RAISING THE STAKES IN THE ULTIMATUM GAME: EXPERIMENTAL EVIDENCE FROM INDONESIA

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The ultimatum game has generated considerable interest because experimental evidence strongly rejects the standard game-theoretic predictions. A limitation to this general result is the possibility that experimental results are an artifact of small stakes. Implementing the ultimatum game in Indonesia makes it possible to raise the stakes to three times the monthly expenditure of the average participant. Even with these sizable incentives, results do not uniformly approach the sub-game perfect, selfish outcomes. More specifically, responders become more willing to accept a given percentage offer at higher stakes, but proposer behavior is largely invariant to stake changes. (*JEL* C91, C78)

I. INTRODUCTION

This study investigates behavior in ultimatum games with very high stakes. The ultimatum game, where a Proposer states a proposed allocation of a monetary sum that a Responder accepts or rejects, has generated much interest due to the fact that the standard game theory predictions are strongly falsified by experimental evidence. A limitation of this evidence, which is tested in this paper, is the possibility that experimental results are an artifact of the use of small or hypothetical stakes.[1]

The experiments reported in this paper were conducted in Indonesia in 1994 where the per capita gross domestic product (US$670)[2] was less than 3% of that in the United States. Conducting the experiments in Indonesia made it possible to increase the implied monetary stakes to a level much greater than that of previous experiments. The largest stakes used were approximately three times the average monthly expenditure of participants.

The real money stakes used varied from approximately US$2.50 to US$100. This allows for a comparison of results of games played with drastically different stakes. The results show no evidence of Proposer behavior moving towards the game theory prediction as the stakes increase.[3] Responders, however, do exhibit increased willingness to accept a given percentage offer in higher stakes games. Hypothetical games are also played. The results from these games differ significantly from the real money games. In particular, there are significantly more rejections of Proposer offers in the hypothetical games and significantly larger variance in behavior than is found in the real money games.

II. THE ULTIMATUM GAME

The ultimatum game involves two players. The players are told the amount they are to allocate between themselves, $A. The "Proposer" acts first and nominates the amount that she wants, $X. The "Responder" then can either accept the offer in which case he receives $A–$X and the Proposer receives $X or he can reject the offer in which case both players receive $0. There is only one offer made and the Responder only gets to respond once.

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1. See Smith and Walker [1993] for a survey of research on the effect of stakes on outcomes in different experimental settings.

2. The World Bank [1994].

3. In this paper a movement in Proposers' behavior towards the game-theoretic prediction is taken to mean that the Proposers' percentage offers decrease, not that the absolute offers decrease.

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Standard game theory assumes that participants play with the sole aim of maximizing their payoffs. As such, it predicts that the Responder should be willing to accept any amount larger than \$0. Knowing this, the Proposer should take just a little less than the whole pie for herself. The subgame perfect equilibrium is thus an allocation of $(A - \varepsilon, \varepsilon)$. However, the standard result from ultimatum games played in the U.S. for moderate amounts of money (typically \$10 to \$15) is that the Proposer will often offer as much as 40% to the Responder. There are many 50:50 splits and there are frequent rejections of small offers. See Thaler [1988] and Camerer and Thaler [1995] for a detailed review of the ultimatum game literature.

III. THE ROLE OF STAKES

Theory

The experimental results of the ultimatum game constitute a rejection of the joint hypothesis of payoff maximization and subgame perfection. One response has been to develop models that incorporate fairness and reciprocity in utility functions. Rabin [1994] constructs a game-theoretic model in which each player puts a premium on fairness. The outcome is a set of "mutual-max" and "mutual-min" outcomes, or "fairness equilibria" which involve punishing someone who is unfair and rewarding someone who is fair. Rabin's model predicts a reversion to the Nash-equilibria as stakes increase. In the ultimatum game, however, every (offer, accept) outcome is a Nash equilibrium. His model thus makes no prediction as to the effect of increasing the stakes on Proposer behavior in ultimatum games. It however predicts that there will be no rejection of small offers once the stakes become arbitrarily large.

Telser [1995] develops an informal model which predicts that as the stakes increase, Responders will become more willing to accept a given percentage offer. He asks the reader to consider an ultimatum game in which the sum to be divided is \$10 million. While a Responder may have been willing to forego a 0.01% offer of one penny in a \$10 game, it is not so clear that the same Responder would be prepared to reject the equivalent percentage offer of \$1000 in the \$10 million game. The model is couched in terms of the law of demand: as the stakes increase the price of fairness increases and hence the quantity demanded decreases.

