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«Another experimental look at reciprocal behavior : indirect» reciprocity»

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Another experimental look at reciprocal behavior: Indirect reciprocity

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Abstract

We experimentally investigate a new form of indirect reciprocity. To that purpose, we put forward a framework that consists of a dictator game followed by an ultimatum game. In this three-player dictator-ultimatum game, the second player has the opportunity to indirectly reward or punish the first player by inciting the third player to accept or reject the division. We find that the proportion of reciprocal players increases when the third player is able to understand perfectly the intentions of the second player. At the same time, we experimentally investigate the generalized reciprocity which consists of a chain of reciprocity with a three-player dictator game. In this context, reciprocal behavior prevails. Such findings highlight a decrease in the proportion of reciprocal motivations as the complexity of strategic interactions increases.

Keywords Indirect reciprocity . Generalized reciprocity . Dictator game . Ultimatum game . Individual behavior

JEL Classification C72, C91, D63

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1. Introduction

Although most economic theories are based on the hypotheses of rationality and self-interest preferences, there is a growing awareness that reciprocity plays important role in economic relationships. In this regard, one important aspect of economic activities is fully concerned: negotiations. For instance, when subjects enter into an agreement, this often follows reciprocal concessions. Fehr et al. (1997) show that reciprocity is an effective contract enforcement device under conditions of contractual incompleteness. Two standpoints are mentioned in the literature. Some see reciprocity as an instance of enlightened self-interest promoted by repeated encounters (reciprocal altruism, Trivers 1971). Whereas for others reciprocity means that in response to kind (unkind) actions, subjects are frequently much nicer (more nasty) than predicted by the self-interest model (strong reciprocity, Gintis 2000). In this last case, subjects are not motivated by future material payoffs; they are viewed as moral and emotional reciprocators. All along this paper, we keep in mind this last definition, i.e. we define reciprocity as a conditional behavior that aims at rewarding kind actions and punishing unkind actions, even when it is costly and there is no direct self-interest to do so.

Experimental economics appears as a fruitful method to investigate such behavior. For example, in the past some studies have sought to highlight the consequences of reciprocity on economic activities (e.g. Fehr et al. 1997; Fehr and Gächter 2000), whereas others have used the tools of experimental economics to determine the factors that promote (or disfavor) reciprocal behaviors (e.g. Blount 1995; Offerman 2002; Stanca et al. 2007). Experimental studies provide clues as to whether subjects have reciprocal motivations. Widely disseminated conclusions about robust observations of reciprocity have motivated developments of theoretical models intended to improve the empirical validity of game theory. For example, Rabin (1993) proposes to incorporate some elements of reciprocity into the utility of subjects. He suggests that beliefs about intentionality (perception of others' intentions) may be as important as are monetary payoffs in driving fairness-related behaviors. Others develop models that incorporate payoff differences into the utility of subjects (e.g. Fehr and Schmidt 1999; Bolton and Ockenfels 2000).

In this paper, we do not intend to contribute to studies on motivations that underlie reciprocity. Instead, we propose two new forms that reciprocal behavior could take. While most researches on reciprocal behavior have primarily concentrated on direct reciprocity (i.e. bilateral relationships such as negotiations between a buyer and a seller), the major part of economic activity points out the intervention of a third actor (go-between in negotiation, for instance). This worry has recently led few economists to study reciprocity in multilateral relationships, and more precisely indirect reciprocity. As clearly mentioned by Albert et al. (2007), indirect reciprocity refers to a situation where cooperation or kindness is based on past behavior of one's partner towards a third subject (see the pioneering analyses of Nowack and Sigmund 1998a, 1998b). Indirect reciprocity implies that the *"return is expected from someone other than the recipient of the beneficence"* (Alexander, 1987, p. 85). Few economists have experimentally investigated the indirect reciprocity without however analyzing the same form of reciprocity. For instance, the studies of Dufwenberg et al. (2001) and Seinen and Schram (2006) deal with the indirect reciprocity where subjects reward or punish another subject not involved in the original situation. Our approach is distinct from this existing literature in two respects. First we propose a new form of indirect reciprocity where the return remains expected from someone other than the recipient of the initial beneficence; nevertheless this other subject is involved in the original exchange. Second, it is a *strong* indirect reciprocity that does not require any repetition. For instance, let us consider a negotiation between three subjects (*A*, *B* and *C*) who act sequentially. Indirect reciprocity proceeds as follows. Following *A*'s kind action towards *B*, *B* cannot directly reward *A* by acting kindly towards *A*. *B* can just act kindly towards a third subject, *C*, so as to incite *C* to be kind towards *A*. As a consequence, *C* has the opportunity to reward *A* by accepting the negotiation. Alternatively, if *B* perceives *A*'s action as unkind, *B* acts unkindly towards *C* who has the opportunity to punish *A* by rejecting the negotiation. This new form of indirect reciprocity may have practical applications in hierarchically structured organizations. In order to test the indirect reciprocity, we conduct an experiment on a new game we term a three-player dictator-ultimatum game. This game consists of a dictator game between player 1 and player 2 followed by an ultimatum game between player 2 and player 3. Through his offer to player 3, player 2 has the opportunity to incite him to accept (to reject) the offer - by offering a high (small) fraction of the offer made by player 1 - if player

1 makes a kind (unkind) offer. Player 2 has the opportunity to reward or to punish player 1, only in an indirect way, *via* the incentive given to player 3.

At the same time we experimentally investigate another new form of reciprocity in multilateral relationships we term generalized reciprocity, according to the definition provided by Ben-Ner et al. (2004) and Kolm (2006). Here, the generalized reciprocity triggers chains of cooperation or kindness, as in an intergenerational contract. As noticed by Kolm (2006), the french system of pensions is a suitable example to illustrate the generalized reciprocity. If we go back to the relationship between the three subjects *A*, *B* and *C*, the generalized reciprocity proceeds as follows: *A*'s kind (unkind) action towards *B* implies that *B* acts similarly towards *C* without any consequences on *A*. A sequential three-player dictator game is used to examine the generalized reciprocity.

Results from the experiment allow us to draw several conclusions. Both reciprocities in multilateral relationships exist. Regarding the former, between 55.55% and 73.68% of player 2s - according to the information treatment - express indirect reciprocity as described here. Secondly, we find a large proportion of choices to be consistent with the generalized reciprocity (85% of player 2s express this behavior). An explanation could refer to the low level of strategic interactions among players in the game used to study the generalized reciprocity. In other words, the proportion of reciprocal subjects in our sample decreases as the complexity of the setting increases.

The remainder of this paper is organized as follows. Section 2 presents the indirect and generalized reciprocity as well as the games used in this experiment. Section 3 describes the experimental design, a set of testable hypotheses and the procedure. Section 4 reports and analyzes the results. Section 5 concludes.

2. Indirect and generalized reciprocities

Rabin (1993) convincingly argues that intentions play a crucial role when subjects (henceforth players) are motivated by reciprocal fairness. Hence, as noted by Dufwenberg and Kirchsteiger (2004), intentions depend on the beliefs of the players and the kindness of players also depends on the possibilities they have. As a consequence, to evaluate the kindness of an action, they infer from other players' choices by comparing these choices with respect to their set of possibilities. Such reasoning underlies the two forms of reciprocity studied in our experiment. To address this issue, we use the Strategy Method to elicit players' strategy[1]. Players submit in advance their choice at each possible decision that can be made by the upstream player. Actual play is then computed from the choices submitted, and payoffs generated accordingly (we will see more precisely how the Strategy Method proceeds in section 3.3). This framework allows us to observe whether players differ in their behavior in accordance with upstream player's intentions. Their choices can thus provide insight into what players consider to be "*fair*".

2.1. Indirect reciprocity

The indirect reciprocity occurs in a situation where a player (henceforth player 2) could not be directly kind or unkind towards an upstream player (henceforth player 1). The sole action of player 2 consists of inciting a third player (henceforth player 3), involved in the original situation, to act according to his wishes. For instance, when player 1 makes an unkind (kind) offer to player 2, player 2 proposes a small (high) fraction of the amount received to player 3 in order to incite player 3 to reject (accept) the offer and therefore to punish (reward) player 1. Player 2 appears as an intermediary player whose only action is to influence the choice of player 3 in the desired sense.

