How do People Play a Repeated Trust Game? Experimental Evidence

Article · January 2004

Source: RePEc

5 authors, including:

Oliver Kirchkamp
Friedrich Schiller University Jena

Karl H. Schlag
University of Vienna

Eyal Winter
Hebrew University of Jerusalem

How do People Play a Repeated Trust Game? Experimental Evidence*

Fabian Bornhorst§ Andrea Ichino§ Karl Schlag§ Eyal Winter¶

February 15, 2004

In an experiment where trust can emerge as the result of a repeated interaction between players, we analyze the determinants of trust and trustworthiness. In a finitely repeated trust game where players have the opportunity to choose among different players we analyze to which extent previously observed playing behavior influences current decisions, controlling for confounding factors. The alternative motives we consider are directional learning, reinforcement learning, reciprocity and rationality. We carry out an econometric analysis of all decisions in the game, the choice, the amount transferred and the amount returned. We do not find evidence for any of the above types being dominant throughout the game. Rather, a mixture of several motives can be observed in the data.

Keywords: economic experiments, reciprocity, reinforcement learning, trust

JEL classification: C92, C73, D83

*We would like to thank the Research Council of the EUI for financing this study. Special thanks to Oliver Kirchkamp for his valuable contribution to the implementation of the experiment.

§Department of Economics, European University Institute, Villa San Paolo, Via della Piazzuola 43, I–50133 Florence (FI), Italy. Corresponding author: Karl.Schlag@iue.it

¶The Hebrew University of Jerusalem.

1 Introduction

The main purpose of this paper is to investigate trust and trustworthiness in a dynamic setting. We provide alternative behavioral motives for such behavior and test for them. We set up an experiment where trust can emerge as the result of an experimentally controlled interaction between individuals. Hence, we do not just study the general propensity of people to trust, but the motives that determine the evolution of trust in repeated interactions.

In the trust game a player is given 100 units of the experimental currency and is allowed to send some to a different player. During the transaction the transferred money is tripled. Finally the recipient is allowed to return part of the tripled transfer with no obligation how much to return to the sender. The money sent can be interpreted as an investment in a project, the increase during the transfer as the return on investment. The project is managed by the recipient who decides how to divide the surplus.

The way that game theory analyzes this trust game is to invoke backwards induction. For any given amount transferred the receiver is best off not returning anything. If the sender knows that he will never get back anything then he will not send anything. The outcome of this behavior is inefficient. This is reminiscent of the Prisoners' Dilemma where similarly an inefficient outcome is predicted by game theory. Any efficient outcome (equivalent here to maximizing the sum of the payoff of the sender and of the receiver) is characterized by the sender sending all 100 units (so the recipient receives 300 units). In our experiment we implement a repeated trust game where players have the opportunity to select a new opponent in each round. However, given that there is a finite number of rounds (6 in our experimental design), the backwards induction argument yields the same result. No player should ever send anything.

The rational prediction is mainly a theoretical benchmark as experiments show that subjects trust (send money) even when the trust game is played only once. Berg et al. (1995) find that subjects send slightly above 50 points and return slightly less to the sender and keep over 100 points for themselves. Among their subjects it was not rational, given the behavior of the recipients who on average return 47 points, to transfer anything. Burks et al. (2002) show that if two subjects get money to send to each other simultaneously (so both are sender and receiver) then subjects send again about 50 points but return much less, namely on average 24 points. Here it is even less rational to send money. Or in other words, subjects are even less trustworthy when they are both sender and receiver. Our design is related to Burks et al. (2002) as all subjects are senders and possibly also receivers. It is also related to Cochard et al. (2000) as we repeat the game a finite number of times. It is different as subjects can choose who to transfer money to.

As game theory is a poor predictor we test for other motives such as reinforcement, reciprocity and directional learning. We find that much of the observed behaviour in the game can be explained by the two motives reciprocity and reinforcement learning. Players reward opponents for their choices and their actions if their behavior was favorable. This is visible in the choice, the transfer made and the ratio returned. In addition, payoff oriented reinforcement is also observable. Players are more likely to repeat their actions if they have proven successful. Finally, the end game effect that can be observed both in the transfers made as in the ratio returned is indicative for some degree of rationality.

The reminder of the paper is organized as follows. Section 2 relates our experiment and the main findings to the existing literature. The experimental design is described in detail in section 3. Section 4 presents some general descriptive statistics on the game. Different behavioral motives are briefly discussed in section 5 before an econometric analysis is undertaken in section 6. The last section concludes and discusses directions for further research.

2 Related Literature

While sociologists mainly use attitudinal surveys on rather vaguely defined concepts of trust and trustworthiness, economists have recently been trying to be more precise on the issue and its conditioning factors. Glaeser et al. (2000) combine survey data and experimental data in an attempt to quantify the general perception of trust towards different groups surrounding an individual. There is evidence that trust and trustworthiness are related to the sociological background of people. For example, Buchan et al. (2000) find mixed support for the relationship between trust and social distance across countries. Fershtman and Gneezy (2001) find different levels of trust according to the opponents' origin. Croson and Buchan (1999), among others, identify gender as another determinant for trust, with women being trusted more than men. These results stress the importance of controlling for confounding factors when the emergence of trust in an economic interaction is analyzed.

Our experimental design combines several elements of previous studies. The basic trust game with one sender and one randomly matched receiver is known from the study by Berg et al. (1995). In this study pairs are matched with assigned roles as sender and receivers to play a one shot trust game. We follow the extension by Burks et al. (2002) that both players assume the role of a sender and receiver at the same time. However, contrary to this study, this was known to the players from the outset. We also combine the element of a repeated game as analyzed by Cochard et al. (2000), but also run a control treatment with one shot interactions. In addition, we add the element of a free choice, which to our knowledge has not been investigated in this context. Our results compare nicely to the existing literature as indicated by table 2.1.

Table 2.1: Results and related literature

study	N	avg. sent (0-100)	average returned	comment
Berg et al. (1995)	32·2	52	47^a	assigned roles as S or R, one shot
Burks et al. (2002)	22·2	65	85^a	assigned roles as S or R, one shot
Burks et al. (2002)	20·2	47	24^a	both are S and R, one shot
Cochard et al. (2000)	30·2	42	$39\%^b$	assigned roles, one shot
Cochard et al. (2000)	16·2	75	$56\%^b$	assigned roles, repeated
this study: repeated	110	76	$54\%^b$	both S and R, choice, repeated
this study: one shot	110	67	$38\%^b$	random assignment, one shot

Note: S and R mean sender and receiver respectively, ^{a} amount sent back, ^{b} ratio returned, conditional on having received a positive amount.

With experimental economics being a rather new field in economics, a thorough econometric analysis of experimental data is more the exception than the rule. Numerous studies content themselves with basic descriptive statistics and significance tests. The advantages of an econometric analysis is that confounding factors can be controlled for, which may prevent premature interpretation of results and that hypothesis can be singled out more clearly. However, to link the experimental setup to the correct econometric specification is not always an easy task. For example, with the exception of rather simple games the derivation of a likelihood function is intractable for more complicated settings. Hence the correspondence between the theoretical model and the empirical specification is not perfect. An exception in this context is the analysis by El-Gamal and Grether (1995) who are able to translate their (simple) game one–to–one into a likelihood function, estimate and identify the relevant parameters.

Identification is a particular problem in the context of behavioral economics. As Manski (2002) points out, several behavioral hypothesis might be observationally equivalent, making it impossible for the econometrician to distinguish between them. Our aim is to characterize typical behaviour at different stages of the game. We confine ourselves to find empirical support for or evidence against such hypothesis controlling for confounding factors.

3 Experimental design

The experiment was conducted using a computerized setup[1] in 4 sessions at the European University Institute near Florence, Italy. Participants were 110 Masters and PhD students from the faculties of Law (30%), History (15%), Social and Political Sciences (23%), and

[1] Using the Z-Tree software, Fischbacher (1999)

Economics (33%). Subjects originated from 15 different European countries. They were between 23 and 36 years old (average: 27.7), and 64% were male. Because it was the first time that experiments were conducted at this place, the subject pool was not experienced in playing games. For each of the four sessions a multiple of five subjects was recruited. The profit earned by participants ranged from Euro 24 to Euro 47.90, with an average of Euro 36.34 (s.d. 4.89), including a 5 Euro show up fee paid to each candidate. Each session (including a 15 min. questionnaire at the end) lasted for about 2 hours. Participants were recruited via email and were invited to sign up on a website. Each session took place in 2-3 computer labs with 10 to 25 computers each, located in different buildings of the university campus. Upon arrival to an assigned computer lab, subjects randomly drew a seat number and an account number. This account number was later used to identify subjects for payment, which was organized anonymously. Further to that, the computer labs were prepared using separators to individualize the environment. In each room, a professor of the university monitored the experiment in a discrete way.

Appendix A has further information about the experimental design. Section A.1 contains a transcript of the instructions. Note that at no point in time subjects were deceived. Subjects could choose how often (max 3 times) they wanted to read through the instructions on the screen. They also had a hard copy of the instructions next to their machines. The instructions were followed by a short quiz of three questions covering the crucial aspects of the game (see appendix A.4). We conclude that all subjects understood the game very well before playing. No major clarification questions were asked. After reading through the instructions subjects were asked to enter information about their age, gender, nationality, and the number of siblings. To increase anonymity, the age displayed to fellow players was modified by adding a random number. This was also mentioned in the instructions further to a general anonymity and privacy statement which can be found in section A.2.

Each session consisted of six treatments. In each treatment, subjects were randomly matched in groups of five players to play the repeated trust game described below.

Free Choice treatments

Treatments one to four and treatment six were so called 'free choice' treatments (f1-f5). In stage one of the game, each player could see some information about the four other players in his group (see figure A.2, the information included the players' nationality, age, gender, and the number of siblings). The subject then decided *who* and *how much* of his initial endowment of 100 to transfer to the player chosen. No entry in any of the boxes corresponds to making no choice, which was also an option. In stage two, (see figure A.3) subjects saw *who* of the other players had chosen them and *how much* each of them had transferred. In addition, this amount was shown multiplied by three. For each player by which a player was chosen (this could be any from 0 to 4 players), they could choose how much to transfer back. In stage three (see figure A.3) subjects were presented a summary of all transfers and returns they had been involved with that happened in this period. The three stages were repeated 6 times. Then, groups were reshuffled and a new treatment was played. Due to the limited amount of subjects in each session and the large size of each group, the re-matching had to be done on a random basis, hence it is not ruled out that subjects could meet again in subsequent groups.

