# Deterministic versus probabilistic consequences of trust and trustworthiness

## *An Experimental Investigation*

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**Abstract**

There is overwhelming evidence of reciprocal behavior, driven by intentions. However, the role of consequences is less clear cut. Experimentally manipulating how efficient trust and reciprocity can be in deterministic and uncertain environments allows us to study how payoff consequences of trust and trustworthiness affect reciprocity. According to the results for our modified Investment Game, trustees reward trust more when trust is more efficient but do not adjust rewards when the efficiency of rewarding is varied. Furthermore, higher deterministic benefits result in higher levels of reciprocity for all trust levels, whereas an uncertain environment diminishes reciprocity.

**Keywords**: trust and reciprocity; consequences; other-regarding preferences; uncertainty; experiment

**JEL classification**: C72, C91

**PsychINFO classification**: 2260, 2340, 3040

# 1 Introduction

Trust and reciprocity—in the form of trustworthiness—are main constituents of social capital and have been observed to improve the efficiency of economic systems (Arrow, 1974) and large organizations (La Porta *et al.*, 1997). According to Coleman (1990), a trust relationship involves at least two parties, a trustor and a trustee, and is characterized by four main aspects: i) trust opens up new opportunities for the trustee; ii) when the trustee rewards trust, the trustor is better off than when not trusting; iii) when the trustor invests in trust, the trustor's resources are accessible to the trustee at no cost; iv) there is a time lag between the choices of the trustor and the trustee (sequentiality).

In this paper, we inquire about trust and reciprocity in a novel interaction setting that deviates from two aspects of Coleman's description. With reference to aspect i), trust benefits the trustee but does not affect her opportunity set. In this way, we overcome the usual endogenous restrictions imposed on reciprocity. With reference to aspect iv), we simply ask the trustee to condition her choices upon choices of the trustor. Strategically, what is crucial in a trust relationship is who can condition on the other's choices. Moreover, in contrast to previous experimental studies of trust, we investigate behavior when consequences of trust and reciprocity are either fully deterministic or governed by chance.

Although trust and reciprocity are distinct, they are closely related as the inclination of trustees to reciprocate depends on how they perceive the trusting behavior of the trustor. The standard economic approach does not distinguish decisions involving trust from decisions under risk (Williamson, 1993). In this framework, the trustor would invest in trust only when its expected gains are positive. Trust is thus rationalizable when the likelihood of rewarding is sufficiently high. However, one has to distinguish the strategic aspect of trust from mere stochastic risk. Eckel and Wilson (2004) and Houser *et al.* (2010), for example, identify no significant correlation between choices involving risk and those involving trust. An fMRI study (McCabe *et al.*, 2001) suggests that the part of the brain involved when individuals mutually interact with each other in trust situations differs from the part involved when individuals face a risky choice task. Additionally, trust is positively influenced by a neuropeptide called oxytocin, whereas risk taking is not (Kosfeld *et al.*, 2005).

However, there is evidence that willingness to take risks impacts on trust behavior in a social setting. Specifically, Bohnet and Zeckhauser (2004) and Bohnet *et al.* (2008) suggest that in trust situations involving social interaction, individuals are less willing to take risks relative to equivalent situations where chance determines the outcome. They experimentally test this hypothesis, which they term betrayal aversion, and robustly support it across different societies and cultures. In particular, when another person rather than nature determines the outcome, trustors demand a higher risk premium to compensate for the costs resulting from a breach of trust.

Trust and reciprocity have been investigated in experimental settings adopting interaction schemes based on a sequential Prisoners' Dilemma. Within the class of games with richer action spaces, the Investment Game (Berg *et al.*, 1995) has attracted a great deal of attention and several replications and variations can be found in the experimental economics literature (for a meta-analysis, see Johnson and Mislin, 2011)[1]. In the Investment Game (hereafter IG), the trustor chooses how much of a fixed endowment (usually a sum of money) to send to the trustee. This "investment in trust" is then multiplied by a positive factor, usually set equal to three, and forwarded to the trustee who decides how much of the received amount to send to the trustor.

The standard rational choice prediction for this game is that the trustee returns nothing to the trustor and that the trustor, anticipating this, does not send anything in the first place. Contrary to this prediction, Berg *et al.* (1995) find that trustors send positive amounts, i.e., on average about half of their endowment, and that trustees return on average slightly less than what is invested

[1]Another form of sequential prisoner's dilemma and a commonly used device to measure reciprocity is the so-called gift exchange game (Fehr *et al.*, 1998) designed to mimic actual gift exchange in labor markets.

by the trustors. Additional studies have replicated this result and a robust finding in trust experiments is that trustees reciprocate even when this is costly to them.

Pillutla *et al.* (2003) observe that both the magnitude and frequency of reciprocating is higher when trustors take large risks resulting in high benefits for trustees relative to small risks that result in low benefits. This finding is contrary to incremental models of the trust process (e.g., Rempel *et al.*, 1985) suggesting that trustors should gradually build trust by initially taking small risks. However, whether the trustees' decision to reciprocate is due to the size of their benefit as opposed to the level of risk taken by trustors is ambiguous. In experimentally disentangling this confound, Malhotra (2004) finds that trust is more likely when the risk of trusting is low, whereas it does not depend on the level of benefit accruing to the trustee. Reciprocity on the other hand is more likely when the accrued benefit is high, but does not depend on the level of risk for the trustor.

Among the IG experiments, the most relevant for our study are those varying the efficiency factor or multiplier. When reciprocity is measured as the proportion of investment returned to the trustor, a higher multiplier decreases the overall level of reciprocity (for a review of results, see Johnson and Mislin, 2011). In our modified IG, both amounts, the one sent by the trustor and the reward of the trustee, are multiplied by efficiency factors. We experimentally manipulate both multipliers along two dimensions: the multipliers can be *high* or *low* and *deterministic* or *probabilistic*. In the deterministic condition, multipliers are known by participants before choosing, while in the probabilistic condition participants only know that they are high or low, with equal probability. Varying multipliers captures different productivity levels of a given input and allows us to explore how consequences affect trust and reciprocity behavior. In our setting, the choice sets of trustors and trustees remain the same across experimental conditions whereas multipliers differ from one condition to the other. Our design renders the IG more symmetric since trustors and trustees have the same action space and their choice sets are independent.

