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Endogenous versus Exogenous Fairness Indices in Repeated Ultimatum Games

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Abstract

In ultimatum games, we often observe some participants rejecting offers that may be normally viewed as "fair" while others accept even lower offers that are typically viewed as "unfair". The objective of this study is to construct and examine an endogenous fairness index that helps explain this phenomenon. To achieve this objective, we construct a repeated ultimatum game environment in which each participant plays the roles of both the sender and the receiver with two different participants. We conjecture that the ratio of the amount that an individual receives divided by the amount the individual sends, captures the benchmark of what constitutes a fair offer for that individual when an offer-acceptance decision has to be made. Our design includes a fixed- and random-partners treatment in the repeated ultimatum game as an attempt to identify and isolate the effects of social distance on offer-acceptance decisions. In addition to the inclusion of the fairness indices in the offer-acceptance models, we introduce measures of social value orientations and risk attitudes as control variables in our analyses. We find that our belief-related fairness index is, in some cases, a better explanatory variable for offer-acceptance decisions than the conventional "offer index" and in other cases significantly augments the "offer index". As well, the offer-acceptance model including the belief-related fairness index can account for likelihoods of accepting less fair offers that can, at times, exceed likelihoods of accepting more fair offers.

Keywords

Fairness, Risk Attitudes, Social Distance, Ultimatum Game, Value Orientation

1. Introduction

Ultimatum game experiments provide researchers with a rich environment for studying questions related to bargaining power, distribution of resources and fairness concerns. Game theory predicts that a rational self-interested proposer is expected to offer a very small (trivial) portion of an endowment and that a rational self-interested (wealth-maximizing) recipient is expected to accept this offer. Data from controlled ultimatum game experiments do not typically support these predictions. There are various explanations offered in the literature for these anomalous observations. In this study we focus on the fairness of the offer as an important determinant of the recipient's decision. In particular, we propose an endogenous measure of fairness based on the actions of the recipient when in the role of a proposer as an important determinant of the recipient's decision to accept or reject an offer.

The usual measure of fairness in ultimatum game environments is the proportion of the proposer's endowment that is offered to the recipient. An offer that is 50% of the proposer's endowment is viewed as fair. An offer that is less than 50% is viewed as unfair. The primary objective of this study is to develop a fairness measure that will permit us to identify situations in which a recipient may at times reject an offer that may otherwise appear to be fair while in other situations may accept an offer that may appear to be unfair. The standard measure of fairness will never support our objective. Because individuals make such decisions, it would be valuable to identify a measure of fairness that would be consistent with these kinds of choices by rational self-interested recipients. To conclude that people are generally not rational makes it difficult to understand the decisions that they make. In addition, it makes the prediction of what people may do in various situations impossible.

2. Detailed Background and Literature

The basic ultimatum game involves two players. The first player is endowed with an asset (money) and is asked to share it with an anonymous second player. The incentive to share resources is created by telling the first player that if the second player does not accept the offer, neither player receives a payoff. If the second player accepts the offer, the two players keep the asset allocation proposed by the first player.

Game theory predicts that a rational self-interested proposer is expected to offer a very small (trivial) portion of the endowment and that a rational wealth-maximizing recipient is expected to accept this offer because something is better than nothing. Contrary to these predictions, the common findings in ultimatum game experiments show that proposers often offer substantial amounts (typically varying between 10% and 50% of the endowment), and that the recipients have the tendency to accept offers that are higher than 25% of the endowment. However, it is not uncommon to observe some responders reject offers that are higher than 30% while others under the same environment accept offers as low as 10%.[1]

[1]See, for example, [1] (Table 4 and Table 5, p. 375) that provide several observations that display this behavior).

A large body of literature provides several explanations for these seemingly anomalous decisions, including participants' views (sensitivities) towards fairness considerations, inequity aversion, other-regarding behavior, risk attitude, culture and the size of the stake.[2] In this study, we focus on fairness. We conjecture that the decisions of individuals in simple bargaining environments to accept or reject offers depend, among other things, on their perceptions of the fairness of the allocation of the shared resources. Typically, but not always, an offer equal to half of the sender's endowment is identified as a fair offer.[3] Correspondingly, if an offer is less than half of the sender's endowment, the offer may be described as being unfair. One challenging issue is that the notion of fairness is difficult to quantify as it may be based on a tacit belief that can only be inferred through an individual's behavior. In addition, the perception of fairness is likely to vary among individuals and perhaps even for the same individual from one context to another (see, e.g., [2] [3] [4] [5]).

Azar *et al.* [4] address the effect on offer acceptances of what individuals believe others will find to be the minimum acceptable offer and on what individuals expect to receive. These beliefs and expectations were obtained for participants and used to evaluate offer-acceptance decisions. The design used in this paper provides an alternative to this mechanism for generating indications of beliefs or expectations that may be less likely to influence the behavior of participants who provide their beliefs or expectations. By asking these questions, the experimenter may be leading the participants to focus on notions of fairness when they are asked to make decisions as senders and the receivers. By asking participants about their expectations and beliefs we may be framing the decisions they must make as senders and responders that will affect the decisions differently than if we had not asked them about these expectations and beliefs.[4]

Gomaa *et al.* [5] compare the effectiveness of an endogenous fairness index to an exogenous fairness index as an explanatory variable that can account for a significant amount of variation in offer-acceptance behavior in a one-shot ultimatum game. Their objective is to identify a fairness index that would permit scenarios in which the likelihood of accepting an unfair offer could exceed the likelihood of accepting a fair offer. The objective in this paper is to extend these results to a repeated ultimatum game environment with either fixed partners or with randomly reassigned partners. In the fixed-partners environment, partners are not reassigned after each decision round. The structure of the repeated game reduces social distance and permits participants to build reputations. In the random-partners environment the one-shot game is extended to evaluate how

[2]Güth and Kocher [6] provide a comprehensive review of ultimatum game research over more than thirty years.

[3]This notion of what is a fair offer in an ultimatum game is common and is included in recent papers by [4] and [6] (p. 398, fn. 11).

[4]Our experiment does not compare the effectiveness of the alternative methods of collecting information about beliefs or expectations and whether our conjecture that asking for beliefs of what is a fair offer or of what individuals expect others will accept will lead to different offer or offer- acceptance behavior than what we find in our sessions. Any differences that may exist between the alternative methods would be worthwhile identifying.

learning about the game and how others play the game will affect the decisions to share a portion of an endowment, but without allowing reputations to be formed. In this environment, partners in the ultimatum game are randomly reassigned after each decision round.

The structure of the ultimatum game environment permits all participants to be both senders and receivers but with different partners. This provides an opportunity for the researcher to create an endogenous measure of fairness that augments the information proved by the magnitude of what is received and that may better explain decisions to accept (or reject) offers than the exogenous measure based on the offer as a proportion of the sender's endowment. This endogenous index is the ratio of what is received to what the receiver sends to another individual. In this context, the amount that an individual sends is considered to be an indication of what the individual believes is a fair allocation of the endowment.

The results of this experiment suggest that reducing social distance by maintaining fixed partners leads to convergence to a greater offer than when partners are randomly reassigned after each decision round. However, by the 3rd round of the repeated game with fixed partners the mean offer is significantly below the conventional "fair" offer of 50 percent of the sender's endowment. With random partners, the offer falls from about 37 percent of the sender's endowment in the one-shot game to 31 percent by the 3rd round of the repeated game. Offer-acceptance models are estimated for both the one-shot game and the 3rd round of the repeated game and we find that the inclusion of the endogenous fairness index results in an estimating equation with a better "fit" than does the exogenous fairness index alone.

