Laboratory Bilateral Gift Exchange: The Impact of Loss Aversion

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Very preliminary draft. Comments are welcome.

1 Introduction

The employment relationship is characterized by incomplete contracts. Labor contracts often take the form of a fixed wage without explicit performance incentives meaning that workers have a large degree of discretion over effort levels. As a consequence, an employee's general job attitude becomes decisive and firms' managers have to be able to interpret or even anticipate this attitude.

In a seminal paper, Akerlof (1982) argue that labor markets are characterized by considerations of "gift exchange": managers offer a gift of pay which is larger than labor's opportunity cost and employees respond by a gift of more than the minimal effort. Gift exchange in labor markets has many important economic consequences, and many experimental studies of gift-exchange have been published. In one of these studies, Fehr, Gächter, and Kirchsteiger conclude that "*In view of the powerful behavioral impact and the efficiency consequences of reciprocity ... it seems doubtful that one can design optimal incentive contracts on the basis of a neglect of reciprocal motivations*". Such considerations about real world labor markets are of interest only if experimental results from the gift exchange game are sufficiently robust.

A certain number of variations and replications of the gift exchange game have been conducted which tend to indicate that the gift exchange results are robust (for an overview of the experimental literature see Gächter and Fehr, 2002). More recently, Charness et al. (2004) present evidence indicating that participants are sensitive to the seemingly innocuous impact of providing or not providing a payoff table to help clarify the experimental contingencies under the typical payoff structure employed in gift-exchange experiments. In addition to the payoff table effect reported, Charness et al. also report significant changes in behavior over time in the level of gift exchange reported with a large decrease of reciprocal responses of employees as the end period draws near. This recent experimental results demonstrate that gift exchange in the laboratory is not as robust as previously thought.

The rest of the paper is organized as follows. Section 2 describes the game theoretic environment. Section 3 provides the motivation for the experimental study and formulates our research hypotheses. Section 4 describes the experimental design and the practical procedures. Results are presented in section 5 and section 6 concludes.

2 Theory

2.1 The Bilateral Gift Exchange Game

The bilateral gift exchange game is a finite extensive game with perfect information in which a manager proposes to an employee a single incomplete contract. The contract offer usually

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consists of two parts: a wage to be paid and a desired effort level.[1] The employee cannot make a counteroffer but chooses whether to accept the contract offer or not.[2] An employee's acceptance creates a contract. The employee, if he has accepted the contract offer, chooses his actual effort level.[3] The employee can choose a lower actual effort level than the desired level specified in the contract, fulfill his contractual agreement by matching the desired effort level, or be more generous to his manager by working harder than specified in the contract. The choice of the effort level is unconstrained in the sense than the manager cannot punish or reward the employee following the choice. The actual effort level in combination with the offered wage, determines both his payoff and the manager's payoff, and terminates the game. A rejection of the contract offer by the employee also terminates the game with both players getting their initial wealth.

Formally, we denote the discretized version of the bilateral gift exchange game by $BGEG = \langle N, S_{manager}, S_{employee}, H, u_{manager}, u_{employee} \rangle$ where

- $N = \{\text{manager}, \text{employee}\}$ is the set of players.
- $S_{manager} = W \times E = \{w_{min}, \ldots, w_{max}\} \times \{1, 2, \ldots, 10\}$ is the manager's strategy set, where $w_{max} \geq w_{min} + 1$. Any element of this set, denoted by $s_{manager}$, is a couple (wage, desired effort level). $S_{employee} = E \cup \{0\}$ is the employee's strategy set. Any element of this set, denoted by $s_{employee}$, is a mapping that assigns either an effort level or the rejection of the contract offer (which simply corresponds to an effort level of 0) to each couple (wage, desired effort level) chosen by the manager. That is, $s_{employee} : W \times E \to E \cup \{0\}$.
- $H = \{\emptyset, (w, \hat{e}), ((w, \hat{e}), e)\}$ is the set of histories, with $(w, \hat{e}) \in W \times E$ and $((w, \hat{e}), e)) \in W \times E \times E \cup \{0\}$.
- $u_{manager} : W \times E \times E \cup \{0\} \to \mathbb{R}$ is the manager's payoff function, and $u_{employee} : W \times E \times E \cup \{0\} \to \mathbb{R}$ is the employee's payoff function. Both payoff functions assign to any strategy profile $s \in S = S_{manager} \times S_{employee}$ a payoff in $\mathbb{R}$, where the null effort level corresponds to the rejection of the contract offer.

Whatever the specification of the players' payoff functions, the manager's *monetary* payoff function is given by

$$\pi_{manager}((w, \hat{e}), e) = \begin{cases} \pi^0_{manager} & \text{if } e = 0 \\ v(e) - w(e) + \pi^0_{manager} & \text{otherwise,} \end{cases}$$

where $\pi^0_{manager}$ is the manager's initial wealth, $v(e)$ is the effort value to the manager with $v(e+1) > v(e)$ and $v(e+2) - v(e+1) \leq v(e+1) - v(e)$ for all $e \in E$, and $w(e)$ is the cost of paying a wage w to the employee if he exerts a strictly positive effort of e with $w(e+1) \geq w(e)$ and $w(e+2) - w(e+1) \leq w(e+1) - w(e)$ for all $e \in E$. To rule out the non-interesting cases, we assume that $v(1) - w(1) > 0$. Similarly, whatever the specification of the players' payoff functions, the employee's *monetary* payoff function is given by

$$\pi_{employee}((w, \hat{e}), e) = \begin{cases} \pi^0_{employee} & \text{if } e = 0 \\ w - c(e) + \pi^0_{employee} & \text{otherwise,} \end{cases}$$

where $\pi^0_{employee}$ is the employee's initial wealth, $c(e)$ is the cost of effort with $c(e+1) > c(e)$ for all $e \in E$ and $c(e+2) - c(e+1) \geq c(e+1) - c(e)$ for all $e \in E$ with strict inequality for some $e \in E$. Both monetary payoff functions are independent of the desired effort level. Without loss of generality, we assume that $w_{min} = c(1)$.

