# Bargaining
# 議價談判

Joseph Tao-yi Wang (王道一)

Lecture 6, EE-BGT

# Bargaining 議價談判

- Bargaining (就是「討價還價」！)
  - Process by which economic agents agree on the terms of a deal (個體間討論條件、達成交易的過程)
- Common even in competitive markets
  - The pit market in NYSE/market experiments (即使在完全競爭市場也很常見，例如紐約股市的交易坑市場)
  - Edgeworth Box (原本是用來研究談判！) was created to show range of possible bargaining outcomes
- Have you ever bargained with someone?
  - 你有跟別人談判過嗎？

# Bargaining 議價談判

- Nash (1950, 1951):
  - (Cooperative) Nash Bargaining Solution (奈許談判解)
  - (Non-cooperative) Nash Equilibrium (奈許均衡)
- Nash could have won two Nobels...
- Nash Program: Is NBS the NE/SPE of a particular game? (奈許問：NBS是否為某賽局的NE/SPE?)
  - Yes: Binmore, Rubinstein and Wolinsky (1986)
- References (參考章節):
  - BGT, Ch. 4, HEE, Ch. 4, *MGS,* Ch. 23

# 2 Bargaining Experiments 兩種談判實驗

- Cooperative NBS vs. Non-cooperative NE
  - 對應合作賽局NBS和非合作賽局NE，也有兩種談判實驗:

1. Unstructured Bargaining Experiments
   - Free form procedure determined by players
   - Closer to naturally occurring bargaining
   - 自由談判實驗：雙方自行決定談判形式過程，較接近實務上談判
2. Structured Bargaining Experiments
   - Procedure specified by experimenter
   - Game theory makes specific predictions
   - 制式談判實驗：形式過程由實驗者決定，賽局論能做出明確預測

# Negotiation Research 協商談判研究

## 3. Negotiation Research in applied psychology

- See review of Bazerman et al. (2000)

- **Bazerman, Magliozzi and Neale (1985)**
  - Negotiate over several issues (ex: price/quantity)
  - Free form communication with fixed deadline
  - Private point schedule (dep. on each issue)
  - 應用心理學研究：雙方各自知道自己的報酬計分方式，在一定時限自由溝通討論，最後須在價格數量等多層面(連續或類別)上達成協議

- **Results:** Deals not Pareto-efficient
  - Affected by systematic heuristics and other cognitive variables (unrelated to game)
  - 結果：達成的協議不都有效率且受到無關的經驗法則與認知因素影響

# Negotiation Research 協商談判研究

- Why not much overlap? (為何沒有交集？)
  - Game theory assumes too much rationality
  - Solvable games are too simplified
  - Hard to apply to Negotiation games
  - 賽局論假設完全理性，解得出來賽局又太簡單，很難用在協商研究
- Like 2 traditions of experimental economics
  - Game experiments are too simplified
  - Hard to apply to market experiments
  - 正如賽局論實驗太過簡單，很難用賽局論來預測市場實驗的結果
- But the research questions are the same!
  - 但是兩者的研究問題是一樣的!

# Unstructured Bargaining 自由談判

- Test: Nash Bargaining Solution (NBS)
  - The point maximizing the product of utility gains (beyond the disagreement point)
  - 奈許談判解(NBS):與談判破裂相較讓雙方效用增加量的乘積最大的解
- Only point satisfying 4 axioms:
  1. Pareto Optimality (效率性、不受額外無關選項影響)
  2. Symmetry (對稱、不受效用平移伸縮影響)
  3. Independence of Irrelevant Alternatives (IIA)
  4. Independence from affine utility transformation

# Nash Bargaining Solution (NBS)

$$S^* = \arg \max_{(x_1,x_2)\in S} (x_1 - d_1)(x_2 - d_2)$$

$$= \arg \max_{(x_1,x_2)\in S} [u_1(x_1) - u_1(d_1)][u_2(x_2) - u_2(d_2)]$$

Satisfies:

1. Pareto Optimality (效率性): $\forall x \in S^*, \nexists y \in S, y > x$
   $\Leftrightarrow y_i \geq x_i \forall i, y_j > x_j$
2. Symmetry (對稱):
   $$d_1 = d_2, (x_1, x_2) \in S^* \Rightarrow (x_2, x_1) \in S^*$$
3. IIA (Independence of Irrelevant Alternatives; 不受額外無關選項影響)
   $S^*$ solves $(T, d)$ if $S^*$ solves $(S, d)$ and $S \subset T$
4. IAT (Independence from affine utility transformation, 不受效用平移伸縮影響): $u_1(x) = Ax + B, u_2(x) = Cx + D$

# Unstructured Bargaining 自由談判

- Roth and Malouf (Psych Rev 1979)
- Player bargain over 100 lottery tickets
  - Risk neutral if can reduce compound lottery
  - 雙方談判如何分配100張彩券(每張 = 1%機率贏得獎金)。用彩券可讓人風險中立地決策(假設人們會把複合機率簡化成單一機率)
- 1 ticket = 1% chance winning a big prize
- Equal ($1) vs. Unequal Prize ($1.25/$3.75)
- Full vs. Partial (know own prize) Info.
- NBS: 50-50 split (NBS預測：50-50 對分)
  - 2x2實驗設計:獎金相同/不同，資訊透明/不透明

# Unstructured Bargaining 自由談判

| Inform-ation | Money Prizes | # of Tickets for Player 2 | | | | | | | % of Dis-agreement |
|---|---|---|---|---|---|---|---|---|---|
| | | 20 | 25 | 30 | 35 | 40 | 45 | 50 | |
| Full Info. | 1/1 | 0 | 0 | 1 | 0 | 1 | 0 | 20 | 0% |
| | 1.25/3.75 | 1 | 6 | 3 | 2 | 2 | 1 | 4 | 14% |
| Part. Info. | 1/1 | 0 | 0 | 0 | 0 | 0 | 1 | 14 | 6% |
| | 1.25/3.75 | 0 | 0 | 0 | 0 | 0 | 3 | 13 | 0% |