To highlight indirect reciprocity we conduct an experiment on a new game we term a three-player dictator-ultimatum game (henceforth DUG). This game consists of a dictator game between player 1 and player 2 followed by an ultimatum game between player 2 and player 3. More precisely, the game proceeds as follows. Participants are randomly assigned to be player 1, player 2 or player 3. Player 1 offers an allocation of money to player 2 without determining the allocation of each opponent

[1] It is possible that the Strategy Method elicits different behaviors compared to responses to actual choices. Nevertheless, empirical evidences are mixed. For instance, Brandts and Charness (2000) or Oxoby and McLeish (2004) find insignificant differences in behavior contrary to Brosig et al. (2003). Roth (1995) pointed out that the Strategy Method overrides the timing of decisions and accordingly evidences for emotions and reciprocity are not clear in this case. That might be true but we find strong support for reciprocity here.

(player 2 and player 3). Player 2 has no veto power and has to propose a division of player 1's offer to player 3. Finally, player 3 decides whether to accept or reject player 2's offer. If player 3 accepts it, all players get the proposed amount. Conversely, if player 3 rejects it, neither player gets anything. According to non-cooperative game theory, a self-regarding player 3 will accept any positive amount of money. Knowing this, a self-regarding player 2 will offer the minimum possible to player 3. Finally, player 1, by anticipating such behaviors, offers the minimum possible to player 2. Therefore the subgame perfect equilibrium is: $X-\varepsilon, \varepsilon_1, \varepsilon_2$, where X denotes the initial endowment, and $\varepsilon, \varepsilon_1, \varepsilon_2$ are positive numbers, as small as possible, with $\varepsilon = \varepsilon_1 + \varepsilon_2$. Nonetheless, in order to allow player 2 to make a choice, whatever the proposal player 1 makes, this latter cannot offer zero to player 2.

We assume that indirect reciprocity will be empirically confirmed if player 2's relative offer (i.e. the percentage of the offer made by player 1 that is proposed to player 3) is positively correlated with player 1's (Figure 1). In order to capture this, we introduce an attitude function (as Kirchsteiger and Sebald 2006):

$$s(x) \to [0,100], \text{ with } s'(x) > 0 \text{ and } s''(x) = 0$$

with s denoting the relative offer of player 2 and x the one of player 1.

We assume an increasing and linear relationship between the relative offers received by player 2 and the relative offers he makes. Figure 1 depicts such behavior and compares it to the equal split.

--------------------------------------*[Insert Figure 1 about here]*---

Fig. 1 Indirect reciprocity Vs. Equal split

2.2. Generalized reciprocity

Another form of reciprocity, known as generalized reciprocity according to the terminology used by many researchers (Ben-Ner et al. 2004; Kolm 2006), is investigated. Generalized reciprocity raises a somewhat different issue of whether kind (or unkind) actions made by player 1 towards player 2 will increase the tendency of player 2 to act similarly towards player 3 without any further consequences on player 1's payoff. Cox (2007) perfectly illustrates generalized reciprocity by taking the example of drivers in a congested roadway: "*If another driver extends me the courtesy of letting me into the street, the probability is essentially 1 that I will extend the same courtesy to the next driver I encounter on that trip.*", (Cox, 2007, p.3-4).

The examination of generalized reciprocity requires removing the veto power of the third player from the DUG. As a result we set up a sequential three-player dictator game (henceforth three-player DG). The theoretical prediction remains the same $(i.e.\ X-\varepsilon, \varepsilon_1, \varepsilon_2)$. Similarly to the previous game, player 1 cannot offer zero to player 2.

It is noteworthy that both indirect and generalized reciprocities involve positively reciprocal behavior and negatively reciprocal behavior while the simultaneous study of positive and negative reciprocity is not usual. Some experimental games are used to elicit positively reciprocal behavior such as trust game or gift-exchange game (Falk 2007; Falk and Gächter 2002, respectively) whereas others like ultimatum game or public good game with punishment (Güth et al. 1982; Fehr and Gächter 2000, respectively) are used to elicit negatively reciprocal behavior. Only few experimental studies seek to test the presence of both positive and negative reciprocity within individuals. Whereas positive and negative reciprocity might be expected to derive from the same underlying trait, Dohmen et al. (2006) find that these traits are behaviorally distinct with potentially different determinants. Our concepts of indirect and generalized reciprocities – which require both positive and negative reciprocity – are therefore more restrictive. In fact, if player 2s share equally the kind offer made by player 1s, such an action could be considered as positive reciprocity. But if they share equally the unkind offer made by player 1s, then they always share equally the amount received. In that case, the intentions of player 1s have no effect on the choices player 2s make. They are only "*fair*", whatever player 1s' intentions. An analogous argument holds if player 2s share unequally the offer made by player 1s, whatever player 1s' intentions. In that case, they act "*unfairly*" and not reciprocally.

3. Experimental design

3.1. Information treatments

Our experimental procedure is designed to explore the presence of both indirect and generalized reciprocities. To that purpose, we conduct five treatments and players only belong to one treatment. The first three treatments aim at revealing the potential existence of indirect reciprocity whereas the last two deal with the generalized reciprocity.

In the first three treatments, player 3s have a veto power and we change the available information of the last two players. Nature chooses the amount of the initial endowment, X, with probability $1/2$ for $X = F$ and $1/2$ for $X = f$. The potential values of X and their probabilities are common knowledge. In all treatments $F = 2f$ and $f = 2{,}000$ points[2]. When players face incomplete information, they were told in their instructions that half player 1s have the large endowment and the other half the small one. Furthermore, only players who have complete information are informed about the value of the endowment X that has been chosen. In treatment A (henceforth TA), the baseline treatment for indirect reciprocity, only player 1s learn which value of X has been chosen; player 2s face incomplete information about X and player 3s face incomplete information about X and player 1s' offer. Treatment B (henceforth TB) differs from TA only in that player 2s know the true value of X. Treatment C (henceforth TC) differs from TB only in that player 3s know player 1's offer. In other words, player 3 faces incomplete information with regard to X.

In the last two treatments player 3s have no veto power in order to examine the generalized reciprocity. In treatment D (henceforth TD), the baseline treatment for generalized reciprocity, only player 1s know the true value of X whereas player 2s and player 3s face incomplete information (as in TA). Finally, in treatment E (henceforth TE) only player 3s face incomplete information (as in TB). Table 1 summarizes the five treatments.

--*[Insert Table 1 about here]*------------------------------------

[2] The conversion rate used was 100 points = 1 euro and offers were made by interval of 100 points.

3.2. Behavioral hypotheses

It is noteworthy that due to the experimental design used, several behavioral hypotheses for player 2s are likely to occur besides the indirect and generalized reciprocities. The questions or issues raised in our experiment can be explicitly stated in terms of the following hypotheses.

Hypothesis 1. True motivations: Selfishness or social preferences?

TD allows discerning what kind of motivations may be generating the choices made by player 2s since they cannot be influenced by player 1s' offer due to their incomplete information, neither by the fear of rejection since player 3s have no veto power. In such framework, if we denote by s the player 2s' relative offer and $\bar{s}$ the equal split[3], then player 2s demonstrate one of the two following motivations. Player 2s offer zero ($s = 0$) to player 3s and we conclude that they have selfish motivations (Hypothesis H1A). Or player 2s offer a positive amount ($s > 0$) to player 3s and we infer that they have "*altruistic*" motivations (Hypothesis H1B). In this last case, player 2s make either an "*unfair*" offer and $0 < s < \bar{s}$ (Hypothesis H1B-1) or player 2s make a "*fair*" offer and $s \geq \bar{s}$ (Hypothesis H1B-2).

Hypothesis 2. Fear of rejection

It is well-known since the pioneering experiment of Forsythe et al. (1994)[4] that the comparison of dictator game offers and ultimatum game offers allows separating offers into a fairness component and a strategic component where the latter is a calculation in order to maximize the expected payoff.

[3] By assuming that players use equal split as a benchmark for evaluating the "*fairness*" of an offer. According to the experimental literature, we consider that the threshold from which player 2s are "*fair*" is such that they propose at least 40% of the offer player 1s make (the strict equal split would be equal to 50%).