[1] In Charness, Frechette, and Kagel (2004), the contract consists only of a wage.

[2] Among others, Maximiano, Sloof, and Sonnemans (2004) do not allow the employee(s) to reject the contract offer.

[3] We adopt the convention that managers are referred to as female and employees are referred to as male.

2.2 Theoretical Predictions

Below, we discuss the nature of the subgame perfect equilibria of the bilateral gift exchange game under a particular specification of the two players' payoff functions.

Predictions under selfishness

In this subsection, we assume that $u_{manager} = \pi_{manager}$ and $u_{employee} = \pi_{employee}$, i.e., both players only care about their monetary payoffs.[4] In order to provide the subgame perfect equilibrium strategies of the two players, we first have to define the tie-breaking rule used by the employee when he is indifferent between exerting an effort level of 0, i.e., rejecting the contract offer, and exerting an effort level of 1, i.e, accepting the contract offer and exerting the subsequent minimal effort level. From now on, we assume that the employee when indifferent between exerting an effort level of 0 and exerting an effort level of 1, chooses to exert an effort level of 0 with a probability p such that $1 \geq p > \underline{p} \geq 0$, and we assume that the manager knows that the employee when indifferent rejects the contract offer with a probability strictly greater than $\underline{p}$ without knowing the exact value of this probability.

In a subgame perfect equilibrium, if the employee accepts the contract offer, he will exert an effort level of 1 as his monetary payoff decreases whenever he chooses a higher effort level. The employee's equilibrium strategy is therefore given by $\hat{s}_{employee}(w, \hat{e}) = p$ if $w = w_{min}$, $\forall \hat{e} \in E$, and $\hat{s}_{employee}(w, \hat{e}) = 1$ $\forall w > w_{min}$, $\forall \hat{e} \in E$. We now determine the manager's equilibrium strategy by backwards induction. If the manager offers a contract with a wage $w = w_{min}$ then she anticipates that the employee will choose to reject the contract offer with a strictly positive probability and that he will exert an effort level of 1 with the complementary to one probability whatever the chosen desired effort level. On the other hand, if the manager offers a contract with a wage strictly greater than w_{min} then she anticipates that the employee will exert an effort level of 1 whatever the chosen desired effort level. Therefore, straightforward computations allow us to conclude that the manager's equlibrium strategy is given by $\hat{s}_{manager} = (w_{min} + 1, \hat{e})$ whenever $\underline{p} \geq (w_{min} + 1(1) - w_{min}(1)) / (v(1) - w_{min}(1))$ with $\hat{e} \in E$. In the following we call the outcome $(w = w_{min} + 1, e = 1)$ the standard prediction, $w = w_{min} + 1$ (respectively $e = 1$) the standard predicted wage (respectively standard predicted effort), and the above reasoning that leads to this prediction the standard theory.

Predictions under social preferences

As Ernst Fehr and coauthors have pointed out on many occasions (see, among others, Fehr and Gächter (2000) and Fehr, Klein, and Schmidt (2004)), there are important and identifiable conditions in which the assumption of selfishness leads to empirically false predictions and may, therefore, generate wrong normative advice. An important class of such conditions arises when, e.g., in the employment relationship, agreements cannot be completely enforced. The gift exchange game illustrates this class of conditions. The key element of the gift exchange game is that a generous offer on the part of the manager, if reciprocated, leads to welfare improving outcomes. However, in case the interaction takes place only once (one-shot game), reciprocal behavior contradicts selfishness and generous offers are inconsistent with rational expectations of selfishness. Likewise, in finitely repeated interactions, both generous offers and reciprocal behavior are inconsistent with common knowledge of rationality and selfishness. On the contrary, if individuals have preferences that relate to income equality like in the inequity-aversion model proposed by Fehr and Schmidt (1999),[5] employees would always exert minimum effort when the offered wage is low but those who dislike the most earning more than others would exert larger effort when offered wages are higher. A higher than minimal effort could also be caused by

[4] We additionally assume that the manager *knows* that the employee's payoff function is given by $\pi_{employee}$.

[5] An individual with an aversion to income inequality would sacrifice own income to increase or decrease others' income so as to achieve a more equal allocation.

reciprocity: employees may want to reward kind actions and punish unkind ones. Effort choices would then increase in wages. Relaxing the selfishness assumption on the employees' side clearly leads to a high wage policy as long as managers either believe that employees are sufficiently inequity-averse or that employees' behavior is driven by reciprocity.

3 Motivation and Hypotheses

The intent of our bilateral gift exchange experiment is to evaluate the relationship between the specification of the manager's monetary payoff function and the wage-setting behavior. Needless to say, the wage-setting behavior determines the importance of gift exchanges as high efforts by employees can only be expected if managers offer high wages. Three variables shape the manager's monetary payoff function: the presence (absence) of potential losses, the level of the manager's return on the employee's effort (i.e., the employee's productivity), and the manager's initial wealth. Part of the specifications we consider have already been used but no previous gift exchange experiment did exhaustively investigate the impact of variations in the manager's monetary payoff function on the level of gift exchange reported.

Potential losses

In most versions of the gift exchange game that have been implemented in the laboratory, the monetary payoff function of the manager prevents her from making losses whatever the wage she offers and the effort level chosen by the employee. More specifically, the typical gift exchange experiment computes the manager's monetary payoff as $(v - w)e/10$ whenever $e \geq 1$ and wage offers above v are not permitted. This specification has been used because the behavior of managers who make losses might be affected by loss aversion, and consequently loss aversion might pollute reciprocal effects.[6] Trying to avoid confounding effects is clearly desirable as new research questions are investigated but the typical specification of the manager's monetary payoff function is problematic. Indeed, in a reasonable implementation of a labor relationship, the wage simply acts as a transfer payment. However, in a typical gift exchange experiment and under the additional assumption that the employee's monetary payoff function is given by $w - c(e)$ whenever $e \geq 1$, the surplus is increasing in the wage for a given (strictly positive and strictly lower than 10) effort level. Managers may then choose high wages not only to elicit high effort levels from employees but also to increase the surplus which makes the interpretation of high-wage policies difficult.[7] Consequently, alternative specifications of the manager's monetary payoff function have to be considered when investigating the importance of gift exchanges in labor markets.