Therefore, the closer the endogenous fairness index is to unity, the closer is the amount received by the person who must make an offer-acceptance decision to a fair offer.[5] When making an offer-acceptance decision, this endogenous measure will be a better reflection of the receiver's notion of the fairness of the offer than is the offer alone. Finally, the data from this experiment offer some insight regarding risk attitudes and social value orientations with respect to offers made and offers accepted and how these decisions may change once the game is played repeatedly.[6]

[5]Fairness may be a more important characteristic of an offer than its magnitude. Fehr and Schmidt [7] note "Responders do not behave in a self-interest maximizing manner … the motive indicated for the rejection of positive, yet 'low', offers is that participants view them as unfair."

[6]It is important to point out that the role of risk is currently a topic of substantial interest in the Management Science and Operations Research literature that considers the decisions made by a firm to supply output to multiple retailers (see [8] [9] [10]). Uncertainty can arise from retailer costs and market size. For example, in the context of the supply-chain competition, it is argued that high or low risk is associated with the risk faced by the supplier with regard to the decision the supplier must make when choosing the amount to supply to different retail outlets. In this environment, it is the risk associated with the choice made by the supplier that is crucial rather than the risk attitude of the supplier who must make a decision. In our environment we are using the risk attitude of the decision maker (risk averse, risk neutral or risk seeking), to help us understand the decisions that are made by our decision maker given the degree of fairness that characterizes the choice that has to be made by our decision maker. The risk attitude of the decision maker and the riskiness of the situation characterize different contexts in which risk is important.

3. Variable Selection

To examine the research questions addressed in this study, we conduct a series of sessions in which individuals participate in an ultimatum game. All participants play the roles of sender and receiver. In this environment, each sender is a receiver of an offer from a participant different from the person to whom she sends an offer.

The sessions are characterized by two design variables and the participants are characterized using four behavioral variables. Two of the behavioral variables, social value orientation and risk attitude, are measured separately from the ultimatum game. This allows us to isolate intrinsic individual characteristics rather than assume that our participants are individualistic and risk-neutral wealth maximizers when we analyze the offer-acceptance decisions made by people participating in the ultimatum game. The other two behavioral variables are indices of fairness that are to different degrees endogenous. The design variables are used as explanatory variables in the analyses of offers. The design and behavioral variables are used in the analyses of the likelihood that an offer is accepted.

3.1. Design Variables

The first design variable is the repeated nature of the game. The game can be played as a one-shot game or as a repeated game. The second design variable is the way partners are assigned in the game. Assignment can be either random or fixed. The one-shot game is necessarily a random-partners game.

3.1.1. Repeated Game with Random Reassignment of Partners

The repeated game provides experience to a participant that is not available through a one-shot random interaction. Knowing that everyone in a session is participating in the repeated interaction may lead participants to consider their interactions as more than simple one-shot encounters; people will learn about the game through repeated interactions with many different people. Introducing the repeated game is an attempt to provide participants with the opportunity to learn more about the game. Maintaining random reassignment is an attempt to avoid confounding the effects of experience with the effects associated with narrowing social distance. This is similar to the repeated design used by [4].

3.1.2. Repeated Game with Fixed Partners

The fixed-partners environment in a repeated game may reduce social distance among individuals and lead to larger allocations than in the random-partners treatment. If you are matched repeatedly with the same sender you may be willing to reject an offer that you believe is too low with the intention of providing an inducement to the sender to respond with a larger offer. This could lead to acceptances being associated with larger offers over time. An alternative, however, is that rejections may lead to lower offers by disappointed senders and ultimately lead to acceptances associated with lower offers over time. The result is not obvious, but it may be affected by the assignment-of-partners treatment as well as behavioral variables such as the participants' value orientations and risk attitudes. In addition, notions of fairness may be important.

3.2. Behavioral Variables

3.2.1. Risk Attitudes

An individual's risk attitude identifies the individual as being risk neutral, risk averse or risk seeking. Generally, a risk-neutral individual will accept a fair bet (or a bet whose odds favor the individual), a risk-averse individual will only accept a bet whose odds are in her favor while a risk-seeking individual will bet against the odds. Risk attitudes are measured using a BDM mechanism [11] that was extended by [12] [13] [14] [15], in which participants report their minimum selling prices for each of 24 lotteries with the prize of 100 Francs of laboratory currency (LF) but with different probabilities of winning.

3.2.2. Social Value Orientations

An individual's social value orientation identifies the individual as being altruistic, cooperative, individualistic, competitive or aggressive.[7] Social value orientations are elicited using the geometric framework introduced by [16] that was extended to the Ring Game by [17] in which participants select a desired income allocation between themselves and an anonymous other person from each of 24 pairs of income allocations.

3.2.3. Fairness Indices

To define the fairness indices, consider four of nine participants (identified as A through I) in a session of an ultimatum game. Participant A sends an offer to B, B sends an offer to D and G sends an offer to A. With respect to participant B, the first fairness index, identified as the Exogenous Index, is equal to the offer sent by A to the receiver B divided by the A's endowment. This is one measure of fairness that may be used to evaluate the likelihood that a receiver will accept an offer (see examples in [18] and [4]). The second fairness index, again with respect to participant B, identified as the Endogenous Index, is equal to the offer sent by A to the receiver B divided by the offer sent by B to D in the role of a receiver.

The first index is described as an exogenous fairness index because the denominator of the index is exogenous to the decisions made by the sender. It is the maximum amount that a sender is able to transfer to a receiver and is determined by the experimenter not the participant. Typically, as noted earlier, an Exogenous Index of 0.50 is described as characterizing a fair offer.

The second index is described as an endogenous fairness index because both

[7]Examples of these categories can be described within the context of how an individual may choose between two different allocations of money between himself and another individual. An altruistic individual will select an allocation that transfers less money to the other person than the individual gives up. Cooperative individuals select allocations that maximize the total received by both people. Individualists select allocations in which their allocation is greatest. Competitors select allocations that give them more than the other individual receives. Aggressors select allocations that minimize the other individual's allocation.

the numerator and denominator of the index are determined within the experiment. From the perspective of receiver B, the denominator is the amount sent by B to individual D in the role of receiver. The denominator in the Endogenous Index used to evaluate the likelihood that B accepts A's offer is interpreted as B's notion of what is a fair share of her endowment to offer to D, and being a fair offer, it is expected to be accepted by C. This is a variant of the receiver's belief variable used by [4]. The receiver's belief about what others would find to be an acceptable offer was used to create an index that was introduced into an offer-rejection model. As the index increased, the likelihood of a rejection was conjectured to rise. Our use of the ultimatum game in which all participants played the role of both sender and receiver permits us to generate a proxy for the beliefs or expectations elicited by [4] without directly asking participants what they believed others would find acceptable.[8] From the perspective of B as a receiver, an Endogenous Index of unity identifies A's offer as a fair offer.

4. Experimental Design and Conjectures

A total of 86 participants were recruited from undergraduate classes at a medium-sized university. During the recruitment phase, students were told that the experiment involved simple decision-making, and that the details would be given to them during the session. In addition, they were told that they were required to participate in two separate sessions. Each session would be conducted on a different day and each session would last no more than two hours. They were also informed that during the course of the sessions they would earn money that would be paid to them in cash at the conclusion of each session.

4.1. Sessions

In the first session, we elicited participants' risk attitudes and social value orientations. The descriptions of the derivation of the risk attitudes and the social value orientation measures are included in [19].[9] Participants are paid privately at the end of the session. The session lasted for about 60 minutes. The average payoff was $15.40.

