^*(e), \Delta^*(e) \}\). Thus, the principal is able to credibly implement a given effort level for a greater range of interest rates under the individual bonus scheme, yielding the following result.

\(^{20}\)By Proposition 5, the principal pays either \(B^*(e)\) or \(\Delta^*(e)\). Note that, depending on the value of \(p(e)\), she implements the smaller of these bonus payments.
Proposition 7 Suppose that performance is non-verifiable and agents are not envious, $\alpha = 0$. Then the principal always (weakly) prefers the individual bonus contract to the group bonus contract.

Figure 2: Profits under non-verifiable performance for non-envious agents in the individual and the group bonus scheme.

Figure 2 illustrates this result.\textsuperscript{21} I therein sketch the firm’s profit in the repeated game, depending on her interest rate. The dashed curve depicts the profit using a group bonus whereas the solid curve depicts the profit under an individual scheme. As long as none of the credibility constraints is binding, profits are equal under either scheme, implementing the first-best outcome. Since $b(e;0) < \min\{B^*(e), \Delta^*(e)\}$, the constraint becomes binding first under the group scheme, i.e. $r_G < r_I(0)$. Under either contract, profits decrease as $r$ further increases since credibly implementable effort levels veer away from $e^{FB}$ and $e^*(0)$, respectively. As derived above, the interest rate, for which a given $e$ can be implemented, is always larger under the individual contract. Consequently, that contract is feasible for a greater range of interest rates, i.e. $\tau_G < \tau_I(0)$. Altogether, profits under the individual bonus scheme exceed profits in the group scheme for any interest rate $r_G < r \leq \tau_I(0)$. Hence, when agents are not envious and credibility is an issue, the principal clearly prefers the individual bonus scheme.

\textsuperscript{21}Figure 2 and all subsequent figures are drawn for the case in which $p(e^{FB}) < \frac{1}{2}$, thus for the group bonus $B^*(e)$. With $p(e^{FB}) \geq \frac{1}{2}$, the principal might switch from $\Delta^*(e)$ to $B^*(e)$ for large interest rates as discussed above. This would induce a kink in the profit path under the group scheme which, however, does not affect any of the results.
Envious Agents

Compared to the foregoing situation, an increase in the agents’ propensity for envy has no impact on the firm’s profits under the group scheme, $V^*_G (r)$, but it shifts the profit curve under an individual contract, $V^*_I (r; \alpha)$, downwards in a continuous way. As a result, for a range of sufficiently small interest rates, the situation resembles that under verifiability; the principal is better off using a group bonus. For small variations in $\alpha$ and sufficiently large interest rates, however, the individual scheme in fact dominates the group scheme. Geometrically, this is represented in Figure 3. If $V^*_I (r; \alpha)$ shifts downwards, it must intersect $V^*_G (r)$ for small variations in $\alpha$, i.e. there is an interest rate $\hat{\tau} (\alpha)$ such that $V^*_I (\hat{\tau} (\alpha), \alpha) = V^*_G (r)$. Thus, by continuity of the profit functions, for any $r > \hat{\tau} (\alpha)$, the principal must be at least as well off with an individual bonus as with a group bonus and absolutely better off for a range of interest rates $\hat{\tau} (\alpha) < r \leq \tau_I (\alpha)$.

![Figure 3: Profits under non-verifiable performance for envious agents in the individual and the group bonus scheme when $\alpha > 0$ is sufficiently small.](image)

The above intuition, however, does not automatically extend to large variations in $\alpha$. This is due to fact that with increasing $\alpha$, the upper interest threshold $\tau_I (\alpha)$ may either decrease or increase, depending on the parameters. If the latter is the case, then it holds that $\tau_G < \tau_I (\alpha)$ for any $\alpha$, and the above result indeed carries over to arbitrary variations in the agents’ propensity for envy. Kragl and Schmid (2008) provide a condition
for which \( \pi_I(\alpha) \) in fact increases in \( \alpha \). Under that condition it must hold that \( \pi_I(\alpha) - \pi_G \) is positive and increasing in \( \alpha \). Consequently, for a range of interest rates \( \hat{r}(\alpha) < r \leq \pi_I(\alpha) \) and for any \( \alpha \), the principal clearly favors the individual bonus scheme over the group scheme. I summarize the above results in the following proposition.