A more appropriate specification of the manager's monetary payoff function is $ve/10 - w$ whenever $e \geq 1$. Fehr and Gächter (1998) conducted a series of gift exchange experiments with the alternative specification and concluded that the overall data pattern confirms that managers' wage-setting behavior is driven by an appeal to employees' reciprocity. More recently, Maximiano, Sloof, and Sonnemans (2004) have investigated whether the level of gift exchange reported in the simple one-manager-one-employee relationship is robust to the introduction of several employees by relying on the alternative specification of the manager's monetary payoff function. Maximiano, Sloof, and Sonnemans reported that their results are in line with the previous findings of the gift exchange literature. The few existing experimental studies which introduced potential losses for managers seem to have established the robustness of the importance of gift

[6] When defined not in terms of preferences but in terms of the underlying utility representation, loss aversion means that the utility of gains relative to a reference point is smaller than the disutility of equal-sized losses. This important psychological concept has been first proposed by Kahneman and Tversky (1979) in the framework of prospect theory.

[7] As a corollary, the fact that the wage and the effort level interact in the typical specification of the manager's monetary payoff function also implies that the marginal value of effort is lower the higher the wage which hinders the effectiveness of high effort as a reciprocal response.

exchanges when, from a behavioral point of view, high-wage policies are more risky. We raise two objections against such a conclusion. First, a clean experimental investigation of this issue would compare the findings of an experimental condition where potential losses are absent with the findings of an experimental condition where potential losses are present by relying on the same pool of subjects, using similar instructions, etc.[8] Second, and more importantly, in all gift exchange experiments with potential losses for managers we are aware of, experimenters provided subjects with some initial endowment to avoid "*real*" losses.[9] We conjecture that by providing some initial endowment to their participants, previous experimental studies have clearly failed to investigate the impact of losses on the level of gift exchange reported. Indeed, Thaler and Johnson (1990) find that under some circumstances a prior gain can increase subjects' willingness to accept gambles.[10] This finding is labeled the house money effect as gamblers often use the phrase "playing with the house money" to express the feeling of gambling while ahead. The essence of the idea is that until the winnings are completely depleted, losses are coded as reductions in a gain, as if losing some of "their money" doesn't hurt as much as losing one's own cash.

In order to investigate the crowding-out of social forces by loss aversion phenomena in the gift exchange game, part of our experimental conditions specify a monetary payoff function for the manager with potential losses and, contrary to the above mentioned studies, none of the participants is endowed with some initial wealth at any stage of the experimental session (participants are also deprived of a show-up fee). The choice of a high-job rent policy by managers in order to appeal to employees' reciprocity is therefore more "risky" than with the standard specification of the payoff function or with some endowment large enough to cover any potential losses.

Employee's productivity

Existing gift exchange experiments assume that the manager's revenue or gross monetary payoff is linear in the employee's effort which leads to tremendous payoff gains for the manager in case she can trigger an effort level beyond the incentive-compatible one. Therefore, and given the additional feature that effort costs are usually trivial,[11] managers should try to elicit employees' reciprocal responses by offering higher wages than the predicted one. And even in the case where many generous wage offers are not reciprocated, if at least some are, managers are better off than when they behave in accordance with the standard prediction. In an attempt to evaluate the boundary conditions of the gift exchange phenomenon, this experimental study considers three different levels of the manager's return on the employee's effort: a low level, a medium level, and a high level which is the one that has been used in previous studies. By relying on a full factorial design, we are able to additionally evaluate the interaction of the productivity of the employee and the presence (absence) of potential losses in the manager's monetary payoff function.

[8] In addition to many experimental sessions with the typical specification of the manager's monetary payoff function, Fehr, Kirchler, Weichbold, and Gächter (1998) conducted two experimental sessions with the alternative specification. The authors concluded that under both specifications both managers and employees were trying to elicit reciprocal responses which resulted in a large increase in the surplus relative to the standard prediction. This conclusion is obviously based on few data and the dynamics of the average job rent differ depending on the manager's payoff function, see Figure 4*b* p. 347, which seems to indicate that the degree of riskiness of a high-wage policy affects managers' behavior (the job rent is the wage offer minus the effort cost of the desired effort level).

[9] Rigdon (2002) conducted an experimental study to evaluate whether behavior consistent with the fair wage-effort hypothesis can emerge and be sustained when effort costs are nontrivial and the social distance between subject and experimenter is increased in the gift exchange game. She relied on the alternative specification of the manager's monetary payoff function but assumed that if the manager offers the maximum wage and the employee responds with the minimum effort, the manager's monetary payoff is equal to zero.

[10] Arkes, Joyner, Pezzo, Nash, Siegel-Jacobs, and Stone (1994) shows that windfall gains are spent more readily than nonwindfall gains where a defining characteristic of a windfall gain is its unanticipated status.

[11] Rigdon's (2002) gift exchange experiment illustrates the impact of nontrivial costs in a double-blind protocol.

To the best of our knowledge, Hannan, Kagel, and Moser (2002) is the only existing gift exchange experiment which implements differences in the employee's productivity. Hannan, Kagel, and Moser (2002) report gift exchange market experiments with the typical specification of the manager's monetary payoff function $((v - w)e/10)$ but where half of the managers have high redemption values ($v = 120$) and half of the managers have low redemption values ($v = 90$).[12] Available wage offers are between 20 and the redemption value. By adding differences in redemption values to the standard gift exchange experiment, Hannan, Kagel, and Moser investigate whether employees, knowing that higher wages are more costly in terms of forgone profits for managers with a low redemption value, respond with greater effort than to managers with a high redemption value at comparable wage levels. The data provide little support for this view but we do not consider this evidence as conclusive. Indeed, as already mentioned, the typical specification of the manager's monetary payoff function implies that the marginal value of effort is lower the smaller the difference between the redemption value and the wage. A high wage offer is not only more costly for a low redemption value manager than for a high redemption value manager but it also implies that a high effort as a reciprocal response is *much* less effective for a low redemption value manager than for a high redemption value manager.[13] By introducing different redemption values in the alternative specification of the manager's monetary payoff function, such a flaw would have been avoided.

