3. Bargaining experiments

- How do we implement bargaining in the lab?
- What are key results from these bargaining experiments?
- Do we see deviations from what is predicted by standard economics?

A bargaining game

- Two subjects have to divide a fixed bargaining cake c = 1 according to the following rules:
- **Move structure**
- Player 1 proposes a division (1-x, x), $0 \leq x \leq 1$.
- x is a multiple of $\varepsilon > 0$, the smallest money unit.
- Player 2 observes the proposal upon which she accepts or rejects.
- In case of acceptance the agreed upon division is implemented in period 1; in case of rejection she makes a counterproposal (1-y,y) at the beginning of period 2. y is a multiple of ε.
- Player 1 observes the counterproposal and accepts or rejects. This ends the game.

Payoffs

- If no agreement is reached both receive zero.
- In case of an agreement in period 1
  - player 1 receives $U = (1-x)$
  - player 2 gets $V = x$.
- In case of an agreement in period 2
  - player 1 receives $U = \delta(1-y)$
  - player 2 gets $V = \delta y$ with $0<\delta<1$.

Behavioral and informational 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 knows that the other player is rational and only motivated by money.
- A3: Player 1 knows that player 2 knows that player 1 is rational and only interested in money.

Predictions

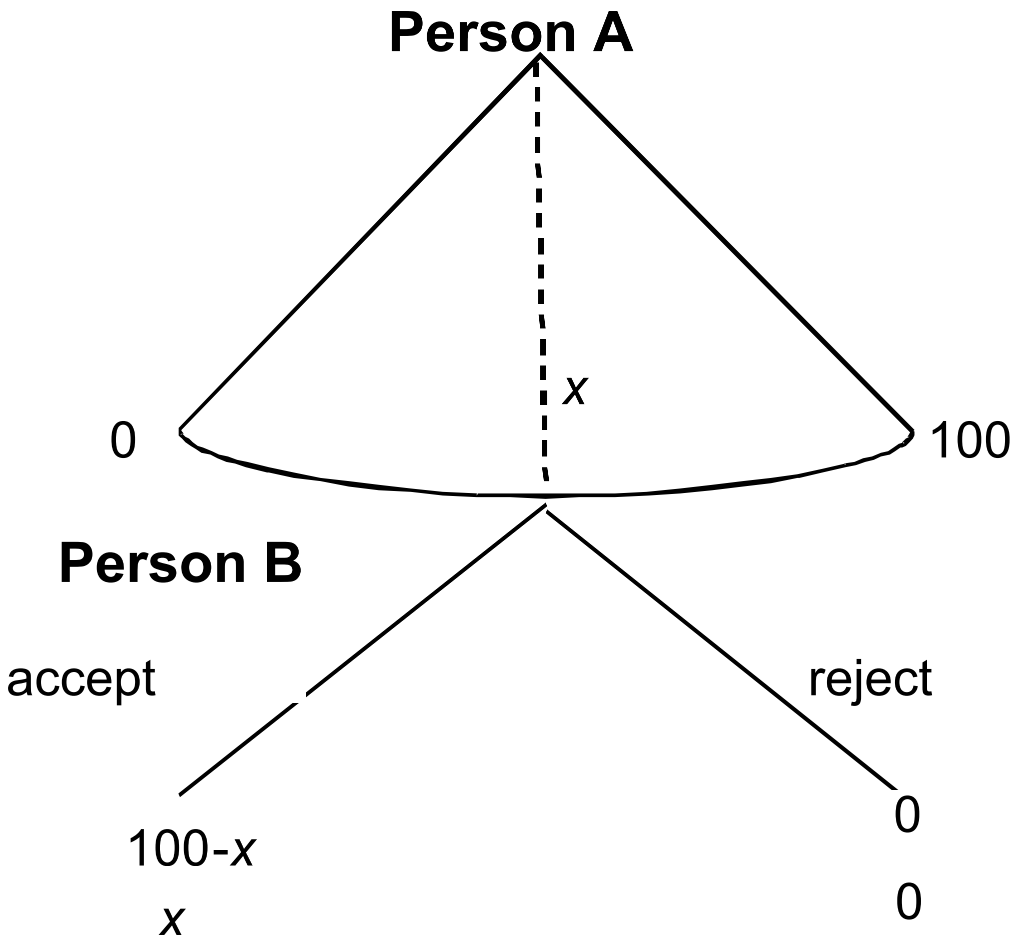
- In period 2 player 1 accepts any multiple of ε including ε itself.
- Player 2 therefore proposes (ε, 1-ε) which yields payoffs of $U = \delta\varepsilon$ and $V = \delta(1-\varepsilon)$.
- In period 1, player 2 will accept any $x > V = \delta(1-\varepsilon)$. Thus, player 1 proposes an x which is at most ε above $V = \delta(1-\varepsilon)$.

Example

- δ=.25, c = 100, ε=1.
  - Player 1 offers 25 at the first stage.
  - Player 2 accepts each offer larger than 24 at the first stage
  - The counteroffer on the second stage is at most 24.
  - Player 1 accepts any positive offer at the second stage

- Note: There are multiple equilibria, which differ only slighltly (one point)

The ultimatum game (Güth, Schmittberger and Schwarze, JEBO 1982)



Güth et al. results (JEBO 1982)

- Ultimatum game: $t = 1$ and c = DM 4 or DM 10, inexperienced subjects.
- All offers above DM 1.
- Modal $x = 0.5$ (7 of 21 cases).
- Mean $x = 0.37$

- A week later (experienced subjects)
- All except one offer above DM 1.
- 2/21 offer an equal split.
- Mean offer 0.32
- 5/21 of the offers are rejected.

- Systematic deviation from standard prediction

No! Standard theory does predict well… 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)

- $t = 2$, $\delta = 0.25$, $c = 100$ pence, $\varepsilon = 1$.
- Prediction for period 2 (if reached): $y = 24$ pence which is accepted.
- Prediction for period 1: $x = 25$ pence which is accepted.
- The game was played twice. In the second game the first-game- responders played the role of proposers.
- Actually there were no responders in the second game but the proposers did not know this.
- How does the experience of being a responder affect proposal behavior?

Results

- Modal offer in the first game 50 pence and 15 percent of the offers are rejected.
- Modal offer in the second game 25 pence!! Standard theory seems to be saved.
- **But…**
- 1. Problem: „How do we want you to play? YOU WILL BE DOING US A FAVOUR IF YOU SIMPLY MAXIMISED YOUR WINNINGS“ (Emphasis and all caps in the original) (quoted after: Thaler, JEP 1988)
- 2. Problem: Compared to the simple ultimatum game equilibrium play is now less unfair. Do subjects play the equilibrium for this reason?
- 3. Problem: Role reversal makes game more fair.

Reply of Güth und Tietz (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.“

- Two periods (t = 2),
- δ=.1 => predicted (90%, 10%)
- δ=.9 => predicted (10%, 90%)
- c = 5 DM, 15 DM, 35 DM.

