Bargaining
(議價談判)

Joseph Tao-yi Wang (王道一)
EE-BGT, Lecture 6

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的!) 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? (奈許大哉問：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, MGSB, 2nd ed., Ch. 14

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 in Applied Psychology

3. Negotiation Research: 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 research questions are the same! (研究問題一樣)

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奈許談判解)

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

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 $S^* \subset T \subset S$
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)

Information (資訊)	Money Prize (雙方獎金金額)	# of Tickets for Player 2 (成員乙所分得的彩券數目)							% of Disagreement (未達成協議的比例)
		20	25	30	35	40	45	50	
Full Info. (不透明)	1/1	0	0	1	0	1	0	20	0%
	1.25/3.75	1	6	3	2	2	1	4	14%
Part. Info. (透明)	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 (羅斯談判解)

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

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), $S^* \subset T \subset S$
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。兩人抽四張A/四張2
- 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."
    - 焦點:「四張A合起來值十英鎊，想賺錢就得合作、一起換十英鎊來分」

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? (行為賽局論的解釋)

- Roth (1985) explains as Coordination Game over allocation focal points 50-50 vs. h-(100-h)
  - Each favoring one ($50 > h$ whenever $50 < 100\text{-}h$)
  - 可用協調賽局解釋: 考慮兩個分配上的協調焦點 50-50 或 h-(100-h)
- Both simultaneously choose to demand their favorite or acquiesce to the less favorable
  - If both demand favorite: Both earn 0
  - If only one demands favorite: Play focal point
  - 兩邊同時選擇「要求有利自己的分配」或「願接受另一個分配」
  - 若都「要求」，兩邊報酬皆為0；只有一方「要求」，則按「要求」分配

Can BGT Explain This? (行為賽局論的解釋)

- If both acquiesce: Earn average of the two focal points $x_1 = (50+h)/2$, $x_2 = (150\text{-}h)/2$
- 若都「接受另一個」則獲得兩分配平均 $x_1 = (50+h)/2$, $x_2 = (150\text{-}h)/2$

- MSE: (混合策略均衡)

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

- Disagreement rates $= \frac{(h-50)^2}{(150-h)(50+h)}$
  (未達成協議的比例)

Can BGT Explain This? (行為賽局論的解釋)

- Roth (bk chp 1985)
- Disagreement rates $= \dfrac{(h-50)^2}{(150-h)(50+h)}$
  (未達成協議的比例)
- Predicted to be 0%→7%→10% (過去結果預測隨$h\uparrow$)
  - for $h = 50, 75, 80$ by pervious experiments
- Data: 7% → 18% → 25% (Direction is right!)
- Murnighan et al. (JRU 1988) (比較靜態正確!)
  - $h = 60, 70, 80, 90$ predict 1%, 4%, 10%, 19%
- Actual data not as good: Constant across h
  - 理論預測未達協議比例應該隨$h\uparrow$，但實驗結果持平

Cause of Disagreement: Self-Serving Bias

- "What is better for me" = "Fair" (對我有利才叫公平)
  - Add this to coordination game explains why more disagreement in data (上述協調賽局加入自利偏誤可解釋結果)
- Same in Kagel, Kim and Moser (GEB 1996):
  - Ultimatum over 100 tickets (P/R value differently)
    - Kagel et al. (96')用最後通牒談判分配100張(對雙方價值不同)的彩券
  - If R unaware of H/L, P_H/P_L propose 55-45/70-30
    - 回應者不知對方價值高低時，提議者在價值高時會給45%，但價值低時只給30%
  - If aware of P_H , R will reject 60-40, wants >50%
    - 回應者知道對方價值較高會拒絕40%、要求比平分更好，使得40%提議被拒絕
  - (Rejection rate = 40%)

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

- Self-serving bias Exp: Loewenstein et al. (JLS 93')
- Read 27-page actual legal case (讀27頁卷宗:機車騎士告車主)
  - 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
    - 30分鐘談判和解(訴訟金額$100k)，每延遲5分鐘須付$5k律師費(和解不成則由退休法官裁定)
- First Guess what judge would award
  - US$1 (or 1 Grade Point) for every $10,000
    - 事先預測和解不成法官會如何判 (實驗中$10,000 = 美金一元或成績1分)

Gap of E(judgment) Predicts Disagreement

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

Group (實驗組別)	Settlement Statistics (和解結果)				E(judgment) Gap (預期判決落差)	
	N	%	periods	(s. e.)	mean (平均)	(s. e.)
Control: Babcock 95'	47	72	3.75	(0.28)	$18,555	(3,787)
(控制組)			(回合)			
Control: Babcock 97'	26	65	4.08	(0.46)	$21,783	(3,956)
(控制組)			(回合)			

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

- Don't know role @ reading: 94% (in 2.51 pds)
  - But you know own role in reality!
    - 閱讀前不知自己是哪一方: 94%在2.51回合和解(但現實雙方立場已知!)