[4] Forsythe et al. (1994) used the dictator game in order to examine which share of the offers observed in the ultimatum game can be explained by altruistic motivations. By removing the veto power of the responder any strategic reason for generous offers - such as fear of rejection - in the dictator game is eliminated, thus leaving only social preferences as possible explanations.

So, the larger the discrepancy between ultimatum game offers and dictator game offers, the larger the strategic component in making offer. Consequently, if player 2s in the three-player DG make, on average, smaller relative offers than the ones in the DUG - under the same information - then offers in the DUG have to be justified by the fear of rejection rather than by a true preference of fairness[5]. The thread of rejection (Hypothesis H2) will be empirically satisfied if: mean relative offer (TA) > mean relative offer (TD) in case of incomplete information and mean relative offer (TB) > mean relative offer (TE) in case of complete information.

Hypothesis 3. Influence of player 1s' intentions

To test whether player 2s are influenced by player 1s' intentions when they make their choices, we proceed in two stages.

Firstly, we compare relative offers made under complete information and those made by player 2s who face incomplete information. The latter cannot be influenced by player 1s' intentions. As a consequence, such comparisons provide a test for the "*income effect*" hypothesis. The "*income effect*" hypothesis assumes that player 2s make a higher relative offer to player 3s since they have the opportunity to share a larger amount, without any consideration for the fairness of player 1s. The rejection of the hypothesis of "*income effect*" leads us to gather that player 2s are influenced by player 1s' intentions when they make their choices.

Secondly, we explore individual correlations between the player 2s' relative offers and the offers player 1s make. Two situations are conceivable.

- Player 2s are influenced by player 1s' intentions and thereby they adjust their relative offers accordingly (Hypothesis H3A). They have either indirect or generalized reciprocal motivations according to the treatment (Hypothesis H3A-1). In this case, the relative offers made by player 2s are positively related to player 1's offers. Or they act strategically to maximize their expected payoff (Hypothesis H3A-2). Here, their relative offers are guided by the desire to maximize their expected payoff without any intention to punish or reward player

[5] We cannot compare offers in TC with TE since more than one component varies between these treatments.

1s. In this aim, the higher player 1s' offer, the smaller player 2s' relative offer, but high enough to incite player 3s to accept it. Finally, data obtained in TB will be compared to those obtained in TC so as to study the impact of player 3s' available information on player 2s' behaviors. We guess that the information of TC reduces the incentives of behaving strategically. It will be interesting to examine whether player 3s' understanding of player 2s' choice promotes indirect reciprocal behavior.

- Player 2s are not influenced by player 1s' intentions (Hypothesis H3B). We do not observe any difference in player 2s' relative offers according to each player 1s' possible offer. Yet, player 2s can have two types of motivation. They have either selfish motivations and consequently offer zero ($s = 0$) to player 3s (Hypothesis H3B-1). Or they have "*altruistic*" motivations and propose a positive offer ($s > 0$) without any correlation with player 1s' (Hypothesis H3B-2).

3.3. Participants and procedures

The sessions were conducted manually at the University of Montpellier I in the Laboratory of Experimental Economics of Montpellier (LEEM). At the beginning of the experiment, to ensure anonymity, participants drew cards to determine their role. Then, they were randomly assigned to seats, which were separated by partitions. No communication was allowed. Participants were randomly assigned to three-person group. Each group consisted of a player 1, a player 2 and a player 3. We used a between-subjects design to avoid the possibility of order or learning effect and a one-shot game so that no participant could ever gain a reputation for being, for instance, "*fair*". This experimental procedure allows circumventing the fear of further retaliations or conversely the hope of further rewards. Moreover, no participant had taken part in experiments similar to the present one. We organized three sessions for T1, three sessions for T2 with 18 participants per session; three sessions for T3 with 21 participants per session; and four sessions for T5, four sessions for T6 with 15 participants per session.

291 undergraduate students[6] were recruited with a standardized e-mail message from a computerized database of students that had volunteered to participate in experiments by registering them on the web site of the LEEM. Participants were students from various departments including history, marketing, mathematics, physics, economics, etc. Prior to the experiment, the participants were told that (i) the money they earned would depend on their decisions and the decisions of others in their experimental group, (ii) they would be paid the earnings of the game at the end of the experiment. A show-up fee of 3 euros was added to cover participation expenses.

As previously mentioned, we used the Strategy Method to elicit player 2s' strategies. The Strategy Method permits to measure how much player 2s would propose for every possible amount received, as figure 2 below shows. This lets us observe whether the relative amount player 2s propose depends on player 1s' intentions. Figure 2 shows how this task looks in our experiment. The use of this method requires some calculations to determine final results of the game. More precisely we proceed as follows. We had selected answers from all members of each group. For player 1's offer, we had associated player 2's share, and once this division selected, we had noted if player 3 - who has to indicate its minimal acceptable offers - accepted or rejected the offer proposed by player 2. The last stage refers only to the DUG since in the three-player DG player 3s have no veto power.

Participants were given written instructions [7] that outlined the purpose of the experiment. Each participant read the instructions before completing a pre-experiment questionnaire. In particular, they had to indicate the payoff of each player under different alternatives of the game. Participants were only allowed to begin after the experimenters had checked the answers to all pre-experiment questionnaires. In addition, a summary containing the vital elements of the procedures was read aloud to participants by the experimenters. For each treatment, one session lasted one hour.

[6] Altogether we recruited 291 participants which include the ones who are "player 1", "player 2" and "player 3". This paper focuses on player 2s' behaviors where we have: 18 "player 2" in TA, 18 in TB, 21 in TC, 20 in TD and 20 in TE. Unfortunately, due to the elimination of participants who failed to understand the instructions, we did not manage to have the same amount of data in each treatment.

[7] Instructions are available from the authors upon request.

--------------------------------------*[Insert Figure 2 about here]*---------------------------------------

Fig. 2 Player 2's decision task

4. Results[8]

The results are presented in three subsections. We first present the true motivations of player 2s, then we examine the influence of player 3s' veto power before exploring the impact of player 1s' intentions on player 2s' choices.

4.1 True motivations

Although our focus is on the influence of player 1s' intentions on player 2s' choices, it is also useful to investigate the true motivations of player 2s. We recall that in TD, player 2s and player 3s face incomplete information about player 1s' endowment and player 3s have no veto power. In such context player 2s cannot be influenced by other players when they make their choices. Consequently we say that this treatment promotes the revelation of their true motivations. Table 2 summarizes player 2s' behavior per treatment depending on their average relative offer. The average relative offer (28.32%) hides a great heterogeneity of motivations that is illustrated by figure 3. Figure 3 presents the histogram for the distribution of relative offers. More precisely, figure 3 shows how the average relative offers of player 2s differ. We note that the largest proportion of choices is positive but "*unfair*", even if the modal class is the 40-50% of the offer received. Besides these choices, 15% of player 2s have selfish motivations (i.e. they give nothing to player 3s) and no one gives 50% or more of the offer received.

----------------------------------*[Insert Table 2 & Figure 3 about here]*-------------------------------

Fig. 3 Heterogeneity of player 2s' behaviors in TD

[8] We focus on results obtained for player 2s where their offers are expressed in percentage of the offer received.

4.2. Impact of player 3s' veto power on player 2s' choices

We next consider the question of whether player 2s are influenced by the veto power of player 3s. Comparison of choices made in the DUG and in the three-player DG points out the impact of player 3s' veto power on decisions made by player 2s. Figures 4 and 5 depict its impacts according to the available information.

Firstly, when player 2s have incomplete information about player 1s' endowment, relative offers are significantly different between both games. On average player 2s offer 45.16% of the offer received in TA and only 28.32% in TD ($p < 0.001$; Mann-Whitney U test). This difference is also significant when we compare the type of player 2s' relative offers as depicted by figure 4: (i) no player 2 acts selfishly when player 3s have a veto power (TA), contrary to TD; (ii) offers classified as "*unfair*" are less frequent (64.70% in TD vs. 22.23% in TA; p<0.001; Chi-square test) and slightly less pronounced when player 3s have a veto power (player 2s offer on average 36.28% in TA vs. 27.60% in TD; $p = 0.151$; Mann-Whitney U test); (iii) similarly, "*fair*" behaviors are more frequent (35.30% in TD vs. 77.77% in TA; p<0.001; Chi-square test) and more pronounced (player 2s offer 43.79% in TD vs. 47.70% in TA; $p = 0.039$; Mann-Whitney U test) when player 3s have the opportunity to reject the proposal. These results support the hypothesis that introducing a veto power from the three-player DG has a substantial impact on player 2s' behaviors, heading towards larger relative offers.