At the beginning of the second session, instructions are distributed and read aloud by the experimenter. The first set of instructions describes the ultimatum game and indicates that the game will be played as a one-shot game for the first round of the session. At this point, participants do not know what will occur in the session after the first round.[10]

[8]An alternative way of generating this fairness measure might be to use the "strategy vector method' to get senders' to tell the experimenter what they would accept if they were receivers (see examples in [20] [21] [22]).

[9]Instructions used to elicit risk attitudes (preferences) and value orientations are posted at https://mceel.mcmaster.ca/research-publications/papers/trustrisk-voinstructions.pdf/view. The social value orientation distinctions derived from the Ring Game have been used to understand decisions made in bargaining games ([18] [19]), voluntary contributions to public good provision ([23] [24] [25]) and investment in research and development [26].

[10]48 of the 86 participants in the first session participated in this ultimatum game experiment.

Each participant is endowed with LF500 at the beginning of each period. Beginning with the first round, participants simultaneously play two roles in the ultimatum game. Participants are separated into two groups; the groups are sent to different rooms. In each round each person (in the role of the allocator of resources) makes an offer to another person who is in the other room (who is randomly selected by the experimenter). The person described previously as the allocator, also plays the role of a receiver, and in this role receives an allocation from someone in the other room.[11]

Following the first round, a second set of instructions is distributed and, again, read aloud by the experimenter. Participants are informed that the game will be played for three more rounds and the pairing protocol is explained to them. In some sessions, the pairings of participants are retained throughout the course of the second, third and fourth rounds. This is the fixed-partners treatment.

In the random-partners treatment, participants are randomly reassigned after each decision round. Participants always make allocations to and receive allocations from different people in each round. Participants receive information at the end of each round on whether their allocations have been accepted or rejected. Participants are paid privately at the end of the session. The session lasted for about 60 minutes. The average payoff was $15.40.[12] The experimental design is summarized in **Table 1**.

Table 1. Experimental Design (Treatments and Observations).

	Round			
Treatment	1	2	3	4
One-Shot Game	48			
Repeated Game (Fixed Partners)		30	30	30
Repeated Game (Random Partners)		18	18	18

4.2. Conjectures

The fixed-partner and random-partner treatments are relevant for the repeated game. The fixed-partner treatment narrows the social distance among individuals and is likely to contribute to a greater tendency to share. This suggests that

<u>*Conjecture* 1</u>. *People in a fixed-partners game will offer more than people in a random-partners game and in a one-shot game.*

The inability of individuals to send signals and develop reputations in the

[11]Suppose there are 6 people participating in a session. The even numbered people are in one room and the odd numbered people are in another room. Participants 1, 3 and 5 are in one room. Participants 2, 4 and 6 are in a different room. Participant 1 sends to participant 2. Participant 2 sends to participant 3. Participant 3 sends to participant 4. Participant 4 sends to participant 5. Participant 5 sends to participant 6. Participant 6 sends to participant 1. In fixed-partners treatments the participant pairings do not change over decision rounds. In random-partners treatments, the pairings are reassigned after each decision round. Participants with even ID numbers (in one room) are always interacting with participants with odd ID numbers (in another room).

[12]Francs were converted into Canadian dollars at the rate LF100 = 1.00 Canadian dollar.

one-shot game and the random-partners repeated game suggests that

Conjecture 2. *Offers in the random-partners repeated game will not be different from offers in the one-shot game.*

The decisions of receivers are likely to be affected by whether they are in a one-shot game, a random-partners game or a fixed-partners game. For individuals in a one-shot game or a random-partners game their rejecting an offer does not send a signal that will necessarily bring a return in a subsequent round. This suggests that

Conjecture 3. *The likelihood of acceptance ceteris paribus will be greater for an individual in a one-shot game or a random-partners treatment than for an individual in a fixed-partners treatment.*

If the offer made by an individual reflects the individual's notion of a fair offer this will be reflected in the decisions the individual makes as a receiver in the ultimatum game. This suggests that

Conjecture 4. *The greater is the fairness index, the greater is the likelihood that an offer will be accepted.*

5. Data Analyses and Results

The analysis proceeds by first evaluating the data using the design variables of the model. The design variables consist of the game treatments (one-shot versus repeated) and the social-distance and reputation treatments (fixed-partners narrows social distance and can create reputations relative to random-partners). If the randomization of participants to treatments is fully effective and if there are enough observations there should be no residual effects related to things other than the design variables. Results are first presented for the offer decisions. These are followed by results for the offer-acceptance decisions.

5.1. Offer Decisions

The Offer Model presented in **Table 2** includes all of the design variables and their interactions. The random-partner and fixed-partner distinction is not introduced until the second round. The constant term in this model is an estimate of the average offer made in the one-shot game. The coefficients and robust standard errors for the Offer Model are estimated using an OLS regression with clustering on participants. Clustering on participant is done to address the repeated observations from each of the 48 participants over the four decision rounds. The model accounts for a significant amount (although not a large amount) of the variation in the offers made across the four rounds of the ultimatum game ($p = 0.000$).

The mean offers sent in each of the four rounds are presented in **Figure 1**. The fixed-partner treatment leads to greater offers than when individuals are making offers to strangers. These differences are statistically significant ($p = 0.041$, $p = 0.000$ and $p = 0.000$ for rounds 1, 2 and 3 of the repeated games). Round 1 and 2 mean offers by fixed partners are marginally significantly greater

Table 2. OLS Regression Coefficients for an Offer Model with Design Variables.

Variable	Coefficient
Period 1, Fixed Partners	12.271
(=1, =0 otherwise)	(−7.657)
	[0.116]
Period 2, Fixed Partners	13.438
(=1, =0 otherwise)	(8.787)
	[0.133]
Period 3, Fixed Partners	20.771
(=1, =0 otherwise)	(8.630)
	[0.020]
Period 1, Random Partners	−29.389
(=1, =0 otherwise)	(13.952)
	[0.041]
Period 2, Random Partners	−46.944
(=1, =0 otherwise)	(12.361)
	[0.000]
Period 3, Random Partners	−55.111
(=1, =0 otherwise)	(10.636)
	[0.000]
Constant	189.063
(One-shot game)	(7.784)
	[0.000]
R-squared	0.163
p-value for F-test on Model Significance	0.000

Note: Robust standard errors are in parentheses; p-values are for two-sided t-tests. The constant term is the mean offer of participants in the one-shot game. In the one-shot game there is no distinction between fixed- and random-partner treatments. There are four observations for each participant. The standard errors are adjusted for 48 clusters – one for each participant.

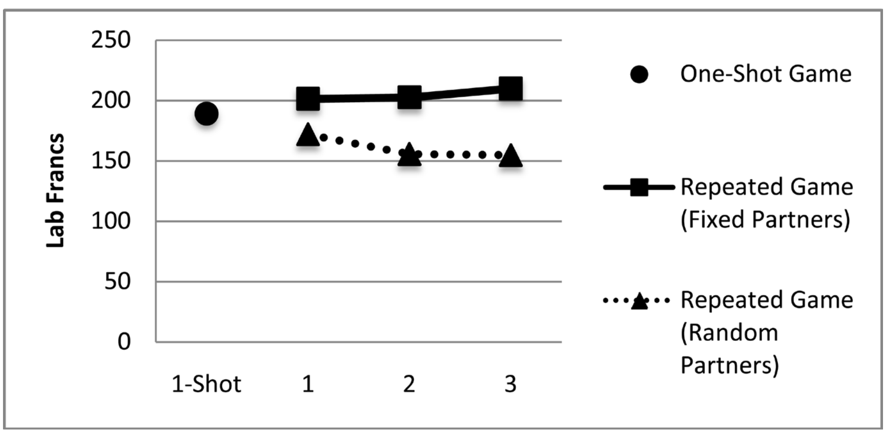

Figure 1. Mean Offer Sent by Decision Round.

than the one-shot game mean offer (one-sided test, p = 0.058 and p = 0.067) and the round 3 mean offer is significantly greater than the mean one-shot game offer (one-sided test, 0.010). The mean offers in rounds 2 and 3 of the fixed-partners treatments are not significantly different from one another (p = 0.882 and p = 0.280). These results support *Conjecture* 1.

