

3. Bargaining Behavior

- A sequential bargaining game
- Predictions and actual behavior
- Comparative statics of bargaining behavior
- Fairness and the role of stake size
- Best-shot versus ultimatum game
- Proposer competition
- Is a “sense of fairness” a human universal?

A Sequential Bargaining Game

- Two players bargain about the division of a given resource c that is perfectly divisible.
 - In period 1 player 1 offers an allocation $(c-x, x)$. Player 2 is informed about the offer and can accept or reject.
 - If player 2 rejects the resource depreciates by $(1-\delta)c$ and he can make a counterproposal $(\delta c - y, y)$. ($0 < \delta < 1$)
 - Player 1 is informed about the counterproposal and can accept or reject.
- Monetary Payoffs
 - If the period 1 offer is accepted: $(c-x, x)$.
 - If the period 1 offer is rejected and the period 2 offer accepted: $(\delta c - y, y)$.
 - If both offers are rejected, both players earn zero.

Prediction

- Assumptions

A0: Both players know the rules of the game.

A1: Both players are **rational** (i.e. forward looking) and **only** interested in their material payoffs.

A2: Both players know that A1 holds.

A3: Player 1 knows that A2 holds for player 2.

- Prediction (backwards induction)

- o In period 2 player 1 accepts any non-negative offer. Therefore, player 2 takes the whole cake and proposes $(0, \delta c)$, which will be accepted.

- o Thus, in period 1 player 2 accepts every offer that yields at least δc for him. Therefore, player 1 proposes the allocation $[(1-\delta)c, \delta c]$, which will be accepted.

Implications

- Equilibrium outcome is $[(1-\delta)c, \delta c]$
- The larger δ the more powerful is player 2.
- No rejections in equilibrium.
- If there is a smallest money unit ε there are multiple equilibria. They are however close to each other.

Remark

- In all of the following experiments subject-subject anonymity is guaranteed.

Predictions and Actual Behavior

A First Test (Güth et.al. JEBO 1982)

- Only 1 period. No counteroffer possible. Rejection leads to (0,0).
 - $c=4$ DM and $c=10$ DM.
 - Inexperienced subjects.
 - Results
 - All offers at least 1DM
 - Modal offer 50% (7 out of 21)
 - Mean offer 37%
 - o One week later (experienced subjects)
 - 20 out of 21 offers at least 1DM
 - 2 out of 21 offers 50%
 - Mean offer 32%
 - 5 out of 21 offers rejected.
- Systematic deviation from the “game theoretic prediction”.

A Rescue Attempt

(Binmore, Shaked, Sutton AER 1985)

“The work of Güth et al. seems to preclude a predictive role for game theory insofar as bargaining behaviour is concerned. Our purpose in this note is to report on an experiment that shows that this conclusion is unwarranted” (p. 1178)

- 2 periods, $c = 100$ pence, $\delta = .25$, $\varepsilon = 1$
- Equilibrium outcome (75,25).
- Each subject plays the game twice with changing roles. In the second game there were no players 2 but this was not known to player 1.
- Idea: If you have been player 2 in the first game you are more likely to backward induct when you are player 1 in the second game

Results of Binmore et al.

- 1. Game: Modal offer 50%, 15% rejections
- 2. Game: Modal offer 25%
- A victory for “Game Theory”?
- However
 - Instructions: “How do we want you to play? YOU WILL DO US A FAVOUR IF YOU SIMPLY MAXIMISE YOUR WINNINGS” (Capital letters in the original).
 - Perhaps the equilibrium is played because it is less unfair.
 - Alternating roles may make the overall outcome more fair.
 - Some responders in game 2 may have taken revenge for low offers in game 1.

Response of Güth and Tietz (J.Econ.Psych? 1988)

“Our hypothesis is that the consistency of experimental observations and game theoretic predictions observed by Binmore et al. is solely due to the moderate relation of equilibrium payoffs which makes the game theoretic solution socially more acceptable.”

- 2 periods,
- Game 1: $\delta=.1 \Rightarrow$ prediction (90%, 10%)
- Game 2: $\delta=.9 \Rightarrow$ prediction (10%, 90%)
- $c = 5 \text{ DM}, 15 \text{ DM}, 35 \text{ DM}.$
- Each subject played one of the two games twice but in different roles.
- Disadvantageous counteroffers led automatically to (0,0).

Results

- $\delta=.1 \Rightarrow$ mean outcome when played first: (76%, 24%),
when played second: (67%, 33%)
 - $\delta=.9 \Rightarrow$ mean outcome when played first: (70%, 30%),
when played second: (59%, 41%)
-
- Substantial deviation from predicted outcome.
 - In Game 1 players move away from the equilibrium when playing the second time.

“Our main result is that contrary to Binmore, Shaked and Sutton
The game theoretic solution has nearly no predictive power.”

A Large Design - Roth & Ochs (AER 1989)

	Two Period	Three Period
	Chips Money	Chips Money
$\delta_1=.4, \delta_2=.4$	Cell 1: (59,41) (\$17.70, \$12.30) to (61,39) (\$18.30, \$11.70)	Cell 5: (76,24) (\$22.80, \$7.20)
$\delta_1=.6, \delta_2=.4$	Cell 2: (59,41) (\$17.70, \$12.30) to (61,39) (\$18.30, \$11.70)	Cell 6: (84,16) (\$25.20, \$4.80)
$\delta_1=.6, \delta_2=.6$	Cell 3: (39,61) (\$11.70, \$18.30) to (41,59) (\$12.30, \$17.70)	Cell 7: (77,23) (\$23.10, \$6.90) to (76,24) (\$22.80, \$7.20)
$\delta_1=.4, \delta_2=.6$	Cell 4: (39,61) (\$11.70, \$18.30) to (41,59) (\$12.30, \$17.70)	Cell 8: (65,35) (\$19.50, \$10.50)

$c = \$30$.

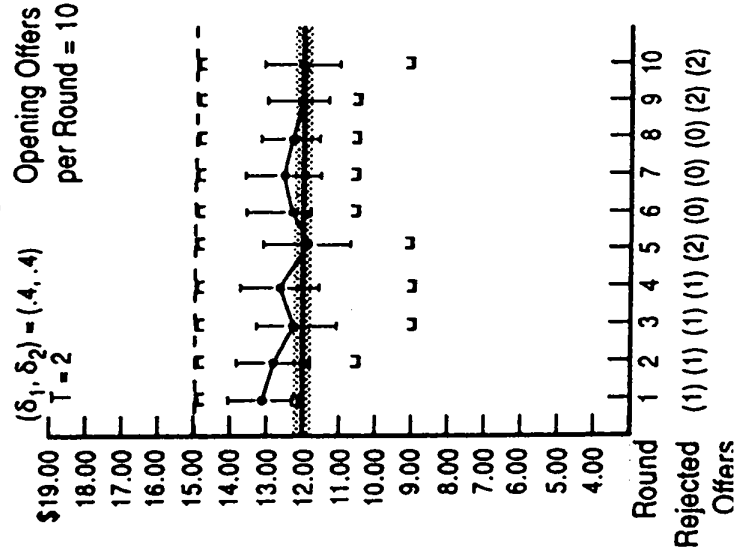
Independent variation of individual discount factors.

In 2-period games: $(c(1-x), cx)$ if x accepted at stage 1, $(\delta_1 c(1-y), \delta_2 cy)$ if y is accepted at stage 2.

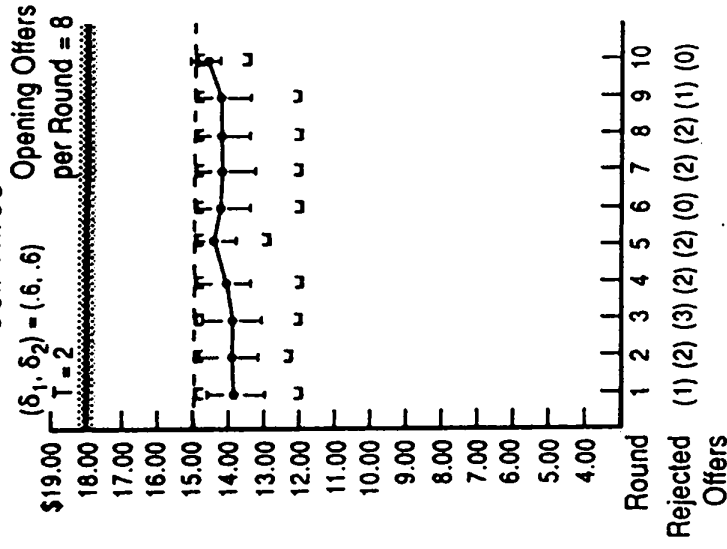
Player 2 can enforce $\delta_2 c$ at stage 2, hence player 1 offer $\delta_2 c$ at stage 1
 δ_1 is irrelevant

Figure 4.1. Experimental design and range of equilibrium predictions. *Source:* Ochs and Roth, 1989.