# Unstructured Bargaining 自由談判

- Results: Agreements cluster at 50-50
  - Rare Disagreement (很少未達成協議，大部分 50-50 對分)
  - 14% Disagree when both know inequality
  - Divide tickets or $$$ payoffs equally
  - Sensitive to $$$ payoffs
  - Violate IAT (indep. of affine transformation)
  - 雙方清楚知道獎金不平等時，有14%未達成協議(彩券 vs. 金錢平分)
  - 結果受金錢多寡影響，違反「不受效用平移伸縮影響」公設
- "Rawlsian" Bargaining Solution explains this
  - Followup: Roth & Murnighan (ECMA 1982)

# "Rawlsian" Bargaining Solution

$$S^* = \arg \max_{(x_1,x_2)\in S} (x_1 - d_1)(x_2 - d_2)$$

$$= \arg \max_{(x_1,x_2)\in S} [u_1(x_1) - u_1(d_1)][u_2(x_2) - u_2(d_2)]$$

Satisfies:

1. Pareto Optimality (效率性): $\forall x \in S^*, \nexists y \in S, y > x$
2. Symmetry $(d_1 = d_2, (x_1, x_2) \in S^* \Rightarrow (x_2, x_1) \in S^*$
3. IIA ($S^*$ solves $(T, d)$ if $S^*$ solves $(S, d)$ and $S \subset T$)
4. Independence of utility transformation preserving preference order & which player has larger gain

$$x_1 - d_1 \geq x_2 - d_2 \Leftrightarrow u_i(x_1 - d_1) \geq u_i(x_2 - d_2)$$

$$x_i \geq y_i \Leftrightarrow u_i(x_i) \geq u_i(y_i)$$

# Unstructured Bargaining 自由談判

- Review earlier studies to find: (回顧先前實驗發現)
  - Murnighan, Roth & Schoumaker (JRU 1988)
- Pairs settle @ final minutes (of 9-12 min)
  - Convey private info (Stubbornness/Delay Cost)?
  - 最後幾分鐘才達成協議 (用以表示自己很堅持/可以負擔延遲成本?)
- Follow-up: Roth & Schoumaker (AER 1983)
  - First play against computer that gives you a lot
- Expect & get this from later human players
  - Strong Reputation (如果有人先跟軟弱的電腦談判、被訓練覺得自己該拿比較多，接下來面對真人態度也會較強硬、並且真的拿比較多)

# Unstructured Bargaining 自由談判

- Mehta, Starmer and Sugden (bk chp. 1992)
- Nash Demand Game (奈許需求實驗): 2 Players
  - Each state demand (兩人分別列出自己的需求金額)
  - Get their demand If sum <= £10, 0 otherwise.
  - 如果總和 <= 10英鎊就會得到所求，不然都得0
- Focal point: Players split 4 Aces + 4 deuces
  - Before bargain, players were told: "4 aces worth £10 together, so to earn $$ you have to pool your aces and agree on how to divide the £10."
    (兩人抽八張牌，其中四張A、四張2)

# Unstructured Bargaining 自由談判

- **Results:** 被告知四張A合起來值十英鎊，因此要賺錢就得把四張A合起來並同意如何平分十英鎊。實驗結果居然受此敘述(與報酬無關)影響!!

- **Aces split 2-2:**
  - Agree 50-50 Split
    (各兩張A就對分)

- **Aces 1-3:** (一張/三張)
  - Half 50-50, (一半對分)
  - Half 25-75;
  - 22% disagree
    (另一半要求25-75，22%爆掉)

| Demand | 1A | 2A | 3A |
|---|---|---|---|
| £2.50 | 11 | 0 | 0 |
| £3.00-4.50 | 5 | 1 | 1 |
| £5.00 | 16 | 40 | 17 |
| £5.50-7.00 | 0 | 1 | 11 |
| £7.50 | 0 | 0 | 4 |
| N | 32 | 42 | 33 |

# Can BGT Explain This? 行為賽局論解釋?

- Roth (1985) explains as Coordination Game
- Two sides simultaneously propose to split tickets either 50-50 or $h$-(100-$h$)
  - 可用協調賽局解釋: 雙方同時提議分配為 50-50 或 $h$-$(100-h)$
- MSE:

$$p_1 = \frac{h-50}{150-h} \quad p_2 = \frac{h-50}{h+50}$$

- Disagreement rates $=$

$$\frac{(h-50)^2}{(150-h)(50+h)}$$

# Can BGT Explain This? 行為賽局論解釋?

- Roth (bk chp 1985)
- Disagreement rates $= \dfrac{(h-50)^2}{(150-h)(50+h)}$
- Predicted to be 0% → 7% → 10%
  - For $h = 50, 75, 80$ in pervious experiments
- Data: 7% → 18% → 25% (Direction is right!)
- Murnighan et al. (JRU 1988)
  - $h = 60, 70, 80, 90$ predict 1%, 4%, 10%, 19%
- Actual data not as good: Constant across $h$

# Can BGT Explain This? 行為賽局論解釋?

- Cause of Disagreement: Self-Serving Bias
  - "What is better for me" = "Fair"
  - 自利偏誤(對我自己有利的才叫公平): 加進上述協調賽局可解釋實驗結果
- Add this to the above coordination game
  - Can explain higher disagreement rate in data
- Same in Kagel, Kim and Moser (GEB 1996):
  - Ultimatum over 100 tickets (P/R value differently)
  - 用最後通牒談判分配100張(對兩人價值不同的)彩券
- P private value higher/lower →Propose 45%/30%
  - 對方不知道價值時提議者會在己方價值高(低)時提議55-45(70-30)
  - Knowing P value higher, R rejects 40%, wants >50%
  - 回應者知道對方價值較高時會要求比50-50更好，使拒絕機率上升到40%

