Trust and Reciprocity in the Investment Game with Indirect Reward

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Abstract

Experimental studies have shown that trust and reciprocity are effective in increasing efficiency when complete contracting is infeasible. One example is the study by Berg et al. (1995) of the investment game. In this game the person who receives the investment is the one who may reward the investor. This is a direct reward game. Similar to Dufwenberg et al.

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(2000) it is investigated to what extent trust and reward are still observable when reward is indirect; i.e., when the investor may only be rewarded by a third person who did not receive his investment. Furthermore we investigate the influence of social comparison (information about other players' investments). Our main finding is that mainly indirect reward reduces significantly mutual cooperation.

1. Introduction

Cooperation often means to invest individually in group success without being sure of one's own share of the group reward. For instance, this may be the case in joint ventures, e.g. R & D-joerg et al. observed that many participants in a laboratory

experiment did invest positive amounts, which can be interpreted as trust. In many cases trust was honored by second movers via positive rewards, which may be interpreted as reciprocity. Reciprocity is usually understood as "punishing someone who has treated me badly" or as "rewarding someone who has treated me well". In case of the investment game reciprocal behavior implies a positive correlation between investments and rewards. That behavior is to some degree guided by trust and reciprocity was shown in several other studies as well (see e.g. Fahr and Irlenbusch (1998), Fehr and Gächter (forthcoming), Güth, Klose, Königstein and Schwalbach (1998)). For a theoretical discussion of motives like fairness and reciprocity see e.g. Bolton and Ockenfels (2000), Fehr and Schmidt (1999) and Rabin (1993).

In this paper we present an experiment in which we investigate trust and reciprocity in investment games with direct reward versus indirect reward. In the direct reward investment game (like the game by Berg et al.) a person X_1 sends an investment to person Y_1 and may be rewarded by person Y_1. In the indirect reward game person X_1 sends an investment to Y_1, but may not be rewarded by Y_1 but by a third person Y_2. Such a game was studied experimentally by Dufwenberg, Gneezy, Güth, and van Damme (2000) who also discuss the relevance of indirect reciprocity. Person Y_2 observes X_1's investment. So, the third person, Y_2, might reciprocally reward X_1's trust. However, we expect that trust and reciprocity are less powerful when reward is indirect rather than direct. This is our main hypothesis. We furthermore investigate in games with direct reward whether the second mover's reward choice depends only on the investment he received himself or whether it is also influenced by information about investments received by other second movers. We refer to this information treatment as 'social comparison'.

We find clear support for our main hypothesis. Investment and reward are strongly reduced when indirect reward is compared with direct reward. This systematic effect cannot be explained by rationality theory nor by a model that combines rationality and noisy play. It sheds some light on the effectiveness of the 'trust–reward' mechanism. Namely, our results suggest that the considerations underlying this mechanism do not only regard the payoff distribution but also regard procedure by which the distribution is achieved (see on the psychological concept of procedural fairness, for instance Tyler, T., (1994), Rutte, C., and Messick, D., (1995)). With respect to social comparison we find that it increases investment and reward. However, these effects are not statistically significant.

The next section explains the experimental games in detail: the investment game with direct reward and full information, the investment game with direct reward and partial information, and the investment game with indirect reward and full information. Section 3 provides a theoretical discussion. Thereafter we describe experimental procedures (section 4). In section 5 we provide the data analysis and in section 6 we discuss our findings.

2. Experimental Games

2.1. Direct Reward Full Information (DFI)

The investment game with **D**irect reward and **F**ull **I**nformation (DFI) is displayed in figure 1. Two players X_1 and X_2 choose investments $x_{1,}$ respectively x_2, which are send to two other players Y_1 and Y_2. Investment x_i has to satisfy :

$$x_i \in \{0, 1, ...10\}, \quad i = 1, 2. \tag{2.1}$$

Player Y_1 (Y_2) receives $3x_1$ ($3x_2$); thus, the invested amounts are tripled. Both players Y_i, $i = 1, 2$, are informed about both investments x_1 and x_2 (**full information**). The disclosure rule is known by all players from the start. Then player

Y_1 (Y_2) chooses reward y_1 (y_2), which is sent to player X_1 (X_2). Reward y_i has to satisfy :

$$y_i \in \{0, 1, ..., 3x_i + 10\}, \quad i = 1, 2. \tag{2.2}$$

After the choices y_i player X_i is informed about y_i, and the game ends. The payoffs are

$$\begin{aligned} \text{Player } X_i &: 10 - x_i + y_i \\ \text{Player } Y_i &: 10 + 3x_i - y_i \end{aligned}$$

for $i = 1, 2$

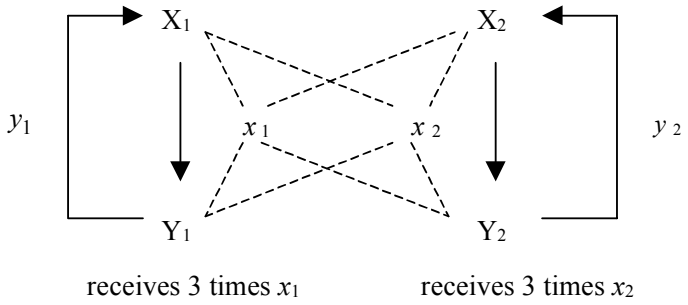

Figure 1 : Direct Reward Full Information (DFI)