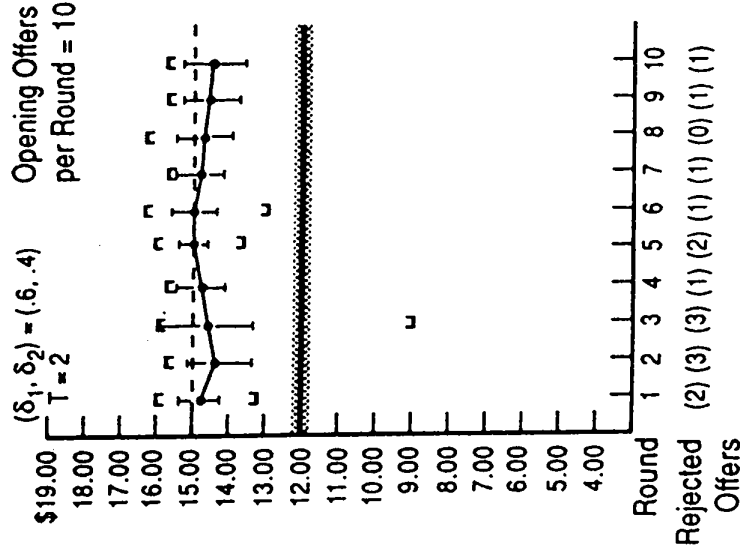
Cell One



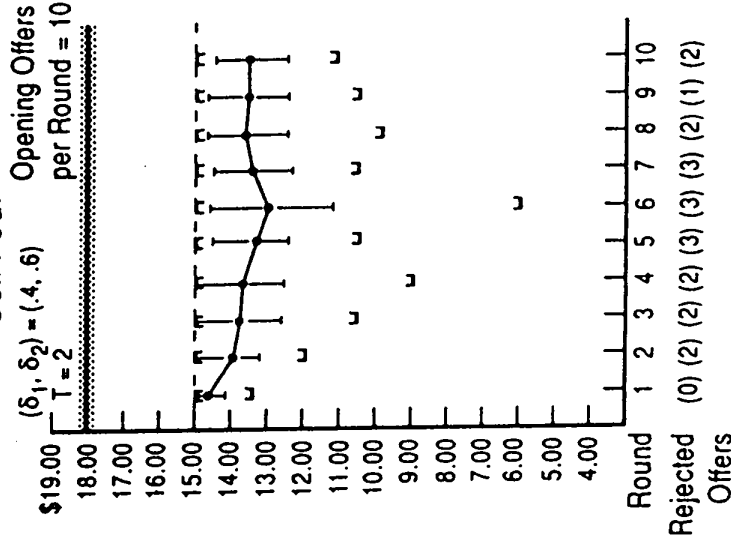
Cell Three



Cell Two



Cell Four



- Maximum observed offer
- Mean plus 2 standard errors
- Mean observed offer
- Mean minus 2 standard errors
- Minimum observed offer

--- Equal division

— Perfect equilibrium offer

▨ Perfect equilibrium interval

Results

- With the exception of cell One the standard prediction is refuted.
- In cell 2-4 the outcome is closer to the equal split than to the standard prediction.
- An increase in the discount factor of player 1 from 0.4 to 0.6 (cell 2 vs. 1) moves the outcome closer to the equal split although, in theory, no change should occur. (have no intuition for this!!)
- Similarly in cell 3 vs. 4. Increase in δ_1 moves payoff closer to equal split.
- Player 2 should receive more than 50% in cell 3 and 4 but player 1 offers 50% or less.

Rejections & Counteroffers

- Rejection rate of period 1 offers similar to 1-period ultimatum game.
- Most rejections lead subsequently to disadvantageous counteroffers.

Study	No. of observations	Rejections of period 1 offer [%]	Disadvantageous counteroffers [in % of rejections]
Güth et.al. 1982	42	19	88
Binmore et. al.	81	15	75
Neelin et. al. (1988)	165	14	65
Ochs Roth (1989)	760	16	81

Interpretation

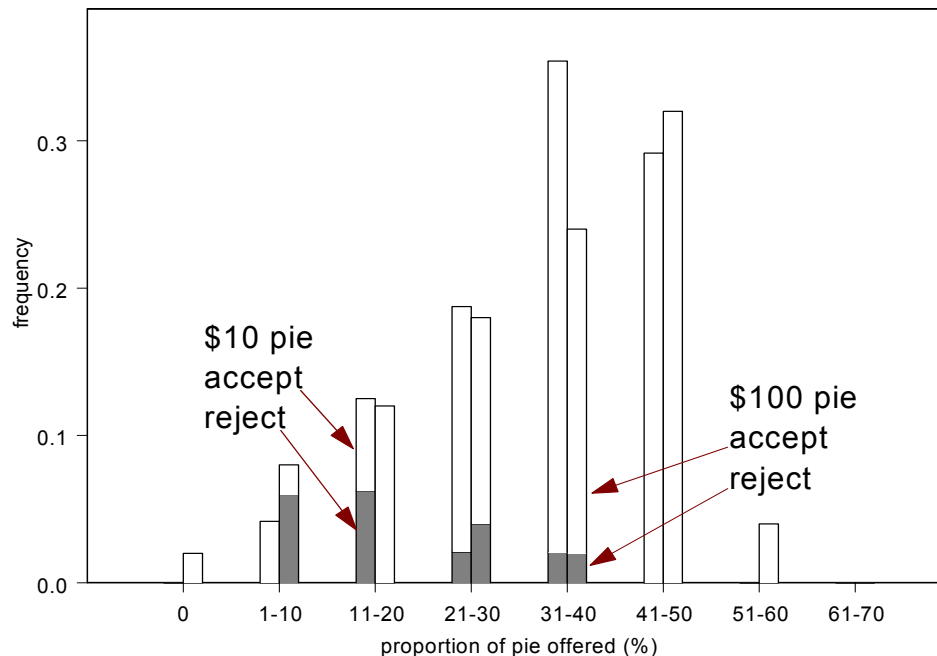
“Perhaps the most interesting observed regularity concerns what happens when first period offers are rejected, both in this experiment and in the previous experiments. Approximately 15 percent of first offers met with rejection, and of these well over half were followed by counterproposals in which player 2 demanded less cash than she had been offered.**we can conclude that these player 2s’ utility is not measured by their monetary payoff, but must include some nonmonetary component.**” (Roth, HB 1995, p. 264)

- The experimenters failed to control preferences.
 - Subjects’ homegrown preferences for relative income seem to be important
- Subjects play a game with incomplete information about the fairness preferences of their opponent (might explain large number of rejections).

Do High Stakes facilitate Equilibrium Play?

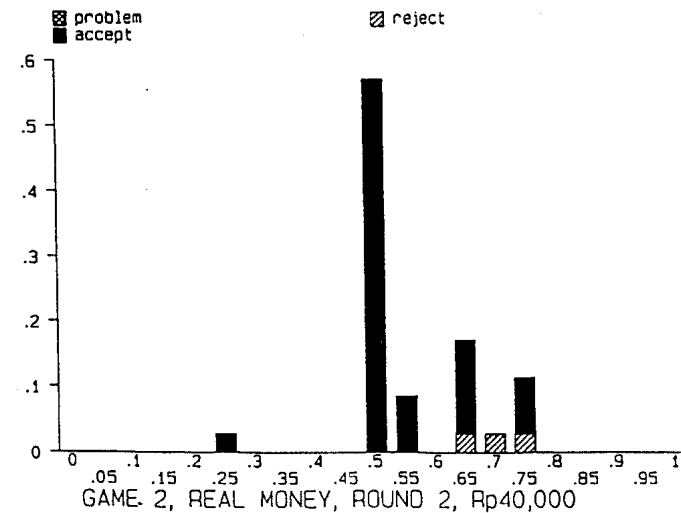
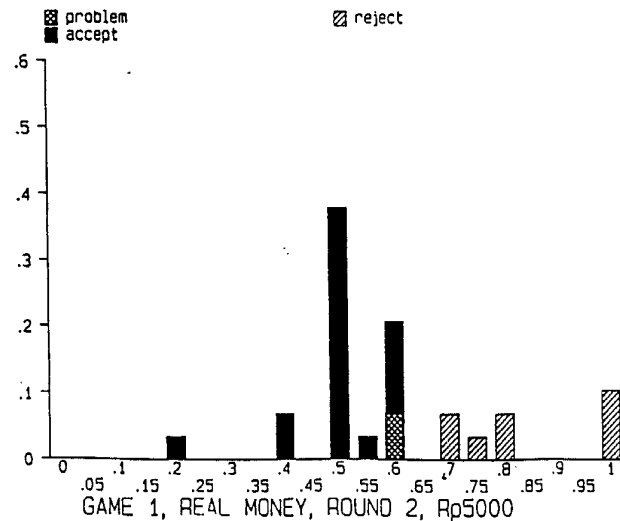
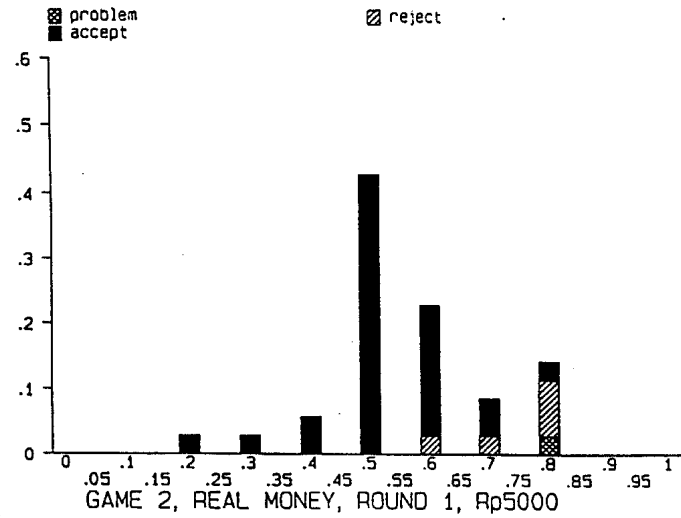
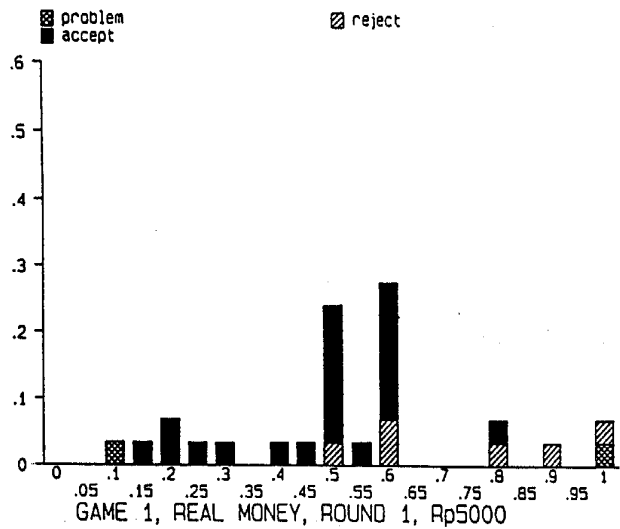
- Hoffman, McCabe, Smith (IJGT 1996): UG with \$10 and \$100
 - Stake size has no effect on offers.
 - Rejections up to \$30