**Proposition 8** Suppose that performance is non-verifiable. Then there are combinations of the agents’ propensity for envy \( \alpha \) and interest rates \( r \) for which the individual bonus scheme is more profitable than the group bonus scheme if and only if

(i) the agents are not too envious, i.e. \( \alpha \) is sufficiently small, or

(ii) the following condition is satisfied at the marginal implementable effort level \( e = \pi_I \):

\[
p(e) > \frac{(c(e) + U_0) p'(e) + c'(e)}{p'(e) + c'(e)} \tag{22}
\]

Intuitively, the above result obtains because the individual bonus scheme rules out free-rider problems and moreover benefits from the incentive effect of envy. Hence, c.p. reneging on the relational contract is less attractive for the firm under the individual bonus scheme, and thus credibility is facilitated by the impact of envy. The individual bonus scheme, however, imposes inequity-premium costs on the firm. For a given level of effort and a positive degree of envy, expected one-period profits are consequently larger in the group scheme. Hence, fulfilling the relational contract is c.p. less attractive for the firm under the individual bonus scheme, and credibility is more difficult due to the impact of envy.

Altogether, the prospect of unequal pay has an ambiguous effect on the principal’s ability to credibly commit to the relational contract when agents are envious. Whenever the principal’s incentive to renege on the (relatively small) individual bonus payments is sufficiently low such that the negative impact of envy on the continuation profit is overbalanced, the individual bonus scheme enhances credibility and is thus superior for high interest rates (see Figure 4). This is guaranteed by condition (22). Intuitively, the inequation requires the continuation profit \( V_I(e; \alpha) \) to react less strongly to an increase in the degree of envy than the bonus payment \( b(e; \alpha) \). From

\[22\] See Kragl and Schmid (2008), proof of Proposition 3.
the condition can further be inferred, that the credibility-enhancing effect is more likely to arise if the precision of the performance measure is large and the effort elasticity of costs is small.\textsuperscript{23}

In summary, the foregoing analysis reveals that there exist cases where reputational equilibria can be sustained for a greater range of interest rates under the individual bonus scheme. The principal then favors the individual bonus contract over the group bonus contract if her interest rate is sufficiently large. Surprisingly, this result not only obtains because of the free-rider problem under a group bonus scheme but also due to the agents’ distaste for wage inequality. Concluding, the different findings of this subsection are illustrated by Figure 4.

Figure 4: Profits under non-verifiable performance in the individual and the group bonus scheme provided that condition (22) is satisfied.

5 Concluding Remarks

In the existing literature on incentive contracts it is commonly assumed that concerns for equity or fairness could serve as an explanation for observed wage compressions or the absence of individual performance pay. The present paper shows that this prediction is certainly valid when incentives are contingent on verifiable performance, but should be qualified once

\textsuperscript{23}For a more detailed discussion of condition (22) and formal derivations see Kragl and Schmid (2008).
performance measures are not verifiable. Specifically, when the incentive contracts are enforced as reputation equilibria in a repeated game, an individual bonus scheme may be more profitable than a group bonus scheme though the former allows for unequitable payoffs which the agents dislike.

This main result emerges from the fact that, with non-verifiable performance, incentive contracts must be self-enforcing which requires a repeated relationship in which the principal is credible to pay a promised reward for good performance. The latter is the case if the principal’s gains from reneging fall short of the discounted gains from continuing the contract. Thus, credible commitment becomes less likely if the firm’s discount rate is small (and her interest rate is large respectively).\(^{24}\) As regards the design of the incentive scheme, high bonus payments as well as small expected firm profits impede credibility. In the present paper, I analyze the incentive provision in an infinitely repeated game of one firm and two workers who have a distaste for earning less than their respective co-worker. Specifically, I compare the profitability of two distinct incentive regimes; individual bonus contracts and group bonus contracts. The analysis reveals that the two schemes exhibit converse forces regarding the principal’s credibility and thus her profits in the repeated employment relationship.

I find that the group bonus contract is superior for large discount rates whereas the individual bonus scheme may become advantageous when the firm’s discount rate is small. In the former case, the firm implements the first-best outcome as inequity-premium costs do not arise under a group bonus contract. For small discount rates, however, credibility becomes an issue and using an individual bonus scheme may become optimal. This is due to the fact that, in order to induce a given level of effort, the individual scheme requires smaller bonus payments than the group scheme, thereby enhancing the firm’s credibility. This obtains because the individual scheme avoids free-rider problems and moreover exploits the incentives associated with unequal pay. The individual bonus scheme, however, also exhibits a negative impact on the firm’s credibility as it implies inequity-premium costs and, consequently, lowers the expected benefits from contract continuation. Whenever the credibility-enhancing effect is stronger, the principal is better

\(^{24}\)For expository purposes, I in the conclusion use the term discount rate which is, of course, inversely related to the firm’s interest rate.
off using an individual bonus scheme if her discount rates is sufficiently small.