Manager's initial wealth

A common finding in gift exchange experiments is that employees on average earn more than managers do. This stylized fact seems at odds with most actual employee-manager relationships, and it contradicts the standard prediction according to which employees earn only one experimental money unit whereas managers obtain non-negligible earnings (usually about ten experimental money units). Standard theory assumes that employees are money maximizers (and managers know this) which is the reason why they accept the contract $(w_{min} + 1, \hat{e})$, where $\hat{e} \in E$, whatever the resulting earnings distribution. Common sense, experimental and field evidence obviously point to the limits of this extreme reasoning. The standard prediction comprises an unfair wage offer and employees can seriously hurt managers by rejecting it at negligible own cost. Managers rationally anticipate this behavior and therefore they refrain from minimum wage offers. Needless to say, we do not claim that the latter argument is the only rationale for the observation of generous wage offers (as those clearly result in a large increase in the surplus from trade relative to the standard prediction) but we conjecture that in employee-manager relationships where managers obtain reasonable earnings even after the contract has been rejected there will be less attempts to elicit reciprocal responses from the employees. To investigate this issue, half of the experimental evidence presented in this paper is based on a manager's monetary payoff function with a strictly positive initial wealth and the other half with the standard specification of zero initial wealth.

3.1 Research Hypotheses

In comparison with the typical gift exchange setting, we conjecture that the presence of potential losses, lower levels of the manager's return on the employee's effort, and a strictly positive initial wealth for the manager will: i) lead managers to offer lower wages, ii) lead workers, in turn, to choose lower effort levels, and iii) reduce the increase in surplus from trade relative to the standard prediction. The following three testable hypotheses formulate this conjecture in more detail.

Loss aversion is a well-documented empirical phenomenon and many experimental studies

[12] The redemption value is the maximal gross profitability of an employee for the manager (provided $e = 10$).

[13] Basically, in case high wages are offered by managers ($w \geq 60$), no reasonable effort level of the employee compensates the low redemption value manager to the same extent as the high redemption value manager.

report clear evidence of loss aversion.[14] Under the reasonable assumption that some managers exhibit loss aversion, we should observe that

H1: Crowding-out of social forces by loss aversion. Wage offers are closer to the standard predicted wage and less gift exchange is observed when managers can make losses than when losses are excluded.

Moreover, loss averse managers will adopt such a wage-setting behavior from the very beginning of the interaction phase.

Our next research hypothesis rests on the assumption that, for a given wage level, employees on average exert the same effort level whatever their productivity. Consequently, under a low employee's productivity, generous wage offers lead to effort levels not high enough to outweigh the additional wage costs. Therefore, we conjecture that

H2: Crowding-out of social forces by low productivity. Wage offers are closer to the standard predicted wage and less gift exchange is observed the lower the employees' productivity.

Contrary to the first hypothesis, most managers will adopt such a wage-setting behavior only at a later stage of their interaction with employees. Indeed, the assumption that the employee's productivity will not affect his reciprocal response has first to be confirmed. If, for a given wage, employees with a low productivity exert a higher effort than employees with a high productivity, our second hypothesis will quite probably be invalidated.

Again, we conjecture that managers will adopt the following wage-setting behavior from the very beginning of the interaction phase.

H3: Crowding-out of social forces by initial wealth. Wage offers are closer to the standard predicted wage and less gift exchange is observed when managers' initial wealth is strictly positive than when it is equal to zero.

4 Experimental design and practical procedures

In this section we introduce the parametrization of the bilateral gift exchange game that we study in our experiment and we discuss the other features of our experimental design. Subsequently, we elaborate on the experimental procedures.

4.1 Experimental design

Drawing on the bilateral gift exchange situation described in section 2, we developed treatments along the specification of the manager's payoff function. In the experiment, both the desired effort level and the actual effort level are chosen from $\{1, 2, \ldots, 10\}$, i.e., $e_{min} = 1$ and $e_{max} = 10$, and the following cost of effort schedule with increasing marginal costs of effort applies:

Effort e	1	2	3	4	5	6	7	8	9	10
Monetary costs $c(e)$	20	21	22	24	26	28	30	32	35	38

Additionally, wages are limited to integers in the range of 20 to 120, inclusive, i.e., $w_{min} = 20$ and $w_{max} = 120$, and $\pi^0_{employee} = 0$. Consequently, the considered payoff function for the employee $(w - c(e))$ is the one which has been widely used in the literature.

[14] Loss aversion can explain many patterns observed in a wide variety of economic domains that are anomalies for the expected utility of terminal wealth model. For example, Camerer (2004) demonstrates that loss aversion can explain the extra return on stocks compared with bonds (the equity premium), the tendency of cab drivers to work long hours on low-wage days, status quo and endowment effects, etc.

Two specifications of the manager's monetary payoff function are considered. The first specification prevents managers from making losses whereas for the second one the manager makes a loss when she pays a high wage and the employee chooses a low effort in response (from here on we denote the two specifications *Base* and *Loss*). Additionally, for each specification of the manager's monetary payoff function, three levels of manager's return on the employee's effort are considered: a low, a medium and a high level, the latter one having been widely used in the literature (from here on we denote the three levels *Low Productivity*, *Medium Productivity* and *High Productivity*). Finally, for each specification of the manager's monetary payoff function, two levels of initial wealth are considered: an initial wealth of 10 and an initial wealth of 0, the latter one corresponding to the usual practice. All in all, twelve experimental conditions have been implemented. Table 1 summarizes our design.