Control Treatment

Between the fourth and the fifth free choice treatment subjects were informed via the screen about a small change in the game. They were again matched in groups of five players, but instead of being able to choose a fellow player, they were *randomly assigned* one of the fellow players (see figure A.5). Hence it was also random by how many players a single player was chosen. In every period of this treatment players faced a new, random choice of the same group. After this treatment, subjects played a last free choice treatment.

4 Descriptive Statistics

The following statistics are organized around the course of the game, starting with statistics regarding the choice, then the amount transferred, and lastly the amount returned. They provide a rough description of the playing behavior. Empirical evidence and interpretation of types will be discussed in section 6. Unless indicated differently, the statistics do not include the control treatment.

4.1 Choice

In each period subjects had the option to choose one of the four players in their group to transfer points to. This group of players remained unchanged for six consecutive periods. Table 4.1.2 summarizes by treatment and period how often subjects decided not to change their playing partner. The analysis period by period shows a slight increase in periods 2-5 from 53% to 57%, and quite a pronounced drop to just 47% who stay with the same partner in the last period. There was also considerable persistence in the choice of partner exceeding one period. From table 4.1.3 it can be seen that while the in the majority of cases a player

Table 4.1.2: Fraction of players that chose the same player as in previous period

	period of treatment					
treatment	2	3	4	5	6	*total*
f1	0.42	0.47	0.50	0.55	0.47	0.48
f2	0.51	0.55	0.58	0.54	0.46	0.53
f3	0.47	0.52	0.53	0.56	0.55	0.53
f4	0.51	0.58	0.57	0.64	0.45	0.55
f5	0.52	0.53	0.61	0.58	0.41	0.53
total	0.49	0.53	0.56	0.57	0.47	0.52

Note: Each treatment/period combination was played 110 times.

was chosen only once (58%), 24% of the players remained with the same choice for at least two periods or more. 2% did not change the player throughout an entire treatment.

Table 4.1.3: Persistence of choice of player

	number of consecutive periods					
	0	1	2	3	4	5
absolute	1899	603	339	225	156	78
fraction	58	18	10	7	5	2

Note: Contrary to table 4.1.2 this table includes period 1.

Since the choice of players occurred simultaneously, it could be that two players chose each other. Such a situation is called a pair. In each group of five players, a maximum of 2 such pairs can be formed. Table 4.1.4 summarizes the fraction of players playing in pairs. It increases in the first two periods, then remains at around 40% before dropping again in $t = 6$. These effects are most pronounced in the last treatment f5. The predetermined treatment (p1) serves as a reference point, here pair formation was random and the expected share of pairs is $4 \cdot p \cdot p = 0.25$, where $p = 1/4$ is the matching probability. Note that this is also roughly the value observed in the first period of the free choice treatments. Conditional on switching to a new player in period t, 37% of the players switched to a player from which they had received in $t - 1$, and 10% switched to a player from which they had received for two consecutive periods. In 36% of the cases a player was not chosen by any of the other players. In 41% a player was chosen by one other player, in 18% by two players. In 6% of the cases a player was chosen by three players, and in 0.5% by all four players.

Additional tables on the choice behavior can be found in the appendix.

Table 4.1.4: Players playing in pairs, percent

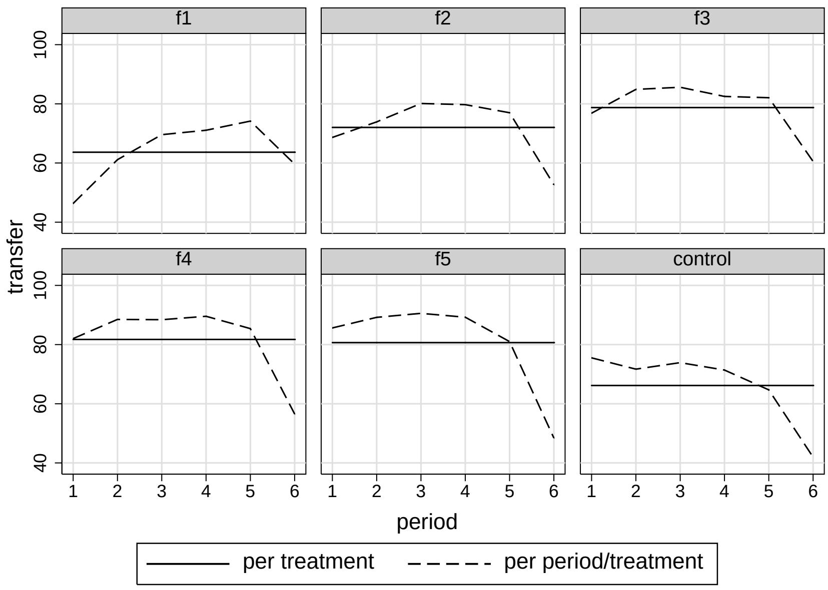
	period of treatment						*total*
treatment	1	2	3	4	5	6	
f1	24	33	36	35	42	38	35
f2	29	36	45	42	42	27	37
f3	25	35	42	35	49	35	37
f4	31	35	38	45	51	22	37
f5	25	40	35	38	40	18	33
f1-f5	27	36	39	39	45	28	36
p1	25	29	20	15	09	13	18

Note: p1 denotes the predetermined treatment where the choice of players was random.

4.2 Transfer

The analysis of the amount transferred per period reveals a significant drop in the last period of each treatment (see the dashed lines in figure 4.1). All free choice treatments exhibit the same effect over time. On average, the amount transferred increases from 72 in period 1 to 83 in period 4, decreases slightly to 80 in period 5 before it drops to 56 in the last period, well below value of the starting period. The average amount transferred rises from 64 in the f1 treatment to 81 in f5 treatment (solid line). The average in the predetermined control is 66 and therefore as low as the first treatment.[2]

Figure 4.1: Average transfer per period and treatment



[2]For a histogram of transfers period by period, see figure B.2 in the appendix.

There is a clustering of transfers at certain values, as table 4.2.5 illustrates. In 56% of the cases the full amount of 100 points was transferred. A second point mass is at the value of 50, which was the amount transferred in 9% of the cases. Figure B.1 in the appendix displays the quantiles of the distribution of the transfers over the periods.

Table 4.2.5: Distribution of transfer τ.

$\tau =$	*absolute*	*fraction*
0	226	7
$1 \leq \tau \leq 49$	386	12
50	286	9
$51 \leq \tau \leq 99$	567	17
100	1,835	56
total	3,300	100

Transfers increase if players repeatedly chose the same player, see table 4.2.6. Note the slight drop in transfers after 5 consecutive periods.

Table 4.2.6: Transfer and periods where same player was chosen as before

	periods of consecutive choice						
	0	1	2	3	4	5	*total*
mean	66.85	80.91	88.67	90.94	92.53	89.82	74.17
median	80	100	100	100	100	100	100

4.3 Return Ratio

The ratio a player got back from his initial transfer is defined as $r = G/(3 \cdot \tau)$, where G is the amount returned and τ is the initial transfer which is multiplied by three upon arrival on the opponent's account. Hence, $r \epsilon [0, 1]$. The average return ratio does not have such a great variation between the free choice treatments (0.51-0.59) but is significantly lower in the control treatment (0.39). The end game effect is also quite visible, the ratio drops from an average of 0.58 in periods 1-5 to 0.33 in the last period. Figure 4.3 depicts this behavior in greater detail.

The return ratio clusters at certain values, as table 4.3.7 illustrates. The biggest point mass is at 1 and at 2/3, followed by 1/2 and 0, which is largely due to the behavior in the last period. For a histogram of the return ratio period by period, see figure B.4 in the appendix.

As with transfers, the ratio returned varies with the persistence of choice. The return ratio increases up to period 3, and drops significantly in the last period of consecutive choice (see table 4.3.8).

Figure 4.2: Average ratio returned per period and treatment

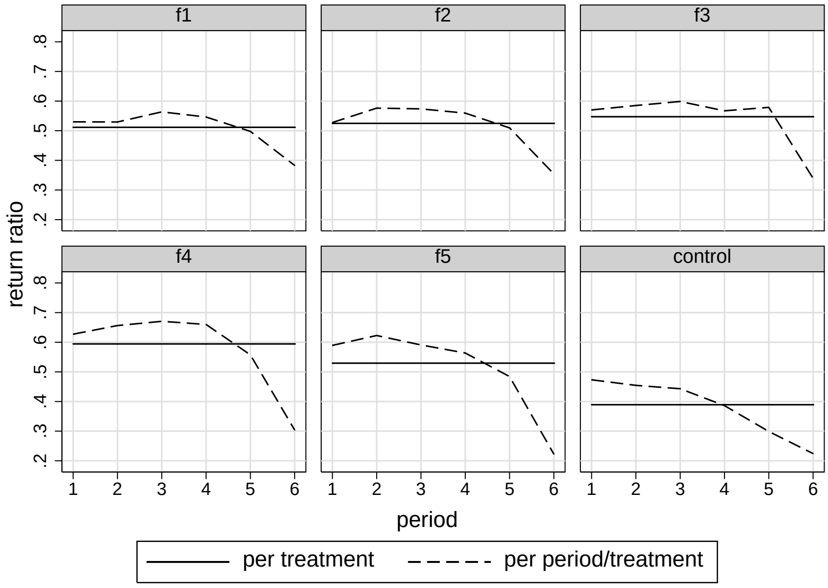


Table 4.3.7: Distribution of the return ratio r

$r =$	*absolute*	*relative*
0	370	12
$0 < r < 1/3$	178	6
1/3	283	9
$1/3 < r < 1/2$	209	7
1/2	492	16
$1/2 < r < 1/2$	227	7
2/3	539	18
$2/3 < r < 1$	222	7
1	554	18
total	3,074	100

Table 4.3.8: Ratio returned and periods where same player was chosen as before

	periods of consecutive choice						
	0	1	2	3	4	5	*total*
mean	0.48	0.58	0.60	0.62	0.57	0.43	0.52
median	0.50	0.58	0.63	0.67	0.65	0.45	0.50

4.4 Summary

The choice of players in the first stage is not random, players show a substantial reluctance to switch to new players. If so, they seem to prefer those players who they have been chosen by before. Previous interaction seems to have a positive effect both on the transfer and on the ratio that is returned to a sender. One can further see from the analysis that players transfer and return more in each repetition of the game up to period 4. In period 5 the end game effect starts, which is visible by stagnating or slightly decreasing transfers. It peaks in the last period where substantially less is transferred and returned.