If Responders react to increased stakes by being more willing to accept a given percentage offer, then the optimal response of Proposers is to offer a smaller percentage of the pie. However, this argument abstracts from the issue of risk. Neither of the above models explicitly model the uncertainty faced by the Proposer. Unlike Responders, Proposers face a risk-return tradeoff. Making a lower offer increases the Proposer's potential monetary gain but also increases the risk of rejection. Proposers' risk attitudes may thus determine their behavior. Proposers may prefer to reduce the risk of rejection when the stakes are higher, a condition defined in Menezes and Hanson [1970] as *Increasing Partial Risk Aversion*. Evidence of increasing partial risk aversion in high stakes games is reported in Binswanger [1981] and could potentially explain the results found in this paper. Note, however, that risk aversion alone does not fully explain deviations from the game theoretic prediction. The risk faced by Proposers is generated by the Responders' unknown preferences for fairness as opposed to wealth maximization.[4]

Previous Experiments

Smith and Walker [1993] survey papers that provide evidence of stake effects.[5] Previous to this study, the highest stakes used in an ultimatum game were US\$100 in Hoffman, McCabe and Smith [1996]. They found that the distribution of Proposer offers did not differ significantly between US\$100 games and US\$10 games. They also provided informal evidence that Responder rejection rates decreased monotonically as the stakes increased. However, they did not control for the offers

4. Bolton [1991] incorporates "relative money" into utility functions to explain the outcome of bargaining games. Relative money is defined as the disparity between the money received by the individual and that received by others. In Bolton's model the effect of increasing stakes is indeterminate. It depends on whether fairness is a normal or inferior good and on the risk preferences of the Proposers.

5. For example, Binswanger [1981] and Kachelmeier and Shehata [1992] conducted experimental lottery games with very high stakes in India and the People's Republic of China, respectively. However, the implications of small stakes differ with the structures of the games. Hence a "case by case" approach is necessary.

being received by the Responders, and their conclusion was based on a small sample.[6] This study uses considerably higher stakes than in Hoffman et al. [1996], provides a larger sample size, and conducts a formal statistical analysis of both Proposer and Responder behavior. The experimental design has the additional advantage of controlling for player heterogeneity.

Straub and Murnighan [1995] also investigated the effect of increasing stakes in the ultimatum game, but with each player having only a small probability of receiving payment on the basis of the game's outcome. (The average expected payoff was $10.) They found no drop in the minimum percentage offer acceptable to Responders until the (hypothetical) stakes increased beyond US$100.

Slonim and Roth [1998] have since examined learning in high stakes ultimatum games in the Slovak Republic (although for lesser sums than in this study). Where comparable, their findings confirm the results presented below. Their results from repeated high stakes games suggest that Proposers may learn to make lower offers over time in such games.

IV. PROCEDURAL DETAILS

Experiments were conducted with students in the Faculty of Sociology and Politics at Gadjah Mada University in Yogyakarta, Central Java. The desired sample size was 40 pairs in each trial; however, class sizes varied with the result that some sessions fell slightly short of this. The English language instructions were translated into Indonesian and then translated back into English to check for any errors. All instructions and explanations were written, thus minimizing the amount of verbal communication. A pretest of 15 pairs of students was run to guard against problems during the real games.

The English language versions are available from the author on request. The games were played in almost complete silence, with the students sitting at least one seat apart from one another. At the start of each session, two examples were given and the students were asked to respond as a group as to how much each player would receive if the Responder accepted the offer and how much if the offer was rejected. The same two examples were used in all sessions.

The instructions stated that the game was anonymous and that they would never play the same person twice. The Proposers sat on one side of the room and the Responders on the other. No player played in more than one session and each session consisted of two rounds. They were told at the start only that there would be "a number of" rounds.[7] The Indonesian currency is the Rupiah and all players received a flat rate of Rp5000 ($US=Rp2160) for playing in addition to any takings in the real money games. Three real money sessions were conducted. The first round in each session was always for Rp5000 and the second round was for the same or an increased amount. In those games where the stakes increased in the second round, participants were not told that this would be the case until the start of that round. The advantage of allowing players to play twice is that it allows one to compare individuals' behavior across rounds and so, unlike many similar analyses of experiments, it is possible to control for the large amount of player heterogeneity that is typical of such experiments. The analysis below will focus on the differences between offers and responses in the two rounds of each game. The one game in which players played for the same amount, Rp5000, makes it possible to separate out the effect of experience and the effect of the increase in the stakes. In addition to the real money games, one hypothetical game was played. Table I shows the details of the different sessions.

According to self-reports from the subjects, the largest stake used, Rp200,000, is about three times the average monthly expenditure of the participants. This is much higher than the largest amounts used in previous ultimatum game studies.

V. RESULTS

Proposer Behavior

Real Money Games. The results of the games are shown in Figures 1, 2, 3 and 4

6. Hoffman et al. [1996] conclude that rejection rates decrease as the stakes increase on the basis of one less rejection (sample size of 26) in the US$100 game compared to the US$10 game. They do not control for offers received or player heterogeneity, and do not test the significance of the difference.

7. This avoids possible changes in behaviour in a pre-announced final round.

TABLE I
Summary of Games Played

Game 1	Game 2	Game 3	Game 4
Real Money	Real Money	Real Money	Hypothetical
I. Rp5000	I. Rp5000	I. Rp5000	I. Rp5000
II. Rp5000	II. Rp40,000	II. Rp200,000	II. Rp200,000
N = 29 pairs	N = 35 pairs	N = 37 pairs	N = 40 pairs

below. The figures show the distribution of Proposer offers and indicate whether the offers were accepted or rejected. Acceptances are shown in black and rejections in the gray shaded area. In a small number of cases the Responder filled in an incorrect answer to the question "How much will you receive if you accept?". In these cases it was assumed that the Responder did not understand the game fully and so the response is marked as a problem (crossed area) rather than as an acceptance or rejection.

