IZA DP No. 1643

Optimal Incentive Contracts under Inequity Aversion

Florian Englmaier
Achim Wambach

June 2005

Optimal Incentive Contracts under Inequity Aversion

Florian Englmaier
University of Munich
and IZA Bonn

Achim Wambach
University of Erlangen-Nuremberg

Discussion Paper No. 1643
June 2005

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
Email: iza@iza.org

IZA Discussion Paper No. 1643
June 2005

ABSTRACT

Optimal Incentive Contracts under Inequity Aversion*

We analyze the Moral Hazard problem, assuming that agents are inequity averse. Our results differ from conventional contract theory and are more in line with empirical findings than standard results. We find: First, inequity aversion alters the structure of optimal contracts. Second, there is a strong tendency towards linear sharing rules. Third, it delivers a simple rationale for team based incentives in many environments. Fourth, the Sufficient Statistics Result is violated. Dependent on the environment, optimal contracts may be either overdetermined or incomplete.

JEL Classification: D23, D63, J31, J33, M12, Z13

Keywords: contract theory, linear contracts, incentives, sufficient statistics result, inequity aversion, incomplete contracts

Corresponding author:

Florian Englmaier
Department of Economics
University of Munich
Ludwigstr. 28 III VG
80539 München
Germany
Email: florian.englmaier@lrz.uni-muenchen.de

* We thank Tobias Böhm, Ernst Fehr, Ray Rees, Hans Zenger and seminar participants at University College London, the London School of Economics, the Zeuthen Workshop in Behavioral Economics, and ESEM in Stockholm 2003 for their comments and suggestions.

1 Introduction

"A given level of pay may be viewed as good or bad, acceptable or unacceptable, depending on the compensation of others in the reference group, and as such may result in different behavior. [...] This is a constraint on the use of any sort of incentive pay."

Milgrom and Roberts (1992, p. 419)

Although Milgrom and Roberts [1992] straightforwardly state that social preferences matter in the design of incentive schemes this issue has received little attention – though the question how to provide appropriate incentives was analyzed in much detail since Holmström's [1979] seminal paper on Moral Hazard [1].

We introduce social preferences[2], captured by inequity aversion following Fehr and Schmidt [1999], into a Holmström [1979] setting where a principal hires an agent who, by his choice of effort, determines the probability distribution of profits. As O'Donoghue and Rabin [1999] have shown for time inconsistency, incorporating behavioral biases in the analysis of incentives can help us to improve our understanding of real world phenomena. We find that analyzing the Moral Hazard problem with an agent that suffers from being worse off or better off than the principal delivers predictions that can explain a number of empirical findings that cannot be easily explained by standard models.

We find that the optimal contract has to trade off three factors: insurance – incentives – fairness. The agent's concern for fairness leads to a tendency towards linear sharing rules. Furthermore the fairness concern delivers a new incentive instrument, as the agent can be rewarded for good performance not only by paying more, but also by paying more equitably. Moreover we find that Holmström's Sufficient Statistics result[3] is violated as

[1] Exemptions are Kandel and Lazear [1993] on peer pressure or the literature on status concerns in Public Finance. Examples for the latter are Lommerud [1989] or Konrad and Lommerud [1993].

[2] Throughout the paper we will use terms like fairness, reciprocity, social preferences, and inequity aversion somewhat interchangeably. What we mean is reciprocal patterns in behavior captured by inequity aversion. See Kolm [2003] for a detailed discussion and classification of different concepts of reciprocity.

[3] The Sufficient Statistics result states that optimal contracts should condition on all informative signals with respect to effort choice and not on uninformative signals.

optimal contracts may be either overdetermined or incomplete. Finally, turning to the multi–agents case, the fairness motive gives a rationale for the widespread use of team incentives even if the performed tasks are independent.

Only recently – backed by experimental research[4] – theoretical frameworks have been developed to model other–regarding preferences. Among the most prominent examples are Rabin [1993], Dufwenberg and Kirchsteiger [2004], Falk and Fischbacher [forthcoming], Cox, Friedman, and Gjerstad [2004] , Fehr and Schmidt [1999], and Bolton and Ockenfels [2000][5]. The first four models – Rabin [1993], Dufwenberg and Kirchsteiger [2004], Falk and Fischbacher [forthcoming], and Cox, Friedman, and Gjerstad [2004] – try to actually model reciprocal behavior. Here the intentions of an agent play a role in how the material results of his actions are evaluated. Whereas these models are certainly closer to a realistic modelling of human behavior they are analytically hardly tractable. In contrast, Fehr and Schmidt [1999] and Bolton and Ockenfels [2000] are only concerned with the effects of actions on final allocations. In these latter two models agents' utility increases in own profit but decreases if they are better or worse off than others. While in Fehr and Schmidt [1999] agents compare own payoffs to everybody else's payoff, in Bolton and Ockenfels [2002] they compare themselves only to the average in the reference group. For the most part of our paper the two models would coincide in their predictions as there are only two players. We use the model by Fehr and Schmidt [1999] to conduct our analysis. While this model neglects intentions and solely focusses on final allocations it fares well in explaining observed experimental results while being still quite simple and tractable. See Fehr and Schmidt [2003] where they show how their model performs in explaining experimental data from numerous experiments.

Another model of other-regarding preferences, though related to the above mentioned papers, is Charness and Rabin [2002]. Whereas the above papers solely restrict attention to relative payoffs affecting individual utility, Charness and Rabin [2002] also introduce a concern for social efficiency into agents' utility function. While linearity does not come automatically we would get all our other main results if we were to use the preferences they

[4]See e.g. Fehr and Schmidt [2003] for a comprehensive survey of these experimental studies.

[5]These topics have been discussed by sociologists for a long time. See for example Gouldner [1960], Goranson and Berkowitz [1966] or Berkowitz [1968]. In the seventies also economists like Selten [1978] were interested in them.

suggest. As should become clear below, what is really key for our results is that agents are intrinsically interested in the other agents' payoff. This is the case in Charness and Rabin [2002], too.

As noted earlier we are not the first to deal with the role of fairness in labor relations. In Akerlof [1982] and Akerlof and Yellen [1988] the labor relation is characterized as a partial gift exchange. A generous wage offer by a firm is interpreted as a gift which is met by the agent with a high effort choice. It is argued that in order to make use of this mechanism wages are kept high and this can account for observed involuntary unemployment. Bewley [1999] offers an extensive survey of numerous interviews with managers and argues that fairness concerns and the fear of harming "working morale'" might explain "Why wages don't fall during a recession".

A number of other researchers rely on controlled laboratory experiments to analyze the effects of social preferences in labor markets. Fehr, Kirchsteiger, and Riedl [1993] replicate the world of Akerlof [1982] and Akerlof and Yellen [1988] in a laboratory and confirm their prediction that even in very competitive environments markets may not clear as wages are kept high to trigger a reciprocal high effort choice. Fehr, Gächter, and Kirchsteiger [1997] argue in an incomplete contracts environment that reciprocity may serve as a contract enforcement device. They show that agents exert (on average) more effort if they face a more generous wage offer. Fehr and Falk [1999] finally combine these two findings and show that principals seem to be aware of the possible contract enforcement power of reciprocity in an incomplete contracts environment. Here wage levels remain high despite the fact that there is unemployment and there are workers willing to work for lower wages. In complete contracts environments however principals tend to squeeze down wage levels on the market clearing level.

Standard economic theory predicts a much more complex and - from a practical point of view - generally undetermined structure to be the optimal solution to the principal agent problem[6]. However, most real world contracts have a very simple linear structure. There have been only few attempts to explain this feature in standard contracting models. Holmström and Milgrom [1987] consider a setting where the agent controls the drift rate of a Brownian motion. They show that the optimal contract is - for a rather specific setting - linear in

[6]See e.g. Holmström [1979] or Mirrlees [1999].

overall outcome. However, the Holmström and Milgrom result depends very delicately on the assumptions they make on the stochastic process and on the form of the utility function[7]. Innes [1990] assumes instead that the agent is risk neutral but wealth constrained. Then the optimal contract makes the agent the residual claimant if the outcome is such that it exceeds a threshold. In those regions the contract takes a linear form. This implies that the optimal contract has a slope of one, something which we rarely observe. Finally, Bhattacharyya and Lafontaine [1995] find a linear sharing rule to be the optimal sharecropping contract in a setting with bilateral moral hazard. But again the results depend on their specific assumption that error terms are additive and normally distributed.

The intuition why inequity aversion in our model helps to explain linearity is straightforward. An inequity averse agent cares for everybody getting a "fair share" of surplus. Now if an additional unit of surplus is to be distributed it should be distributed according to these fair shares. This holds for every additional unit of surplus. When every marginal unit is distributed according to fixed shares this is the very definition of a linear sharing rule.

Next to the topic of linearity another main focus of contract theory has been completeness of contracts. So while violations of Holmström's Sufficient Statistics result with respect to contractual incompleteness are widely accepted and a huge literature following Grossman, Hart and Moore deals with its implications, only recently attention has been paid to the fact that real world contracts may be overdetermined[8]. Again our model offers an explanation for either observation. Contracts may be overdetermined as inequity aversion implies an intrinsic interest in the distribution of firms' profits. If profit consists not only of parts influenced by agents' effort choices, agents might still want to participate in variations of overall profit. On the other hand this intrinsic interest in a firm's profit might render it infeasible to contract on better performance measures than profit as this might lead to too inequitable distributions. Thus contracts may be incomplete in equilibrium.

Finally our analysis offers an explanation for the prominence of team incentives. If workers care about each others payoffs it may be optimal to condition workers' pay on their co–

[7]See Hellwig and Schmidt [2002] for a detailed discussion and a discrete time approximation of the Holmström and Milgrom [1987] continuous time model.

[8]See for example Bertrand and Mulainathan [2001] who find that CEO pay varies as much with non informative signals as with informative ones.

workers' performance. This type of team incentives can be interpreted as a kind of insurance not only against income shocks but also against the disutility from being worse or better off than the co–workers.

Recently a couple of papers have dealt with the matter of incorporating social preferences into contract theory. Fehr, Klein and Schmidt [2004] analyze - experimentally and theoretically - the interaction of fair and selfish agents that are offered contracts by a principal. They find that incomplete bonus contracts perform better than more complete contracts. However, they severely restrict the set of contracts available to the principal.

Rob and Zemsky [2002], Huck, Kübler and Weibull [2003], and Neilson and Stowe [2004] look at optimal incentive intensity when agents exhibit some form of social preferences but restrict the class of contracts to linear incentive schemes. While Neilson and Stowe [2004] focus on the single agent case Rob and Zemsky [2002] and Huck, Kübler and Weibull [2003] look at problems with multiple agents.

So do Rey Biel [2002], Itoh [forthcoming], Dur and Glazer [2003] and Bartling and von Siemens [2004a,b]. These papers restrict the agents effort choice to a binary decision while we allow for a continuous choice. Finally, Demougin and Fluet [2003] and Grund and Sliwka [2003] look at tournaments amongst inequity averse agents[9].