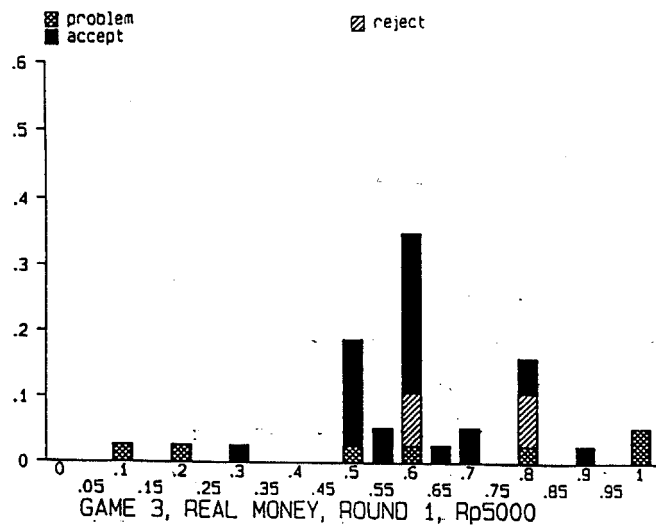
Offers and rejections in ultimatum games (Hoffman et. al., 1994)



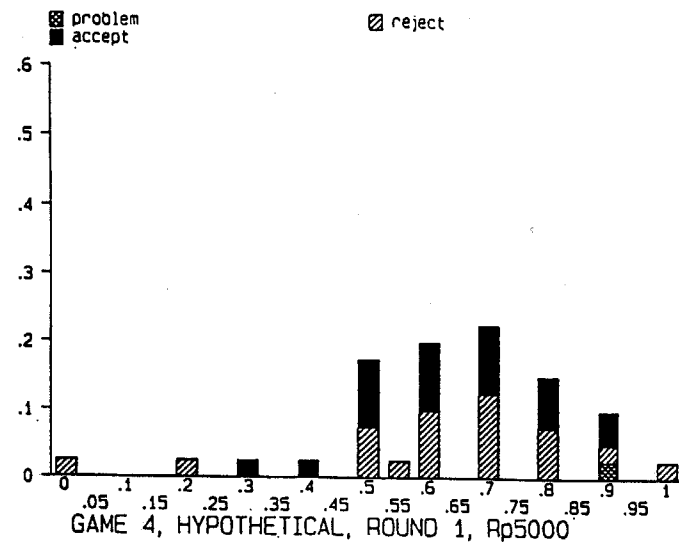
Stake Size - continued

- Cameron (EI 1999): UG in Indonesia \$2.5, \$20, \$100 (GDP/capita = \$670)
 - o Higher stakes generate offers closer to the equal split.
 - o Regressions reveal a small decrease in rejection probability, conditional on offer size, in response to increase in stakes.
 - o In case of only hypothetical offers proposers make many more greedy offers. In addition, offers between 40 and 50% are rejected.
 - o Note: The following figures report the amount demanded by the proposer.

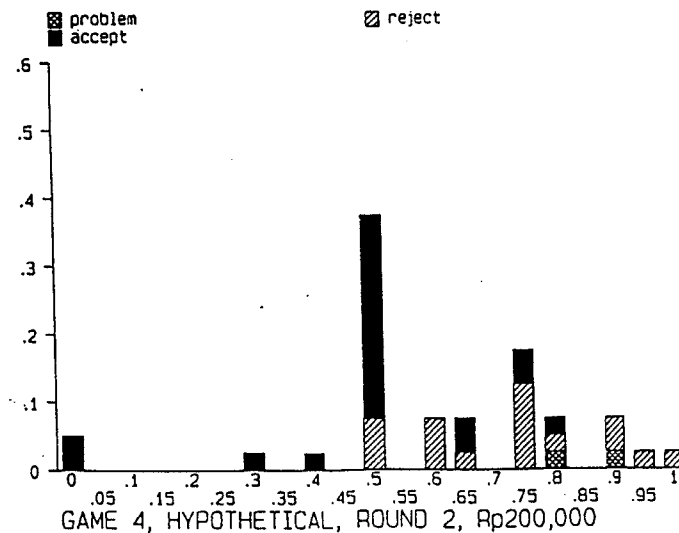
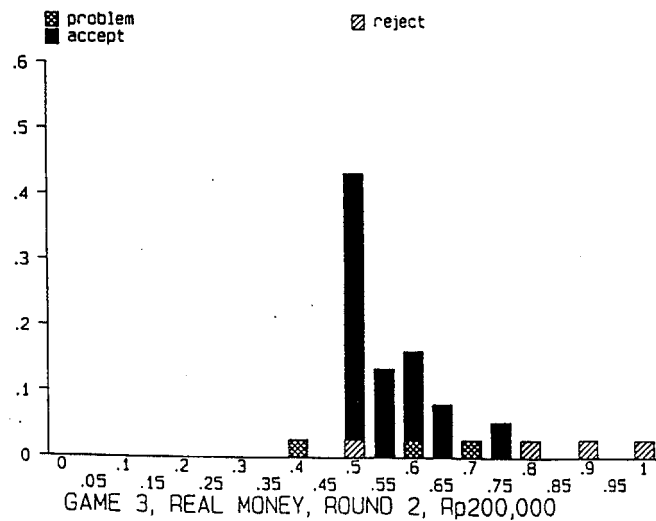




GRAPH 3



GRAPH 4

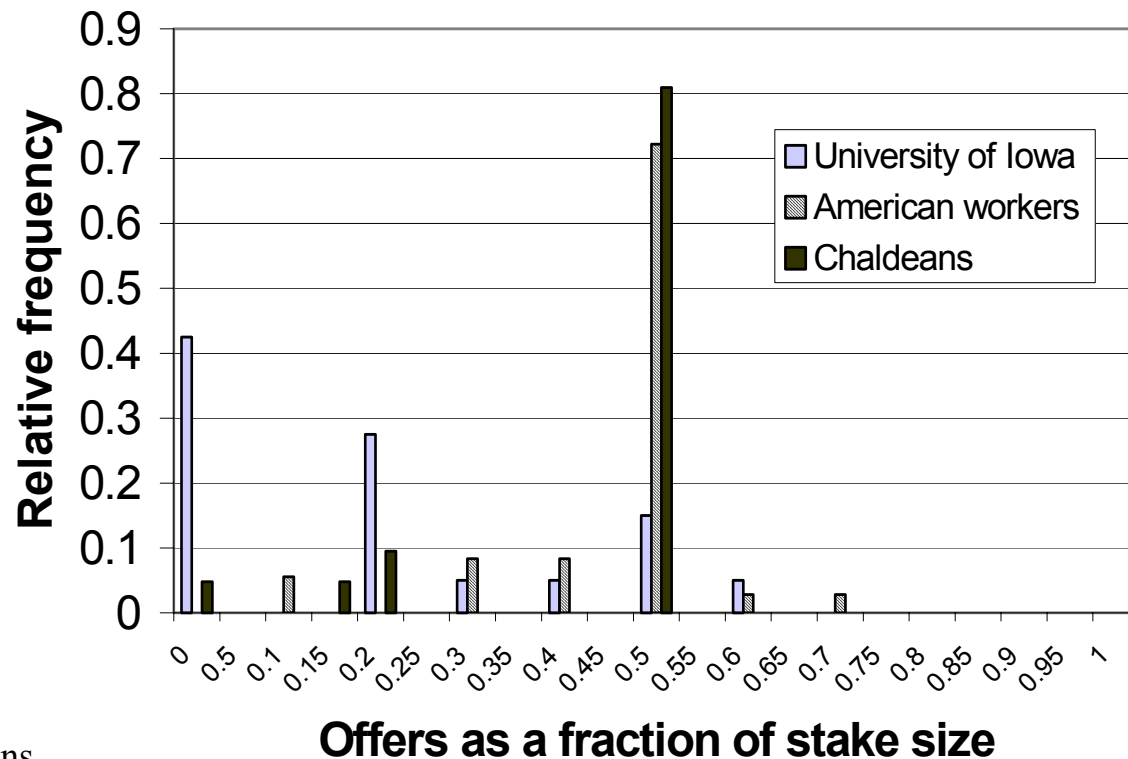


Altruism versus Fear of Rejections

- Forsythe et. al. (GEB 1994) compare a dictator game (where the responder cannot reject) with an ultimatum game.
- Modal offer in the UG 50%; modal offer in the DG 0%.
 - However, on average proposers still give roughly 20% in the DG and there is a “mass point” at 50%.
 - Some people make fair offer because of fear of rejections in the UG, some for altruistic reasons.
- Hypothetical play leads to much more equal splits in the DG but has no effect in the UG.