The first result is that the low stakes (Rp5000) Indonesian games are not significantly different from the results commonly observed in the United States. The Rp5000 amount was chosen because it has approximately the same purchasing power as $10 to $15 in the U.S. (although it is a much larger share of average earnings).[8] The mode of the pooled Round 1 Indonesian offers is 40%, the mean is 43% and there are frequent rejections of small offers. A Mann-Whitney nonparametric test does not reject the null hypothesis that these results are the same as the US$10 results reported in Roth et al. [1991] and in Hoffman, McCabe and Smith [1996], with p-values of 0.251 and 0.625 respectively. Comparisons of the acceptance rates also fail to find significant differences between the Indonesian and U.S. responses (p-values of 0.698 and 0.144).[9]

Figures 2 and 3 show the results for Games 2 and 3, respectively. These figures indicate a slight shift toward more equal offers in the higher stakes round. However, comparisons of Rounds 1 and 2 within games reflect the effect of two factors: the increase in the stakes *and* the learning or experience effect. For that reason, in Game 1 the students played for the same amount Rp5000 in both rounds. The results of Game 1 can then be used as a control for the effect of learning.[10] The experimental design makes it possible to examine the effect of stakes in three ways. First, across games (comparing Round 2 in Games 1, 2, and 3); second, within games (comparing Rounds 1 and 2 within each game); and third within player (comparing the change in individuals' behavior between Rounds 1 and 2 in each game). Table II reports the summary statistics depicted in the figures.

Across Game Tests. If it is established that there are no significant differences across the groups of players in the different games, the test for the influence of stakes can simply compare the distribution of offers in Round 2 of Games 1, 2 and 3. Pairwise Mann-Whitney tests do not reject the null hypothesis that the Round 1 real money game distributions of offers were the same at the conventional $\alpha = .05$ level. (p-values: Game 1 vs. 2, 0.701; Game 2 vs. 3, 0.079; Game 1 vs. 3, 0.068). In Round 2 when the stakes differed across the games, the null hypothesis of equality of the distributions could also not be rejected (p-values: Game 1 vs. 2, 0.396; Game 2 vs. 3, 0.380; Game 1 vs. 3, 0.846). These results suggest that Proposer behavior is invariant to stakes.[11]

8. In terms of purchasing power, the World Bank [1994] estimates that US$1 in Indonesia buys as much as $4.40 in the U.S.

9. Those interested in such cross-cultural comparisons should see Roth, Prasnikar, Okuno-Fujiwara and Zamir [1991], a study which reports the results of playing the ultimatum game and a comparable market experiment in four countries. The authors find some differences in bargaining behavior but not in market behavior.

10. Note that the first rounds of Games 1, 2 and 3 are identical in all respects. That is, participants in Games 2 and 3 did not know that they would be playing for higher stakes in the second round.

11. Although no significant player heterogeneity was detected at the .05 level, the marginally significant p-values for the Round 1 comparison of Games 1 and 3 and Games 2 and 3 when coupled with the relatively weak power of the Mann-Whitney test suggest that player heterogeneity may play a role. A more powerful test would thus control for player heterogeneity by conducting within game and within player comparisons.