As pointed out above, most of these models are less general than ours as they restrict themselves either to deterministic production technologies, binary effort decisions or in that they focus their analysis not on inequity aversion but envy, i.e. the worker cares only about being worse off and not about being better off. The latter effect however is confirmed by empirical and experimental data.

The remainder of this paper is structured as follows. In section 2 we explain the basic model and discuss the key assumptions. In section 3 we derive the optimal contracts for the situation where effort is contractible while in section 4 we focus on the Moral Hazard problem with non–contractible effort choice. In section 5 we do comparative statics with respect to the degree of inequity aversion and the profit level. Section 6 contains two extensions. First we allow for additional signals and shed light on the question of contractual completeness and then we study the multi–agent case. Section 7 compares our main findings with several

[9] For a comprehensive treatment of this literature see Englmaier [2005].

stylized empirical facts. Section 8 concludes and the Appendix contains the proofs.

2 The Model

2.1 The Basic Model

This section sets out the basic model. In the section thereafter we will discuss several points that might be considered as critical.

We model the interaction between a risk neutral, profit maximizing principal and a utility maximizing agent who is inequity averse towards his principal. In the extensions section we deal with the case of multiple agents, exhibiting inequity aversion towards each other and towards the principal.

The principal hires the agent to work for him. The profit x realized at the end of the period is continuously distributed in an interval $[\underline{x}, \overline{x}]$ with density $f(x|e)$ which is determined by the effort e exerted by the agent. As the principal is neither risk averse nor inequity averse he wants to maximize his expected net profit

$$EU_P = \int_{\underline{x}}^{\overline{x}} f(x|e)[(x - w(x)]dx$$

where $w(x)$ is the wage paid to the agent.

The agent's utility function is additively separable and has three parts: First, he derives utility from wealth, $u(w(x))$, which is strictly increasing in the wage payment. Second, he suffers from effort $c(e)$ with $c'(e) > 0$. Finally the convex function $G(\cdot)$ captures his concern for equitable allocations. To decide whether an allocation is fair or unfair the agent compares her payoff $w(x)$ and the principal's net payoff $[x - w(x)]$[10]. Therefore the agent's utility is

[10] Our results qualitatively also hold for a richer model where the agent compares her net payoff $[w(x) - c(e)]$ to the principal's net payoff $[x - w(x)]$. See the Appendix for a brief exposition of this case.

****

Figure 1: Example for $G(\cdot)$

****

given by

$$\begin{aligned} EU_A &= u\left(w(x)\right) - c(e) - \alpha G\left([x - w(x)] - w(x)\right) \\ \text{with} &\quad G'(\cdot) > 0 \text{ if } [x - w(x)] > w(x) \;,\; G'(\cdot) < 0 \text{ if } [x - w(x)] < w(x) \\ & G''(\cdot) > 0 \\ & G(0) = 0 \;,\; G'(0) = 0 \end{aligned}$$

α is the weight the agent puts on achieving equitable outcomes. One could think of this weight embedded in $G(\cdot)$, but to ease comparative statics we write it explicitly.

Figure 1 shows one possible graph of $G(\cdot)$. A quadratic function, $(\cdot)^2$, would be an example for a function fulfilling our assumptions. However, the function has by no means to be symmetric around 0, i.e. the equitable allocation. Thus we allow for the agent suffering much more from disadvantageous inequity than from advantageous inequity. Note that assuming convexity of $G(\cdot)$ implies an aversion towards lotteries over different levels of inequity.

We assume that the agent can ensure himself a utility level $\overline{U}$ in the outside market implying that the principal has to obey the agent's participation or individual rationality constraint $EU_A > \overline{U}$.

We assume that the Monotone Likelihood Ratio Property[11] applies, i.e.

$$\frac{\partial \left(\frac{f_e(x|e)}{f(x|e)} \right)}{\partial x} > 0.$$

This ensures that the higher the realization of profit the more likely it is that high effort was exerted.

[11] Cf. Milgrom [1981].

2.2 Discussion of the Assumptions

This section addresses several aspects of the model that might be considered critical. We start with our assumption that the principal has no concern for equity, but is selfish. We believe self selection of profit maximizing types into being entrepreneurs is a strong argument for this modelling choice. However, we can allow for the principal to be inequity averse, too. See the appendix for a brief outline of such a model. Assuming inequity aversion on the principal's side only strengthens our results as now both parties have a preference for equitable distributions and are pushing for an equal sharing rule.

Our assumption of $G(\cdot)$ being convex differs slightly from the original exposition of Fehr and Schmidt [1999][12]. While utility in their model is also additively separable in income, effort and inequitable outcomes they describe the disutility caused by inequitable outcomes in a piecewise linear way. Our formulation is analytically more convenient to handle as we deal with continuously differentiable functions. However, the basic driving force of our model is present in their model, too. The agent is risk averse towards lotteries over levels of inequity. Whilst our convex formulation makes the agent also locally averse towards such lotteries their piecewise linear formulation implies only global aversion towards such lotteries.

Choosing the standard of comparison as comparing payoffs and equality to be the reference point for an allocation to be considered as fair is an assumption that can be also relaxed. The qualitative nature of our results remains entirely unchanged if we choose a formulation where the agent considers a fixed share $\frac{1}{k}$ of payoffs as fair or where the agent desires a fixed share of the net rent, i.e. payoffs net of agent's effort costs and any costs borne by the principal[13].

In contrast to standard contract theory models the assumption of an exogenously given outside option is not without loss of generality. Using it here basically implies that the agent no longer compares to the principal once he is not employed by him. Thus the reference group is restricted to the firm. This is however empirically backed by Bewley [2002].

One can ask whether focussing on the agent comparing himself to the principal and not

[12] They chose a piecewise linear model of the form $U_i(x_i) = x_i - \alpha_i \max\{x_j - x_i, 0\} - \beta_i \max\{x_i - x_j, 0\}$.

[13] However cf. Young [1994] and Selten [1978] for detailed discussions of the non–trivial task to capture equity in economic models.

to the other agents[14] is the appropriate thing to look at. We do not question the fact that those intra worker comparisons are very important. However, we firmly believe that workers indeed compare themselves to their superiors and, as Ed Lazear[15] puts it "...it is not obvious that workers should care more about harming other workers than they do about harming capital owners" when they contemplate shirking. An example for the importance of such vertical comparisons are the massive quarrels at *American Airlines* in 2003 that took place after the company had imposed massive wage cuts on the workers to avoid bankruptcy and it became known that the executives had not participated in these salary cuts. The unrest was explicitly pointed at this fact and *American Airlines* CEO Donald Carty had to resign after it became public that executives had secured their pension plans and claims from these cuts. Charness and Kuhn [2004] found in a labor market experiment where firms could employ workers that in evaluating the fairness of a situation it seems to be much more important for the agents how they fare compared to their (experimental) employer as compared to how they fare compared to the other workers in the experiment. Furthermore one has to note that all the important papers on the role of fairness from Akerlof [1982], over Rabin [1993], and the numerous papers by Ernst Fehr and his collaborators were framed in a setting where agents reciprocated towards their bosses.

Finally one could ask whether the relevant principals are really firm owners (as in our model) or the managers. Our model allows for this interpretation also, as long as this manager has discretion over the worker's pay and the manager's wealth depends on the agent's actions, e.g. via a stock option plan.

3 Contractible Effort

We start our analysis with the case where the principal can contract on effort, i.e. there is no Moral Hazard problem present. In this situation the principal wants to maximize his expected profit net of wage payments and has to obey only the agent's participation

[14] However, we deal with this case in the Extensions section.

[15] cf. Lazear [1995], p.49

constraint (PC). Thus the problem becomes

$$\begin{aligned} \max_{e,w(x)} \quad EU_P &= \int_{\underline{x}}^{\overline{x}} f(x|e)\,[x - w(x)]\,dx \\ s.t. \quad (PC) \quad EU_A &= \int_{\underline{x}}^{\overline{x}} f(x|e)\,[u\,(w(x)) - \alpha G(x - 2w(x))]\,dx - c(e) \geq \overline{U}. \end{aligned}$$

Note that $[x - 2w(x)]$ as the argument of $G(\cdot)$ is derived by simplifying the initial comparison $[[x - w(x)] - w(x)]$. To isolate effects we first assume the agent to be risk neutral with respect to variations in income, i.e. $u\,(w(x)) = w(x)$.

In standard contracting models the contract structure in this setting is entirely undetermined. The principal is just interested in extracting all the rent from the relationship and as there is no risk aversion as a source of deadweight loss he can do so with any contract. However, introducing inequity aversion changes the picture.

Proposition 1 *If effort is contractible and the agent is risk neutral with respect to wealth the unique optimal contract is linear with slope* $\frac{1}{2}$.

The intuition for this result is that inequity aversion is the only source of welfare loss in the problem. Similar to risk aversion the agent dislikes here variations in inequity. Thus the deadweight loss can be minimized by offering a constant level of inequity over all realizations of x, i.e. a linear contract with slope $\frac{1}{2}$. Generically there will be a deadweight loss in equilibrium as the principal extracts the rent with a lump sum payment, thus inflicting some inequity on the agent. However, the principal's ability to use this lump sum payment is restricted by the agent's concern for inequity.

Corollary 1 *With contractible effort and a risk neutral agent the principal's profit decreases in the agent's concern for inequity,* α.

To see this, first consider the case where leaving the agent half the surplus suffices to make him participate and even makes him better off than with his outside option. Now the principal extracts this rent via the lump sum payment. This reduces the agents utility by

****
Figure 2: Forces at Work
****

making him poorer and by inflicting inequity on him. For a higher α, i.e. more concern for inequity, this latter effect is more pronounced and the principal can extract only a lower lump sum payment. In the case where leaving the agent half the surplus does not suffice to make him participate and violates the participation constraint, the principal tries to induce participation of the agent by paying him a lump sum transfer. The agents' utility increases as he is now richer but this effect is dampened as the utility is decreased due to the induced inequity. This latter effect is more pronounced for a higher α. Thus the principal has to pay a higher transfer to make the agent participate[16].

Proposition 1 gives us the prerequisites to fully describe all the forces at work in our model. Figure 2 shows these three forces. As in standard models the agent's insurance motive calls for a flat wage as this takes away all the risk from him. The principal's wish to provide incentives calls for a wage scheme that makes the agent residual claimant of profits, i.e. has a slope of 1. Finally, inequity aversion calls for an equal sharing rule as this insures the agent against variations in the level of inequity.

With this at hand we can enrich our model by introducing risk aversion for the agent. In standard models of contract theory the solution is simply offering the agent a flat wage. As there is no need to provide incentives the principal just has to ensure that the agent is fully insured.

Including now inequity aversion alters the situation. Looking at Figure 2 we see that as there is not yet a need to provide incentives the optimal contract's structure will be determined in the interplay of risk aversion (calling for a flat wage) and inequity aversion (calling for an equal sharing rule).

Proposition 2 *If effort is contractible and the agent is risk averse with respect to wealth the optimal contract is strictly increasing with a slope between* 0 *and* $1/2$.