Students versus Non Students

Figure 4: Dictator game allocations



Based on Camerer&Fehr
Forthcoming in: Foundations
of Human Sociality, Oxford
University Press

Generosity versus Anonymity in the Dictator Game

- Hoffman, McCabe, Smith (GEB 1995): double anonymous DG, i. e., subjects know that the experimenter does not know their individual decisions. Experimenter only knows the distribution of decisions.
 - 70% give 0, no offer above 30% when double-anonymity prevails. Under single anonymity the usual result (mode at 0 and 50%, mean 20%)
 - Attempt to argue that outcomes that deviate from the self-interest hypothesis are mainly due to the fact that subjects do not want to behave greedily in front of the experimenter.
 - Could be an experimenter demand effect. Why does the experimenter ensure that he cannot observe my actions? Does she want me to behave greedily?
 - Bolton, Katok and Zwick (IJGT 1998) and Johanneson & Persson (EL 2000) could not replicate the double blind effect in the DG. The former attribute the effect in Hoffman et al. to presentation differences across treatments.
 - DG outcome is very labile; weak effects can have a big influence; therefore bad as a basis for generalizations to strategic situations.

Anonymity in the Ultimatum Game

Bolton and Zwick (GEB 1995)

- Compare single anonymous with double anonymous UGs.
- Comparison of single anonymous Ugs with single anonymous impunity game (= IG). IG is like UG but in case of a rejection only the responder's payoff is zero whereas the proposer keeps what he proposed for him.
 - In the IG the responder cannot punish.
- **Punishment hypothesis:** In the IG offers are lower than in the UG.
 - Confirmed: in the last 5 periods all offers in the IG are subgame perfect under the selfishness assumption.
- **Anonymity hypothesis:** Under double anonymity offers in the UG are lower.
 - Rejected: Offers are lower in the first five, but higher in the second five periods. In general, offers under double anonymity similar to those in other single anonymous UGs.

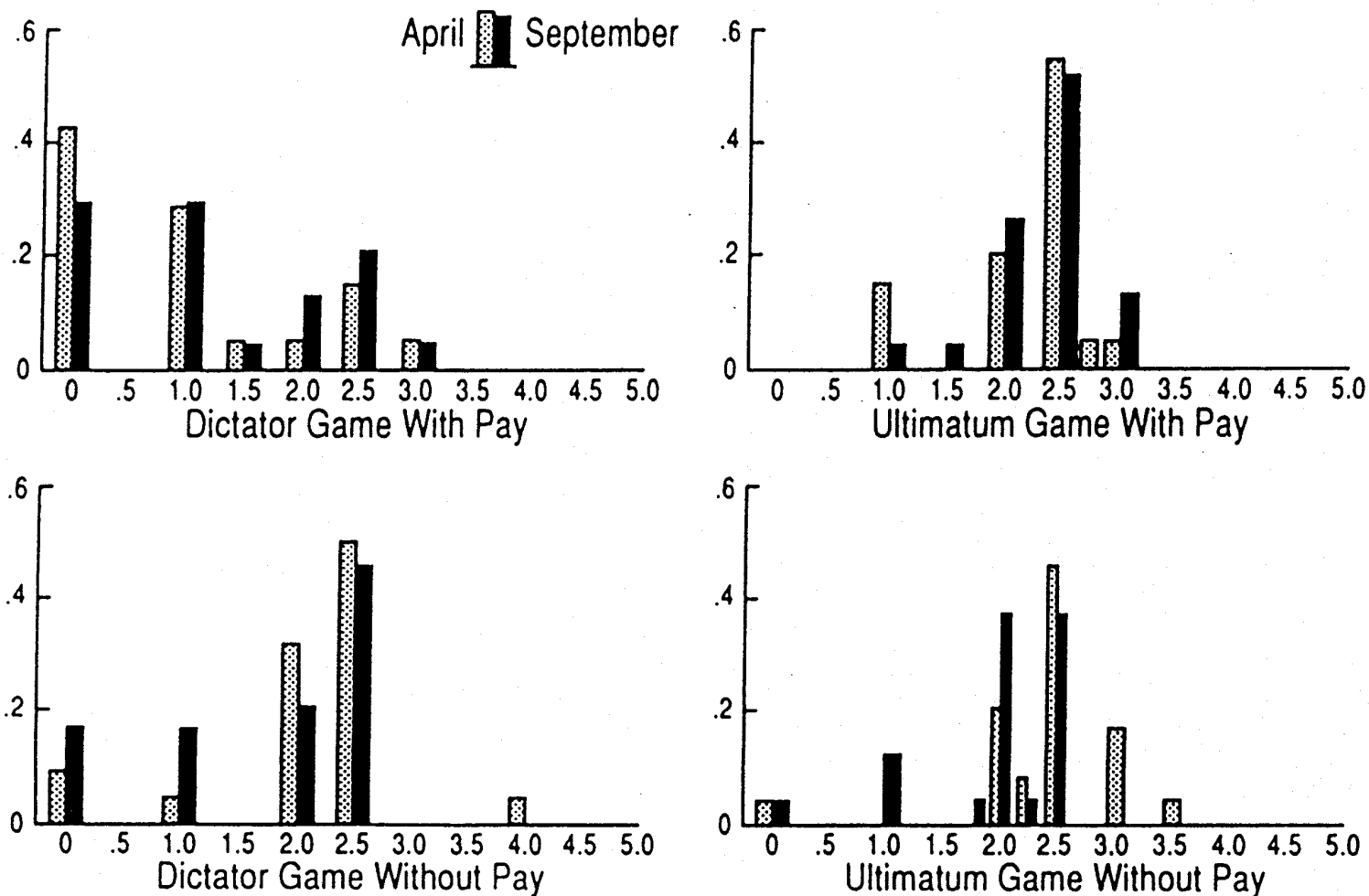


Figure 4.4. Offers in dictator and ultimatum games. *Source:* Forsythe, Horowitz, Savin, and Sefton 1994.

Accepting Unfair Outcomes

- Best Shot Game (invented by Harrison & Hirshleifer JPE 1989)
 - Player 1 chooses contribution q_1 to a public good
 - Player 2 observes q_1 and then chooses q_2
 - **Key feature: the total contribution to the public good is $\max(q_1, q_2)$**
 - Linear cost
 - Revenue is concave

Payoff Table for Best Shot Game

No. of public goods units	Revenue	Marginal Revenue	Cost	Marginal Cost
0	0	-	0	-
1	1.00	1.00	0.82	0.82
2	1.95	0.95	1.64	0.82
3	2.85	0.90	2.46	0.82
4	3.70	0.85	3.28	0.82
5	4.50	0.80	4.10	0.82
...21

Prediction

- For $q_1=0$ player 2 chooses $q_2=4$. Payoffs (3.7, 0.42)
- For $q_1=1$ player 2 chooses $q_2=0$. Payoffs (.18, 1)
 - Note that once player 1 provided a positive level of the public good player 2 can only increase the total level provided by contributing more than the first player. Contributing less or the same is a complete waste.
- For $q_1=2$ player 2 chooses $q_2=0$. Payoffs (.31, 1.95)
- For $q_1=3$ player 2 chooses $q_2=0$. Payoffs (.39, 2.85)
- For $q_1=4$ player 2 chooses $q_2=0$. Payoffs (.42, 3.7)
- By backward induction, player 1 chooses $q_1=0$
 - Note, if player 2 responds to this with $q_2=0$ both players receive 0.

Results

- Harrison & Hirshleifer conduct the experiment with private information about payoffs.
 - Quick convergence to the subgame perfect equilibrium
 - Is this due to lack of public payoff information?
- Prasnikar & Roth (QJE 1992),
 - Best Shot Game with public and private payoff information.
 - Under public payoff information convergence is even quicker.

Table 4.3. Mean Offers by Periods

Periods	Ultimatum Game (mean x_2) ^a	Best Shot, full information game (mean q_1) ^b	Best Shot, partial information game (mean q_1) ^c
1	4.188 (0.329)	1.625 (0.610)	2.700 (0.617)
2	3.825 (0.530)	0.875 (0.482)	2.900 (0.994)
3	3.725 (0.480)	1.125 (0.597)	3.000 (0.848)
4	3.581 (0.438)	0.125 (0.116)	2.100 (0.793)
5	4.231 (0.276)	0.125 (0.116)	2.700 (0.906)
6	4.418 (0.234)	0.125 (0.116)	1.250 (0.605)
7	4.294 (0.166)	0.000 (0.000)	1.100 (0.537)
8	4.531 (0.155)	0.000 (0.000)	0.800 (0.505)
9	4.325 (0.232)	0.000 (0.000)	0.950 (0.567)
10	4.531 (0.155)	0.000 (0.000)	0.700 (0.401)

Source: Prasnikar and Roth 1992.

Note: Values in parentheses are standard errors.

^a Perfect equilibrium prediction: $x_2 = 0$.