FIGURE 1

Game 1 Proposer and Responder Behavior

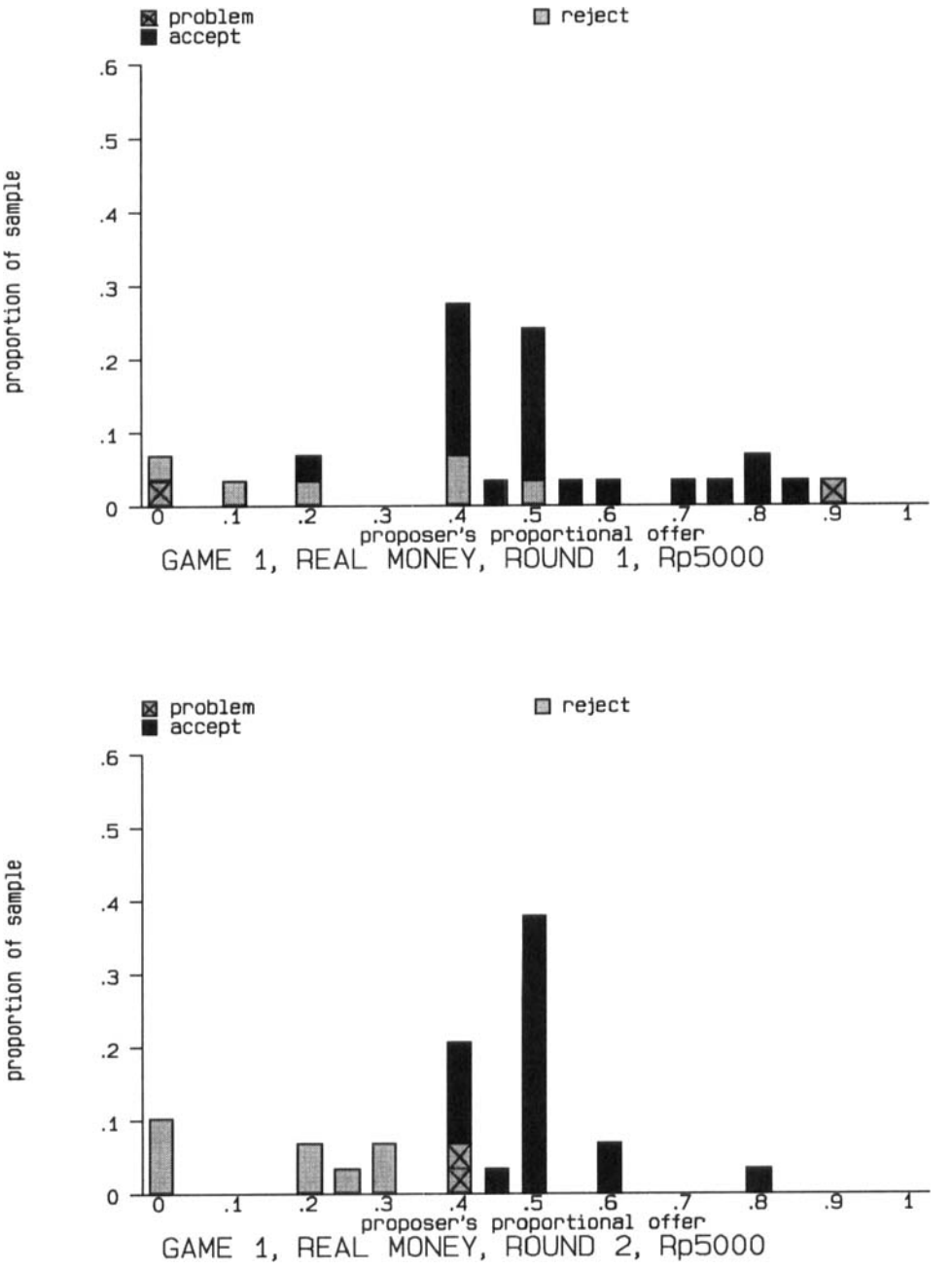
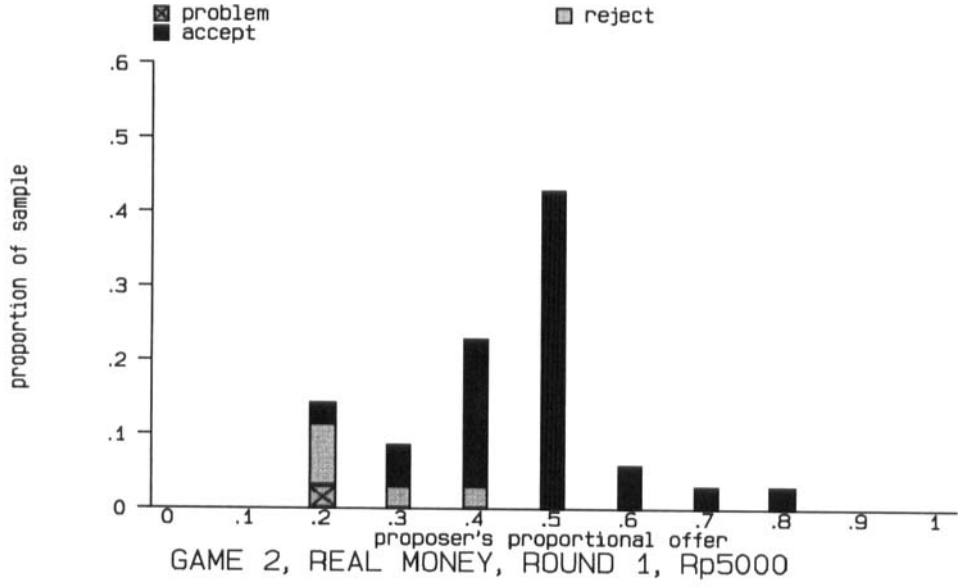