In our view, such an experimental design can serve two purposes. First, we examine the robustness of trust and reciprocity. So far, it is not clear from previous experimental studies whether their qualitative findings will remain valid in more complex trust experiments. Our participants make several choices confronting them with competing concerns like aversion to mistrust, efficiency seeking and reciprocity inclinations, possibly triggered by preserving a self-image of trustworthiness. Second, we assess how various motives influence behavior in such an experimental setup. In more complex environments, the cognitively more demanding task might influence behavior, e.g. by crowding out or weakening other-regarding concerns. When conclusions from trust and reciprocity experiments are invalidated by complexity, this would certainly question their robustness and relevance for institutional design and policy.[2]

Theoretical contributions suggest that both intentions and payoff consequences affect pro-social behavior. Rabin (1993), for example, discusses fairness in normal form games as originating from intentions of others: if intentions of others are perceived as good (bad), this may trigger a positive (negative) reaction. In this vein, Dufwenberg and Kirchsteiger (2004) develop a reciprocity model for extensive form games, allowing for information updating by the players. Fehr and Schmidt (1999) measure fairness in terms of payoffs and suggest that the material consequences of actions matter more. Specifically, individuals seem to suffer when they are either better or worse off than others in terms of payoff (i.e., inequity aversion). McCabe *et al.* (2003) compare observed choices in two simple experimental settings. In the first, trustees can either choose a fair or a selfish move after a trust move by the trustor whereas in the second, trustees have the same options, but the trustor is not given the opportunity to trust the trustee. Whereas the payoff consequences of the trustee's action do not change, intentions of trustors are accessible to trustees only in the first setting. McCabe

[2]In our view, experimentalists should not necessarily shy away from cognitively demanding tasks but try to check that they are fully comprehended by participants. This is checked by control questions in our study.

*et al.* show that fairness is observed in both settings but is much more frequent when good intentions can be signaled. Falk and Fischbacher (2006) present a model of reciprocity which allows us to categorize behavior in our experiment: the perceived kindness of an action is determined both by intentions underlying the action and its consequences. Due to reciprocity concerns, higher levels of perceived kindness are expected to be rewarded more. The model accounts for many stylized facts observed in a wide range of experimental games.

In our modified IG, the cost of trust is kept constant whereas its payoff consequences change across treatments both in their size (high vs. low efficiency gains) and nature (probabilistic vs. deterministic). Larger transfers to the trustor or the trustee are expected to trigger stronger reciprocity. We show that investments with higher deterministic benefits for the trustee induce more reciprocity. When the efficiency of trust is probabilistic, the overall levels of reciprocity are in line with those observed in the low deterministic condition. Furthermore, most trustees do not condition their level of reciprocity on the expected consequences of reward. As a result, trust profitability is positively affected by multipliers in the game. However, trustors seem to disregard the levels of both multipliers, i.e., their own and that applied to amounts sent by the trustee, and generally fail to grasp fruitful investment chances.

# 2 Method

## 2.1 Design

We experimentally investigate trust behavior in modified versions of the Investment Game (Berg *et al.*, 1995). $X$ (the trustor) chooses an amount $x$ that she sends to $Y$ (the trustee) from among four possible options: 0, 3, 6, or 9 ECU.[3] Before being forwarded to $Y$, $x$ is multiplied by an efficiency factor $m$. In turn, $Y$ chooses an amount $y$ that she sends to $X$ from among the same four possible options: 0, 3, 6, or 9 ECU.

[3] ECU stands for Experimental Currency Unit used in the experiment.

To capture the sequential structure of the game, $Y$ can condition on the choice of $X$, i.e. $Y$'s choice of $y$ is a function of $x$ in the sense of $y(x)$. A strategy of $Y$ assigns amounts $y$ for all possible $x$ choices of $X$, i.e. for each possible $x$ which $X$ can send, $Y$ decides on the corresponding amount $y$ that is sent to $X$. The amount $y$ sent by $Y$ is multiplied by an efficiency factor $n$ prior to being forwarded to $X$. The payoff of $X$ ($\pi_X$) is $\pi_X = E - x + ny$, whereas the payoff of $Y$ ($\pi_Y$) is $\pi_Y = E - y(x) + mx$. The initial endowment $E = 9$ is given to each participant at the start of each round.

The efficiency factor $m$ is experimentally manipulated in a within-subject fashion: in a deterministic condition, it can be either 4/3 ($m_{LOW}$) or 3 ($m_{HIGH}$); in a probabilistic condition, it can be 4/3 or 3 with equal likelihood ($m_{LOW/HIGH}$). Accordingly, each $X$ participant has to choose an amount to send for $m_{LOW}$, $m_{HIGH}$ and $m_{LOW/HIGH}$, being aware that each condition has the same likelihood to be chosen but not yet knowing which one of the three applies.

Factor $n$ is subjected to the same manipulation, but the variation is performed between subjects. Thus, participants in one session are exposed to a single value of $n$ chosen as 4/3 ($n_{LOW}$), 3 ($n_{HIGH}$), and 4/3 or 3 with equal likelihood ($n_{LOW/HIGH}$). All multipliers take a value greater than one so that efficiency opportunities can be exploited. While preserving the general features of the IG, our design allows trust and reward to promote efficiency.

Given our experimental design, $X$ has to choose one of the four possible values of $x$ for each realization of $m$, deterministic with 4/3 and 3, and probabilistic. Thus, in each round, $X$ is asked to report three distinct choices, knowing that only one of them is actually going to be implemented. $Y$ chooses one of the four possible values of $y$ for each $m$ and for each possible amount sent by $X$ for the given $m$. It follows that in each round, $Y$ is asked to report $4 \times 3 = 12$ distinct choices of which, eventually, only one is implemented.[4]

After each round both participants are reminded of the multipliers $m$ and $n$, respectively, and informed about their random realizations when the multipliers

[4]For details on how choices were collected, see the instructions reported in Appendix A.

are stochastic. Additionally, they are informed about their own as well as the other's actual choice and about their payoff.

## 2.2 Behavioral Predictions

The experimental design allows us to test alternative hypotheses about the determinants of reciprocity. Under the standard assumption of selfish rationality, both $x$ and $y$ should be zero across conditions. Similar to the standard IG, $Y$ does not have an incentive to send back a positive amount to $X$, irrespective of the amount sent by the latter. Accordingly, an opportunistic $X$ would send nothing to $Y$. However, when individuals value the social consequences of their actions, outcomes may emerge that deviate from behavior based on common opportunism.[5]

Previous studies have highlighted the role of trust and reciprocity in interaction settings similar to the one investigated here (for a survey, see Camerer, 2003). A reciprocity-minded $Y$ is likely to send to the corresponding $X$ an amount $y$ which is increasing with $x$. An $X$ anticipating such conditioning may thus trust $Y$ and send a positive amount $x$. Our analysis focuses on reciprocity and, thus, on $Y$'s behavior.