The round 1, 2 and 3 mean offers in the random-partners treatment are significantly lower than the mean one-shot game offer (one-sided tests, p = 0.061, 0.000 and 0.000). We can reject the null hypothesis that offers from random-partners games are equal to those of one-shot games in favor of the alternative that offers are lower than those in the one-shot environment. These results do not support *Conjecture* 2.

Our conjecture was that repeated play among participants in fixed-partners games would reduce social distance between participants relative to what would occur in repeated games with random partners. This would result in increases in offers in the former treatment and relative to the latter treatment. The data confirm this. What was unanticipated was the decay in offers by participants in the repeated game with random partners. Individuals in repeated games tend to contribute about 40 percent of their endowments when with fixed partners and about 30 percent of their endowments when with randomly assigned partners.

5.2. Acceptance Decisions

5.2.1. Design Variables

The Offer-Acceptance Model presented in Table 3 includes all of the design variables and their interactions. The random-partner and fixed-partner distinction is not introduced until the second round. The coefficients and robust standard errors for the Offer-Acceptance Model are estimated using a probit regression with clustering on participants. Clustering on participant is done to address the repeated observations from each of the 48 participants over the four decision rounds. The dependent variable is whether the offer was accepted or not (equal to 1 if accepted and 0 if not accepted). The constant term in this model is an estimate of the z-statistic associated with likelihood that the offer made in the first round (the one-shot game) is accepted.

The model does not account for a significant amount of the variation in the acceptance of offers made across the four rounds of the ultimatum game (p = 0.886). The sample mean acceptance rate of 77 percent is the best estimate of the acceptance rate based on the model using only design variables.[13]

The mean offer acceptance rates in each of the four rounds are presented in Figure 2. Based on Table 3 regression results, none of these acceptance rates are significantly different from any other rate whether we compare across games, over rounds or across partnering environments. Considering only the design variables, it appears as if social distance does not matter and the reputation that

[13]The mean estimated z-statistic using the regression coefficients in Table 3 and the 192 observations in the sample is 0.7416. This corresponds to an estimated likelihood of acceptance of 77 percent, which is also the actual percentage of offers accepted.

Table 3. Probit Regression Coefficients for an Offer Acceptance Model with Design Variables.

Variable	Coefficient
Period 1, Fixed Partners	−0.046
(=1, =0 otherwise)	(0.303)
	[0.88]
Period 2, Fixed Partners	−0.159
(=1, =0 otherwise)	(0.330)
	[0.629]
Period 3, Fixed Partners	−0.363
(=1, =0 otherwise)	(0.327)
	[0.267]
Period 1, Random Partners	−0.252
(=1, =0 otherwise)	(0.413)
	[0.542]
Period 2, Random Partners	−0.138
(=1, =0 otherwise)	(0.408)
	[0.734]
Period 3, Random Partners	0.443
(=1, =0 otherwise)	(0.431)
	[0.303]
Constant	0.887
(One-shot game)	(0.212)
	[0.000]
Pseudo R-squared	0.011
p-value for F-test on Model Significance	0.886

Note: Robust standard errors are in parentheses; p-values are for two-sided t-tests. The constant term is an estimate of the z-statistic associated with the likelihood that the offer made in the first round (the one-shot game) is accepted. In the one-shot game there is no distinction between fixed- and random-partner treatments. There are four observations for each participant. The standard errors are adjusted for 48 clusters – one for each participant.

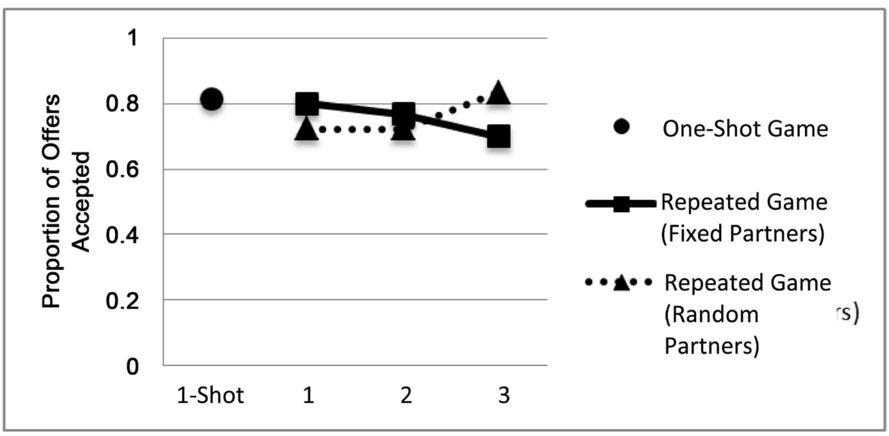

Figure 2. Mean Acceptance Rate by Decision Round.

can be established through the repeated game does not matter for offer-acceptance decisions. These results do not support Conjecture 3.

5.2.2. Behavioral Variables

The behavioral variables that may account for offer-acceptance decisions are the participants' value orientations, risk attitudes and considerations of the fairness of the offers they receive. The social value orientation variable for an individual is the slope of the resultant vector computed by finding the sum of the 24 amounts allocated by the individual to her anonymous partner and dividing this by the sum of the 24 amounts she allocates to herself. The slope of this vector can range from $+\infty$ to $-\infty$.[14]

Risk attitudes are captured with three categorical variables. Risk aversion takes the value of 1 if the participant is risk averse and 0 otherwise. Risk seeking takes the value of 1 if the participant is risk seeking and 0 otherwise. If the participant is risk neutral both risk aversion and risk seeking are 0.

Two fairness indices were defined earlier. The Exogenous Index is the ratio of the amount offered to an individual in the receiving role of the ultimatum game divided by the endowment of the sender of the offer. The Endogenous Index is the ratio of the amount offered to an individual in the receiving role of the ultimatum game divided by the amount that the receiving individual offered when in the sending role. The mean Exogenous Indices and Endogenous Indices over the four rounds of the ultimatum games are summarized in Figure 3 and Figure 4.

The mean Exogenous Index was 0.38 in the one-shot game. This rose to 0.42 by the 3rd round of the repeated game for fixed-partners games and fell to 0.31 for the random-partners games. This mirrors the behavior of the offers shown in Figure 1. The increases and decreases from the one-shot game by the 3rd period of the repeated games are statistically significant for the Exogenous Indices (see the results for the Offer Model in Table 2).

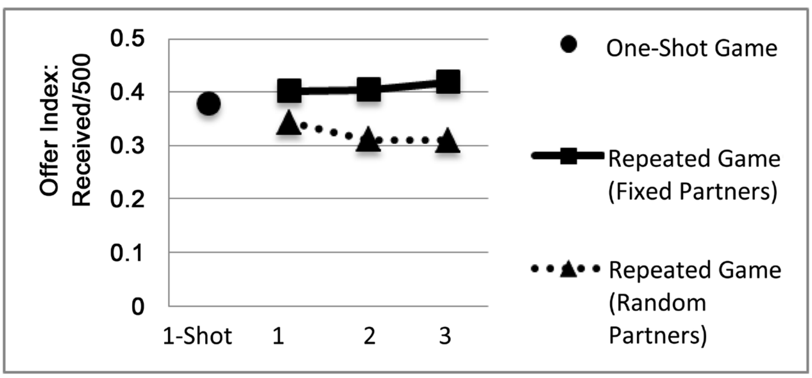

Figure 3. Mean *Exogenous Index* by Decision Round.