FIGURE 2
Game 2 Proposer and Responder Behavior



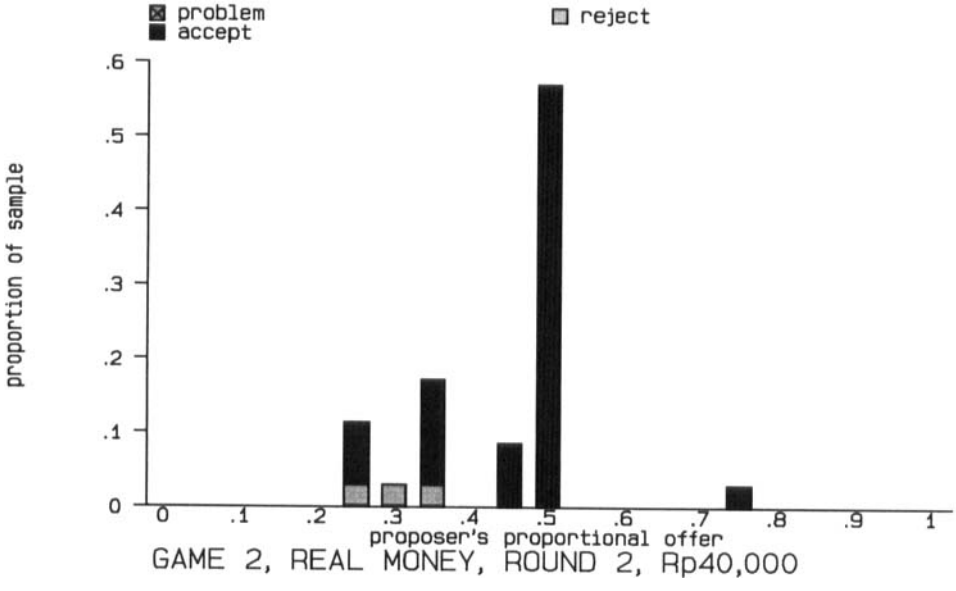
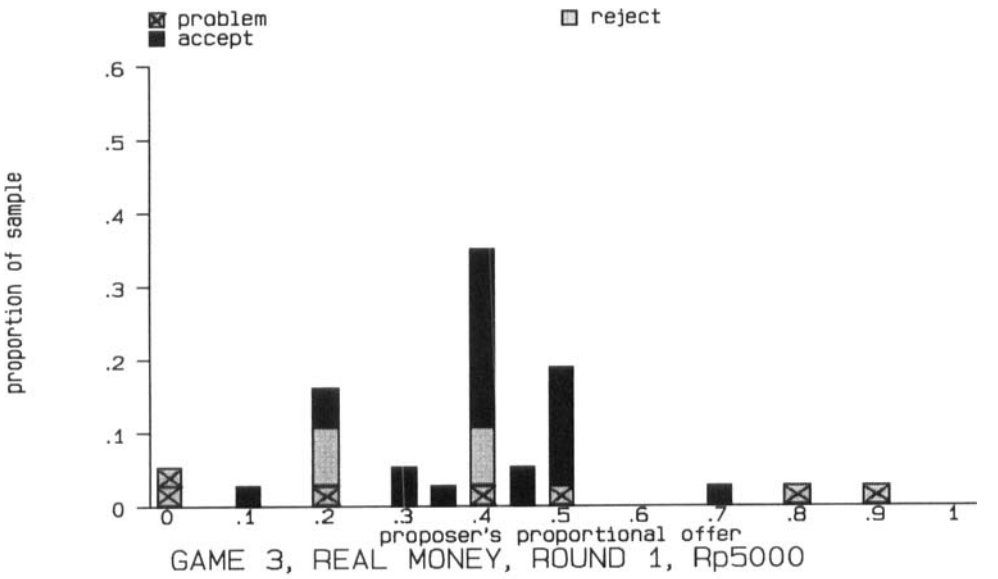


FIGURE 3
Game 3 Proposer and Responder Behavior



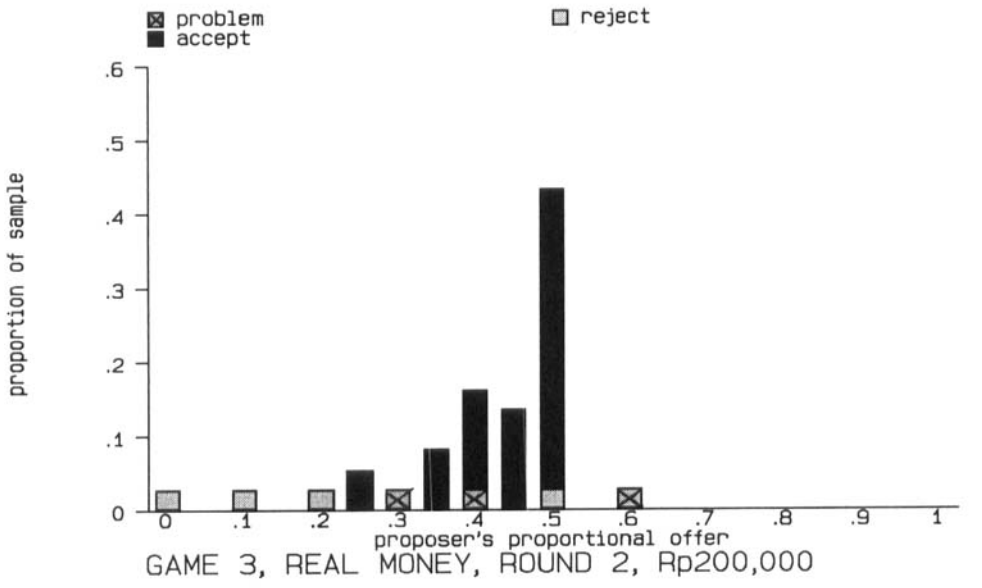
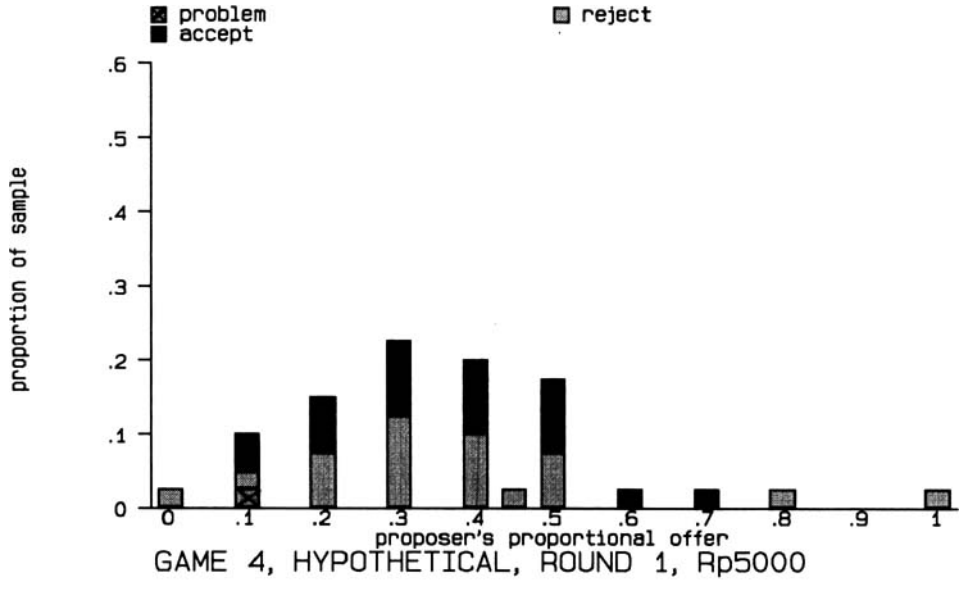