[16] Note that in some cases due to a high degree of inequity aversion it may not be possible to make the agent willing to participate at all.

This shows that we should always observe some profit sharing, even if it is not necessary for incentive reasons or when profits are not a good performance measure. Section 7 contains several observations backing this conjecture.

4 Non–Contractible Effort

Now we turn to the analysis of the classical Moral Hazard problem as we drop the assumption that effort can be contracted upon. When designing the contract the principal now has to keep in mind that the agent will act opportunistically and try to avoid effort costs by shirking. Thus the optimal contract has to be self enforcing, i.e. the agent has to find it in his own best interest to act as desired by the principal.

This incentive constraint (IC) the principal has to obey in addition to the above introduced participation constraint has the form

$$\text{(IC)} \quad e \in \arg\max_{\widetilde{e}} \quad EU_A = \int_{\underline{x}}^{\overline{x}} f(x|\widetilde{e}) \left[u\left(w(x)\right) - \alpha G(x - 2w(x)) \right] dx - c(\widetilde{e})$$

and captures the fact that the agent will maximize his utility by choosing effort optimally given the offered compensation scheme.

In order to solve the problem we rely – as it is standard in the literature – on the First Order Approach and replace the above maximization problem by its first order condition

$$(IC') \quad 0 = \int_{\underline{x}}^{\overline{x}} f_e(x|e)[u(w(x)) - \alpha G\left(x - 2w(x)\right)]dx - c'(e).$$

First we look again at the case of a risk neutral agent. The standard contracting model (with a non–inequity averse agent) delivers a simple way to efficiently implement the first best effort level: The principal simply "sells the firm to the agent", i.e. offers a wage scheme with slope one, making the agent residual claimant of all accruing profits. As the agent is risk neutral he does not suffer from taking over the whole risk and as he is residual claimant his incentives are socially efficient. The solution in the case with a risk neutral but inequity averse agent looks different.

Proposition 3 *If effort is not contractible and the agent is risk neutral with respect to wealth the optimal contract is strictly increasing with a slope between* $1/2$ *and* 1*.*

In the standard model there is nothing that would speak against making the agent residual claimant. But now as the agent is inequity averse we note that making him residual claimant implies generically very unequal allocations and thus the degree of inequity being very volatile. Therefore the need to give high incentives and the desire to insure the agent against fluctuations in inequity work against each other and have to be balanced off in the optimal contract.

As noted above in the standard model it is optimal to implement the full information effort level also under Moral Hazard. Under inequity aversion this is not possible as we have just one instrument, the slope of the wage scheme, to balance the need to incentivice and the desire to insure against varying degrees of inequity.

Proposition 4 *If effort is not contractible the full information allocation is not implemented though the agent is risk neutral with respect to wealth.*

This hints again at the fact that inequity aversion is a friction similar to risk aversion that acts as a source of welfare loss in the model. If the principal gave higher powered incentives that would lead to too inequitable allocations for which the agent would have to be compensated up front. Thus incentives are distorted downwards. However, it is not clear whether effort under inequity aversion will be lower than in the standard case as in some cases the agent will want to work harder as he also suffers if the principal is worse off than he is.

Now we approach the fully fledged problem and allow for risk aversion in the agent's preferences. Already in the standard model, where only the motive to insure the agent against fluctuations in wealth and the need to provide sufficient incentives are present, there is no clear cut prediction for the shape of the optimal incentive scheme, next to it being strictly increasing. This is due to the Monotone Likelihood Ratio Property which tells us that a higher profit level is informative with respect to the agent's effort choice. If we now turn to the analysis of our model where we additionally have to take into account the agent's concern for equity the situation gets even more complicated. Thus we cannot make a very sharp prediction either.

Proposition 5 *If effort is not contractible and the agent is risk averse with respect to wealth the optimal contract is strictly increasing.*

Now one instrument has to balance off three countervailing forces and the shape of the scheme is determined by their interplay. We know that the scheme is increasing for two reasons: As in the standard model higher profit levels are informative signals and are therefore used to reward the agent. But additionally the agent cares for an increasing wage scheme for reasons of fair sharing.

Exploiting this latter reasons allows us to state that if the agent's concern for fairness is strong enough we get an increasing wage scheme no matter whether high profit levels are informative or not.

Proposition 6 *For any given signal quality there exits a value for* α, *the agent's concern for equity, such that the Monotone Likelihood Ratio Property is not needed to ensure the optimal contract being strictly increasing in* x.

5 Comparative Static Properties

To be able to be more precise with respect to the contractual structure we analyze the comparative static properties of our results. First we analyze what happens if the agent's concern for equity, captured by α, increases.

Proposition 7 *If* α, *the agent's concern for equity increases the optimal contract converges to* $w(x) = 1/2x$, *i.e. the equal split.*

If α increases, at some point this concern for equity becomes the dominant driving force for the structure of the contract and overrules all other motives. To the agent it is more important to ensure equity than to avoid risk and to the principal it is just too expensive to provide incentives over the equal split - as this would imply inequitable allocations at least sometimes. To compensate the agent for this risk then becomes prohibitively costly.

Looking at the comparative statics with respect to x shows another interesting property.

Proposition 8 *As the realized profit level increases the optimal contract specifies a more equitable distribution of overall profit.*

Thus inequity aversion is not only another friction but also delivers an additional incentive instrument. The effect is clearcut under risk neutrality and holds under risk aversion if the agent is already generously compensated in monetary terms. In this case the additional utility from decreased inequity is more important than additional monetary compensation and makes reduced inequity a valuable source of incentives[17].

This concludes the analysis of the basic model and we turn to the analysis of some extensions.

6 Extensions

6.1 Overdetermined Contracts

As pointed out above, inequity aversion is one reason why the agent is inherently interested in how the profits are divided - not only via the channel of its informative use in incentive provision. To prove this consider the following setup: The firms' profit Π can be separated into two parts x and y, i.e. $\Pi = x + y$. While the distribution of x depends on the effort e exerted by the agent, y is purely randomly distributed. In the appendix it is shown that contrary to the well known sufficient statistics result, the optimal contract when the agent exhibits inequity aversion conditions on y, although this variable contains no information concerning the effort choice.

Proposition 9 *With inequity averse agents the sufficient statistics result no longer applies. Optimal contracts may be overdetermined, i.e. contain non relevant information with respect*

[17] The paper by Rey Biel [2002] uses a related effect.

to effort choice.

The intuition is along the lines of Proposition 1. Profit serves not only as a signal whether or not the agent exerted enough effort, but is also important for the agent's utility as he has a concern for equitable distributions. As the agent compares his payoff to the firm's profit, y is taken into account when equitability is judged. Therefore it has to be taken into account when the contract is written. If this is not done one ends up with too much inequity for which the agent has to be compensated upfront.

6.2 Incomplete Contracts

In economic theory much more attention has been paid to incomplete contracts than to overdetermined contracts. Interestingly our model can also account for incompleteness. Suppose we have the following situation. The principal has now not only access to profit x but also to another more direct performance measure m. The signal m contains additional information on the agent's effort choice and should be therefore – following Holmström's [1979] Sufficient Statistics Result – included in the optimal contract. In our set up this is not necessarily the case.

Corollary 2 *If* α*, the agent's concern for equity, converges to* ∞ *the optimal contract is uniquely defined by* $w(x) = \frac{1}{2}x$ *and additional informative signals are disregarded. Thus the optimal contract is incomplete.*

Note that this holds even for the extreme case where the signal x is dominated in the sense of Second Order Stochastic Dominance by signal m. The idea behind this result is again that the improved incentives cannot compensate for the fact that the agent now has to be compensated for less equitable allocations. Therefore it might be better to forego the chance to use superior performance measures and instead stick to profit in which the agent is intrinsically interested[18].

[18] Note that if net–of–effort payoffs are compared this result no longer holds as now agents have not only an intrinsic interest in profit but also in effort (via effort costs). Thus the contract will always condition on all available sufficient statistics with respect to effort choice.

6.3 Team Incentives

Another natural extension is to analyze what happens if there is not only one agent but many as inequity aversion should be also important when agents interact with peers. Suppose there is one principal and two agents. The agents' tasks are technologically independent. Each agent has to choose an effort level e_i to influence a distribution function $f_i(x_i|e_i)$ where x_i is the profit generated from agent i's project. Only the x_i are contractible. The agents compare each others' gross payoff and the principal's payoff. The principal offers a contract $w_i(x_1, x_2)$ that can in principle depend on both performance measures.

Agent 1's utility function takes the form

$$\begin{aligned} EU_1^A &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x|e_1)f_2(x|e_2)u_1(w_1(\cdot)) - \alpha_P G\left([(x_1+x_2) - [w_2(\cdot)+w_1(\cdot)]] - w_1(\cdot)\right) \\ &\quad -\alpha_A H(w_2(\cdot) - w_1(\cdot))\, dx_1 dx_2 - c(e) \\ &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x|e_1)f_2(x|e_2)u_1(w_1(\cdot)) - \alpha_P G(x_1+x_2-w_2(\cdot)-2w_1(\cdot)) \\ &\quad -\alpha_A H(w_2(\cdot) - w_1(\cdot))\, dx_1 dx_2 - c(e). \end{aligned}$$

α_P measures how much weight he puts on the comparison towards the principal. The agent now suffers if his payoff $w_1(\cdot)$ differs from the principal's gross payoff $(x_1 + x_2)$ net of total wage payments $(w_2(\cdot) + w_1(\cdot))$. The disutility is – as in the basic model – captured by a convex function $G(\cdot)$. The agent also suffers if his payoff $w_1(\cdot)$ differs from his co–worker's payoff $w_2(\cdot)$. His concern for equity towards the other agent is weighted by α_P and measured by the convex function $H(\cdot)$.

As before the agent is risk averse against variations in equity towards his co–worker. The optimal contract takes care of this.

Proposition 10 *If agents are inequity averse there is a rationale for team incentives even if tasks are technologically independent and there is a sufficient statistic for every agent.*

Standard theory would suggest that if there is no technological link between agents' tasks and therefore no scope for relative performance evaluation to filter out common shocks, conditioning pay on other agents' output only adds noise. Following the Sufficient Statistics result the principal should therefore not condition upon such uninformative signals. But inequity averse agents have an intrinsic interest in other agents' performance. Conditioning pay on others' performance ensures that there is not too much inequity among the workers. This reduces the compensation agents demand for the risk of facing inequitable allocations and hence reduces the principal's costs. It is important to note that the optimal contract generally has no relative performance evaluation component but rather rewards agents for high team output. Relative performance features enter only when the initial pay is very uneven and serve to reduce payoff inequalities between the agents and between agents and principal. It is again the tradeoff between optimal incentive provision and ensuring equity that drives this result. Focussing on the extreme case where inequity aversion is the sole driving force we get a very simple contractual structure.

Corollary 3 *If agents' concern for equity among them becomes very large* ($\alpha_A \to \infty$) *the optimal contract is a simple team contract basing each agent's pay solely on overall profit.*

Related to this issue is an observation by Bartling and von Siemens [2004b]. They argue that keeping salaries secret can never be optimal as it would limit the possibilities to insure the agent against variations in income as compared to his co–workers.