[14]The slope of the vector for an altruist is equal to or greater than 2.414. The slopes for a cooperator are between 0.414 and 2.414; for an individualist, between 0.414 and −1; for a competitor, between −1 and −2.414. The slope of the vector for an aggressor is less than −2.414. 19 individuals are identified as cooperators, 28 are identified individualists and 1 is competitive.

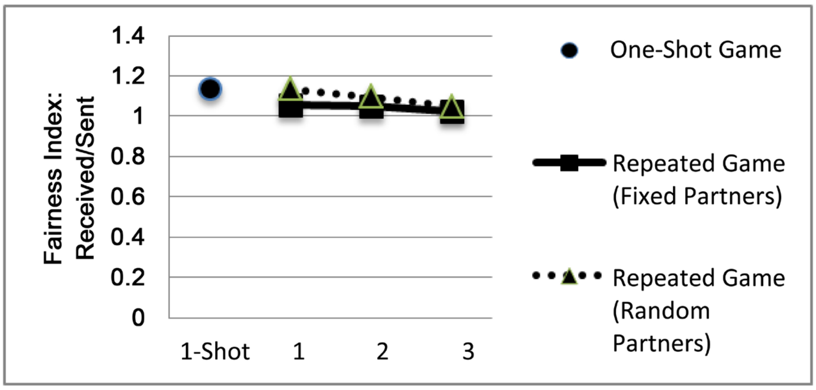

Figure 4. Mean *Endogenous Index* by Decision Round.

The mean Endogenous Index was 1.13 in the one-shot game. This fell to 1.02 and 1.05 for the fixed-partners and random-partners by the 3rd round of the repeated games. A model identical to that presented in Table 2 for the offer sent, using only the design variables period and partner, does not account for a significant amount of the variation in the Endogenous Indices faced by receivers across the four rounds of the ultimatum game ($p = 0.893$). None of mean indices shown in Figure 4 is significantly different from any other or from unity. The sample mean Endogenous Index of 1.08 is the best estimate of the Endogenous Index based on the model using only design variables.

This sub-section has described the fairness indices we will use to help understand the offer-acceptance behavior of participants in the ultimatum games. The role of social value orientations, risk attitudes, fairness indices and the desirability of the Endogenous Index relative to the Exogenous Index are the objectives of the next sub-section.

5.2.3. Behavioral Models

We are focusing on round 3 of the repeated game because this is the round for which the participants have the most experience and it is more likely that the behavior in this round is more representative of equilibrium behavior than that in earlier rounds. We compare the Offer-Acceptance Models of the one-shot game and the 3rd round of the repeated game.

Coefficients and robust standard errors for alternative probit regressions of the Offer-Acceptance Model for the one-shot game are presented in Table 4. A comparable set of probit regressions is provided for the repeated game in Table 5. The only design variable included in these regressions is the variable representing the random-partner treatment (equal to 1 if the participant is in a random-partner game and 0 if the participant is in a fixed-partner game) in the regressions for the 3rd round of the repeated game. The constant terms in the regressions capture the estimates of the z-statistic representing the likelihood that an individual who is pro self and risk neutral in the one-shot game or who is pro self, risk neutral and in the fixed-partner game, will accept an offer.

Table 4 presents three empirical models and Table 5 presents two. Model I is the baseline model that includes the Exogenous Index and the behavioral variables identifying social value orientation and risk averse or risk seeking attitudes in the one-shot and repeated games. The Random Partners variable and the interaction of the Random Partners variable and the Exogenous Index are also included in Model I for the 3rd round repeated game. The dependent variable is whether or not the participant accepted the offer received from a sender (equal to 1 if accepted and 0 if not).

Model II includes the addition of the Endogenous Index and the interaction of the two indices as independent variables that may account for any changes in acceptance attributed to one of the fairness indices conditional on the value of

Table 4. Probit Regression Coefficients for Alternative Offer-Acceptance Models with Behavioral Variables: One-Shot Game.

	Model		
Variable	I	II	III
Exogenous Index (X)	13.386 (3.186) [0.000]	−28.451 (27.629) [0.303]	
Endogenous Index (N)		−2.361 (7.454) [0.751]	5.868 (1.424) [0.000]
Interaction of Exogenous & Endogenous Indices (XxN)		35.047 (33.875) [0.301]	
Social Value Orientation (slope of resultant vector)	0.402 (0.535) [0.451]	1.356 (0.780) [0.082]	0.956 (0.556) [0.085]
Risk Averse (=1, =0 otherwise)	0.736 (1.014) [0.468]	1.305 (1.055) [0.216]	1.157 (1.117) [0.300]
Risk Seeking (=1, =0 otherwise)	0.986 (0.572) [0.091]	0.515 (0.758) [0.497]	0.523 (0.664) [0.431]
Constant (Pro Self, Risk Neutral Participants)	−4.076 (1.106) [0.000]	2.037 (5.449) [0.709]	−4.353 (1.192) [0.000]
Pseudo R-squared	0.457	0.595	0.567
p-value for χ^2-test on Model Significance	0.001	0.032	0.001
Test: the coefficients of X and XxN are not different from zero (the main effect X)		$\chi^2 = 1.08$ p = 0.584	
Test: the coefficients of N and XxN are not different from zero (the main effect of N)		$\chi^2 = 7.80$ p = 0.020	

Note: Robust standard errors are in parentheses; p-values for two-sided z-tests are in brackets.

Table 5. Probit Regression Coefficients for Alternative Offer-Acceptance Models with Behavioral Variables: Third Round of the Repeated Game.

	Model	
Variable	I	II
Random Partners (P) (=1, =0 otherwise)	−4.540 (4.373) [0.299]	896.554 (55.343) [0.000]
Exogenous Index (X)	24.165 (6.342) [0.000]	−257.803 (101.283) [0.011]
Endogenous Index (N)		−109.565 (45.133) [0.015]
Interaction of Exogenous & Endogenous Indices (XxN)		330.856 (122.816) [0.007]
Interaction of Exogenous Index & Random Partners (XxP)	33.058 (17.873) [0.064]	−4094.601 (199.928) [0.000]
Interaction of Endogenous Index & Random Partners (NxP)		−1391.977 (76.869) [0.000]
Interaction of Endogenous & Exogenous Indices & Random Partners (XxNxP)		6327.811 (283.799) [0.000]
Social Value Orientation (slope of resultant vector)	−1.019 (0.484) [0.035]	−0.533 (0.626) [0.394]
Risk Averse (=1, =0 otherwise)	1.509 (0.734) [0.040]	3.183 (0.700) [0.000]
Risk Seeking (=1, =0 otherwise)	0.353 (0.706) [0.617]	−2.871 (1.013) [0.005]
Constant (Pro Self, Risk Neutral, Fixed Partners)	−8.850 (2.290) [0.000]	83.944 (36.754) [0.022]
Pseudo R-squared	0.513	0.768
p-value for χ^2-test on Model Significance	0.000	0.000

Note: Robust standard errors are in parentheses and p-values for two-sided z-tests are in brackets.

the other index. As well, the interaction of the Random Partners variable with each of the fairness indices and the three-way interaction of the Random Partners variable and the fairness indices are included in the 3rd round Model II regression to account for any changes in acceptance that may be attributed to any of these interactions.[15]

Model III is a restricted model that follows from evaluation of the coefficients of the variables included in Model II. Model III is only reported for the 3rd round of the repeated game.

