Conformity and adaptation in groups*

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Abstract

We construct a simple model of norm-referenced behaviour for agents interacting within a broader group, and conduct a laboratory experiment to examine its predictions. Agents receive disutility (utility) if they act more selfishly (generously) towards others than is the norm, as well as if they accept more selfish (generous) behaviour from others. With heterogeneous agents, the equilibrium distribution of behaviours within a group is non-degenerate. Further, when agents move between groups, their behaviour adapts accordingly. The experimental results confirm these predictions, and suggest that individual behaviour can be explained as the interaction between innate selfishness-aversion and the external social environment.

Keywords: group behavior, norms, conformity, fairness, ultimatum game.

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Human beings have a natural desire to conform to socially accepted standards of behavior in order to gain approval of their peers, as well as to feel inwardly worthy of such approval. Adam Smith (Smith, 1790) explains that social standards of behavior are generated by the interaction of this desire with two principles inherent in human nature—sympathy and justice. Sympathy enables a man to place himself in the position of another, and justice drives him to treat others in the same way that he would himself wish to be treated in their situation. In Smith's words, "Nature...[when she formed man for society]...has endowed him, not only with a desire of being approved of, but also with a desire of being what ought to be approved of... ." (III.1.14) Thus adherence to approved behavior is not only an action for public display but also for private satisfaction. Asch's early studies (see, e.g., Asch 1956) show that the urge to conform is not limited to matters of moral import but extend to objective assessments of fact.

Economists have since accumulated substantial evidence that socially approved standards, which we will call norms, significantly condition the behaviors of economic agents in bilateral or small-group transactions. In experimental studies, Roth et al. (1991); Henrich et al. (2001) and Henrich (2000) have demonstrated that norms vary widely between cultures. Norms are frequently supported by threats of punishment (Fehr and Fischbacher, 2003), which may be as mild as disapproval (Andreoni and Bernheim, 2009; Bicchieri and Chavez, 2010). Even in the absence of punishment, the likelihood of being observed by others may increase the incentive to conform, suggesting that the first of Smith's desires (being approved of) may wield greater power than the second (being what ought to be approved). It has further been observed in empirical investigations that there are significant differences between contexts in acceptable standards of behavior.[1]

Sustained and significant differences in behavior between cultures would suggest that behavior is culturally determined and hence the acquisition of norms happen earlier rather than later in life. However, it has also often been noted that migrants to a new culture adapt their behavior significantly, which indicates that individuals do adapt to different norms even later in life when placed in a population that displays behavior significantly different from that to which they have previously been accustomed (see

[1]There are several excellent surveys of the literature. See for example, Kagel and Roth (1995), Chapters 2 and 4, Fehr and Schmidt (1999); Oosterbeek et al. (2004) and Fehr and Fischbacher (2004).

Waters, 2005 for a partial survey). In studies of worker productivity and absences, it has been found that workers adapt their behavior to different standards when they move between environments (Ichino and Maggi, 2000; Bandiera et al., 2010; Falk and Ichino, 2006).

This paper presents the results of a laboratory experiment based on the ultimatum game to explore norm-referenced behavior.[2] We explore whether a norm of behavior develops when a group of individual interact (pairwise) repeatedly, how information influences this process, and whether agents that move between groups adapt readily to the different norms in their new environments.

Our subjects play a repeated ultimatum game within two separate and non-interacting groups. Players are randomly rematched within their groups in each period. Assignment to groups is based on the initial offer each subject makes as proposer. Those who make initial offers below the median are placed in the "low" group, and the remainder form the "high" group.

Our primary question is whether, and how readily, subjects adapt to different norms. Intuitively, the norm in a group is the typical behavior of the group. However, neither "norm" nor "typical" are well-defined concepts in economics. Our candidate for the norm is the average offer in the group in each round.

We investigate whether the average offer becomes stable as members of a group interact, and whether individual offers cluster more closely around the average as time progresses. We consider the average to be a *norm* if these two criteria are satisfied. We find that, indeed, the offers in each group (high and low) tend to converge quickly to a stable level. The averages are substantially different between the groups (44 percent and 26 percent of the stake, respectively). Further, the distribution around the norm tightens within each group as time passes.

To examine adaptation, we move a small number of participants from the "low"

[2] An ultimatum game is played between two players. One player—designated the "proposer"—proposes a division of a given sum of money between herself and the other player, who is the "responder". The responder either accepts the proposal, in which case the money is divided as proposed, or he rejects it, which results in the money being withdrawn and no payments made to either player. We refer to the sum that the proposer offers to the responder as the "offer". The subgame-perfect equilibrium is a proposal that gives (almost) nothing to the responder, and is accepted. However, this outcome is never observed in an experimental setting; proposers tend to make offers much closer to an equal division, while responders consistently reject selfish offers.

group to the "high group", and vice versa, after several rounds of the game have been played. Several more rounds of the game are then played. We find that players that are moved between groups do indeed adapt quickly to the norms of their new groups.

It is natural to ask whether greater information about the actions of others hastens the development of the norm. In one treatment, we provide information to subjects about the average offers made in previous rounds. We find that the speed of convergence is more rapid when participants are provided public information about average behavior, than in the other treatment where no such information is provided and participants must infer group behavior from their private histories. Prior socialization has a persistent effect in the low-information treatment, but the effect becomes insignificant in the high-information treatment.

The design of our experiment departs from previous experiments based on the ultimatum game in one significant element: in each round we assign each participant the roles of both proposer and responder in separate simultaneous games. This is intended to eliminate the asymmetry between proposer and responder. Since each player assumes both roles in each round, all players will receive the same payoff if all offers are identical and all are accepted. If the norm is well-known and generally adhered to, then the only deviation from perfect fairness consists of making an offer that is different from the norm. An offer below the norm is a selfish deviation while one above the norm is an altruistic deviation. The "fair" offer is therefore clearly identified with the norm, and independent of its numerical value. Thus the experiment investigates adherence to the group norm, rather than the location of the fairness norm.

Earlier studies suggest that the location of the fairness norm is culturally determined. In their classic study, Roth et. al. (1991) conducted an experiment based on the ultimatum game in four cities on different continents. They found that the distributions of offers in different cities were significantly different, implying that in some cities (Tokyo and Jerusalem) the probability of a high offer being made was lower than in other cities (Ljubljana and Pittsburg). However, there were no correspondingly significant differences in the probability that an offer would be rejected, which depended on the position of the offer within the distribution for that city, and not on the absolute value of the offer. The authors cautiously concluded that the tendency to make lower (or higher) offers and correspondingly to accept lower (or higher) offers in some cities was a function of 'culture' (also defined cautiously). Henrich (2000) and Henrich et al. (2001) provide evidence that behavior deviates significantly and systematically from the selfish model in a diverse collection of remote societies, with wide variation between the societies in norms of behavior. In her experiment conducted in Yogyakarta, Indonesia, Cameron (1999) provides some evidence that, within a culture, these norms are robust to large changes in the stake.

We interpret this as meaning that the perception of what constitutes an acceptable or "fair" division under the circumstances differs between socio-economic contexts. Fairness may thus be constituted as a function of socialization, which inculcates in individuals a perception of acceptable versus unacceptable behavior. This sense, adequately nurtured, may well enter the utility functions of individuals in a quantifiable way, whereby one experiences disutility in accepting (or witnessing) an offer that is patently unfair relative to the local norm.

This interpretation presupposes well-defined criteria for acceptable behavior. An objective criterion is difficult to define for ultimatum games. Perfect fairness or a 50-50 split may provide a notional criterion. However, in a single play of the ultimatum game, there is an inherent asymmetry between the two players (proposer and responder), and evidence shows that subjects often consider it fair for the proposer to receive a somewhat larger fraction of the pie. The acceptable premium varies significantly from context to context, as the discussion above indicates. Our design makes the subjects symmetric and allows us to focus on deviations from the average offer as indicators of deviations from fairness.

Our primary objective is to explore whether agents adapt readily to different norms. In life it is often the case that individuals who have been socialized in groups with certain norms of behavior sometimes find themselves placed in groups that act according to significantly different tenets. In the experiment, the participants that are moved between the "high" and the "low" groups adjust their behavior in the direction of conformity with their new groups. Again, this conformity is faster and much more marked in treatments where information about group averages is publicly disseminated.

Our results find some support in the literature on peer effects in the workplace. We cite three examples. Ichino and Maggi (2000) studied shirking behavior among employees in a large Italian firm with branches in the north and south of Italy. Shirking behavior was more common in the south, but workers who transferred from one region to the other tended to conform to the norms in their destination region. The authors note that some of this effect may be explained by selection, since the set of transferees in general did not appear to be a random draw from the region of origin. Bandiera et al. (2010) observe that the productivity of workers tend to increase when they work in the company of high-productivity colleagues and decrease in the company of low-productivity colleagues, even when there are no wage-incentives nor externalities in output. Falk and Ichino (2006) study workers working singly and in pairs, and find that the productivity varies less within pairs.

Young (2008) provides a succinct overview of economic approaches to understanding social norms. Some aspects of our study also bear relationships to investigations of mergers (Weber and Camerer, 2003; Feiler and Camerer, 2010) and group formation (Weber, 2005).

Andreoni and Blanchard (2006) report an experiment that is similar to ours in the sense that they attempt to suppress the fairness aspect of ultimatum game offers. In their setting, the payoffs of proposers and responders depend on their performance vis-a-vis others of the same type, rather than on interactions in game-playing pairs. As a consequence fair-minded subjects should also play the selfish, subgame-perfect strategies. However, their investigation focuses on learning on the part of the subjects, which is a concern quite distinct from ours.

Cooper and Dutcher (2011) use data from several other experiments to explore the effect of experience on the behaviors of participants. They find that, as players gain experience, they tend to accept high offers (greater than 20 percent of the pie) and reject low offers (less than 20 percent) more often. We find a similar tendency, except that in out study the dividing line ("norm") evolves from the characteristics of the player group. Interestingly, they find "a strong negative relationship between the previous offer received and the likelihood that the current offer is accepted", which is evident in our data as well. In addition, we find that agents tend to significantly increase their offers if the previous offer was rejected.

Each of the papers discussed above has a goal distinctly different from that of the present paper. Our results suggest that agents who find themselves in a group tend to choose actions that conform to perceived norms of the group, and find it unacceptable when others take actions that deviate too much from those norms in the direction of selfishness. Further, this norm develop endogenously within a group; it is a product of group interaction and not hardwired in individuals.

Our observations are consistent with the possibility that individual agents have behavioral preferences that lead them to make offers that are selfish or generous *relative to the local norm*, and the personal characteristics that determine these preferences are similarly distributed in both groups. We find that the distribution of offers around the average is almost identical for the high and the low groups, though the averages themselves are very different. Further, the agents that are moved from the low to the high group make offers in the high group that, *relative to the local norm*, have a very similar distribution to the offers they had made before the move in the low group. The same is true of players that were moved from the high to the low group. In the low-information treatment this is only true up to a consistent bias, but the bias is considerably smaller in the high-information treatment. It is therefore likely that each agent's individuality consists of a preference about where to locate relative to the norm, rather than a preference over the absolute division of the pie.

It is important to underline that, in the first half of the experiment, we do not attempt to disentangle the extent to which agents converge to an exogenous group norm and the extent to which the norm itself develops in response to the behaviors of the individual agents (see Manski (1993)). The norm itself is identified by the two characteristics that it is stable, and that there is a decline in the dispersion of individual offers around it. The second half of the experiment, where some individuals are moved between groups that have established significantly different norms, explores whether individual agents adapt to a norm different from what they previously experienced.

In Section 1 we describe the design of the experiment in detail. Section 2 discusses the intuitive economic reasoning, in the form of a rudimentary model, that drives our empirical analysis. Section 3 presents the main results, and Section 4 analyses the variables that detemine the offers made by individuals. Section 5 concludes.

1 Description of the experiment

The experiment is based on the ultimatum game played repeatedly in anonymous, randomly matched pairs. In each round, each subject participated in two separate games with (typically) different, randomly matched partners: in one game the subject acted as a proposer and proposed a division of 100 Experimental Dollars (ED, 100 ED = 1 AUD) between herself and a responder, in the other game she acted as a responder and either accepted or rejected a division of 100 ED proposed by her partner. The experiments were conducted in the BizLab (previously known as ASBLab) at the University of New South Wales Business School, which is a relatively new facility with computer terminals separated by dividers. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). Participants were recruited using the recruitment system ORSEE (Greiner, 2004). No subject could participate in more than one session of the same experiment.

Sessions and rounds: We ran five session of each of two treatments T1 and T2. Each session had between 18 and 24 participants (even numbers). Altogether there were 108 participants in the five sessions of treatment 1 (TI), and 110 in the five sessions of treatment 2 (T2). Each session ran for 31 rounds, and in each round, each participant participated in two instances of the ultimatum game as described above.