# Babcock et al.(AER 1995,Law&Social Inquiry 1997)

  - Self-serving bias Exp: Loewenstein et al. (JLegalStud 93')

- Read 27-page actual legal case 讀27頁卷宗/談判和解
  - Motorcyclist sues driver: $100,000 injury damage
- Bargain for 30 min. to settle it for ?? dollars
  - $5000 legal fees for every 5-min delay
  - Retired judge imposes award if no agreement
- First Guess what judge would award
  - US$1 (or 1 Grade Point) for every $10,000
  - 30分鐘談判和解(訴訟金額$100,000)，每延遲5分鐘須付$5000律師費
  - 事先預測和解不成法官會如何判 (實驗中$10,000 = 一美金或 1 GPA)

# Gap of E(judgment) Predicts Disagreement

- Baseline: 70% cases settled at period 3-4 (out of 6)
- E(judgment) differ by $20,000 (20% of $100,000)
  - 控制組結果: 70%的組在第3-4回合達成和解(總共6回合)
  - 雙方預期判決結果的落差在$20,000左右(訴訟金額的20%)

| Experimental Condition | | Settlement Stat. | | | E(judgment) Gap | |
|---|---|---|---|---|---|---|
| | N | % | periods | (s.e.) | mean | (s.e.) |
| Control (Babcock 95) | 47 | 72 | 3.75 | (0.28) | $18,555 | (3,787) |
| | | | | | | |
| Control (Babcock 97) | 26 | 65 | 4.08 | (0.46) | $21,783 | (3,956) |
| | | | | | | |

# More Pairs Settled (and More Rapidly) if...

- Don't know role @ reading: 94% (in 2.51 pds)
  - Or, before bargaining, 1st tell about bias &
- List Weakness of own case: 96% (in 2.39 pds)

| Experimental Condition | | Settlement Stat. | | | E(judgment) Gap | |
|---|---|---|---|---|---|---|
| | N | % | periods | (s.e.) | mean | (s.e.) |
| Control (Babcock 95) | 47 | 72 | 3.75 | (0.28) | $18,555 | (3,787) |
| Didn't know roles | 47 | 94 | 2.51 | (0.21) | -$6,275 | (4,179) |
| Control (Babcock 97) | 26 | 65 | 4.08 | (0.46) | $21,783 | (3,956) |
| 1st List weakness | 23 | 96 | 2.39 | (0.34) | $4,676 | (6,091) |

p<0.01 ≒0 p=0.01 p=0.02 ≒0

# Summary for Unstructured Bargaining

- Focal points affect bargaining outcome
- Chip value affect bargaining outcome
  - Violate IAT Axiom of NBS
- BGT Explanation: Bargainers try to coordinate under multiple focal points
- Self-serving bias predict costly delay/settle
  - "Outcome favoring me is more likely/fair"
  - Caused by knowing my role when reading case

# Structured Bargaining 制式談判

- Finite Alternating-Offer Game (有限回交互提案)
- Binmore, Shaked & Sutton (1985): 2 period
- 1 offers a division of 100p to 2
- If 2 rejects, makes counteroffer dividing 25p
  - 成員甲提議如何分配100p，成員乙回應。若拒絕則由他提議分配25p
- SPE: Offer 25-75 (子賽局完全均衡：成員甲提議25-75)
- Experimental Results: mode at 50-50, some 25-75 and others in between
  - 實驗結果：提議分配的衆數在50-50，有些在25-75，其他在兩者之間

# Structured Bargaining 制式談判

- Neelin, Sonnenschein and Spiegel (1988)
  - Economics undergrads yield different results
- Are they taught backward induction? Also,
  - 經濟系大學部學生實驗結果不同，因為學過倒推法？還是實驗說明？
- Binmore – "YOU WOULD BE DOING US A FAVOR IF YOU SIMPLY SET OUT TO MAXIMIZE YOUR WINNINGS."
- Neelin – "You would be discussing the theory this experiment is designed to test in class."

# Structured Bargaining 制式談判

- Social Preference or Limited Strategic Thinking? (是因為人們有社會偏好，還是理性思考有限制？)
- Johnson, Camerer, Sen & Rymon (2002), "Detecting Failures of Backward Induction: Monitoring Information Search in Sequential Bargaining," *Journal of Economic Theory,*104 (1), 16-47.
- Some do not even look at the last stage payoffs in 3-stage bargaining games!
  - 三回合談判，有人「不看」最後一回合

# Structured Bargaining 制式談判

- Random Termination vs. Discounting
- Zwick, Rapoport and Howard (ToD 1992)
- Divide $30 with random termination
- Continuation probabilities 0.90, 0.67, 0.17
- SPE: 14.21, 12, 4.29
  - Accepted final offers: 14.97, 14.76, 13.92
- Close to discounting results (50-50 & SPE)
  - 14.90, 14.64, 13.57

# Structured Bargaining

- Fixed Delay Cost in Bargaining
  - Lost wages, profits, etc.
- SPE: Strong side (lower delay cost) gets all
- Rapoport, Weg and Felsenthal (ToD 1990)
  - Divide 30 shekels (pseudo-infinite horizon)
  - Fixed Cost: 0.10 vs. 2.50 or 0.20 vs. 3.00
- Strong support for SPE: In the 1st round,
  - Strong P offer 4.4-7.9, weak R accept 60-80%
  - Weak P offer low, strong R accept 30%, but later quickly settle in 2nd (35%) or 3rd-4th (22%)