Note that (2.2) implies that player Y_i may send back even more than the tripled investment. In the experiment this meant that we gave players Y_i an initial money amount of 10 units. It is the same amount each player X_i received. By this we guaranteed that players Y_i might earn something even if investment is zero. Furthermore, it is advantageous in the indirect reward game (see below), since it allows player Y_i to reward player X_j even if the investment of player X_i is zero.

In DFI exchange takes place within pairs (X_1 with Y_1 and X_2 with Y_2) but not between pairs. Interaction between pairs is purely informational. Moreover, the information is strategically irrelevant in view of economic rationality (see below). Information flows are visualized by the dotted curves in Figure 1. In DFI treatment, all players, X, X_2, Y_1 and Y_2 are informed about both, x_1 and x_2.

2.2. Direct Reward Partial Information (DPI)

The investment game with **D**irect reward and **P**artial **I**nformation (DPI) is displayed in figure 2. It is the investment game studied by Berg et al. It is equivalent to DFI except for the information players Y_i, $i = 1, 2$, receive about the chosen investments. Namely, in DPI player Y_i is informed only about x_i, but not about x_j ($i = 1, 2$, $i \neq j$). Figure 2 presents two pairs playing DPI in order to stress the similarity between the games we investigate. The dotted curves represent the information flows (i.e. Y_i is only informed about x_i). In the experiment subjects were told they were subdivided into groups of four and would be matched in pairs. Even though in DPI the subdivision into groups of four is meaningless, we introduced the experiment in this way in order to make experimental procedures between treatments as similar as possible.

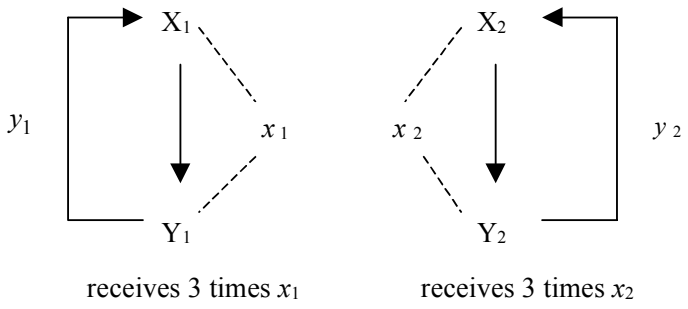

Figure 2 : Direct Reward Partial Information (DPI)

2.3. Indirect Reward Full Information (IFI)

The investment game with **I**ndirect reward and **F**ull **I**nformation (IFI) is displayed in figure 3. It is equivalent to DFI except for the way rewards are handled. Namely, in IFI the reward y_i chosen by player Y_i is not transferred to player X_i, but to player X_j ($i = 1, 2$, $i \neq j$). Player X_i is informed about y_j, and the game

ends. Thus, the payoffs are

$$\begin{aligned} \text{Player } X_i &: 10 - x_i + y_j \\ \text{Player } Y_i &: 10 + 3x_i - y_i \end{aligned}$$

for $i = 1, 2$, $i \neq j$.

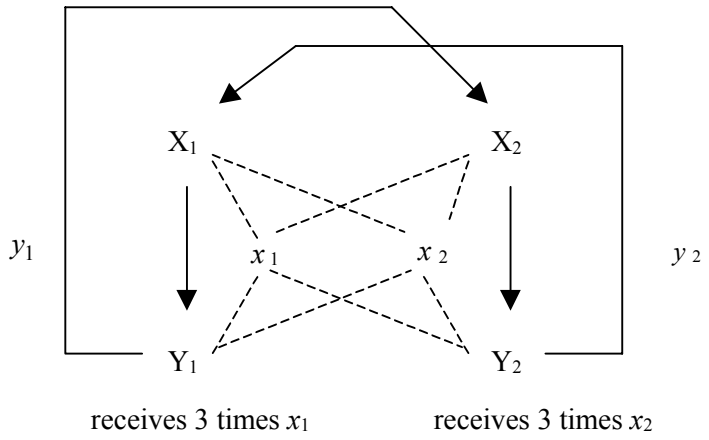

Figure 3 : Indirect Reward Full Information (IFI)

So, in IFI a player X_i cannot be rewarded by the person who received his investment, but by another person who may or may not have received an investment by player X_j (**indirect reward**).