1) One-shot games

- Model I

Model I includes the Exogenous Index and the value orientation and risk attitude variables. The coefficient of Exogenous Index is positive and significant (p = 0.000). As the offer rises, the greater is the likelihood that the offer will be accepted. This provides support for Conjecture 4.

- Model II and Model III

Model II extends Model I by introducing the Endogenous Index into the model. The interaction of the two indices is also introduced. This improves the "fit" of the Offer-Acceptance Model.[16] However, the Exogenous Index is not included in Model III, which represents the "best" model using the variables we have considered. Based on the Model II regressions for the one-shot game we find that the main effect of the Exogenous Index is not statistically significant given the inclusion of the Endogenous Index (p = 0.584).

However, given the inclusion of the Exogenous Index the main effect of the Endogenous Index is statistically significant (p = 0.020). To evaluate the effect a change in the Exogenous Index could have on the likelihood that an offer is accepted we can evaluate the derivative of the estimating equation with respect to the Exogenous Index at the maximum and minimum possible values that the Endogenous Index could take given our sample. The derivative is the coefficient of the Exogenous Index plus the coefficient of the interaction term multiplied by the Endogenous Index. For our sample the maximum amount sent was LF300 and the minimum amount sent was LF100. This results in a maximum possible Endogenous Index of 3.00 and a minimum of 0.33. The resulting values of the derivative are not significantly different from zero (p = 0.467 and p = 0.328 for the high and low values respectively). We conclude that we can omit the Exogenous Index from Model III for the one-shot game.

The coefficient of Endogenous Index in Model III is positive and significant (p = 0.000). As the offer received rises or as the amount sent by the receiver falls,

[15]It is possible that a fairness index may have a different impact on the likelihood that an offer is accepted in the fixed-partners treatment than in the random-partners treatment. If the coefficient of the interaction term were significant, this would identify such an effect. Also, the likelihood that an offer is accepted if it increases from LF175 to LF200 may be different if the Endogenous Index is 1 than if it is 0.8. If the product of the Endogenous Index and the coefficient on the interaction term were not significant, only the change in the offer would matter. If the interaction term were significant, both the change in the offer and the value of the Endogenous Index would matter.

[16]"While pseudo R-squared values cannot be interpreted independently or compared across datasets, they are valid and useful in evaluating multiple models predicting the same outcome on the same dataset. In other words, a pseudo R-squared statistic without context has little meaning. A pseudo R-squared only has meaning when compared to another pseudo R-squared of the same type, on the same data, predicting the same outcome. In this situation, the higher pseudo R-squared indicates which model better predicts the outcome."
See http://www.ats.ucla.edu/stat/mult_pkg/faq/general/Psuedo_RSquareds.htm

the greater is the likelihood that the offer will be accepted. This provides support for *Conjecture* 4.

The only behavioral variable that has a statistically significant impact on the likelihood of acceptance is the social value orientation measure. The Offer-Acceptance model for the one-shot game that includes the Endogenous Index displays a positive effect on offer acceptance as the social value orientation of an individual increases. More pro-social individuals are more likely to accept offers than pro-self individuals (p = 0.085).

2) Repeated games

- Model I

Model I includes the Exogenous Index and the partners treatment, value orientation and risk attitude variables. The main effect of Exogenous Index (based on the joint test that the coefficients for the Exogenous Index and the interaction of the Index and Random Partners are zero) is significant (p = 0.000) and as the Exogenous Index (the offer) rises, the greater is the likelihood that the offer will be accepted. This provides support for *Conjecture* 4.

The main effect of the Random Partners treatment is also significant (p = 0.003). However, whether the difference between the likelihood that an offer will be accepted in the fixed-partners or random-partners treatment depends on the size of the Exogenous Index. If the Exogenous Index is 0.5 (offer of LF250), it will be more likely that the offer will be accepted in the fixed-partners treatment than in the random-partners treatment and this difference is significant (p = 0.006). However, if the Exogenous Index falls to 0.36 (an offer of LF180), the difference is still greater for the fixed-partners treatment, but only marginally significant (p = 0.092). When the Exogenous Index falls below 0.355 (an offer of LF177.50) the difference, regardless of whether it is positive or negative, is no longer significantly different from zero. Conjecture 3 is that individuals in fixed-partners treatments will be less likely to accept offers than those in random-partners treatments. The data do not support this conjecture with Model I.

Using Model I, both the social value orientation measure and the risk attitudes of individuals have significant effects on the likelihood that offers are accepted. More pro-social individuals are less likely to accept offers than pro-self individuals and risk-averse individuals are more likely to accept offers than risk-neutral or risk-seeking individuals.

- Model II

The Model II regression in **Table 5** includes both the Exogenous and Endogenous Indices. All of the coefficients of the variables included in Model II, other than the social value orientation, are statistically significant, the main effects of Random Partners and the Exogenous and Endogenous Indices are significant (p = 0.000 in each case[17]) and the "fit" of the Offer-Acceptance model is improved with the introduction of the Endogenous Index (see footnote 16).

[17]This is a χ^2-test of the null hypothesis that the variables Random Partners and the three interaction terms with Random Partners are jointly equal to zero.

Fairness Indices

To evaluate the effect of change in an index on the likelihood that an offer will be accepted in the repeated game requires the consideration of two cases: the fixed-partners case and the random-partners case. From Model II of the repeated game (Table 5) the estimating equation identifies the z-statistic that captures the likelihood that an offer will be accepted. The estimated variables are zi(P = 0) and zi(P = 1), the z-statistics associated with the fixed-partners treatment and the random-partners treatment. The two estimating equations can be expressed as

$$\text{zi}(\text{P}=0)=\alpha+\beta\text{B}-257.803\text{Xi}-109.565\text{Ni}+330.806\text{XiNi} \tag{1}$$

and

$$\begin{aligned}\text{zi}(\text{P}=1)=\alpha+\beta\text{B}+896.554-257.803\text{Xi}-109.565\text{Ni}+330.806\text{XiNi}\\-4094.601\text{Xi}-1391.977\text{Ni}+6327.811\text{XiNi}\end{aligned} \tag{2}$$

where α is the regression constant, B is the matrix of behavioral variables and β is the matrix of coefficients for these variables, Xi is the Exogenous Index and Ni is the Endogenous Index. We are interested in evaluating how zi(P = 0) and zi(P = 1) change when each index changes. The signs of the derivatives of equations (2) and (3) with respect to Xi and Ni will allow us to evaluate Conjecture 4. Let zi(P = 0)j and zi(P = 1)j represent the derivatives of Equations ((1) and (2)) where j = (Xi, Ni).

$$\text{zi}(\text{P}=0)\text{X}=-257.803+330.806\text{Ni} \tag{3}$$

$$\text{zi}(\text{P}=0)\text{N}=-109.565+330.806\text{Xi} \tag{4}$$

$$\text{zi}(\text{P}=1)\text{X}=-4352.404+6658.617\text{Ni} \tag{5}$$

$$\text{zi}(\text{P}=1)\text{N}=-1501.542+6658.617\text{Xi} \tag{6}$$

These derivatives indicate that for our sample, increases in the *Exogenous Index* will result in increases in the likelihood of an acceptance if the receiver's Endogenous Index exceeds 0.779 in the fixed-partners treatment and 0.654 in the random-partners treatment. Increases in the *Endogenous Index* will result in increases in the likelihood that an offer will be accepted if the Exogenous Index exceeds 0.331 in the fixed-partners treatment and 0.226 in the random-partners treatment. Using Model II to test the statistical significance of the positive signs of the derivatives indicates that the critical values of the *Endogenous Indices* are 0.825 and 0.658 for the change in the *Exogenous Index* and the critical values of the *Exogenous Indices* are 0.351 and 0.228 for the change in the *Endogenous Index*[18].