5 Motives and Behavioral Theories for making Predictions

Several motives and learning theories compete in explaining the way people behave. Duffy and Nagel (1997), for example use their experimental data on the so called 'beauty contest' to test a simple model of adaptive learning behavior. A similar approach is taken by Ho et al. (1998). However, several other experimental studies show that factors such as reciprocity and fairness (Falk, 2003; Falk and Fischbacher, 1999) also determine the behavior.[3]

5.1 Reinforcement learning (RIF)

Reinforcement Learning is payoff oriented behavior, according to which people adopt the strategies that have proven to be successful in the past. Originating from psychology and biology, where it has been widely studied in both humans and animals, this learning strategy has recently been introduced to economics (Erev and Roth, 1998). Reinforcement learning is not a strategic way of behavior as individuals do not systematically reflect on their actions. They do not consider information about other players' outcome and solely concentrate on their own performance, even if additional information would be useful. Positive reinforcement means that the same action is taken again at least with same probability, the more likely the more successful. Negative reinforcement in turns implies that the same action will be taken again with smaller probability, the less likely the less successful.

In the game players could invest part of their endowment to a player of their choice. Such an interaction can be considered successful if at the end of the period, a player has more points than at the beginning. In such a case it is likely that the player will repeat his choice. Notice that the variable of interest is the absolute value of points obtained from interaction.

[3] For an overview on learning in economics, see Slembeck (1999)

5.2 Reciprocity (RCP)

Reciprocity is a motive oriented behavior. In actions based on reciprocity cooperative and friendly behavior is rewarded and unfriendly or non–cooperative behavior is punished. Both punishing and rewarding are actions that are costly to the agent. Falk and Fischbacher (1999) provide a formal definition of reciprocity in a specific game–theoretic setting. It is important to highlight that altruism, in contrast to reciprocity, is an unconditional attitude (see e.g. Cox (2002)), whereas reciprocity conditions on the actions of others.

In the repeated trust game with the opportunity to choose an opponent, reciprocity might come in at several stages. A reciprocal type would reward friendly behavior such as choosing a player or having transferred a substantial amount of points by subsequently choosing that player and returning a large share. If a player experiences that an opponent does not behave friendly, he would punish the opponent by not choosing the player again or returning less in a subsequent interaction.

5.3 Directional learning type (DLT)

The Directional Learning approach was developed by Selten and Stoecker (1986) for simultaneous move games. According to this theory, after some experience people evaluate their experience and adjust their behavior in the direction of the better decision. DLT does not make any predictions about the quantitive change of behavior, but indicates the qualitative direction of the change.

In the repeated trust game, players of DL type have a strategy for each constellation of to whom and how much to send as well as a return ratio for each subject they can receive money from. If the sender receives more points back than he sent a better response (given that the responder does not change his return ratio) is to choose the same again and to send more. Similarly, if a subject receives money from the same subject again then a better response is to decrease the return ratio.

5.4 Rationality (RTN)

The finitely repeated trust game has a unique Nash equilibrium in which each player sends 0 in each period and returns 0 whenever something positive is received. This is invoked by backwards induction, anticipating a zero return in the last period from a rational player, no player will ever transfer any points in the preceding period and so forth. This result is based on the assumption that all players are, and know that all players are rational. In a game with incomplete information and different types (e.g. rational and non–rational), however, trust and reciprocity might emerge as the effect of reputation building. Given a (known) proportion of irrational (i.e. trustworthy) players in the populations, rational players mimic their behavior and by doing so, build a reputation as trustworthy players. In the last period they will, however, always reveal their type.

If the game was played by rational agents, in any case they would reveal their type in the last stage of the game. The end game effect can largely be attributed to rational playing behavior.

6 Econometric Analysis

6.1 The choice of a player

In the first stage of the game, subjects had the possibility to choose between four players or they could decide not to transfer any points. Several motives might play a role for a subject to revise her decision who to transfer points to after the first round. In particular, the success she had with her behavior and the observed behavior of the other players influence her decision to revise her choice or not. Not only the fact that she has chosen a player before or that another player has chosen her might influence this decision but also the amount transferred in each of the cases might play a role.

6.1.1 Hypotheses

The types outlined in section 5 (RIF, RCP, DLT, RTN) are driven by different motives when choosing a player. Hypothesis of how a particular type would act and react in the first stage of the game can be derived from the theory. These hypotheses are formulated from the perspective of a sending player.

Hypothesis RCP 1 *One is more likely to choose a player from which a transfer was received in the previous period and who transferred a lot (100 points).*

Hypothesis RCP 2 *One is more likely to choose the same again if that player returned a lot (returned ratio is greater or equal than 1/2).*

Hypothesis RIF 1 *One is more likely to choose the same again if the payoff was high (greater or equal than 150).*

Hypothesis DLT 1 *One is more likely to choose the same again if that player returned more than one sent (returned ratio is greater or equal than 1/3).*

6.1.2 Specification

The framework in which the theoretical predictions will be addressed is the conditional logit model (McFadden, 1973). The data set at hand is one of the rare cases in which the econometrician not only observes the characteristics of the actual choice, but also of all other choices. This framework allows to identify how previous playing behavior affects current choices, controlling for choice specific attributes such as gender, age, and other covariates. Hence, one can test to which extent the choice probabilities in the empirical model are consistent with theoretical predictions for each type. Throughout the experimental setup individuals were constrained in the number of alternative choices. Hence, the underlying assumption that derives from the particular structure of the conditional logit model, the independency of irrelevant alternatives (IIA) seems natural in this case. The multiple choice model is best motivated using a random utility[4] model representation. Define

$$U_{ijt} \text{ as the utility of } i \text{ if } i \text{ chooses } j \text{ at time } t \text{, and}$$

$$d_{ijt} = \begin{cases} 1 & \text{if } i \text{ chooses } j \text{ in } t, \\ 0 & \text{otherwise}. \end{cases}$$

In the game under consideration, each player has five choices, $j = \{0, 1, 2, 3, 4\}$, at each point in time. A period t extents over all three stages of the game: choice, transfer, and transfer back. The five choices are mutually exclusive and exhaustive. The choice $j = 0$ is the decision to make no transfer at all, and this utility is normalized to zero.

In general, in the conditional choice model, it is not possible to identify coefficients of variables that do not vary within groups. In particular, individual specific effects cancel out of the probability specification. This does not mean, however, that individual effects are not accounted for; i–specific characteristics just do not affect the *relative* probabilities of choice. Effects of attributes of a player i such as gender, nationality or age can be estimated if they are interacted with choice varying characteristics.[5]

[4]The word 'utility' does not necessarily mean the utility in the strict microeconomic sense. Utility here should rather be interpreted as a broad measure of the happiness a player derives from a particular choice.

[5]Throughout the paper we group the nationalities into participants from North and participants from South. Further analysis of the effect of nationality on the playing behaviour can be found in Bornhorst et al. (2004).

The basic random utility model is defined as:

$$
\begin{aligned}
U_{i0t} &= 0 \\
U_{i1t} &= \alpha(i \rightarrow 1)_{t-1} + \delta(i \leftarrow 1)_{t-1} + \lambda(i \leftrightarrow 1)_{t-1} + \nu X_1 + \epsilon_{i1t} \\
U_{i2t} &= \alpha(i \rightarrow 2)_{t-1} + \delta(i \leftarrow 2)_{t-1} + \lambda(i \leftrightarrow 2)_{t-1} + \nu X_2 + \epsilon_{i2t} \\
U_{i3t} &= \alpha(i \rightarrow 3)_{t-1} + \delta(i \leftarrow 3)_{t-1} + \lambda(i \leftrightarrow 3)_{t-1} + \nu X_3 + \epsilon_{i3t} \\
U_{i4t} &= \alpha(i \rightarrow 4)_{t-1} + \delta(i \leftarrow 4)_{t-1} + \lambda(i \leftrightarrow 4)_{t-1} + \nu X_4 + \epsilon_{i4t}
\end{aligned} \tag{1}
$$

where $(i \rightarrow j)_{t-1}$ means that player i has chosen j in the previous period but not vice versa. Similarly, $(i \leftarrow j)_{t-1}$ means that player j has chosen player i in the previous round but not vice versa. Finally, $(i \leftrightarrow j)_{t-1}$ means that i and j have formed a pair in the previous period. Note that, put together, the three variables cover all possible cases in which there was interaction, as compared to the history $(i - j)_{t-1}$, which denotes the case in which the players have not interacted in $t-1$. The other covariates X_j include the remaining choice specific characteristics such as gender, nationality (both interacted with the corresponding attributes of i) age, and siblings. Notice that the previous choice of i is interpreted as a characteristic of the choice j in t. By the same token, the fact that a player was chosen by some other player in period $t-1$ becomes a characteristic of that player in t. Hence, previous playing behavior can be seen as observable choice specific attributes in t.[6]

So far only the model only accounts for the choice relating variables, e.g. if a a player was chosen or not. In an additional set of estimates, the random utility model presented in (1) will be enriched by adding variables characterizing in more detail the previous behavior. To this end, the choice variables defined above will be interacted with variables indicating a specific behaviour, as outlined in the hypothesis. Define τ_{ijt-1} as the transfer from i to j in $t-1$ and G_{ijt-1} as the amount player i got back from player j in $t-1$. Then,

$$
\begin{aligned}
r_{ijt-1} =& \frac{G_{ijt-1}}{3 \cdot \tau_{ijt-1}} \text{ is the ratio } i \text{ got back from } j \text{ in } t-1 \\
\pi_{ijt-1} =& 100 - \tau_{ijt-1} + G_{ijt-1} \text{ is the payoff of player } i \text{ in } t-1
\end{aligned}
$$

In addition, the variable τ_{jit-1}, the amount i received from j in $t-1$ will be used. Notice that these variables only take positive values if the respective choice specific dummy variables defined above take the value one and are zero otherwise.