# Outside Option and Threat Points

- Binmore, Shaked and Sutton (QJE 1989)
  - Two players bargain over £7, discount $\delta = 0.9$
  - Player 2 has outside option of £0, £2, or £4
- Split-the-difference (NBS): 47%, 64%, 76%
  - Divide surplus beyond the threat points
- Deal-me-out (SPE): 47%, 47%, 57%(=4/7)
  - Options matter only if is credible; ignore if $< \frac{\delta}{1-\delta}$
- BGT, Figure 4.4: Deal-me-out wins
  - £0, £2: spike around 50% / £4: cluster @ 57%

# Incomplete Information

- Add Asymmetric Information to bargaining
- More realistic, but
  - Hard to bargain for a bigger share AND convey information at the same time
- Might need to turn down an offer to signal patience or a better outside option

# Seller Make Offer to Informed Buyer

- Rapoport, Erve, and Zwick (MS 1995)
- Seller: Own item (worthless to herself)
- Buyer: Private reservation price is unif.[0,1]
- Seller makes an offer each period
- Common discount factor $\delta$

# Seller Make Offer to Informed Buyer

- Unique Sequential Equilibrium:
- Seller Offer:

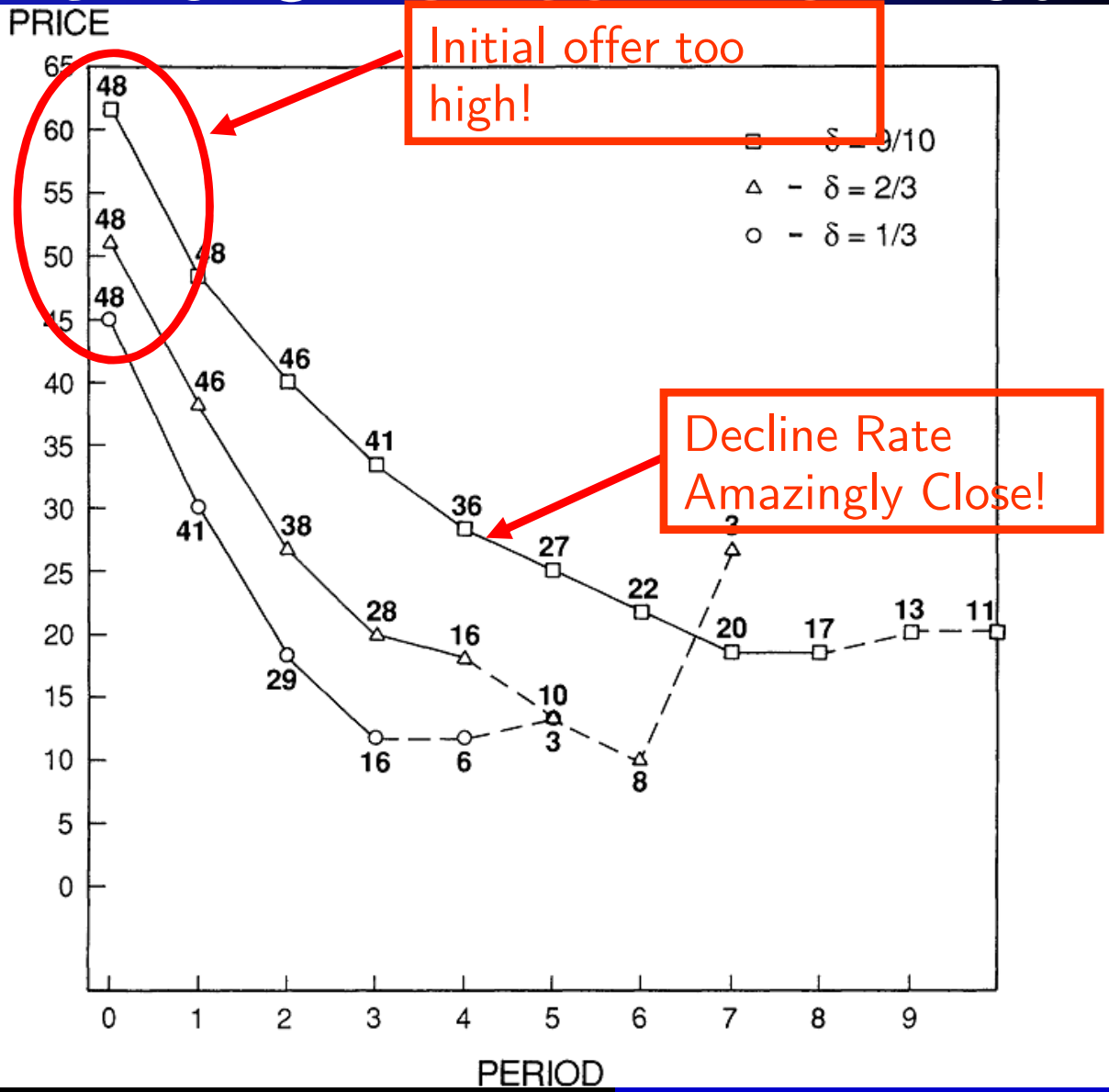
$$p_0 = \gamma \cdot \frac{1-\delta}{1-\gamma\cdot\delta},\ \ \gamma = \frac{1-\sqrt{1-\delta}}{\delta}$$

- Subsequently: $p_t = p_0 \cdot \gamma^t$
- Buyer Accepts if $p_t \leq v \cdot \frac{1-\delta}{1-\gamma\cdot\delta}$

# Seller Make Offer to Informed Buyer

- Complicate Strategy: Depend on $\delta$
  - Price discriminate high/low-value buyers
  - Price declines slow enough so high-value buyers will not want to wait
- Can subjects get these in experiments?
  - Different $\delta$ : H (0.90), M (0.67), L (0.33)
  - Opening $p_0$: H (0.24), M (0.36), L (0.45)
  - Discount $\gamma$ : H (0.76), M (0.68), L (0.55)