7 Empirical Evidence

Our first central finding is, that the distribution of profits within a firm actually matters when agents are inequity averse. Rotemberg [2003] has several examples that clearly show that agents are very much interested in their companies' profits and the distribution of the produced rents. Lord and Hohenfeld [1979] report a study of major league baseball players who became "free agents"[19] in one season where club owners had made use of an option to cut wages by 20%. After this wage cut these players' – beforehand better–than–average – performance declined significantly, only to go up again after they had signed with new clubs. While standard theory would predict that performance should go up if the agent is looking for a new job to signal his high ability to the market, models of reciprocity are in line with

[19] A professional athlete who is free to sign a contract to play for any team.

this behavior. In our framework the declining performance can be seen as a means of the players to lower owner's profits in order to equalize shares of profits after the 20% cut.

Greenberg [1993] reports a field experiment in several plants of a firm where theft after a cut in wages was measured. In those plants where wages were cut "with no good reason" theft went up significantly. This study controls for the argument that a theory of efficiency wages could explain this finding[20]. Taking into account social preferences allows us to interpret the increase in theft as the employees stealing back what they view their fair share. In a similar vein we can interpret Bewley's [1999] finding that the productivity loss in a firm after a wage cut is stronger in boom times, i.e. when firms' profits are high, than in a downturn when firms run losses[21].

In a meta study Thaler [1989] reports systematic and persistent inter industry wage differentials, i.e. an equally qualified worker in the same job earns significantly more in a high profit industry. The papers by Blanchflower, Oswald and Sanfey [1996] and Hildreth and Oswald [1997] find the same and additionally the intertemporal effect that increased firm profits feed through to wage increases. Whilst these facts are contradicting standard labor market theories they are again consistent with fairness based theories of rent sharing.

Our second central result is the tendency towards linear and equal sharing rules implied by agents exhibiting inequity aversion. Taking a global perspective the most widespread incentive contracts are sharecropping contracts. As empirical studies by Bardhan and Rudra [1980], Bardhan [1984], Young [1996] and Young and Burke [2001] from India and Illinois find those are predominantly linear. Moreover 60% to 90% of these sharecropping contracts stipulate equal splitting rules. Allen [1985] states that "metayage", the French word for sharecropping, actually means "dividing in half". The same holds for the Italian term "mezzadria".

Now let us turn to the analysis of contractual completeness. While it is hardly questioned that real world contracts are predominantly incomplete there has been less focus on overdetermination of contracts. There are several sources showing the widespread use of employee stock and stock options also for lower tier workers. For example *CISCO Systems* has such

[20] By the wage cut the value of retaining the job declines and thus the worker is more willing to take the risk of getting caught stealing and loosing the job.

[21] Cf. Bewley [1999], p. 203 tables 12.4 and 12.5.

schemes for every single employee and is a very successful company in terms of profit and in terms of retaining their workforce. At *Starbucks* even part time workers are entitled to such schemes. A 1987 US Government Accounting Office survey shows that 54% of non-unionized and 39% of unionized *Fortune 1,000* firms had firm wide profit sharing plans in place. Knez and Simester [2001] report the enormous success of *Continental Airlines* that introduced a firmwide profit sharing scheme. Their econometric study showed that the increases in productivity can be largely accounted for by this profit sharing plan. The study by Oyer and Schaefer [2003] shows in addition that the adoption of broad based employee stock and stock option plans is much more common in smaller firms. If one is willing to accept that in smaller groups social comparisons are more important this points at a fairness based interpretation. These findings fit in our analysis as inequity averse workers are interested in profit sharing plans inherently - even if these stock and stock options are not good performance measures as a single lower tier worker's influence on the stock price is certainly negligible[22].

These findings, however, also hold for top tier employees. Bertrand and Mullainathan [2001] find that CEO income reacts equally strongly to "lucky" and to "general" profits, where lucky profits are those not controllable by the CEO. Furthermore they find that in firms with "anti–takeover–clauses" (that protect the CEO) not only the CEO earns more, but also all other employees. So whilst the finding on CEO income could also be interpreted a la Bebchuk and Fried [2003] as the CEO – who basically can freely set his own pay – just diverting money from the shareholders to herself, the latter finding is very much in line with a theory of an inequity averse workforce that demands to be taken care of fairly.

Bandiera, Barankay, and Rasul [forthcoming] present a field experiment where they were able to alter the incentive structure for field workers in a UK farm. They find that incentives based on relative performance measures perform worse than incentives based on individual measures of performance. They argue that an effort dampening effect due to fairness or reciprocity motives - caused by the negative externality of own effort generated by the relative performance contracts - is a likely explanation for their result. Thus it is suggestive to believe that team based contracts, implying a positive externality of own effort - would in the presence of fairness considerations work even better.

[22]Moreover is stockholding in the own company bad from a portfolio composition perspective as this is highly correlated with risks to a employee's (firm specific) human capital.

Finally our analysis of teams fits the study by Agell [2003] who finds that there are systematic differences in pay structure between large and small firms where small firms have less competitive schemes (no relative performance evaluation, more wage compression) in place. Taking it again as given that in smaller groups social comparisons are more important this fits our results that with multiple agents compensation should be rather team then relative performance based.

8 Conclusion

Our analysis has shown that incorporating social preferences in the analysis of optimal incentives can improve our understanding of real world incentive schemes a lot. If agents exhibit an aversion towards inequitable distributions the optimal contract has to balance the agent's concern for insurance and fairness and the principal's desire to provide adequate incentives.

The agent's concern for equity adds a rationale for linear sharing rules and it adds an additional incentive instrument: the agent can be rewarded for better performance not only by paying more, but also by paying more equitably. Due to the inherent interest in the distribution of profits, Holmström's Suffcient Statistics result is violated and optimal contracts may be either overdetermined or even incomplete. Along the same lines of reasoning we get a rationale for team incentives even if tasks are independent. Thus, introducing inequity aversion into the analysis of contracting problems offers a plausible explanation for an array of empirical phenomena at once.

However, our analysis is only a first step in the - as we believe - right direction and there remain many open questions to be tackled. If social preferences are important and matter for effort exertion and incentive provision it would naturally be of importance for firms to be able to alter them. And Milgrom and Roberts [1992] already point out that a large share of companies' Human Resource Management activities is targeted at shaping employees preferences. While this question is central to researchers in Organizational Behavior or Human Resource Management it has received only little attention by economists[23].

[23] Rotemberg [1994] is one prominent exception, although his focus is slightly different.

A related question is, how an interaction is perceived by the agent. What is the relevant time horizon, what are the limits of a relation? Psychologists would call this “bracketing”. The right framing of the work interaction is surely another important task for managers within a firm.

Another interesting question is whether there is sorting with respect to the “fairness type” in the labor market. Casciaro [2001] reports that people can detect whether others have social feelings towards them and O’Reilly and Pfeffer [1995] and Oliva and Gittell [2002] report about *Southwest Airlines* that apparently uses this and hired only after checking for social type. In Southwest’s hiring process these social factors were more important than ability or past performance. So it remains to be determined for what jobs or tasks socially motivated workers are especially desirable or detrimental.

Finally it is important to understand, what determines the reference group for social comparison processes. As relative income comparisons have the above described effects on incentives and effort it is important to control to whom agents compare such that ill-led comparisons do not lead to detrimental outcomes.

9 Appendix

9.1 Proofs

Proof of Proposition 1

The principal’s problem is given by

$$\begin{aligned} \max_{e,w(x)} \quad EU_P &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)\,[x - w(x)]\,dx \\ s.t.(PC) \quad EU_A &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)\,[u\,(w(x)) - \alpha G(x - 2w(x))]\,dx - c(e) \geq \overline{U} \end{aligned}$$

and the Lagrangian takes the form

$$\begin{aligned} L &= \int_{\underline{x}}^{\overline{x}} f(x|e)\,[x - w(x)]\,dx \\ &\quad -\lambda \left[\overline{U} - \int_{\underline{x}}^{\overline{x}} f(x|e)\,[u\,(w(x)) - \alpha G(x - 2w(x))]\,dx + c(e) \right] \end{aligned}$$

The First Order Condition is then given by

$$\frac{\partial L}{\partial w(x)} = -f(x|e) + \lambda f(x|e) u'\,(w(x)) + \lambda f(x|e) 2\alpha G'\,(x - 2w(x)) = 0.$$

Dividing by $f(x|e)$ and rearranging yields

$$\frac{\lambda u'\,(w(x)) - 1}{\lambda 2\alpha} = G'\,(x - 2w(x))\,.$$

Note that for risk neutral agents $u'\,(w(x))$ is a constant: $u'\,(w(x)) = u$

$$\begin{aligned} \frac{\lambda u - 1}{\lambda 2\alpha} &= G'\,(x - 2w(x)) \\ \frac{\lambda u - 1}{\lambda 2\alpha} &= const. \\ &\Longrightarrow \\ G'\,(x - 2w(x)) &= const. \\ &\Leftrightarrow \\ x - 2w(x) &= const. \text{(due to convexity of } G\,(x - 2w(x))\,\text{)} \\ &\Leftrightarrow \\ w(x) &= \frac{const.}{2} + \frac{x}{2} \end{aligned}$$

Proof of Proposition 2

The principal's problem, the Lagrangian and the first order condition are as in Proposition 1 and can be rewritten as

$$-1 + \lambda\,[u'\,(w(x)) + 2\alpha G'\,(x - 2w(x))] = 0.$$

Totally differentiating this expression yields

$$\begin{aligned} 0 &= w'(x)u''(w(x)) + 2\alpha G''(\cdot)(1 - 2w'(x)) \\ w'(x) &= \frac{[2\alpha G''(\cdot)] - \left[\frac{1}{2}u''(w(x)) - \frac{1}{2}u''(w(x))\right]}{(4\alpha G''(\cdot) - u''(w(x)))} \end{aligned}$$

Note, that $w' > 0$ holds.

$$\begin{aligned} w'(x) &= \frac{2\alpha G''(\cdot) - \frac{1}{2}u''(w(x))}{4\alpha G''(\cdot) - u''(w(x))} \\ &\quad + \frac{\frac{1}{2}u''(w(x))}{4\alpha G''(\cdot) - u''(w(x))} \\ w'(x) &= \frac{1}{2} + \frac{u''(w(x))}{(8\alpha G''(\cdot) - 2u''(w(x)))}. \end{aligned}$$

Note that

$$\frac{u''(w(x))}{(8\alpha G''(\cdot) - 2u''(w(x)))} < 0$$

as

$$u''(w(x)) < 0.$$

Thus

$$0 < w'(x) < \frac{1}{2}$$

holds.