Player i chooses player j if this yields highest utility. Hence,

$$
\mathrm{P}(d_{ijt} = 1) = \mathrm{P}(U_{ijt} > U_{ikt}) \; \forall \, k \neq j.
$$

[6]In econometric terms, the variable $(i \rightarrow j)_{t-1}$ is not strictly exogenous. This causes each observation d_{ijt} to be a function of previous disturbances. However, to re–establish consistency, the d_{ijt} are assumed to be predetermined in the sense that they are independent from subsequent disturbances ϵ_{ijt+1} (Greene, 2000).

Assume that the errors are i.i.d. with $F(\epsilon_{ijt}) = \exp(-e^{-\epsilon_{ijt}})$, so that the model takes the form of the conditional logit model (Maddala, 1993, pp. 60–61). Grouping the coefficients into the vector $\boldsymbol{\beta}$ and the regressors into $\mathbf{X}_{ijt}$ the probability of a choice j is

$$\mathrm{P}(d_{ijt} = 1) = \frac{e^{\boldsymbol{\beta}\mathbf{X}_{ijt}}}{\sum_{j=1}^{5} e^{\boldsymbol{\beta}\mathbf{X}_{ijt}}} \tag{2}$$

which is the standard McFadden (1973) conditional logit specification. Hence, the log likelihood function to estimate $\boldsymbol{\beta}$ is the sum over all such probabilities for all choices, for all individuals and for all periods, for all K treatments:

$$\log L(\boldsymbol{\beta}) = \sum_{k=1}^{K}\sum_{t=2}^{T}\sum_{i=1}^{N}\sum_{j=1}^{5} d_{ijt}\log \mathrm{P}(d_{ijt} = 1)$$

where $K = 5$, $T = 6$, $N = 110$, which yields a total of 2750 units facing a five choices decision problem as described in (1), or equivalently, 13750 observations.

6.1.3 Estimation results and interpretation

Table 6.1.1 and 6.1.2 contain the estimation results of various specifications of the model presented in equation (2). Consider specification C1. This model disregards any success or failure of previous choices and forms the basis for the following analysis. However, it becomes clear that having chosen a player before and having been chosen by a player makes it more likely to choose that player again. The effects are of the same order of magnitude, with the effect of $i \leftarrow j$ being slightly bigger. Interestingly the effect of a pair is the sum of the two events, suggesting that there is no pair-specific effect. Hypothesis RCP 1, that the probability of choosing a player is increasing in the the amount received from that player is addressed in specification C2 in table 6.1.1. This specification interacts the variables which indicate that j chose i ($j \leftrightarrow j$ and $i \leftarrow j$) with an indicator whether a transfer of 100 points was made by j. Indeed, the likelihood of choosing a player who transferred previously is significantly higher if that transfer was 100 points (1.70>1.09). This is more so the case if the players have chosen each other in the previous period (3.02>1.82). Hence, hypothesis RCP 2 is finds empirical support. However, it should be noted that even if j transferred less than 100 points a player is more likely to choose that player again.

Hypothesis RCP 2 and DLT 1 are addressed in specification C3 and C4 which state that choosing the same again is more likely if that player returned a lot. In these specifications (C3 and C4 in table 6.1.2) the variables that relate i's own previous choice are interacted with the indicators on how successful this interaction was. The first thing to notice is that both find some empirical support – the likelihood of choosing the same again is higher if the return

Table 6.1.1: Choice: conditional logit estimation results 1

	C1	C2
$i \leftrightarrow j$	2.66 (.08)***	.
$i \rightarrow j$	1.24 (.06)***	1.24 (.06)***
$i \leftarrow j$	1.41 (.07)***	.
$i \leftarrow j \wedge \tau_{ji} = 100$	.	1.7 (.09)***
$i \leftarrow j \wedge \tau_{ji} < 100$	.	1.09 (.10)***
$i \leftrightarrow j \wedge \tau_{ji} = 100$	.	3.02 (.10)***
$i \leftrightarrow j \wedge \tau_{ji} < 100$	.	1.82 (.13)***
Obs.	13750	13750
Pseudo R^2	.25	.25
log likelihood	-3337.8	-3298.2

Note: All variables refer to the previous playing round. Reported values are coefficients, standard errors in parenthesis. *, ** , *** denote significance to the 90, 95 and 99 percent level. Controls included are: age and siblings of all 4 players, gender and nationality of i interacted with the attributes of j.

ratio was higher than 1/2 (1/3). In both cases, if the players have formed a pair they seem less sensitive to the return ratio, because even if the ratio returned was below the threshold the likelihood of choosing the same is higher as opposed to choosing a new player. Note that if only i has chosen j but not vice versa and the return ratio is below 1/3, the effect of choosing the same again is small and only significant at the 5 percent level. It is difficult to disentangle hypotheses RCP 2 and DLT 1 because they differ only in the presumed functional form between the returned ratio and the choice. However, the model which allows a break at 1/2 fits the data slightly better.

The picture that emerges for the payoff is very similar as can be seen in specification C5. Players enforce there choice upon receiving a high payoff, and do more so in pairs than otherwise, which is what hypothesis RIF 1 suggests. However, even after receiving a low payoff they enforce their action- albeit with much lower probability.

Table 6.1.3 summarizes the main results of this section, which provided econometric evidence that the choice of a player depends on his own previous behaviour and on that of his opponents. Players seem to reciprocate behaviour as they reward more if they were chosen by other players and were treated well Players also reinforce their own choice if the payoff was high. However, the analysis has also shown that there is a residual reluctance to switch to

Table 6.1.2: Choice: conditional logit estimation results 2

	C3	C4	C5
$i \leftarrow j$	1.47 (.07)***	1.47 (.07)***	1.48 (.07)***
$i \rightarrow j \wedge r_{ij} \geq 1/2$	1.70 (.07)***	.	.
$i \rightarrow j \wedge r_{ij} < 1/2$	.32 (.10)***	.	.
$i \leftrightarrow j \wedge r_{ij} \geq 1/2$	3.10 (.10)***	.	.
$i \leftrightarrow j \wedge r_{ij} < 1/2$	1.71 (.13)***	.	.
$i \rightarrow j \wedge r_{ij} \geq 1/3$	.	1.45 (.06)***	.
$i \rightarrow j \wedge r_{ij} < 1/3$	.	.32 (.14)**	.
$i \leftrightarrow j \wedge r_{ij} \geq 1/3$	.	2.91 (.09)***	.
$i \leftrightarrow j \wedge r_{ij} < 1/3$	.	1.21 (.20)***	.
$i \rightarrow j \wedge \pi_{ij} \geq 150$	.	.	1.82 (.08)***
$i \rightarrow j \wedge \pi_{ij} < 150$	.	.	.66 (.08)***
$i \leftrightarrow j \wedge \pi_{ij} \geq 150$	.	.	3.2 (.10)***
$i \leftrightarrow j \wedge \pi_{ij} < 150$	.	.	1.78 (.12)***
Obs.	13750	13750	13750
Pseudo R^2	.27	.26	.27
log likelihood	-3223.6	-3275.4	-3230.3

Note: See notes to table 6.1.1.

new players that is not captured by the motives outlined above. Even if players were treated badly the mere fact that they were chosen by someone or made a specific choice increases the likelihood of choosing the same player again.

6.2 The amount transferred

In the second stage of the game the players could choose how much of their endowment of each period to transfer to a player. Again, several motives might lead to an increase or decrease in the amount transferred after period 1. Previous playing experience as well as the limited amount of repetitions might influence the decision how much to transfer.

Table 6.1.3: Choice: summary of findings

hypothesis	*...probability of i choosing j is [higher if]*	*evidence*
RCP 1	i received a lot from j	yes
RCP 2	j returned a lot previously	yes
DLT 1	j returned more than i sent	weak
RIF 1	i had a high payoff	yes

6.2.1 Hypotheses

Hypothesis RCP 3 *Transfers are higher if sent to a player from which a high transfer was received in the previous period.*

Hypothesis RCP 4 *Conditional choosing the same player, transfers are increasing in the ratio returned in the previous period.*

Hypothesis RIF 2 *Conditional on choosing the same player again, transfers are increasing in the payoff received in the previous period.*

Hypothesis DLT 2 *Conditional on choosing the same again, transfers are higher (lower) if the ratio returned in the previous period is greater (smaller) than 1/3.*

Hypothesis RTN 1 *Transfers are lower in the last period*

6.2.2 Estimation results and interpretation

The basic framework in which the hypothesis will be addressed is

$$\tau_{it} = \alpha d_{ijt-1} + \beta d_{jit-1} + \delta X_{jt} + \eta Z_{it} + u_{it} \tag{3}$$

which forms the basis for the analysis. The variable d_{ijt-1} and d_{jit-1} are as defined in the previous section. The matrices X_{jt} and Z_{it} contain a set of j and i specific characteristics respectively and u_{it} is a random error component. According to the hypothesis, the choice variables d_{ijt-1} and d_{jit-1} will be interacted with variables that characterize previous playing behaviour. Since there are repeated observations for the same individual in the sample, the standard errors are corrected for any possible within-individual correlations.[7]

To facilitate the reading of the tables, the following notation is introduced. Each player i is also a Sender denoted by S. In each t, S chooses a Receiver R. This action is indicated by a dashed arrow, because it disregards weather the two formed a pair.[8]

[7] See Moulton (1986)

[8] The specification disregards the formation of pairs as indicated by $i \leftrightarrow j$ in the previous section. The reason for doing so is because it simplifies the presentation of results. In results not reported here it became clear that the qualitative results regarding the hypothesis do not change if the pair formation is considered explicitly.

- $S \dashrightarrow R$: means that in $t-1$ S has chosen R and the choice of R is not specified,
- $S \dashleftarrow R$: means that in $t-1$ R has chosen S and the choice of S is not specified.

Together with the event

- $S - R$: which means that in $t-1$ both S and R had no interaction

these variables sum up to one. In the subsequent analysis, the last variable will be the omitted variable.