Our data indicate that in 15 of 18 random-partners games and in 25 of 30 fixed-partners games the critical values of the *Exogenous Indices* were exceeded

[18]The values of the fairness indices that satisfy Equations ((3) through (6)) as equalities will identify a value of the derivative of zero. For a positive effect, the values of the relevant indices must exceed the values that satisfy Equations ((3) through (6)). Model II can be used to determine the value at which the critical value of the index results in a value of the derivative that is positive and statistically significant. These are the values reported in the footnoted sentence.

and an increase in the *Endogenous Index* would have led to an increase in the likelihood of an offer being accepted. Furthermore, in 16 of 18 random-partners games and in 24 of 30 fixed-partners games the critical values of the *Endogenous Indices* were exceeded and an increase in the *Exogenous Index* would have led to an increase in the likelihood of an offer being accepted. Overall, increases in each of the indices from their realized values would have had a positive impact on acceptance likelihoods 5 times out of 6. This provides qualified support for Conjecture 4 but does not support a conclusion that increases in either of these indices unconditionally results in an increase in the likelihood that an offer is accepted.

Partners Treatments

The Model II regression that includes behavioral variables as well as the Random Partners variable identifies a significant random-partners treatment effect in the 3rd round of the repeated games that was not identified by the model that accounted for only design variables (see the last paragraph in subsection 5.2.1).

The following describes the effect of random partners (relative to fixed partners) on the estimated z-statistic (that captures the likelihood that an offer is accepted) for the 3rd period of the repeated game using Model II. zi(P = 0) is the estimated z-statistic given a fixed-partners treatment and a given set of behavioral variables B and the fairness indices Xi and Ni where Xi is the *Exogenous Index* and Ni is the Endogenous Index. **Table 6** presents the mean values for the fairness indices (pooled across partners treatments), their standard deviations and their ranges in the 3rd round of the repeated games.

Table 6. Descriptive Statistics for Fairness Indices in Round 3 of the Repeated Games.

Index	Observations	Mean	Std. Dev.	Minimum	Maximum
Exogenous Index	48	0.38	0.09	0.20	0.60
Endogenous Index	48	1.03	0.27	0.55	2.00

The change in the z-statistic (and corresponding likelihood of accepting an offer) associated with a move from the fixed-partners treatment to the random-partners treatment is equal to $\mathrm{zi}(\mathrm{P}=1)-\mathrm{zi}(\mathrm{P}=0)=\Delta\mathrm{zi}$. Based on Model II in **Table 5**,

$$\Delta\mathrm{zi} = 896.554 - 4094.601\mathrm{Xi} - 1391.977\mathrm{Ni} + 6327.811\mathrm{XiNi} \quad (7)$$

If Δzi is evaluated at the sample means (Xi equals 0.38 and Ni equals 1.03) Δzi is greater than 0. This positive difference is statistically significant (χ^2-test, p = 0.000). The implication is that at the sample means and given a set of behavioral variables, the likelihood that an offer is accepted will be greater for a receiver in the random-partners treatment than for a receiver in the fixed-partners treatment. We have also evaluated Δzi at combinations of the extreme values of the two fairness indices. These combinations, the resulting sign of the differences (Δzi) and the p-values associated with these differences are presented in **Table 7**.

These Δzi values indicate that the effect of the random-partners treatment is not uniform across all possible combinations of the fairness indices. Comparing

Table 7. z-statistic Changes and p-values for Corresponding χ^2-tests that the Changes Associated with Changing Partners Treatments are Statistically Significant When Considering Minimum and Maximum Potential Indices.

$X_{i,}$ N_i	Δz_i	p-value
0.20, 0.55[a]	>0	0.152
0.60, 2.00	>0	0.000
0.60, 1.20[b]	>0	0.000
0.20, 1.00[a]	<0	0.000

Notes: [a]The minimum Exogenous Index is 0.20 (when the amount sent is LF200). The maximum Exogenous Index is 0.60 (when the amount sent is LF300). When the Exogenous Index is 0.20 the maximum possible Endogenous Index is 1.00 (LF100 received divided by LF100 sent) and the minimum Endogenous Index is 0.33 (LF100 received divided by LF300 sent). However, the smallest Endogenous Index observed is 0.55. This value is used in place of 0.33. [b]When the Exogenous Index is 0.60 the maximum possible Endogenous Index is 3.00 (LF300 received divided by LF100 sent) and the minimum Endogenous Index is 1.00 (LF300 received divided by LF300 sent). However, the largest Endogenous Index observed is 2.00, and so this replaces 3.00 in this test and the smallest Endogenous Index that could be observed is 1.20 (LF300 received divided by LF250 sent; there is only one observation of LF300 being sent in this round and so the receiver facing a Exogenous Index of 0.6 cannot have sent LF300). 1.20 replaces 1.00 in this test.

scenarios in which the indices are at the lowest values (0.20 and 0.55) or the highest values for the sample (0.60 and 2.00) there will be greater likelihood that the offer would have been accepted in the random-partners treatment than in the fixed-partners treatment. In the first scenario this difference is not statistically significant but in the second scenario the difference is statistically significant. When we evaluate the treatment using the highest *Exogenous Index* and lowest Endogenous Index, corresponding to an offer of LF300, the largest offer made in this experiment, the Δzi value remains positive, indicating that it would be more likely that the offer will be accepted in the random-partners treatment than in the fixed-partners treatment. However, in the scenario in which an offer of LF100 is received, and the maximum possible *Endogenous Index* is realized given this offer, Δzi is negative and statistically significant (p = 0.000). In this scenario, the likelihood that the offer is accepted is greater for the fixed-partners treatment than for the random-partners treatment. These examples indicate that by adding the fairness indices to the design variables we can identify scenarios in which there are significant effects associated with the Random Partners variable. However, because the magnitudes of the indices are important in determining the likelihood of accepting an offer, the data do not support *Conjecture* 3 that offers are more likely to be accepted in random-partners scenarios that in fixed-partners scenarios.

Risk Attitudes

Neither risk attitude variable in Model III of the one-shot game Offer- Acceptance regressions is statistically significant (p = 0.300 and p = 0.431 for risk-averse and risk-seeking individuals, respectively). However, in Model II of the 3rd round of the repeated game the risk attitudes of individuals are significant (p = 0.000 and p = 0.005 for risk-averse and risk-seeing individuals, respectively). The coefficients indicate that risk-averse individuals are more likely to accept offers than are risk-neutral individuals while risk-seeking individuals are more likely to reject offers than are risk-neutral individuals.

Social Value Orientation

A claim that, ceteris paribus, pro-social individuals are more likely to accept offers than pro-self individuals can be accepted based on the results of Model III for the one-shot games (one-sided test, p = 0.043). The data from the 3rd round of the repeated game cannot support this conclusion. The result from the Offer-Acceptance regression in Model II of the repeated game that includes both the *Exogenous* and *Endogenous Indices* does not show a significant relationship between an individual's social value orientation and the likelihood that an individual will accept an offer (p = 0.394). We conclude that the narrowing of social distance through repeated interaction has dampened the effect that was associated with social value orientation in the one-shot game.

5.2.4. Why Does Someone Accept A While Someone Else Rejects B > A?

Consider the two pairs of players 1 and 2. Each player has an endowment of LF500. For the pair of players, player 1 sends LF200 to player 2 and player 2 sends LF100 to player 3. For the second pair, player 1 sends LF250 to player 2 and player 2 sends LF250 to player 3. Our comparison focuses on the decisions made by the two individuals in the player 2 roles. Who is more likely to accept the offer received from player 1?