Proof of Proposition 3

Now the principal has to take care of the agent's incentive constraint. Thus his problem is given by

$$\begin{aligned}
\max_{e,w(x)} \quad EU_P &= \int_{\underline{x}}^{\overline{x}} f(x|e)\,[x - w(x)]\,dx \\
\text{s.t.(PC)} \quad EU_A &= \int_{\underline{x}}^{\overline{x}} f(x|e)\,[u\,(w(x)) - \alpha G\,(x - 2w(x))]\,dx - c(e) \geq \overline{U} \\
\text{(IC)} \quad e &\in \arg\max_{\widetilde{e}} \quad EU_A = \int_{\underline{x}}^{\overline{x}} f(x|\widetilde{e})\,[u\,(w(x)) - \alpha G(x - 2w(x))]\,dx - c(\widetilde{e}) \\
\text{(IC}') \quad 0 &= \int_{\underline{x}}^{\overline{x}} f_e(x|e)[u(w(x)) - \alpha G\,(x - 2w(x))]dx - c'(e)
\end{aligned}$$

where the Lagrangian takes the form

$$\begin{aligned}
L = & \int_{\underline{x}}^{\overline{x}} f(x|e)\,[x - w(x)]\,dx \\
& -\lambda \left[\overline{U} - \int_{\underline{x}}^{\overline{x}} f(x|e)\,[u\,(w(x)) - \alpha G(x - 2w(x))]\,dx + c(e) \right] \\
& -\mu \left[0 - \int_{\underline{x}}^{\overline{x}} f_e(x \mid e)[u(w(x)) - \alpha G\,(x - 2w(x))]dx + c'(e) \right].
\end{aligned}$$

The resulting first order condition can be divided by $f(x|e)$ and rewritten to

$$\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)} \right] [u'\,(w(x)) + 2\alpha G'\,(x - 2w(x))] - 1 = 0.$$

Totally differentiating with respect to x yields

$$\begin{aligned}
0 = & \left[u''\,(w(x))\,w'(x) + 2\alpha G''\,(x - 2w(x))\,(1 - 2w'(x)) \right] \\
& + \mu \frac{\left(\frac{f_e(x|e)}{f(x|e)} \right)'}{\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)} \right]} [u'\,(w(x)) + 2\alpha G'\,(x - 2w(x))]
\end{aligned}$$

where $\left(\frac{f_e(x|e)}{f(x|e)}\right)'$ denotes the derivative of the likelihood ratio $\left(\frac{f_e(x|e)}{f(x|e)}\right)$ with respect to x. Note that due to risk neutrality $u''(w(x)) = 0$ and $u'(w(x))$ is a constant. Thus we get

$$w'(x) = \frac{1}{2} + \frac{\mu \left(\frac{f_e(x|e)}{f(x|e)}\right)' \frac{[u'(w(x))+2\alpha G'(x-2w(x))]}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}}{4\alpha G''(x-2w(x))}$$

where all terms but

$$\frac{[u'(w(x)) + 2\alpha G'(x - 2w(x))]}{\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right]}$$

are obviously positive. To ensure that

$$\frac{[u'(w(x)) + 2\alpha G'(x - 2w(x))]}{\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right]}$$

is positive, too, check again the first order condition:

$$\begin{aligned}\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right][u'(w(x)) + 2\alpha G'(x - 2w(x))] - 1 &= 0 \\ &\Leftrightarrow \\ [u'(w(x)) + 2\alpha G'(x - 2w(x))] &= \frac{1}{\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right]}.\end{aligned}$$

This is only possible if the both terms $[u'(w(x)) + 2\alpha G'(x - 2w(x))]$ and $\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right]$ have the same sign. Thus all terms from above are strictly positive and $w'(x) > \frac{1}{2}$ holds.

Proof of Proposition 4

Note that here - in contrast to standard principal agent models - the optimal First Best contract is unique. The Lagrangian of the First Best Problem has the form

$$L = E[U_P(x - w(x))|e] - \lambda[\overline{U} - E[U_A|e]]$$

The derivative of the Lagrangian with respect to effort yields

$$\frac{\partial L}{\partial e} = \frac{\partial E[U_P(x - w(x))|e]}{\partial e} + \lambda \frac{\partial E[U_A|e]}{\partial e} = 0$$

The second expression is the derivative of the agent's incentive constraint and therefore has to be zero in optimum in the Second Best case. If we plug in the First Best wage scheme, which according to Proposition 1 has the form $w^*(x) = \gamma + 1/2x$, the term $\frac{\partial E[U_P(x-w(x))|e]}{\partial e}$ changes to $1/2\frac{\partial E[x|e]}{\partial e}$, which has to be zero in order to guarantee the First Best solution if the Incentive Constraint holds in the Second Best. But, as we assumed $c(e) > 0$, it can not be an equilibrium if $\frac{\partial E[x|e]}{\partial e}|_{e=e^{FB}}$ is equal to zero, as we could reduce the effort, and hence $c(e)$ without reducing the expected value of x. Therefore $\frac{\partial E[U_A|e]}{\partial e} \neq 0$ must hold in the First Best, which implies that the First Best allocation is not implementable in the Second Best.

Proof of Proposition 5

The principal's problem, the Lagrangian and the first order condition look like in the proof of Proposition 2. The latter can be written as

$$\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right] \left[u'\left(w(x)\right) + 2\alpha G'\left(x - 2w(x)\right)\right] - 1 = 0.$$

Totally differentiating this expression with respect to x yields

$$\begin{aligned} 0 \quad = \quad & \left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right] \left[u''\left(w(x)\right) w'(x) + 2\alpha G''\left(x - 2w(x)\right)\left(1 - 2w'(x)\right)\right] \\ & + \mu \left(\frac{f_e(x|e)}{f(x|e)}\right)' \left[u'\left(w(x)\right) + 2\alpha G'\left(x - 2w(x)\right)\right]. \end{aligned}$$

which can be rearranged to

$$\begin{aligned} w'(x) \quad = \quad & \frac{2\alpha G''\left(x - 2w(x)\right)}{\left[4\alpha G''\left(x - 2w(x)\right) - u''\left(w(x)\right)\right]} \\ & + \frac{\mu \left(\frac{f_e(x|e)}{f(x|e)}\right)' \left[u'\left(w(x)\right) + 2\alpha G'\left(x - 2w(x)\right)\right]}{\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right] \left[4\alpha G''\left(x - 2w(x)\right) - u''\left(w(x)\right)\right]}. \end{aligned}$$

As all terms are strictly positive (see the proof of Proposition 2 which shows that the last term has to be positive) it holds that $w'(x) > 0$.

Proof of Proposition 6

Taking the limit for $\alpha \to \infty$ in the proof of Proposition 5 implies the proposition as the slope of $\frac{1}{2}$ is independent of the signal quality.

PROOF OF PROPOSITION 7

We can rewrite the first order condition as

$$\frac{1}{\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)}\right]} = 2\alpha G'\left(x - 2w(x)\right) + u'\left(w(x)\right).$$

Now convergence to $1/2x$ implies that with an increase in α for any given $\tilde{x}$, $w(\tilde{x})$ has to be increased (decreased) if $x - 2w(x) > 0$ $(x - 2w(x) < 0)$. Remember that

$$\begin{aligned} G' > 0 \quad for \quad x - 2w(x) &> 0 \\ G' < 0 \quad for \quad x - 2w(x) &< 0. \end{aligned}$$

The first order condition has to hold in any point. The left hand side is, given x, a constant.

For $x - 2w(x) > 0$, i.e. a situation where $w(x) < 1/2x$, an increase in α has to be balanced by an increase in $w(x)$. This decreases $G'\left(x - 2w(x)\right)$ and decreases $u'\left(w(x)\right)$.

For $x - 2w(x) < 0$, i.e. a situation where $w(x) > 1/2x$, an increase in α has to be balanced by a decrease in $w(x)$. This increases $G'\left(x - 2w(x)\right)$ - which is negative - and increases $u'\left(w(x)\right)$.

To see that the convergence is in fact complete, consider the limit of $\alpha \to \infty$. Remember the Participation constraint:

$$s.t. \quad (PC) \quad EU_A \;=\; \int_{\underline{x}}^{\overline{x}} f(x|e)\left[u\left(w(x)\right) - \alpha G(x - 2w(x))\right]dx - c(e) \geq \overline{U}.$$

Dividing the whole expression by α we get

$$\int_{\underline{x}}^{\overline{x}} f(x|e)\left[\frac{u\left(w(x)\right)}{\alpha} - G(x - 2w(x))\right]dx - \frac{c(e)}{\alpha} \geq \frac{\overline{U}}{\alpha}.$$

For the limit of $\alpha \to \infty$ the relevant constraint now is

$$\int_{\underline{x}}^{\overline{x}} f(x|e)\left[-G(x-2w(x))\right]dx \geq 0.$$

Note that this can only be satisfied if $G(\cdot)=0$ which in turn is only true for $w(x)=\frac{1}{2}x$.

Proof of Proposition 8

Remember that the first order condition can be written as

$$G'\left(x-2w(x)\right)=\frac{1}{2\alpha}\left[\frac{1}{\left[\lambda+\mu\frac{f_e(x|e)}{f(x|e)}\right]}-u'\left(w(x)\right)\right]$$

First look at the situation when the agent is risk neutral. If x increases $\frac{f_e(x|e)}{f(x|e)}$ goes up (as we assumed Monotone Likelihood Ratio Property), $u'\left(w(x)\right)$ is not affected and the whole latter term goes down. Thus the absolute value of $G'\left(\cdot\right)$ decreases, in term implying a lower degree of inequity.

Under risk aversion the situation is a bit more complicated. If x increases we know that $w(x)$ also increases and thus $u'\left(w(x)\right)$ decreases. Now we can either assume that the effect on $\frac{f_e(x|e)}{f(x|e)}$ always dominates the effect on $u'\left(w(x)\right)$ which is a strong restriction on the class of allowed utility functions. Or we impose $u'''\left(\cdot\right)>0$ and argue that there exists a payment level $\hat{w}(x)$ such that from there on the first effect always dominates.

Proof of Proposition 9

Suppose the firms' profit Π can be separated into two parts x and y, i.e. $\Pi=x+y$. While the distribution $f(x\mid e)$ of x depends on the effort e exerted by the agent, y is purely randomly distributed and its density is given by $g(y)$. To show that the sufficient statistics result does not apply when the agent exhibits inequity aversion consider the principal's optimization problem

$$\begin{aligned}
\max\ EU_P &= \int_{\underline{x}}^{\overline{x}} f(x|e)xdx + \int_{\underline{y}}^{\overline{y}} g(y)ydy - \int_{\underline{x}}^{\overline{x}}\int_{\underline{y}}^{\overline{y}} w(x,y)f(x|e)g(y)dxdy \\
\text{s.t.(PC)}\ \overline{U} &\leq \int_{\underline{x}}^{\overline{x}}\int_{\underline{y}}^{\overline{y}} \left[u\left(w(x,y)\right) - \alpha G(x+y-2w(x,y))\right] f(x|e)g(y)dxdy - c(e) \\
\text{s.t.(IC)}\ e &\in \arg\max_{\widetilde{e}} \int_{\underline{x}}^{\overline{x}}\int_{\underline{y}}^{\overline{y}} \left[u(w(x,y)) - \alpha G(x+y-2w(x,y))\right] f(x|\widetilde{e})g(y)dxdy - c(\widetilde{e}) \\
(\text{IC}')\ 0 &= \int_{\underline{x}}^{\overline{x}}\int_{\underline{y}}^{\overline{y}} f_e(x|e)g(y)[u(w(x,y) - \alpha G(x+y-2w(x,y))]dxdy - c_e(e)
\end{aligned}$$

where $g(y)$ is the density function for y, the random part of the profit.