^b Perfect equilibrium prediction: $q_1 = 0$.

^c Perfect equilibrium prediction: $q_1 = 0$.

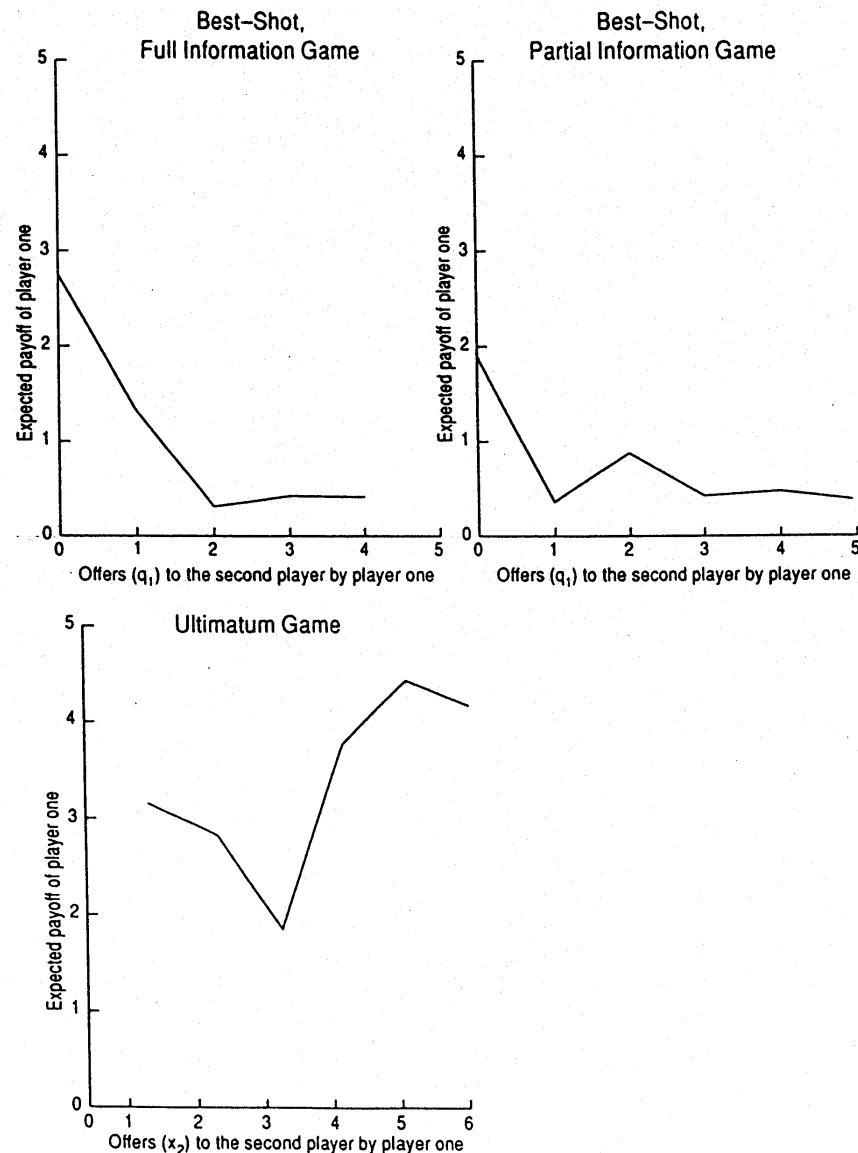


Figure 4.6. Expected payoff of each offer. Source: Prasnikar and Roth 1992.

What drives the difference?

UG: rejections of higher offers more expensive

→ higher acceptance probability

→ higher offers in UG are profitable

BSG: “rejections” ($q_2 = 0$) of higher offers (high q_1) cheaper

→ high offers face low acceptance probability

→ high offers in BSG are not profitable

However: Why does player 2 accept the very uneven payoff distribution (9:1) in the BSG but not in the UG? (see fairness models)

Multiproposer-Ultimatum Game (Roth and Prasnikar QJE 1992)

- 9 proposers simultaneously make an offer x .
- 1 responder decides whether to accept or reject the highest offer.
- Rejection: all players receive 0.
- Acceptance: $(10-x, x)$ for the pivotal proposer and the responder, zero for all other proposers.
- Pivotal proposer: those with the highest offer or a random draw among those with the highest offers.
- \$0.05 is the smallest money unit.
- Prediction
 - Responders accept all positive offers.
 - At least two proposers offer \$9.95 or
 - At least two proposers offer \$10.

Table 4.4. The Highest and Second-Highest Prices in Each of the Markets and the Basic Descriptive Statistics

Period	Market	Highest Price (\$) ^a	Second-Highest Price (\$) ^a	Mean and SD ^b	Mode ^c	Median	N ^d
1	A	8.90 (1)	8.25 (1)	6.48 (2.52)	8.05	8.05	9
	B	9.90 (1)	8.95 (1)	6.76 (1.84)	5.00	6.50	9
2	A	9.60 (1)	9.00 (1)	6.57 (3.07)	5.00	8.05	9
	B	9.90 (1)	9.00 (2)	6.69 (3.26)	x	8.00	9
3	A	9.85 (1)	9.65 (1)	7.24 (3.24)	x	9.00	9
	B	10.00 (1)	9.95 (1)	8.08 (2.31)	x	9.00	9
4	A	10.00 (2)	9.95 (2)	7.32 (4.00)	x	9.90	9
	B	9.95 (1)	9.90 (1)	7.31 (2.67)	9.00	9.00	9
5	A	10.00 (2)	9.95 (2)	9.14 (1.61)	x	9.90	9
	B	10.00 (2)	9.95 (2)	7.93 (2.76)	x	8.50	9
6	A	10.00 (3)	9.95 (1)	7.21 (3.69)	10.00	9.00	9
	B	10.00 (1)	9.95 (4)	7.81 (3.32)	9.95	9.95	9
7	A	10.00 (1)	9.95 (2)	6.43 (3.28)	x	7.00	9
	B	10.00 (1)	9.60 (1)	5.23 3.07	5.00	5.00	9
8	A	10.00 (2)	9.85 (1)	5.76 (3.74)	x	5.00	9
	B	10.00 (2)	9.85 (1)	5.72 (4.31)	x	7.00	9
9	A	10.00 (1)	9.95 (1)	4.73 (4.11)	x	5.00	9
	B	10.00 (1)	9.95 (1)	5.98 (3.72)	x	5.00	9
10	A	10.00 (2)	9.95 (1)	6.22 (4.23)	x	9.00	9
	B	10.00 (2)	9.95 (1)	6.47 (3.32)	5.00	5.00	9

Source: Prasnikar and Roth 1992.

^a The number in parentheses is the number of buyers who bid that price.

^b Numbers in parentheses are standard deviations.

^c An "x" in the mode column means that there were fewer than three observations at any one price.

^d N represents the number of buyers in each of the markets.

Results

- Right from the beginning offers were very high (mean of \$8.95).
 - Competition important from the beginning (no learning required).
- Rapid convergence towards the equilibrium. From period 5 onwards the equilibrium offer is \$10.
- How can we explain the presence of fair outcome in the UG and of very uneven outcomes in this market game? (see fairness models)

Culture, Fairness & Competition

(Roth, Prasnikar, Okuno-Fujiwara & Zamir 1991)

- UG and market game with proposer competition in Tokyo, Ljubljana, Jerusalem und Pittsburgh.
- Problems
 - o Experimenter effects -> same experimenters
 - o Language -> double translation
 - o Prominent numbers -> same experimental currency
 - o Stake size -> provide stakes with comparable purchasing power
 - o Subject pool effect -> recruit subjects with the same observable characteristics.
 - o Questions remain: Do we really measure cultural differences here? How is culture defined? Differences in beliefs about the opponents' behavior? Differences in preferences? Differences in the perception of what the game is about? Differences in the rules of thumb that are triggered by the experiments?

Results

- In period 1 there are differences in market outcomes across countries but in all countries markets converge to the SPE-outcome.
- In period 1 the modal offer in the UG is 500 in all countries.
- In period 10 the offers in the UG are still far higher than in the SPE.
 - Modal offer in US and Slovenia is still 500.
 - Modal offer in Israel 400 and in Japan at 400 and 450, resp..
- For any given offer between 0 and 600 Israel has the highest acceptance rate -> explains the lowest offers.
- Japan has higher acceptance rates than the US and Slovenia -> explains that offers in Japan are lower than in the US and Slovenia.