# Seller Make Offer to Informed Buyer



# Seller Make Offer to Informed Buyer

- Can subjects get these in experiments?
  - Different $\delta$: H (0.90), M (0.67), L (0.33)
  - Opening $p_0$: H (0.24), M (0.36), L (0.45)
  - Discount $\gamma$ : H (0.76), M (0.68), L (0.55)
- Buyers accept the 1st or 2nd offer below v
  - Accept offers too soon
- Sellers ask for higher prices (than equil.)
  - But discount $\gamma$ : H (0.81), M (0.68), L (0.55)

# Strikes and 1-Sided Information

- Forsythe, Kennan and Sopher (AER 1991)
- Only Informed bargainer I sees pie size
  - Either large ( $\pi_g$ ) or small ( $\pi_b$ )
- Free-form bargaining
- Uninformed U can strike to shrink pie by $\gamma$
- Can we predict what happens?

# Strikes and 1-Sided Information

- Myerson (1979): Revelation Principle
  - I announces true state
  - U strikes to shrink pie by $\gamma_g$ or $\gamma_b$
  - I gives U (based on true state) $x_g$ or $x_b$
- IC requires:

$$(\gamma_g - \gamma_b)\pi_b \leq x_g - x_b \leq (\gamma_g - \gamma_b)\pi_g$$

# Strikes and 1-Sided Information

- Interim Incentive Efficiency requires:

$$\gamma_g = 1, x_g - x_b = (1 - \gamma_b)\pi_g$$

- Strike ( $\gamma_b < 1$) if and only if $p\pi_g > \pi_b$

- Deriving this is complicated...
- Could ANY subject get close to this?

# Strikes and 1-Sided Information

- Random Dictator (RD) Axiom:
  - Agree fair mix between each being dictator to propose mechanism
- Then:

$$\gamma_g = 1, x_g = \frac{\pi_g}{2}, \gamma_b = \frac{1}{2}, x_b = 0 \text{ if } p\pi_g > \pi_b$$

$$\gamma_g = 1, x_g = \frac{\pi_b}{2}, \gamma_b = 1, x_b = \frac{\pi_b}{2} \text{ if } p\pi_g < \pi_b$$

# Strikes and 1-Sided Information

- This is a win-win experiment:
  - Success if theory predictions are close
  - If not, will point to which assumption fails
- Forsythe et al. (AER 1995):
  - 10 minute sessions; written messages
- Is Myerson (1979) confirmed?
  - Surprisingly yes, though not perfect...

# Strike Condition Off

$$p\pi_g < \pi_b$$

| Game | $p$ | State | $\pi$ | $\pi_U$ | $\pi_I$ | total | %Strike |
|---|---|---|---|---|---|---|---|
| III | 0.5 | b | 2.80 | | | | |
| | | g | 4.20 | | | | |
| | | aver. | 3.50 | 1.50 | 1.80 | 3.29 | 6.0 |
| | | pred. | | 1.40 | 2.10 | 3.50 | 0.0 |
| IV | 0.25 | b | 2.40 | | | | |
| | | g | 6.80 | | | | |
| | | aver. | 3.50 | 1.21 | 2.04 | 3.24 | 7.4 |
| | | pred. | | 1.20 | 2.30 | 3.50 | 0.0 |

# Strike Condition On

$$p\pi_g > \pi_b$$

| Game | $p$ | State | $\pi$ | $\pi_U$ | $\pi_I$ | total | %Strike |
|---|---|---|---|---|---|---|---|
| I | 0.5 | b | 1.00 | | | | |
| | | g | 6.00 | | | | |
| | | aver. | 3.50 | 1.05 | 2.00 | 3.05 | 13.0 |
| | | pred. | | 1.50 | 1.75 | 3.25 | 7.1 |
| II | 0.75 | b | 2.30 | | | | |
| | | g | 3.90 | | | | |
| | | aver. | 3.50 | 1.41 | 1.76 | 3.18 | 9.3 |
| | | pred. | | 1.46 | 1.75 | 3.21 | 8.3 |

# Sealed-Bid in Bilateral Bargaining

- Both buyers and sellers have private information
- Sealed-Bid Mechanism
  - Both write down a price
  - Trade at the average if $p_b > p_s$
  - Call Market: Many buyers vs. many sellers
- Two-Person Sealed-Bid Mechanism
  - One form of bilateral bargaining

# Sealed-Bid in Bilateral Bargaining

- Two-Person Sealed-Bid Mechanism
- Buyer $\mathrm{V} \sim$ unif.[0,100]; Seller $\mathrm{C} \sim$ unif.[0,100]
- Piecewise-linear equilibrium: (not unique)
  - Chatterjee and Samuelson (1983)
  - Max. ex ante gains (Myerson & Satterthwaite 83)

$$p_b = \begin{cases} V & \text{if } V < 25 \\ \frac{25}{3} + \frac{2}{3}V & \text{if } V \geq 25 \end{cases}$$

$$p_s = \begin{cases} 25 + \frac{2}{3}C & \text{if } C < 75 \\ C & \text{if } C \geq 75 \end{cases}$$

# Sealed-Bid in Bilateral Bargaining

- Radner and Schotter (JET 1989): 8 sessions
- 1, 2, 8: Baseline as above
- 3: Trade at price $(v + c + 50)$ / 3 if $v > c+25$
  - Should bid their values $v = V$, $c = C$
- 4: Price $= v$, (Buyers should bid $v = V/2$ )
- 5,6: Alternative distribution for more learning
  - Distribution w/ more trade (for learning): $\mathrm{m}=0.438$
- 7: Face-to-face bargaining