The Lagrangian is given by

$$\begin{aligned}
L &= \int_{\underline{x}}^{\overline{x}} f(x \mid e)xdx + \int_{\underline{y}}^{\overline{y}} g(y)ydy - \int_{\underline{x}}^{\overline{x}}\int_{\underline{y}}^{\overline{y}} w(x,y)f(x \mid e)g(y)dxdy \\
&\quad -\lambda\left[\overline{U} - \int_{\underline{x}}^{\overline{x}}\int_{\underline{y}}^{\overline{y}} \left[u(w(x,y)) - \alpha G(x+y-2w(x,y))\right] f(x \mid e)g(y)dxdy + c(e)\right] \\
&\quad -\mu\left[0 - \int_{\underline{x}}^{\overline{x}}\int_{\underline{y}}^{\overline{y}} f_e(x \mid e)g(y)[u(w(x,y) - \alpha G(x+y-2w(x,y))]dxdy + c_e(e)\right].
\end{aligned}$$

The first order condition for the principal's optimization problem has the following form

$$-1 + \lambda\left[u'(w(x,y)) + 2\alpha G'(\cdot)\right] + \mu\frac{f_e(x|e)}{f(x|e)}\left[u'(w(x,y)) + 2\alpha G'(\cdot)\right] = 0.$$

An application of the implicit function theorem yields

$$\frac{\partial w}{\partial y} = \frac{\alpha G''(\cdot)}{4\alpha G''(\cdot) - u''(w(x,y))} > 0 \qquad \forall\ \alpha \neq 0.$$

As w depends on y, which does not contain any information about the agent's effort choice the sufficient statistics result does not apply. Not surprisingly, for $\alpha = 0$, i.e. a purely selfish agent, the sufficient statistics result applies again, as there $w_y(y) = 0$ holds.

PROOF OF COROLLARY 2

The proof follows immediately from the proof of Proposition 7. For $\alpha \to \infty$ the optimal contract is uniquely determined by $w(x) = \frac{1}{2}x$, no matter whether effort is contractible or not. Thus effort is disregarded.

PROOF OF PROPOSITION 10

For the case with two agents the utility of agent 1 is given by

$$\begin{aligned} EU_1^A &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)[u_1(w_1(\cdot)) - \alpha_P G([x_1+x_2-w_2(\cdot)-w_1(\cdot)] - w_1(\cdot)] \\ &\quad -\alpha_A H(w_2(\cdot)-w_1(\cdot)]]dx_1dx_2 - c(e) \\ &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)[u_1(w_1(\cdot)) - \alpha_P G(x_1+x_2-w_2(\cdot)-2w_1(\cdot)] \\ &\quad -\alpha_A H(w_2(\cdot)-w_1(\cdot)]]dx_1dx_2 - c(e) \end{aligned}$$

where $w_1(\cdot) = w_1(x_1, x_2)$ and $w_1(\cdot) = w_2(x_1, x_2)$.

Thus the principal's problem takes the form

$$\begin{aligned} \max_{e,w(x)} \quad EU_P &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)\left[x_1+x_2-w_2(\cdot)-w_1(\cdot)\right]dx_1dx_2 \\ \text{s.t.(PC)} \quad EU_A &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_i(x_i|e_i)f_j(x_j|e_j)[u_i(w_i(\cdot)) - \alpha_P G(\cdot) - \alpha_A H(\cdot)]dx_1dx_2 - c(e_i) \geq \overline{U} \\ i,j &\in \{1,2\}, i \neq j \\ \text{(IC)} \quad e \in \arg &\max_e \quad EU_A = \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_i(x_i|e_i)f_j(x_j|e_j)[u_i(w_i(\cdot)) - \alpha_P G(\cdot) - \alpha_A H(\cdot)]dx_1dx_2 - c(e_i) \\ i,j &\in \{1,2\}, i \neq j \\ \text{(IC}'\text{)} \quad 0 &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_{i_{e_i}}(x_i|e_i)f_j(x_j|e_j)[u_i(w_i(x_i,x_j)) - \alpha_P G(\cdot) - \alpha_A H(\cdot)]dx_1dx_2 - c'(e_i) \\ i,j &\in \{1,2\}, i \neq j \end{aligned}$$

and the Lagrangian becomes

$$
\begin{aligned}
L &= \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)\left[x_1+x_2-w_2\left(x_1,x_2\right)-w_1\left(x_1,x_2\right)\right]dx_1dx_2 \\
&\quad -\lambda_1\left[\overline{U}-\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)[u_1\left(w_1\left(x_1,x_2\right)\right)-\alpha_{P1}G_1\left(\cdot\right)-\alpha_{A1}H_1\left(\cdot\right)]dx_1dx_2+c(e_1)\right] \\
&\quad -\lambda_2\left[\overline{U}-\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)f_2(x_2|e_2)[u_2\left(w_2\left(x_1,x_2\right)\right)-\alpha_{P2}G_2\left(\cdot\right)-\alpha_{A2}H_2\left(\cdot\right)]dx_1dx_2+c(e_2)\right] \\
&\quad -\mu_1\left[0-\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_{1_{e_1}}(x_1|e_1)f_2(x_2|e_2)[u_1\left(w_1\left(x_1,x_2\right)\right)-\alpha_{P1}G_1\left(\cdot\right)-\alpha_{A1}H_1\left(\cdot\right)]dx_1dx_2+c'(e_1)\right] \\
&\quad -\mu_2\left[0-\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_{2_{e_2}}(x_2|e_2)f_1(x_1|e_1)[u_2\left(w_2\left(x_1,x_2\right)\right)-\alpha_{P2}G_2\left(\cdot\right)-\alpha_{A2}H_2\left(\cdot\right)]dx_1dx_2+c'(e_2)\right].
\end{aligned}
$$

Dividing the first order condition by $f_1\left(\cdot\right)f_2\left(\cdot\right)$ and rearranging yields

$$
1=\left[\lambda_1+\mu_1\frac{f_1'\left(\cdot\right)}{f_1\left(\cdot\right)}\right]\left[u_1'\left(\cdot\right)+2\alpha_{P1}G_1'\left(\cdot\right)+\alpha_{A1}H_1'\left(\cdot\right)\right]+\left[\lambda_2+\mu_2\frac{f_2'\left(\cdot\right)}{f_2\left(\cdot\right)}\right]\left[\alpha_{P2}G_2'\left(\cdot\right)-\alpha_{A2}H_2'\left(\cdot\right)\right].
$$

Differentiating this expression with respect to x_2 , simplifying and solving for $\frac{\partial w_1(\cdot)}{\partial x_2}$ gives us

$$
\begin{aligned}
\frac{\partial w_1\left(\cdot\right)}{\partial x_2} &= \frac{\left[\lambda_1+\mu_1\frac{f_1'(\cdot)}{f_1(\cdot)}\right]\left[2\alpha_{P1}G_1''\left(\cdot\right)\left[1-\frac{\partial w_2(\cdot)}{\partial x_2}\right]+\frac{\partial w_2(\cdot)}{\partial x_2}\alpha_{A1}H_1''\left(\cdot\right)\right]}{K} \\
&\quad +\frac{\left[\lambda_2+\mu_2\frac{f_2'}{f_2}\right]\left[\alpha_{P2}G_2''\left(\cdot\right)\left[1-2\frac{\partial w_2(\cdot)}{\partial x_2}\right]+\frac{\partial w_2(\cdot)}{\partial x_2}\alpha_{A2}H_2''\left(\cdot\right)\right]}{K} \\
&\quad +\frac{\mu_2\frac{\partial\left[\frac{f_2'}{f_2}\right]}{\partial x_2}\left[\alpha_{P2}G_2'\left(\cdot\right)-\alpha_{A2}H_2'\left(\cdot\right)\right]}{K}
\end{aligned}
$$

where K is defined as

$$K = \left[\lambda_2 + \mu_2 \frac{f_2'}{f_2}\right]\left[\alpha_{P2} G_2''(\cdot) + \alpha_{A2} H_2''(\cdot)\right] - \left[\lambda_1 + \mu_1 \frac{f_1'}{f_1}\right]\left[u_1''(\cdot) - 4\alpha_{P1} G_1''(\cdot) - \alpha_{A1} H_1''(\cdot)\right].$$

Note that $K > 0$ as $G''(\cdot)$, $H''(\cdot)$ are strictly positive by assumption and $u''(\cdot)$ is strictly negative. Further we know that $\frac{\partial w_2(\cdot)}{\partial x_2}$ is strictly between 0 and 1. First note that $\frac{\partial w_1(\cdot)}{\partial x_2}$ is generically different from 0. Furthermore we see that $\frac{\partial w_1(\cdot)}{\partial x_2} > 0$ holds most of the time. Only when the wages are such that agent 1 is already far better off than agent 2, i.e. $H_2'(\cdot)$ very high, or when the principal is worse off than the agents, i.e. $G_2'(\cdot)$ very negative and $\frac{\partial w_2(\cdot)}{\partial x_2}$ larger than $\frac{1}{2}$, the expression may be negative and $w_1(\cdot)$ decreases in order to reduce inequality. The same logic applies for the N agent case.

Proof of Corollary 3

As in the Proof of Proposition 7 we divide the Participation Constraint by α and consider the relevant constraint in the limit of $\alpha_A \to \infty$

$$\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1) f_2(x_2|e_2) - H(\cdot)] dx_1 dx_2 \geq 0$$

which only holds for $H(\cdot) = 0$ which in turn is only true for $w_1(\cdot) = w_2(\cdot)$. Thus the two H terms drop out of the optimization problem and the principal maximizes the same problem as in the situation with one agent under the constraint that $w_1(\cdot) = w_2(\cdot) \forall x_i, x_j$. From the above analysis we know that the optimal contract will be increasing and thus we have a simple team performance contract.