In IFI treatment, all players, X_1, X_2, Y_1 and Y_2 are informed about both, x_1 and x_2. These information flows are visualized by the dotted curves in Figure 3.

3. Economic Rationality versus Trust and Reciprocity

The game theoretic analysis of all three investment games is trivial: Pure income maximization calls for $y_i^* = 0$ independent of the level of investment and of the

game type. Consequently, investment should be zero as well ($x_i^* = 0$). The same holds if one assumes maximization of a more general utility function, as long as one relies on individualistic preferences and non–satiation in money.

But previous experiments on DPI–games showed positive rewards (see e.g. Berg and al. (1995) and Dufwenberg, and al. (2000); in both studies 80% of the subjects reward the trustors). In line with other authors we refer to it as 'reciprocity'. More specifically, reciprocity proposes a positive relationship between the reward person X receives from person Y and the investment which X sent to Y beforehand. X's investment may be seen as a trustful move: X trusts in Y's reciprocity. We call this the 'Trust–Reciprocity' mechanism.

In our study we investigate whether trust and reciprocity are effective even with indirect reward. We expect that some participants will invest and be rewarded even in IFI, but that on average investments and rewards will be lower than in DFI. Indirect reward makes trust and reciprocity less powerful. While this might be intuitively convincing, it is not backed by rationality. Even if one allows for noisy play, thereby justifying positive investments and rewards, rationality does not lead to a differential prediction between games.

DPI is a control treatment, which allows for comparison with other studies. Furthermore comparing behavior between DPI and DFI allows to assess the impact of 'social comparison'. The only difference between the two games is whether player Y_i is informed about both investments or only about the investment he received himself. So, in DFI he can compare x_i and x_j (social comparison) but in DPI he can not. Therefore we will attribute any difference in behavior between the two games to the impact of social comparison.

4. Experimental Procedures

The experiment took place as a classroom experiment with 94 student participants (undergraduates in economics and business administration attending the

same course). Participants were seated in a large lecture hall with sufficient space between them such that they could not observe each others' decisions. Communication between participants was forbidden. After being seated they received written instructions (see Appendix A). Instructions were written in English rather than German to facilitate replication in another country. Each subject participated only in a single game and received only the instructions for that game. Clarifying questions were asked and answered privately. Then we asked the participants to fill out a control questionnaire (Appendix B) in order to check for understanding. Only after all questions had been correctly answered the experiment continued. Then X–decision forms were distributed (see Appendix C) to X–participants. After investment decisions had been made the forms were collected, and the investment decisions were entered into the Y-decision forms (Appendix D) according to the rules of the respective game (full information versus partial information). The Y-decision forms were then distributed to Y–participants and collected after they had made the reward decisions. Players X_i were informed about the reward they received (y_i in DFI and DPI, y_j in IFI).

Finally, participants had to answer a simple post-experimental questionnaire (see Appendix E). The questionnaire mainly asks how one would have behaved in the respective other role and how one rated one's partners on a bipolar scale. These data were collected as an additional source of information, but we will not use them here.

Monetary earnings were 15 DM on average (about 8 US$ at the time of the experiment).

5. Empirical Analysis

Individual decision observed in DFI, DPI and IFI are respectively reported in Table 1, 2 and 3 (Appendix F). In this section, we present our main finding (result

1) and some additional ones (results 2 to 4). A discussion and some intuitive justification of the observed effects will be provided in the next section.

Result 1: Indirect reward decreases investment: $x_i(IFI) < x_i(DFI)$.

Figures 4 shows the frequency distributions of investments for each treatment. Figure 5 contains the respective cumulative frequency distributions (*cdf*'s). Comparing the *cdf*'s shows that the *cdf* for DFI first order stochastically dominates that of IFI. Mean investments are 1.9 in IFI compared to 6.9 in DFI. A Mann-Whithney U-test (MWU) clearly rejects the Null-Hypothesis in favor of result 1 ($p = 0.002$, one–tailed, exact test, $N = 36$).

Result 2: Social comparison increases investment: $x_i(DFI) > x_i(DPI)$.

According to figure 5 the line representing the *cdf* of DPI lies almost everywhere above that of DFI. In both treatments about 80% of players X_i choose positive investment. Mean investment in treatment DFI is 6.1 compared to 4.8 in DPI (see table 4). However, since the variances are large, the difference is not statistically significant according to a Mann-Whithney U-test (MWU: $p = 0.266$, one–tailed, exact test, $N = 29$). Further non–parametric tests regarding other distributional changes (e.g. the Kolmogorov-Smirnov two sample test as well as the Moses test) report insignificance as well.