To obtain some testable qualitative predictions, we employ the Falk and Fischbacher (2006) model. An econometric test of a modified version of the model will be presented in Section 3.3. In Falk and Fischbacher's model, the utility $U_Y$ of a trustee $Y$ is given by $U_Y = \pi_Y + \rho_Y \sum \varphi_X(\cdot)\sigma_Y(\cdot)$. The factor $\varphi_X$ is the kindness term measuring $Y$'s perception of the action by $X$. In our setting, $\varphi_X$ captures payoff consequences of $X$'s actions, with $\varphi_X > 0$ denoting a kind action of $X$ and $\varphi_X < 0$ denoting an unkind action, in terms of payoff accruing to $Y$.[6] An action is deemed kind if it increases the payoff of the other

[5] What this requires in our setting is that $X$ and $Y$ only care for their own payoff and that $X$ knows that $Y$ is opportunistic in this sense.

[6] In the original model of Falk and Fischbacher (2006), $\varphi_X$ accounts also for intentions of X. In our interaction setting, the intention factor as defined by Falk and Fischbacher (2006) does not play a relevant role because when $X$ chooses to send a positive amount to $Y$, then $Y$ can clearly infer the intentional kindness of $X$'s choice. In such a situation, the intention factor of $X$ is at its maximum level and does not interfere with distributional considerations.

with respect to a reference standard. We assume the reference standard to be given by the initial endowment. Thus, any positive investment by $X$ is a kind action towards $Y$. The second component of the Falk and Fischbacher model is the reciprocation term $\sigma_Y$, capturing how $Y$ responds to the perceived kindness of $X$'s action. When an action is perceived as unkind, $Y$ reciprocates with a negative $\sigma_Y$ by negatively affecting the payoff of $X$. The opposite holds when $X$'s actions are perceived as kind. The reciprocal response to $X$'s actions generates an extra source of utility, added to the monetary payoffs, that is mediated by a reciprocity factor $\rho_Y$.

The model provides some qualitative predictions about the impact of the controlled variation of the efficiency factors $m$ and $n$ on the behavior of $Y$. For a given $x$, a higher $m$ increases the perceived kindness of $X$, due to the higher monetary benefits accruing to $Y$. This, in turn, will induce a kinder reaction on the part of $Y$. The kindness of $Y$'s reaction is measured by the monetary benefits for $X$. In this respect, different levels of $n$ are likely to affect the size of the reaction. To achieve the same monetary benefits for $X$, a higher $y$ is needed for a smaller $n$ relative to a higher $n$. Accordingly, higher levels of $y$ should be observed for higher levels of $m$ and lower levels of $n$. We therefore expect to observe the highest levels of $y$ in the $m_{HIGH}$,$n_{LOW}$ treatment and the lowest levels of $y$ in the $m_{LOW}$,$n_{HIGH}$ treatment.

In the econometric specification of Section 3.3, we modify the original Falk and Fischbacher (2006) model and assume allocational concerns to be captured by the inequity aversion model of Fehr and Schmidt (1999).[7] The intuition for this is that a positive amount sent by $X$ creates an advantageous allocation for $Y$, who kindly reacts to the well perceived action of $X$ by reducing the gap between their payoffs. In Section 3.3, we capture reciprocity concerns among $Y$ participants by estimating a parameter of sensitivity to advantageous differences in payoffs.

[7] We thank an anonymous referee for pointing out that in our symmetric setting the outcome-oriented model of Fehr and Schmidt may predict reciprocity.

### 2.3 Participants and Procedure

The experiment was run in Jena (Germany) using the laboratory of the Max Planck Institute of Economics. Participants, students of the Friedrich Schiller University Jena, were recruited using the ORSEE system (Greiner, 2004). The computerized experiment was programmed and conducted using the z-Tree software (Fischbacher, 2007). A total of 184 participants took part in six experimental sessions, and had a median age of 23 years (lower quartile = 21, upper quartile = 25).[8] The gender composition was quite balanced with 43.5 % of the participants being male.

Upon arrival at the laboratory, participants were randomly assigned to cubicles preventing interaction with other participants. Each participant received written instructions and was given a few minutes to read them privately. Then a member of the experimental staff read aloud the instructions and participants were offered a chance to privately ask clarifying questions. Before the start of the experiment, participants had to answer some control questions checking their understanding of the instructions.

The experiment consisted of four rounds. At the beginning of the experiment, participants were randomly assigned to either role $X$ or $Y$ and kept their assigned role for the remainder of the experiment. In each round, an $X$ participant was randomly matched with a $Y$ participant and participants were made aware that they would not be matched with the same partner in subsequent rounds.

At the end of the experiment, one of the four rounds was randomly selected for payment, with the intent of focusing participants on the game at hand rather than on a holistic plan for the entire experiment. Experimental Currency Units (ECU) were used during the experiment and participants were aware of the exchange rate of 2 ECU= €1 from the beginning. Final payment, including experimental earnings and the show-up fee of €2.50, was paid in private to each

[8]In total, we conducted five sessions with 32 participants and one session with 24 participants.

participant prior to leaving the laboratory.[9] The payments are in line with average payments disbursed at the laboratory of the Max Plank Institute of Economics.

# 3 Results

## 3.1 Descriptive Statistics

### 3.1.1 Choices of X

Figure 1 describes the distribution of individual-level average $x$ choices over the four experimental rounds, for each $n$ and $m$.

[Figure 1 about here]

Most of the average choices of $X$ are within the interval 3–6, with slightly higher values observed in conditions $n_{LOW/HIGH}$ and $n_{HIGH}$ in comparison to condition $n_{LOW}$. However, a series of Wilcoxon Rank Sum tests does not highlight a statistically significant impact of the multipliers $m$ and $n$ on choices of $X$. In summary, $X$ participants do not fully trust their partners and do not condition their behavior on $m$ and $n$ parameters.

**Result 1** *Overall $X$ participants reveal intermediate trust levels and are not responsive to possible consequences of own or $Y$'s actions, as captured by multipliers $m$ and $n$.*

Thus, like financial investors, trustors mostly engage in portfolio diversification by keeping part of their monetary endowment as a risk-free asset but also invest in risky trust. Here, this risk is only strategic in the case of deterministic multipliers and, additionally, stochastic when multipliers are probabilistic.

[9] On average, participants earned €8.797. Earnings were, on average, higher for $Y$ participants (€9.774) than for $X$ participants (€7.819).

#### 3.1.2 Choices of Y

For each $n$ and $m$, Figure 2 provides a summary description of the distribution of individual-level average choices of $Y$ conditional on potential choices of $X$.