------------------------------------*[Insert Figure 4 about here]*---

Fig. 4 Impact of player 3s' veto power on player 2s' choices in case of incomplete information

Secondly, let us turn to the comparison when player 2s have complete information about player 1s' endowment. The observed changes are amazingly less relevant (40.11% in TB vs. 30.21% in TE; $p = 0.178$; Mann-Whitney U test). A detailed analysis clarifies the reason for this observation. We only note (i) the suppression of selfish behaviors and (ii) offers classified as "*unfair*" less marked (31.18% in TB vs. 16.50% in TE; $p = 0.021$; Mann-Whitney U test). Figure 5 and Chi-square test shed more light on the lack of differences with regard to the frequency of "*unfair*" and "*fair*" offers (44.45% in TB vs. 47.37% in TE; *p*=0.753 for the former; 55.55% in TB vs. 52.63% in TE; *p*=0.774 for the latter). We interpret the above findings (i.e. under complete information) as evidence that the fear of rejection does not constitute an explanation of observed choices. Our conclusion contradicts previous results obtained by Forsythe et al. (1994) - and often replicated - who notice a significant reduction in offers in the dictator game compared to the ultimatum game. They accordingly conclude that the threat of rejection leads player 1s to make larger offer.

---------------------------------*[Insert Figure 5 about here]*--

Fig. 5 Impact of player 3s' veto power on player 2s' choices in case of complete information

4.3. Influence of player 1s' intentions on player 2s' choices

4.3.1. Do intentions matter?

The central finding of this paper is clear upon examination of player 2s' relative offers according to player 1s' intentions. To that purpose, we have to reject the hypothesis of "*income effect*" (i.e. the larger player 1s' offers, the larger player 2s' relative offers, without any consideration for the fairness of player 1s). For this reason, we rely on the comparison of the distributions of player 2s' relative offers from the five treatments. This comparison is used to discriminate among choices determined solely by the "*material side*" and choices influence - at least in part - by intentions of the upstream player. If we consider the aggregate behavior of all player 2s, the Kruskal Wallis test rejects the null hypothesis of "*income effect*", i.e. the distributions of relative offers are the same in all treatments ($\chi^2(4) = 148.997$, $p < 0.001$). Moreover it is important to note that the distributions of player 2s' relative offers between TA and TB and those between TD and TE are significantly different at the 1% level. One interprets this finding as an indicator of the impact of player 1s' intentions on player 2s' choices. Since player 2s are influenced by the intentions of player 1s, we now proceed in two stages to ascertain the type of reaction that occurs in complete information. We first consider results for the DUG and next data from our three-player DG.

4.3.2 Indirect reciprocity Vs strategic behaviors

In order to gain further insights into the driving forces behind player 2s' behaviors in the DUG, we look for correlations between player 1's offers and player 2's relative offers at the individual level[9]. This allows us to classify player 2s into two groups according to the relationship between the offers received and the relative offers they make. Those with a negative correlation are the strategic player 2s and those with a positive correlation are the reciprocal player 2s.

In the game under consideration, both strategic and reciprocal motivations are observed in each treatment. The calculation of individual correlations underlines a dichotomy of motivations in TB. Figures 6 and 7 depict the patterns of such behaviors and show how average relative offers in each treatment vary according to player 1s' relative offers. The Spearman rank correlation test[10] shows that 44.45% of player 2s act strategically (Hypothesis H3A-2; r = -0.705, $p < 0.001$ when $X = F$ and r = -0.929, $p < 0.001$ when $X = f$). One point to note in figure 6 is the clear decrease in player 2s' relative offers. They offer almost 90% of the amount received when the offers made by player 1s are very small and when these latter become large they offer less than 50%. Nevertheless, from a player 1s' offer close to 65% of their endowment, the relative offers made by player 2s are roughly stable. This means that strategic player 2s find harder to propose a small relative offer the more the money is at stake since they seek to maximize their expected payoff and the probability of acceptance accordingly. For the others (55.55% of player 2s) the relative offers they make are positively correlated to the offers received (r = 0.561, $p < 0.001$ when X = F and r = 0.669, $p < 0.001$ when X = f). We conclude from

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[9] As we have seen in the section on reciprocity (section 2), the DUG is used to explore indirect reciprocity while generalized reciprocity could occur in the three-player DG.

[10] All coefficients of correlation in this paper are calculated with this method. The coefficient of correlation is calculated on the average of player 2s' relative offers, for each player 1s' offer. Nonetheless, the distinction between players paired with player 1s who have f and those who have F is required since the threshold for "*fair*" offers differs according to the amount of the initial endowment.

the Spearman rank correlation test that 55.55% of player 2s exhibit indirect reciprocity (Hypothesis H3A-1). Figure 7 sheds more light on the influence of player 1s' relative offers on player 2s' relative offers. It shows a zero offer when player 1s propose the smallest offer in order to incite player 3s to reject the offer. Then we note a strong increase in player 2s' relative offer until player 1s offer 10% of their endowment before a slight stabilization between 40-50% of the offer received. These latter choices aim at inciting player 3s to accept the offer so as to indirectly reward the kindness of player 1s.

In order to support our findings we rely on the comparison of the average of player 2s' relative offers when player 1s make offers below the equal split and the average of player 2s' relative offers when player 1s make offers beyond the equal split, for both strategic and reciprocal player 2s. The Wilcoxon sign rank test confirms the relevance of the influence of player 1s' intentions for reciprocal player 2s ($Z = -2.805$, $p = 0.005$) and the amount at stake for strategic ones ($Z = -2.521$, $p = 0.012$). Nonetheless, we wish to highlight at this point that our evidences are clear but limited since we do not find strong behavioral differences. For instance, player 2s who express reciprocity do not make a zero offer when player 1s are "*unfair*" and, subsequently, when player 1s become "*fair*" they do not share equally the offer received. The opposite argument holds for player 2s who act strategically[11]. We witness a low level of changes in behaviors.

----------------------------------*[Insert Figures 6 & 7 about here]*-------------------------------------

Fig. 6 Trend of player 2s' relative offers in case of strategic behaviors

Fig. 7 Trend of player 2s' relative offers in case of reciprocal behaviors

As expected in TC, player 3s' available information (i.e. the knowledge of offers player 1s make) promotes indirect reciprocity (55.55% in TB vs. 73.68% in TC). Unfortunately, the difference fails to be statistically significant ($p=0.114$; Chi-square test). The proportion of reciprocal players is

[11] This observation explains that the introduction of a dummy variable representing the intentions of player 1s (this variable being equal to 1 if player 1s have "*fair*" intentions and 0 otherwise) is rarely significant in further random-effects ordered probit regressions. That is why regressions are implemented without it.

not only higher but the positive correlation is also stronger, whatever the level of the endowment (r = 0.945, $p < 0.001$ when $X = F$ and

r = 0.719, $p = 0.001$ when $X = f$). Figure 7 shows that from an offer of player 1s larger than 15% of their endowment, in the TC the relative offers made by player 2s are higher than in the TB. For the others (i.e. 26.32% of player 2s), we note a negative correlation between the offers received and the relative offers they make that supports the hypothesis of strategic behaviors (r = -0.213, $p = 0.188$ when $X = F$ and r= -0.649, $p = 0.002$ when $X = f$). The negative correlation observed in TC is noticeably less strong compared to the one in TB and the proportion of strategic players decreases from 44.45% in TB to 26.32% in TC ($p = 0.031$; Chi-square test). We conclude that player 2s are influenced by the appraisal of player 3s when they make their choices. The information provided in TC reduces the incentives of behaving strategically.

As noted by Fehr and Gächter (2000), there is a substantial proportion of players who behave for reciprocal reasons but there is also a non-trivial proportion of players who exhibit strategic reasoning. The proportion of indirect reciprocal players in our experiment is quite similar to the one reported by Fehr et al. (1997) who find that between 40% and 60% of subjects engage reciprocal behavior in bilateral relationships.