In the first round (round 0), pairings were made across the entire set of participants for the session. Each participant made a proposal in the game in which s/he was a proposer. However, these offers were withheld and sent to receivers only at the end of the session. Participants were then ordered according to the value of offers they made. The participants that made offers in the lower half of the distribution were grouped together (the "low group", or GL in this paper), and those that were in the upper half of the distribution were grouped together (the "high" group, or GH). The players only knew their own groups as the "red" or the "blue" group. Since we started with an even number of players, the two groups had equal numbers of players. In subsequent rounds, players were paired within their respective groups, so that each group constituted a separate sub-session. Fifteen rounds of the game (rounds 1 to 15) were then played.

After round 15, an equal number of players from each group (high and low) were randomly selected and moved to the other group (low or high). In each session, this number was the largest integer less than or equal to a third of the number that were originally in the group. Hence in sessions that had a total of 18 or 20 players (9 or 10 per group), three players were moved from each group, and in sessions with 24 players four players were moved from each group. Another fifteen rounds (rounds 16 to 30) were then played in the new groups.

Finally the offers from round 0 were communicated to the respective recipients, who responded to the offers. Each player was then informed of the total payoff that s/he had accumulated, and was paid this amount. This concluded a session.

In treatment 2, after every even numbered round starting with round 2, each player was informed of the average of all the offers that were made in his/her group in the previous two rounds. Players in treatment 1 were not provided any information. This constituted the sole difference between treatments 1 and 2. Note that, when some players were moved from their original groups and started to play in new groups in round 16, they had no information regarding the average offer in their new group. Only after they had played one round (and hence made one offer and responded to one offer) did they receive this information.

Information given to players: Players were given a printed instruction sheet at the beginning of the experiment, which they had adequate time to read. The instructions were also read out to them, and there was an opportunity to ask questions. The ultimatum game was explained to players, as was the structure of each round in which each player participated both as a proposer and a responder. The conversion rate between experimental dollars and Australian dollars was explained. We rounded payoffs up to half-dollars for convenience. They were told that they would play one round across the entire session and that offers made in this round would be withheld until all the subsequent rounds were played. They were told that they would then be divided into two groups and play 30 rounds within those groups. After 15 rounds a few players would be reallocated between groups, and subsequent games would be played within the newly constituted groups. The players were told that the two groups were the “red” group and the ”blue” group.

At the beginning of each round 1 to 30, with the exception of round 16, each player was reminded that “you are in the red (or blue) group”. At the beginning of round 16 each player got a message saying “you were previously in the red (or blue) group”, followed by a message which read either "you are still in the red (or blue) group", or "you are now in the blue (or red) group".

As mentioned earlier, after every even numbered round starting with round 2, each player in the treatment 2 sessions was also sent a message saying "the average offer in your group in the previous two rounds was [value of the average offer]". Of course, any information that was given to players was the correct information.

Information *NOT* given to players: Players were not informed of the number of players that would be exchanged between the groups after the first set of 15 rounds. They were not informed of the criterion that would be (or was) used to sort them into groups, either before or after the sorting. This was done to ensure that players were grouped according to their initial beliefs, and assignments were not affected by strategic considerations.[3] We observe that the average payoffs of players in the two groups were remarkably similar (Tables 1 and 2), so group assignment did not have any significant impact on payoffs.

At no stage was any participant given false information, or information calculated to mislead. The terms "norm" or "conformity" or "fairness" or any of their derivatives were not used anywhere in the written or verbal instructions.

2 Conceptual framework

We interpret the mean offer behavior of the group as the norm. If behavior conforms to the norm, then as agents accumulate more information their offers must converge to the mean. Offers may move closer to the mean for two reasons. First, if an agent prefers to conform to the perceived norm, then she would make offers closer to the norm to the extent that her accumulated information allows her to do so. Alternatively, norm-referenced behavior may be reflected in the responses—agents reject offers that they judge to be too far below the norm as their information allows them to make this judgement with increasing confidence. In the latter case, purely profit-maximizing behavior would lead proposers to then make offers closer to the norm. In either case, if

[3]One reader has objected that this constitutes "deception by omission". We have two responses. First, participants were informed of the entire sequence of events, so they could have deduced that their initial offer may be used in the assignment process. Secondly, providing this information outright would systematically bias the initial offers of participants, and hence render it impossible to explore how the tension between initial beliefs and observed peer behavior is resolved.

the distribution of offers converge to the mean as the game progresses, we may interpret this as evidence of norm-regarding behavior. Further, since subjects are provided clear information about the average offers in treatment 2, whereas information is imperfectly gleaned from private histories in treatment 1, we expect the convergence to occur faster in treatment 2.

We assume that agents are risk-neutral and get positive utility from income earned in each round. If nevertheless an agent rejects low offers, then it follows that she receives disutility from accepting a selfish offer, or utility from rejecting it. Similarly, agents may make higher offers relative to the mean even when a lower offer would be accepted because they obtain utility from being generous. The extent of an agent's disutility from accepting a selfish offer may well be related to her utility from making a generous one, but we have no *a priori* basis for predicting whether, and how, the two are related.

Below we present the full-information version of a model that is consistent with such norm-referenced behavior. We abstract from the problem of learning and assume all agents know the norm, but agents in a specific match do not know their partners' preferences. In the empirical analysis we incorporate learning by postulating that the differences between successive offers reflect new information that agents obtain between periods, as indicated later in this section.

2.1 A model with complete information

Consider a one-shot economy with a large number of agents who are randomly matched to engage in pairwise transactions. A transaction consists of a single ultimatum game with agents assigned the roles of proposer and responder. Each agent simultaneously participates in two games with different partners; one as a proposer and one as a responder.

Let z be the total amount to be divided in a match between a proposer P and a responder R. Let x be the offer made by the proposer. Let μ represent the average offer or "norm" in the group to which the pair belong. If the position of the offer relative to the norm matters to the responder, then her utility from accepting the offer must be of the form $u^R = u(x, \hat{\mu}_R; \alpha)$, where α is a parameter that captures her attitude towards deviations from the norm, and $\hat{\mu}_R$ is her (point) estimate of the norm. In this simplified model $\hat{\mu}_R = \hat{\mu}_P = \mu$. We posit the following simple additive version for the responder's utility:

$$u^R(x, \mu; \alpha) \;=\; x \;+\; \alpha(\frac{x-\mu}{\mu})$$

where α is positive if selfish (generous) deviations from the norm generate disutility (utility).

We normalize the utility from rejecting an offer to zero.[4] An agent's optimal response is then to accept if and only if

$$u^R(x, \mu; \alpha) \geq 0 \Longrightarrow x \geq \frac{\alpha\mu}{\alpha+\mu}.$$

Note that as μ increases without bound, the acceptance threshold converges to α. This is consistent with Rabin's (1993) hypothesis that players put a premium on fairness, but "the bigger the material payoffs, the less the players' behavior reflects their concern for fairness".[5]

Different degrees of tolerance for deviations are captured by differences in α. A higher α indicates an agent who is more intolerant of selfish behavior in others, and corresponds to a higher acceptance threshold. If players are heterogeneous, then there will be a non-degenerate distribution of acceptance thresholds, and offers further below the norm will be rejected with greater probability.

Specifically, let α be distributed on $[0, \infty)$ according to some probability distribution function $F(\alpha)$, and associated density function $f(\alpha)$. We assume that the set $\{\alpha : f(\alpha) > 0\}$ is a non-degenerate, connected interval, and $f(.)$ has no mass-points so $F(.)$ is continuous and increasing over some connected interval $[\underline{\alpha}, \bar{\alpha}) \;\subseteq\; [0, \infty)$.

[4] An agent may of course receive positive utility from rejecting particularly selfish offers, since this denies the proposer a correspondingly high payoff. It is not difficult to incorporate this possibility.

[5] However, Cameron (1999) provides evidence to the contrary. The behavior that Cameron observes is better represented by a form such as

$$u^R(x, \mu; \alpha) \;=\; x \;+\; \alpha(x-\mu)$$

which gives an acceptance threshold $\tilde{x}(\mu) = \frac{\alpha}{1+\alpha}\mu$. Here we have $x \longrightarrow \mu$ as $\alpha \longrightarrow \infty$.

Let $\tilde{x}(\alpha)$ be the acceptance threshold corresponding to α, then we have

$$\alpha = \frac{\mu \tilde{x}(\alpha)}{\mu - \tilde{x}(\alpha)}$$

Note that (i) $\tilde{x}(\alpha)$ is increasing in α, (ii) $\tilde{x}(\alpha) \longrightarrow \mu$ as $\alpha \longrightarrow \infty$, (iii) $x(\underline{\alpha}) \geq 0$, and (iv) $x(\bar{\alpha}) \leq \mu$. Acceptance thresholds are distributed according to the distribution function

$$\Pi(x, \mu) \;=\; \begin{cases} 0 & \text{if} \quad x < x(\underline{\alpha}) \\ F(\frac{\mu x}{\mu - x}) & \text{if} \quad x(\underline{\alpha}) \leq x \leq x(\bar{\alpha}) \\ 1 & \text{if} \quad x > x(\bar{\alpha}) \end{cases} \tag{1}$$

Since $f(\alpha) > 0$ for $\alpha \in (\underline{\alpha}, \bar{\alpha})$, it follows that $\Pi(x, \mu)$ is strictly increasing in $(x(\underline{\alpha}), x(\bar{\alpha}))$.

In what follows we make two simplifying assumptions. First, $[\underline{\alpha}, \bar{\alpha}) = [0, \infty)$, so $x(\underline{\alpha}) = 0$ and $x(\bar{\alpha}) = \mu$. Secondly, we assume that $0 < x^* < \mu$. These assumptions make the statement of results much less cumbersome by eliminating corner solutions. Our results, appropriately restated, go through in the general case.

A perfectly selfish proposer who receives utility only from income will make an offer x^* that maximizes expected monetary payoff $\Pi(x, \mu)(z - x)$. At an interior maximum, the offer x^* solves

$$\Pi'(x, \mu)(z - x) - \Pi(x, \mu) = 0. \tag{2}$$

It can be checked that this yields a maximum if $\Pi(., \mu)$ is not "too" convex at the solution. Corresponding inequality conditions apply for solutions at $x = 0$ and $x = \mu$.[6]

Proposers may not maximize expected monetary payoff. We assume that norm-adherence also features in the utility of proposers, leading them to make offers different from x^*. We postulate a utility function for a proposer of the form:

$$u^P(x, \gamma) \;=\; \Pi(x, \mu)(z - x) - \gamma e^{(\mu - x)}, \tag{3}$$

where $\Pi(x, \mu)$ is the probability that x will be accepted, z is the size of the pie to

[6]There may be multiple local maxima, depending on the shape of $f(\alpha)$, which can be reduced by putting corresponding restrictions on $f(.)$.

be divided, and $\gamma \geq 0$ is a parameter reflecting the agent's selfishness-aversion in her capacity as a proposer. Let the proposers' selfishness-aversion parameters γ be distributed as $G(\gamma)$ on some connected subinterval of $[0, \infty)$.

The first-order condition for maximization of the proposer's utility is

$$\Pi'(x, \mu)(z - x) \; - \; \Pi(x, \mu) \; + \; \gamma e^{(\mu - x)} \; = \; 0 \tag{4}$$

and the second-order condition is

$$\Pi''(x, \mu)(z - x) \; - \; 2\Pi'(x, \mu) \; - \; \gamma e^{(\mu - x)} \; \leq \; 0 \tag{5}$$

where $\Pi'(x, \mu)$ is the derivative of Π w.r.t. x. Given the responder's utility function and the assumptions we have made on $F(.)$ (and hence $\Pi(.)$), we have $\Pi(x, \mu) < 1$ and $\Pi'(x, \mu) > 0$ when $x < \mu$, and $\Pi(x, \mu) = 1$ and $\Pi'(x, \mu) = 0$ when $x \geq \mu$. It follows from (4) that

Proposition 1 *A proposer's optimal offer $x(\gamma, \mu)$ as a function of his selfishness-aversion γ and the average offer μ is given by:*

$$x(\gamma, \mu) \; = \; \begin{cases} = x^* & \text{if } \gamma = 0 \\ \in (x^*, \mu) & \text{if } \gamma \in (0, 1) \\ = \mu & \text{if } \gamma = 1 \\ > \mu & \text{if } \gamma > 1 \end{cases} \tag{6}$$

Proof: If $\gamma = 0$, then (4) reduces to (2), yielding line 1.

Invoke the implicit function theorem. Totally differentiate condition (4) and rearrange to get:

$$\frac{\partial x(\gamma, \mu)}{\partial \gamma} \; = \; -\frac{e^{(\mu - x)}}{D}$$

where D is the left-hand-side of condition (5). It follows that $x(\gamma, \mu)$ is non-decreasing in γ, and strictly increasing at a strict maximum.