Group (實驗組別)	Settlement Statistics (和解結果)				E(judgment) Gap (預期判決落差)	
	N	%	periods	(s. e.)	mean (平均)	(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)

$p<0.01$

$\fallingdotseq 0$

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

- Or, before bargaining, 1st tell about bias and
- List Weakness of own case: 96% (in 2.39 pds)
  - 談判前告知有此偏誤，並請其列出己方立場弱點: 96%在2.39回合和解

Group (實驗組別)	Settlement Statistics (和解結果)				E(judgment) Gap (預期判決落差)	
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Control: Babcock 95'	47	72	3.75	(0.28)	$18,555	(3,787)
	$p<0.01$					
Didn't know roles	47	94	2.51	(0.21)	$6,275 $\fallingdotseq 0$	(4,179)
Control: Babcock 97'	26	65	4.08	(0.46)	$21,783	(3,956)
	$p=0.01$				$p=0.02$	
1st List Weakness	23	96	2.39	(0.34)	$4,676 $\fallingdotseq 0$	(6,091)

Summary for Unstructured Bargaining

- Focal points affect bargaining outcome
  - 「焦點」會影響談判結果
- Chip value affect bargaining outcome
  - Violate IAT Axiom of NBS
    - 各自籌碼或彩券的價值會影響談判結果
    - (違反奈許談判解的IAT公設，使之受效用平移伸縮影響)
- BGT Explanation: Bargainers may fail to coordinate under multiple focal points
  - 行為賽局論: 談判雙方在多重「焦點」下協調，可能無法達成協議

Summary for Unstructured Bargaining

- Self-serving bias predict costly delay/settle
  - 自利偏誤預測較不易達成和解、延遲情況
- "Outcome favoring me is more likely/fair"
  - 對我有利的情況較公平、更可能發生
- Caused by knowing my role when reading case
  - 來自於閱讀卷宗時已經知道自己是哪一方

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.:"
    - Binmore請學生極大化自己的報酬 vs. Neelin說上課會討論相關理論

Janet Currie

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

Random Termination vs. Discounting

- Zwick, Rapoport and Howard (T&D 1992)
- Divide $30 with random termination
  - 兩人分配$30，無限回合但可能隨機結束。還有下一回合的機率如下:
- Continuation probabilities 0.90, 0.67, 0.17
- SPE prediction: (均衡預測) 14.21, 12, 4.29
  - Accepted final offers: 14.97, 14.76, 13.92
    - 最後接受分配與金額縮水的結果類似(50-50平分&均衡)
- Close to discounting results (50-50 & SPE)
  - 14.90, 14.64, 13.57

Fixed Delay Cost in Bargaining (固定拖延成本)

- Lost wages, profits, etc. (利潤,薪資損失)
- SPE: Strong side (lower delay cost) gets all
  - 均衡預測:強勢者(拖延成本低)會全拿
- Rapoport, Weg and Felsenthal (T&D 1990)
  - Divide 30 shekels (pseudo-infinite horizon)
    - 談判分配30舍克勒 (「假裝」無窮期)
  - Fixed Cost: 0.10 vs. 2.50 or 0.20 vs. 3.00
    (固定拖延成本)

Fixed Delay Cost in Bargaining (固定拖延成本)

- Strong support for SPE: In the 1st round,
  - 實驗結果支持均衡預測: 在第一回合
  - Strong P offer 4.4-7.9, weak R accept 60-80%
    - 強勢者提議給對方4.4-7.9，且60-80%弱勢者會接受
  - Weak P offer low, strong R accept 30%, but later quickly settle in 2nd (35%) or 3rd-4th (22%)
    - 弱勢者提議70%會被強勢者拒絕，但很快修正，故35%(22%)的組第2(3-4)回合達成協議

Outside Option and Threat Points (威嚇點)

- Binmore, Shaked and Sutton (QJE 1989)
  - 2 players bargain over £7, discount factor $\delta = 0.9$
    - 雙方談判如何分配£7，折現率=0.9
  - Rubinstein-Stahl solution is $\left(\frac{1}{1+\delta}, \frac{\delta}{1+\delta}\right)$ (談判解)
  - Player 2 has outside option of £0, £2, or £4
    - 若不達成協議成員乙仍可獲得£0, £2,或£4
- Split-the-difference (NBS): 47%, 64%, 76%
  - 平分差額(NBS)的預測: 47%, 64%, 76%
  - Divide surplus beyond the threat points
    - 雙方會平方超出威嚇點以外的部分

Outside Option and Threat Points (威嚇點)