FIGURE 4
Game 4 Proposer and Responder Behavior



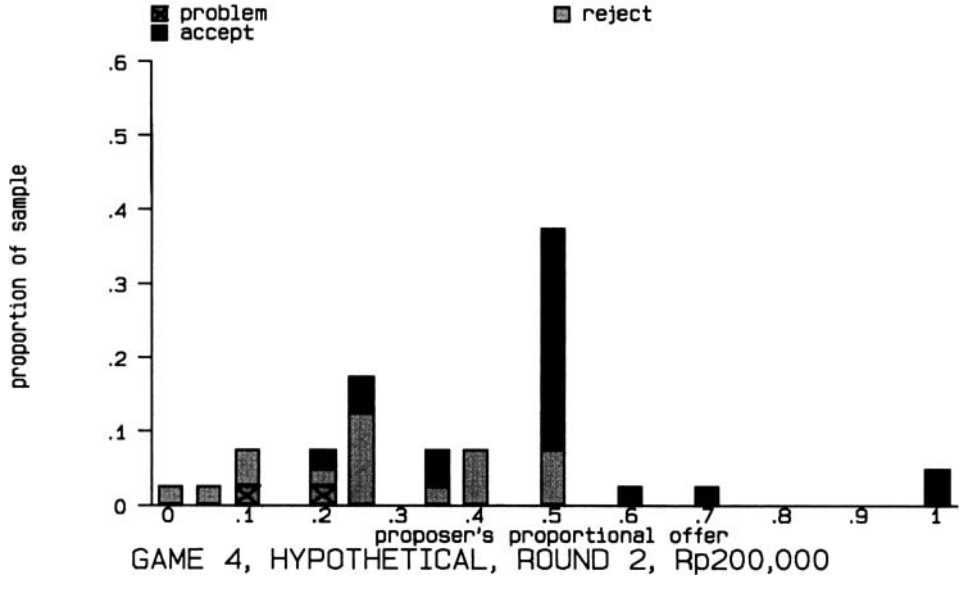


TABLE II
Summary Statistics of Proposer and Responder Behavior

	Game 1	Game 2	Game 3	Game 4
Round 1				
Amount	Rp5000	Rp5000	Rp5000	Rp5000 Hypothetical
Mean offer	0.4672	0.4331	0.3849	0.3627
Mode	0.40	0.50	0.40	0.35
Std. Dev.	0.2291	0.1395	0.1853	0.1954
Acceptance Rates	76.9%	85.3%	79.3%	47.4%
Round 2				
Amount	Rp5000	Rp40,000	Rp200,000	Rp200,000 Hypothetical
Mean offer	0.3990	0.4475	0.4192	0.3961
Mode	0.50	0.50	0.50	0.50
Std. Dev.	0.1846	0.1024	0.1204	0.2135
Acceptance Rates	69.2%	91.2%	89.7%	55.3%
Mann-Whitney Tests (p-values)	0.389	0.873	0.085	0.368
N	29	35	37	40

Within Game Tests. Mann-Whitney tests across rounds are reported in Table II. The distributions of Proposer offers in Rounds 1 and 2 are insignificantly different from each other at the 5% level in all of the real money games (Game 1 $p = 0.389$, Game 2 $p = 0.873$ and Game 3 $p = 0.085$).[12]

Within Player Tests. Table III presents the results of differences-in-differences tests across the three games. The differences in individual proposers' Round 1 and Round 2 offer proportions are calculated (Round 2 minus Round 1). The average and standard deviation of these differences are calculated for each game and are tested to assess whether they differ across games. Table III shows that the mean differences in Proposer percentage offers are positive in both Games 2 and 3, indicating that on average, offers became more generous from Round 1 to Round 2. In contrast, the Game 1 mean difference is negative. However, pairwise t-tests do not reject the null hypothesis of no significant differences in the mean Round 1 to 2 differences across games at the $\alpha = .05$ level. The p-value for Game 1 versus Game 2 is 0.141, for Game 1 versus 3 is 0.053 and for Game 2 versus Game 3 is 0.632. The F-test of equality across all three games also cannot be rejected. The standard deviation of differences between Round 1 and Round 2 offers is significantly lower in both Games 2 and 3 relative to Game 1. This indicates that there is a much greater variation in changes in percentage offers between rounds when the stakes remain constant and low than when they increase.