The redemption value of an employee in the *Base* condition, denoted by v_B, is set equal to 120. Accordingly, the parametrization of the experimental condition *Base High Efficiency* corresponds exactly to the one widely used in the literature. With such a parametrization, if the employee rejects the contract offer, both players end up with zero payoff whereas, in equilibrium, managers earn (almost) 10 experimental money units and employees earn 1 experimental money unit. Therefore, managers might offer wages higher than the equilibrium wage just to make sure than employees would not punish them by rejecting the contract offer as the cost of punishing is negligible. In the *Base High Efficiency + 10* experimental condition, the effectiveness of a punishment strategy by employees is decreased as managers are endowed with 10 experimental money units. In order to obtain (almost) identical equilibrium payoffs in the *Base* condition and in the *Loss* condition, v_L, the redemption value of an employee in the *Loss* condition, is set equal to 100.[15]

In the *Base High Efficiency* experimental condition, managers have a substantial incentive to initiate cooperation by offering wages higher than $w_{min} + 1$ as dramatic efficiency gains can be achieved: the achievable efficiency gains are up to 1100%. We reduce the achievable efficiency gains in the *Low Efficiency* experimental conditions. For example, the efficiency gains are "only up" to 900% in the *Base Low Efficiency* condition.

4.2 Practical procedures

Eighteen laboratory sessions were conducted at the laboratory of the Max Planck institute in Jena from December, 2004 till March, 2005. We collected six independent observations per experimental condition. A total of 576 (mostly undergraduate) students from the University of Jena participated in the study; no one participated in more than one session.[16] Average earnings were about 11 euros (std. = 5.17) for at most 90 minutes. We did not endow our participants with some initial wealth (they also got no show-up fee). Our participants had to sign a letter of agreement before the start of the experimental session in which they agreed to cover losses by either incomes from future participation in experimental sessions or by their own money. Accordingly, by agreeing to take part to one of our experimental sessions, the participants could not avoid incurring losses but by not trading. We are confident that most of our subjects valued future participation more than having to cover a reasonable loss as the large majority of the subjects belonging to the Jena participant database have taken part to 5 or more experiments.

The experiment was computerized using z-tree (Fischbacher, 1999). A session consisted of thirty separate periods, with sixteen managers and sixteen employees in the session. In each session two experimental conditions with different productivity levels were ran simultaneously with two matching groups of eight participants per condition (4 managers and 4 employees per matching group). Each participant received a copy of the written instructions, which were read aloud to the group. At the beginning of the experimental session subjects were randomly

[15] Such a parametrization leads to perfectly identical payoffs in both conditions for the outcome $(20, 1)$ and, of course, whenever the contract is rejected.

[16] Subjects were recruited and invited using ORSEE (Greiner, 2004).

Table 1: Experimental design.

Experimental condition	Manager's payoff function	
Base Low Productivity	$\begin{cases} \frac{1}{10}(v_B - w) \times \left(e^{.8}\right) \\ 0 \end{cases}$	if contract is accepted otherwise
Base Low Productivity + 10	$\begin{cases} \frac{1}{10}(v_B - w) \times \left(e^{.8}\right) + 10 \\ 10 \end{cases}$	if contract is accepted otherwise
Base Medium Productivity	$\begin{cases} \frac{1}{10}(v_B - w) \times \left(e^{.9}\right) \\ 0 \end{cases}$	if contract is accepted otherwise
Base Medium Productivity + 10	$\begin{cases} \frac{1}{10}(v_B - w) \times \left(e^{.9}\right) + 10 \\ 10 \end{cases}$	if contract is accepted otherwise
Base High Productivity	$\begin{cases} \frac{1}{10}(v_B - w) \times e \\ 0 \end{cases}$	if contract is accepted otherwise
Base High Productivity + 10	$\begin{cases} \frac{1}{10}(v_B - w) \times e + 10 \\ 10 \end{cases}$	if contract is accepted otherwise
Loss Low Productivity	$\begin{cases} \frac{1}{10}v_L \times \left(e^{.8}\right) - w + 20 \\ 0 \end{cases}$	if contract is accepted otherwise
Loss Low Productivity + 10	$\begin{cases} \frac{1}{10}v_L \times \left(e^{.8}\right) - w + 30 \\ 10 \end{cases}$	if contract is accepted otherwise
Loss Medium Productivity	$\begin{cases} \frac{1}{10}v_L \times \left(e^{.9}\right) - w + 20 \\ 0 \end{cases}$	if contract is accepted otherwise
Loss Medium Productivity + 10	$\begin{cases} \frac{1}{10}v_L \times \left(e^{.9}\right) - w + 30 \\ 10 \end{cases}$	if contract is accepted otherwise
Loss High Productivity	$\begin{cases} \frac{1}{10}v_L \times e - w + 20 \\ 0 \end{cases}$	if contract is accepted otherwise
Loss High Productivity + 10	$\begin{cases} \frac{1}{10}v_L \times e - w + 30 \\ 10 \end{cases}$	if contract is accepted otherwise

Notes: $v_B = 120$, $v_L = 100$, $w \in \{20, \ldots, 120\}$, and $e \in \{1, \ldots, 10\}$ if contract is accepted.

allocated to their roles as "managers" and "employees", respectively. They kept their role throughout the whole experiment. Each manager was randomly rematched with an employee of the same matching group in each period. Subjects were not aware of the restricted form of rematching to limit repeated game effects.

The payoff functions were common information, and participants were required to calcu-

late both manager and employee payoffs in four exercises with hypothetical wage-effort pairs. These exercises were reviewed before proceeding with the experiment, insuring that subjects understood the payoff function and that higher effort meant higher employer earnings, but lower employee earnings. At the conclusion of a session, participants were paid individually and privately, at a conversion rate of 60 experimental money units to each euro.

A payoff table showing manager payoffs for all combinations of effort and wages (in multiples of 10) was provided with the instructions.

5 Experimental Results

In this section we present the findings of our bilateral gift exchange experiment. Even though our main interest lies in the managers' wage-setting behavior, we first discuss the employees' effort choices. Indeed, previous gift exchange experimental studies have demonstrated that efforts are reciprocal responses to wage offers which implies that the optimal wage-setting behavior depends on the actual wage-effort schedule of the employees. A good understanding of the managers' wage decisions therefore requires a proper evaluation of the employees' motivation for reciprocity. After having discussed the actual behavior of both the employees and the managers, we turn to the actual earnings subjects obtain in the experiment and compare the actual efficiency gains with those reached at the standard prediction.