- Deal-me-out (SPE): 47%, 47%, 57%(=4/7)
  - 來真的才算數(SPE)的預測: 47%, 47%, 57%(=4/7)
  - Ignore non-credible options below $\left(\frac{\delta}{1-\delta}\right)$
    - 只有當威脅可信時才影響結果，所有威嚇點小於↗ 通通不算數
- Result (BGT, Figure 4.4): Deal-me-out wins
  - £0, £2: spike around 50% / £4: cluster @ 57%
    - 結果符合來真的才算數(£0, £2: 50%附近特別多/£4:集中在57%)
- Follow-ups:
  - Binmore, Proulx, Samuelson & Swierzbinski (EJ98)
  - Forsythe, Kennan and Sopher (bk chp 1991)

Incomplete Information (資訊不透明)

- Add Asymmetric Information to bargaining
  - 在談判實驗中加入資訊不透明的情形
- More realistic, but
  - Hard to bargain for a bigger share AND convey information at the same time
    - 更真實，但是很難同時傳遞訊息又獅子大開口
- Might need to turn down an offer to signal patience or a better outside option
  - 可能必須要用拒絕某一方案來展示自己有更好的外部選項

Seller Make Offer to Informed Buyer

- Rapoport, Erve, and Zwick (MS 1995)
- Seller: Own item (worthless to herself)
  - 賣方：擁有一單位某商品(對自己無價值)
- Buyer: Private reservation price is unif.[0,1]
  - 買方：只有自己知道保留價格分配為uniform[0,1]
- Seller makes an offer each period
  - 每回合賣方提議價格
- Common discount factor δ
  - 相同的折現率 δ

Seller Make Offer to Informed Buyer

- Unique Sequential Equilibrium: (唯一的序列均衡)
- Seller Offer: (賣方提議)

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

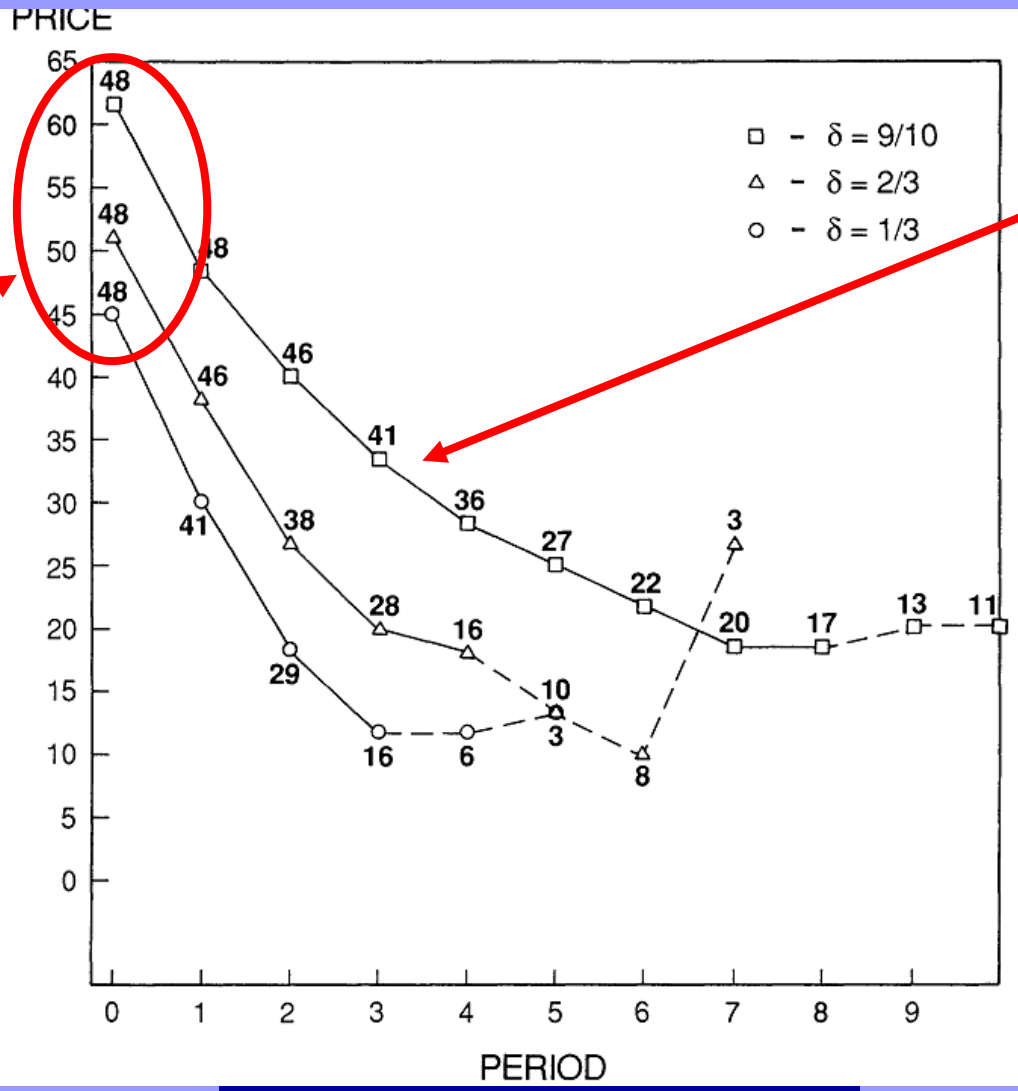
- Subsequently: $p_t = p_0 \cdot \gamma^t$
  - (接下來)
- Buyer Accepts if $p_t \leq v \cdot \frac{1-\delta}{1-\gamma\cdot\delta}$
  - (買方接受底線為)