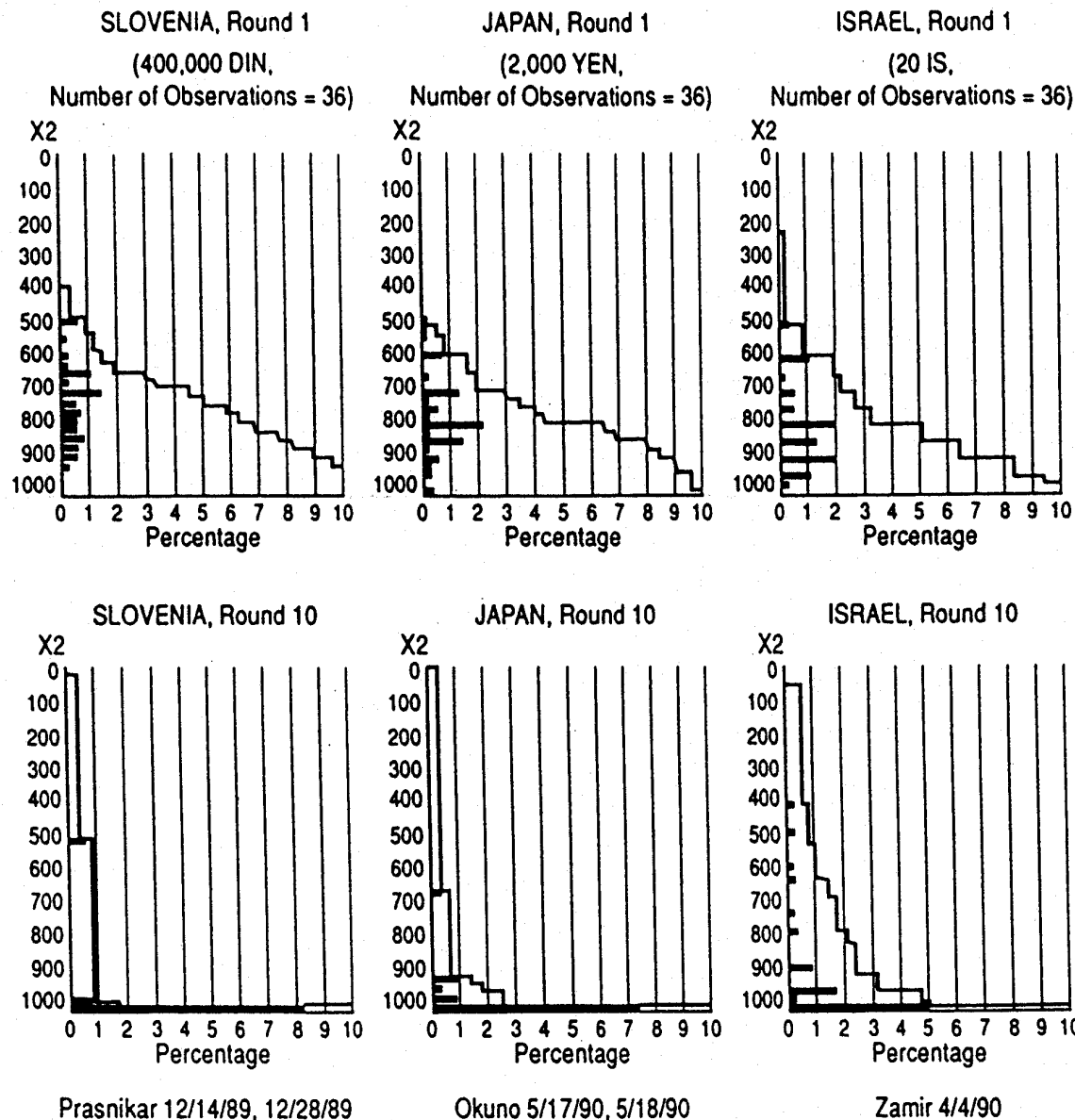
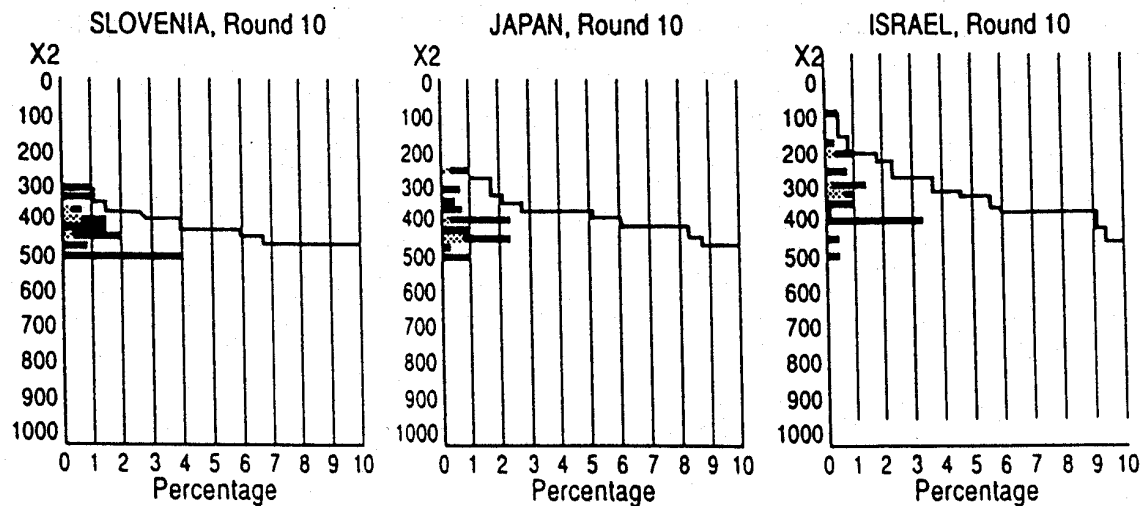
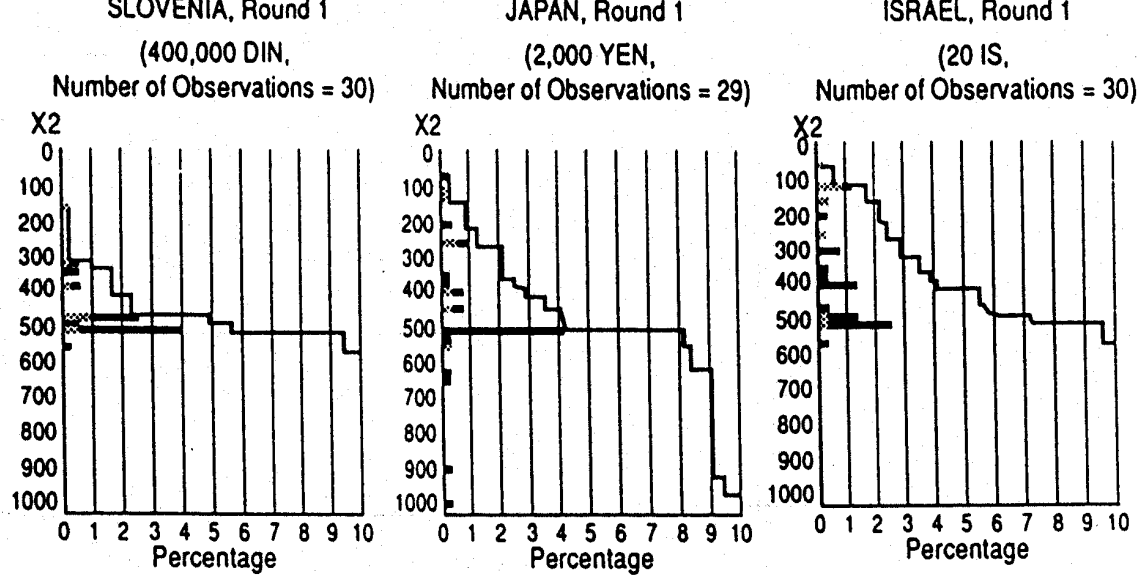


Figure 4.7a. Distribution of market offers in Slovenia, Japan, and Israel. *Source:* Roth, Prasnikar, Okuno-Fujiwara, and Zamir 1991.



Prasnikar 12/14/89, 12/22/89, 12/27/89 Okuno 4/20/90, 5/10/90, 5/11/90 Zamir 4/25/90, 5/7/90, 5/16/90

— Accepted Offers Rejected Offers

Figure 4.7b. Distribution of bargaining offers in Slovenia, Japan, and Israel. *Source:* Roth, Prasnikar, Okuno-Fujiwara, and Zamir 1991