The hypotheses distinguish between the behavior towards the same and different choice. Hence, variables are interacted with a variable that indicates whether the same choice was made in t and $t-1$. If a variable corresponds to the set of same choice or the set of different choice will be indicated by s and d, respectively.

Consider table 6.2.1. Specification T1 is the starting point for the analysis. Having been chosen by a player previously increases transfers on average by 11 points. Repeating the own choice also increases the transfer, on average by 7 points. In the specification T2 the amount received is interacted with the indicator ($S \dashleftarrow R$). The coefficient is positive and significant, providing evidence for hypothesis RCP 3 that transfers increase in the amount received from a player previously. Hypothesis RCP 4 which relate transfers to the amount returned in previous rounds also finds empirical support, see specification T3. This is evident from the positive coefficients of the previous choice multiplied with the return ratio received and interacted with same and different choice. However, upon having received a high return ratio players increase their transfer even if they choose a different player. Hence, the *additional* reward when choosing the same player is the difference 16.7 - 8.1 = 8.6, which is significant.

The results for hypothesis RIF 2 are similar, for which evidence is provided in specification T4. Players do increase their transfer after high payoffs. However, again they do so *regardless* to whether they repeat their choice or not. While in the case of the return ratio the relative difference between the coefficients same and different choice was substantial, in the case of payoffs it still significant but much smaller.

Hypothesis DLT 2 is addressed in table 6.2.2. Notice that hypothesis RCP 4 is a more general version of DLT 2 - while latter one presumes a structural break at the cutoff point 1/3, the former one just says that transfers are an increasing function of the ratio returned previously. Hence the two hypothesis are difficult to disentangle. In table 6.2.2 two cutoff points - one at 1/2 and one at 1/3 are analyzed. While the evidence is weak, it seems that the cut-off point at 1/3 is more pronounced than the one at 1/2. This can be concluded from the fact that players increase their transfers when sending to a new player if they were returned more than 1/3 previously. If the cut off is chosen to be more than 1/2 they do not alter their transfers. Also the R^2, while only marginally, is larger in the previous case.

Finally, hypothesis RTN 1 is confirmed by the data. Table 6.2.3 reports the coefficients for the period dummy variables included in the regressions. It is evident that transfers increase slightly in the third period relative to the second but drop on average by 5 points in the last period. Notice that this is the case in both regressions T3 and T5, where the amount received was included as well as the ratio returned. Hence the end game effect is *additional* to any decreases in transfer that could have been induced by lower receipts or return ratios in the previous period.

Table 6.2.1: Transfer: estimation results 1

	T1	T2	T3	T4	T5
$S \dashleftarrow R$	10.98 (1.53)***	.	10.01 (1.47)***	8.6 (1.29)***	.
$S \dashrightarrow R$	7.22 (1.54)***	6.79 (1.53)***	.	.	.
$(S \dashleftarrow R) \cdot \tau_{ji}$	.	.13 (.02)***	.	.	.1 (.01)***
$(S \dashrightarrow R) \cdot r_{ij} \mid s$	.	.	16.65 (2.2)***	.	.
$(S \dashrightarrow R) \cdot r_{ij} \mid d$	.	.	8.14 (2.96)***	.	.
$(S \dashrightarrow R) \cdot \pi_{ij} \mid s$	.	.	.	.09 (.01)***	.09 (.01)***
$(S \dashrightarrow R) \cdot \pi_{ij} \mid d$	.	.	.	.07 (.01)***	.07 (.01)***
Obs.	2540	2540	2502	2502	2502
R^2	.21	.22	.23	.26	.27

Note: $\mid s$ and $\mid d$ means that the variable is interacted with same (s) or different (d) choice. Control variables are: gender, age, siblings, and nationality of sender and receiver, dummies for session and treatments. Dummies for each period.

Table 6.2.4 summarizes the main findings of this section. The transfer made clearly re-frlects the motives of reciprocity and reinforcement, as transfers increase if players were treated good or if they were successful in their previous choice. It important to note that even individuals choose new players the behaviour of their previously chosen players influences the size of the new transfer.

Table 6.2.2: Transfer: estimation results 2

	T6	T7
$(S \leftarrow\!\!-\!- R) \cdot \tau_{ji}$	.13 (.02)***	.13 (.02)***
$\mathbf{1}\{r_{ij} \geq 1/3\} \mid s$	13.13 (2.26)***	.
$\mathbf{1}\{r_{ij} \geq 1/3\} \mid d$	6.82 (2.06)***	.
$\mathbf{1}\{r_{ij} \geq 1/2\} \mid s$	.	7.92 (1.33)***
$\mathbf{1}\{r_{ij} \geq 1/2\} \mid d$	.	.08 (1.78)
Obs.	2502	2502
R^2	.23	.22

Note: see notes to table 6.2.1.

Table 6.2.3: Transfer: estimation results for period dummies

	T3	T5
period 3	1.56 (.80)*	1.35 (.80)*
period 4	1.24 (.93)	1.07 (.92)
period 5	.018 (1.05)	-.28 (1.04)
period 6	-4.95 (1.91)**	-5.26 (1.89)***

Note: Effects with respect to period 2. See notes to table 6.2.1.

6.3 The ratio and the amount returned

In the last stage of the game, conditional on having been chosen in the first stage, subjects decided how much of the amount transferred to them (multiplied by 3) to send back to the original sender. Two competing measures of this will be used. One variable, already introduced in the previous sections, is the ratio returned, defined as $r_{it} = \frac{G_{it}}{3 \cdot \tau_{it}}$, where G_{it} is the amount that the Sender gets back. The measure r_{it} is naturally bounded between 0 and 1, because a player cannot transfer back more than received. From a receiver's perspective, the variable G_{it} is the amount he pays back to the sender, and will henceforth be called P_{jt}. This variable, which is naturally bounded by 3 times the amount received τ_{jt}, will be the second measure of return in this section.

Due to the nature of the game, when players take the decision how much to transfer back,

Table 6.2.4: Transfer: summary of findings

hypothesis	*...transfers are higher / increasing if*	*evidence*
RCP 3	the returned ratio was high	yes
RCP 4	R sent a lot	yes
RIF 2	the payoff was high	yes
DLT 2	R returned more than 1/3	weak
	...transfers are lower	
RTN 1	in the last period	yes

they know already who has chosen them in this period t. Hence, in period t receivers know if they are playing in a pair or not and by whom they have been chosen.

6.3.1 Hypotheses

The hypothesis are formulated from the perspective of the player that takes action, i.e. the receiver.

Hypothesis RCP 5 *The ratio returned (or the amount paid back) is higher if the transfer received was high.*

Hypothesis RIF 3 *The return ratio (or the amount paid back) is higher if received from a player for the second time.*

Hypothesis DLT 3 *The return ratio (or the amount paid back) is lower if received from a player for the second time.*

Hypothesis RTN 2 *The return ratio (or the amount paid back) is lower in the last period.*

6.3.2 Estimation results and interpretation

The choice of players in stage one of the game leads to a particular feature of the data analyzed in this section. A player might have been chosen by 0, 1, 2, 3 or even 4 other players. Hence, at each period t there are between 0 and 4 observations for each player of an amount paid back. In total, of course, there are as many observations as for the initial transfer.

The framework to be used in this section goes along the lines of section 6.2.2. Consider the equation for the amount ratio returned

$$r_{jit} = \alpha d_{jit} + \beta d_{jit-1} + \gamma d_{jit-1} + \delta X_{it} + \eta Z_{jt} + u_{it} \tag{4}$$

where the variables are as defined above. Notice that for player j to make a move in t, it has to be that he was chosen by i, ie $d_{ijt} = 1$. Table 6.3.1 presents results for four specifications, two for the ratio returned (R1 and R2) and two for the amount paid back (P1 and P2). The names S for sender and R for receiver remain unchanged, even though it is now the receiver to take action. Note that by default, the sender must have chosen the receiver in period t, otherwise the receiver does not make a move. Thus, either S and R formed a pair in t (if $(S \dashleftarrow R)_t$ is one), or S chose R but not vice versa.

The first thing to notice is that if R also chose S returns are significantly higher. In specifications R2 and P2 one can find support for hypothesis RCP 5. The amount received increases the ratio returned, regardless to weather R and S are playing in a pair or not. If they are, however, the increase is slightly stronger.

The fact that a player is chosen by a Sender for the second time also affects the ratio returned (or the amount sent back). In any case, this effect is strong and positive, which is supporting hypothesis RIF 3 and is evidence against hypothesis DLT 3.

Further, there is clear evidence for hypothesis RTN 2, that the returns are lower in the last period. Moreover, as can be seen from the period effects reported in table 6.3.1 the decrease starts as early as in period 4 and is very pronounced in the last period.

Table 6.3.1: Returned ratio / amount paid back : estimation results

	R1	R2	P1	P3
$S \dashrightarrow R$	.07	.06	26.21	15.62
	(.02)***	(.02)***	(5.84)***	(4.51)***
$S \dashleftarrow R$	-.004	-.008	-2.34	-3.12
	(.02)	(.02)	(6.24)	(4.59)
$S \underset{t}{\dashleftarrow} R$	.07	.	25.46	.
	(.02)***		(5.33)***	
$\tau_{ji} \mid s$	.	.002	.	2.03
		(.0004)***		(.09)***
$\tau_{ji} \mid d$	.	.001	.	1.73
		(.0004)***		(.09)***
period 3	-.009	-.009	-3.14	-6.35
	(.01)	(.01)	(4.3)	(3.72)*
period 4	-.03	-.03	-9.05	-11.6
	(.01)***	(.01)***	(4.96)*	(3.82)***
period 5	-.09	-.09	-26.29	-28.46
	(.02)***	(.02)***	(6.16)***	(5.33)***
period 6	-.21	-.21	-60.48	-53.45
	(.03)***	(.03)***	(8.94)***	(7.69)***
Obs.	2540	2540	2540	2540
R^2	.16	.18	.18	.42

Note: The first two variables refer to $t-1$. $\mid s$ and $\mid d$ means that the variable is refers to the same (s) or different (d) choice for the Receiver, compared to the previous period. Control variables are: gender, age, siblings, and nationality of sender and receiver, dummies for session and treatments.