Seller Make Offer to Informed Buyer

- Complicate Strategy: Depend on δ
  - Price discriminate high/low-value buyers
  - Price declines slow enough so high-value buyers will not want to wait
    - 均衡策略很複雜且跟 δ 有關: 對保留價格不同的買方實施價格歧視, 價格下降速度慢到讓高保留價格者不願意等待 (受試者做得到嗎?)
- Can subjects get these in experiments?
  - Different δ: H (0.90), M (0.67), L (0.33) (不同折現率)
  - Opening p_0: H (0.24), M (0.36), L (0.45) (初始出價)
  - Discount γ: H (0.76), M (0.68), L (0.55) (降價幅度)

(賣方對保留價格未知的買方提議)

Seller Make Offer to Informed Buyer



Initial offer too high!

(初始出價太高!)

Decline Rate Amazingly Close!

(但降價幅度很接近理論預測)

Seller Make Offer to Informed Buyer

- Can subjects get these in experiments?
  - Different δ: H (0.90), M (0.67), L (0.33) (不同折現率)
  - Opening p_0: H (0.24), M (0.36), L (0.45) (初始出價)
  - Discount γ : H (0.76), M (0.68), L (0.55) (降價幅度)
- Buyers accept the 1st or 2nd offer below v
  - Accept offers too soon
    - 當出價低於v，買方兩回合內就會接受(接受得太早/應該再等一會兒)
- Sellers ask for higher prices (than equilibrium)
  - 跟均衡相比，賣方初始出價太高，但實際降價幅度非常接近理論預測
  - But discount γ : H (0.81), M (0.68), L (0.55)

Strikes and 1-Sided Information (資訊不透明與罷工)

- Forsythe, Kennan and Sopher (AER 1991)
  - Only Informed bargainer I sees pie size π_g or π_b
    - 只有一方 I 知道總分配金額是「大 (π_g)」或「小(π_b)」
- Uninformed U can strike to shrink pie by γ
  - 不知情的另一方 U 可以罷工使金額縮水 γ
- Can we predict what happens?
  - Free-form bargaining
    - 你能預測自由談判下的實驗結果會如何嗎?

Strikes and 1-Sided Information (資訊不透明與罷工)

- Myerson (1979): Revelation Principle
  - 顯示真實原則

1. I announces true state (I 宣布真實狀況)
2. U strikes to shrink pie by γ_g or γ_b
   - U 罷工會讓金額變成 γ_g 或 γ_b (看 I 宣布多少)
3. I gives U (based on true state) x_g or x_b
   - (根據真實狀況) I 給 U x_g 或 x_b

Strikes and 1-Sided Information (資訊不透明與罷工)

- IC requires: (誘因符合限制式)

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

- Interim Incentive Efficiency requires: (中間誘因效率)

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

- Strike ($\gamma_b < 1$) if and only if $p\pi_g > \pi_b$
  - 罷工 ($\gamma_b < 1$) 的充分必要條件
- Deriving this is complicated... (解出這些條件很複雜...)
- Could ANY subject get close to this? (會有人解出來嗎?)

Strikes and 1-Sided Information (資訊不透明與罷工)

- Random Dictator (RD) Axiom: (隨機獨裁分配公設)
  - Agree fair mix between each being dictator to propose mechanism (同意隨機決定由誰獨裁決定分配機制)
- Then: (則)

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

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

Strikes and 1-Sided Information (資訊不透明與罷工)

- This is a win-win experiment: (這是一個雙贏實驗)
  - Success if theory predictions are close
  - If not, will point to which assumption fails
    - 如果結果符合理論預測，表示我們驗證了理論
    - 如果不符合，我們可以看出哪一個假設出問題
- Forsythe et al. (AER 1995): (文字溝通10分鐘)
  - 10 minute sessions; written messages
- Is Myerson (1979) confirmed? (顯示真實原則是否被驗證?)
  - Surprisingly yes, though not perfect...
    - 出乎意料地正確，但是還不夠完美...