Next note that $\Pi(x, \mu)$ reaches unity at $x = \mu$ and is constant thereafter, so the left-hand-side of (4) is $\gamma - 1$ for $x = \mu$, which implies that $x(\gamma, \mu) = \mu$ when $\gamma = 1$ (line 3). Since $x(.)$ is increasing in γ we have line 2. Finally, for $x > \mu$ by the preceding argument we have $\gamma e^{(\mu - x(\gamma,\mu))} - 1 = 0$, hence $x(\gamma, \mu) > \mu$ when $\gamma > 1$. ■

We can now define an equilibrium for this economy. Intuitively, given the distributions $G(.)$ and $F(.)$, we are looking for an offer function $x(\gamma, \mu)$ such that the mean offer is μ, and $x(\gamma, \mu)$ maximizes expected utility for a proposer with parameter γ when each responder chooses her responses to maximize her utility given α and μ.

Definition 1 *: Given distributions F and G for α and γ, an offer function $x(\gamma, \mu)$ is an* equilibrium *if $\mu = E_G x(\gamma, \mu)$, and $x(\gamma, \mu)$ maximizes (3) where $\Pi(x)$ is defined by equation (1).*
If $x(\gamma, \mu)$ is an equilibrium, then μ is an equilibrium norm*.*

Proposition 2 *If the equilibrium offer distribution $x(\gamma, \mu)$ is non-degenerate, then $G(\gamma)$ is non-degenerate and contains unity in the interior of its support.*

Proof: The first part (non-degenerate) is obvious. Suppose unity is not in the interior of the support of $G(.)$. Then by Proposition 1, either $x(\gamma, \mu) \leq \mu \;\; \forall \gamma$, or $x(\gamma, \mu) \geq \mu \;\; \forall \gamma$. But then since x is non-degenerate and is weakly monotone in γ (see proof of Proposition 1, μ cannot be the mean of $x(\gamma, \mu)$. ■

In particular, if the support of $G(.)$ lies entirely to the left of unity, then in equilibrium all proposers offer x^*. Similarly, if the support of $G(.)$ lies entirely to the right of unity, then in equilibrium all proposers offer z.[7]

2.2 Learning and the empirical specification

The above analysis presumes that each agent precisely knows the mean at each point of time. However, the subjects in treatment 1 of our experiment acquire this information from the offers and responses they receive in successive rounds, and the subjects in T2 in addition receive more precise information from public announcements.

Since in our experiment agents do not have complete and perfect information, we assume that a move (offer or response) by a given agent at any point of time is determined by the information that the subject has accumulated prior to that move, and by her individual characteristics. Hence any change in the offer between periods t and $t + 1$ is driven by additional information received after the period t offer was made.

[7]Indeed, Henrich observed some tribes that did consistently offer the entire pot.

Additional information consists of the offer received in period t, the response the subject made to this offer, and the response received to the offer that the subject made in period t.

It is likely that that new information will have a strong effect in the early rounds when prior information is sparse, but a smaller effect in later rounds. The proposer's accumulated wealth at the time of making the offer may also be relevant. These considerations suggest the following specification for $t \geq 1$:

$$OM^j_{i,t+1} - OM^j_{i,t} \;=\; f^i[(OR^j_{i,t} - OR^j_{i,t-1}, RR^j_{i,t}, RM^j_{i,t}, W^j_{i,t}, t+1) \tag{7}$$

Where OM denotes "Offer made", OR denotes "offer received", and RM and RR denote responses made and received respectively. W is accumulated wealth. Subjects are indexed by i, groups by j, and time by t. In the estimations in Section 4 we use a slightly amended formulation, which nevertheless yields similar results.

Similarly, the subject's response to the offer she receives is determined by the offer itself, and the information she has acquired prior to receiving the offer. This latter information is incorporated in the offer she has made in the same period. In the empirical analysis that follows we focus on explaining the offer behavior of agents, since we do not have sufficient information on their latent responses.

In the next section we present the broad results. We argue that norms are established within groups that interact with each other, and that agents who are moved to different groups adjust to the new norms. The behavior of agents in the experiment is also broadly consistent with the predictions of the norm-referenced utility framework outlined above. Section 4 analyzes the impact of accumulated information on the offer behavior of the agents, and assesses the implications of the findings.

3 Overview of the results

There are two treatments, T1 and T2. Players in T1 had access only to their private histories; players in T2 were informed of the value of average offers in their groups after every even-numbered period. In each treatment, the initial offer was used to divide participants into a low group GL (offers in the lower half of the distribution), and a high group GH (upper half of the distribution). In round 16 of each session of each treatment, one-third of the players in each of GL and GH were randomly reassigned to the other group, GH or GL.

3.1 Summary statistics and general observations

Table 1 summarizes the data. The upper panel reports the key outcomes for periods 1-15 in aggregate, as well as disaggregated by treatment, group, and treatment/group. The lower panel of Table 1 similarly documents outcomes for periods 16-30. It does not distinguish between movers and non-movers—that comparison appears in Table 2.

In periods 1-15, there are no significant differences between treatments 1 and 2 in terms of average offer, rejection probability or profit. The value of the initial offer (around 40 ED) and rejection probability over all periods (around 16%) are comparable to findings in other studies. For example, in the 75 experiments summarized by Oosterbeek et al. (2004) the average offer was also 40% and the average rejection rate was about 16%. However, in our study the average offer over the 15 periods is lower at 34ED.

Columns (2) and (3) report the outcomes for GL and GH, respectively, pooled across treatments. Mean offers in rounds 1-15 are 26 ED and 43 ED for low and high groups, respectively, with rejection rates of 20% and 14%. The average initial bid in period 0 is about 27 ED for players in the low group and 53 ED for players in the high group. Columns (4)-(7) document outcomes for GH and GL by treatment. The average offer in GL in treatment 2 is a little lower than that in treatment 1, while the acceptance probability is higher. Within GH, the average offers, profits and probability of accepting an offer are very similar across treatments.

Within GL, offers in the lowest quintile of the (group-specific) offer distribution are rejected 61% of the time, within GH 57% of such low offers are rejected. Unsurprisingly, when we turn our attention to offers in the lowest quintile of the pooled distribution, we find that such offers are substantially more likely to be rejected in GH (67%) than in GL (43%). Our findings are in line with results of other studies that find that the propensity to reject low offers (defined independently of context) depends on geographical location or cultural background of the respondents (see for example Roth et al., 1991 and Henrich et al., 2001). On the other hand, our results show that there is little difference between the groups in the propensity to reject offers in the bottom quintile of the group-specific distribution.

The mean offers in rounds 16-30 are similar to the means in rounds 1-15. Compared to the first fifteen rounds, rejection rates in rounds 16-30 are lower in GL (15% compared to 20%) while there is no change in rejection rates in GH (14%). In rounds 16-30, there is a small decline compared to rounds 1-15 in the mean offer in all treatment groups except GL in treatment 1. As a result, the average offer in GL T2 is further below that in GL T1 than it was in rounds 1-15, with the difference being about one standard deviation of the pooled distribution. However, there is no significant difference in acceptance rates between GL T1 and GL T2. There are no significant differences between average offers or acceptance rates between GH T1 and GH T2 in rounds 16-30.

3.2 Norm referenced behavior

Figure 1 shows the average offer over time for each treatment, pooled across all sessions, in the high and low groups. The differences between the low and high groups are substantial and they persist throughout the game. We distinguish between two stages, before and after the move of one third of players between the groups. The average offers made by the players who are moved between groups are shown by the dotted lines in figure 1. These players enter round 16 with significantly higher or lower offers than the destination group but converge fairly quickly to the group average. This convergence occurs faster in T2, where information on average offers in the group is available in every other round.

Table 2 documents the outcomes in rounds 16-30 distinguishing between stayers and movers. Comparison between average offers in the first 15 rounds and the last 15 rounds provides information about adjustment to the prevalent norm. Non-movers exhibit very slight changes in the offers or acceptance rates. Non-movers in GL T1 do not change their behavior while there is slight increase of 2.5 ED in the average offer in GL T2, possibly due to higher offers from ex-GH players. Offers in GH decline 2 ED on average.

On the other hand, movers show substantial changes in offers and acceptance rates. Movers from GH to GL decrease their offer by 17 ED on average and movers from GL to GH increase their offers by 11 ED. The changes in T2 are larger than in T1. T2 players receive more accurate information about the mean offer in every even round and therefore update their beliefs faster than T1 players. Acceptance rates are lower for those who move from the high to the low groups than for non-movers, while movers from GL to GH have much higher acceptance rates.

A primary objective of this exercise is to investigate whether individual behavior conforms to the norm of the group. This has two parts. First, we need to identify a behavior that is a candidate for the norm. Intuitively, this behavior should be reasonably stable for the group over time. The second part is to verify that agents take account of the norm in choosing their actions. As the game progresses, players receive information about the behavior of other members of the group. As a result, their beliefs about the average behavior should converge over time. If agents conform to the norm, then their behavior should also converge. Indeed, if behavior does not converge towards the norm, it is difficult to impart meaning to the term “norm” in this context.

Our proposed candidate for the norm is the average offer made in the group. Figure 1 shows that in each treatment and in each group GH and GL, the average offers converge to a stable level over time. There is some disruption that occurs when players from a different group (with a different stable average) enter the group in period 16, but the average offers again converge to a stable level thereafter. Importantly, the new arrivals that enter a group in period 16 clearly adapt their behavior to that prevailing in the group they have now joined.

We find that the distribution of offers around the mean does tighten as the game progresses. Figure 2 presents the standard deviations of the distribution of offers around the session/group means in each period.[8] In both treatments and for both GH and GL we find that the standard deviation declines through rounds 1 to 15, increases abruptly in round 16, and then declines again after round 16, when players are moved

[8] For a given treatment, Let the offer of agent i in session h and group j at time t be x^i_{hjt}. Let the average offer in that session, group and period be μ_{hjt}. Figure 2 shows the standard deviation of the distribution of the deviations $d^i_{hjt} = x^i_{hjt} - \mu_{hjt}$ aggregated over sessions h for each group j for each t.

between groups. The speed of convergence to the mean varies but the differences are relatively small. Only in GL in treatment 2, the spike at round 16 is relatively small and there is correspondingly a smaller decline after round 16. However, the overall decline in dispersion is comparable to the other groups.

While the dispersion of offers initially falls over time, it stabilises in the later periods at strictly positive levels. If we allow that agents have much better information in the later periods about behavior in their groups, then this indicates that there is some intrinsic heterogeneity in offer behavior. In terms of our simple model, The norm adherence coefficients (γ) of the agents appears to have a non-degenerate distribution which contains unity in its interior (ref. Proposition 2).

If agents decide on their actions only with reference to group norms, then we should expect that the distribution of offers around the mean should be similar between the high and low groups. Figure 3 shows that this is indeed true. For each group GH and GL in treatment 1, the upper panel of Figure 3 plots the deviations of offers from the mean of the relevant session and period. The lower panel shows the same information for Treatment 2. In each case, the distributions for GH and GL are very similar. Figure 3 also shows the distributions of offers that were rejected in each group. We note that for Treatment 1 this distribution for the high group sits slightly but distinctly to the left of that for the low group, indicating that in GH responders are willing to accept offers somewhat further below the mean than in the low group. This is in accordance with Rabin's hypothesis discussed in Section 2, and is different from the behavior that Cameron observed in Indonesia. However, in T2 there is no systematic difference between the two groups, suggesting that the difference observed in T1 may be a result of the slower diffusion of information.

The distribution of offers is constrained above by self-interest that counteracts generosity, and below by the threat of refusal. Figure 4 show the fraction of offers that are rejected in successive intervals of 5 ED below the mean. Again, we see that in the high group offers below but close to the mean are rejected with somewhat smaller probability than in the low group. However, this should not obscure the fact that very much smaller offers, in absolute terms, are accepted in the low group. An offer that is 15 ED below the mean in the high group, and hence rejected with about 70% probability, would in absolute terms be marginally higher than the mean offer in the low group and be almost always accepted. It is important to note that the rejection rate falls quickly to near zero as the value of offers rises past the mean. Indeed, while more than half of the offers that are 10ED below the mean are rejected, only about one in twenty offers that are 5ED above the mean are rejected. This lends some (limited) support to our presumed distribution of the parameter α (see equation 1).

Finally, we inquire whether a player who moves from one group to another locates himself at the same position relative to the mean in the new group as he did in the old group. A cursory glance at figure 1 suggests that the players moved up from GL to GH tend on average to make offers lower relative to the mean after the move, and the opposite is true for those moved down. Figures 5 and 6 offer an alternative view. The distributions of the deviations of offers from the current session/period mean is plotted for movers separately for periods 6-15 and periods 21-30. We discard the first five periods at the start and after the move to focus attention on choices after allowing some time for the initial adjustment to group behavior. We find that in Treatment 1 (figure 5) those who move up tend to make offers that are lower, relative to the mean, than they made in their previous group, while those who are moved down make offers that are higher. In treatment 2 (Figure 6), this tendency is still evident, but much weaker than in Treatment 1. One may conjecture that the norm an agent was exposed to in the past continues to carry weight, but this weight is much smaller when more accurate information about current norms is available. It also lends support to our specification of the proposers' utility, where selfishness-aversion is evaluated relative to the norm rather than to some absolute personal standard.