To summarize, the examination of Proposer behavior in the real money games does not show any movement towards the sub-game perfect Nash equilibrium outcome as the stakes increase. In fact, across game, within game and within player comparisons almost uniformly conclude that Proposer behavior is invariant to stake changes.[13] The changes in percentage offers between Rounds 1 and 2 are

12. Tests of population proportions were also conducted. There is a statistically significant decrease in low offers from Round 1 to Round 2 in the games in which the stakes increased, whereas in Game 1 (where the stakes are constant across the two rounds) there is no such decrease in the number of offers at the low end of the range. In Game 2 the number of offers less than 20% fell significantly from 5 (14.3%) in Round 1 to zero in Round 2 ($p = 0.020$). The pattern is similar and more dramatic in Game 3. The number of offers for amounts less than 40% decreased significantly from 25 (67.6%) to 15 (40.5%), ($p = 0.010$), and offers less than 20% fell from 9 (24.3%) to 3 (8.1%), ($p = 0.022$).

13. The tests of population proportions detected statistically significant movement away from the game-theoretic wealth maximizing proposals when the stakes increase.

TABLE III

Difference in Difference Tests: Differences Between First and Second Round Proposer Offer Proportions (Round 2 – Round 1)

	Mean Difference	Standard Deviation of Differences
Game 1	–0.0683	0.3150
Game 2	0.0104	0.1424
Game 3	0.0343	0.1595
Game 4	0.0333	0.2353
P-values of difference in differences:[a]		
Game 1 vs. Game 2	0.1419	0.0000*
Game 1 vs. Game 3	0.0533	0.0001*
Game 2 vs. Game 3	0.6318	0.2547
Game 3 vs. Game 4	0.9814	0.0102*
Test of Equality of Mean Differences in Games 1, 2 and 3: $p = 0.1372$		

[a]The *p*-value for the null hypothesis of no difference in the differences.

*Indicates a significant difference across the games at the 5% level.

also significantly more uniform when the stakes increase than when the stakes are constant, perhaps signifying a more shared reaction of Proposers to the increase in stakes.

Real Money versus Hypothetical Money

Figure 4 presents the results of the hypothetical games. A comparison of Figures 3 and 4 can be used to examine the effect of using real money as opposed to playing hypothetically. The figures show no obvious differences in the overall distribution of offers. Mann-Whitney tests do not reject the null hypothesis that the distributions are the same in the real money and hypothetical game (*p*-values of 0.445 in Round 1 and 0.498 in Round 2). Table III shows that the difference in mean differences between Round 1 and Round 2 offers in the real and hypothetical games is not significant.[14] However, the standard deviation of the changes in percentage offers between Round 1 and Round 2 is much greater in the hypothetical game than in the real money game.

Thus, the above analysis of Proposer behavior produces the following results:

1. With respect to the real money results, the evidence lends no support to the speculation that proposals might move closer to the game-theoretic predictions as the stakes increase.

2. With respect to the hypothetical results, the null hypothesis that the distributions of offers are the same in the real money and hypothetical game cannot be rejected.

Responder Behavior

Table II shows the acceptance rates in each round of each game which are defined as the percentage of offers that are accepted by Responders.[15] The acceptance rates are much lower in the hypothetical game than in the real money game. Acceptance rates also increase as stakes increase in the real money games. This cannot however be taken to indicate that Responders are more willing to accept a given percentage offer at higher stakes.[16] As we have seen above, there is evidence suggestive that some offers may have become more gen-

14. Also, unlike the real money game, the proportion of Proposers who offer less than 20% does not decrease significantly when the hypothetical stakes are increased.

15. Responders who filled in an incorrect answer to "If I accepted the offer I would receive ..." in either round of the game were dropped from the sample used to analyze responder behavior.

16. Even though the acceptance rates are much smaller in the higher stakes rounds, there were still some surprising rejections in the high stakes games that show a significant divergence from game-theoretic behavior. For example, one individual in Game 3 gave up Rp41,000 by rejecting an offer. His response to the expenditure question on the questionnaire identifies him as someone in the lowest expenditure category which makes the Rp41,000 approximately equivalent to his average monthly expenditure.

TABLE IV
Linear Probability Model of Responder Behavior

	Linear Probability Model with Random Effects
A1	–0.0635 (–0.779)
A2	0.0855 (1.168)
A3	0.1077 (1.384)
hyp1	–0.2615 (–3.576)
hyp2	–0.2277 (–3.134)
Offer Share	1.137 (8.088)
σ^2	0.0143
Constant	0.3161 (4.346)
Test: A1 = A2 = A3	Pr > $chi^2(2)$ = 0.1822
Test: hyp1 = hyp2	Pr > $chi^2(1)$ = 0.6784
Test: A3 = hyp2	Pr > $chi^2(1)$ = 0.0003
Test: A1 = A2 (one-tailed)	Pr > t = 0.063
Test: A1 = A3 (one-tailed)	Pr > t = 0.045
Test: A2 = A3 (one-tailed)	Pr > t = 0.407
Adjusted R-squared	0.3045
N	254

Dependent Variable = 1 if accepted, 0 if rejected. t-statistics are shown in parentheses.
Aj = 1 in the second round of Game j, 0 otherwise.
hypt = 1 in Round t if the game is hypothetical, 0 otherwise.

erous as the stakes increased, which may explain why we see more acceptances. In other words, it may be that the more generous offers (and not a greater willingness of Responders to accept a given percentage offer) explain the higher acceptance rates in the higher stakes games.