9.2 The Problem for an inequity averse principal

The principal's problem is only slightly changed due to his changed objective function, now including a part capturing his suffering from inequitable allocations, $-\beta H(2w(x) - x)$. For this part the same assumptions as on $G(\cdot)$ apply.

$$\begin{aligned}
\max_{e,w(x)} \quad EU_P &= \int_{\underline{x}}^{\overline{x}} f(x \mid e) \left[[(x - w(x)] - \beta H(2w(x) - x) \right] dx \\
s.t.(PC) \quad EU_A &= \int_{\underline{x}}^{\overline{x}} f(x \mid e) \left[u\left(w(x)\right) - \alpha G(x - 2w(x)) \right] dx - c(e) \geq \overline{U} \\
(IC) \; e &\in \arg\max_e \quad EU_A = \int_{\underline{x}}^{\overline{x}} f(x \mid e) \left[u\left(w(x)\right) - \alpha G(x - 2w(x)) \right] dx - c(e) \\
(IC') \quad 0 &= \int_{\underline{x}}^{\overline{x}} f_e(x \mid e)[u(w(x)) - \alpha G\left(x - 2w(x)\right)]dx - c'(e)
\end{aligned}$$

The resulting first order condition of this problem can be written as

$$-1 - 2\beta H'(2w(x) - x) + \left(\left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)} \right] \right) (u'(w(x,y)] + 2\alpha G'(x - 2w(x))) = 0.$$

Differentiating this first order condition yields after rearranging

$$\frac{\partial w}{\partial x} = \frac{2\beta H''(\cdot) + 2\alpha G''(\cdot) \left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)} \right] + \mu \left(\frac{f_e(x,y|e)}{f(x,y|e)} \right)' (u'(w(x,y)] + 2\alpha G'(x - 2w(x)))}{4\beta H''(\cdot) + 4\alpha G''(\cdot) \left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)} \right] - \left[\lambda + \mu \frac{f_e(x|e)}{f(x|e)} \right] u''(w(x,y))}.$$

We see that α and β, i.e. agent and principal fairness attitudes work in the same direction.

9.3 The Problem with inequity aversion defined over net rents

The preferences of the agent are given by

$$\begin{aligned}
EU_A &= \int_{\underline{x}}^{\overline{x}} f(x \mid e) \left[u\left(w(x)\right) - \alpha G([x - w(x)] - \left[w(x) - u^{-1}\left(c(e)\right) \right]) \right] dx - c(e) \\
&\Leftrightarrow \\
EU_A &= \int_{\underline{x}}^{\overline{x}} f(x \mid e) \left[u\left(w(x)\right) - \alpha G(x - 2w(x) + u^{-1}\left(c(e)\right)) \right] dx - c(e)
\end{aligned}$$

The change here is now that the agent no longer compares gross payments $[[x - w(x)] - w(x)]$ but corrects for his effort costs measured in monetary units $[[x - w(x)] - [w(x) - u^{-1}(c(e))]]$. Thus the principal's problem takes the form

$$\max_{e,w(x)} \quad EU_P = \int_{\underline{x}}^{\overline{x}} f(x|e)[(x - w(x)]dx$$

$$s.t.(PC) \quad EU_A = \int_{\underline{x}}^{\overline{x}} f(x|e) \left[u(w(x)) - \alpha G(x - 2w(x) + u^{-1}(c(e)))\right] dx - c(e) \geq \overline{U}$$

$$(IC)\ e \in \arg\max_e \quad EU_A = \int_{\underline{x}}^{\overline{x}} f(x|e) \left[u(w(x)) - \alpha G(x - 2w(x) + u^{-1}(c(e)))\right] dx - c(e)$$

$$(IC') \quad 0 = \int_{\underline{x}}^{\overline{x}} f_e(x|e)[u(w(x)) - \alpha G(x - 2w(x) + u^{-1}(c(e)))]dx - \int_{\underline{x}}^{\overline{x}} f(x|e)\alpha G'(x - 2w(x) + u^{-1}(c(e)))u^{-1'}(c(e))\, c'(e)dx - c'(e)$$

The resulting first order condition is

$$-1 + \left[\lambda + \mu\frac{f_e(x|e)}{f(x|e)}\right][u'(w(x)] + 2\alpha G'(\cdot)] - \mu 2\alpha G''(\cdot)u^{-1'}(c(e))\, c'(e) = 0$$

which we can solve for

$$G'(\cdot) = \frac{1}{2\alpha}\left[\frac{1 + \mu 2\alpha G''(\cdot)u^{-1'}(c(e))\, c'(e)}{\left[\lambda + \mu\frac{f_e(x|e)}{f(x|e)}\right]} - u'(w(x)]\right]$$

and

$$w'(x) = \frac{1}{2} + \frac{\frac{1}{2}u''(w(x)) + \mu\frac{\left(\frac{f_e(x,y|e)}{f(x,y|e)}\right)'[u'(w(x)) + 2\alpha G'(\cdot)]}{\left[\lambda + \mu\frac{f_e(x,y|e)}{f(x,y|e)}\right]}}{4\alpha G''(\cdot) - u''(w(x))} + \frac{4\alpha G'''(\cdot)u^{-1'}(c(e))\, c'(e)}{[4\alpha G''(\cdot) - u''(w(x))]\left[\lambda + \mu\frac{f_e(x,y|e)}{f(x,y|e)}\right]}.$$

Compare this to the solution of the standard problem

$$w'(x) = \frac{1}{2} + \frac{\frac{1}{2}u''(w(x)) + \mu\frac{\left(\frac{f_e(x|e)}{f(x|e)}\right)'[u'(w(x)) + 2\alpha G'(\cdot)]}{\left[\lambda + \mu\frac{f_e(x|e)}{f(x|e)}\right]}}{4\alpha G''(\cdot) - u''(w(x))}$$

and note that the basic structure is very similar to the original problem as it differs only by one additively separable term which is positive (negative) whenever G''' is positive (negative).

10 References

1. Agell, J. [2003] 'Why Are Small Firms Different? Managers' Views', CESifo Working Paper Series No. 1076

2. Akerlof, G.A. [1982] 'Labor contracts as a partial gift exchange' , *Quarterly Journal of Economics*, Vol. 97(4), 543-569

3. Akerlof, G.A. and J.L. Yellen [1988] 'Fairness and Unemployment', *American Economic Review*, Vol. 78(2) , pp. 44-49

4. Allen, F. [1985] 'On the Fixed Nature of Sharecropping Contracts', *Economic Journal*, Vol. 95, pp. 30-48

5. Austin, W. [1977] 'Equity Theory and social comparison processes', in Social Comparison Processes, J.M. Suls and R.L. Miller, eds. (Washington D.C., Hemisphere Publishing Corporation)

6. Bandiera, O., I. Barankay, and I. Rasul [2005] 'Social Preferences and the Response to Incentives: Evidence from Personnel Data', forthcoming *Quarterly Journal of Economics*

7. Bardhan, P. [1984] 'Land, Labor, and Rural Poverty', (New York NY: Columbia University Press)

8. Bardhan, P. and A. Rudra [1980] 'Terms and Conditions of Sharecropping Contracts: An Analysis of Village Survey Data in India', *Journal of Development Studies*, pp. 287-302

9. Bartling, B. and F. von Siemens [2004a] 'Efficiency in Team Production with Inequity Averse Agents', Working Paper, University of Munich

10. Bartling, B. and F. von Siemens [2004b]'Inequity Aversion and Moral Hazard with Multiple Agents', Working Paper, University of Munich

11. Bhattacharyya, S. and F. Lafontaine [1995] 'Double-sided moral hazard and the nature of share contracts', *RAND Journal of Economics*, Vol. 26 (4), pp. 761-781

12. Bebchuk, L. A. [2003] 'Why Firms Adopt Antitakeover Arrangements', *University of Pennsylvania Law Review*, Vol. 152, pp. 713-753

13. Berkowitz, L. [1968] 'Responsibility, Reciprocity and social distance in help-giving: An experimental investigation of English social class differences', *Journal of Experimental Social Psychology*, Vol. 4, pp. 46-63

14. Bernardo, Antonio E. and I. Welch [2001] 'On the Evolution of Overconfidence and Entrepreneurs', *Journal of Economics and Management Strategy*, Vol. 10 (3), pp. 301-330

15. Bertrand, M. and S. Mullainathan [2001] 'Are CEOs Rewarded for Luck? The Ones without Principals are', *Quarterly Journal of Economics*, Vol. 116 (3), pp. 901-932

16. Bewley, T.F. [1999] 'Why Wages Don't Fall During a Recession' (Cambridge: Harvard University Press)

17. Bewley, T. F. [2002] 'Fairness, Reciprocity, and Wage Rigidity', Cowles Foundation Discussion Paper No. 1383

18. Blanchflower, D.G. and A. J. Oswald [1988] 'Profit-Related Pay: Prose Discovered?', *The Economic Journal*, Vol. 98, pp. 720-730

19. Blanchflower, D.G. and A. J. Oswald and P. Sanfey [1996] 'Wages, Profits and Rent-Sharing', *Quarterly Journal of Economics*, Vol. 111, pp. 227-252

20. Bolton, G. E. and A. Ockenfels [2000] 'ERC – A Theory of Equity, Reciprocity and Competition', *American Economic Review*, Vol. 90(1), pp. 166-193

21. Casciaro, T. [2001] 'Interpersonal Affect and the Formation of Joint Production Networks', Working Paper, Harvard Business School

22. Charness, G. and P. Kuhn [2004] 'Do Co-WorkersÆ Wages Matter? Theory and Evidence on Wage Secrecy, Wage Compression and Effort', IZA Working Paper No. 1417

23. Charness, G. and M. Rabin [2002] 'Understanding Social Preferences With Simple Tests', *The Quarterly Journal of Economics*, Vol. 117(3), pp. 817-869

24. Cox, J.C., D. Friedman and S. Gjerstad [2004] 'A Tractable Model of Reciprocity and Fairness', LEEPS Working Paper

25. Demougin, D. and C. Fluet [2003] 'Inequity Aversion in Tournaments', Working Paper, Humboldt University Berlin

26. Demougin, D. and C. Fluet [2003] 'Group vs. Individual Performance Pay When Workers Are Envious', CIRANO Working Paper

27. Dufwenberg, M. and G. Kirchsteiger [2004] 'A Theory of Sequential Reciprocity', *Games and Economic Behavior*, Vol. 47, pp. 268-98

28. Dur, R. and A. Glazer [2003] 'Optimal Incentive Contracts when Workers envy their Bosses', Working Paper, University of California at Irvine

29. Engelmann, D. and M. Strobel [2002] 'Inequality Aversion, Efficiency, and Maximin Preferences in Simple Distribution Experiments', MERIT Research Memorandum 2002-013

30. Englmaier, F. [2005] 'A Survey on Moral Hazard, Contracts, and Social Preferences', in Psychology, Rationality and Economic Behaviour: Challenging Standard Assumptions, Bina Agarwal and Alessandro Vercelli, eds.