Table 6.3.2: Return: summary of findings

hypothesis	*...return is*	*evidence*
RCP 5	higher if the transfer received was high	yes
RIF 3	higher if the received for two consecutive periods	yes
DLT 3	lower if the received for two consecutive periods	no
RTN 2	lower in the last period	yes

Table 6.3.2 summarizes the main findings of this section.

7 Final remark

This paper analyzes the determinants of trust and trustworthiness in an experiment where trust can emerge as the result of repeated interaction between individuals. We add an element of choice to the setting of a repeated trust game, in that players have the opportunity to choose among four players. For each opponent, players see information such as age, nationality and gender. The influence of four different behavioral and learning theories is looked at: directional learning, reinforcement learning, reciprocity and rationality. The econometric analysis goes along the three stages of the game: choice, transfer and return, controlling for confounding factors. It sheds light on the behavioral motives behind each decision. The low degree of formalization and a certain degree of observational equivalence makes a clear discrimination between the competing approaches impossible. While it is not possible to attribute the entire playing behavior to a single type, at each decision several motives seem to influence the decisions taken, some being of higher explanatory power than others. It was shown that a mixture of several motives is at play at each stage of the game. In the same way as rationality does not offer a satisfying explanation for the behavior of the players, none of the alternative motives such as reinforcement or reciprocity is able to capture all facets of the observed behavior.

References

BERG, Joyce; DICKHAUT, John and MCCABE, Kevin (1995): «Trust, Reciprocity and Social History», *Games and Economic Behaviour*, 10: 122–142.

BORNHORST, Fabian; ICHINO, Andrea; SCHLAG, Karl and WINTER, Eyal (2004): *Trust and Trustworthiness Among Europeans: South - North Comparison*, mimeo.

BUCHAN, Nancy; CROSON, Rachel T.A. and JOHNSON, Eric J. (2000): «Trust and Reciprocity: An International Experiment», *mimeo*.

BURKS, Stephen V.; CARPENTER, Jeffrey P. and VERHOOGEN, Eric (2002): «Playing Both Roles in the Trust Game», *Journal of Economic Behaviour and Organization*, 1–22.

COCHARD, François; PHU, Nguyen Van and WILLINGER, Marc (2000): *Trust and Reciprocity in a Repeated Investment Game*, mimeo.

COX, James C. (2002): *How to Identify Trust and Reciprocity*, mimeo.

CROSON, Rachael T.A. and BUCHAN, N. (1999): «Gender and Culture: International Experiemntal Evidence from a Trust Game», *American Economic Review: Papers and Proceedings*, 89: 386–391.

DUFFY, John and NAGEL, Rosemarie (1997): «On the Robustness of Behavior in Experiemental Beauty Contest Games», *Economic Journal*, 107: 1684–1700.

EL-GAMAL, Mahmoud A. and GRETHER, David M. (1995): «Are People Bayesian? Uncovering Behavioral Strategies», *Journal of the American Statistical Association*, 90 (432): 1137–1145.

EREV, I. and ROTH, A. (1998): «Predicting How Poeple Play Games: Reinforcement Learning in Experimental Games with Unique, Mixed Strategy Equilibria», *American Economic Review*, 88 (4): 848–881.

FALK, Armin (2003): «Homo Oeconomicus versus Homo Reciprocans: Ansaetze Fuer ein Neues Wirtschaftspolitisches Leitbild?», *Perspektiven der Wirtschaftspolitik*, 4 (1): 141–172.

FALK, Armin and FISCHBACHER, Urs (1999): *A Theory of Reciprocity*, Working Paper Institut Fuer Empirische Wirtschaftsforschung, Zuerich: Universitaet Zuerich.

FERSHTMAN, C. and GNEEZY, U. (2001): «Discrimination in a Segmented Society: An Experimental Approach», *Quaterly Journal of Economics*, 116 (1): 351–377.

FISCHBACHER, Urs (1999): *Z-Tree: Zurich Toolbox for Readymade Economic Experiments*, Working Paper No. 21, University of Zurich: Institute for Empirical Research in Economics.

GLAESER, Edward; LAIBSON, David L.; SCHEINKMAN, Jose A. and SOUTTER, Christine L. (2000): «Measuring Trust», *Quaterly Journal of Economics*, 811–846.

GREENE, William H. (2000): *Econometric Analysis*, New Jersey: Prentice Hall, 4th ed.

HO, Teck-Hua; CAMERER, Colin and WEIGELT, Keith (1998): «Iterated Dominance and Iterated Best Response in Experimental P-Beauty Contests», *American Economic Review*, 88 (4): 947–969.

MADDALA, G. S. (1993): *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge: Cambridge University Press.

MANSKI, Charles F. (2002): «Identification of Decision Rules in Experiments on Simple Games of Proposal and Response», *European Economic Review*, 46: 880–891.

MCFADDEN, Daniel (1973): «Conditional Logit Analysis of Qualitative Choice Behavior», in: «Frontiers in Econometrics», (ed. ZAREMBKA, P.), New York: Academic Press.

MOULTON, Brent R. (1986): «Random Group Effects and the Precision of Regression Estimates», *Journal of Econometrics*, 32: 385–397.

SELTEN, Reinhard and STOECKER, R. (1986): «End Behaviour ein Sequences of Finite Prisoner's Dilemma Supergames - A Learning Theory Approach», *Journal of Economic Behavior and Organization*, 7 (1): 47–70.

SLEMBECK, Tilman (1999): *Learning in Economics: Where Do We Stand?*, Discussion Paper No. 9907, St. Gallen: St. Gallen University.

A Appendix A: Experimental design

A.1 Instructions

Screen 1

- You will randomly be matched with **4 other players** to play a **game**.
- Each game consists of **three stages** which will be described on the following screens.
- The game will be repeated **for 6 periods** with the **same** players.
- After the 6 periods, you will randomly be **re-matched** with four new players.
- This re-matching will be repeated **six times** (time permitting).

Screen 2

Stage 1 of 3

Your endowment in each period is **100 points**, equivalent to **0.35 Euros**
You can choose **if** you want to transfer any points to your fellow players or not. If so, you decide **to whom** and **how much**. You can choose **only one person** and you can transfer any amount between **0 and 100**. If you decided not to transfer points at all, just click the button. Every transfer made in stage 1 will be **multiplied by the factor 3** as it arrives on the other player's account.

Screen 3

In stage 1 the other 4 players have simultaneously made a similar decision to yours. Due to the simultaneity their choice does not depend on your decision.

Stage 2 of 3

You will see **who** of the other players have chosen you and **how much** has been transferred to you. It might be that you were chosen by none, 1, 2, 3 or even all 4 players.
If you got a transfer from a player, you can decide **if** and **how much** you want to transfer back to **this player**. You can transfer back anything **between zero and three times** the initial transfer to you. If you were chosen by more than one player, you can choose different amounts for each of them.

Screen 4

Stage 3 of 3

In this stage you see the results of the period, how much you transferred and how much the player you have chosen initially **transferred back** to you.
You will also see the profit in Euro you made in this period.

Screen 5

Remember...

- After you finished playing the three stages, you will play this game six times with the same players.
- After the 6 periods, you will randomly be **re-matched** with four new players.
- This re-matching will be repeated **six times** (time permitting).

Do you want to read the instructions again or continue directly with a short quiz?

Screen before the predetermined treatment

The game you will play now is **slightly different** from the one you have played before.
Contrary to the previous game, in Stage 1 you will **not have the possibility to choose a player**. Instead, a **random choice** will be made for you. You can only **decide how much** you want to transfer to the player already determined.
Notice that this also affects stage 2, as it is now random by how many players you were chosen.

A.2 Privacy Statement

The privacy and Anonymity statement reads as follows.
All information we collect undergoes a strict anonymization process, not only ensuring anonymity among players but also ensuring that you stay anonymous to us. No private information will be collected. During the experiment you will see some information about your fellow players. We have ensured that you cannot identify them personally, and vice versa, they cannot identify you. Remember that this experiment runs over different rooms, thus involving much more individuals than those seated in your room. At the end of the session, you will be asked to type in the account number you obtained before. Please keep this number, because after notification you can pick up an envelope with your payment at the porters lodge.

A.3 Screenshots

See figures A.1 to A.5 for some black and white screenshots of the game.