# Estimated Buyer Bid Function Slope

| | Below cutoff | | | Above cutoff | | |
|---|---|---|---|---|---|---|
| Session | β | β_hat | T-stat | β | β_hat | T-stat |
| 1 | 1 | 1.00 | (0.01) | 0.67 | 0.85* | (4.14) |
| 2 | 1 | 0.91 | (-0.52) | 0.67 | 1.06 | (1.28) |
| 8 | 1 | 0.91 | (-0.14) | 0.67 | 0.80* | (2.32) |
| 3 | 1 | 0.92 | (-0.08) | 1 | 0.73* | (-2.64) |
| 4 | 0.5 | 0.55 | (0.66) | 0.5 | 0.58* | (2.32) |
| 5 | 1 | 0.80* | (-4.17) | 0.438 | 0.50 | (1.12) |
| 6(-20) | 1 | 0.85 | (-1.40) | 0.438 | 0.40 | (-0.56) |
| 6(21-) | 1 | 1.11 | (0.70) | 0.438 | 0.32 | (-1.55) |

# Estimated Seller Bid Function Slope

| | Below cutoff | | | Above cutoff | | |
|---|---|---|---|---|---|---|
| Session | β | β_hat | T-stat | β | β_hat | T-stat |
| 1 | 0.67 | 0.58 | (-1.38) | 1 | 0.97 | (-0.32) |
| 2 | 0.67 | 0.74 | (1.28) | 1 | 1.07 | (0.14) |
| 8 | 0.67 | 0.75 | (1.65) | 1 | 1.07 | (0.17) |
| 3 | 1 | 1.06 | (1.04) | 1 | 0.67 | (-0.58) |
| 5 | 0.438 | 0.48 | (0.87) | 1 | 1.00 | (0.60) |
| 6(-20) | 0.438 | 0.57* | (2.16) | 1 | 0.97 | (-0.79) |
| 6(21-) | 0.438 | 0.52 | (1.20) | 1 | 0.95 | (-0.69) |

# Sealed-Bid in Bilateral Bargaining

- Face-to-face yields efficiency 110%
  - Some truthfully reveal; others do not
- Radner and Schotter (1989, p.210):
  - The success of the face-to-face mechanism, if replicated, might lead to a halt in the search for better ways to structure bargaining in situations of incomplete information.
  - It would create, however, a need for a theory of such structured bargaining in order to enable us to understand why the mechanism is so successful.

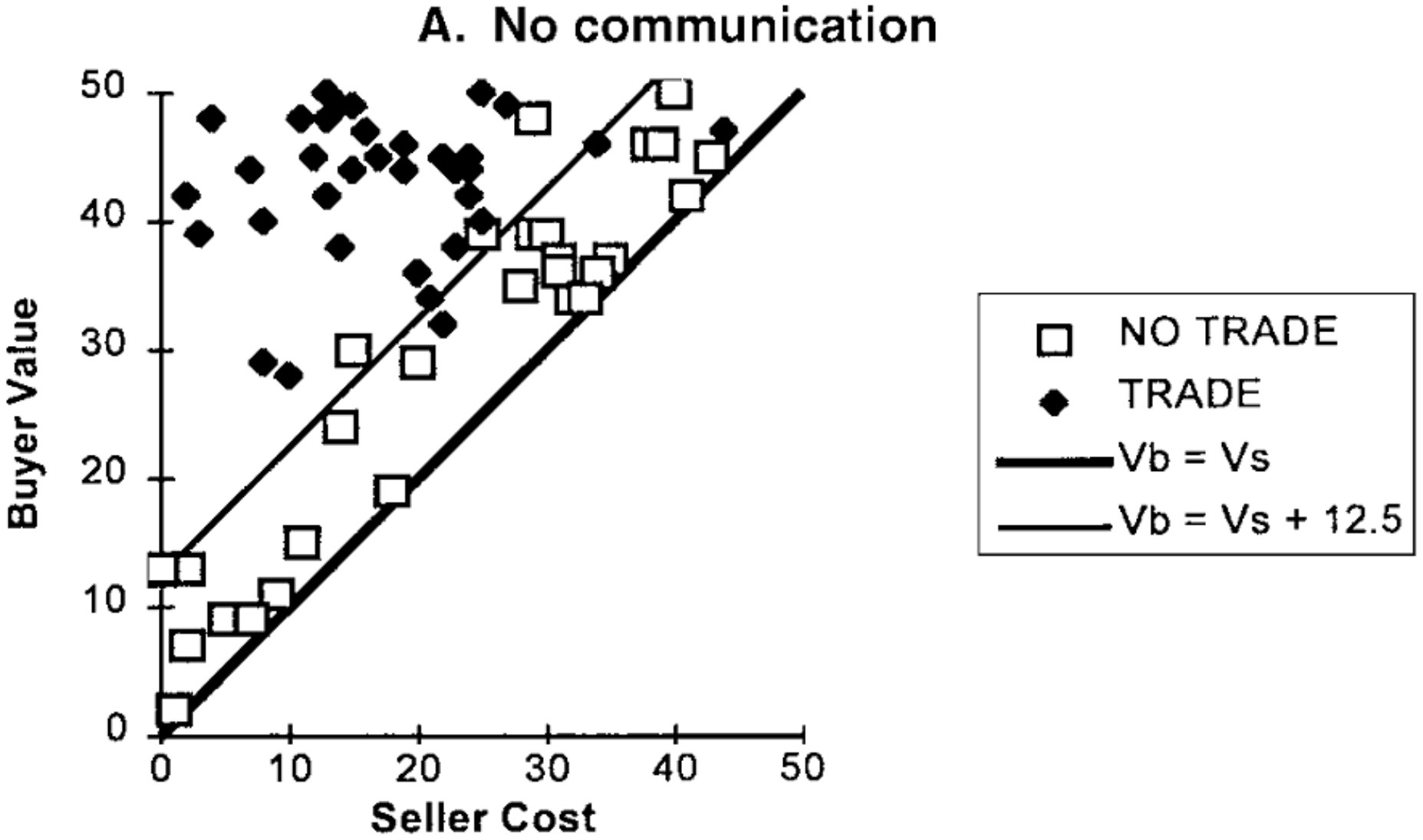
# Sealed-Bid in Bilateral Bargaining

- Follow-up Studies:
- Schotter, Snyder and Zheng (GEB 2000)
  - Add agents
- Rapoport and Fuller (1995)
  - Strategy method; asymmetric value dist.
- Daniel, Seale and Rapoport (1998)
  - Asymmetric value distribution (20 vs. 200)
- Rapoport, Daniel and Seale (1998)
  - Flip buyer-seller asymmetry; fixed pairing