31. Englmaier, F. and A. Wambach [2002] 'Contracts and Inequity Aversion', CESifo Working Paper No. 809

32. Englmaier, F. and A. Wambach [2004] 'Contracts and Inequity Aversion', Working Paper, University of Munich

33. Falk, A. and U. Fischbacher (forthcoming) 'A Theory of Reciprocity', *Games and Economic Behavior*

34. Fehr, E. and A. Falk [1999] 'Wage rigidity in a competitive incomplete contract market', *Journal of Political Economy*, Vol. 107, pp. 106-134

35. Fehr, E. and S. Gächter and G. Kirchsteiger [1997] 'Reciprocity as a contract enforcement device: Experimental evidence', *Econometrica*, Vol. 65, pp. 833-860

36. Fehr, E. and G. Kirchsteiger and A. Riedl [1993] 'Does Fairness Prevent Market Clearing? An Experimental Investigation' , *Quarterly Journal of Economics*, Vol. 108 (2), pp. 437-459

37. Fehr, E. and A. Klein and K. M. Schmidt [2004] 'Contracts, Fairness And Incentives', CESifo Working Paper No. 1215

38. Fehr, E. and K.M. Schmidt [1999] 'A Theory of Fairness, Competition and Cooperation', *Quarterly Journal of Economics*, Vol. 114(3), pp. 817-868

39. Fehr, E. and K.M. Schmidt [2003] 'Theories of Fairness and Reciprocity - Evidence and Economic Applications' in M. Dewatripont et.al.(eds.) Advances in Economics and Econometrics, Eighth World Congress of the Econometric Society, Vol. 1 (Cambridge: Cambridge University Press), pp. 208-257

40. Gneezy, U. and A. Rustichini [2000] 'Pay enough or don't pay at all', *Quarterly Journal of Economics*, Vol. 115(2), pp. 791–810

41. Goranson, R.E. and L. Berkowitz [1966] 'Reciprocity and responsibility reactions to prior help', *Journal of Personality and Social Psychology*, Vol. 3 (2), pp. 227-232

42. Gouldner, A.W. [1960] 'The norm of reciprocity: A preliminary statement', *American Sociological Review*, Vol. 25, pp. 161-178

43. Greenberg, J. [1993] 'The Social Side of Fairness: Interpersonal Classes of Organizational Justice', in R. Cropanzano (ed.) Justice in the Workplace, (Hillsdale, NJ: Erlbaum

44. Grund, M. and D. Sliwka [2002] 'Compassion and Envy in Tournaments', IZA Discussion Paper No. 647

45. Hellwig, M. and K.M. Schmidt [2002] 'Discrete–Time Approximations of the Holmstrom–Milgrom Brownian–Motion Model of Intertemporal Incentive Provision', *Econometrica*, Vol. 70 (6), pp. 1139-1166

46. Hildreth, A. and A.J. Oswald [1997] 'Wages and Rent-Sharing: Evidence from Company and Establishment Panels', *Journal of Labor Economics*, Vol. 15, pp. 318-337

47. Holmström, B. [1979] 'Moral Hazard and Observability', *Bell Journal of Economics*, Vol. 10, pp. 74-91

48. Holmström, B. and P. Milgrom [1987] 'Agregation and Linearity in the Provision of Intertemporal Incentives', *Econometrica*, Vol. 55, pp. 303-328

49. Huck, S., D. Kübler, and J. Weibull [2003] 'Social Norms and Economic Incentives in Firms', Working Paper, University College London

50. Huck, S. and P. Rey Biel [2003] 'Inequity Aversion and the Timing of Team Production', ELSE Working Paper, University College London

51. Itoh, H. (forthcoming) 'Moral Hazard and Other-Regarding Preferences', *Japanese Economic Review*

52. Innes, R. [1990] 'Limited Liability and Incentive Contracting with Ex-Ante Action Choices', *Journal of Economic Theory*, Vol. 52, pp. 45-67

53. Jensen, M.C. and K. J. Murphy [1990] 'Performance Pay and Top–Management Incentives', *Journal of Political Economy*, Vol. 98, pp. 225-264

54. Kandel, E. and E.P. Lazear [1992] 'Peer Pressure and Partnerships', *Journal of Political Economy*, Vol. 100(4), pp. 801-817

55. Knez, M. and S. Duncan [2001] 'Firm-Wide Incentives and Mutual Monitoring at Continental Airlines', *Journal of Labor Economics*, Vol. 19 (4), pp. 743-772

56. Kolm, S. C. [2003] 'Reciprocity: Its Scope, Rationales and Consequences', in: Handbook on the Economics of Giving, Reciprocity and Altruism, Gerard-Varet, L. and S. C. Kolm and J. M. Ythier eds. (North Holland)

57. Konrad, K. A. and K. E. Lommerud [1993] 'Relative standing comparisons, risk taking, and safety regulations', *Journal of Public Economics*, Vol. 51 (3), pp. 345-358

58. Lommerud, K. E. [1989] 'Educational Subsidies when Relative Income Matters', *Oxford Economic Papers*, Vol. 41, pp. 640-652

59. Lord, R. G. and J. A. [1979] 'Hohenfeld Longitudinal Field assessment of Equity E ects on the Performance of Major League Baseball Players', *Journal of Applied Psychology*, Vol. 64, pp. 19-26

60. Masclet, D. [2002] 'Peer Pressure in Work Teams: The Effects of Inequity Aversion', Working Paper, University Lyon

61. Mayer, B. and T. Pfeiffer [2003] 'Prinzipien der Anreizgestaltung bei Risikoaversion und sozialen Pr"aferenzen', Working Paper, University of Vienna

62. Milgrom, P. and J. Roberts [1992] 'Economics, Organization and Management', (Englewood Cliffs NJ: Prentice Hall)

63. Mirlees, J. [1999] 'The Theory of Moral Hazard and Unobservable Behaviour, Part I', *Review of Economic Studies*, Vol. 66, pp. 3-22

64. Neilson, W. S. and J. Stowe [2004] 'Incentive Pay for Other-Regarding Workers', Working Paper Fuqua School of Business at Duke University

65. Nelson, W. R. [2001] 'Incorporating Fairness into Game Theory and Economics: Comment', *The American Economic Review*, Vol. 91 (4), pp. 1180-1183

66. O'Donoghue, T. and M. Rabin [1999] 'Incentives for Procrastinators', *The Quarterly Journal of Economics*, Vol. 114(3), pp. 769-816

67. Oliva, R. and J. H. Gittell [2002] 'Southwest Airlines in Baltimore', Harvard Business School Case 9-602-156

68. O'Reilly, C. and J. Pfeffer [1995] 'Southwest Airlines: Using Human Resources for Competitive Advantage (A)', Stanford Graduate School of Business Case HR-1A

69. Oyer, P. and S. Schaefer [2003] 'Why Do Some Firms Give Stock Options To All Employees?: An Empirical Examination of Alternative Theories', Working Paper, Stanford GSB

70. Pelzman, J. [1976] 'Trade Integration in the Council of Mutual Economic Assistance: Creation and Diversion l954-l970', The Association for Comparative Economic Studies Bulletin 18 (3), pp. 39-59

71. Rabin, M. [1993] 'Incorporating Fairness into Game Theory and Economics', *American Economic Review*, Vol. 83 (5), pp. 1281-1302

72. Rasmusen, E. [1987] 'Moral Hazard in Risk-Averse Teams', *RAND Journal of Economics*, Vol. 18(3), pp. 428-435

73. Rey Biel, P. [2002] 'Inequity Aversion and Team Incentives', ELSE Working Paper, University College London

74. Rob, R. and P. Zemsky [2002] 'Social Capital, Corporate Culture, and Incentive Intensity', *RAND Journal of Economics*, Vol. 33 (2), pp. 243-257

75. Roethlisberger, F. J. and W. J. Dickson (1939] 'Management and the Worker' (Cambridge, Mass.: Harvard University Press

76. Rotemberg, J. [1994] 'Human Relations in the Workplace', *Journal of Political Economy*, Vol. 102(4), pp. 684-717

77. Rotemberg, J. [2003] 'Altruism, Reciprocity and Cooperation in the Workplace', in: Handbook on the Economics of Giving, Reciprocity and Altruism, Gerard-Varet, L. and S. C. Kolm and J. M. Ythier eds. (North Holland)

78. Selten, R. [1978] 'The equity principle in economic behavior' , Decision Theory and Social Effects, H.W. Gattinger and W. Leinfellner, eds. (Dordrecht, Holland: D. Reidel)

79. Selten, R. [1998] 'Features of experimentally observed bounded rationality', *European Economic Review*, Vol. 42, pp. 413-436

80. Siemens, F. v. [2004] 'Inequity Aversion, Adverse Selection and Employment Contracts', Working Paper, University of Munich

81. Thaler, R.H. [1989] 'Anomalies: Interindustry Wage Differentials', *Journal of Economic Perspectives*, Vol. 3(2), pp. 181-193

82. Young, H.P. [1994] 'Equity: In Theory and Practice', (Princeton NJ: Princeton University Press)

83. Young, H.P. [1996]'The Economics of Convention', *Journal of Economic Perspectives*, Vol. 10, pp. 105-122

84. Young, H.P. and M.A. Burke [2001] 'Competition and Custom in Economic Contracts: A Case Study of Illinois Agriculture', *American Economic Review*, Vol. 91, pp. 559-573

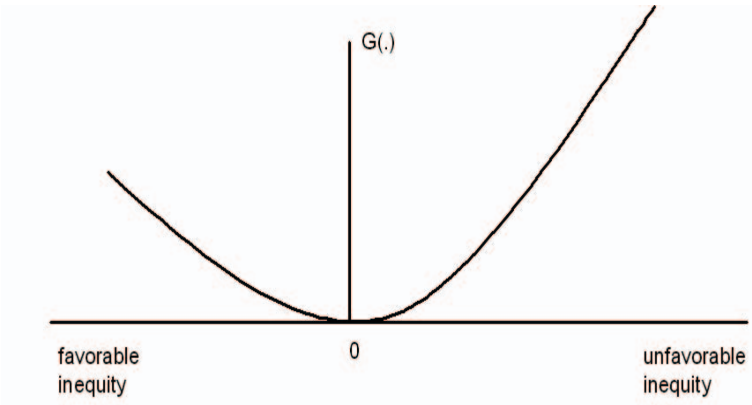

Figure 1: Example of G(.)

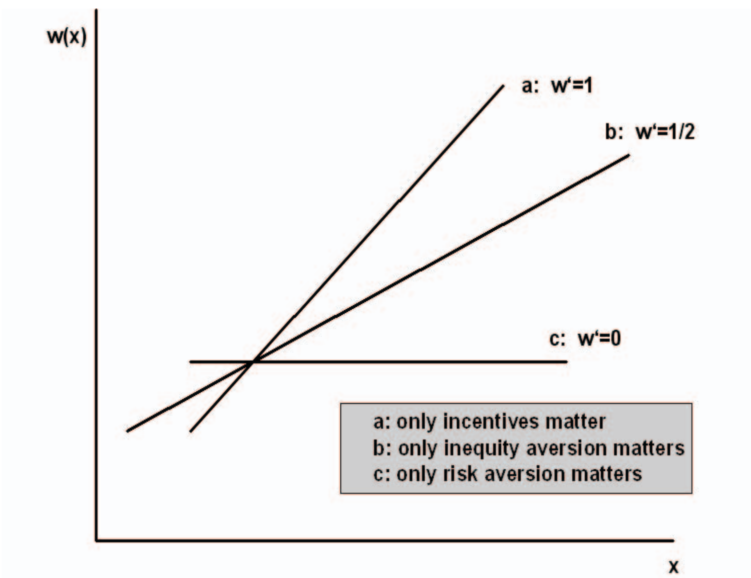

Figure 2 : Driving Forces for the wage structure