In sum, our data supports the following interpretation of behavior. Once agents obtain some information about the average behavior of other agents in the group within which they are interacting, our data suggests that agents then choose actions that conform to to that average. Thus actions tend to cluster more closely to the average as time passes and more information is available. It is in this sense of increased clustering of actions that the average may be thought of as a norm.

Further, in both the high and the low groups we observe that agents do not converge completely to the mean. Some agents continue to make offers that are higher while others make offers that are lower, creating a somewhat smooth distribution. This heterogeneous behavior of agents is more clear in treatment 2, where the average offers are clearly communicated to all agents but offers nevertheless remain dispersed. It suggests that some agents are naturally more altruistic in making offers, while others are naturally less so. It is evident from figure 2 that, as time passes, the dispersion of offers stabilizes at a positive level and does not go to zero. In terms of the model in section 2, agents appear to put different utility weights on deviations of offers from the average, both when making and responding to offers, i.e., there is a non-degenerate distribution of the selfishness-aversion parameter γ for proposers. Similarly, the more selfish an offer is *relative to the norm*, the larger is the proportion of agents that find it unacceptable, hence the rejection rate is higher for offers that are further below the norm. This is consistent with a non-degenerate distribution of the parameter α. When information is more noisy, there is greater tolerance for selfish offers.

Finally, when agents move from one group to the other, they adjust to the norm of the new group they find themselves in. This adjustment occurs fairly quickly, and appears to be only constrained by the speed at which information about the new norm is accumulated. The norm learned in the previous group does seem to impart an initial bias to their actions. Thus agents become relatively less generous when moved up from a low-mean group to a high-mean group, and the converse is also true. However, this bias is small or negligible when accurate information about group behavior is available, as observed in treatment 2.

The observations above suggest that the initial distribution of offers that we see in round 0 is a consequence of different preconceptions about the norm that participants have before they receive any information about the group, rather than individual differences in the degree of selfishness or generosity. The different norms that develop subsequently in the two groups result from the clustering of individuals with similar preconceptions rather than those with similar tendencies to be selfish or generous. It is a possible, if rather bold, conjecture that the universal element of human social behavior is the distribution of a generosity/selfishness parameter that dictates the distribution of positions around a local norm. The specific local norms that develop in different societies could then be the result of exigencies of history or institutional development. This is certainly consistent with an institutional or coordination approach to history, and is testable using appropriately designed experiments. It is also consistent with the resuts of Roth et.al. (1991), and with the remarkable stability of rejection ratios across a large number of ultimatum game experiments (Oosterbeek et al., 2004).

4 Statistical determinants of offers

Our primary hypothesis is that the offers that an individual makes are determined by her estimate of the mean offer in the group and by her personal characteristics (e.g., whether she is naturally selfish, her prior socialization, etc.). The personal characteristics dictate where she will position herself relative to the mean.

As time passes, players receive new information about group behavior, and hence form better estimates of the group mean. When a player makes an offer in period t, we expect that he is using all the information that he has at that point. Before he makes the next offer in period $t+1$ he receives a response (accept or reject) to his t-offer, he himself receives an offer in t, and he responds to that offer. In treatment 1, this is all the new information that he obtains between the two offers. In T2, if t is even, he also learns the average offer in the group.

If players act rationally and use all the information at their disposal, then it follows that any difference between the offers in successive periods must be the result of this new information. However, It is intuitively plausible that an offer conveys more information about the group mean when the player has observed only a few earlier offers, than when she has observed many earlier offers. Hence we expect that the additional information conveyed by new offers and responses must diminish as time passes. The exception to this is when players know they have been moved to a new group in period 16, where the new observations are likely to convey much more information.

In rounds $1-15$, we expect offers to converge to the mean (in the sense of diminishing variance), and we expect this convergence to be faster treatment 2. The main innovation of the game is in rounds $16-30$, after one third of participants are randomly moved across GH and GL. Based on the discussion in Section 2, we use the following estimation equation separately for treatments 1 and 2.

$$\begin{aligned} OM^j_{i,t+1} \quad = \quad & \beta_0 + \beta_1 OM^j_{i,t} + \beta_2 OR^j_{i,t} + \beta_3 RR^j_{i,t} + \beta_4 RM^j_{i,t} + \beta_5 W^j_{i,t} + \beta_6 \overline{O}^j_t + \beta_7 IB^j_i \\ & + t * \left(\beta_8 + \beta_9 OM^j_{i,t} + \beta_{10} OR^j_{i,t} + \beta_{11} RR^j_{i,t} + \beta_{12} RM^j_{i,t} + \beta_{13} IB^j_i \right) + \epsilon^j_{i,t}, \end{aligned}$$

where i, j, and t denote the individual, the group and the time period respectively. OM is the offer made by the agent, OR is the offer received, RM and RR respectively denote the response made and received (0 if "reject" and 1 if "accept"), W is the individual's accumulated wealth, $\overline{O}$ is the group average offer and IB is the initial bid. All estimations include a gender indicator.

The summary statistics for the two sets of periods are presented in Table 1, both for the entire population as well as by group and treatment. Table 2 presents the statistics separately for movers and non-movers. Note in particular that the average offers of non-movers change little between the first and the second half of the experiment, while those of the movers show large changes. This indicates that individuals adjust their behavior when placed in environments governed by different norms, and suggests that the social environment influences behavior along with individual characteristics.

Table 3 reports regression results of equation (8) for periods $1-15$ for each group GL and GH in each treatment T1 and T2. In OLS estimations we control for individual effects by including the initial offer in period 0 and a gender indicator. The initial bid is made before receiving any information from other players and we use it as a proxy for individual characteristics. However, the initial bid can be a noisy measure of individual beliefs. We also perform a fixed effects estimation, FE, to further control for individual effects. The FE estimation accounts for unobserved heterogeneity by subtracting means to remove any time invariant components of the model.

The offer made in period t sums up information the individual had in the previous period. This information is updated by the offer received in period t, and the accept/reject decision for offer made and received. Interactions of these variables with the period t are included to evaluate how determinants of offer change during the experiment. We also include the mean offer made in period t in the relevant group and session; this control mimics the additional information available for T2 participants. Finally, total profit received till period t is included to control for wealth effects.

Columns (1)-(4) in Table 3 report the OLS results of equation (8) for the first 15 periods. Acceptance (by the partner) of the offer made by the agent in the previous period reduces the current offer; this negative effect declines over time in GL but not in GH. Accepting the received offer also has a negative effect on the offer made in the subsequent period and this negative effect also declines over time, but this is significant only in GL. We find that the importance of one's own previous offer increases over time while the importance of the most recent received offer decreases. This agrees with our expectation that, as time passes, previously accumulated information gains more weight in the decision than newly received marginal information. However, these effects are small and insignificant.

We do not find that wealth affects the offer value. As expected, the mean offer positively affects the offer value in T2, however it is not statistically significant in GH and only significant at the 5% level in GL. The estimated effect of the mean offer is relatively small, probably because it does not add much information beyond the first few periods.

FE estimations of equation (8) for periods 1 to 15 are in columns (5)-(8) of Table 3. The differences between FE and OLS estimates indicate that individual characteristics are important in determining the offer value. However, these characteristics are not adequately captured by the initial bid, which is not significant in the explanation of offer values in the OLS estimation. The main difference between the FE and OLS results is in the coefficient β_1 of the offer made in the previous period t. On the other hand, there is only a slight difference in β_2, the coefficient of offer received in t, suggesting that individual characteristics do not influence how agents use received information to update their beliefs.

In $t = 0$ participants are sorted into GL and GH based on their initial (period 0) offers (BI_{ij}). It is therefore important to reflect on the possible sources of the dispersion between the initial offers. There are two important potential sources; one is that there is a large dispersion in the participants' initial beliefs about the group norm, the other is that, while the initial beliefs are similar, there is wide dispersion between the participants' individual characteristics (i.e., the selfishness-aversion coefficient γ).

There is a substantial difference between the the mean offers made in the two groups in periods 1-15. Within each group, the mean offer across the periods is much closer to the average initial offer made in the group. This is consistent with either possibility above, or a combination of the two. However, in periods 16-30, we find that movers converge closely to the norms in their new groups. Further, the distributions around the group mean of offers made by movers is not very different in the old and new groups. We also note that the distribution of offers around the mean is nearly identical in GH and GL even in periods 1-15. This suggests that responses of individuals to perceived norms is similar in the two groups, but the sorting rule that we used to form the groups amplified the effect of the dispersion of initial beliefs about the norm.

In $t = 16$ one third of each group was randomly selected and moved to the other group (GL to GH or GH to GL). We estimate equation (8) and test how offer value established in the first 15 rounds affects individual behavior in the final 15 rounds of the game. For comparison, we perform estimations for players who moved groups and for those who remain in their original group.

The OLS and FE results are reported in Tables 4 and 5, respectively. Columns (1)-(4) report results for non-movers and columns (5)-(8) report results for movers. The first variable of interest is the mean of offers made by the player in rounds 1-15, which reflects his/her response to the group norm in the first half of the experiment. For non-movers, this continues to be the prevailing norm, and has a large and significant effect on offers in rounds 16-30. However, this effect is small and not significant for the movers. For movers the main determinant of offers in 16-30 is the norm in the new group, so the offers they made in the first 15 periods cease to be important.

The second variable is the offer made in the previous period. In periods 16-30, the effect of the offer made in period t on the offer made in $t + 1$ is more pronounced for movers than non-movers. For non-movers, recent offers incorporate little additional information over the mean of periods 1-15. For the movers, however, recent offers reflect substantial new information about their new groups, and hence remain important.

Our main estimations use specification in equation (8). As a check we also estimate equation (7) using the OLS methodology for each treatment group, for the initial and final rounds of the game. Additionally, we examine differences in behavior between movers and non-movers as we do in Table 4. Estimation results are reported in Appendix A, Tables A.1 and A.2. The findings are very similar to those reported in Tables 3 and 4.

Results in Tables 1-5 indicate that individuals tend to behave according to the norms prevalent in their groups, and they adjust quickly to new norms when placed in a different environment. This is more evident in the FE model. In the case of agents that move from one group to another, prior socialization or environment plays some role, but not a large role in determining later behavior.

5 Conclusions

Our findings add to the literature that investigates the relationship between culture or environment and attributes such as rationality, fairness and generosity. The existing experimental literature shows that individuals take account of social norms such as those of fairness in one-to-one or small-group interactions. It also points out that there are substantial differences in group behavior between different locations and environments, some of which may be determined by accidents of history. Our experiment contributes to a sharpening of these results by decoupling norm-adherence from subjective fairness. We show that group norms develop among individuals that repeatedly interact with each other, and when individuals are placed in a new environment with a developed norm they adjust their behavior quickly to conform to the new social environment.

Our observations are consistent with the hypothesis that agents display fairness and/or selfishness-aversion both in making offers and responding to offers. Further, there is perceptible diversity within the population in the degree of selfishness-aversion. While some agents make offers below the norm, others make offers which are distributed to the right of the norm, even though it is evident that offers at or marginally above the norm are accepted with near-certainty. Finally, the behavior of our agents in general, and of movers in particular, confirms that this selfishness aversion is not referenced by an absolute standard but by the observed distribution of behaviors in the reference group within which the agents interact.