In all experimental conditions the number of potential trades is 720 (4 potential trades per period and per matching group).

5.1 Employees wage-effort schedule

In order to investigate the relationship between the specification of the managers' monetary payoff function and the employees' wage-effort schedule, we use a linear mixed effects model with random intercepts for the matching group and for the subject within each matching group where the dependent variable is the actual effort choice. The set of covariates contains: an intercept, the desired effort level ($\hat{e}$), the accepted wage offer (w), the employee's *Productivity* whose default value is low, *Loss* which is an indicator variable taking a value of 0 in the *Base* observations and 1 otherwise, *Ten* which is an indicator variable taking a value of 0 in the no initial wealth observations and 1 otherwise, some interaction effects, and the inverse Mill's ratio. Indeed, due to non-random sampling of the observations – we can only include accepted contract offers – we have to account for the sample selection bias. This is done by estimating a probit regression on contract acceptance and deriving the inverse Mill's ratio to use the two-step Heckman procedure. A significant coefficient for the inverse Mill's ratio indicates that we, indeed, would have a sample selection bias if we did not control for it. The final presented model is reached by starting with a model including all possible interactions of mentioned covariates and applying a sequential elimination procedure for variables and indicators that do not significantly contribute to the model fit at the 5 % level using likelihood ratio tests. We control for heteroskedasticity by modelling the variance function and estimating the respective variance parameters jointly with the normal model coefficients. This procedure significantly improves the model fit. Table 2 shows the results of the regression.

Our regression results provide strong evidence for a positively sloped wage-effort relation as higher wages elicited higher average effort levels in all experimental conditions. This is a qualitative confirmation of the already existing evidence on gift exchange in experimental labor markets. From a quantitative point of view, in the *Base High Productivity* condition the results are quite similar to those obtained by Fehr, Kirchler, Weichbold, and Gächter (1998):[17] when the wage increases by ten units the average effort increases by approximately .9 unit. On the other hand, the desired effort level has no significant influence on the actual effort choice. Managers cannot influence the reciprocal response of their employees beyond the material

[17] The degree of reciprocity is stronger in our data.

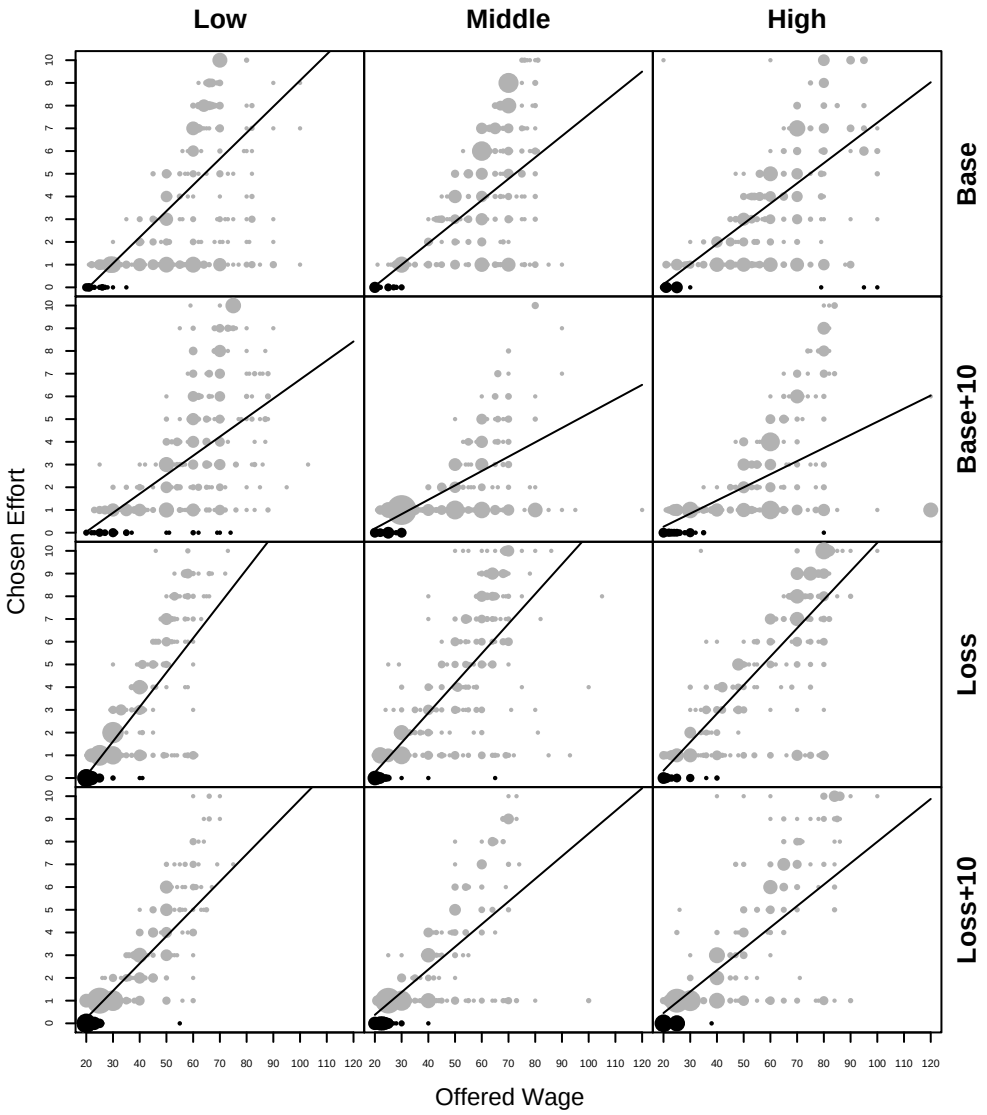
Table 2: Linear mixed effects model with actual effort choice as dependent variable.