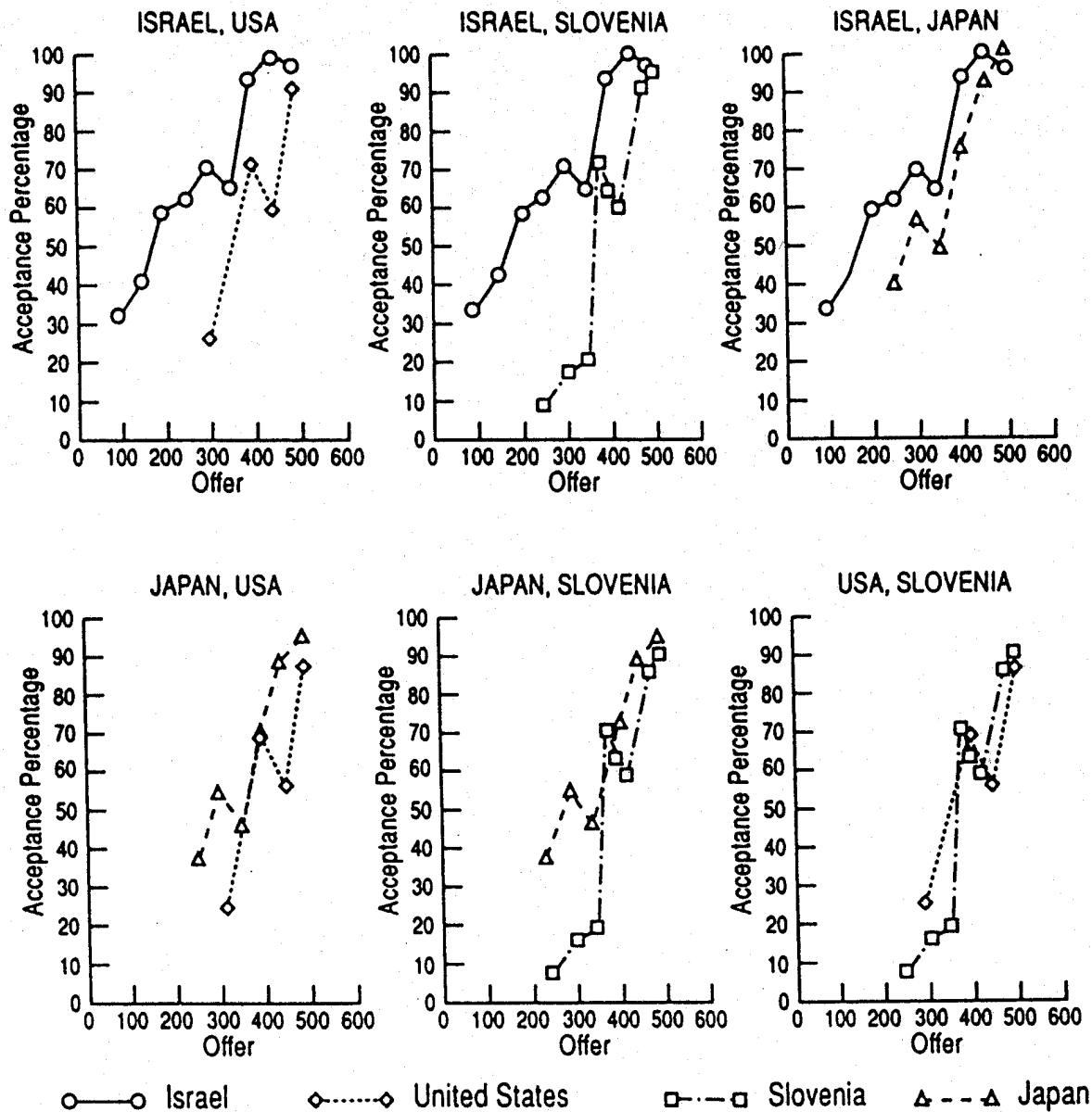


Figure 4.7c. Pairwise comparisons of acceptance rates in bargaining. *Source:* Roth, Prasnikar, Okuno-Fujiwara, and Zamir 1991.

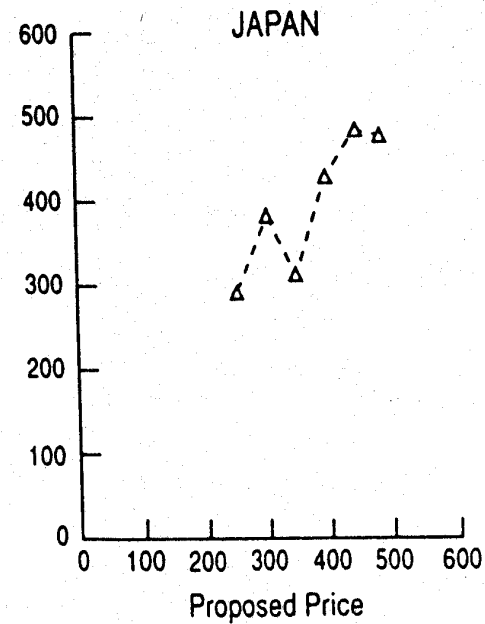
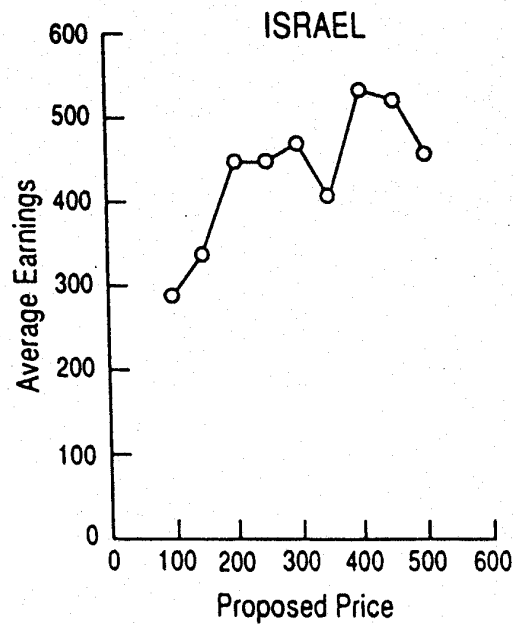
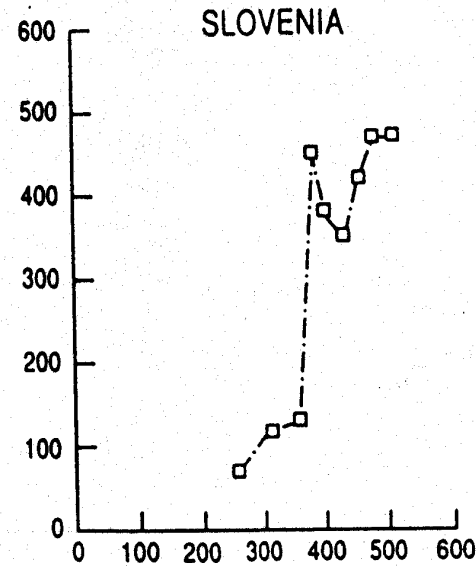
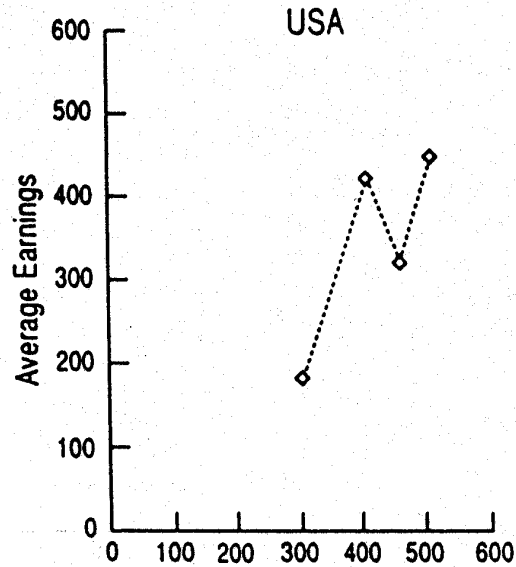


Figure 4.7d. Buyers' earnings in bargaining, by Proposed Price. *Source:* Roth, Prasnikar, Okuno-Fujiwara, and Zamir 1991.

Ultimatum Game in Small Scale Societies

Henrich, Boyd, Bowles, Camerer, Fehr, Gintis, McElreath
(AER 2001)



Henrich explaining the Ultimatum Game



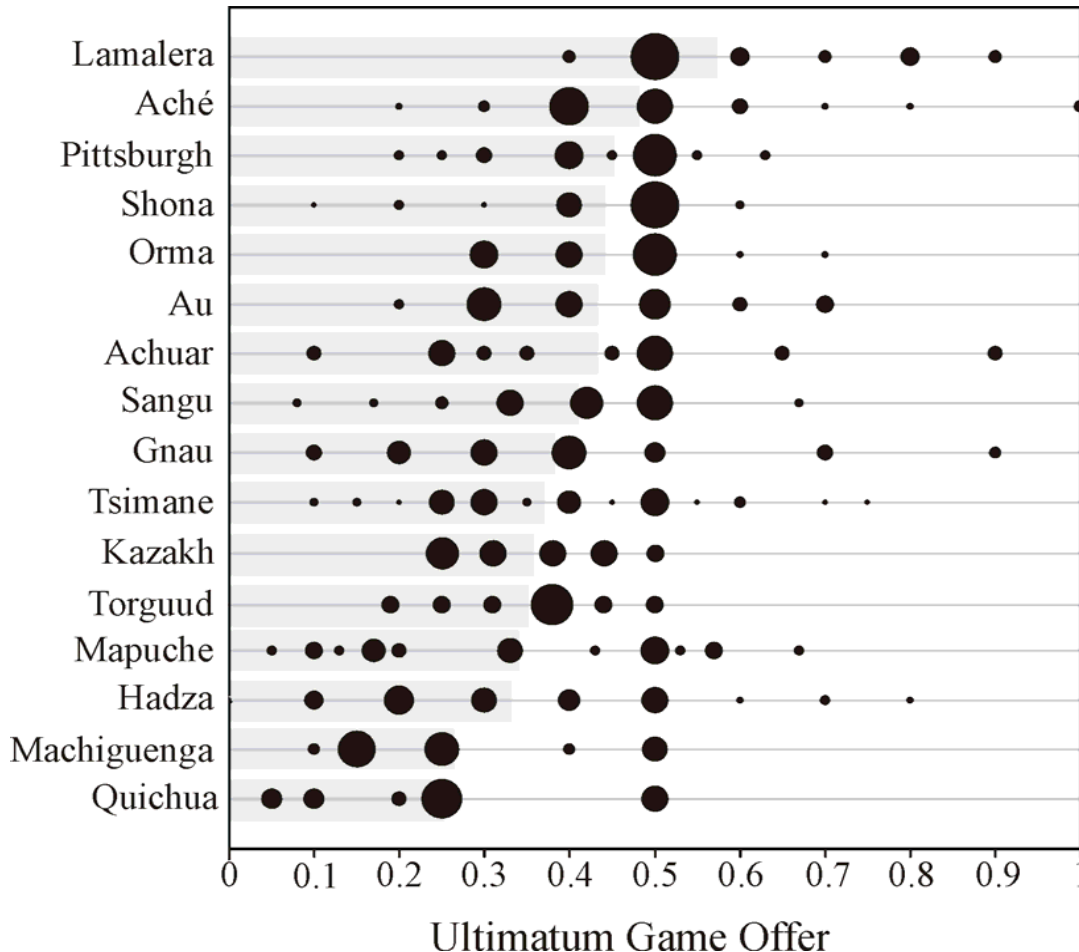




Results

- The self-interest model is not supported in any society.
- Considerable variability across different societies.
- Group level differences in the degree of market integration and the potential payoffs to cooperation explain a substantial portion of the between-group variance.
- Individual level economic and demographic variables do not explain the behavioral variance within and across societies.
- Behavior in the UG is in general consistent with the patterns of everyday life in the different societies. Examples:
 - Extreme fairness among the Lamalera and the Ache.
 - Little fairness among the Machiguenga.
 - Super fair offer among the Au and the Gnau.