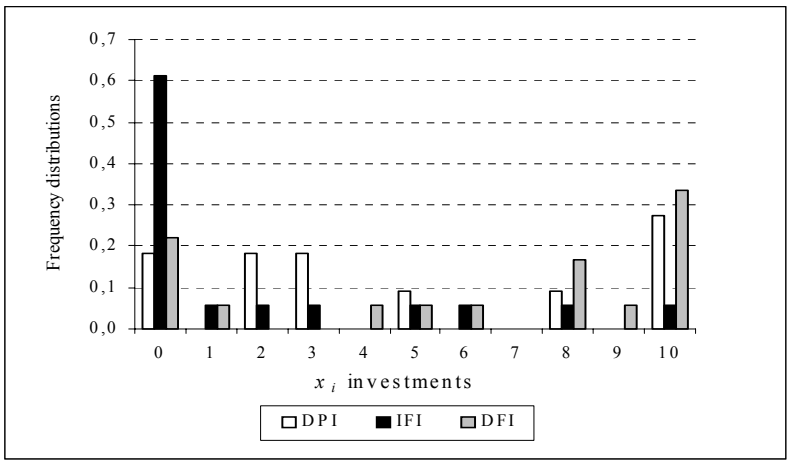

Figure 4: Frequency distributions of x_i-investments for DPI, DFI and IFI treatment.

From results 1 and 2 one can conclude that indirect reward affects investment behavior more strongly than social comparison. I.e., starting from a situation where both, social comparison and direct reward are present (treatment DFI), removing social comparison (DPI) reduces investment, and introducing indirect reward (IFI) reduces investment as well. But, the decrease due to indirect reward is stronger than the decrease due to removing social comparison. This is supported by the finding that investment is significantly smaller in DPI compared to IFI (MWU: $p = 0.013$, one–tailed, exact test, $N = 29$).

Result 3: Many trustees do not reward at all; i.e., they choose $y_i = 0$.

Table 4 reports that on average about 66% of all trustees chose zero reward ($y_i = 0$). The proportion varies between treatments. It is 45% in DPI, 61% in DFI and as high as 83% in IFI. Compared to other experiments on investment games these numbers are quite high. For instance, Berg, Dickhaut and McCabe find a zero reward proportion of 25% in their no history treatment[1]. Including reward equals to 1 let this number increase to 50% which is comparable to the reward behavior observed in our DPI treatment (54%). Others report proportions between 24% and 33% (Fahr and Irlenbusch (1998), Dufwenberg et al. (2000), Willinger et al. (2000)). So, even in our control treatment DPI featuring the game of Berg et al. rewards of zero occurred more often than in these other studies. Also the proportion of zero investments ($x_i = 0$) is high. It is 35% on average and 18% in DPI compared to the 6% and 11% respectively reported in Berg et al.'s no history and history[2] treatments.

[1] This situation corresponds to the basic trust game replicated by our $DPI-$treatment.

[2] In the history treatment, Berg, and al. provide information about trust and reward behavior observed in previous sessions (of the no history treatment) to their subjects.

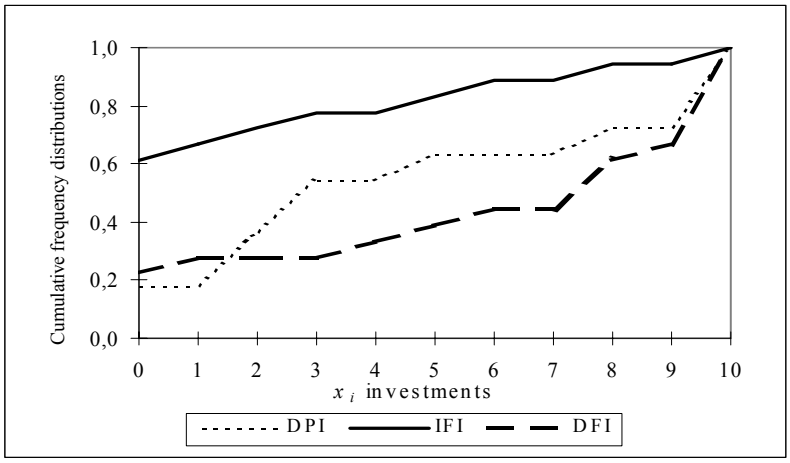

Figure 5: Cumulative frequency distributions of x_i-investments for DPI, DFI and IFI treatment.

We can only speculate about the reasons for these differences. One reason might be that all our subjects were students of economics and business administration, who might be more focussed one making money than average persons (cf. Frank, Gilovich and Regan (1993)). Bolle (1998) found also a high proportion of no trust (24%) for students of economics (note that in his study trustor had only the possibility to trust fully, i.e. investment was either equal to player X total endowment or nil). While the large proportions of zero investments and zero rewards are somewhat surprising, these data do not question our main conclusions regarding comparisons between treatments. The probability of being rewarded is lower with indirect reward (IFI) than with direct reward (DFI and DPI). This is in line with what we proposed above.[3]

Result 4: We find reciprocity when reward is direct. Reward is higher when social comparison is favorable.

[3]Chi-Square tests upon these differences fail. To support this point statistically, we would have to collect more data.