Results

- Games with $\delta = 0.1$: In the first trial the mean x was 0.24, in the second trial (with reversed roles and different opponents) the mean x was 0.33.
- Games with $\delta = 0.9$: In the first trial the mean x was 0.3, in the second trial the mean x was 0.41.
- Conclusion: Both the first and the second trial results are far from the predicted equilibrium. Twice experienced players do not move towards the predicted equilibrium but in the direction of the equal split.

➢ Very different to what is predicted

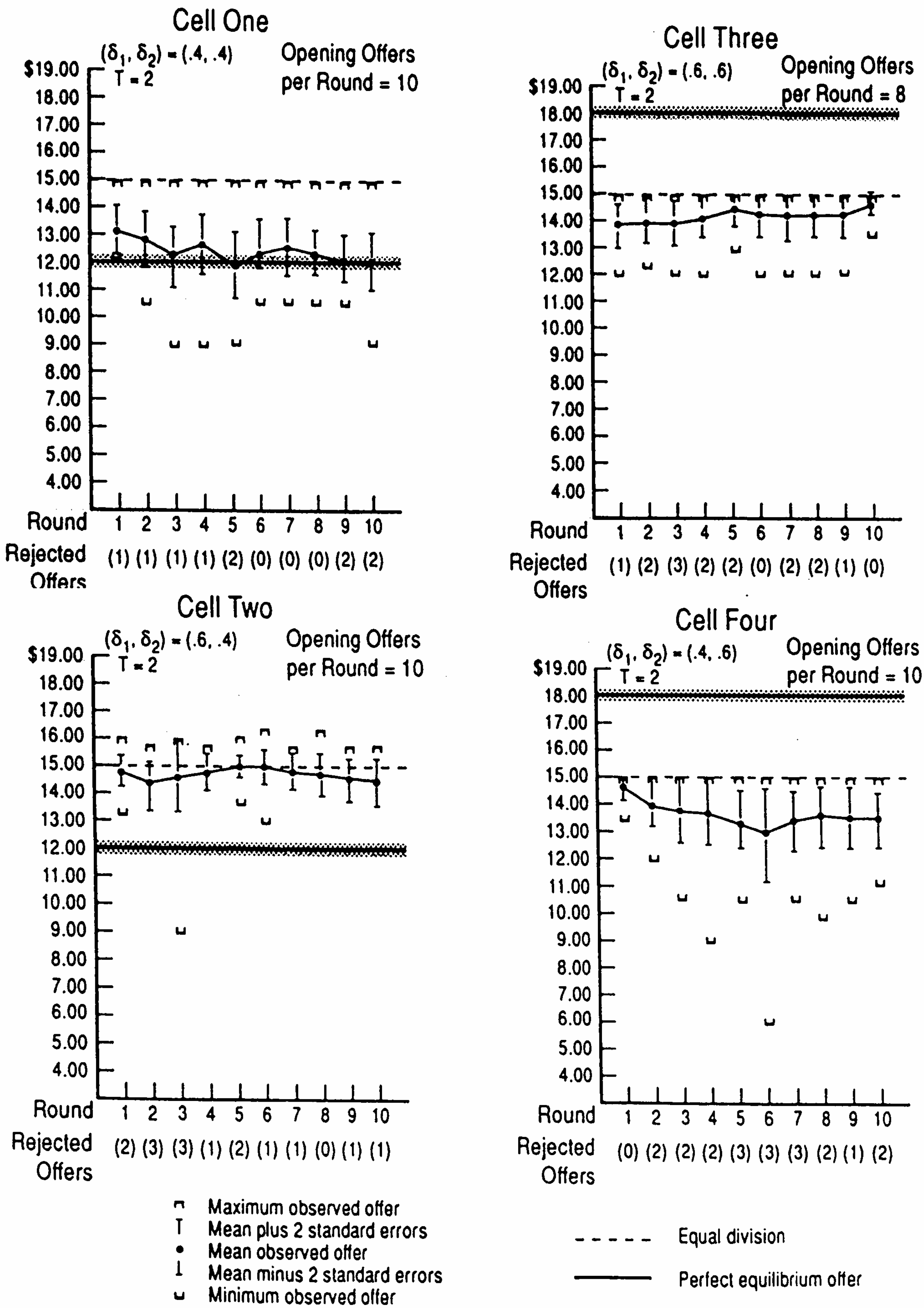
"Our main result is that contrary to Binmore, Shaked and Sutton .... The game theoretic solution has nearly no predictive power."

Ochs and Roth (1989)

- They test some comparative statics
- We only concentrate on their two-period games.
- Each cell is played for 10 rounds with different opponents.
- No role reversals. Round that is decisive for payments is randomly selected at the end.
- c = $ 30. Discount factors are varied independently.
- Notice: $\delta 1$ is irrelevant for the prediction

Results

- **Cell 1:** $\delta 1 = 0.4$, $\delta 2 = 0.4$, prediction: $x \cong 0.4 \times \$30$ („close“ to what is observed in previous experiments).
- **Result 1:** x converges to the game theoretic prediction (see Figure 4.2.a)
- **Cell 2:** $\delta 1 = 0.6$, $\delta 1 = 0.4$, prediction as in cell 1 but psychologically player 1 is now “stronger” because he looses less in case that he receives something positive in $t = 2$.
- **Result 2:** In all periods the hypothesis that $x = 0.5$ cannot be rejected
- **Cell 3:** $\delta 1 = 0.6$, $\delta 2 = 0.6$, prediction: $x \cong 0.6 \times \$30$ (gives player 2 more than the equal split).
- **Results 3:** Except for the last period the hypothesis that $x = 0.5$ can be rejected (see Fig. 4.2b)
- **Cell 4:** $\delta 1 = 0.\ 4$, $\delta 1 = 0.6$, prediction as in cell 3 but psychologically player 1 is now “weaker” relative to cell 3 because he looses more in case of rejection.
- **Result 4:** x is in general even lower than in result 3 although the difference is probably not significant (see Fig. 4.2b).



Opening offers to Player 2. *Source:* Ochs and Roth 198?.