4.3.3 Generalized reciprocity Vs strategic behaviors

We use TE to explore the generalized reciprocity. In the treatment under consideration, the data analysis shows that 85% of player 2s express generalized reciprocity and the strength of positive correlation is similar to that of TC (r = 0.744, $p < 0.001$ when $X = F$ and r = 0.972, $p < 0.001$ when $X = f$ in TE). This finding implies that in the three-player DG, although any advantages to be gained from the absence of a veto power (the opportunity to give nothing in order to maximize their payoffs without any risk, for instance), 85% of player 2s exhibit the generalized reciprocity. For the other player 2s, data reported in Table 2 indicate that 5% of player 2s act selfishly which supports the prediction of game theory (i.e. player 2s are money maximizers; Hypothesis 3B-1). While the selfish behavior can easily be explained in the three-player DG, the choices made by the remainder 10% is more difficult to interpret since their choices highlight a negative correlation between the offers received and the relative offers to player 3s they make. By analogy with the terminology used in the DUG, we call this behavior a "*strategic behavior*" even if the meaning of this strategy is misplaced in this context. We conclude that the large majority of player 2s agrees with the above mentioned statements, implying that generalized reciprocity is the rule rather than the exception.

Yet, we make intrapersonal comparisons of choices to examine whether player 2s change their relative offers according to player 1s' offers. More precisely, we compare the average of player 2s' relative offers when player 1s make offers below the equal split and the average of player 2s' relative offers when player 1s make offers beyond the equal split. The Wilcoxon sign rank test shows that the average relative offer is significantly higher when player 1s make offers beyond the equal split than below it for reciprocal player 2s[12] (Z= -3.362, $p < 0.001$). A closer inspection reveals however that there is substantial heterogeneity in the strength of reciprocal inclinations among players.

Finally, our data point out that a significantly larger proportion of player 2s exhibit generalized reciprocity than indirect reciprocity when player 2s have the same available information (85% in TE vs. 55.55% in TB; p=0.015; Chi-square test). The proportion of indirect reciprocal players comes close to that of generalized reciprocal players when player 3s have the opportunity to perfectly understand the underlying intentions of player 2s (73.68% in TC vs. 85% in TE; p=0.383; Chi-square test). However, we should emphasize that in TB and TC the relative offers made by player 2s are higher than in TE. Our results suggest that the complex framework of the DUG seems to lower preferences for reciprocity promoting strategic behaviors.

4.3.4. Econometric analysis

In this subsection we probe deeper into the previous issue. We provide an econometric analysis of whether player 1s' intentions influence - positively or negatively - the choice made by reciprocal and strategic players, respectively. The data set is extended to all possible offers of player 1s and their

[12] We haven't got enough data for strategic player 2s to perform the Wilcoxon sign rank test.

impacts on the type of player 2's relative offers are estimated. Consequently, we have several observations per subject (one for each player 1's possible offer) and hence we estimate panel models. Rather than player 2's relative offer to player 3, we focus on the type of player 2's relative offer. To that purpose, we use ordered probit regressions. The dependent variable is the type of player 2's relative offer y and the partition of the domain of y into subsets is such that[13]:

$$y_i = \begin{cases} 0 & if\ \ player\ \ 2\ offers\ less\ than\ 20\%\ of\ \ the\ i^{th}\ \ player\ 1's\ offer \\ 1 & if\ \ player\ \ 2\ offers\ between\ 20\%\ and\ \ 40\%\ of\ \ the\ i^{th}\ \ player\ 1's\ offer \\ 2 & if\ \ player\ \ 2\ offers\ at\ least\ 40\%\ of\ \ the\ i^{th}\ \ player\ 1's\ offer \end{cases}$$

The observed level of the type of relative offer is assumed to be related to the continuous latent variable of kindness y_i^* in the following way:

$$y_i = \begin{cases} 0 & if\ \ y_i^* \le c_1 \\ 1 & if\ \ c_1 < y_i^* \le c_2 \\ 2 & if\ \ y_i^* > c_2 \end{cases} \qquad \forall i = 1,...,N$$

with $c_2 > c_1$ and the latent variable y_i^* is as follows:

$$y_i^* = Z_i \beta + \varepsilon_i$$

with $Z_i = (Z_i^1,...,Z_i^K), \forall i = 1,...,N$, $\beta = (\beta_1,...,\beta_K)' \in \Re^K$, where β denotes the vector of parameters to be estimated, K is the number of explanatory variables Z_i and ε_i the error term assumed to be i.i.d and normally distributed $(0,\sigma_\varepsilon^2)$.

[13] These threshold values are directly in line with explanations provided by the experimental literature. If player 2s propose less than 20% of the amount received, they are classified as selfish (a selfish player would be the one who proposes 0 but we haven't got enough observations to create such class); if they offer between 20% and 40% of the amount received, they act kindly without making an equal split; lastly, if they propose at least 40% of the amount received they are seen as "*fair*" even if the strict equal split would be equal to 50%.

The panel structure of our sample provides the opportunity to control for individual effects. The substantial heterogeneity observed in our sample leads us to rule out models with fixed individual effects[14]. As a consequence, the statistical framework used is the random-effects ordered probit model to allow for unobserved heterogeneity. The j^{th} type of relative offer player 2s make $(\text{with } j = 1, \ldots, J)$, with respect to the i^{th} offer player 1s make $(\text{with } i = 1, \ldots, N)$ is specified as follows:

$$y^*_{ji} = Z_{ji}\beta + \mu_j + \varepsilon_{ji}$$

where μ_j denotes the individual specific term, and ε_{ji} is the normally distributed random error term with $(0, \sigma^2_\varepsilon)$. The random components μ_j are normally distributed $(0, \sigma^2_\mu)$ and μ_j are independent of ε_{ji}. In addition, Z_{ji} are independent of μ_j and ε_{ji} $\forall\{i, j\}$. However, we do not observe y^*_{ji}, but rather an indicator variable:

$$y_{ji} = \begin{cases} 0 & \text{if } Z_{ji}\beta + \mu_j + \varepsilon_{ji} \leq c_1 \\ 1 & \text{if } c_1 < Z_{ji}\beta + \mu_j + \varepsilon_{ji} \leq c_2 \\ 2 & \text{if } Z_{ji}\beta + \mu_j + \varepsilon_{ji} > c_2 \end{cases}$$

As usual in random-effects ordered probit model, we assume that $c_1 = 0$ and $\sigma^2_\varepsilon = 1$. Due to the small amount of data for strategic or reciprocal player 2s in some treatments[15], our analysis is based on pooling the data corresponding to all treatments where player 2s have complete information (i.e. TB,

[14] As Vieira (2005), in the absence of a satisfactory fixed-effects estimator for the ordered probit model we rely on the random-effects ordered probit specification. In order to have an indication as to whether this hypothesis is reasonable for the case under analysis, we have run ordinary least square equations for player 2's relative offers and we have performed a Hausman test. The obtained statistics (H = 1.59, p=0.451 for reciprocal subjects and H = 0.80, p=0.671 for strategic subjects) favor the random-effects model.

[15] Results obtained in random-effects ordered probit regressions per treatment and type of players are available from the authors upon request.

TC and TE) [16]. All regressions include dummies for treatment effect, using TB as the baseline treatment[17]. We provide two different regressions. The first one deals with player 2s we have classified as reciprocal and the second refers to player 2s considered as strategic. We include as explanatory variables[18] the logarithmic player 1's relative offer $(\ln(x_{ji}))$ and a dummy variable corresponding to the initial endowment ($X_{ji} = 1$ if player 1s have the large endowment and 0 otherwise). The model is estimated by maximum likelihood methods using the random-effects ordered probit routine of the statistical package Stata[19].

---*[Insert Table 3 about here]*---

Table 3 reports the results of the regressions analysis. Firstly, the estimates support our gathering of data since dummy variables that stand for the information treatments are seldom significant. Secondly, if we compare the results of the standard ordered probit equations with the random-effects estimates, we find that the likelihood increases dramatically when we introduce random-effects, and especially for reciprocal player 2s. Furthermore the McFadden R-square rises

[16] By proceeding in clear regression for reciprocal and strategic player 2s, there is the same relationship between the type of relative offers player 2s make and the relative offers player 1s make. Panel data used is appropriate and the sole source of heterogeneity could come from μ_j .