Table IV presents the regression results that test the significance of these differences in rejection behavior.[17] The dependent variable equals 1 if the offer was accepted, and 0 if it was rejected. It is regressed on the offer share received from the Proposer and the dummy variables, A1, A2, A3, hyp1, and hyp2, defined as follows:

Aj = 1 *in the second round of Game j*
0 otherwise

hypt = 1 in Round *t* if the game is hypothetical
0 otherwise

The coefficients on the variables A1, A2, and A3 represent the average probability of acceptance of a given percentage offer in Round 2 of each of Games 1, 2 and 3 relative to a first round real money game. The coefficients on hyp1 and hyp2 capture the probability of acceptance in Rounds 1 and 2 respectively of the hypothetical game relative to the first round real money game. For example, a player is 26.15% more likely to reject a given percentage offer in the first round of the hy-

17. Table IV reports results obtained from a Linear Probability Model (LPM). A probit model was also estimated and its statistical results were almost identical. The LPM model results are reported because they produce coefficients that can be interpreted in terms of probabilities.

pothetical game than in the first round of a real money game. Random effects are used to control for player heterogeneity.[18]

The F-test of equality of the coefficients on A1, A2 and A3 shows that the differences between the probabilities of acceptance of a given percentage offer in the real money games are statistically insignificant (p-value = 0.182).[19] However a one-tailed t-test of the null hypothesis that A1 = A3 against the alternative hypothesis that A1 < A3 rejects the equality of the coefficients with a p-value of 0.045. The same test of A1 = A2 narrowly fails to reject equality at $p = 0.063$. The insignificant F-test of equality across all three games is thus heavily influenced by the similarity between Responder behavior in the two higher stakes games (A2 and A3), not between responder behavior in the low stakes games and the higher stakes games.

The acceptance rates in the hypothetical game (Game 4) are significantly lower than in Game 3 ($p < .001$ in both Round 1 and Round 2). There is no significant difference in the rejection rate as the hypothetical stakes increase in Game 4 (p-value = 0.678).

VI. CONCLUSIONS

The experiments in this paper do not support the speculation that the rejection of game-theory predictions in the experimental setting of the ultimatum game is an artifact of small stakes. Significant deviations from game-theoretic behavior persist even in high-stakes games. There is no evidence of any movement in Proposer behavior towards the predicted game-theoretic outcome as the monetary stakes increase. However, the results do suggest that Responders react to higher stakes by becoming more willing to accept a given percentage offer. These differing reactions of Proposers and Responders may reflect the reaction of Proposers to the risk of losing a greater absolute amount. Proposers must juggle the conflicting pressures of potentially greater gain versus the risk of loss. If a Proposer's utility function is characterized by increasing partial risk aversion, his/her optimal response to increased stakes may not be to offer less. In contrast, Responders face a more transparent decision where rejecting a positive offer means foregoing a monetary payoff with certainty. In higher stakes games a rejection of a given percentage offer involves foregoing a much larger absolute sum.

The dictator game, in which the Responder must accept the Proposer's offer, eliminates the risk faced by the Proposer and allows one to examine Proposers' tastes for fairness directly. Playing the dictator game with very high stakes would be an interesting extension for further research.

Game theoretic models such as Rabin [1994][20] that incorporate fairness and reciprocity in a game-theoretic setting are also promising avenues of research. Rabin's model predicts a reversion to the Nash-equilibria as stakes increase. As mentioned above, every (offer, accept) outcome is a Nash equilibrium in the ultimatum game. Rabin's model is thus not troubled by the invariance of Proposer behavior. The persistence of rejections at high stakes does however raise the question as to how high the stakes need be in order to compel the reversion to Nash equilibria.

In addition to looking at the effect of increasing the stakes from small amounts of real money to larger amounts of real money, the difference between playing with real stakes and playing for hypothetical stakes was examined. When the stakes were hypothetical, there was significantly greater variation in Proposer behavior and Responders rejected proposals significantly more often. It is thus necessary to use real stakes when analyzing behavior in the framework of the ultimatum game.

18. There are too few responders who change their response from Round 1 to Round 2 to use fixed effects as a method for analyzing rejection behavior. See Hsiao [1986] for an explanation of the use of random effects.

19. Note that the coefficient on A1 captures the "learning" effect. The coefficients on A2 and A3 capture the learning effect and the effect of increased stakes. The test of the null hypothesis, A1 = A3, for example, can be rewritten as H_0: A3–A1 = 0. This nets out the learning effect and tests whether the stake effect is statistically significant. In contrast, tests of significance of the individual coefficients, A2 and A3 are within game comparisons. They do not control for learning and so are not able to examine the statistical significance of the stake effect.

20. And similarly Bolton [1991].

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