Disadvantageous responses

- In case player 2 made a counter offer he often asked for less money than player 1 had offered
- Similar as rejections in the ultimatum game

study	Number of obs.	First offer rejections in %	Disadvantegous responses 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

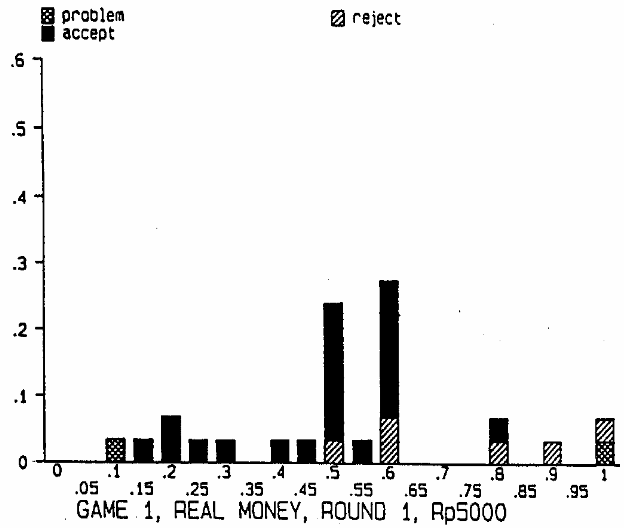
- Preferences cannot be controled
- Relative income is relevant
- There is incomplete information about the opponent’s type
  - o offers are made under this incomplete information condition
  - o this explains the large number of rejections

- We come back to this interpretation when we talk about fairness and reciprocity

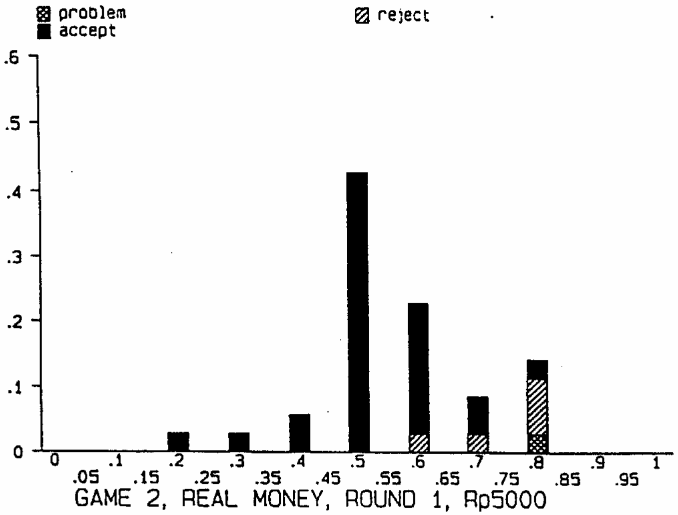
Do higher stakes lead to more equilibrium play?

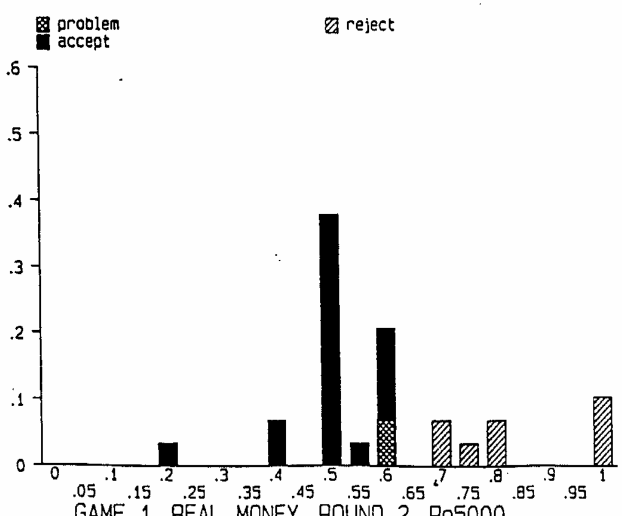
- Hoffman, McCabe, Smith (1996): UG with 10$ and 100$
  - Offers are not determined by the size of the cake.
  - Rejections up to 30$
- Cameron (1995): UG in Indonesia 2.5$, 20$, 100$ (GDP/Person = 670$)
  - The higher the stakes the more offers apporach 50/50.
  - Rejection behavior independent of stakes.
  - Without payments we see differences: less generous offers and more rejections.