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Figure 1a: Group means, movers and non-movers, treatment 1

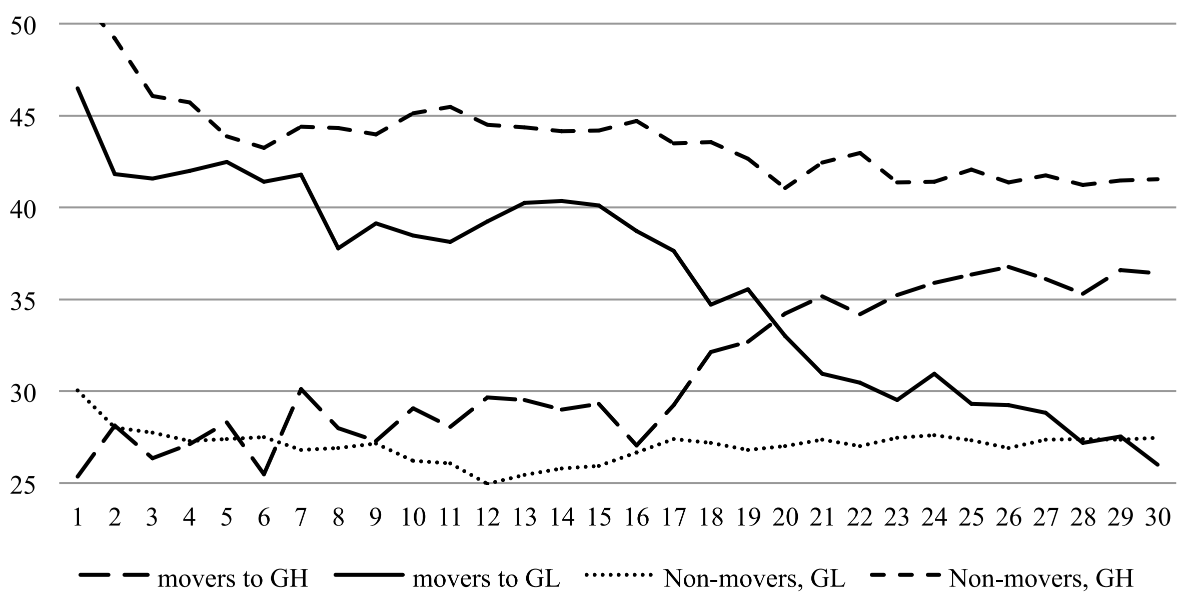
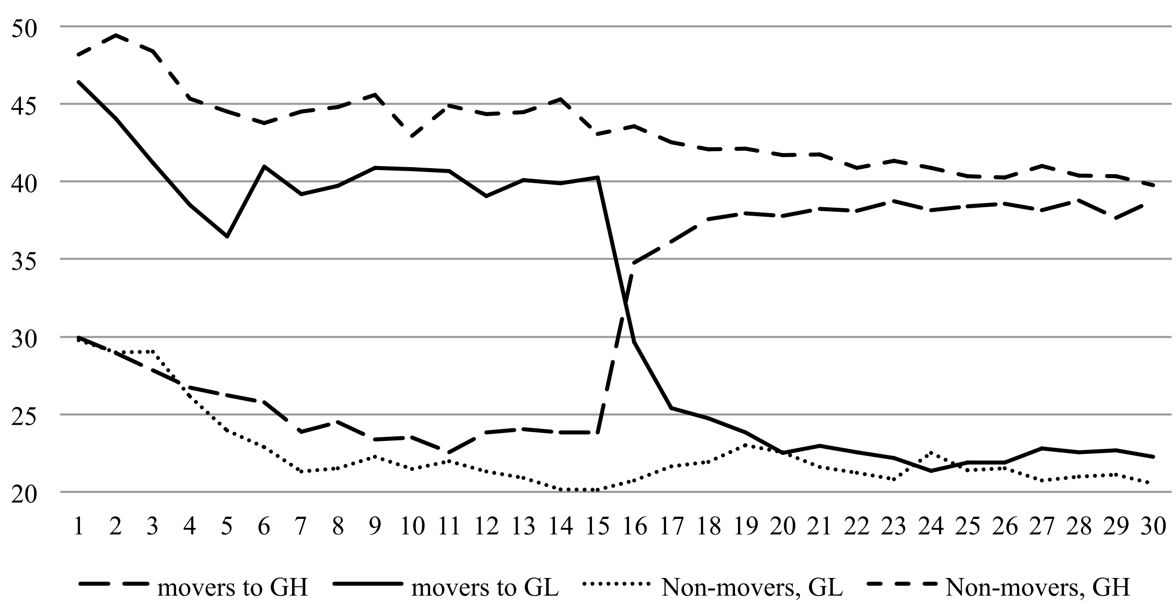


Figure 1b: Group means, movers and non-movers, treatment 2



Note: means are calculated for each round for movers and non-movers in GL and GH in treatment groups 1 and 2.

Figure 2a: SD of deviations from session mean, by period, treatment 1

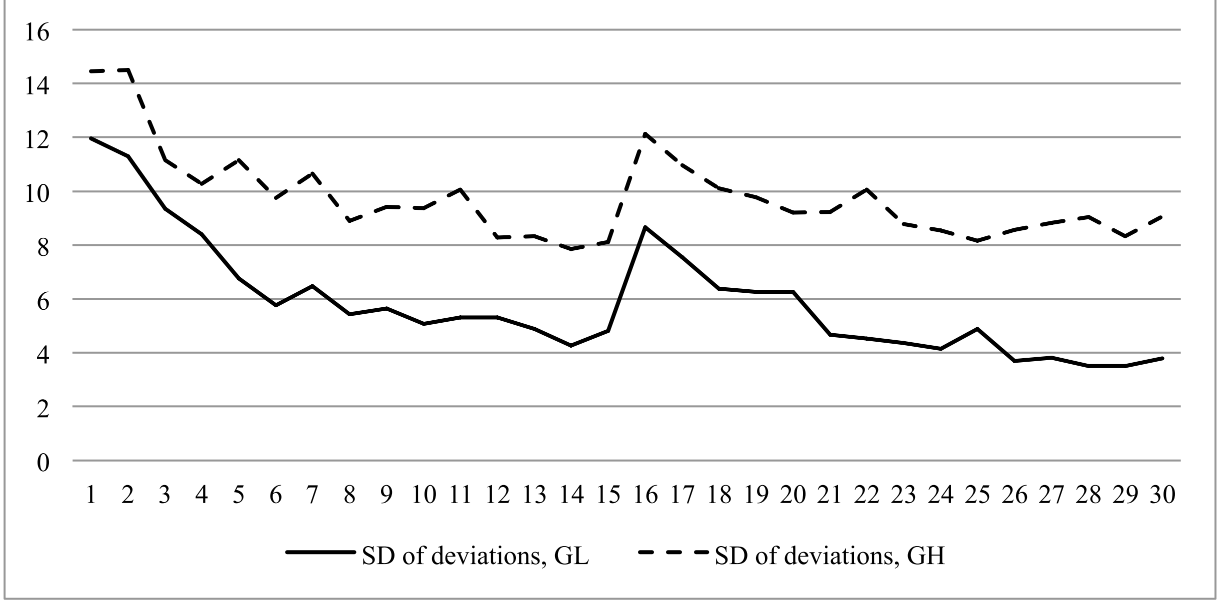
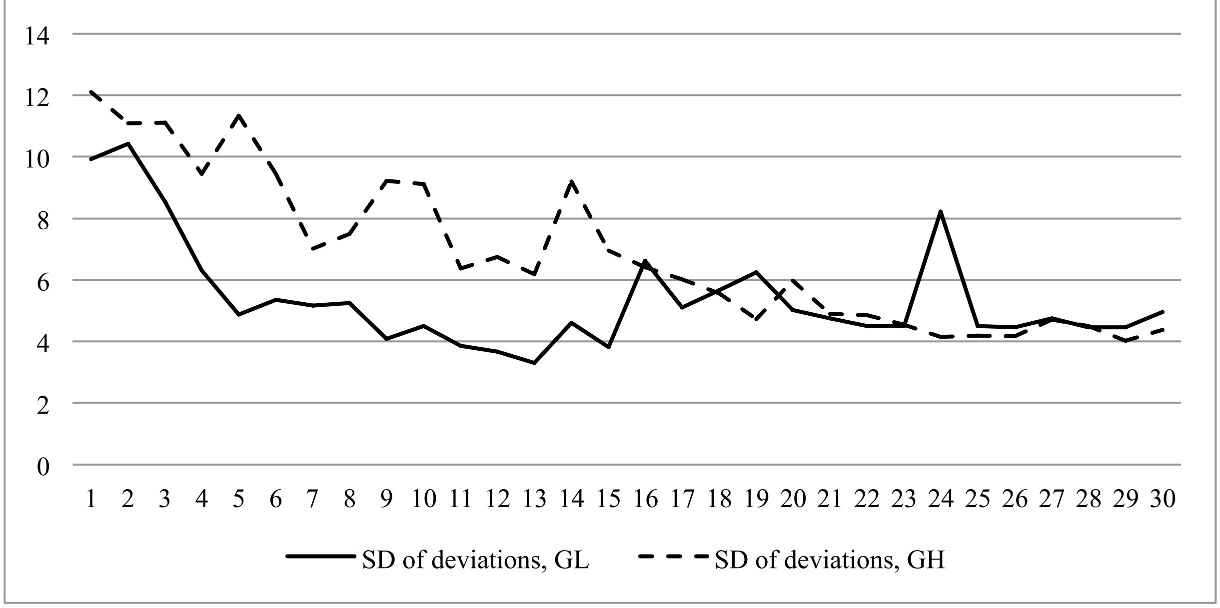


Figure 2b: SD of deviations from session mean, by period, treatment 2



Note: stadard deviations of individual deviations from the corresponding session mean calculated for each period, within each session, group and treatment.

Figure 3a: T1 offers and rejections, by deviation of offer from group/ session/period mean