[Figure 2 about here]

From Figure 2, we observe that $Y$ participants condition upon the choice of their respective partners for each level of $m$ and $n$. However, average and median values show that the reactions of $Y$ participants do not perfectly match the choices of their $X$ partners. When comparing choices across alternative levels of $n$, it emerges that $Y$ participants reward intentions of trustors and do not strictly link their actions to the consequences of trust. Given $n$, average $y$ is always bigger for $x = 9$ and $m_{LOW}$ than for $x = 6$ and $m_{HIGH}$, even though the latter generates more positive consequences for Y (12 vs 18, respectively).

**Result 2** *Higher levels of trust trigger higher rewards for all levels of the multipliers $m$ and $n$.*

Whether proportional reciprocity, when correctly anticipated by X, renders trust a profitable investment depends, of course, on the proportionality factor of the reaction but also on the multiplier $n$. The issue of trust profitability is addressed by the regression estimates reported below.

### 3.2 Regression Analysis

#### 3.2.1 Determinants of Reciprocity

To analyze $Y$'s reciprocity, we specify a multi-level logistic model. The dependent variable *yrecp* takes the value one if $Y$ reciprocates, defined as $Y$ sending back an amount $y$ equal to, or greater than, the amount $x$ sent by $X$. Otherwise, *yrecp* takes the value zero. The model is estimated by the maximum likelihood procedure implemented in GLLAMM.[10] The main advantage of GLLAMM is

[10]The acronym GLLAMM stands for Generalized Linear Latent and Mixed Models. For a review, see Rabe-Hesketh *et al.* (2005).

that it allows for the inclusion of several nested random effects representing unobserved heterogeneity at different levels of a hierarchical data set (Rabe-Hesketh *et al.*, 2005). In our experiment, both $X$ and $Y$ participants make repeated choices and are randomly assigned to matching groups at the start of each round, which is taken into account in our estimation.

The behavioral predictions, discussed in subsection 2.2, predict the highest level of reciprocity for the combination of $m_{HIGH}$ and $n_{LOW}$, and the lowest level of reciprocity for the combination of $m_{LOW}$ and $n_{HIGH}$. The latter multiplier combination serves as the base case in our regression analysis.

The explanatory variables include the multipliers of $X$ ($m_{HIGH}$ and $m_{LOW/HIGH}$), the multipliers of $Y$ ($n_{LOW}$ and $n_{LOW/HIGH}$), and the period variable. The underlying logistic model thus takes the form:

$$p_i = Pr(yrecp_i = 1) = f(\beta_0 + \beta'\mathbf{Z}_i) \quad (1)$$

where,

$\beta'\mathbf{Z}_i = \beta_1 n_{LOW_i} + \beta_2 n_{LOW/HIGH_i} + \beta_3 m_{HIGH_i} + \beta_4 m_{LOW/HIGH_i} + \beta_5 Period_i + \beta_6 x_{6_i} + \beta_7 x_{9_i}$.

The regression specification controls for the main effect of multipliers, for the impact of rounds and for the level of trust displayed by the counterpart.[11] Table 1 summarizes the results of the regression estimate.

[Table 1 about here]

The results show that in terms of $X$'s multipliers, $m_{HIGH}$ has a positive significant impact on the reciprocity of $Y$, compared to the baseline. Moreover, reciprocity is more likely for higher levels of trust displayed by $X$, as shown by the estimated coefficients of $x_6$ and $x_9$ and by the significant difference between the two (see W-st3). In contrast, $m_{LOW/HIGH}$ has no significant impact on the reciprocity of $Y$. For $Y$'s multipliers, no significant impact on reciprocal behav-

[11]In an exploratory extended regression model, we added the four possible multiplier interactions as regressors. The results did not change substantially.

ior is observed, as shown by the insignificant coefficients of these multipliers.[12]

**Result 3** *By positively reacting to the consequences of trust, $Y$ participants reciprocate more for higher levels of $m$ and $x$. However, $Y$ participants do not react to the consequences of their own rewarding by not adjusting their reaction to multiplier $n$, i.e. to the efficiency of $y$.*

Probabilistic consequences of trust seem to displace reciprocity concerns, with reciprocity levels for $n_{LOW/HIGH}$ being not significantly different from those for $n_{LOW}$ (see $W$-$st1$). However, reciprocity levels for $m_{LOW/HIGH}$ are lower than those for $m_{HIGH}$ (see $W$-$st2$).

**Result 4** *Probabilistic consequences of rewards diminish reciprocity concerns: for the probabilistic multiplier, reciprocity levels are lower than those observed for $m_{HIGH}$ and similar to those observed for $m_{LOW}$.*

### 3.2.2 Profitability of Trust

The profitability of trust depends on the amount $y$ sent by $Y$ and on the multiplier $n$. When taking into account only the choices of X participants who submit a strictly positive $x$, the average (median) return on the investment equals to 9.094 (7.000), with a standard deviation of 6.168. The small average return and the high risk seem to question the attractiveness of investing for reasonable risk preferences. The ex-post best reply to the choice profile of the Y population would have yielded average (median) earnings of 13.450 (11.000), with a standard deviation of 5.858. Overall, X participants tend to perform significantly worse than the optimal benchmark (Wilcoxon Rank Sum Test, p-value$< 0.001$), with rates of return from 1% to 49%.

The regression of Table 1 shows that $Y$ participants positively react to higher amounts $x$ but do not adjust their reactions to the consequences of their own actions, i.e., to $n$. To better understand the determinants of the profitability

[12]In an analysis not reported here, we estimated coefficients in the regression model (1) for different levels of x, separately. For all x levels, the analysis was qualitatively coherent with the one reported in Table 1.

of trust, we estimate a multilevel linear model.[13] The dependent variable *Rate of return (%)* measures the rate of return of the investment made by $X$ and is given by $\left(\frac{ny}{x}-1\right)*100$.[14] As independent variables, we include the multipliers of $X$ ($m_{HIGH}$ and $m_{LOW/HIGH}$), the multipliers of $Y$ ($n_{LOW}$ and $n_{LOW/HIGH}$), the period variable ($Period$), and two dummy variables controlling for the level of trust displayed by $X$ ($x_6$ and $x_9$).

Table 2 reports the outcomes of two distinct regressions, one restricted to strictly positive levels of $y$ and one for all levels of $y$. Particular emphasis is given to the former because estimated coefficients in the latter are likely to be biased by the high number of observations clustered at the lower bound of the distribution. We focus on the estimation restricted to $y > 0$ since we are mainly interested in how the explanatory variables impact on how much to reciprocate.