Strike Condition Off (罷工條件不成立) $p\pi_g < \pi_b$

Game (賽局)	p	State (狀況)	π	π_U	π_I	Total (加總)	% Strike (罷工)
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 Off (罷工條件不成立) $p\pi_g < \pi_b$

Game (賽局)	p	State (狀況)	π	π_U	π_I	Total (加總)	% Strike (罷工)
III	0.5	b	2.80	1.47	1.18	2.66	5.2%
		g	4.20	1.52	2.41	3.93	6.5%
		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	1.08	1.04	2.12	11.8%
		g	6.80	1.58	5.03	6.61	2.9%
		aver.	3.50	1.21	2.04	3.24	7.4%
		pred.		1.20	2.30	3.50	0.0%

Strike Condition On (罷工條件成立) $p\pi_g > \pi_b$

Game (賽局)	p	State (狀況)	π	π_U	π_I	Total (加總)	% Strike (罷工)
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%

Strike Condition On (罷工條件成立) $p\pi_g > \pi_b$

Game (賽局)	p	State (狀況)	π	π_U	π_I	Total (加總)	% Strike (罷工)
I	0.5	b	1.00	0.31	0.30	0.61	39.0%
		g	6.00	1.78	3.70	5.48	8.7%
		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	1.06	0.84	1.90	17.2%
		g	3.90	1.53	2.07	3.59	7.9%
		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 (買賣雙方都各自知道自己的成本/保留價格)
- Sealed-Bid Mechanism (密封投標機制)
  - Both write down a price (雙方都寫下一個價格)
  - Trade at the average if $p_b > p_s$ (當$p_b > p_s$則以均價成交)
  - Call Market: Many buyers vs. many sellers
    - 公開喊價：許多買方 vs. 許多賣方
- Two-Person Sealed-Bid Mechanism
  - One form of bilateral bargaining
    - 雙人密封投標機制: 一種特定的雙邊談判

Two-Person Sealed-Bid Mechanism

- Buyer V: unif.[0,100]; Seller C: unif.[0,100]
  - 買方價值 V: unif.[0,100]; 賣方成本 C: unif.[0,100]
- Piecewise-linear Equilibrium: (not unique)
  - Chatterjee and Samuelson (1983) (一個分段線性均衡)
  - Myerson & Satterthwaite (1883): Maximize ex ante gains (極大化事前報酬)

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

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

Two-Person Sealed-Bid Mechanism

- Radner and Schotter (JET 1989): 8 sessions
- 1, 2, 8: Baseline as above (場次1,2,8為對照組/如上所述)
- 3: Trade at price $(v + c + 50) / 3$ if $v > (c+25)$
  - Should bid their values $v = V$, $c = C$
    - (場次3改變交易價格決定方式，讓誠實下標買方價值/賣方成本為上策)
- 4: Price $= v$, (Buyers should bid $v = V/2$)
  - (場次4價格為買方出價；買方出價應為價值之半/場次5,6改分配增加學習)
- 5,6: Alternative distribution for more learning
  - Distribution w/ more trade (for learning): m=0.438
- 7: Face-to-face bargaining (場次7為面對面談判)

(用資料估計買方出價函數斜率)

Estimated Buyer Bid Function Slope

Session (場次)	Below Cutoff (前段) β	Below Cutoff (前段) $\hat{\beta}$	Below Cutoff (前段) t-stat (t值)	Above Cutoff (後段) β	Above Cutoff (後段) $\hat{\beta}$	Above Cutoff (後段) t-stat (t值)
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	(-0.88)	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)

(用資料估計賣方出價函數斜率)

Estimated Seller Bid Function Slope

Session (場次)	Below Cutoff (前段) β	Below Cutoff (前段) $\hat{\beta}$	Below Cutoff (前段) t-stat (t值)	Above Cutoff (後段) β	Above Cutoff (後段) $\hat{\beta}$	Above Cutoff (後段) t-stat (t值)
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)

(面對面可達到110%效率)

Face-to-face Yields 110% Efficiency

- Some truthfully reveal; others do not (因部分人講真話)
- 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. (如果面對面談判的成功可重複驗證，那也許就不必再費心尋找資訊不全下、更好的制式談判方式了)
  - 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. (反而需要更好的制式談判理論來解釋為什麼面對面的方式這麼成功)

Follow-up Studies (後續研究)

- Schotter, Snyder and Zheng (GEB 2000)
  - Agent bargains face-to-face for you (派代表幫你談判)

- Rapoport and Fuller (1995)
  - Strategy method; asymmetric value distribution
    - 詢問完整策略、買方價值/賣方成本分配不對稱

Follow-up Studies (後續研究)