[17] We have arbitrarily chosen the treatment with the lower fraction of reciprocal players as the baseline treatment. Nonetheless, we obtain the same results whatever the treatment used as baseline.

[18] Unfortunately, we have no information about socio-demographic characteristics of subjects to improve our regressions and to provide finer explanations. A larger model including the square of the logarithmic player 1's relative offer was also run but this variable has been rarely significant in random-effects ordered probit regressions per treatment and per type of players and hence it was dropped from the analysis.

[19]Convergence was reached with the default convergence criterion and initial parameters, so that no further modifications were needed. As routine in ordered probit, the variance of the error term is standardized so that $\sigma_{\varepsilon} = 1$. Thus the total error variance is equal to $1+\sigma^2_{\mu}$.

between the usual ordered probit (columns 1 and 3) and the random-effects ordered probit (columns 2 and 4) for both strategic and reciprocal subjects. Finally estimates indicate the importance of heterogeneity (the significance of sigma). These findings are robust to the use of the random-effects model. As expected, the logarithmic player 1s' relative offer has a strong positive impact on the type of player 2s' relative offer reciprocal player 2s make. In order to have a better understanding of this process, we calculate the marginal effects of the logarithmic player 1's relative offer and the initial endowment on the probability that player 2s make a particular type of relative offer. Marginal effects reported in Table 4 underline that an increase in the logarithmic player 1's relative offer implies a decrease in the probabilities $Y = 0$ and $Y = 1$ (i.e. player 2s make a low relative offer). On the contrary, marginal effects point out that an increase in the logarithmic player 1's relative offer leads to a rise in the probability that player 2s make a generous relative offer. If we turn to the initial endowment, it seems that being paired with a player 1 who has the large endowment increases the probability to propose a high fraction of the amount received. Conversely in case of strategic behaviors (column 4 of table 3), being paired with a player 1 who has the large endowment decreases the probability to make generous offers. The logarithmic player 1s' relative offer has the predicted sign: player 2s' type of relative offer is negatively related to player 1s'relative offers. Yet, marginal effects (table 4) highlight that an increase in the logarithmic player 1s' relative offer promotes low relative offers for player 2, especially $Y = 0$.

---*[Insert Table 4 about here]*--

5. Conclusion

In this study, we conduct experiments designed to shed some light on two forms of reciprocity: indirect and generalized reciprocities. We set up an experiment on a three-player dictator-ultimatum game to study the indirect reciprocity whereas the generalized reciprocity requires an experiment on a sequential three-player dictator game. The influence of player 1s' intentions on player 2s' choices is captured by the comparison of relative offers made under incomplete and complete information. Then once the influence of intentions is checked, we study the correlation between the offers player 1s make and the relative offers player 2s make.

With regard to indirect reciprocity, analysis of individual correlations reveals a statistically significant positive correlation in 55.55% of player 2s when player 3s face incomplete information about player 1s' offer and 73.68% when they know its amount. However, this result disguises a great heterogeneity in the strength of reciprocal forces. Other subjects behave strategically so as to minimize the probability of rejection. These results put into perspective behaviors exhibited in hierarchically structured organizations. As mentioned by Kocher et al. (2008), a team leader often makes decisions that do not coincide with the majority opinion of the team. Indirect reciprocity provides an example of how an individual try to punish or reward a team leader even when it is in an indirect way. To illustrate this point, let us consider a manager who manages a team and provides financial means, without having a clue about the work that the team does. If the team leader assesses as low the provided financial means, he has the opportunity to offer a small wage to the team follower who won't be incited to exert a high effort. This relation has been investigated many times with gift-exchange game experiments (Falk and Gächter 2002; Charness et al. 2004) which highlight a significantly positive wage-effort relationship. Finally, the low level of efforts devoted to the task implying a low level of productivity, this leads to the dissatisfaction of the manager. The manager is indirectly punished by the team leader. The reverse argument holds for large financial means provided by the manager. Nonetheless, strategic behaviors are likely to occur in such context too. For that, it suffices to assume that the team leader tries to maximize his monetary payoff. In this aim, he has to propose to the team follower a wage such that the team follower is urged to make the expected effort. Our findings are in line with those of Fehr and Schmidt (2006) who believe that the most important heterogeneity in strategic games is the one between purely selfish subjects – who seek to maximize their expected payoffs – and subjects with a preference for reciprocity.

We also investigate another form of reciprocity which involves neither reward nor punishment. This context removes all strategic motivations that consist of maximizing the expected payoff and we observe that a large fraction of subjects (85%) express reciprocity.

We find in all cases a majority of subjects who are genuinely motivated by reciprocity. However, the proportion of reciprocal types in our sample decreases as the complexity of the setting increases. This conclusion is in line with the previous works of Camerer and Fehr (2006) and Fehr and Tyran (2008) who underline the importance of environment since aggregate outcomes appear as the result of strategic incentives (i.e. if goods are strategic complements or strategic substitutes).

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Figure 1: Indirect reciprocity Vs. Equal split

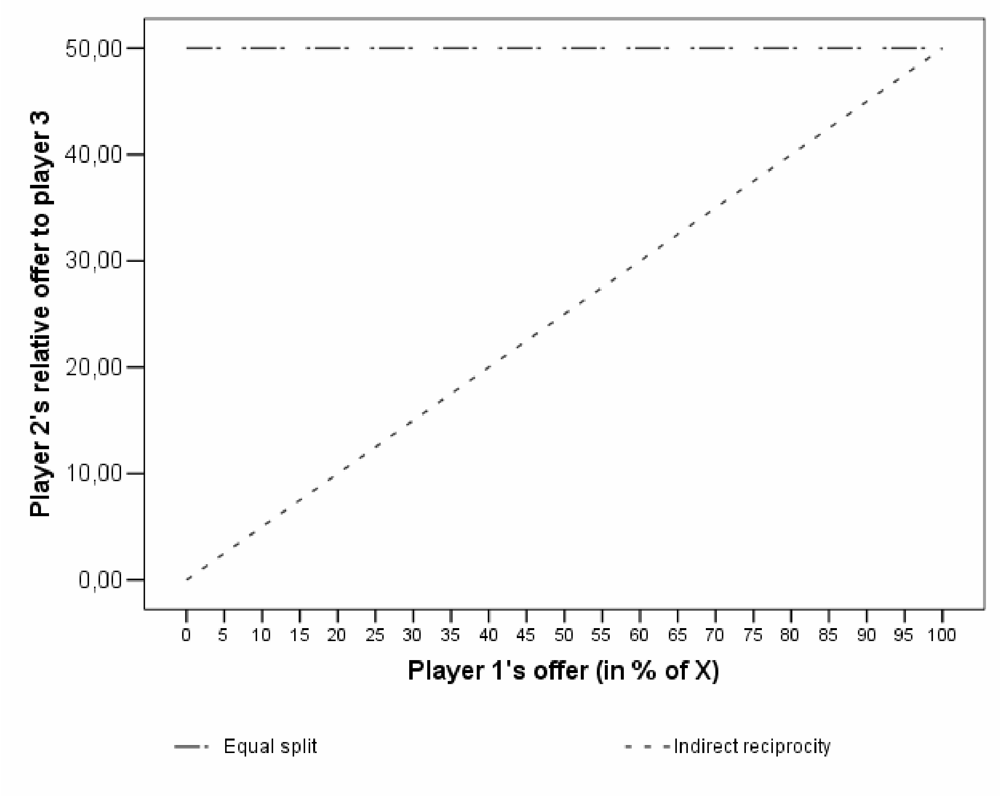


Table 1: Information treatments

	Player 2's available information about player 1's endowment	Player 3's available information about player 1's offer	Player 3's veto power
TA	incomplete	incomplete	yes
TB	complete	incomplete	yes
TC	complete	complete	yes
TD	incomplete	incomplete	no
TE	complete	incomplete	no

Figure 2: Player 2's decision task

Please make a mark with "X" to the amount you will give to player 3 (only in white boxes), for each player 1's offer to you in the following table:

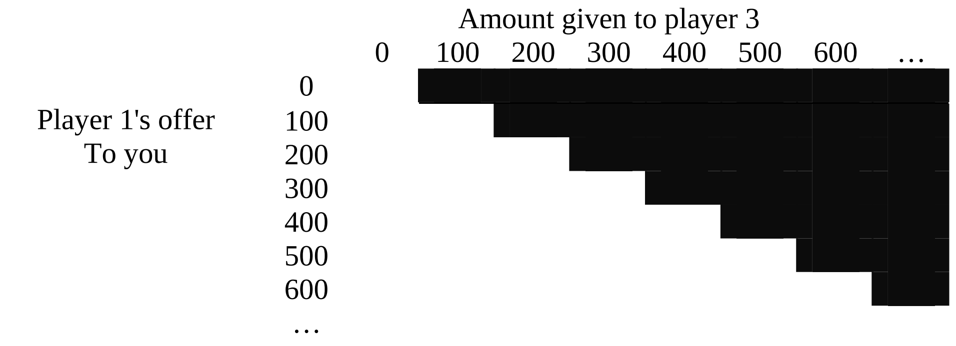


Table 2: Player 2s'relative offers per treatment and type of behavior

			TA	TB	TC	TD	TE
Selfish behaviors		Frequency	0%	0%	0%	15%	5%
"*Altruistic*" behaviors	"*Unfair*" division	Frequency[a]	22.23%	44.45%	31.57%	64.70%	47.37%
		Average offer[b]	36.28%	31.18%	28.41%	27.60%	16.50%
	"*Fair*" division	Frequency[a]	77.77%	55.55%	68.43%	35.30%	52.63%
		Average offer[b]	47.70%	47.26%	45.50%	43.79%	45.57%
All players		Average offer[b]	45.16%	40.11%	40.10%	28.32%	30.21%

[a]In percentage of "*altruistic*" players; [b] in percentage of player 1's offer.

Figure 3: Heterogeneity of player 2s' behaviors in TD

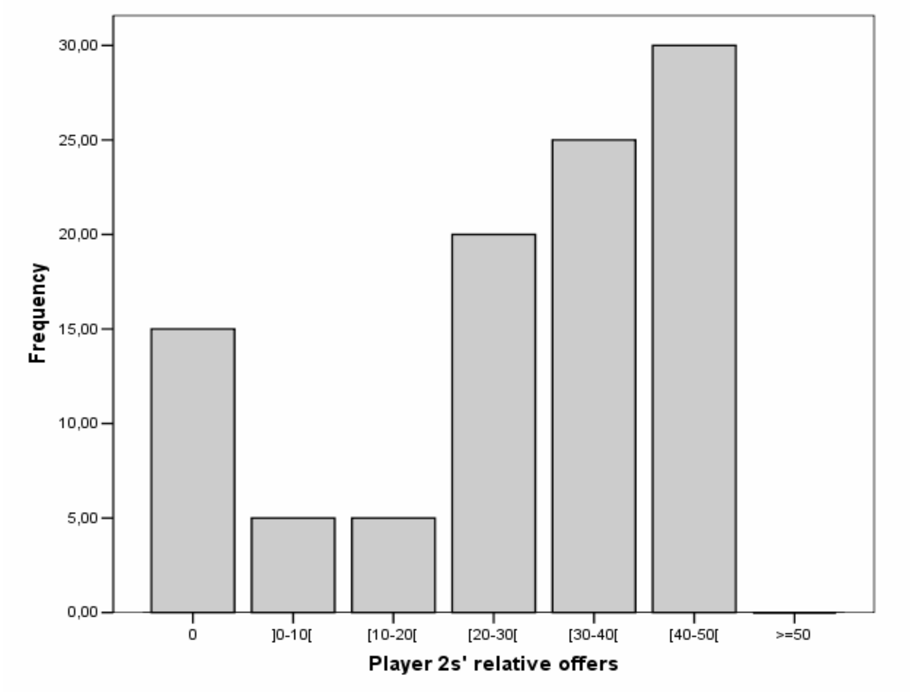


Figure 4: Impact of player 3s' veto power on player 2s' choices
In case of incomplete information

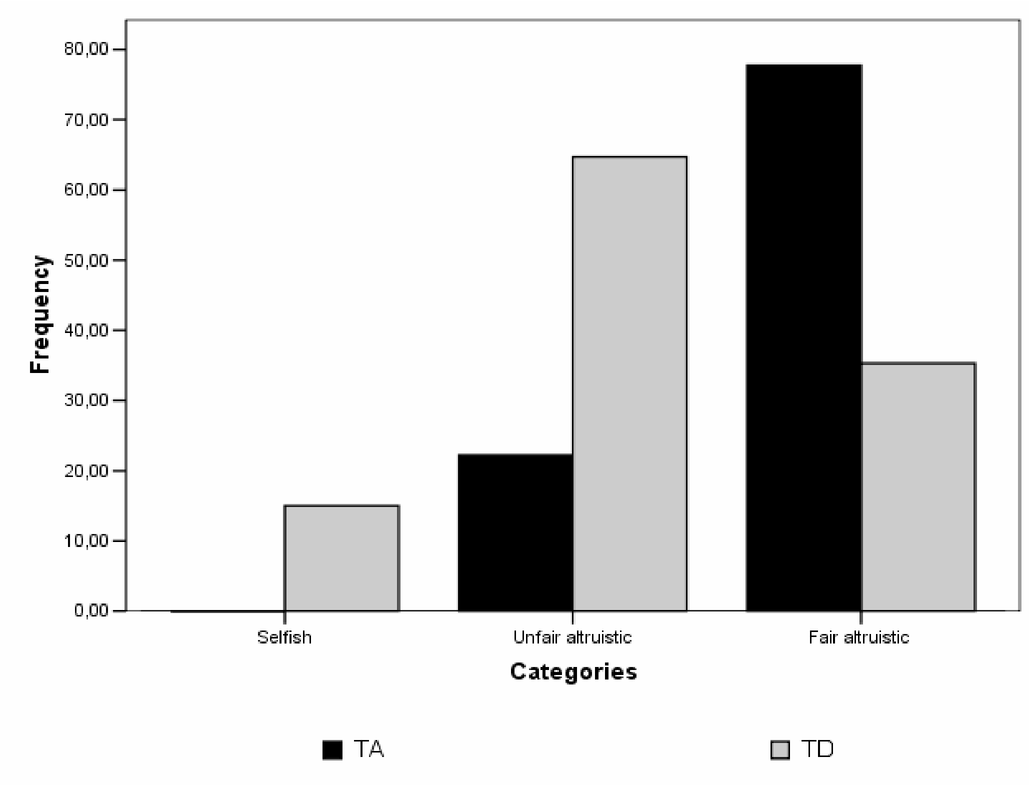


Figure 5: Impact of player 3s' veto power on player 2s' choices
In case of complete information