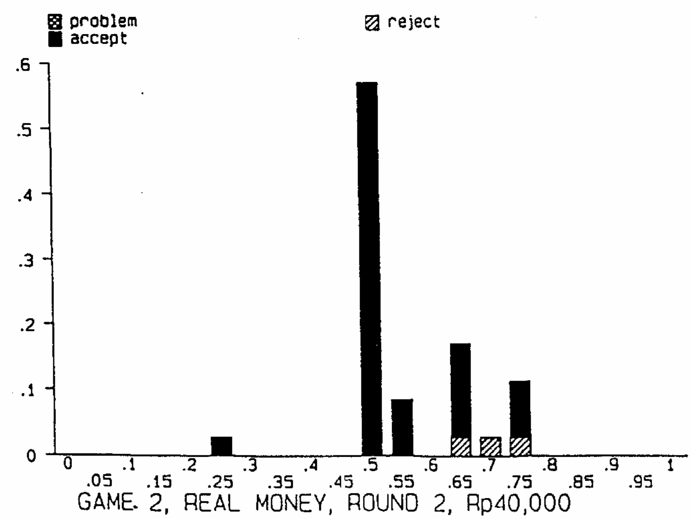
GRAPH 1



GRAPH 2

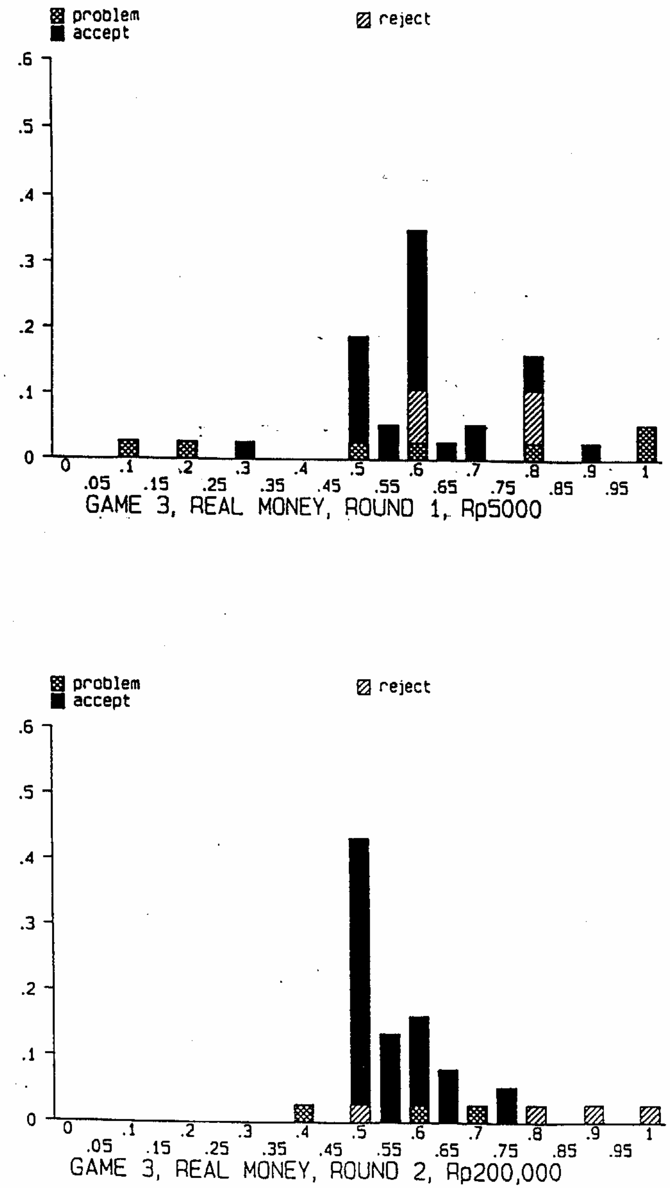




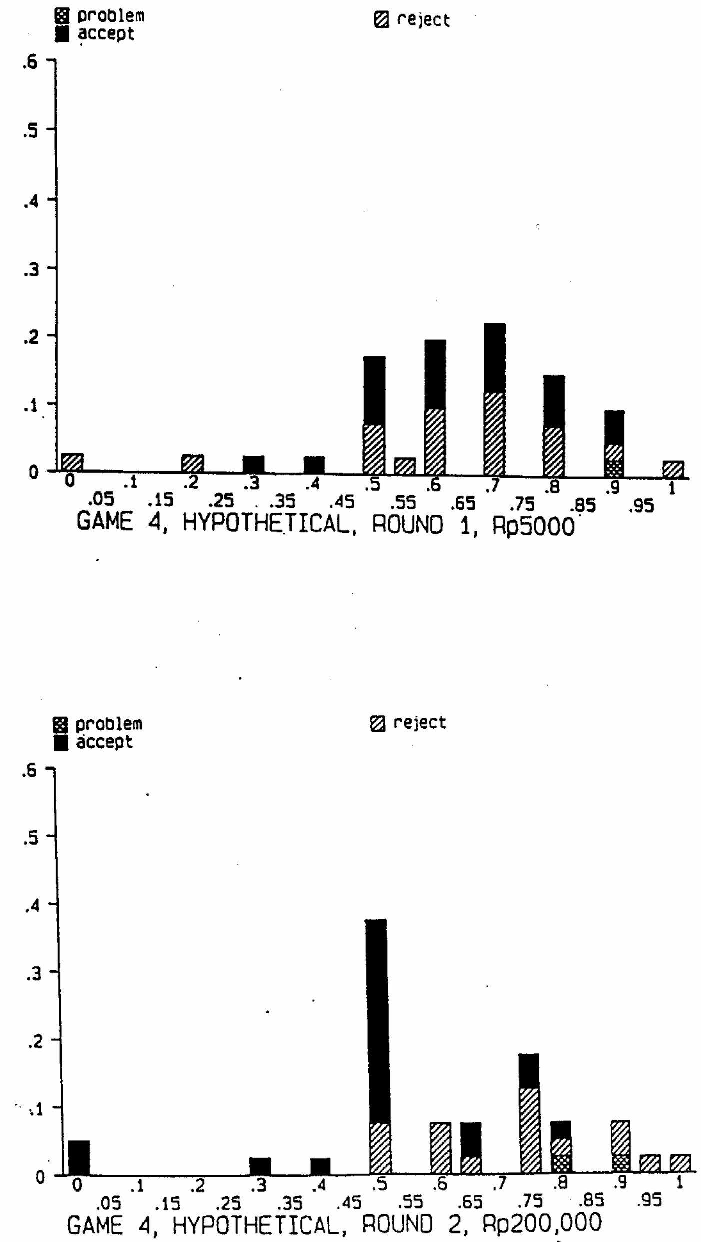


Source: Cameron (1995)

GRAPH 3



GRAPH 4



Source: Cameron (1995)

Ultimatum game results (1)

Percentage of offers below 0.2 and between 0.4 and 0.5 in the Ultimatum Game

Study (Payment method)	Number of observati ons	Stake Size (Country)	Percent age of offers with $s < 0.2$	Percentage of offers with $0.4 \leq s \leq 0.5$
Cameron [1995] (all Ss paid)	35	Rp 40.000 (Indonesia)	0	66
Cameron [1995] (all Ss paid)	37	Rp 200.000 (Indonesia)	5	57
FHSS [1994] (all Ss paid)	67	\$5 and \$10 (USA)	0	82
Güth et al. [1982] (all Ss paid)	79	DM 4 - 10 (Germany)	8	61
Hoffman, McCabe and Smith [1996] (all Ss paid)	24	\$10 (USA)	0	83

Ultimatum game results (2)

Hoffman, McCabe and Smith [1996] (all Ss paid)	27	$ 100 (USA)	4	74
Kahneman, Knetsch and Thaler [1986) (20 % of Ss paid)	115	$10 (USA)	?	75[a]
Roth et al. [1991] (random payment method)	116[b]	approx. $10 (USA, Slovenia, Israel, Japan)	3	70
Slonim & Roth [1997] (random payment method)	240[c]	SK 60 (Slovakia)	0.4[d]	75
Slonim & Roth [1997] (random payment method)	250[c]	SK 1500 (Slovakia)	8[d]	69
Aggregate result of all studies[e]	875		3.8	71

a: percentage of equal splits, b: only observations of the final period, c: observations of all 10 periods, d: percentage of offers below 0.25, e: without Kahneman, Knetsch and Thaler [1986].

Does altruism explain the high first mover offers?

- **Forsythe et al. (GEB 1994)** compare simple ultimatum games with dictator games. In the latter, the proposer proposes a division (1-x, x) of the bargaining cake, which is then implemented.
- **Result 1:**
  - o In the dictator game the distribution of x shifts significantly towards x = 0 relative to the ultimatum game **if real money is at stake** (modal offer is x = 0).
  - o If only hypothetical questions are asked no such shift can be observed.
- **Result 2:**
  - o Even with real pay there is a concentration of offers around the equal split (see Fig. 4.4)
- **Conclusion:** Some of the subjects seem to be motivated by altruism but the higher concentration of offers around the equal split in the ultimatum game suggests that behavior cannot be fully attributed to altruism.