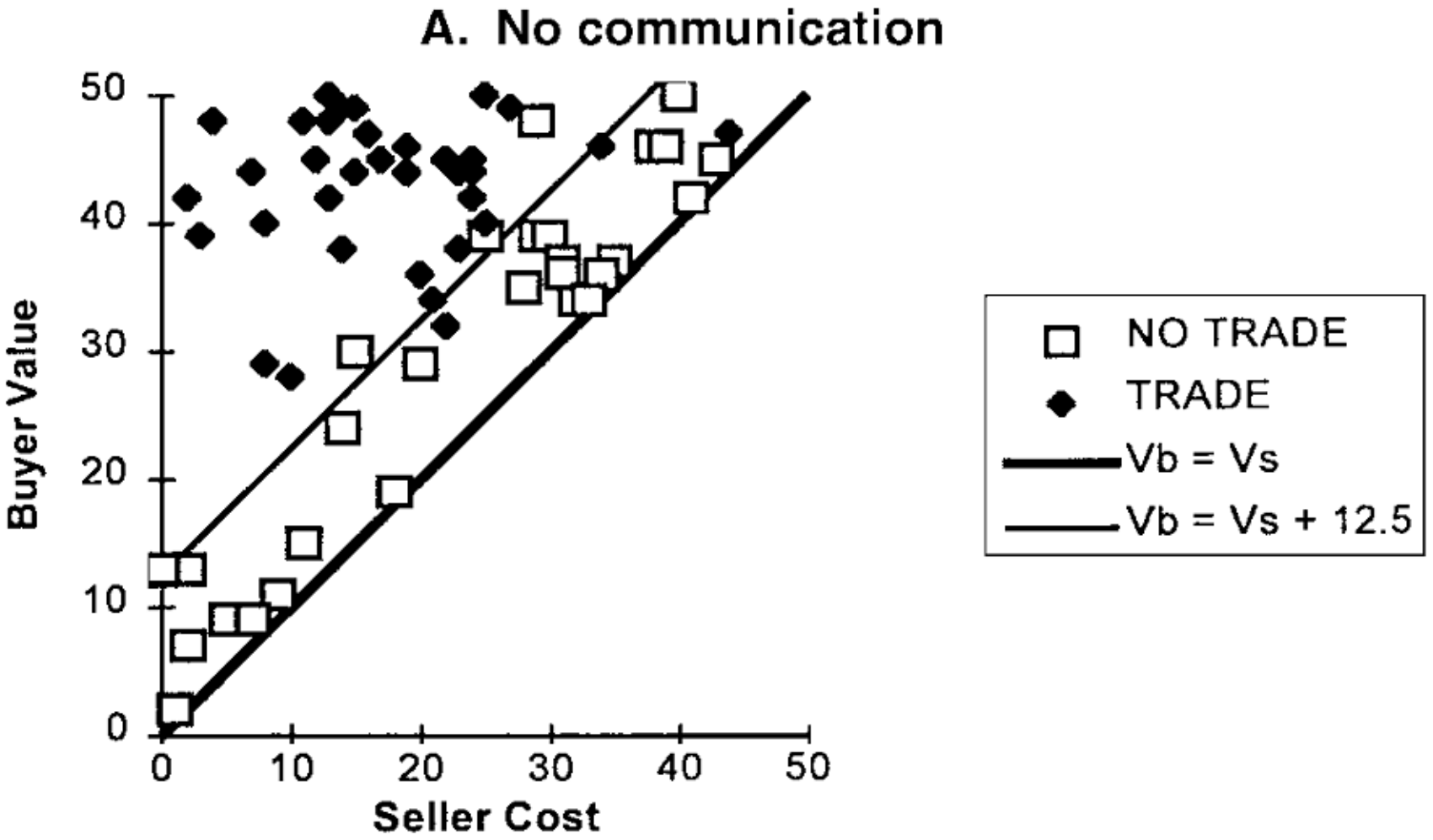
- Daniel, Seale and Rapoport (1998)
  - Asymmetric value distribution (20 vs. 200)
    - 買方價值/賣方成本分配不對稱 (0-20 vs. 0-200)

- Rapoport, Daniel and Seale (1998)
  - Flip buyer-seller asymmetry; fixed pairing
    - 買方價值/賣方成本的分配不對稱反過來、固定配對