[Table 2 about here]

The analysis restricted to reciprocators (with choices $y > 0$) shows that in the baseline condition $n_{HIGH}, m_{LOW}$, investments tend to generate high positive returns, with the amount received back being more than three times the amount invested. When the positive consequences of the investment are further improved by $m_{HIGH}$, the returns on investment are even higher, as captured by the coefficient of $m_{HIGH}$. However, profitability of trust seems to largely depend on the multiplier of $Y$: for $n_{LOW}$, returns of the investment sharply decline. The same holds for the probabilistic $n$, whose negative impact, however, is weaker than that of $n_{LOW}$ (see W-st1). For $m_{LOW/HIGH}$ no significant difference compared to $m_{LOW}$ is observed, but the impact in terms of profitability is significantly lower than that of $m_{HIGH}$ (see W-st2).

**Result 5** *The profitability of trust is positively affected by the multiplier $m$ via*

[13]The regression model in Table 1 is estimated by the maximum likelihood procedure implemented in GLLAMM and controls for repeated choices at the individual and the group level.

[14]The regression estimate refers only to strictly positive amounts ($x > 0$). In condition $n_{LOW/HIGH}$, the expected value of $ny$ is used to calculate the dependent variable *Rate of return (%)*.

*an increase in the proportionality of reaction, and by the multiplier n that directly increases the returns for X participants of each unit sent by Y participants.*

Table 2 shows that the profitability of an investment decreases with the amount invested, showing a stronger negative effect for an investment of 9 than for an investment of 6 (see also W-st3). Thus, $Y$ participants do not reward more risk borne by $X$ participants with higher returns on the investment. Furthermore, investments become less profitable as participants gain experience.

**Result 6** *The profitability of an investment decreases with the amount invested and with experience.*

Finally, it should be noticed that, at least in qualitative terms, findings of the regression analysis on the subsample of reciprocators are consistent with those from the regression analysis for the entire population of trustees.

## 3.3 Maximum Likelihood Estimation

As specified in Section 2.2, the Falk and Fischbacher (2006) model provides some insights into the likely behavior in our experiment. We present here a parametric estimation of a modified model, in which reciprocity of participants is driven merely by payoff considerations. In particular, $Y$ is assumed to be concerned about the positive difference between her payoff and that of $X$. The concerns of $Y$ regarding this difference are captured by the coefficient $\beta$, measuring reciprocity attitudes due to the psychological cost of being better off than the other (Fehr and Schmidt, 1999).[15] The utility of $Y$ is given by $U_Y = \pi_Y - \beta_Y(\pi_Y - \pi_X)$, where $\pi_Y$ and $\pi_X$ are the monetary payoffs of $Y$ and $X$, respectively.

To obtain an estimate of the parameter $\beta$, we adopt a maximum likelihood approach similar to that employed by Goeree and Holt (2000) and Blanco et al.

[15] In a footnote, Falk and Fischbacher (2006) explicitly mention the Fehr and Schmidt (1999) model as a potential candidate to capture reciprocity of individuals who are purely outcome oriented.

(2011). Individuals are assumed to choose according to a logit rule and the same utility function is applied to all subjects.[16]

When pooling data, the estimated $\beta$ is 0.358.[17] However, estimates differ across alternative parameter configurations. The range of estimated $\beta$ coefficients vary from a low-end point of 0.222, in condition $m_{HIGH}, n_{HIGH}$, to a high-end point of 0.389 in condition $m_{HIGH}, n_{LOW}$. In general, for a given $m$ the highest $\beta$ is estimated for $n_{LOW}$ and the lowest $\beta$ for $n_{HIGH}$.

To gain a further understanding of payoff concerns captured by $\beta$, we also consider the modified utility function $U_Y = \pi_y - \left[(\gamma x + \theta)(\pi_Y - \pi_X)\right]$. In this specification, $\theta$ measures innate allocational concerns, like $\beta$ in the previous specification, and $\gamma$ measures allocational concerns that depend on the degree of trust displayed by $X$. A positive $\gamma$ implies that $Y$ experiences a higher psychological cost of inequality for higher levels of trust. This will induce stronger reciprocal reactions for higher levels of trust.

The estimated $\theta$ and $\gamma$ coefficients are both statistically different from zero and equal to 0.249 and 0.017, respectively. Thus, we confirm that payoff considerations are likely to affect reciprocity. However, concerns for advantageous allocations are not fully exogenously determined, like in the original model of Fehr and Schmidt (1999), but depend on the other's behavior. Stated simply, the psychological cost of a trustee who is better off than a trustor increases when the trustor is more trusting.

**Result 7** *$Y$ participants are concerned about advantageous payoff allocations. Such concerns are stronger for higher levels of trust displayed by $X$ and weaker for higher efficiency of $Y$'s own actions.*

[16] According to the logit rule, an individual $Y$ who has N options available chooses $k \in N$ with likelihood $p_k = exp(U_Y^k)/\sum_{j=1,\dots,N} exp(U_Y^j)$. Here, $U_Y$ is given by $U_Y = \pi_Y - \beta_Y(\pi_Y - \pi_X)$. Unlike Goeree and Holt (2000), we are not primarily concerned in how rational participants are and thus omit the estimation of the parameter $\mu$ measuring sensitivity to a change in utilities.

[17] Interestingly, the estimated $\beta$ is quite close to the value of 0.380 reported by Blanco et al. (2011) in a similar estimation exercise. When performing an individual-level estimation, the average $\beta$ is equal to 0.284 and 75% of the participants have a $\beta \leq 0.351$.

# 4 Discussion and Conclusions

Our experimental setting allows us to evaluate how payoff consequences affect trust and reciprocity. Consequences of trust and reciprocity are the amounts received and depend on the multipliers. Whereas the choice sets of trustors and trustees remain the same across experimental conditions, multipliers differ from one condition to the other. By systematically varying the multipliers, i.e., the efficiency of trusting (choice $x$) and rewarding trust (reaction $y = y(x)$ to $x$), we test how reciprocity is affected by payoff consequences.

Overall, trustees react to the advantageous allocations created by trustors' kindness. The strength of the reaction is affected by trust and efficiency. The impact of efficiency is, however, one-sided: trustees reward trust more when $m$ is high rendering trust highly profitable for them but do not condition their reciprocity on how profitable the reward is for their trustor. As a result, the profitability of trust is positively affected by both multipliers. The impact of the probabilistic multiplier $m$ is the same as that of the low deterministic multiplier $m$. A probabilistic multiplier of the trustor's choice seems to dampen reactions of the trustees disproportionately. Trust profitability decreases with the number of rounds played and, quite surprisingly, with the amount invested. The latter seems to be anticipated by trustors who generally display intermediate or low trust levels. At the same time, trustors are quite unresponsive to alternative levels of $m$ and $n$ and, thus, do not seem to fully anticipate how efficiency parameters influence trust profitability.