Model I in Table 4 (the one-shot game) includes the Exogenous Index and the behavioral variables. Based on this model and given no difference between risk attitude and social value orientation of players 2, the determining values in the estimates of the likelihood that the offer is accepted are the products of the coefficients on the Exogenous Index variable (the same for both players 2) and the values of the Exogenous Index (0.4 for the first individual and 0.5 for the second). The product of the coefficient and the index is greater for the offer of LF250 than for the offer of offer of LF200. Now consider the case of the 3rd round in the repeated games but focus on the fixed-partners treatment in Model I (Table 5). Only the products of the coefficients on the Exogenous Index variable (the same for both players 2) and the values of the Exogenous Index (0.4 for the first individual and 0.5 for the second) determine the outcome. We obtain the same result as in the one-shot game example. For whatever pairs of offers we consider, given that social value orientations and risk attitudes of the individuals are the same we expect to find it more likely that a larger offer will be accepted than a smaller offer.

Now consider the same pair of offers and the Offer-Acceptance Model III for the one-shot games and Offer-Acceptance Model II for the repeated game. For the one-shot game, Model III does not include the Exogenous Index. As in the previous discussion, the determining value in the Model III regression equation is the product of the coefficient on the Endogenous Index variable and the value of the Endogenous Index. The difference in this example is that for the first player the value of the Endogenous Index is 2 (what she received from player 1, LF200, divided by what she sent to player 2, LF200) but for the second player this value is 1 (what she received from player 1, LF250, divided by what she sent to player 2, LF250). The two products are 11.736 for the first individual and 5.868 for the second.[19] The difference is significant (p = 0.000). The individual who received the LF200 offer is more likely to accept this offer than the individual who received the LF250 offer.

For the repeated game, both of the fairness indices are included in the offer-acceptance model. Using the regression for Model II in **Table 5**, for both the fixed-partners and random-partners treatments, the difference between the likelihoods that the offers described above are accepted is determined by the sum of three terms.[20] When these sums are evaluated for the two individuals we have described above, we find that for both the fixed-partners and random-partners treatments the likelihood that the LF200 offer is accepted is greater than the likelihood that the LF250 offer is accepted.[21]

Including the *Endogenous Index* in the Offer-Acceptance model extends the usefulness of the model. With this extension, the model can accommodate situations in with offers that may be characterized as fair may be less likely to be accepted than offers that may appear to be unfair offers. This arises because in addition to the offer, the Endogenous Index includes information about what the receiver sends to others which may be interpreted as what the receiver believes is a fair share of her endowment to allocate to another individual. The amount sent to another by the receiver permits us to generate an endogenous measure of fairness that is not captured by the Exogenous Index made up of the offer and the sender's endowment. This is comparable to obtaining information about the participants' beliefs or expectations, but without alerting the participants to this by explicitly asking about them (which could frame the game in a way that may affect offers).[22]

6. Conclusions

We have used a repeated ultimatum game to examine the role of social distance

[19]11.736 is the product of the regression coefficient 5.868 (from Model III in **Table 4**) and the Endogenous Index 2.00 and 5.868 is the product of the regression coefficient and the Endogenous Index 1.00.

[20]For the fixed-partners treatment the three terms are −257.803X − 109.565N + 330.856XN where X and N are the values of the Exogenous and Endogenous Indices. For the random-partners treatment the three terms are −4352.404X − 1501.543 + 6327.811XN. These are from Model III in **Table 5**.

[21]In the fixed-partners treatment the sum of the three terms for the first person is −57.566 and for the second person it is −73.039. In the random-partners treatment the sum of the three terms for the first person is 318.201 and for the second person it is −513.84. In both cases the larger terms are significantly greater than the smaller terms (p = 0.0425 in the fixed-partners treatment and p = 0.000 in the random-partners treatment.

[22]Using the offer-acceptance regression (6) from [4] (Table 4, p. 9) we find that if the change in the expectation variable is less than 2.429 times the change in the offer proportion the probability of rejecting the offer falls. Comparing the two cases used in the text above, the change in the offer proportion is −0.1 and the change in the expectation variable is −0.3. −0.3 is less than −2.429. For this example, using the Offer-Acceptance model presented by [4] in regression (6), it is more likely that the higher offer will be rejected than the lower offer. The belief or expectation is an important variable.

on offers made and on offer-acceptance decisions. The environment used had participants playing the roles of both senders and receivers. This enabled us to create indices that capture different concepts of fairness that we used to evaluate acceptance decisions. The ultimatum game environment enables us to gather information that we believe is a proxy for the beliefs or expectations that receivers have about what constitutes a fair offer. The fairness indices that we use in our offer-acceptance models include the conventional fairness index measured as the amount sent divided by the sender's endowment as well as the ratio of what is sent to the receiver divided by what the receiver sends to another participant in the receiver's role as a sender. In addition to the inclusion of partners treatments to capture social distance and the fairness indices in the offer-acceptance models, we introduce measures of social value orientation as well as risk attitudes as variables in our offer-acceptance models.

A particular objective was to identify a fairness index that would permit scenarios in which the likelihood of accepting an unfair offer could exceed the likelihood of accepting a fair offer. We show that the *Endogenous Index* successfully accomplishes this. This is an advantage over the conventional fairness index, which is the *Exogenous Index* in our experiment.

The behavioral variables that we introduce into our analysis help account differences in behavior over time. Pro-social individuals are more likely to accept offers in one-shot games than pro-self individuals but the significant effect of social value orientation disappears by the 3rd round of the repeated games (with the narrowing of social distance).

Risk attitudes do not have a significant impact on the likelihood that an offer is accepted in the one-shot games, but by the 3rd round of the repeated game, the likelihood of offer acceptance is greater for risk-averse individuals than risk-neutral individuals and is greater for risk-neutral individuals than risk-seekers.

We find that narrowing social distance among participants in the repeated ultimatum game by using fixed-partners leads to significant increases in offers over those sent when participants are randomly matched period after period in the repeated game. In the random-partners treatment, the mean offer falls to 31 percent of the sender's endowment by the 3rd period of the repeated game. In the fixed-partners treatment, the mean offer rises to 42 percent of the sender's endowment. These compare with 38 percent in the one-shot game. Even with the narrowing of social distance in the fixed-partners treatment, the offer remains significantly below the conventional fairness measure of 50 percent of the sender's endowment. It may be that the participants believe that the role of sender established a claim on the endowment. Accordingly, there may be an active endowment effect that restricts the realization of the 50 percent offer. Perhaps senders in repeated fixed-partners games think that 15 to 25 percent of their endowment is an entitlement and that they choose to share equally 75 to 85 percent of the balance of the endowment with the other person. Over several rounds of repeated play an offer close to 40 percent emerges. This requires further study.

Our experiment does not compare the effectiveness of the alternative methods of collecting information about beliefs or expectations and whether our conjecture that asking for beliefs of what is a fair offer or asking what individuals expect others will accept will lead to different offer or offer-acceptance behavior than what we find in our sessions. Any differences that may exist between the alternative methods would be worthwhile identifying.

Extrapolating beyond our data, our results that notions of fairness may not be fixed for all parties in a bargaining situation may help us understand some decisions that we observe some economic agents make when they forfeit potentially good opportunities in business interactions such as negotiating mergers and acquisitions or labour and management contracts. Similarly diverse notions of fairness can easily be the source of failures in legislative interactions or treaty negotiations among national governments.

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