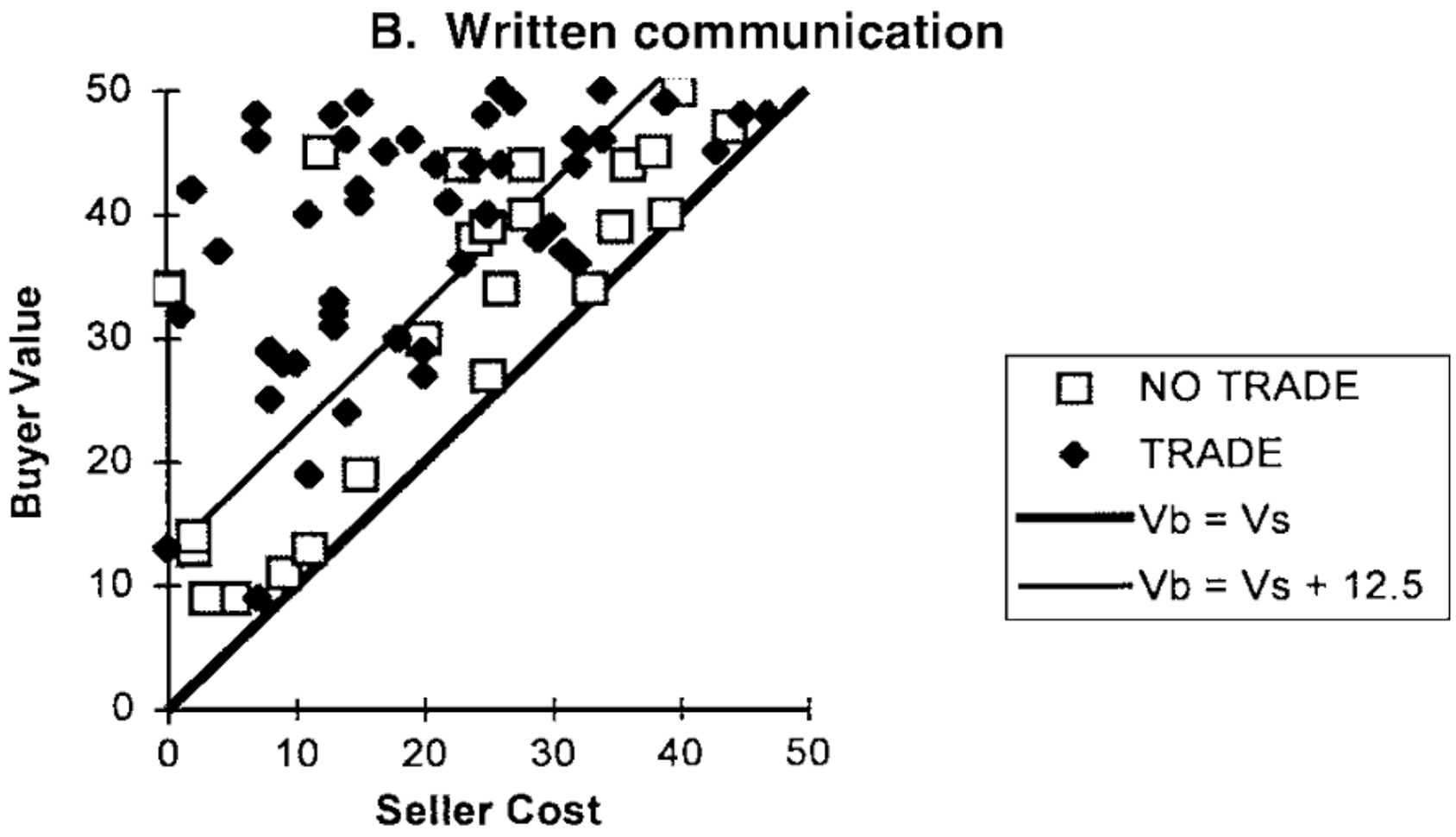
# Communication vs. Sealed-Bid

- Valley et al. (GEB 2002): Communication
- Buyer/Seller Values/Costs ~ uniform[0, $50]
  - Bargain by stating bids; 7 periods; no rematch
  - Half had no feedback
- No communication: Sealed-bid in 2 minutes
- Written communication: Exchange messages for 13 minutes before final bid
- Face-to-face: Pre-game communication