In our view, these findings are surprising and provoking. Although reciprocity is based partly on consequences and partly on intentions, it is highly role dependent how these two reciprocity concerns matter. Trustors seem to consider trust as a valuable investment opportunity but are not strongly affected by its efficiency. What trustees mainly match by reciprocating are the costs of trustors by, on average, reacting proportionally to $x$. What they do not try to achieve, however, is to linearly relate the consequences of trust (i.e., $mx$)

to the consequences of reciprocity (i.e., $ny$).

To allow such findings, we employed a rather complex experimental design, confronting participants with several choice tasks. Whereas $X$ participants had to consider different $m$, $n$ constellations, $Y$ participants were aware of the $m$, $n$ constellations but did not yet know to which choice $x$ they finally had to react. This somewhat unusual design was employed to balance the complexity of the choice task of both roles $X$ and $Y$. Game theoretically, this does not matter, but emotionally it may have rendered our experimental scenario a rather "cold" one (for a discussion of "hot" play and "cold" strategy method, see Brandts and Charness, 2011).

The discussion of "hot" versus "cold" play so far is mainly restricted to "one off" experiments. The relevance of this distinction for experienced behavior is questionable and probably rather minor. In our view, a "cold" environment provides a convenient first testbed and, of course, much more informative choice data. One can later test whether main effects emerging in an environment of this kind will survive when it gets "hot", where additionally, one should also explore experience effects. In institutional design one may, for instance, be less concerned about purely "hot" effects since, by becoming more experienced, participants might become less emotional.

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# A Instructions (Translation from German)

You have been recruited to take part in a computer administered experiment. You receive a 2.5 Euros show up fee for taking part in the experiment. Please read the following instructions carefully.

Prior to the experiment, you will have to answer a few questions testing your comprehension of these instructions. Please note that the instructions are written in male gender only for convenience, and refer to both genders equally.

Please do not talk and please raise your hand if there are any specific questions during the experiment. An experimenter will come to assist you. Please remain silent and switch off your mobile phone. If you violate these rules we will have to exclude you from the experiment and all payments.

You will be either a Participant X or a Participant Y. Participants will be randomly assigned to role X or to role Y and will keep that role for the rest of the experiment. The experiment extends over 4 rounds. New pairs of X and Y participants are randomly formed before each round. Each participant X will not be paired with the same participant Y more than once in the 4 rounds of the experiment. Participants will not be informed by us, during or after the experiment, whom they are matched with. In each round the participants with a given role face the same decision task. However, the decision tasks of Participants X and Y differ as will be detailed below.

During the experiment you are going to make your choices by using experimental currency units (ECU). All participants are given an initial endowment of 9 ECU. At the end of the experiment, ECU will be converted into Euros at an exchange rate of 2 ECU = 1 Euro. As an example, if you have 16 ECU, this is equivalent to 8 Euros. Only one of the four rounds is randomly drawn for payment at the end of the experiment.

The decisions that you make during the experiment will affect your final payoff.

## Interaction Structure

### PARTICIPANT X

Participant X chooses how much to send to Participant Y. Participant X can send only one of the following amounts: 0, 3, 6, 9 ECU.

The amount that Participant X sends to Participant Y will then be multiplied by a multiplier **m**. The multiplier m is either 4/3 or 3 or "?". In case of m=?, the multiplier **m** is either 4/3 or 3 with equal likelihood.

The following table shows the ECU received by Participant Y for each amount of ECU sent by Participant X and for each value of m. In case of m=?, both payoffs of Y are equally probable.

| ECU | | **Y receives** | | |
|---|---|---|---|---|
| | | **m=4/3** | **m=3** | **m=?** |
| **X sends** | **0** | 0 | 0 | 0 |
| | **3** | 4 | 9 | 4 or 9 |
| | **6** | 8 | 18 | 8 or 18 |
| | **9** | 12 | 27 | 12 or 27 |

**PARTICIPANT Y**

Participant Y can react to what Participant X has sent her/him and chooses how much to send to Participant X. Participant Y can send only the following amounts: 0, 3, 6, 9 ECU.

The amount that Participant Y sends to Participant X will then be multiplied by a multiplier **n**. The multiplier **n** is *3 (4/3; ?, which means that the multiplier m is either 4/3 or 3 with equal likelihood).* [`Only the multiplier relevant for the implemented treatment is shown to participants`].

The following table shows the ECU received by Participant X for each amount of ECU sent by Participant.

| *ECU* | | ***X receives*** | | |
|---|---|---|---|---|
| | | ***n=4/3*** | ***n=3*** | ***n=?*** |
| | ***0*** | *0* | *0* | *0* |
| ***Y sends*** | ***3*** | *4* | *9* | *4 or 9* |
| | ***6*** | *8* | *18* | *8 or 18* |
| | ***9*** | *12* | *27* | *12 or 27* |

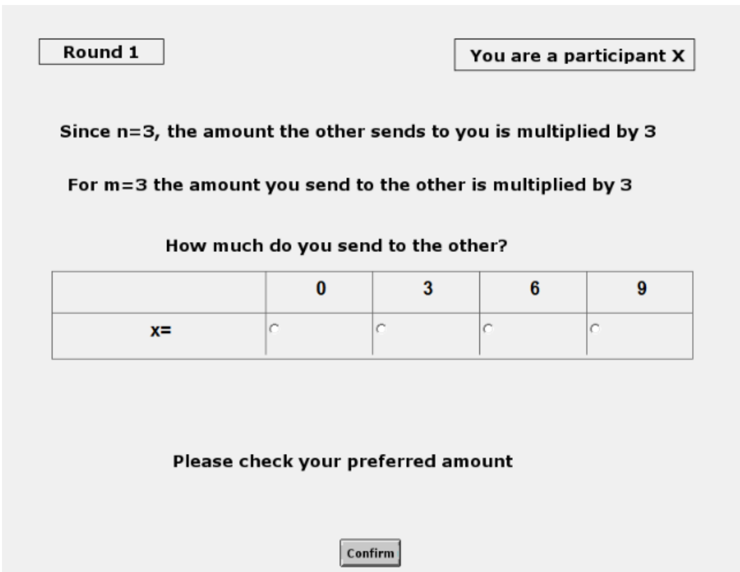
[`Only the column relevant for the implemented treatment is shown to participants`]

## Decision Tasks

**PARTICIPANT X**

Participant X will be asked to report the amount he/she intends to send to Participant Y by filling up some tables similar to the one in Figure 1. The amount sent can be equal to 0, 3, 6, or 9 ECU

Participant X has to decide before knowing the actual value of her/his multiplier **m**. This implies that for each possible value of **m**, he/she has to submit a choice. The choices are submitted on three distinct screens that differ only for the value of **m**.