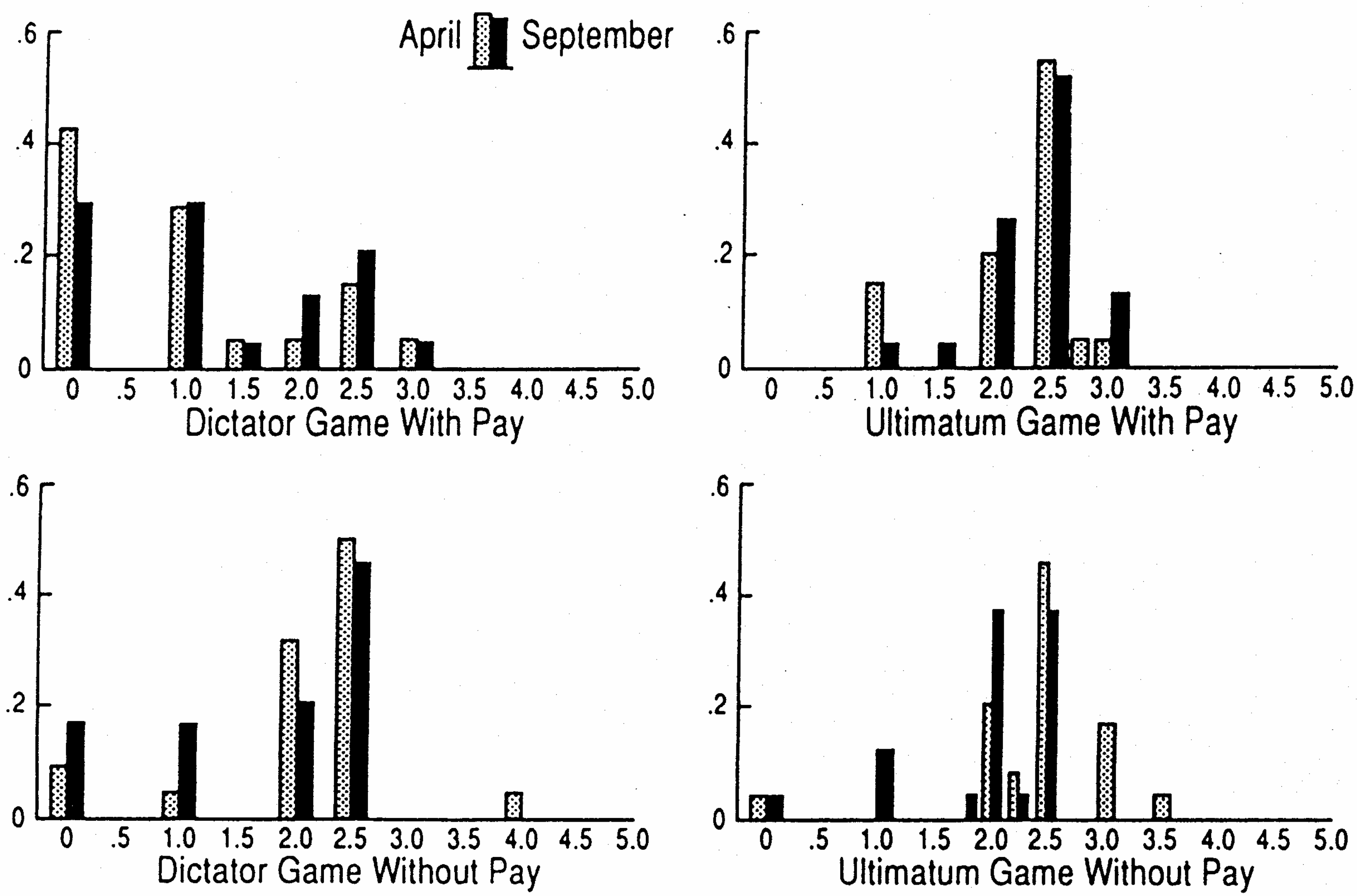


Figure 4.4. Offers in dictator and ultimatum games. *Source:* Forsythe, Horowitz, Savin, and Sefton 1994.

Single blind vs. double blind

(Hoffman, McCabe and Smith (GEB 1995)

- Conjecture that experimenters exert a kind of social control merely by being able to observe subjects' actions.
- They report that if it is ensured that subjects know that the **experimenter cannot observe individual decisions** approximately **70 percent** of the subjects in the dictator game **give nothing** and almost no offers above 0.3 can be observed.

- Has probably no relevance for the ultimatum game
- And: does such an environment itself lead to some sort of experimenter effect?

Punishment versus Anonymity
Bolton and Zwick (GEB 1995)

- Comparison of one-period ultimatum games with and without subject-experimenter anonymity (but always subject-subject anonymity).
- Comparison of one-period ultimatum game with the impunity game which has the same move structure as the ultimatum game but the same incentive structure as the dictator game. In the impunity game only subject-subject anonymity prevailed.
- Impunity Game: Player 1 proposes a division (1-x, x)
- Player 2 accepts or rejects. In case of rejection player 2 gets nothing while player 1 still gets 1-x.
- Punishment option is removed.

Impunity game (2)

- Punishment hypothesis: First movers in the ultimatum game choose “high” offers because of the fear of rejection.
  - o Prediction: Lower offers in the impunity game compared to the ultimatum game.
- Anonymity hypothesis: First movers in the ultimatum game do not want to be judged by the experimenter to be greedy and selfish.
  - o Prediction: With subject-experimenter anonymity there are significantly lower offers than without subject-experimenter anonymity in the ultimatum game.

Impunity game (3)

- Results
- Punishment confirmed - Anonymity rejected
- In the ultimatum game offers in the first five periods are slightly lower under anonymity, in the second five periods they are slightly higher. In general offers are similar to other non anonymous ultimatum games.
- In the impunity game 100 percent of all offers in the last five rounds are equilibrium offers.

Do subjects accept unfair offers? The best shot game

- Best Shot Game (Harrison, Hirshleifer, JPE 1989)
  - o player 1 chooses contribution q_1 for a public good
  - o player 2 chooses contribution q_2 for a public good
  - o Total contribution to public good is $\max(q_1,q_2)$
  - o Costs are linear in contribution
  - o Revenue is concave in contribution

Payoffs in the Best Shot Game

Number of units to PG	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	...	...	...	...

Predictions

- If q1=0 player 2 chooses q2 =4. Payoffs (3.7, 0.42)
- If q1=1 player 2 chooses q2 =0. Payoffs (.18, 1)
- If q1=2 player 2 chooses q2 =0. Payoffs (.31, 1.95)
- If q1=3 player 2 chooses q2 =0. Payoffs (.39, 2.85)
- If q1=4 player 2 chooses q2 =0. Payoffs (.42, 3.7)
- Player 1 chooses q1=0

    - (If player 2 answers with contributing 0 as well, both would earn zero).

Result

- Harrison, Hirshleifer play the game with private information about payoffs.
  - o Convergence to subgame perfect Nash Equilibrium
- Prasnikar Roth (QJE 1992),
  - o Best Shot Spiel with public information
  - o They also find convergence to the SPNE
  - o This is surprising since it implies unequal payoffs

  - o Intuition: Intentions (see discussion about fairness models)

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: $q_1 = 0$.