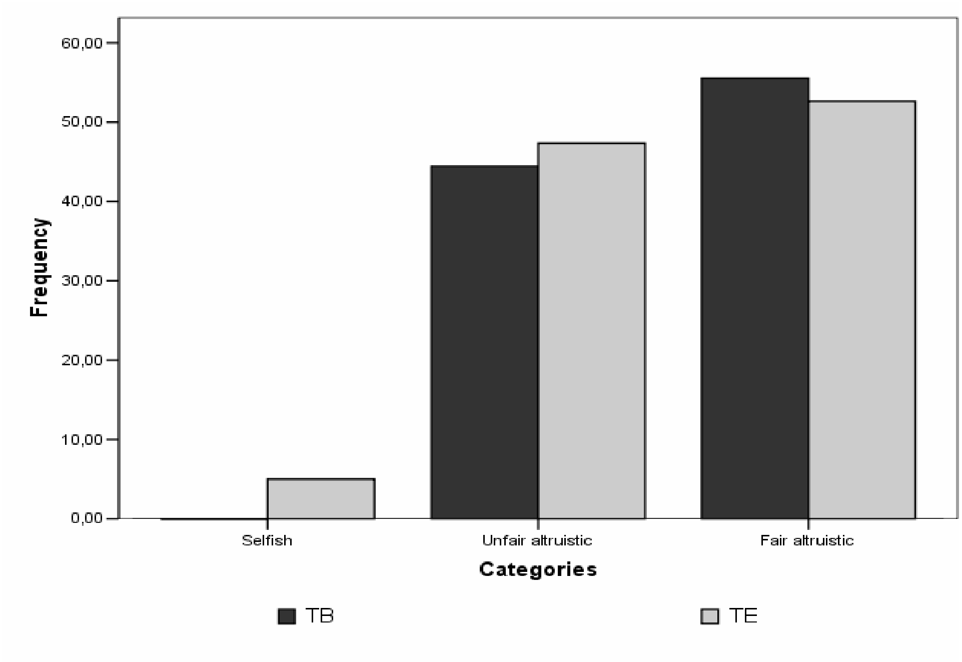


Figure 6: Trend of player 2s' relative offers in case of strategic behaviors

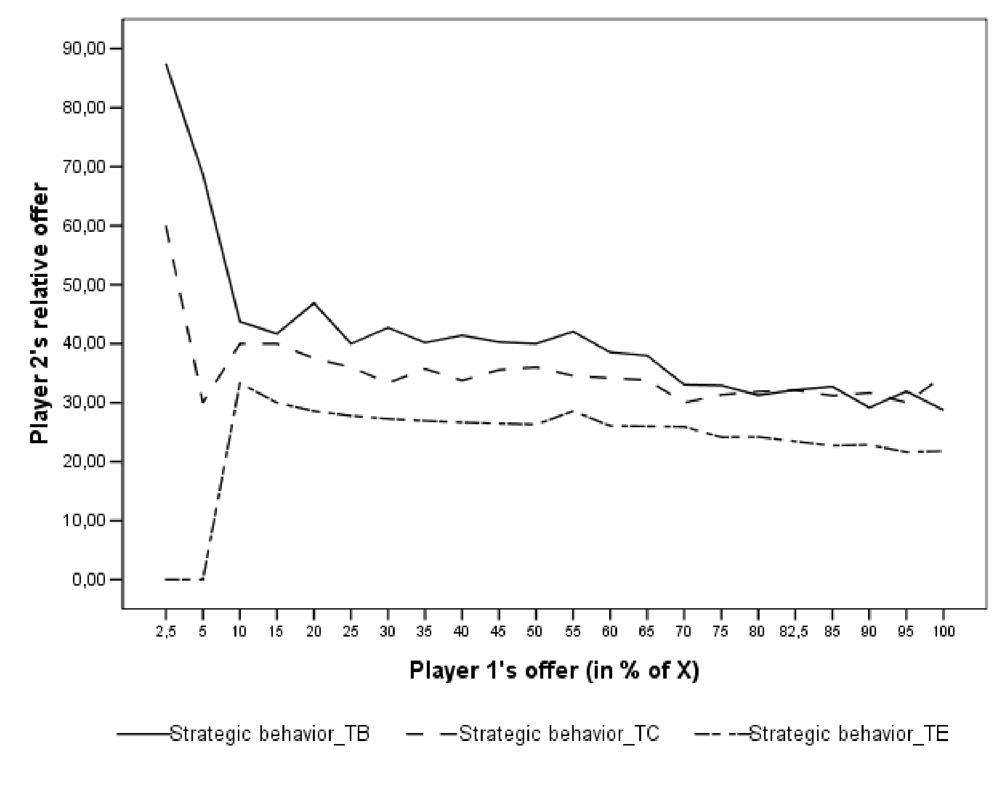
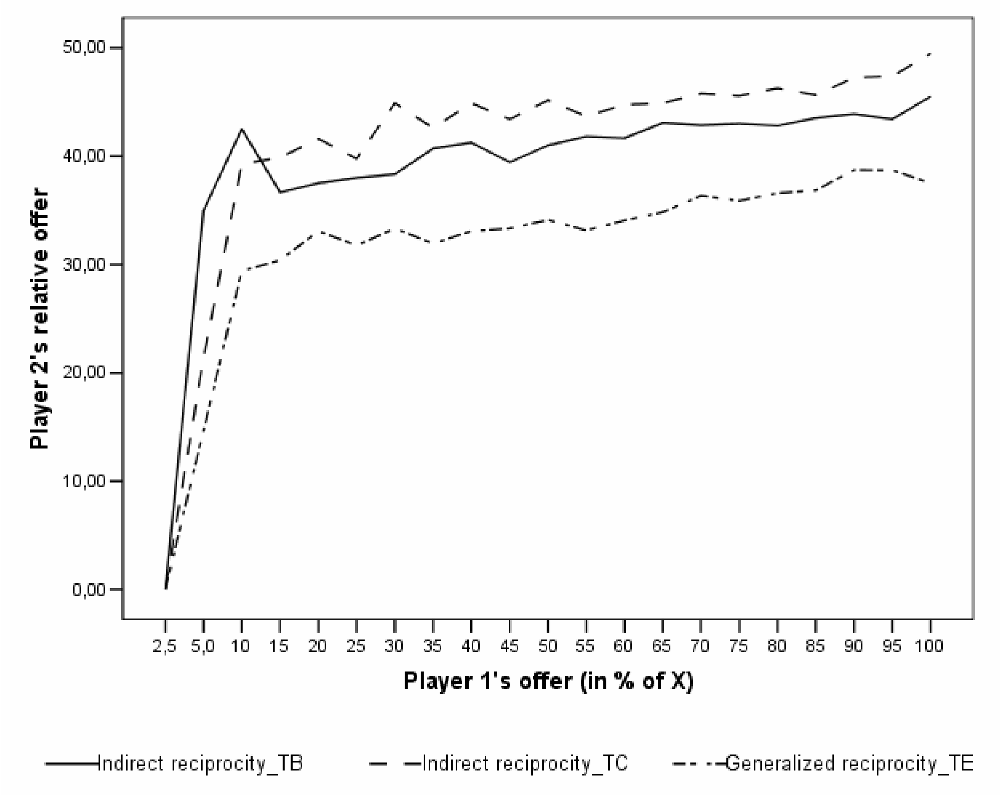


Figure 7: Trend of player 2s' relative offers in case of reciprocal behaviors



Player 2's relative offer
50,00
40,00
30,00
20,00
10,00
0,00
2,5 5,0 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Player 1's offer (in % of X)
Indirect reciprocity_TB
Indirect reciprocity_TC
Generalized reciprocity_TE

Table 3: Ordered probit regressions and random-effects ordered probit regressions on the type of player 2s' relative offers per type of behavior

	Reciprocal player 2s		Strategic player 2s	
	ordered probit model	random-effects ordered probit model	ordered probit model	random-effects ordered probit model
Player 1's relative offer (in Ln)	0.5036***	1.0956***	-0.2362***	-0.4270***
	(0.0429)	(0.0420)	(0.0675)	(0.0432)
Initial endowment (=1 if $X = F$)	0.6694***	1.3285***	-0.2090*	-0.8203***
	(0.0792)	(0.2346)	(0.1208)	(0.2378)
TC	0.4523***	0.4562	-0.1249	0.1105
	(0.0974)	(0.3762)	(0.1216)	(0.3044)
TE	-0.1310	-0.7044*	-0.4868**	-0.6034
	(0.0900)	(0.4050)	(0.1608)	(2.2390)
Constant	-1.0648***	-1.9180***	1.9837***	3.0775***
	(0.1830)	(0.4581)	(0.2820)	(0.2139)
Observations	1260	1260	440	440
Individuals	-	41	-	15
Log likelihood	-920.5266	-508.2197	-450.5022	-268.7216
Wald χ^2	248.0344	824.6137	28.9450	363.5611
Prob > χ^2	0.0000	0.0000	0.0000	0.0000
McFadden R-Square	0.112	0.448	0.031	0.404
Mu[a]	0.8392***	1.9360***	1.0364***	1.9990***
	(0.0492)	(0.0694)	(0.0705)	(0.0855)
Sigma[b]	-	1.4088***	-	1.5776***
	-	(0.1081)	-	(0.1604)

***, **, * : parameter estimate at the .01, .05 or .1 level. Standard errors in parentheses. [a] Threshold parameters for index; [b] Standard deviation of random effect.

Table 4: Marginal effects

	Reciprocal player 2s			Strategic player 2s		
	Y = 0	Y = 1	Y = 2	Y = 0	Y = 1	Y = 2
Player 1's relative offer (in Ln)	-0.0599	-0.1543	0.2142	0.0581	-0.0043	-0.0768
Initial endowment (=1 if $X = F$)	-0.0961	-0.1787	0.2748	0.1503	0.0014	-0.1517

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