Altogether, I show that there are combinations of inequity aversion and discount rates for which the relational individual bonus contract is more profitable than the group bonus contract. Moreover, there are cases where the group contract becomes yet infeasible whereas the individual bonus contract still yields positive profits. Interpreting the firm’s discount rate as a measure of the life span of a firm’s employment at the market, my findings suggest that, with non-verifiable performance and inequity averse agents, group incentives are optimal for long-term employment whereas individual incentives may become optimal when employment is of short duration.\footnote{Allowing for infinitely long-lived workers, this result directly transfers to the life span of the individual employment relationship.} This complements the findings of Che and Yoo (2001) who derive a similar result driven by peer pressure with respect to individual effort choice.

It is worth briefly discussing some assumptions of my model. First, as regards the agents’ preferences, I have focused on envy. My results, however, extend to the case of also compassionate agents as proposed by Fehr and Schmidt (1999). This is due to the fact that the characterization of inequity aversion implies the extent to which agents dislike being outperformed to exceed the extent to which they resent being ahead; $\alpha > \beta$. In fact, my findings are strengthened when agents exhibit preferences for status or pride as reflected by assuming $\beta < 0$.\footnote{For evidence on this kind of preferences see e.g. Loewenstein, Thompson, and Bazerman (1989) and Moldovanu, Sela, and Shi (2007).} Status seeking leads to even stronger incentives on the one hand and acts contrary to the expected disutility from being behind on the other hand, thereby increasing profits.\footnote{Note that for the case $\beta < 0$ and $\alpha < |\beta|$, the principal can exploit the agents’ other-regarding preferences in such a way that profits even exceed first-best profits.} As a result, credibility of the firm is unambiguously facilitated by this kind of preferences. Altogether, my results are supported for a preference structure which is also known as ‘behindness aversion’ (see e.g. Neilson and Stowe (2008)).

Second, throughout the analysis, I have assumed that agents are not financially constrained. Dropping this assumption, however, would reinforce my results. Due to the large bonus payments, the group scheme then becomes expensive for the principal in terms of the rents left to the agents. This
reduces continuation profits and thus makes credibility more difficult. Individual bonus contracts, in contrast, allow for smaller incentive payments and consequently imply smaller rents. The resulting larger continuation profit favors credibility. Hence, for large discount rates, the advantage of the group scheme is weakened. For small discount rates, the beneficial effect of envy on the firm’s credibility becomes even stronger.

Third, it is worth pointing out that I have restricted the analysis to the extreme cases of pure individual and group bonus schemes. When credibility becomes an issue such that the first-best group bonus is no longer credible, the principal could alternatively pay some amount of individual bonus in addition to a reduced group bonus in order to lower the absolute incentive payment. Concerning the principal’s credibility, however, I expect the basic trade-offs identified in the present paper to carry over to such a combined bonus scheme. Again, the incentive effect of envy favors credibility whereas the dissatisfaction associated with the prospect of unequal pay makes it more difficult. Compared to the pure bonus schemes analyzed in this paper, both effects’ magnitude would certainly be smaller. As the individual bonus scheme, however, not only involves an incentive effect but also solves the free-rider problem, there may exist intermediate discount rates for which a combined bonus scheme could be superior. Nevertheless, for non-intermediate discount rates, my results would reestablish. Specifically, for small discount rates, only a pure individual bonus contract alleviates or yet guarantees credibility.

Concluding, my findings underline that empirically observed cultural differences in social preferences should not be neglected in organizational decisions. For example, Alesina, Di Tella, and MacCulloch (2004) and Corneo (2001) find Europeans to exhibit a higher propensity for inequity aversion in comparison to U.S. Americans. In a recent empirical cross-country investigation, Isaksson and Lindskog (2007) find that Swedish, Hungarian, and German people are more supportive of redistribution than U.S. Americans. The existing theoretical literature suggests that these social differences play a crucial role for the design of incentive schemes. In particular, when performance is verifiable, inequity averse preferences may render team incentives optimal. The present analysis suggests that opposed implications may result for those occupations for which performance is not verifiable and firms thus
have to rely on self-enforcing agreements.

References