Treatments	DFI	DPI	IFI
$N - pairs\ (X_i, Y_i)$	18	11	18
$x_i - medians$	8	3	0
$x_i - means$	6.1	4.8	1.9
$x_i - Std.\ dev.$	17.11	16	10.06
$y_i - means$	4.3	5.3	.8
$y_i - Std.\ dev$	6.6	6.8	2.4
proportion of $x_i = 10$	.33	.27	.06
proportion of $x_i = 0$	.22	.18	.61
proportion of $y_i = 0$	.61	.45	.83
proportion of $(y_i \geqslant x_i > 0)$	.50	.67	.29
Return on investment[4]	.71	1.09	.43

Table 4: Main statistical results

Berg, et al., (1995), Dufwenberg et al., (2000), Willinger et al. (2000) found evidence for reciprocal behavior in the sense that reward was positively correlated with investment. Nevertheless, none of these studies show significant correlation between donation and reward behavior. To see whether this is supported by our data as well we ran a regression analysis in which the dependent variable y_i was coded into $\{0, 1\}$ to estimate the probability of positive reward[5] $prob(y_i > 0)$. We estimated the following logit regression model:

$$prob(y_i > 0) = \frac{1}{1 + e^{-z_i}}$$

[4]For all teatments, the return of investment corresponds to $\sum y_i / \sum x_i$.There is no difference between the direct (DPI and DFI) and indirect (IFI) treatments due to separate addition in numerator and denominator.

[5]The dependent variable y_i is 1 if $y_i > 0$ and it is 0 otherwise.

with

$$\begin{aligned} z_i = \alpha \quad & +\beta_1 x_{i,DFI} + \gamma_1 (x_{i,DFI} - x_{j,DFI}) \\ & +\beta_2 x_{i,IFI} + \gamma_2 (x_{j,IFI} - x_{i,IFI}) \\ & +\beta_3 x_{i,DPI} \end{aligned}$$

$i = 1, 2$. The variable $x_{i,DPI}$ represents a dummy variable for the investment of player X_i in treatment DPI. It is defined as

$$x_{i,DPI} = \begin{cases} x_i(DPI) & \text{, if player } X_i \text{ belongs to treatment group } DPI \\ 0 & \text{, otherwise.} \end{cases}$$

All other variables are defined analogously. $\alpha, \beta_{1,}\beta_{2,}\beta_{3,}\gamma_1$ and γ_2 are parameters to be estimated.

Table 5 reports estimation results. Overall the estimated model is insignificant. This might be due to the large proportion of choices $x_i = 0$. Nevertheless we shortly discuss the qualitative effects. The model captures at once the influences of different reward rules as well as social comparison for all three treatments. The parameters $\beta_{1,}\beta_2$ and β_3 are positive. So, the investment which player Y_i receives has a positive influence on the probability of reward in all three treatments. Note that the influence is estimated separately for each treatment condition. It is significant for (DFI) and (DPI); i.e., with direct reward.[6] This is evidence for reciprocity. It replicates findings of other studies on direct reward games. The return on investment ($\sum y_i / \sum x_i$) is larger than 1 in DPI (see table 4). So, in this treatment on average it paid to invest a positive amount. But it did not pay in DFI and IFI. Thus, even though we find reciprocity, most reward decisions were unfair in the sense that an investor received less than his invested amount.

[6] In separate regressions for each treatment only the effect of $x_{i,DFI}$ is significant.

Variables		B.	S.E.	Sig.
$x_{i,DFI}$	β_1	.256	.129	.046
$x_{i,IFI}$	β_2	.230	.120	.055
$\beta_3 x_{i,DPI}$	β_3	.209	.209	.333
$(x_{i,DFI} - x_{j,DFI})$	γ_1	$-.004$	.120	.973
$(x_{j,IFI} - x_{i,IFI})$	γ_2	$-.016$	.215	.941
	α	-1.738	.584	.003
Log Likelihood		51.705		
N		47		

Table 5: Estimation results of our logit regression model.

The influence of social comparison is estimated separately for DFI and IFI. The coefficient γ_1 measures the influence of $(x_{i,DFI} - x_{j,DFI})$, which is the excess investment of player X_i compared to player X_j. The larger this difference the more favorably player X_i compares to X_j. If social comparison is important for behavior, this should increase player Y_i's inclination to reward X_i. Thus, γ_1 should be positive, which it actually is although not significantly. Similarly, γ_2 measures the influence of $(x_{j,IFI} - x_{i,IFI})$ which is the excess investment of player X_j compared to X_i. Remember that in treatment IFI it is player X_j who receives the reward of player Y_i. Thus, one should naturally expect that γ_2 is positive. But, it is negative and thus counterintuitive. However, it is insignificant.