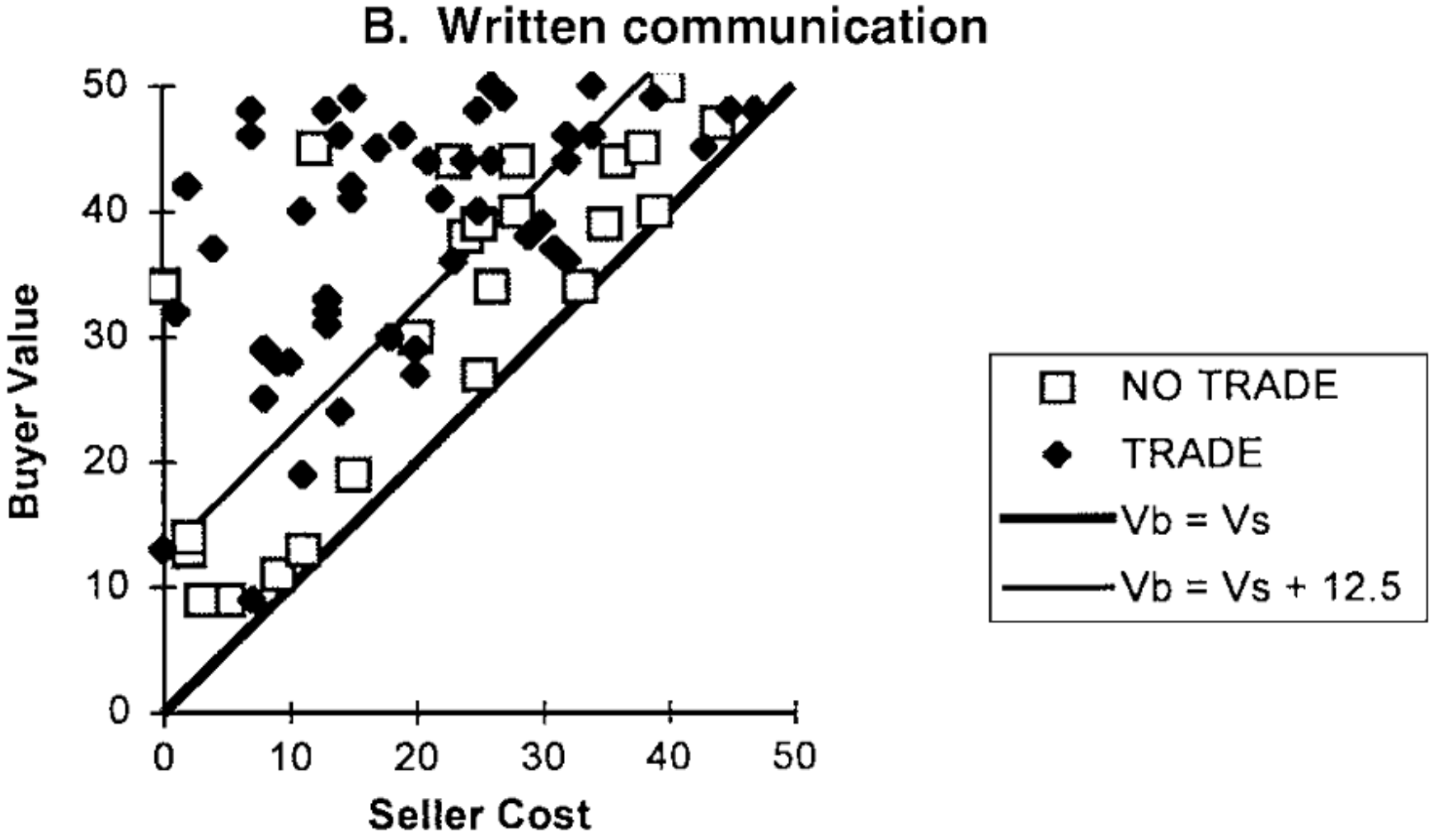
Communication vs. Sealed-Bid (溝通 vs. 密封投標)

- Valley et al. (GEB 2002): Communication (溝通)
- Buyer/Seller Values/Costs: uniform[0, $50]
  - 買方價值/賣方成本的分配都是 uniform[0, $50] (透過出價來談判)
  - Bargain by stating bids; 7 periods; no rematch
  - Half had no feedback (七回合不重複配對/一半沒有看結果)
- No communication: Sealed-bid in 2 minutes
  - 沒有溝通(2分鐘內密封投標) vs. 文字溝通(13分鐘傳紙條交換意見) vs. 當面(事前溝通)
- Written communication: Exchange messages for 13 minutes before final bid
- Face-to-face: Pre-game communication