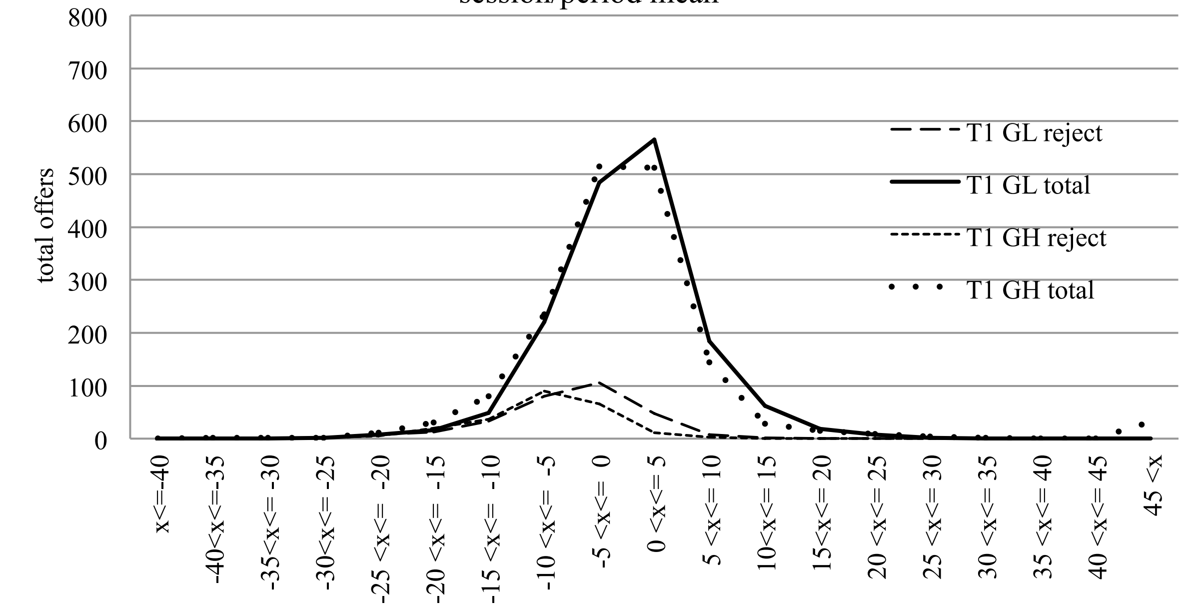
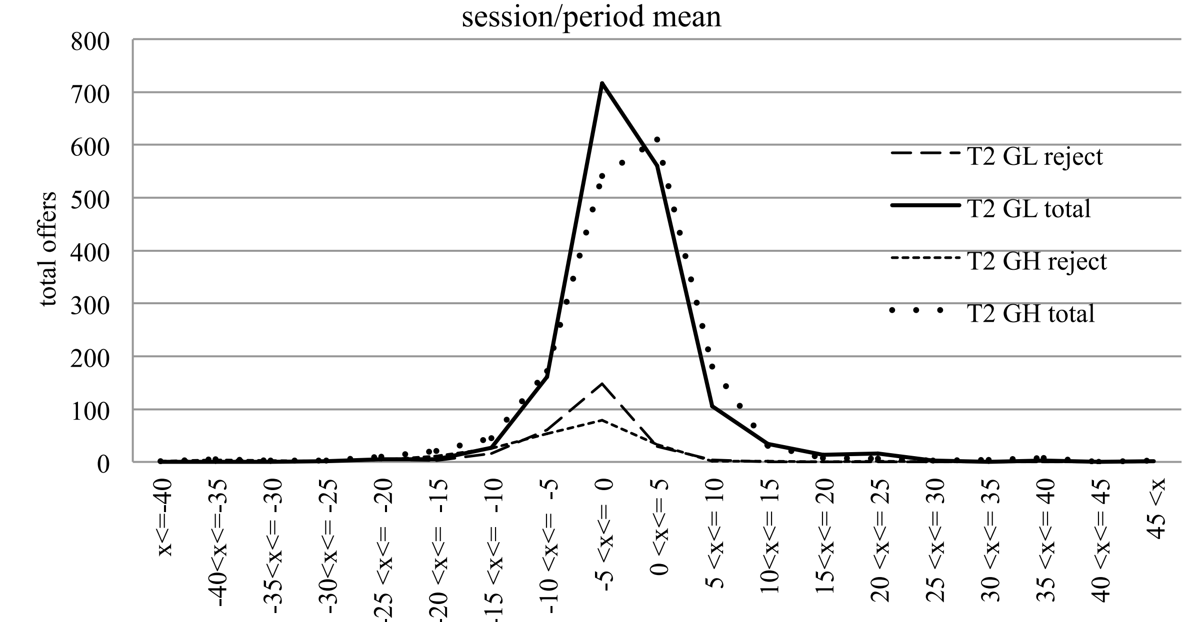
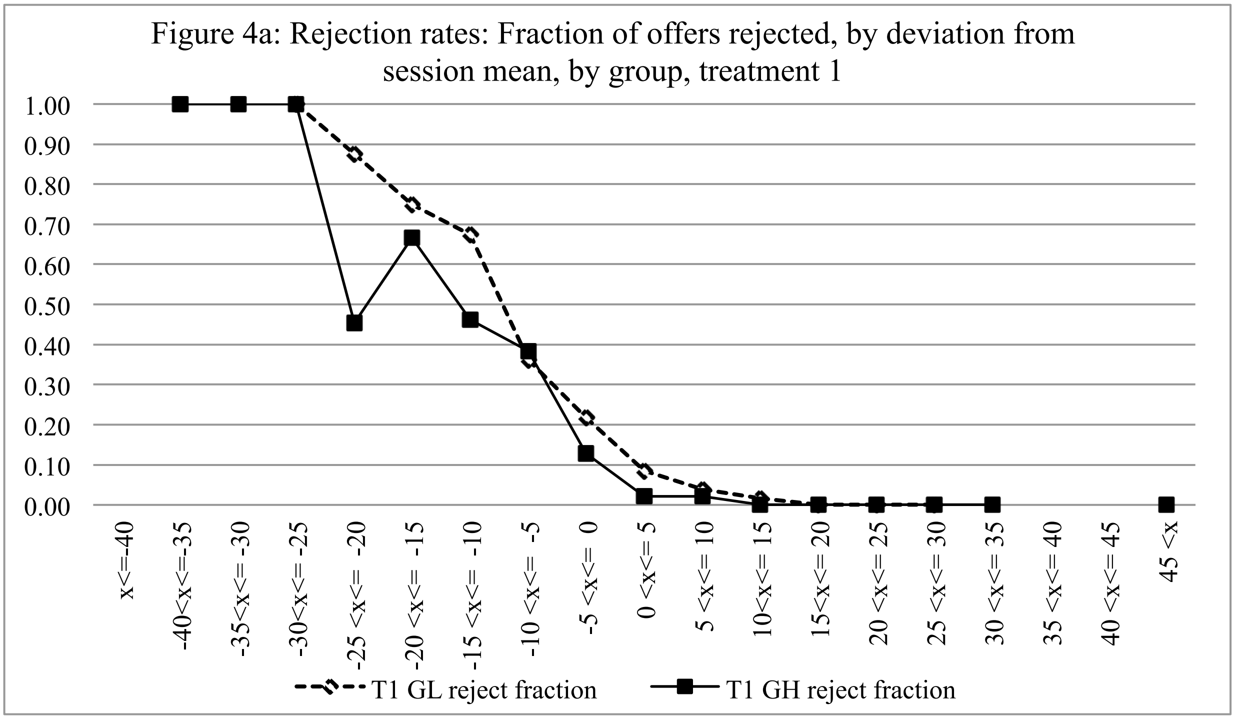
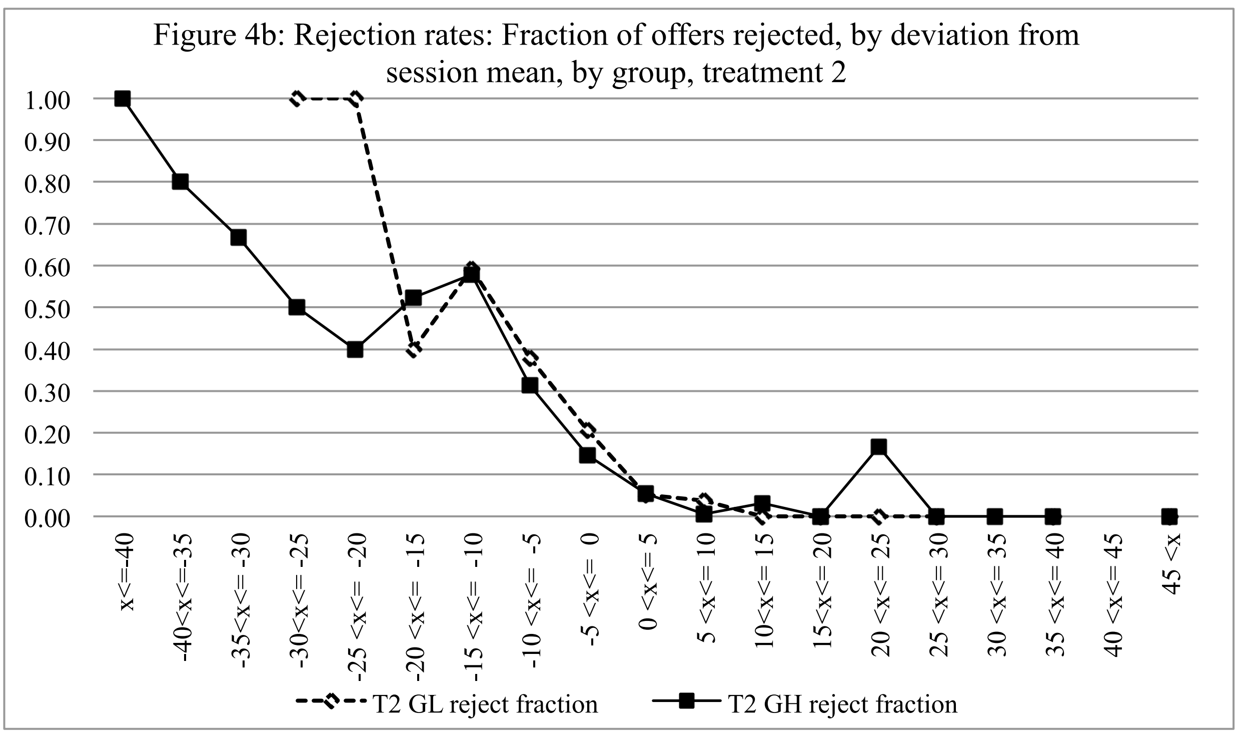


Figure 3b: T2 offers and rejections, by deviation of offer from group/ session/period mean



Note: The figures show numbers of offers made and offers rejected within respective ranges of deviations from the mean in the corresponding group/session/period/treatment.





Note: The figures show proportions of offers rejected within respective ranges of deviations from the mean in the corresponding group/session/period/treatment.

Figure 5a: Movers-up (treatment 1): Distribution of offers relative to the mean, last ten periods before and after the move

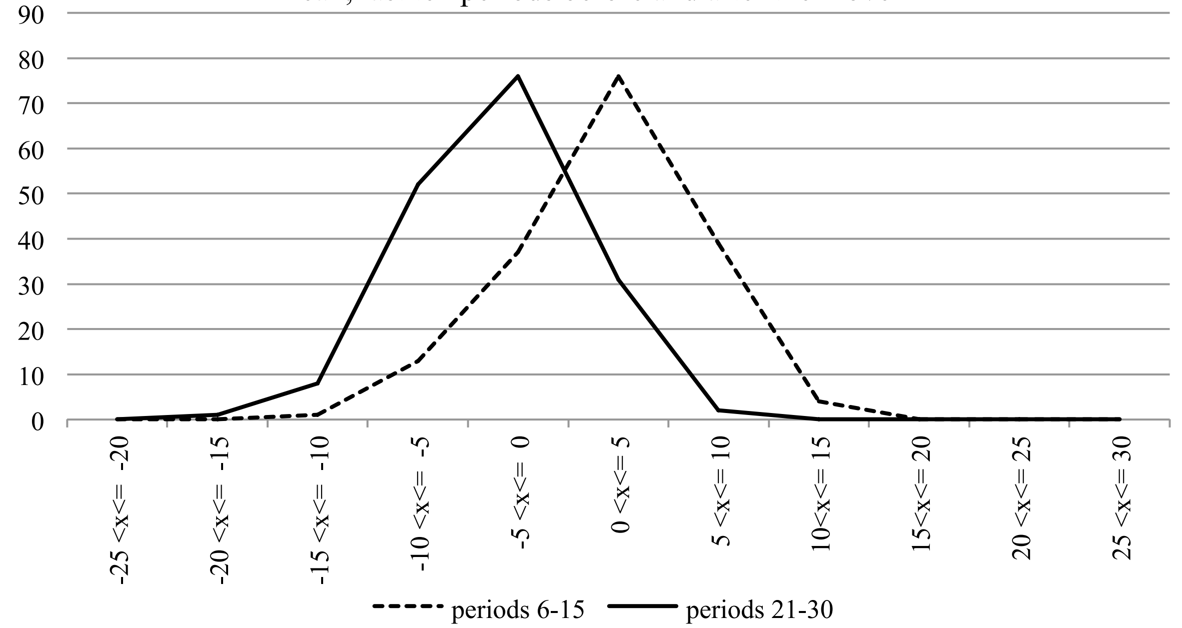
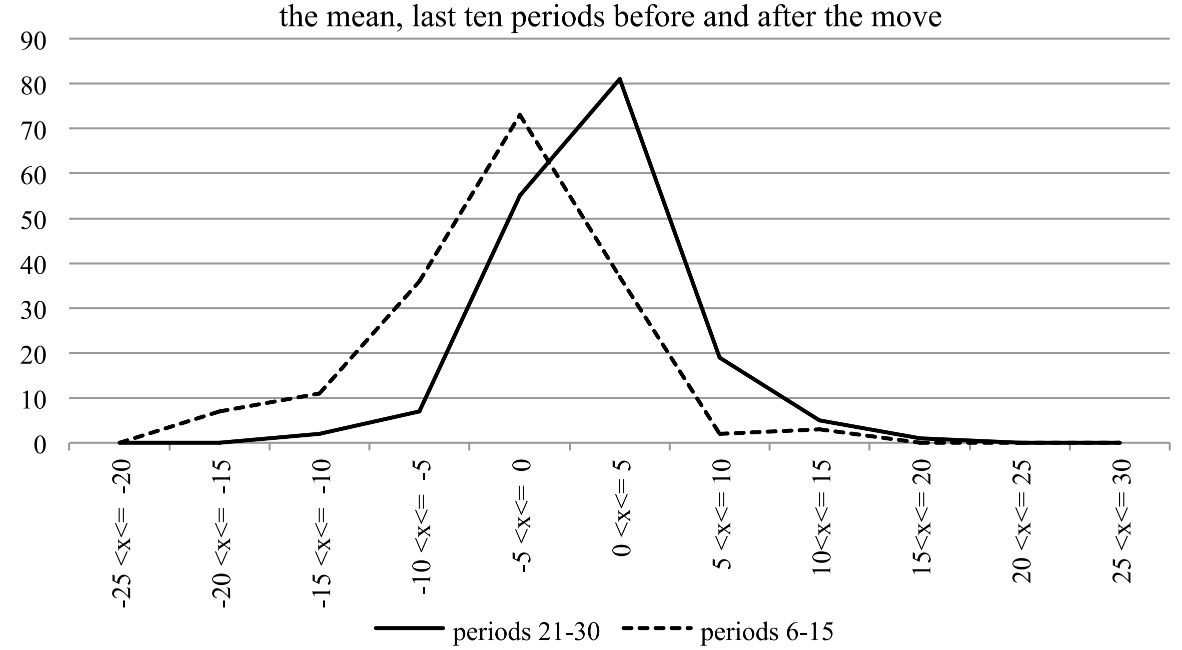
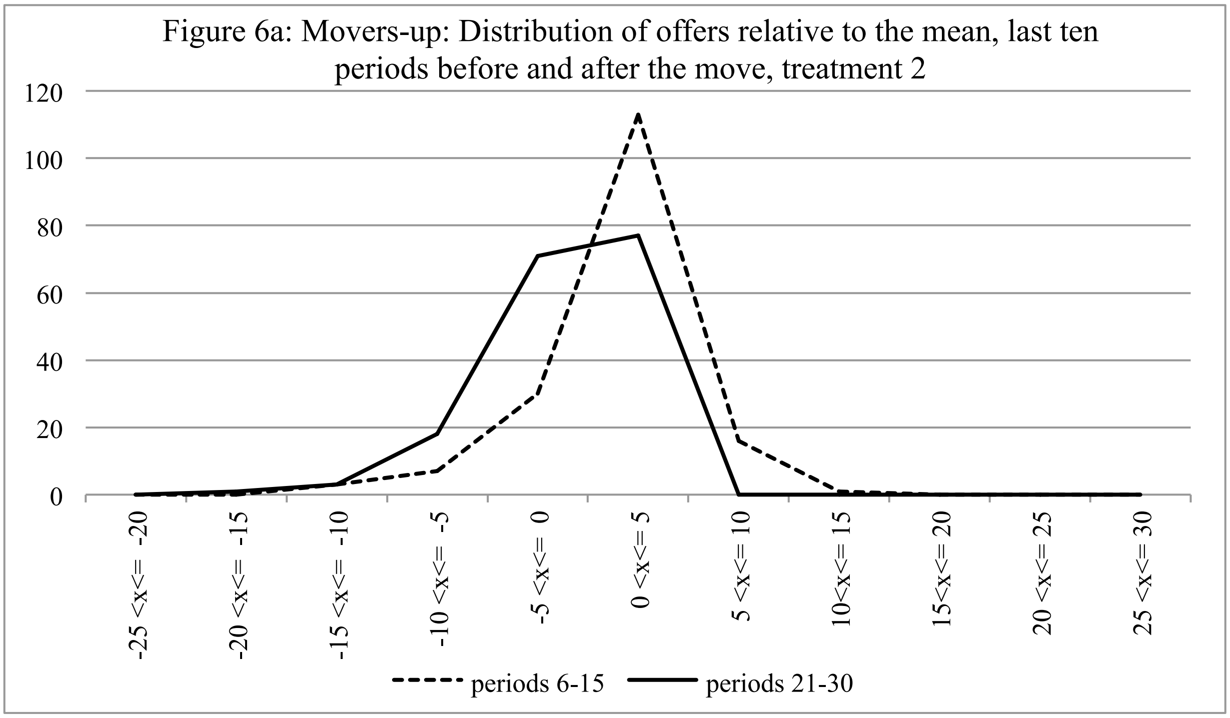
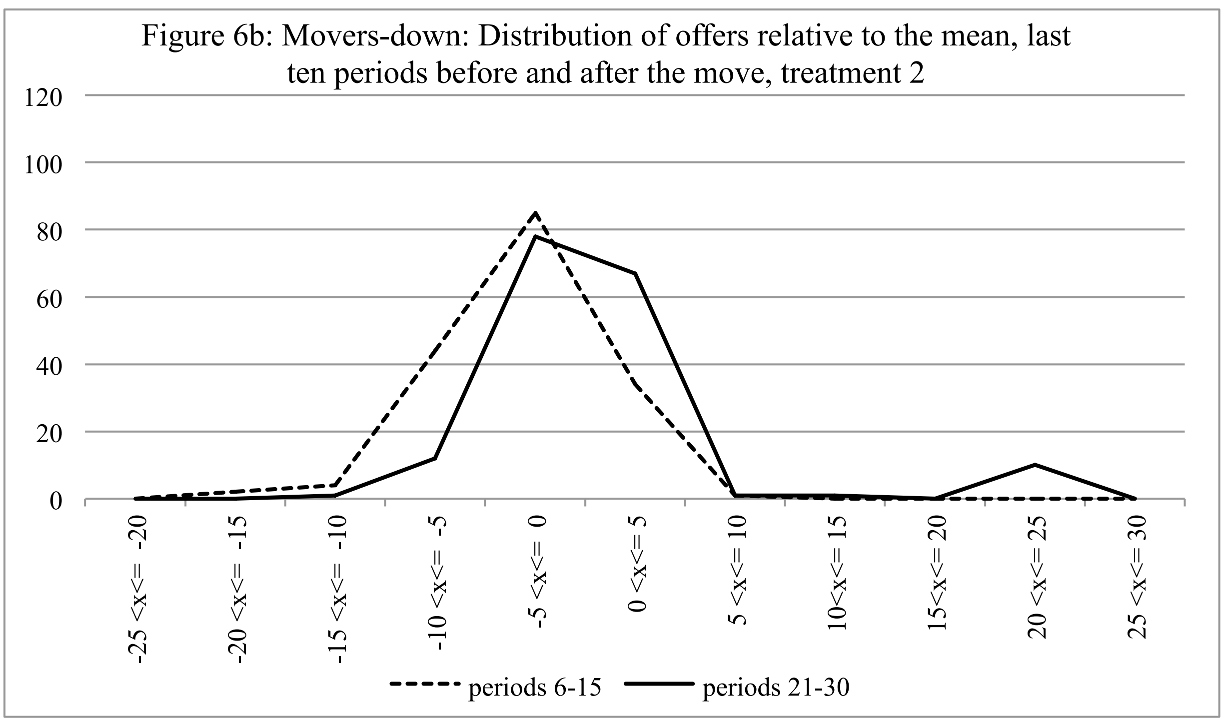