6. Discussion

The main issue of our study was to investigate whether trustful investment and reciprocal reward occur even when reward is indirect rather than direct. More

specifically, we investigate whether the reward mode makes a difference. The answer to both questions is yes: even with indirect reward we observe positive investments and positive reward. But, compared to the direct reward treatment, investment and reward are substantially and (statistically) significantly reduced.

We think this result is an important qualification of the functioning of the 'trust–reciprocity' mechanism. Trust and reciprocity do not work at the same level for all reward modes. With direct reward the 'trust–reciprocity' mechanism can be regarded an implicit contract. The trustor chooses an investment and sends it to a person he trusts in. He may not only *hope* but *expect* to receive a reward, similar to someone who expects to be paid according to a contract that was agreed upon. If reciprocity is a social norm then the 'trust–reciprocity' mechanism has the character of an implicit contract.

This seems different with indirect reward. Here, investment has the character of gift giving or a donation. It can not be considered an implicit contract on an exchange between two parties, simply because the recipient of the donation is not the person who may reward. In principle, on might think of the four parties (players X_1, X_2, Y_1 and Y_2) forming an implicit contract. However, this would be a more complex contract than an two person one, and we consider it less natural. In any case these are just some informal and suggestive arguments regarding subjects' possible perceptions of the different reward modes. They are intended to give an intuitive justification for the effect we found, since this cannot be justified according to economic rationality. Thus our results shed new light on the $Titmus-$debate as discussed by Dufwenberg et al. (2000). Rationality does not lead to differential predictions regarding the treatment influence. It predicts zero investment and zero reward in all treatments. Even allowing for noise play does not help. With noise one may rationalize positive investment and reward levels; however, this does not account for a systematic differences across treatments.

We also found that investment and rewards are to some degree influenced by social comparison. Social comparison increases investment and it increases the reward of that investor who compares favorably to another investor. Both findings are preliminary, however. They need to be statistically validated by other studies.

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Appendix A

Instructions $-DFI-$

In the experiment you will interact anonymously in groups of four participants. You will not be informed about their identity nor will they be informed about yours.

Let us denote the four participants that interact in one group by X_1, X_2, Y_1, and Y_2. Each participant gets DM 10 as an initial endowment. You will interact according to the following rules

1. X_1 chooses x_1 with $0 \leq x_1 \leq 10.$; the amount $3 \cdot x_1$ will be sent to Y_1.

   X_2 chooses x_2 with $0 \leq x_2 \leq 10.$; the amount $3 \cdot x_2$ will be sent to Y_2.

2. All four participants are informed about both, x_1 and x_2.

3. Y_1 chooses y_1 with $0 \leq y_1 \leq 10 + 3x_1$; the amount y_1 will be sent to X_1.

   Y_2 chooses y_2 with $0 \leq y_2 \leq 10 + 3x_2$; the amount y_2 will be sent to X_2.

This ends the interaction.

Monetary earnings are calculated as follows

- $10 - x_1 + y_1$ for X_1
- $10 + 3x_1 - y_1$ for Y_1
- $10 - x_2 + y_2$ for X_2
- $10 + 3x_2 - y_2$ for Y_2

Please, raise your hand if you have questions concerning these rules. We will try to clarify them privately.

Instructions $-DPI-$

In the experiment you will interact anonymously in groups of four participants. You will not be informed about their identity nor will they be informed about yours.

Let us denote the four participants that interact in one group by X_1, X_2, Y_1, and Y_2. Each participant gets DM 10 as an initial endowment. You will interact according to the following rules

1. X_1 chooses x_1 with $0 \leq x_1 \leq 10.$; the amount $3 \cdot x_1$ will be sent to Y_1.

   X_2 chooses x_2 with $0 \leq x_2 \leq 10.$; the amount $3 \cdot x_2$ will be sent to Y_2.

2. Only participant Y_1 is informed about x_1, Only participant Y_2 is informed about x_2.

3. Y_1 chooses y_1 with $0 \leq y_1 \leq 10 + 3x_1$; the amount y_1 will be sent to X_1.

   Y_2 chooses y_2 with $0 \leq y_2 \leq 10 + 3x_2$; the amount y_2 will be sent to X_2.

This ends the interaction.

Monetary earnings are calculated as follows

- $10 - x_1 + y_1$ for X_1
- $10 + 3x_1 - y_1$ for Y_1
- $10 - x_2 + y_2$ for X_2
- $10 + 3x_2 - y_2$ for Y_2

Please, raise your hand if you have questions concerning these rules. We will try to clarify them privately.

Instructions $-IFI-$

In the experiment you will interact anonymously in groups of four participants. You will not be informed about their identity nor will they be informed about yours.

Let us denote the four participants that interact in one group by X_1, X_2, Y_1, and Y_2. Each participant gets DM 10 as an initial endowment. You will interact according to the following rules

1. X_1 chooses x_1 with $0 \leq x_1 \leq 10$; the amount $3 \cdot x_1$ will be sent to Y_1.

   X_2 chooses x_2 with $0 \leq x_2 \leq 10$; the amount $3 \cdot x_2$ will be sent to Y_2.