Variable	Value	p-value
Intercept	-2.170	$< .01$
$\hat{e}$	-.009	.125
w	.115	$< .01$
Productivity=Medium	.559	.041
Productivity=High	.748	$< .01$
Loss	-.538	.017
Ten	.754	$< .01$
Inverse Mill's ratio	-.045	$< .01$
w:Productivity=Medium	-.021	.015
w:Productivity=High	-.026	$< .01$
w:Loss	.036	$< .01$
w:Ten	-.031	$< .01$
Random Intercept: .056		
Number of observations: 7723		

incentives provided by the wage offer. The most interesting insight from our statistical analysis is that employees adjust their reciprocal responses to the specification of the managers' monetary payoff function. In fact, the slope of the wage-effort relation increases (decreases) the less (more) favorable the specification of the manager's monetary payoff function. For a given wage, employees exert more effort when i) managers can make losses and ii) the lower their productivity. On the other hand, for a given wage, employees exert less effort when managers are advantaged by an initial endowment. The impact of the *Loss* specification is especially substantial: by offering a wage of 50 units, a manager can expect on average an extra effort in the *Loss* condition from 1/3 (under high productivity) to 43 % (under low productivity) in comparison with the *Base* condition. Such an adjustment in the employees' reciprocal behavior could possibly lead to more or less identical managers' wage offers in most of the experimental conditions, and, therefore, research hypotheses $H1$ and $H2$ could be invalidated. However, two additional insights cast doubt on this possibility to hold. First, according to our estimation results, by making a wage offer of 50 units, a manager obtains on average a higher monetary payoff than the standard predicted payoff in the *Base* condition but not in the *Loss* condition. Second, substantial heterogeneity among employees is observed in the data as the 95 % confidence interval of the wage-effort slope is approximately given by [.003, .227]: a number of employees choose the minimum effort level regardless of the wage while others act very reciprocally. The tremendous variability in employees' reciprocal responses is further illustrated by Figure 1 which shows the distribution of effort choices for the different levels of offered wages. A substantial mass of the observations lies on the horizontal line of the minimum effort level which indicates that even wages high enough to cover the costs of the maximal effort level were often not reciprocated. Still, another non-negligible mass of the observations lies on the upper right part of the graph in most experimental conditions meaning that very high wages (above 60 units) elicited maximal effort levels. Finally, the estimated reciprocal behavior in the *Ten* condition leads us to conjecture that our third research hypothesis should definitely hold.

Figure 4 in the Appendix shows the cumulative distribution of accepted and rejected wage offers in each experimental condition. The main insight is that lower wages are accepted in the *Loss* condition in comparison to the *Base* condition especially for low and medium employees' productivities. Again, employees pay attention to the specification of the manager's monetary payoff function when deciding upon acceptance or rejection of the wage offer. It is reassuring to observe that a large majority of the rejected wage offers are in the interval $\{20, \ldots, 30\}$.

Figure 1: Wage-effort relation.



Note: The circular areas are proportional to the numbers of observations they represent. Black circles denote rejected offers. The regression line is drawn according to the estimation results reported in table 2.

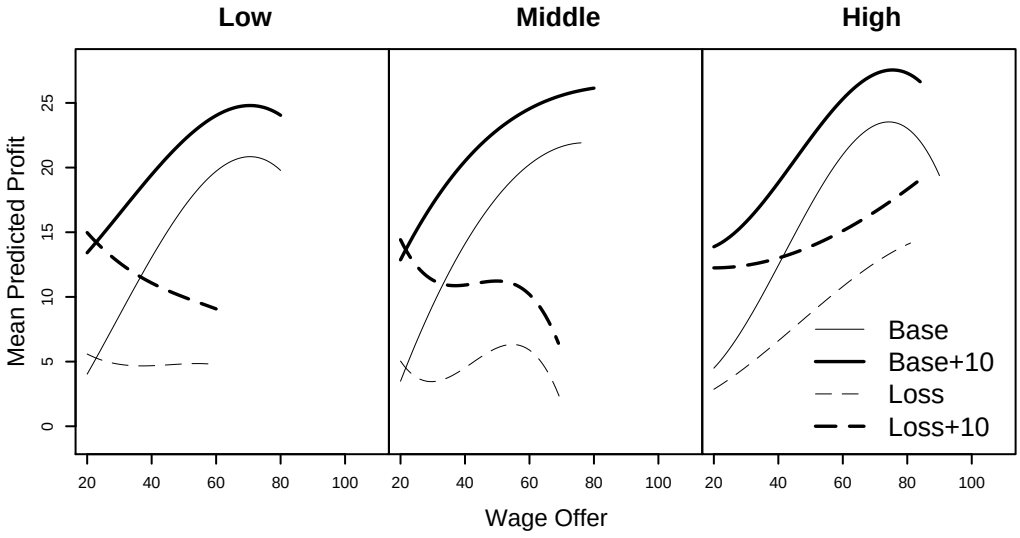
5.2 Managers wage-setting behavior

According to the evidence presented in the previous section, by paying high wages managers can induce employees to choose a high effort *on average*. If the reciprocal behavior of the employees is anticipated by the managers a high wage policy should prevail as long as the offered wage is compensated by a sufficiently high effort. We first investigate the impact of the reciprocal behavior of employees on the managers' earnings.

Figure 2 shows the managers' mean predicted monetary payoffs for different accepted wage offers in each experimental condition. The regression curves are drawn according to the estimation results of a linear mixed effects model where the set of covariates contains in addition to an intercept and the variables *Productivity*, *Loss* and *Ten*, the accepted wage offer, the accepted wage offer squared and the accepted wage offer at the power of three plus some interaction effects (details can be obtained from the authors upon request).

Managers' earnings increase with wages in the *Base* and *Base + 10* experimental conditions up to a certain threshold. In those two experimental conditions, whatever the employees' pro-

Figure 2: Managers' mean predicted monetary payoffs as a function of accepted wage offers.



ductivity, a manager benefits from offering a sufficiently high wage (typically above 35 units) in comparison with the standard predicted monetary payoff. Managers typically maximize their monetary payoffs by offering a wage of about 70 units, and, interestingly enough, a closer look at the data enables us to conclude that most offered contracts are profit maximizing given the employees wage-effort schedule. The picture is quite different in the *Loss* and *Loss + 10* experimental conditions. As expected, the employees' adjustment in reciprocal behavior is not enough to compensate for the presence of losses as a manager never benefits from offering a high wage in comparison with the standard predicted monetary payoff (except for wages above 60 units when the productivity is high and the manager's initial wealth equals zero). Another finding clearly in line with the employees wage-effort schedule is that the difference in managers' mean earnings between the conditions with a strictly positive endowment and those without is smaller than the amount of this endowment for accepted wage offers larger than the standard predicted wage.