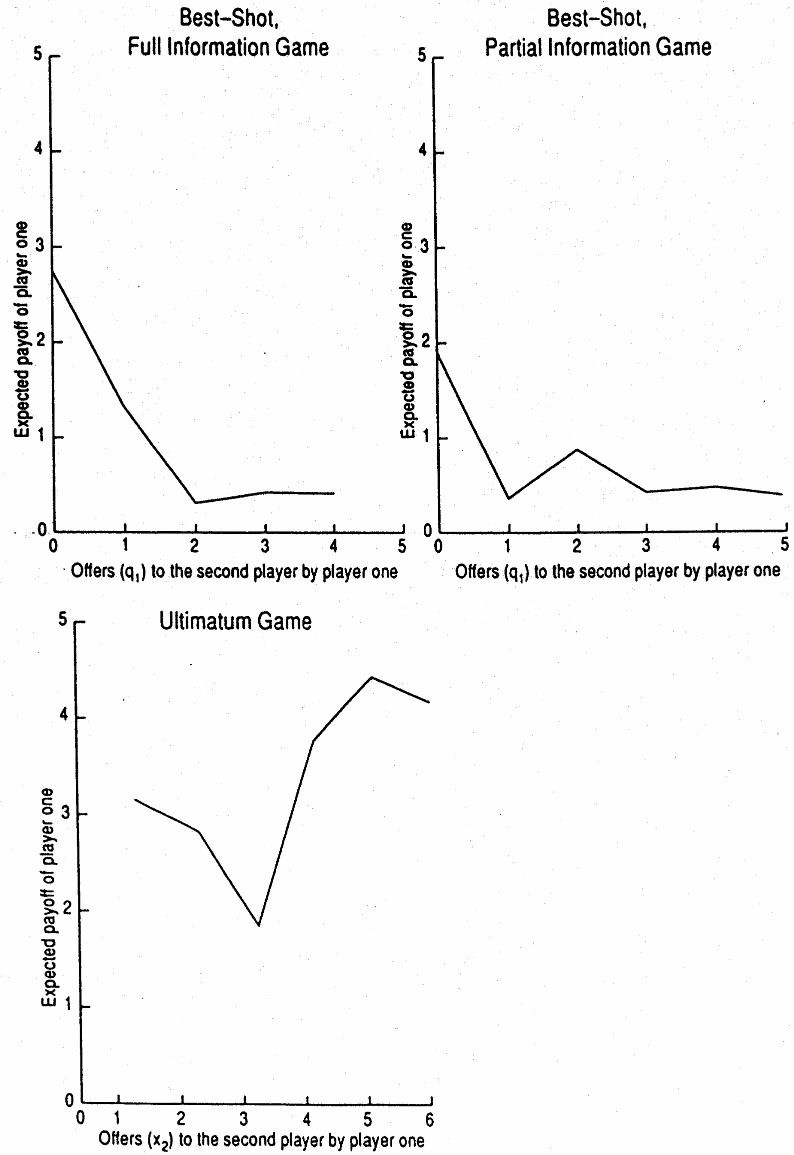


Figure 4.6. Expected payoff of each offer. *Source:* Prasnikar and Roth 1992.

Multi-Proposer-Ultimatum game
(Prasnikar and Roth QJE 1992)

- 9 proposers simultaneously make an offer between 0 and 10 to one responder.
- Responder decides to accept or reject the best offer x_b
- In case of rejection all ten players get zero. In case of acceptance responder receives x_b.
- The proposer whose proposal has been accepted receives 10 - x_b. All others receive zero.
- Prediction (based on smallest offer = 0.05)
  - o Responder accepts any $x_b > 0$.
  - o Any proposal strictly below 9.95 cannot be an equilibrium because by bidding up 5 cents a proposer can increase his payoff.
  - o 9.95 and 10 are equilibrium proposals.

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.

Result

- High offers from the very beginning (mean offer 8.9$)
    - o Competition plays an important role right from the beginning
- Quick convergence to the equilibrium

- How can this result be reconciled with the fact that in bilateral ultimatum bargaining subjects refuse unfair payoff allocations? (see fairness models)

Does culture matter?
(Roth et al. 1991)

- Single-Proposer and Multi-Proposer Ultimatum Games in Tokyo, Ljubljana, Jerusalem and Pittsburgh (Roth et al. AER 1991).
- Experimenter has to control for
  - o Experimenter effects (use same experimenters)
  - o Language effects (use double translation)
  - o Currency effects due to prominent numbers (use experimental currency)
  - o Stakes effects (monetary earnings should have the same real purchasing power)
  - o Subject pool effects (use subjects with identical observable characteristics, socio-economic status questionnaire)

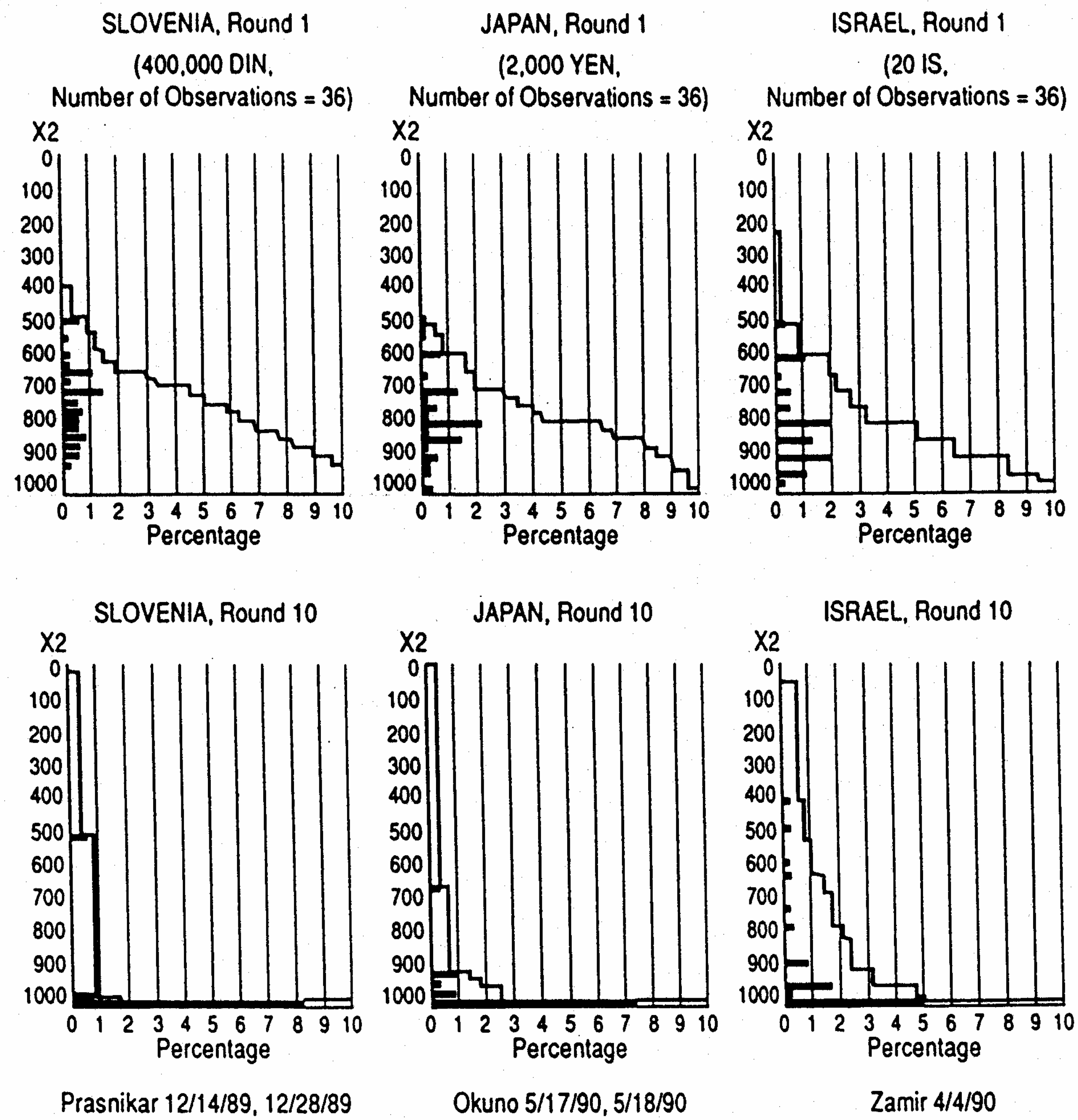


Figure 4.7a. Distribution of market offers in Slovenia, Japan, and Israel. *Source:* Roth, Prasnikar, Okuno-Fujiwara, and Zamir 1991.