2. All four participants are informed about both, x_1 and x_2.

3. Y_1 chooses y_1 with $0 \leq y_1 \leq 10 + 3x_1$; the amount y_1 will be sent to X_2.

   Y_2 chooses y_2 with.$0 \leq y_2 \leq 10 + 3x_2$; the amount y_2 will be sent to X_1.

This ends the interaction.

Monetary earnings are calculated as follows

- $10 - x_1 + y_2$ for X_1
- $10 + 3x_1 - y_1$ for Y_1
- $10 - x_2 + y_1$ for X_2
- $10 + 3x_2 - y_2$ for Y_2

Please, raise your hand if you have questions concerning these rules. We will try to clarify them privately.

Appendix B

Control Questions

Please, fill out this questionnaire completely.

To check whether you have understood the instructions we kindly ask you to derive the payoff consequences of some arbitrarily specified decisions, namely $x_1 = 7$, $x_2 = 3$, $y_1 = 5$, $y_2 = 9$.

How much does each of the four participants earn?

X_1 earns ☐

Y_1 earns ☐

X_2 earns ☐

Y_2 earns ☐

What is minimal/maximal amount of total earnings (by X_1, Y_1, X_2, and Y_2)?

All four participants together earn at least ☐

All four participants together can earn at most ☐

Appendix C

- **Player *X*-decision form in *DPI* treatment:**

1. You are X_1 and you get an initial endowment of 10 DM.

Please, choose x_1 with $0 \leq x_1 \leq 10$; $x_1 =$ ☐ (Please, fill in !)

2. The amount $3 \cdot x_1$ will be sent to Y_1.

And, only participant Y_1 is informed about x_1.

3. Y_1 sends you $y_1 =$ ☐ (Will be filled in by experimenter)

Your monetary earning is $10 - x_1 + y_1 =$ ☐ (Please, calculate yourself)

- **Player *X*-decision form in *DFI* treatment:**

1. You are X_1 and you get an initial endowment of 10 DM.

Please, choose x_1 with $0 \leq x_1 \leq 10$; $x_1 =$ ☐ (Please, fill in !)

2. The amount $3 \cdot x_1$ will be sent to Y_1

You have chosen $x_1 =$ ☐

X_2 has chosen $x_2 =$ ☐ } (will be filled by the experimenter)

3. Y_1 sends you $y_1 =$ ☐ (Will be filled in by experimenter)

Your monetary earning is $10 - x_1 + y_1 =$ ☐ (Please, calculate yourself)

- **Player *X*-decision form in *IFI* treatment.**

1. You are X_1 and you get an initial endowment of 10 DM.

Please, choose x_1 with $0 \leq x_1 \leq 10$; $x_1 =$ ☐ (Please, fill in !)

2. The amount $3 \cdot x_1$ will be sent to Y_1

You have chosen $x_1 =$ ☐

X_2 has´ chosen $x_2 =$ ☐ } (will be filled by the experimenter)

3. Y_2 sends you $y_2 =$ ☐ (Will be filled in by experimenter)

Your monetary earning is $10 - x_1 + y_2 =$ ☐ (Please, calculate yourself)

Appendix D

- **Player *Y*-decision form in *DPI* treatment.**

1. You are Y_1 and you get an initial endowment of 10 DM.

2. X_1 sends you $x_1 =$ ☐ (Will be filled in by experimenter)

Only you and participant Y_1 are informed about x_1.

You dispose of the amount $10 + 3x_1 =$ ☐ (Please, calculate yourself)

3. Please, choose y_1 with $0 \leq y_1 \leq 10 + 3x_1$ $\quad y_1 =$ $\square$ (Please, fill in !)

The amount y_1 will be sent to X_1.

Your monetary earning is $\quad 10 + 3x_1 - y_1 =$ $\square$ (Please, calculate yourself)

- **Player *Y*-decision form in *DPI* treatment.**

You are Y_1 and you get an initial endowment of 10 DM.

1. X_1 sends you $\quad x_1 =$ $\square$ (Will be filled in by experimenter)

You dispose of the amount $\quad 10 + 3x_1 =$ $\square$ (Please, calculate yourself)

2. X_1 has chosen $x_1 =$ $\square$
   X_2 has chosen $x_2 =$ $\square$
   } (will be filled by the experimenter)

3. Please, choose y_1 with $0 \leq y_1 \leq 10 + 3x_1$ $\quad y_1 =$ $\square$ (Please, fill in !)

The amount y_1 will be sent to X_1

Your monetary earning is $\quad 10 + 3x_1 - y_1 =$ $\square$ (Please, calculate yourself)

- **Player *Y*-decision form in *IFI* treatment.**

You are Y_1 and you get an initial endowment of 10 DM.