Figure 5b: Movers-down (treatment 1): Distribution of offers relative to the mean, last ten periods before and after the move



Note: For movers-up/down, the figures show the frequency distribution of deviations of offers from the mean in the corresponding group/session/period/treatment.





Note: For movers-up/down, the figures show the frequency distribution of deviations of offers from the mean in the corresponding group/session/period/treatment.

Table 1: Summary statistics, means and standard deviations

	1<=t<16						
	all	GL	GH	GL, TR1	GH, TR1	GL, TR2	GH, TR2
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
offer	34.72	25.63	43.82	27.25	43.89	24.04	43.75
	13.35	8.36	11.00	8.68	11.80	7.71	10.16
acceptance rate	0.83	0.80	0.86	0.78	0.86	0.83	0.87
	0.37	0.40	0.34	0.42	0.35	0.38	0.34
accept<20%	0.66	0.67	0.43	0.61	0.38	0.71	0.45
	0.47	0.47	0.50	0.49	0.52	0.45	0.51
accept<20%, by group	0.66	0.61	0.57	0.47	0.54	0.64	0.51
	0.47	0.49	0.50	0.50	0.50	0.48	0.50
initial bid	40.19	27.31	53.07	26.28	53.43	28.33	52.73
	17.40	12.10	11.30	11.76	11.26	12.34	11.33
bid in 1st period	38.99	29.20	48.77	28.56	49.96	29.84	47.60
	16.27	11.79	14.09	12.80	14.78	10.68	13.29
total profit	82.48	79.04	85.91	74.52	85.91	83.47	85.91
	15.73	16.31	14.34	17.47	14.82	13.72	13.86
male	0.55	0.51	0.58	0.46	0.54	0.56	0.62
	0.50	0.50	0.49	0.50	0.50	0.50	0.49
N	3270	1635	1635	810	810	825	825

	15<t<=30						
	all	GL	GH	GL, TR1	GH, TR1	GL, TR2	GH, TR2
offer	32.59	25.26	39.92	28.50	39.69	22.07	40.14
	11.40	7.59	9.74	6.47	11.50	7.25	7.63
acceptance rate	0.86	0.85	0.86	0.86	0.85	0.85	0.87
	0.35	0.35	0.35	0.35	0.36	0.36	0.34
avg offer in 1<=t<16	34.72	30.13	39.32	31.24	39.90	29.04	38.74
	11.71	9.29	12.07	9.03	12.45	9.41	11.67
total profit	83.74	83.05	84.44	81.89	83.12	84.19	85.72
	8.82	8.62	8.96	9.71	9.62	7.22	8.06
male	0.55	0.55	0.54	0.57	0.43	0.53	0.65
	0.50	0.50	0.50	0.49	0.49	0.50	0.48
N	3270	1635	1635	810	810	825	825

Note: TR1 and TR2 refer to treatment 1 (uninformed) and treatment 2 (informed), respectively. GH and GL refer to groups with high and low mean initial offer, respectively.

Table 2: Summary statistics, means and standard deviations , movers and non-movers,

	non-movers					
	GL	GH	GL, TR1	GH, TR1	GL, TR2	GH, TR2
	(1)	(2)	(3)	(4)	(5)	(6)
offer	24.35	41.73	27.22	42.20	21.48	41.26
	6.74	10.38	5.81	12.43	6.37	7.80
acceptance rate	0.88	0.81	0.88	0.79	0.88	0.82
	0.33	0.40	0.32	0.41	0.33	0.38
avg offer in 1<=t<16	25.17	45.33	26.88	45.35	23.45	45.30
	6.20	9.47	6.93	10.92	4.80	7.75
total profit	81.48	85.37	80.02	85.19	82.95	85.55
	8.80	9.60	10.11	10.36	6.95	8.79
male	0.57	0.61	0.57	0.51	0.57	0.70
	0.50	0.49	0.50	0.50	0.50	0.46
N	1110	1110	555	555	555	555

	movers					
	GL	GH	GL, TR1	GH, TR1	GL, TR2	GH, TR2
offer	27.18	36.09	31.30	34.22	23.28	37.85
	8.83	6.78	6.95	6.35	8.66	6.72
acceptance rate	0.80	0.97	0.82	0.97	0.79	0.96
	0.40	0.18	0.39	0.16	0.41	0.19
avg offer in 1<=t<16	40.63	26.61	40.73	28.05	40.54	25.26
	4.99	5.13	4.83	5.22	5.15	4.67
total profit	86.35	82.46	85.95	78.62	86.73	86.09
	7.19	7.04	7.28	5.58	7.10	6.32
male	0.51	0.40	0.59	0.24	0.44	0.56
	0.50	0.49	0.49	0.43	0.50	0.50
N	525	525	255	255	270	270

Note: TR1 and TR2 refer to treatment 1 (uninformed) and treatment 2 (informed), respectively. GH and GL refer to groups with high and low mean initial offer, respectively. Upper panel presents statistics for players who did not change groups. The lower panel presents statistics for movers, players who were randomly moved from GH to GL (columns (1), (3), (5)) or from GL to GH (columns (2) (4), (6)) in round 16.

Table 3: Determinants of offer made in t+1, 1<=t<15

	OLS				FE			
	TR1		TR2		TR1		TR2	
	GL	GH	GL	GH	GL	GH	GL	GH
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
offer made	0.668***	0.706***	0.597***	0.480**	0.520***	0.433**	0.554***	0.211*
	(0.0372)	(0.1292)	(0.0619)	(0.1497)	(0.0518)	(0.1125)	(0.0700)	(0.0894)
offer made * t	0.010	0.013	0.009	0.015	-0.016	-0.008	-0.018**	-0.016*
	(0.0090)	(0.0085)	(0.0072)	(0.0137)	(0.0104)	(0.0061)	(0.0063)	(0.0067)
offer received	0.149*	0.131*	0.261***	0.097	0.145**	0.104**	0.240***	0.044
	(0.0615)	(0.0594)	(0.0250)	(0.0992)	(0.0346)	(0.0285)	(0.0157)	(0.0766)
offer received *t	0.001	-0.008	-0.01	0.001	0.001	-0.002	-0.005	0.005
	(0.0119)	(0.0046)	(0.0064)	(0.0082)	(0.0071)	(0.0048)	(0.0074)	(0.0083)
offer rec. accepted	-1.311	-5.058**	-4.207***	-3.956**	-2.6	-4.927***	-4.810***	-5.034*
	(0.7931)	(1.3643)	(0.6992)	(0.9780)	(1.2325)	(0.8028)	(0.9611)	(1.8348)
offer rec. accepted*t	-0.037	0.473***	0.194**	0.377**	0.143	0.394**	0.311*	0.638**
	(0.1354)	(0.0874)	(0.0636)	(0.0853)	(0.1656)	(0.1314)	(0.1217)	(0.1868)
offer made accepted	-8.199***	-6.447**	-7.500***	-4.807*	-6.751***	-4.474*	-6.487**	-1.946
	(1.1729)	(1.5810)	(1.2488)	(2.2383)	(0.8384)	(1.7598)	(1.6409)	(2.2252)
offer made accept*t	0.406**	0.278	0.492**	0.256	0.417**	0.227	0.489**	0.137
	(0.1365)	(0.1418)	(0.1113)	(0.3032)	(0.1275)	(0.1461)	(0.1282)	(0.3137)
initial bid	0.072	-0.079	0.086**	-0.058				
	(0.0421)	(0.0709)	(0.0276)	(0.0678)				
initial bid *t	-0.004	0.005	-0.005*	0.004				
	(0.0036)	(0.0073)	(0.0018)	(0.0065)				
mean offer in t	0.052	0.125*	0.125*	0.155	0.007	0.261*	0.274***	0.220
	(0.0447)	(0.0545)	(0.0521)	(0.2760)	(0.0771)	(0.1214)	(0.0520)	(0.1658)
total profit till t	0.001	-0.009**	-0.005	-0.011	-0.015*	-0.004	-0.022**	-0.029***
	(0.0013)	(0.0024)	(0.0032)	(0.0062)	(0.0064)	(0.0060)	(0.0061)	(0.0055)
t	-0.434**	-0.254	0.032	-0.459	1.167*	0.281	1.696**	2.267**
	(0.1426)	(0.6264)	(0.3698)	(1.0273)	(0.4991)	(0.5043)	(0.5365)	(0.7880)
const	7.889**	15.226*	5.136**	23.579***	15.333***	18.224**	4.369*	31.029***
	(1.7900)	(5.5250)	(1.5629)	(4.9484)	(2.3013)	(5.5224)	(2.0422)	(3.3643)
N	756	756	770	770	756	756	770	770
R2 adj.	0.687	0.740	0.726	0.460	0.363	0.270	0.607	0.123

Note: Columns (1)-(4) report OLS results and columns (5)-(8) report FE results, *t* refers to round played. TR1 and TR2 refer to treatment 1 and treatment 2, respectively. GH and GL refer to groups with high and low mean initial offer, respectively. All regressions include gender indicator. Observations are clustered at session level. Significance levels are noted as follows, *** 0.01; ** 0.05; *0.1.