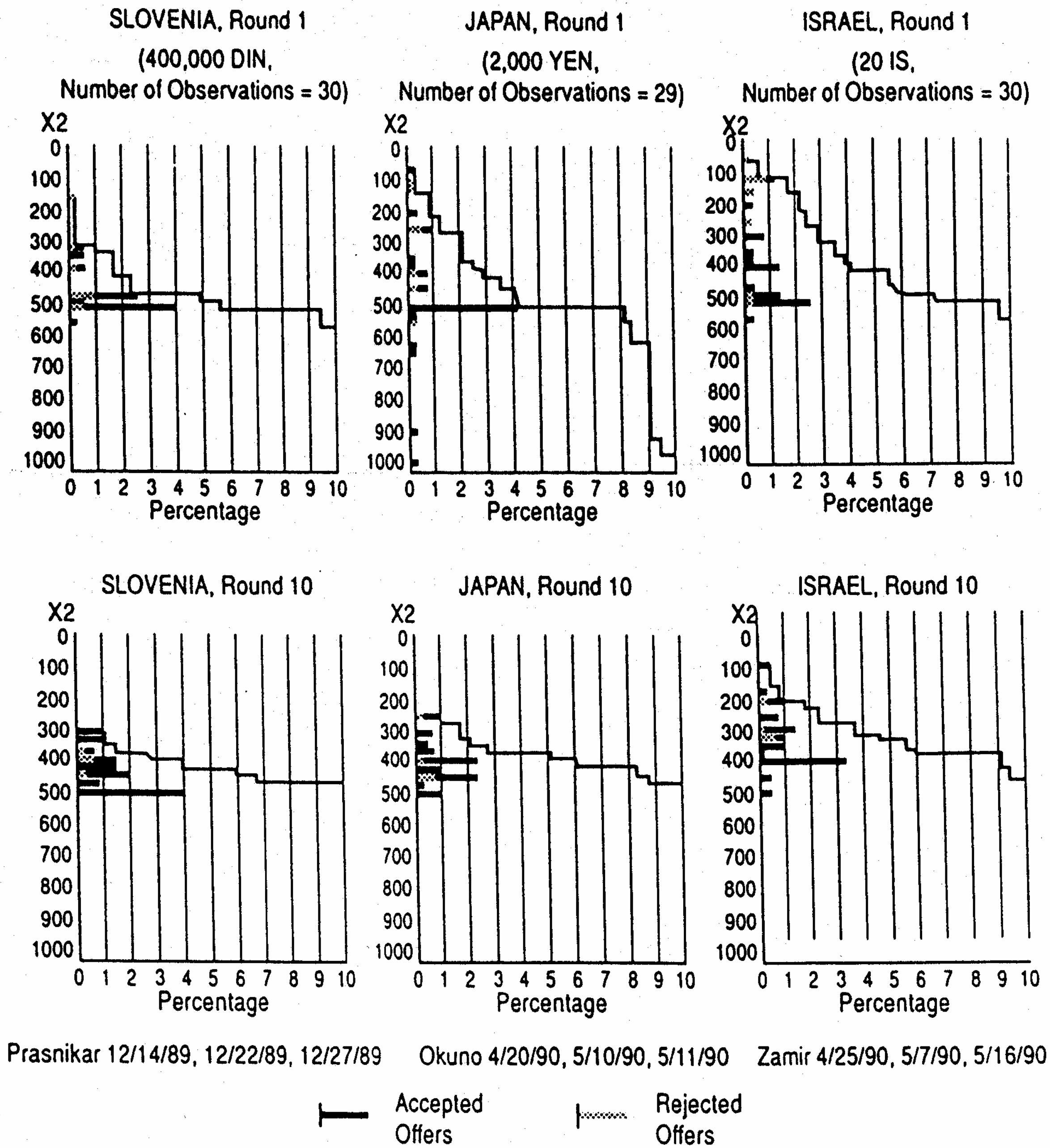


Figure 4.7b. Distribution of bargaining offers in Slovenia, Japan, and Israel. *Source:* Roth, Prasnikar, Okuno-Fujiwara, and Zamir 1991.