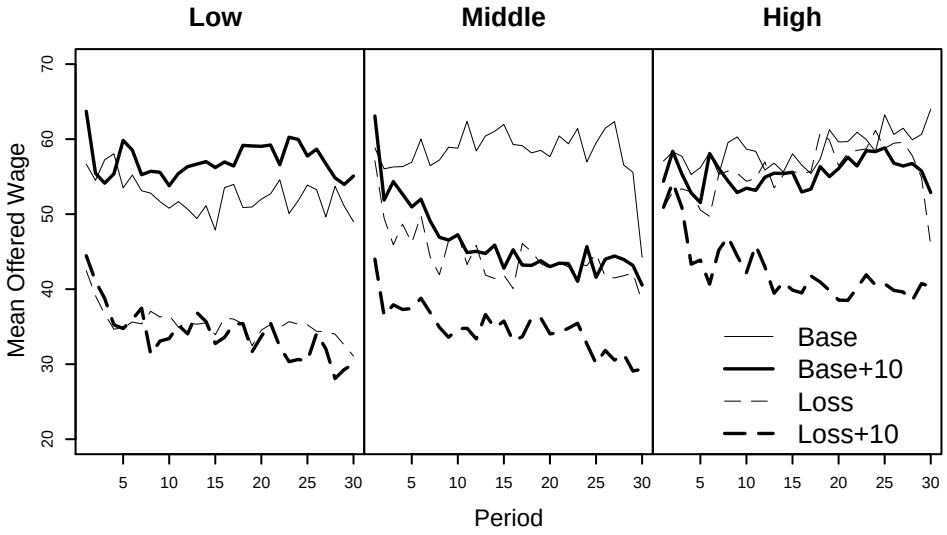
In order to investigate the managers' wage-setting behavior, we use a linear mixed effects model where the dependent variable is the logarithm of the accepted wage offer and the set of covariates contains in addition to an intercept and the variables *Productivity*, *Loss* and *Ten*, the variable *Period* and some interaction effects (details can be obtained from the authors upon request). This statistical analysis leads to the following findings. First, wages are significantly lower in the *Loss* condition than in the *Base* condition but when the employees' productivity is high this difference is reduced. Second, whether managers own some initial endowment or not does not significantly influence their wage-setting behavior. Third, the employees' productivity does not significantly influence the wage offers. Finally, except for an end-game effect, wages do not evolve much over time. We confirm graphically these statistical results with Figure 3 which shows for each experimental condition the evolution of the average wage offer over time.

Based on this evidence we can conclude that: i) research hypothesis $H1$ is confirmed, i.e., loss aversion refrain managers from trying to elicit reciprocal responses from employees and it therefore prevents the achievement of large efficiency gains; ii) research hypothesis $H2$ and $H3$ are invalidated, i.e, slightly lower employees' productivities do not influence the managers' wage-setting behavior neither does an initial endowment.

6 Conclusion

Fehr, Kirchler, Weichbold, and Gächter (1998) compare an experimental condition where they

Figure 3: Temporal paths of managers' average wage offers.



completely avoid losses (the specification of the manager's monetary payoff function is $(v-w)\cdot e$) with another experimental condition in which the manager can make losses (the specification of the manager's monetary payoff function is $v \cdot e - w$). They report that the pattern of reciprocal interactions is basically the same in both experimental conditions. Similarly, Fehr and Gächter (1998) conducted a series of gift exchange market experiments where the specification of the manager's monetary payoff function is $v \cdot e - w$ and concluded that the observed behavioral patterns result in a large increase in the total gains from trade relative to the equilibrium prediction. More recently, Maximiano, Sloof, and Sonnemans (2004) have investigated whether the level of gift-exchange reported in the simple one-manager-one-employee relationship is robust to the more realistic situation in which the manager has several employees. Whatever the number of employees who work for the manager, the specification of the manager's monetary payoff function is of the form $v \cdot e - w$. Maximiano, Sloof, and Sonnemans report that their results are in line with the previous findings.

Our data clearly establish that the effect of social forces is dramatically crowded out by the loss aversion effect. How can we reconcile the results obtained by Fehr and coauthors in many experimental studies or those obtained by Maximiano, Sloof, and Sonnemans with our results? There is a substantial difference in the way we have implemented losses in the laboratory and the way Fehr and coauthors or Maximiano, Sloof, and Sonnemans have done it. More precisely, in all the past studies we are aware of, the experimenters provided all subjects with some initial endowment to avoid losses! We did not endow our participants with some initial wealth (they also got no show-up fee). Our participants had to sign a letter of agreement before the start of the experimental session in which they agreed to cover losses by either incomes from future participation in experimental sessions or by their own money. Accordingly, by agreeing to take part to one of our experimental sessions, the participants could not avoid incurring losses but by not trading. Thaler and Johnson (1990) find that under some circumstances a prior gain can increase subjects' willingness to accept gambles.[18] This finding is labeled the house money effect as gamblers often use the phrase "playing with the house money" to express the feeling of gambling while ahead. The essence of the idea is that until the winnings are completely depleted, losses are coded as reductions in a gain, as if losing some of "their money" doesn't hurt as much as losing one's own cash. We conjecture that by providing some initial endowment to their participants, previous experimental studies have clearly failed to investigate the impact

[18]See also Arkes, Joyner, Pezzo, Nash, Siegel-Jacobs, and Stone (1994) who show that windfall gains are spent more readily than nonwindfall gains where a defining characteristic of a windfall gain is its unanticipated status.

of losses on the level of gift exchange reported. In order to confirm this intuition, we plan to replicate some of our experimental sessions where participants will be endowed with some initial wealth.

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Appendix

Figure 4: Cumulative distribution of wage offers.