[reproduction of the screenshot of condition n=3 and m=3]
Figure 1: Participant X's screen

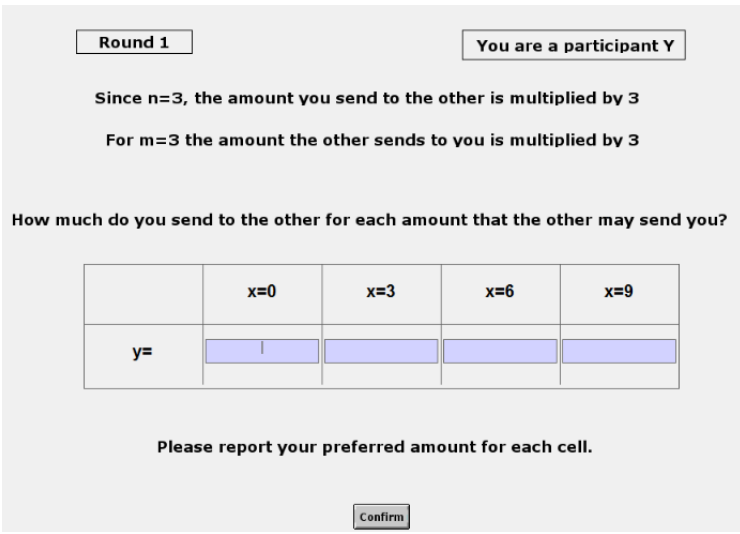
Figure 1 refers to m=3, however similar decisions have to be made by X for the other possible m values, m=4/3 and m=?.

Note that Participant X must choose without being able to condition on the choice y by Participant Y whereas Participant Y can react differently to different decisions x by Participant X.

**PARTICIPANT Y**

Participant Y will be asked to report the amount he/she intends to send to Participant X by filling up some tables similar to the one in Figure 2. The amount sent can be equal to 0, 3, 6, or 9 ECU

Participant Y has to decide before knowing the actual choice of the other, and the actual value of the multiplier **m** of the other. This implies that for each possible **m**, he/she has to submit four choices, one for each potential choice of the other. The choices are submitted on three distinct screens that differ only for the value of **m**.




[reproduction of the screenshot of condition n=3 and m=3]
Figure 2: Participant Y's screen

Figure 2 refers to m=3, however similar decision tables have to be filled out for the other possible m values, m=4/3 and m=?.

## Round Payoffs

Once Participants X and Participants Y have made their choices, payoffs in the round are computed.

The payoff of Participant X is defined by subtracting from the initial endowment of 9 Euros the amount x sent to Participant Y and by adding the amount y received from Participant Y multiplied by the multiplier **n** (ny). Thus, the payoff of Participant X is equal to 9-x+ny ECU.

The payoff of Participant Y is defined by subtracting from the initial endowment of 9 Euros the amount y sent to Participant X and by adding the amount x received from Participant X multiplied by the multiplier **m** (mx).Thus, the payoff of Participant X is equal to 9-y+mx ECU.

In more details, the following procedure defines the round payoffs

- The multiplier **m** is randomly chosen for each pair of participants
- The choices made for the chosen multiplier **m** are employed to compute the payoffs of the participants as specified above.

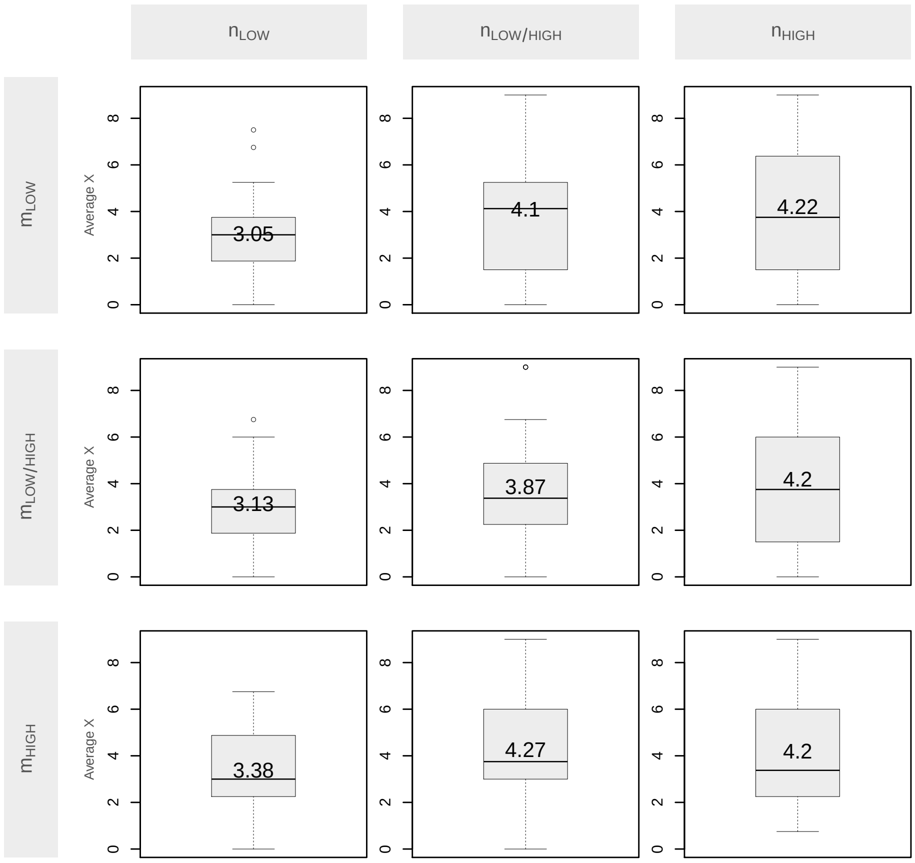
At the end of each round, both participants are informed about the randomly drawn multiplier **m**, about the choices made by the other participant, and about their own payoff.

## Final Payments

The experiment is composed of 4 independent rounds, but only one of the four rounds is randomly chosen for payment. The payoff in the randomly drawn round is going to define the final payment in the experiment. The amount of ECU obtained in the round are exchanged with Euros at the conversion rate of 2 ECU = 1 Euro. As an example, if in the randomly drawn round the payoff is of 9 ECU, the final payment in the experiment is equal to 4.5 Euros (obtained as 9/2). The show-up fee of 2.5 Euros and the final payment in the experiment will be paid out privately in cash at the end of the experiment.