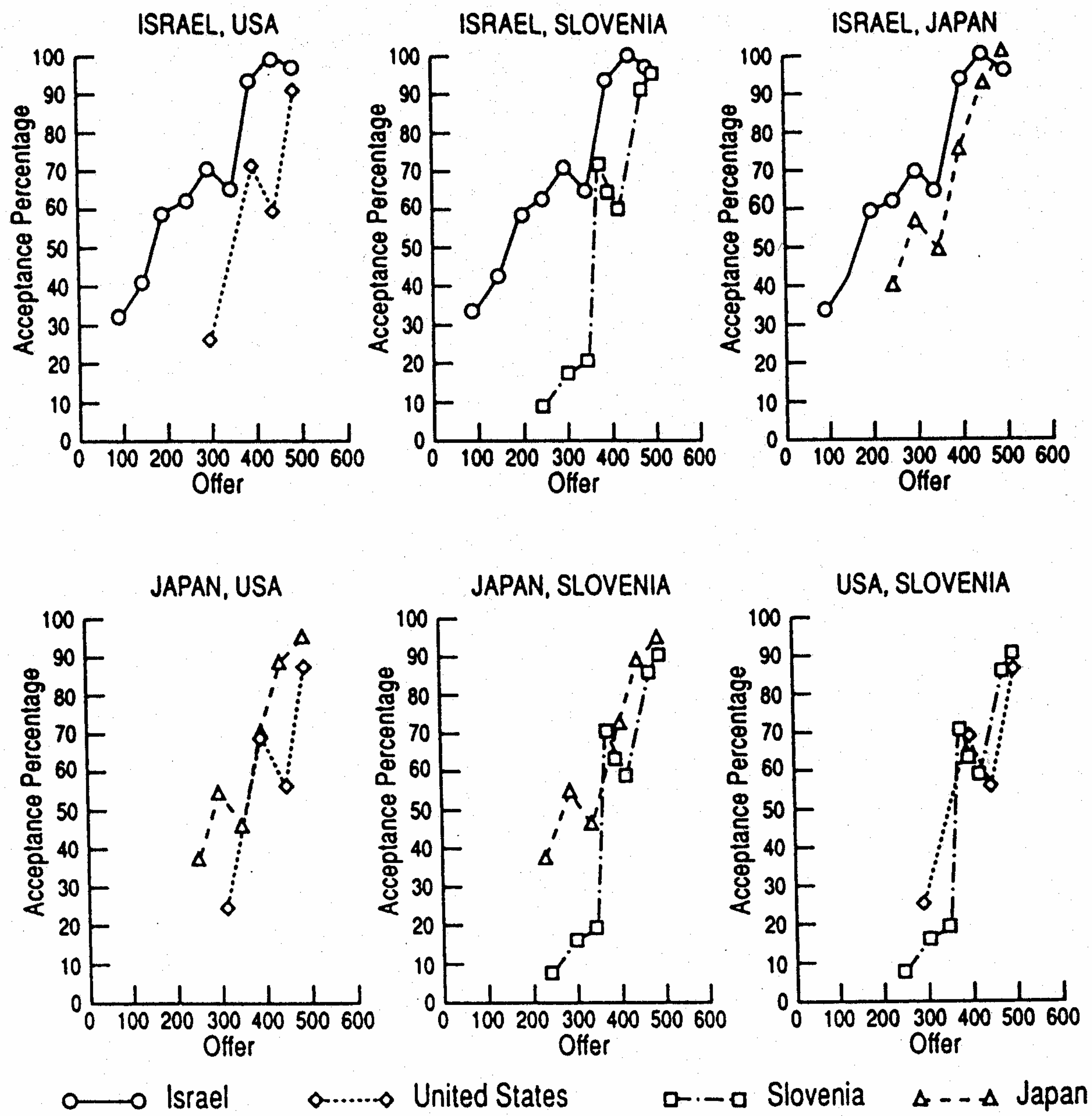


Figure 4.7c. Pairwise comparisons of acceptance rates in bargaining. *Source:* Roth, Prasnikar, Okuno-Fujiwara, and Zamir 1991.

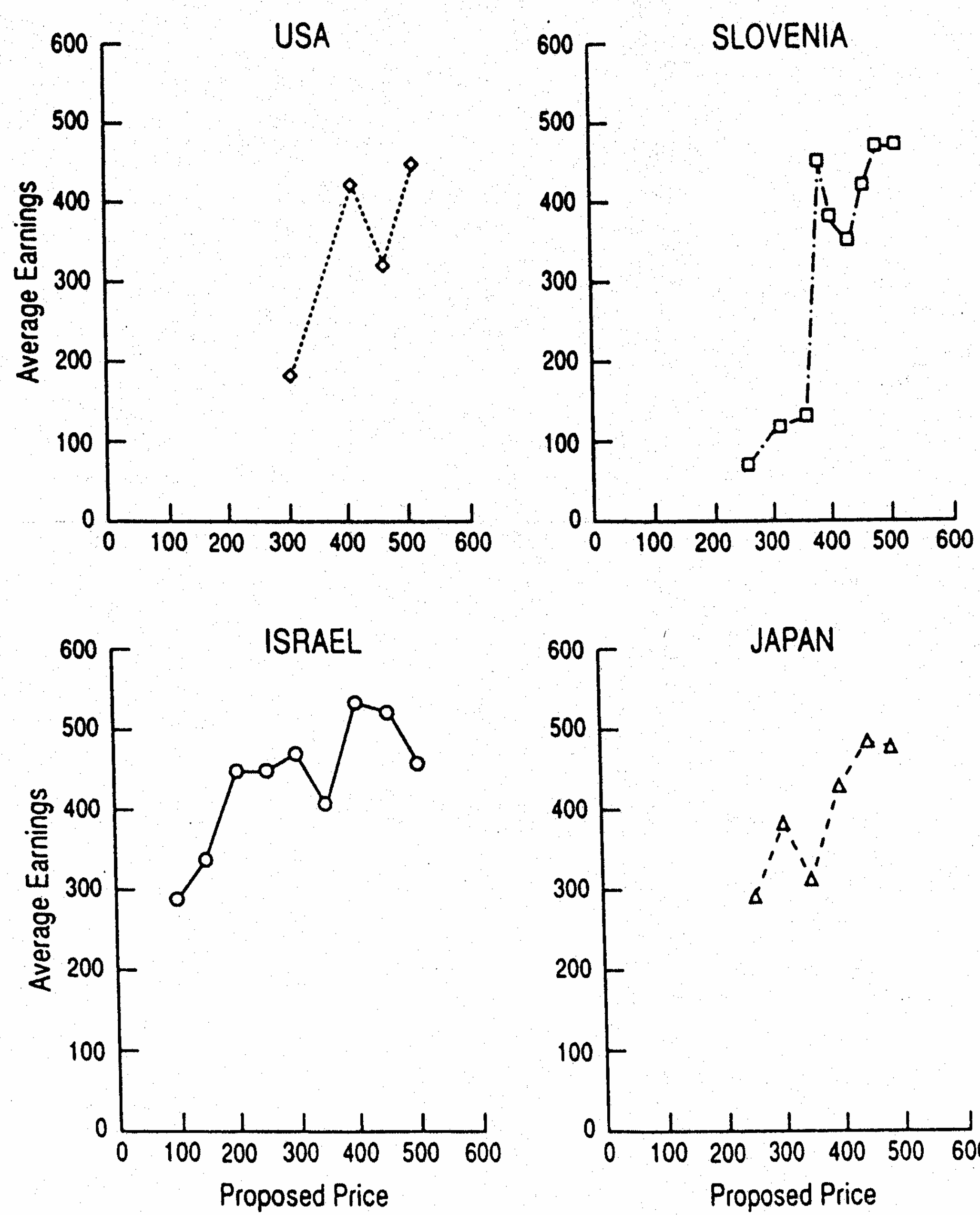


Figure 4.7d. Buyers' earnings in bargaining, by Proposed Price. *Source:* Roth, Prasnikar, Okuno-Fujiwara, and Zamir 1991.

Results

- No big differences in the proposer competition
- UG: in all cultures clear deviations from the subgame perfect equilibrium
  - In period 1 there are differences in market outcomes across countries. But in all four countries markets converge to the SPE.
  - In period 1 the modal offer in the ultimatum game is 500 units of experimental currency in all four countries.
  - In period 10 in each country offers are far from equilibrium. But there are inter-country differences. Modal offer in US and Slovenia still 500. In Japan modal offer is 400 and 450 while in Israel it is 400.
  - For any given price offer between 0 and 600 Israel has the highest acceptance rates. Japan has higher acceptance rates than the US and Slovenia. This explains that Israel has the lowest and Japan the second lowest offers.

UG in "primitive societies"
(Henrich, Boyd, Bowles, Camerer, Fehr, Gintis, McElreath AER 2002)

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