1. X_1 sends you $\quad x_1 =$ $\square$ (Will be filled in by experimenter)

You dispose of the amount $10 + 3x_1 =$ ☐ (Please, calculate yourself)

2. X_1 has chosen $x_1 =$ ☐
   X_2 has chosen $x_2 =$ ☐ (will be filled by the experimenter)

3. Please, choose y_1 with $0 \leq y_1 \leq 10 + 3x_1$ $y_1 =$ ☐ (Please, fill in !)

The amount y_1 will be sent to X_2

Your monetary earning is $10 + 3x_1 - y_1 =$ ☐ (Please, calculate yourself)

Appendix E

Postexperimental Questionnaire

Imagine that you are participant Y_2 in the previous experiment and that you observe values of x_1 and x_2 as shown in the left column of the following table (table 1). Please insert into the right column which decision y_2 you would choose in each respective case.

Values	My choice:
$x_1 = 0, \quad x_2 = 10$	$y_2 =$
$x_1 = 10, \; x_2 = 0$	$y_2 =$
$x_1 = 0, \quad x_2 = 0$	$y_2 =$
$x_1 = 5, \quad x_2 = 5$	$y_2 =$
$x_1 = 10, \; x_2 = 10$	$y_2 =$

(2) Now, imagine that you are participant X_1 and that you would observe values of x_2 as shown in the left column of table 2 (see below) before you have to choose x_1. Please insert into the right column which decision x_1 you would choose in each respective case.

Values	My choice:
$x_2 = 0$	$x_1 =$
$x_2 = 1$	$x_1 =$
$x_2 = 5$	$x_1 =$
$x_2 = 9$	$x_1 =$
$x_2 = 10$	$x_1 =$

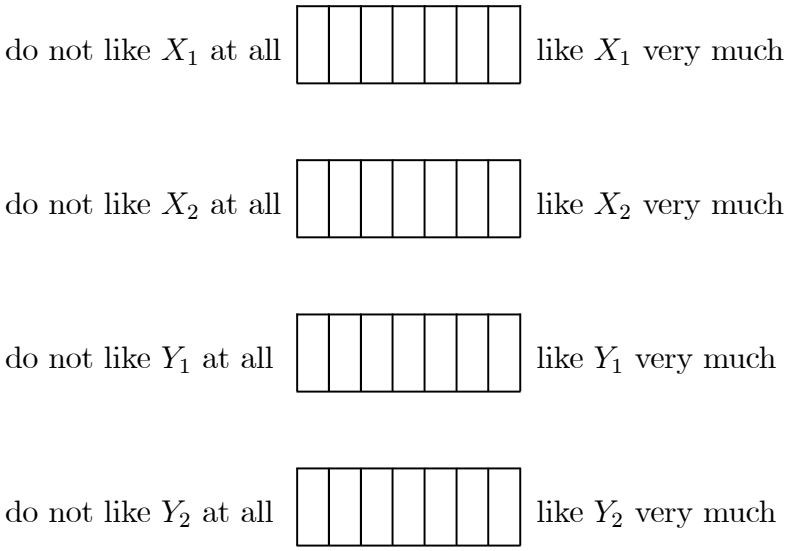
(3) Which x_1 would you have chosen as X_1 without information about x_2?

I would have chosen $x_1 =$ ☐

How would you have reacted as Y_1 given you had observed this choice of x_1?

As Y_1 I would have reacted to x_1 by choosing $y_1 =$ ☐

(4) Please, rank on the following scale how much you like or dislike the other three participants in your group.



Appendix F

Individual data per treatments

Table 1: Treatment with Direct reciprocity and Partial Information (DPI).

	Decisions	
DPI	X	Y
	3	0
	0	0
	8	16
	10	0
	0	0
	2	1
	3	9
	10	20
	5	8
	10	0
	2	4
Averages	4,8	5,3
Std. Dev.	3,8	6,8

Table 2: Treatment with Direct reciprocity and Full Information (DFI):

DFI	Decisions			
Groups	X_1	Y_1	X_2	Y_2
A	10	0	6	8
B	10	5	8	0
C	10	0	1	0
D	10	0	10	5
E	0	0	5	0
F	0	0	0	0
G	0	0	8	16
H	4	0	9	18
I	10	20	8	5
Averages	6	2.8	6.1	5.8
Std. Dev.	4.6	6.3	3.3	6.6

Table 3: Treatment with Indirect reciprocity and Full Information (IFI).

DFI	Decisions			
Groups	X_1	Y_1	X_2	Y_2
A	0	0	0	0
B	0	0	0	0
C	8	1	10	0
D	5	0	0	0
E	0	0	0	0
F	0	0	2	0
G	3	0	0	0
H	0	0	6	4
I	0	10	1	0
Averages	1,8	1,2	2,1	0,4
Std. Dev.	2,8	3,1	3,3	1,3