Table 4: Determinants of offer made in t+1, OLS, 15<=t<=30

	non-movers				movers			
	TR1		TR2		TR1		TR2	
	GL	GH	GL	GH	GL	GH	GL	GH
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
offer made	0.508**	0.314	0.371*	0.234	0.400*	0.608***	0.370**	0.611***
	(0.116)	(0.217)	(0.140)	(0.278)	(0.155)	(0.123)	(0.105)	(0.108)
offer made * t	0.023**	0.025***	-0.000	0.042	0.015	0.016	0.054***	0.014
	(0.006)	(0.005)	(0.014)	(0.026)	(0.017)	(0.011)	(0.010)	(0.009)
offer received	0.053	0.057	0.116	0.218***	0.196**	0.216	0.193***	-0.125
	(0.026)	(0.028)	(0.075)	(0.043)	(0.071)	(0.111)	(0.038)	(0.108)
offer received * t	-0.000	-0.000	-0.003	-0.010	0.005	-0.016	-0.016**	0.019
	(0.004)	(0.003)	(0.006)	(0.012)	(0.009)	(0.013)	(0.005)	(0.011)
offer rec. accepted	-0.028	-0.906	0.246	-3.291**	-5.485***	-7.192	-3.865	-4.887*
	(0.512)	(0.786)	(1.018)	(0.959)	(0.880)	(6.842)	(1.994)	(1.865)
offer rec. accepted*t	-0.007	-0.025	-0.044	0.130	0.347*	0.748	0.335	0.428
	(0.091)	(0.106)	(0.074)	(0.065)	(0.153)	(0.642)	(0.168)	(0.292)
offer made accepted	-3.838***	0.151	-1.705	-1.487	-3.314	-2.352	-4.434	-1.647
	(0.511)	(2.046)	(0.914)	(0.884)	(5.295)	(2.140)	(3.302)	(0.815)
offer made accept*t	0.147	-0.416**	0.088	-0.072	0.022	0.049	0.169	0.009
	(0.083)	(0.120)	(0.048)	(0.128)	(0.565)	(0.254)	(0.344)	(0.196)
mean offer 12<t<16	0.349**	0.668**	0.514**	0.361	0.203	-0.129	0.336*	0.012
	(0.088)	(0.211)	(0.172)	(0.188)	(0.095)	(0.191)	(0.149)	(0.096)
mean offer 12<t<16*t	-0.020**	-0.026**	-0.010	-0.022	-0.014*	0.009	-0.035**	-0.021
	(0.005)	(0.007)	(0.009)	(0.015)	(0.005)	(0.016)	(0.013)	(0.010)
mean offer in t	0.046	0.059	0.097*	0.271**	0.008	0.120	0.114	0.343**
	(0.042)	(0.084)	(0.042)	(0.072)	(0.122)	(0.135)	(0.103)	(0.092)
total profit till t	-0.000	-0.001	0.000	0.001*	0.003*	-0.000	-0.001	0.002
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.003)
t	-0.156**	0.493	0.181	-0.518	-0.869	-0.797	0.313	-1.428*
	(0.051)	(0.272)	(0.187)	(0.372)	(0.566)	(0.531)	(0.559)	(0.574)
const	4.301	-1.741	-1.605	1.562	9.991	12.977	0.214	12.401*
	(2.639)	(1.988)	(2.085)	(5.555)	(4.780)	(10.210)	(3.524)	(5.010)
N	555.000	555.000	555.000	555.000	255.000	255.000	270.000	270.000
R2 adj.	0.769	0.902	0.698	0.866	0.670	0.764	0.825	0.789

Note: The variable *t* is the round played minus 15. TR1 and TR2 refer to treatment 1 and treatment 2, respectively. GH and GL refer to groups with high and low mean initial offer, respectively. Movers are players who were randomly moved from GH to GL (columns (5) and (7)) or from GL to GH (columns (6) and (8)) in round 16. All regressions include gender indicator. Observations are clustered at session level. Significance levels are noted as follows, *** 0.01; ** 0.05; *0.1.

Table 5: Determinants of offer made in t+1, FE, 15<=t<=30

	non-movers				movers			
	TR1		TR2		TR1		TR2	
	GL	GH	GL	GH	GL	GH	GL	GH
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
offer made	0.235*	0.259	0.157	0.070	0.388*	0.430**	0.179**	0.274**
	(0.1084)	(0.1759)	(0.0859)	(0.2239)	(0.1476)	(0.1203)	(0.0423)	(0.0812)
offer made * t	0.001	-0.002	-0.009	0.013*	0.000	0.005	0.016	0.008
	(0.0037)	(0.0040)	(0.0071)	(0.0057)	(0.0215)	(0.0126)	(0.0129)	(0.0066)
offer received	0.050*	0.066	0.092	0.072**	0.232*	0.192**	0.205***	-0.019
	(0.0210)	(0.0403)	(0.0608)	(0.0170)	(0.1013)	(0.0689)	(0.0338)	(0.0484)
offer received * t	0.001	0.001	-0.005	0.001	0.003	-0.010	-0.016**	0.016**
	(0.0024)	(0.0025)	(0.0055)	(0.0039)	(0.0091)	(0.0075)	(0.0044)	(0.0052)
offer rec. accepted	-1.217*	-1.786	0.196	-1.628**	-7.348***	-7.274	-2.334	-2.17
	(0.4837)	(1.2170)	(0.8788)	(0.3577)	(1.1819)	(4.9512)	(1.3220)	(1.1793)
offer rec. accepted*t	0.155	0.018	-0.022	0.121	0.628**	0.76	0.199	0.251
	(0.0798)	(0.1211)	(0.0799)	(0.0640)	(0.1811)	(0.4428)	(0.1583)	(0.1429)
offer made accepted	-2.995***	0.840	-1.451	-0.801	-3.124	-1.722	-3.374	-0.794
	(0.5418)	(2.1678)	(0.7823)	(0.9433)	(4.8584)	(2.1160)	(2.5452)	(0.7681)
offer made accept*t	0.203	-0.369**	0.073	-0.012	-0.002	0.074	0.077	0.065
	(0.1090)	(0.1260)	(0.0590)	(0.0982)	(0.5052)	(0.2226)	(0.2232)	(0.1221)
mean offer in t	0.078	0.342	0.189	0.361	-0.634	0.043	0.16	-0.052
	(0.1749)	(0.2952)	(0.1379)	(0.2037)	(0.3605)	(0.1402)	(0.4903)	(0.1662)
total profit till t	-0.014**	-0.008	0.000	-0.008**	-0.006	-0.014*	-0.003	-0.026**
	(0.0031)	(0.0060)	(0.0033)	(0.0023)	(0.0033)	(0.0058)	(0.0033)	(0.0062)
t	0.919***	0.913	0.208	-0.059	-0.436	0.857	-0.066	1.091
	(0.1936)	(0.6563)	(0.2485)	(0.2669)	(0.9689)	(0.6931)	(0.8590)	(0.5838)
const	36.287***	28.043***	11.426**	37.796***	53.622**	32.814**	18.092	65.055***
	(7.8751)	(5.6013)	(2.5021)	(5.9062)	(11.9529)	(8.2456)	(17.6528)	(8.9827)
N	555	555	555	555	255	255	270	270
R2 adj.	0.209	0.165	0.045	0.245	0.578	0.588	0.396	0.419

Note: The variable *t* is the round played minus 15. TR1 and TR2 refer to treatment 1 and treatment 2, respectively. GH and GL refer to groups with high and low mean initial offer, respectively. Movers are players who were randomly moved from GH to GL (columns (5) and (7)) or from GL to GH (columns (6) and (8)) in round 16. Observations are clustered at session level. Significance levels are noted as follows, *** 0.01; ** 0.05; *0.1.

Table A.1: Determinants of update in offer made in t+1, [OM_t+1 - OM_t]

	1<=t<15				15<=t<130			
	TR1		TR2		TR1		TR2	
	GL	GH	GL	GH	GL	GH	GL	GH
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
d offer received	0.063**	0.034	0.125**	0.034	0.038	0.059**	0.082**	0.079*
	(0.022)	(0.023)	(0.039)	(0.033)	(0.025)	(0.020)	(0.019)	(0.030)
offer rec. accept	-0.322	-1.386**	-1.731**	-0.413	0.041	-1.140	0.262	-1.263*
	(0.371)	(0.418)	(0.510)	(0.564)	(0.288)	(0.823)	(0.803)	(0.524)
offer made accept	-6.847***	-6.701***	-5.370***	-6.370***	-4.589***	-3.872***	-2.692**	-3.729***
	(0.810)	(0.944)	(0.496)	(0.771)	(0.461)	(0.663)	(0.599)	(0.714)
mean offer in t	-0.020	-0.004	-0.036	-0.154	-0.017	-0.027	-0.007	0.025*
	(0.013)	(0.026)	(0.025)	(0.099)	(0.021)	(0.016)	(0.017)	(0.011)
total profit till t	0.004***	0.003	0.003	0.002	0.001	0.000	0.001	0.001
	(0.001)	(0.003)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)
t	-0.181**	-0.146	-0.204	-0.110	-0.035	-0.036	-0.178*	0.031
	(0.050)	(0.216)	(0.211)	(0.145)	(0.062)	(0.075)	(0.073)	(0.029)
male {0,1}	0.100	0.274	0.444	-0.019	-0.127	-0.134	0.086	0.368**
	(0.104)	(0.312)	(0.230)	(0.234)	(0.146)	(0.249)	(0.059)	(0.093)
_cons	5.346***	5.450***	5.666**	10.084*	3.460**	5.262**	4.356**	0.754
	(0.850)	(1.081)	(1.481)	(4.061)	(1.242)	(1.260)	(1.359)	(0.805)
N	702	702	715	715	810	810	825	825
R2 adj.	0.273	0.175	0.238	0.093	0.177	0.123	0.074	0.131

Note: The variable *t* is the round played minus 15. TR1 and TR2 refer to treatment 1 and treatment 2, respectively. GH and GL refer to groups with high and low mean initial offer, respectively. Observations are clustered at session level. Significance levels are noted as follows, *** 0.01; ** 0.05; *0.1.

Table A.2: Determinants of update in offer made in t+1, [OM_t+1 - OM_t], 17<=t<=30

	non-movers				movers			
	TR1		TR2		TR1		TR2	
	GL	GH	GL	GH	GL	GH	GL	GH
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
d offer received	0.02	0.062*	0.033	0.038	0.058	0.034	0.076**	0.019
	-0.01	-0.025	-0.032	-0.038	-0.067	-0.019	-0.021	-0.016
offer rec. accept	0.039	-1.108	0.688	-0.76	-0.685	-3.55	0.214	-0.184
	-0.404	-0.665	-1.235	-0.405	-0.887	-4.985	-0.219	-0.412
offer made accept	-3.268***	-5.543***	-2.031*	-3.891**	-6.052**	-3.203***	-3.377***	-2.570**
	-0.286	-0.813	-0.866	-0.854	-1.777	-0.595	-0.673	-0.859
mean offer in t	-0.004	-0.024	-0.031	0.043**	-0.049	-0.028	-0.002	-0.002
	-0.017	-0.012	-0.025	-0.013	-0.023	-0.021	-0.027	-0.021
total profit till t	0.001	0	0.002*	0.001	0.004***	0.002	0	0.002
	0	-0.001	-0.001	0	-0.001	-0.001	-0.001	-0.001
t	-0.033	0.027	-0.155*	-0.017	-0.226*	-0.257*	0.063	-0.179
	-0.071	-0.125	-0.06	-0.026	-0.086	-0.102	-0.086	-0.1
male {0,1}	-0.033	-0.272	-0.131	-0.130*	-0.078	0.32	-0.252	0.054
	-0.076	-0.185	-0.157	-0.057	-0.302	-0.35	-0.524	-0.23
_cons	1.839	5.980**	2.474*	1.9	5.033*	9.925	1.49	3.306
	-1.833	-1.957	-0.892	-1.347	-2.274	-5.608	-1.157	-1.942
N	481	481	481	481	221	221	234	234
R2 adj.	0.178	0.158	0.036	0.149	0.145	0.218	0.209	0.149

Note: The variable *t* is the round played minus 15. TR1 and TR2 refer to treatment 1 and treatment 2, respectively. GH and GL refer to groups with high and low mean initial offer, respectively. Movers are players who were randomly moved from GH to GL (columns (5) and (7)) or from GL to GH (columns (6) and (8)) in round 16. Observations are clustered at session level. Significance levels are noted as follows, *** 0.01; ** 0.05; *0.1.