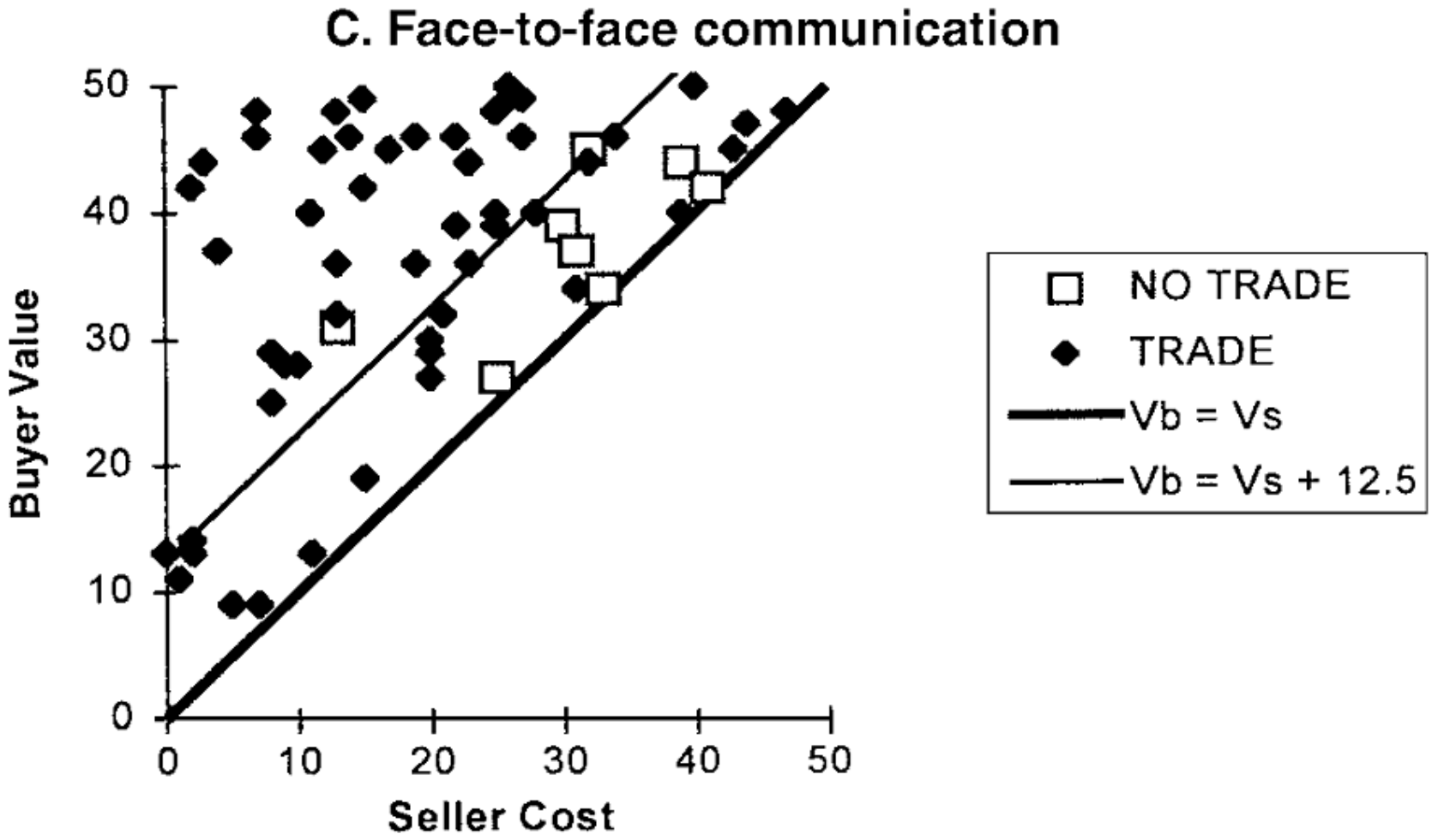
# Communication vs. Sealed-Bid



# Communication vs. Sealed-Bid



# Communication vs. Sealed-Bid



# Communication vs. Sealed-Bid

- Empirical bid function slope = 0.7 (~0.67)
- Why are there "gains of communication" ?
- Slope of buyer bids against seller bids=0.6
- Buyers bid higher when seller bids higher
  - Mutual bidding of values (common in students)
  - Mutual revelation of values (com. in students)
  - Coordinating on a price (40% written; 70% face)

# Communication vs. Sealed-Bid

- Coordinating on a price
  - Happens 40% in written, 70% in face-to-face
- Not truth-telling (only 1/3)
  - TT not coordinated (4% written, 8% face)
- Feel each other out; give enough surplus
  - Modal – equal split of surplus
- Variance of surplus doubles (by mismatch)

# Conclusion

- Unstructured Bargaining
  - Focal divisions; competing focal points
  - Self-serving bias (erased by veil of ignorance or stating weakness of own case)
- Structured Bargaining
  - Deviate toward equal splits
  - Social preference models could explain this
  - But Johnson et al. (JET 2002) suggest limited look-ahead as reason for such deviations

# Conclusion

- Outside options affect bargaining divisions only if threats are credible
  - Lower fixed cost player gets everything
- Information Asymmetry: One-Sided
  - Revelation Principle + Random Dictator: Good
  - Bazaar mechanism:
  - Offers decline as theory predicts, but start too high and respond to $\delta$ wrongly
  - Buyers accept too early

# Conclusion

- Bilateral Bargaining: Two-Sided
  - Sealed-bid mechanism: between truthful revelation and piecewise-linear equilibrium
- Players over-reveal values in face-to-face
  - Too honest, but "more efficient"
- Communication → agree on a single price
- Why theory does better in sealed-bid than alternative-offer bargaining?
  - Is sealed-bid cognitively more transparent?

# 致謝

感謝 Management Science還有以下三位教授讓我們在第47張投影片使用下述論文的圖片:

Amnon Rapoport & Ido Erev & Rami Zwick, 1995. "**An Experimental Study of Buyer-Seller Negotiation with One-Sided Incomplete Information and Time Discounting**," Management Science, INFORMS, vol. 41(3), pages 377-394, March.

感謝Games and Economic Behavior 還有以下四位教授讓我們在77、78、79 這三張投影片中，使用以下文章的一張圖表：

Kathleen Valley[a], Leigh Thompson[b], Robert Gibbons[c], Max H. Bazerman[d] **"How Communication Improves Efficiency in Bargaining Games,"** Games and Economic Behavior**,** Volume 38, Issue 1, January 2002, Pages 127–155