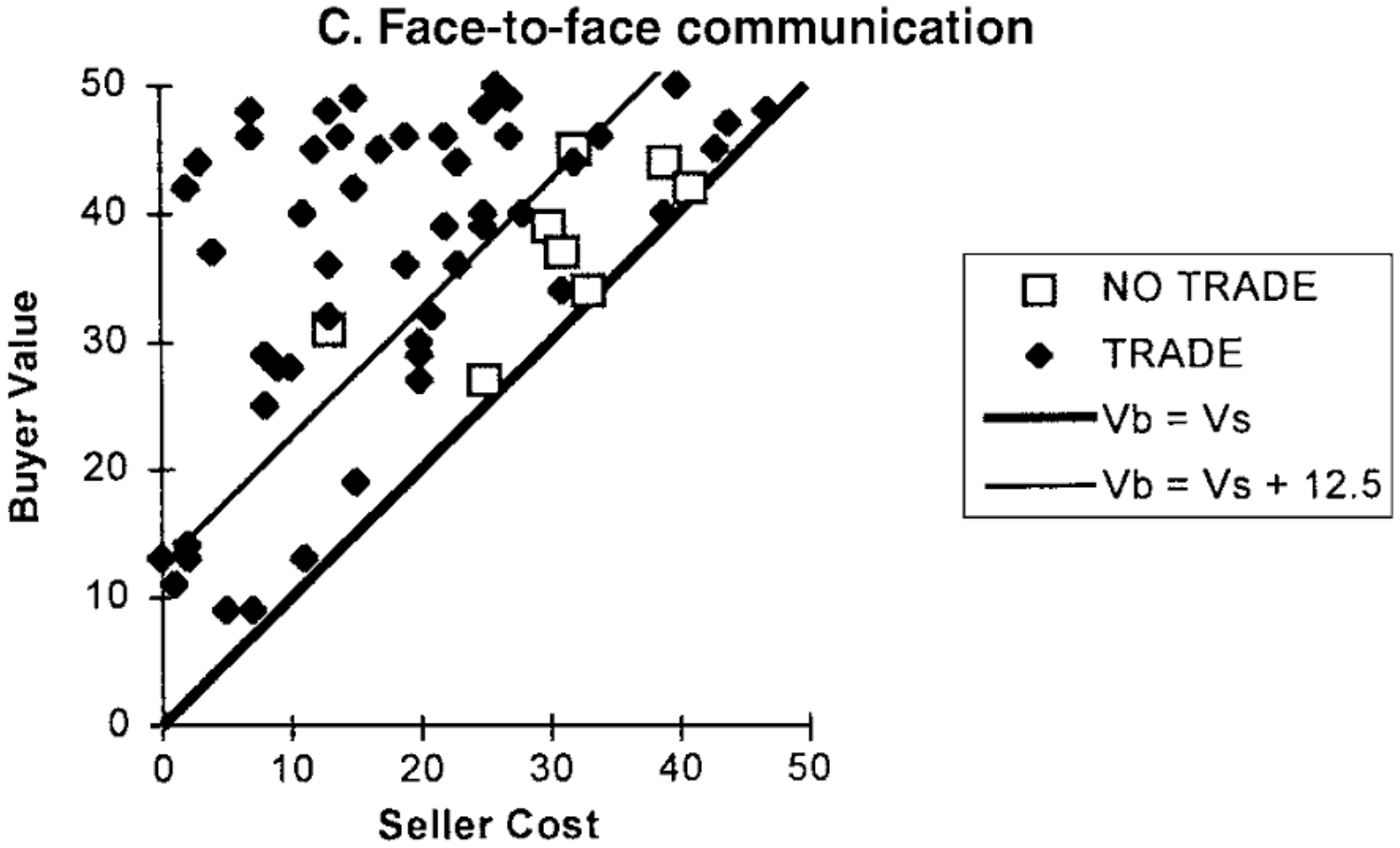
Communication vs. Sealed-Bid (溝通 vs. 密封投標)



Communication vs. Sealed-Bid (溝通 vs. 密封投標)



Communication vs. Sealed-Bid (溝通 vs. 密封投標)



Communication vs. Sealed-Bid (溝通 vs. 密封投標)

- Empirical bid function slope = 0.7 (near 2/3)
  - 實驗資料估計出來的出價函數斜率(=0.7)接近三分之二
- Why are there "gains of communication"?
  - 「溝通的好處」哪來?
- Slope of buyer bids against seller bids=0.6
- Buyers bid higher when seller bids higher
  - 賣家出價約為買家的六成且賣家出價愈高、買家出價愈高
  - Mutual bidding of values (common in students)
  - Mutual revelation of values (common in students)
    - (學生受試者更傾向)一起用真實價值/成本出價或一起揭露

Communication vs. Sealed-Bid (溝通 vs. 密封投標)

- Coordinating on a price (40%文字/70%當面協調相同出價)
  - Happens 40% in written, 70% in face-to-face
- Not truth-telling (only 1/3) (講真話只有1/3且未協調)
  - TT not coordinated (4% written, 8% face)
- Feel each other out; give enough surplus
  - Modal – equal split of surplus (彼此試探後給足交易好處)
- Variance of surplus doubles (by mismatch)
  - (大多平分交易好處，但交易好處的變異數倍增，因為協調不成)

Conclusion (結論)

- Unstructured Bargaining (自由談判: 焦點/競爭的焦點)
  - Focal divisions; competing focal points
  - Self-serving bias (erased by veil of ignorance or stating weakness of own case) (自立偏誤可以無知之幕或找己方弱點抗衡)
- Structured Bargaining (制式談判)
  - Deviate toward equal splits (朝平分偏離均衡預測/因社會偏好?)
  - Social preference models could explain this
  - But Johnson et al. (JET 2002) suggest limited look-ahead as reason for such deviations
    - 但MouseLAB結果顯示也可能來自無法「無限往前看」的有限理性

Conclusion (結論)

- 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 δ wrongly
  - Buyers accept too early

Conclusion (結論)

- 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?