Figure A.1: Screenshot of the CV information

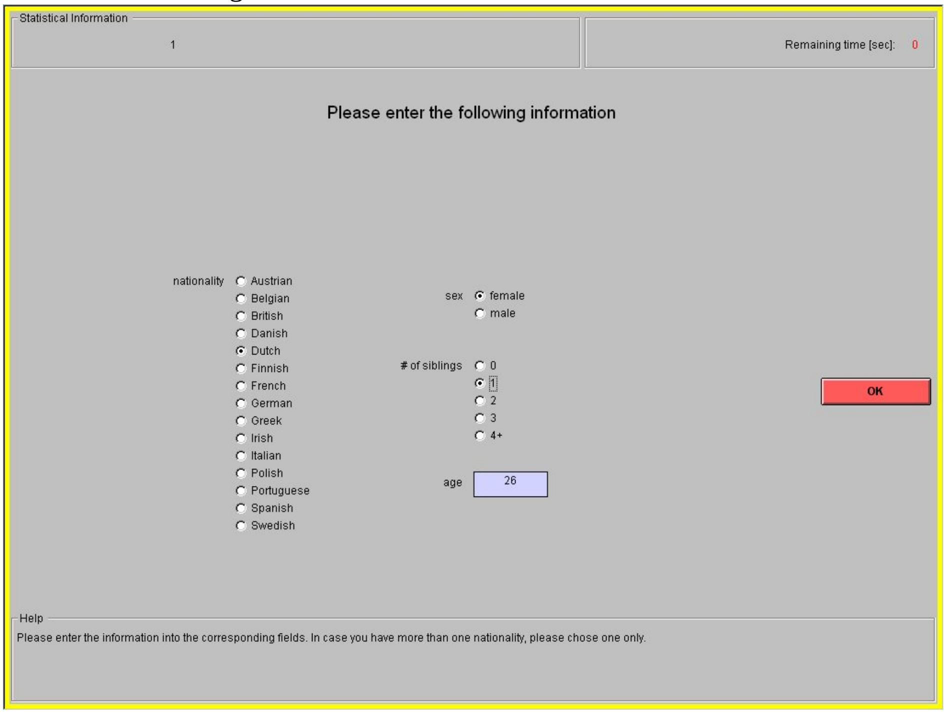


Figure A.2: Screenshot of the first stage

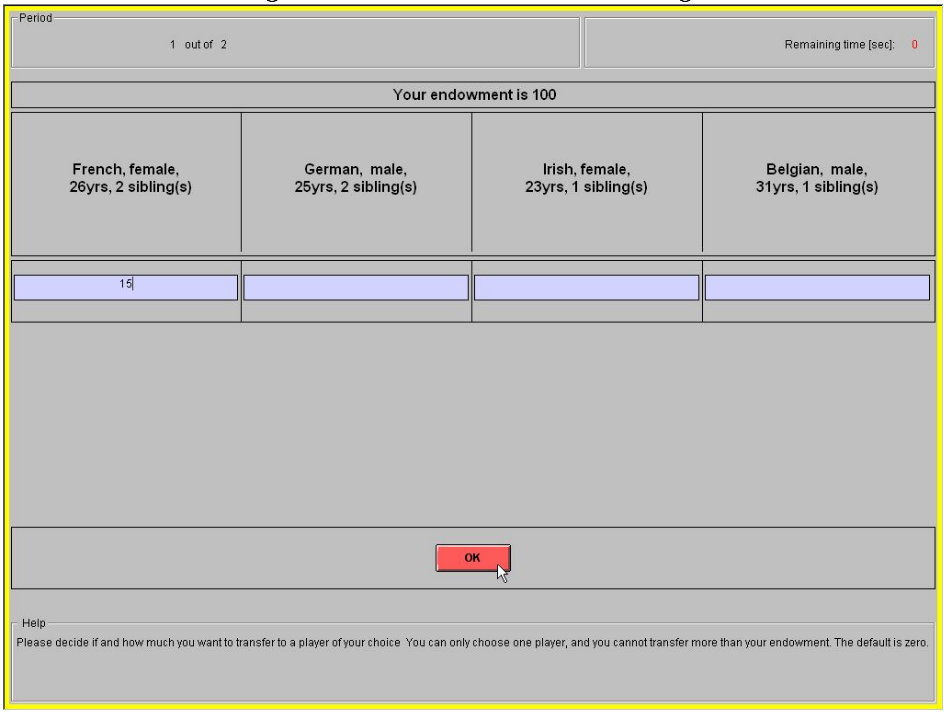


Figure A.3: Screenshot of the second stage

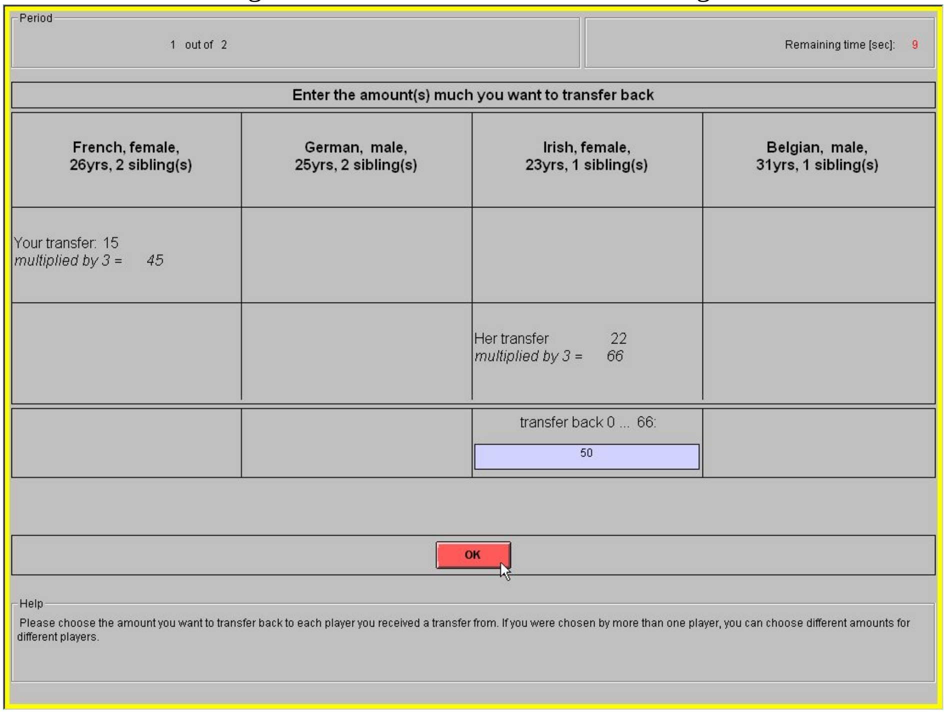


Figure A.4: Screenshot of the third stage

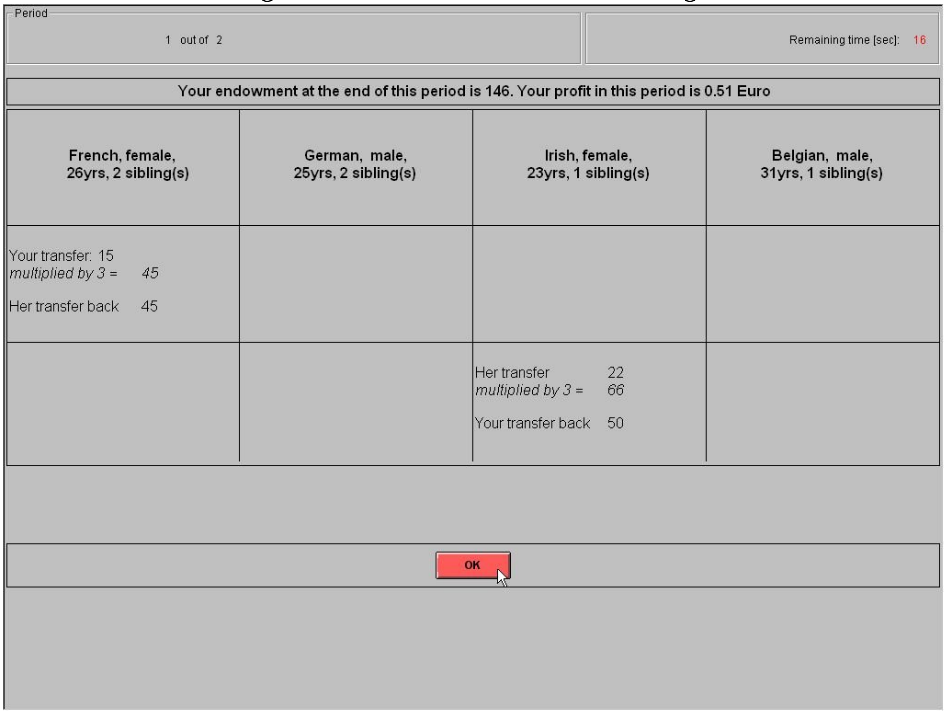


Figure A.5: Screenshot of the first stage of the predetermined treatment

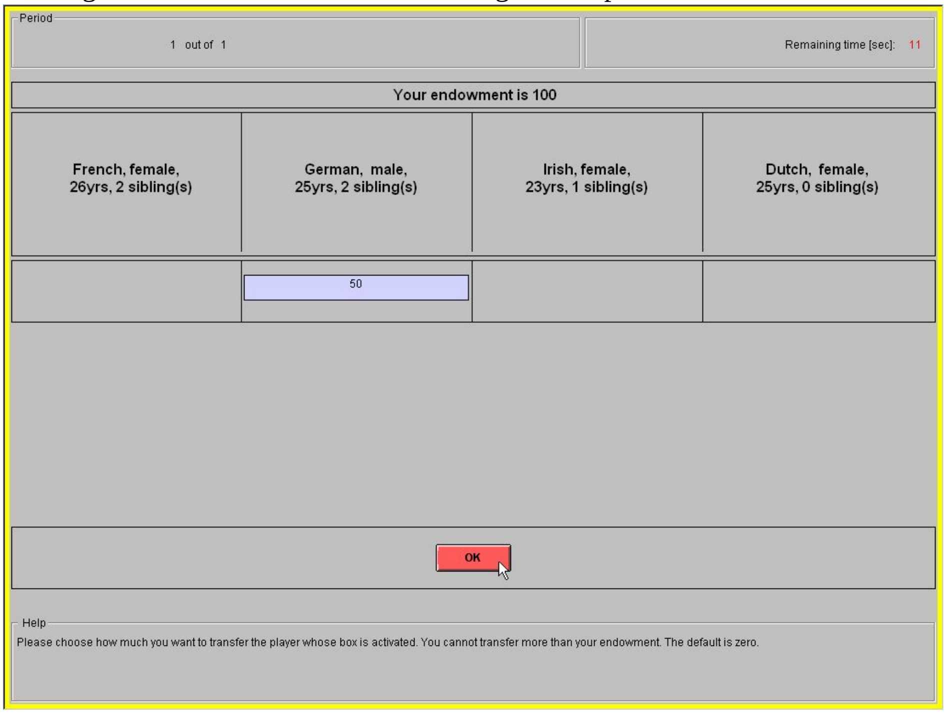


Table A.4.1: Results of the quiz: percent of all answers

	Question		
Answer	1	2	3
A	19	1	1
B	21	95*	5
C	60*	4	94*

Note: * denotes the correct answer.

A.4 Quiz

Note: Subjects always saw the actual values of the expressions involving X, Y, Z.
Question 1: [Subjects had to choose an amount X between 1 and 100.] "Imagine you transferred X points to player two in stage 1. Assume further that she made no transfer to you in stage 1. How many points can you transfer back to her in stage 2 at most?"

A: $3X$ B: X C: 0

Question 2: [Subjects drew random number Y between 0 and 100 by clicking on a button.] "Your drew the number Y. Assume you transferred this amount to one player in stage one. How much can the other player transfer back to you at most?"

A: 0 B: $3Y$ C: Y

Question 3: "Please press the button below to determine randomly how much you will be paid back. Remember that this number can be between 0 and $3Y$." [next screen] "Summary Question: Initially, from your 100 points you transferred Y to the player. Let us assume the player transferred you back Z in the next stage. You had no interaction with other players. Based on this, what is the balance on your account?"