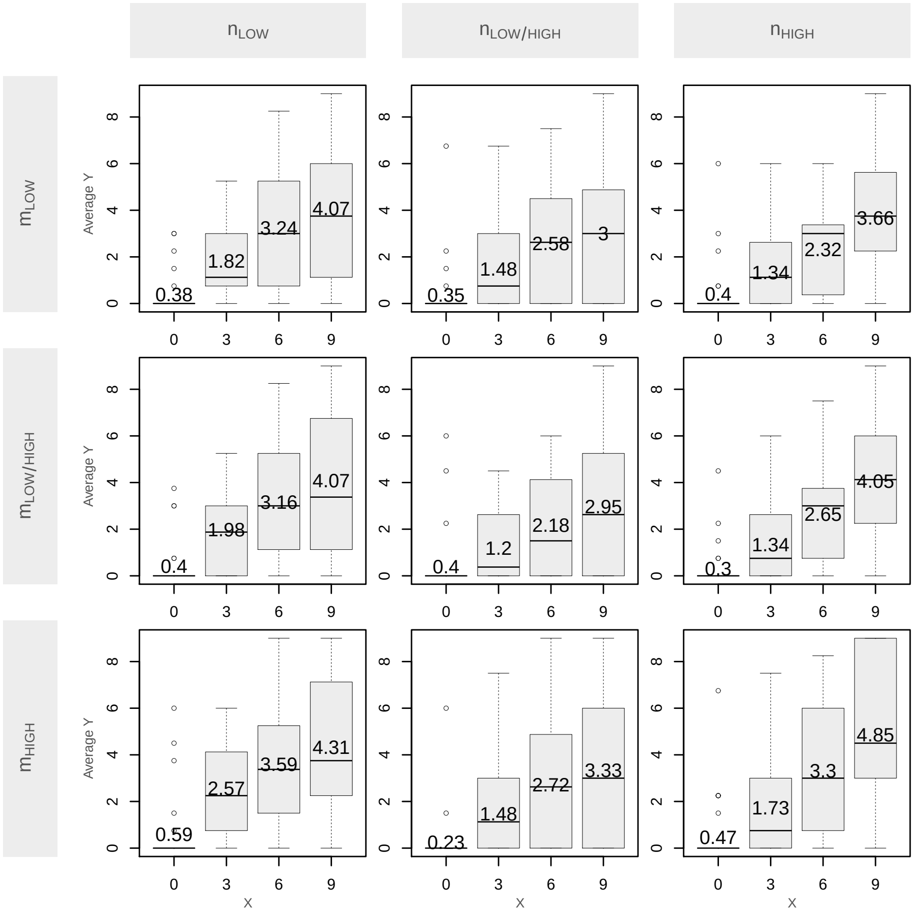
# B Figures

Figure 1: Choices of X Participants (average at the individual level)*




*Figures within diagrams represent mean values.

Figure 2: Choices of Y Participants (average at the individual level)*




*Figures within diagrams represent mean values.

# C Tables

Table 1: Determinants of Reciprocity (GLLAMM: logistic)

| Reciprocity∼ | Coeff (Std. Err.) |
|---|---|
| *(Intercept)* | 1.816 (0.436)$^{***}$ |
| $n_{LOW}$ | 0.622 (0.606) |
| $n_{LOW/HIGH}$ | 0.044 (0.592) |
| $m_{HIGH}$ | 0.537 (0.105)$^{***}$ |
| $m_{LOW/HIGH}$ | 0.000 (0.104) |
| $x_6$ | -3.071 (0.125)$^{***}$ |
| $x_9$ | -3.749 (0.142)$^{***}$ |
| *Period* | -0.209 (0.038)$^{***}$ |
| $W$-$st1$ | 0.90 |
| $W$-$st2$ | 26.21$^{***}$ |
| $W$-$st3$ | 24.24$^{***}$ |
| Log likelihood | -1854.6 |
| No. of level 1 (2) [3] units: | 4416 (92) [24] |
| Level 2 random effects variance$^{\diamond}$ | 3.338 (0.649) |
| Level 3 random effects variance$^{\diamond\diamond}$ | 0.513 (0.439) |

$W$-$st1$ : Wald statistic for the hypothesis that $n_{LOW} = n_{LOW/HIGH}$
$W$-$st2$ : Wald statistic for the hypothesis that $m_{HIGH} = m_{LOW/HIGH}$
$W$-$st3$ : Wald statistic for the hypothesis that $x_6 = x_9$
$^{\diamond}$subjects; $^{\diamond\diamond}$matching groups
$^{***}$(0.001);$^{**}$ (0.01);$^{*}$ (0.05); $^{\circ}$(0.1); significance level

Table 2: Profitability of Trust (GLLAMM: linear)

| | Coeff (Std. Err.) | |
|---|---|---|
| Rate of return (%)∼ | Reciprocators ($y > 0$) | All ($y \geq 0$) |
| *(Intercept)* | 226.622 (18.952)$^{***}$ | 102.500 (22.417)$^{***}$ |
| $n_{LOW}$ | -146.437 (21.709)$^{***}$ | -68.921 (27.739)$^{*}$ |
| $n_{LOW/HIGH}$ | -65.454 (21.649)$^{**}$ | -61.994 (27.390)$^{*}$ |
| $m_{HIGH}$ | 31.647 (9.452)$^{**}$ | 25.885 (9.663)$^{**}$ |
| $m_{LOW/HIGH}$ | 9.839 (9.618) | -0.372 (9.729) |
| $x_6$ | -93.230 (11.025)$^{***}$ | -27.194 (10.298)$^{**}$ |
| $x_9$ | -125.670 (15.773)$^{***}$ | -26.955 (13.461)$^{*}$ |
| *Period* | -9.712 (3.656)$^{**}$ | -23.001 (3.644)$^{***}$ |
| $W$-$st1$ | 12.85$^{***}$ | 0.06 |
| $W$-$st2$ | 5.18$^{*}$ | 7.45$^{**}$(0.01) |
| $W$-$st3$ | 4.72$^{*}$ | 0.00 |
| Log likelihood | -2615.8 | -5028.5 |
| No. of level 1 (2) [3] units: | 443 (78) [24] | 812 (89) [24] |
| Level 2 random effects variance$^{\diamond}$ | 2106.9 | 1334.0 |
| Level 3 random effects variance$^{\diamond\diamond}$ | 729.8 | 2263.4 |

$W$-$st1$ : Wald statistic for the hypothesis that $n_{LOW} = n_{LOW/HIGH}$
$W$-$st2$ : Wald statistic for the hypothesis that $m_{HIGH} = m_{LOW/HIGH}$
$W$-$st3$ : Wald statistic for the hypothesis that $x_6 = x_9$
$^{\diamond}$subjects; $^{\diamond\diamond}$matching groups
$^{***}$(0.001);$^{**}$ (0.01);$^{*}$ (0.05); $^{\circ}$(0.1); significance level