Distribution of Offers

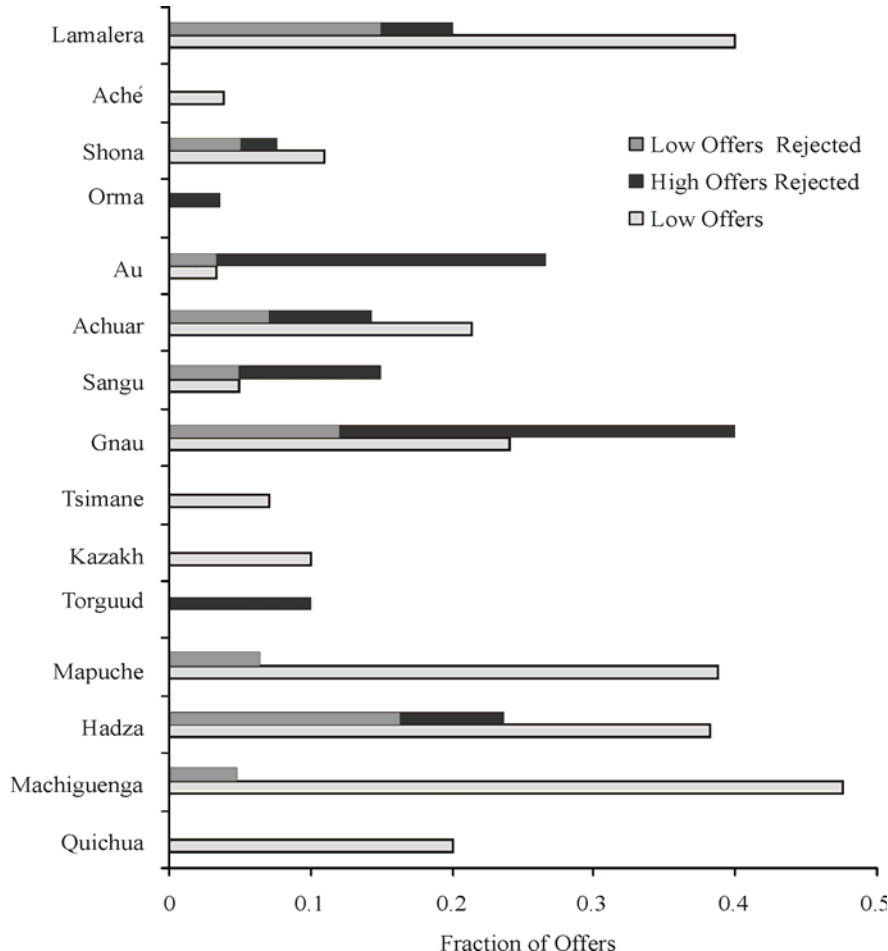


A Bubble Plot showing the distribution of Ultimatum Game offers for each group. The size of the bubble at each location along each row represents the proportion of the sample that made a particular offer. The right edge of the lightly shaded horizontal gray bar is the mean offer for that group. Looking across the Machiguenga row, for example, the mode is 0.15, the secondary mode is 0.25, and the mean is 0.26.

Henrich, Boyd, Bowles, Camerer Fehr, Gintis, McElreath (AER 2001)

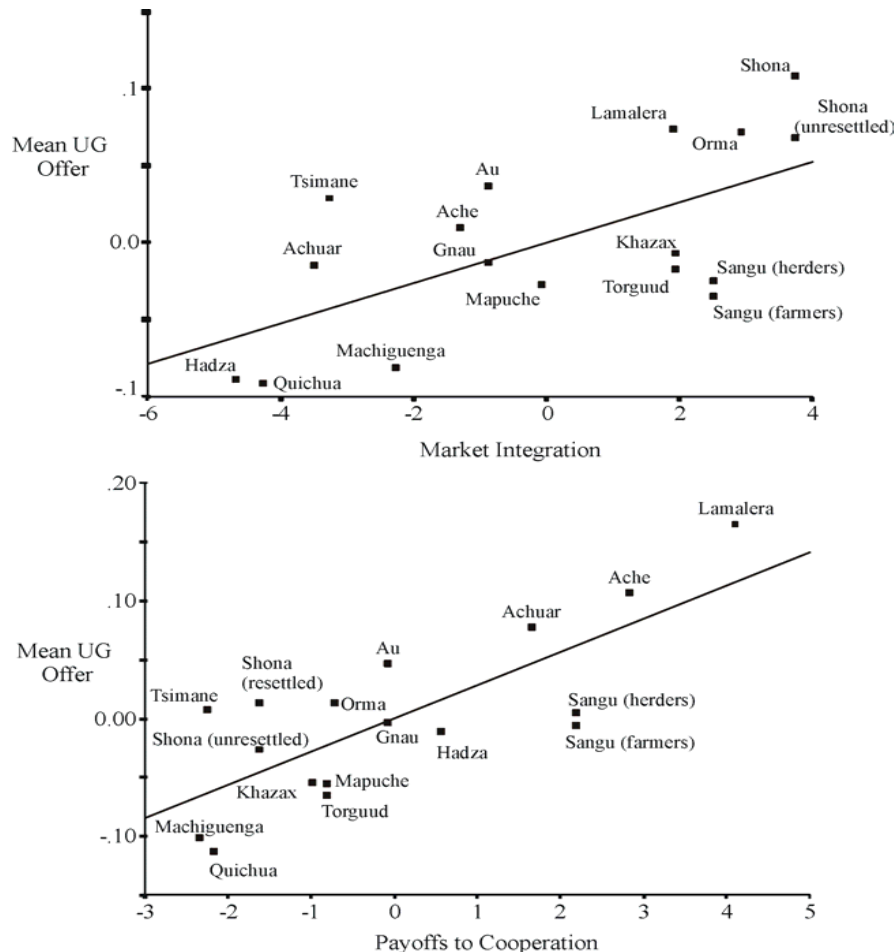
Group	Country	Mean offer	Modes (% of sample)	Rejection rate	Rejections of 20% pot
Machiguenga	Peru	0.26	0.15/0.25 (72%)	1/21	1/10
Hadza (Small Camp)	Tanzania	0.27	0.20 (38%)	8/29	5/16
Tsimané	Bolivia	0.37	0.5/0.3/0.25	0/70	0/5
Quichua	Ecuador	0.27	0.25 (47%)	2/13	1/2
Hadza (all Camps)	Tanzania	0.33	0.20/0.50 (47%)	13/55	9/21
Torguud	Mongolia	0.35	0.25 (30%)	1/20	0/1
Khazax	Mongolia	0.36	0.25		
Mapuche	Chile	0.34	0.50/0.33 (46%)	2/30	2/10
Au	PNG	0.43	0.3 (33%)	8/30	1/1
Gnau	PNG	0.38	0.4 (32%)	10/25	3/6
Hadza (Big Camp)	Tanzania	0.40	0.50 (28%)	5/26	4/5
Sangu (farmers)	Tanzania	0.41	0.50 (35%)	5/20	1/1
Unresettled	Zimbabwe	0.41	0.50 (56%)	3/31	2/5
Achuar	Ecuador	0.42	0.50 (36%)	0/16	0/1
Sangu (herders)	Tanzania	0.42	0.50 (40%)	1/20	1/1
Orma	Kenya	0.44	0.50 (54%)	2/56	0/0
Resettled	Zimbabwe	0.45	0.50 (70%)	12/86	4/7
Ache	Paraguay	0.51	0.50/0.40 (75%)	0/5	0/8
Lamelara	Indonesia	0.58	0.50 (63%)	0/2	0.37

Rejection Behavior



Summary of Ultimatum Game Responder's Behavior. The lightly shaded bar gives the fraction of offers that were less than 20% of the pie. The length of the darker shaded bar gives the fraction of all Ultimatum Game offers that were rejected. The gray part of the darker shaded bar gives the number of these low offers that were rejected as a fraction of all offers. The low offers plotted for the Lamalera were sham offers created by the investigator.

Economic Determinants of Group Differences



Partial regression plots of mean Ultimatum Game offer as a function of indexes of Market Integration and Payoffs to Cooperation. The vertical and horizontal axes are in units of standard deviation of the sample. Because MI and PC are not strongly correlated, these univariate plots give a good picture of the effect of the factors captured by these indexes on the Ultimatum Game behavior.

The Modelling of Fairness-Driven Behavior

- Even and uneven outcomes are observed. What drives these differences?
- Possible explanations
 - Bounded rationality.
 - Learning
 - Random errors
 - Non-selfish preferences.
 - A combination of these forces.
- More on this in the lectures on fairness theories and statistical game theory.