A: 0 B: $3Y$ C: $100 - Y + Z$

Table A.4 summarizes the results. Subjects got a feedback screen after each answer indicating if they were correct or mistaken and stating the correct answer. While in the first question many subjects made mistakes, in questions 2 and 3 almost all subject answered correctly.

B Appendix B: Additional figures and tables

B.1 Statistics on choice

Table B.1.1: Some coordination might take place, the number of pairs in a group increases over periods 1-5. Note that in $t = 6$ there is a significant drop in the number of pairs.

Table B.1.1: Number of pairs in group per period, percent

	# of pairs in group		
period	0	1	2
1	42	50	08
2	27	59	15
3	19	64	17
4	15	73	12
5	13	63	25
total	26	59	15

Table B.1.2: Pairs in periods and breakup, percent

	% of possible	% of potential	breakup of pairs		
period	pairs	new pairs formed	% of total[a]	one sided	two sided
1	32	32	.	.	.
2	43	32	50	83	17
3	48	30	41	85	15
4	47	28	44	76	24
5	55	33	33	74	26
6	34	15	59	66	34
total	43	·	40	75	25

Note: Column three refers to the number of total unbroken of pairs from previous round.

[a] The total as a fraction of existing pairs in $t - 1$.

B.2 Statistics on transfer

Figure B.1: Distribution of transfer over periods

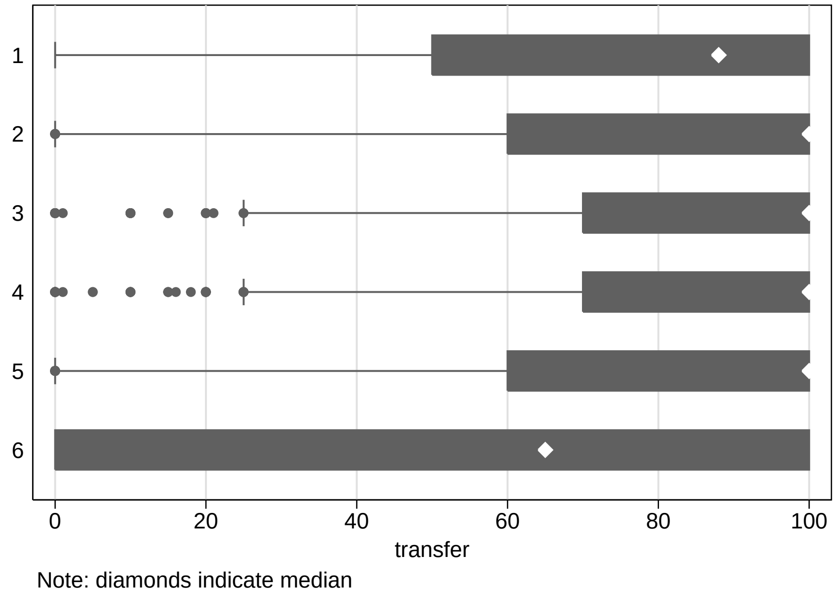
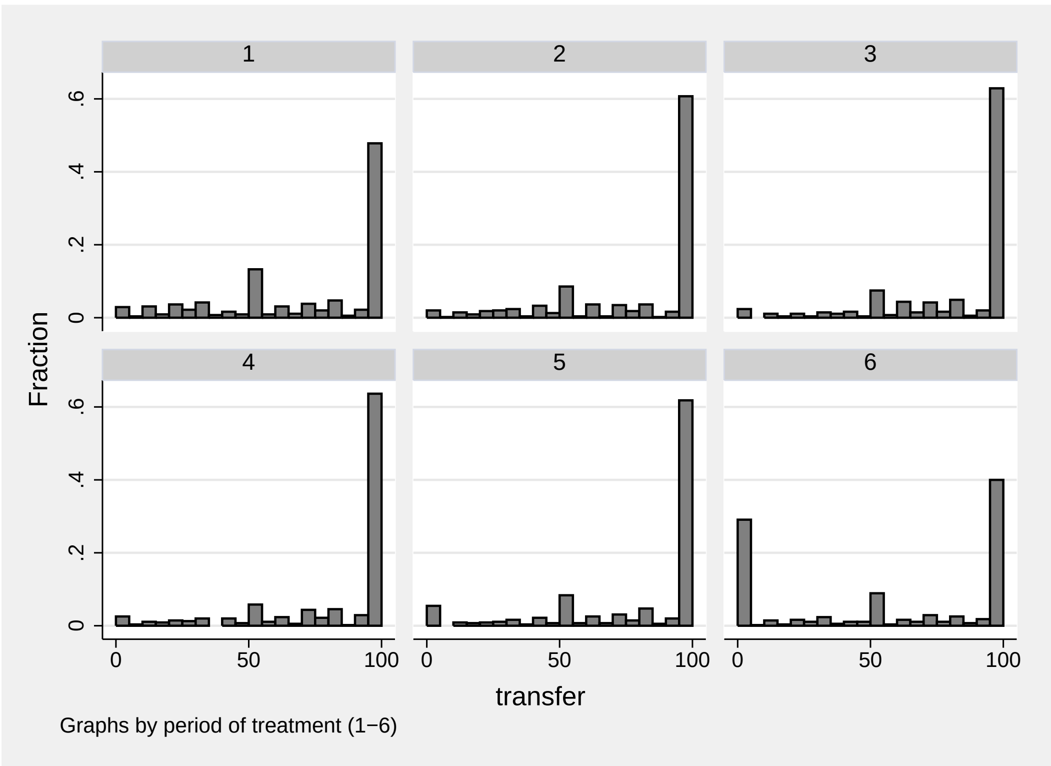


Figure B.2: Histogram of transfer, periodwise



B.3 Statistics on the return ratio and on the amount paid back

Figure B.3: Distribution of return ratio over periods

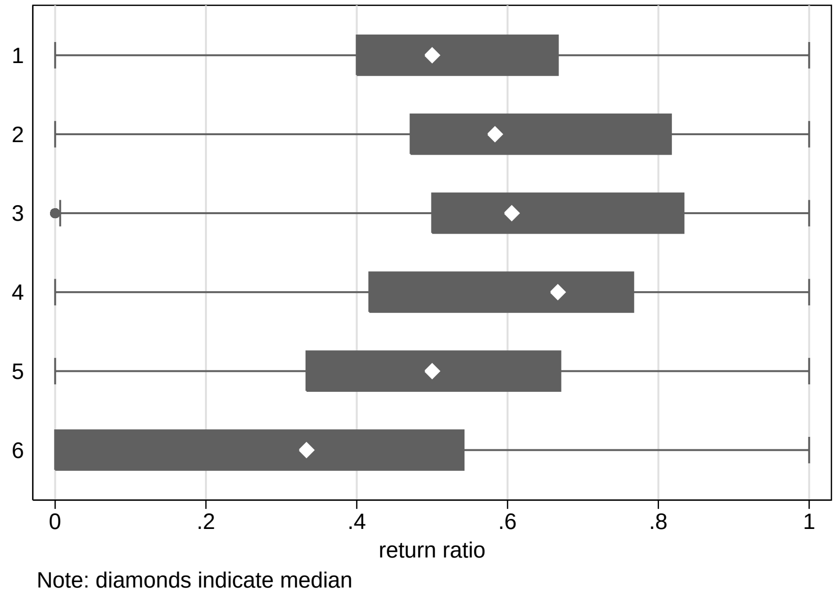


Figure B.4: Histogram of ratio returned, periodwise

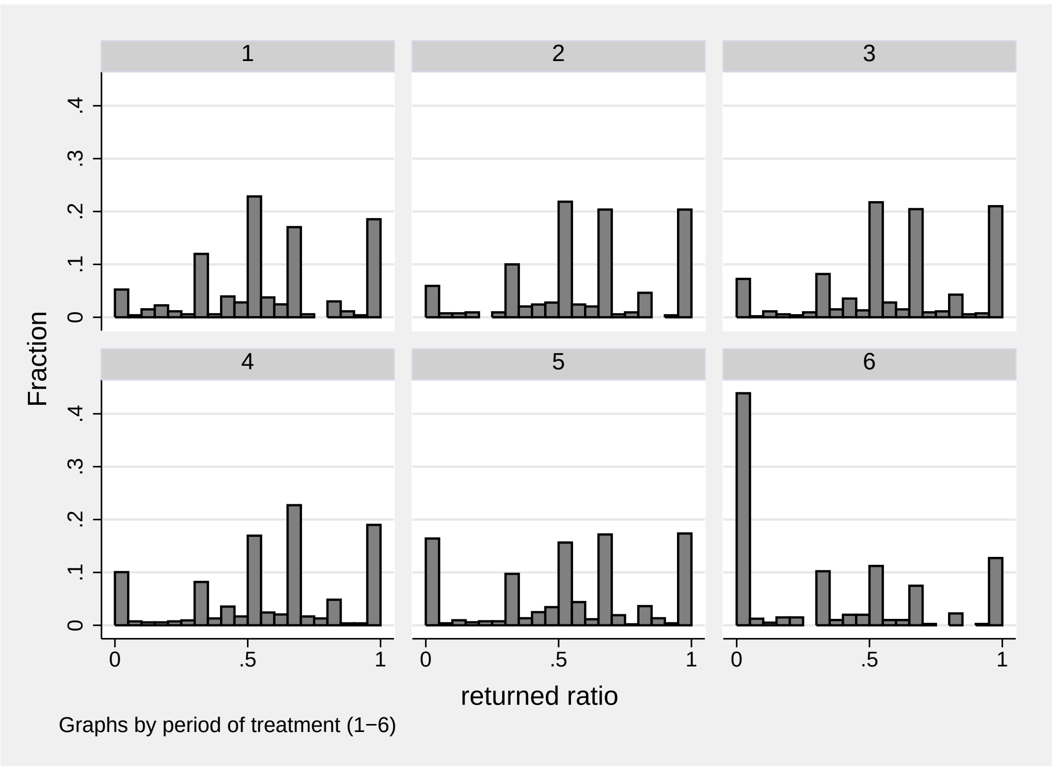


Figure B.5: Histogram of absolute amount returned, periodwise