1.5.6 The Firms' Hold-Up Problem

Two firms reach agreement on a joint venture, and then each invests in a sunk asset.

Each worries:

"They've got me over a barrel" — because of fear of:

- being forced to accept disadvantageous terms later, or
- its investment being devalued by the other's actions.

— the **hold-up problem**

Because of the absence of complete contracts (see later).

Example of the Hold-Up Problem

Assume the asset is entirely worthless outside the joint venture: *sunk*.

The cost of the investment is 2 for each firm,
and the gross return for the venture is 8, or a net return of 4.

Assume division of the gross return can occur through costly actions, which cannot be contracted.

Actions: "Grab" or "Don't grab".

Grabbing costs 3.

If neither Grabs, then equal shares = 2.

If both Grab, then equal shares = −1.

If A Grabs but B Doesn't, then A gets 8 − 2 − 3 = 3 and B gets −2.
And vice versa.

The Hold-Up Problem

		B	
		Grab	Don't
A	Grab	−1, −1	3, −2
	Don't	−2, 3	2, 2

TABLE 1. The payoff matrix (A, B)

A Prisoner's Dilemma, *but* —

the firms don't have to play!

The threat of opportunism completely destroys the incentive to invest:
If the firms can't commit not to try to Grab, then no investment will take place:

Market example: 1920s General Motors and the independent Fisher Body company.

1.5.7 Chicken!

The notorious game of Chicken!, as played by young men in fast cars.
Here “Bomber” and “Alien” are matched.

Chicken!

		Bomber	
		Veer	Straight
Alien	Veer	Blah, Blah	Chicken!, Winner
	Straight	Winner, Chicken!	Death? Death?

TABLE 2. The payoff matrix (Alien, Bomber)

1.6 Modelling Players' Preferences

In *two-person games*, each of the two players has only n possible *actions*:

$\therefore$ represent the game with a $n \times n$ payoff matrix.

Two actions per player: $n = 2$.

$\therefore$ Each player faces four possible combinations.

For a one-shot game in *pure strategies*
(i.e., no dice rolling or mixing of pure strategies):

need only *rank* the four combinations:

best, good, bad, worst:

$\rightarrow$ payoffs of 4, 3, 2, and 1, respectively

Complications ...

Larger numbers of possible actions:

harder to rank the larger number of outcomes
(with three actions there are $3 \times 3 = 9$),
but ranking sufficient.

(i.e. *ordinal preferences*, instead of asking "by how much is one outcome preferred to another?")

Later, with **mixed strategies** (probabilistic or dice-throwing) and unpredictability:

- use *probabilities* over actions and
- the *expected values* of the possible outcome
- use *cardinal measures* over the amounts, usually dollar amounts, which are unambiguous, *and the numbers matter*!

A Pricing Rivalry Duopoly Game

- You (and your team) are sellers of a homogeneous, unbranded commodity.
- There is one other seller of this product in the market.
- Since the product is a commodity, buyers will automatically buy from the seller with the lower price.
- If both sellers charge the same price, then the two sellers split the market.
- If one seller charges a lower price, then that seller gets all the sales.

Demand For The Product

The industry demand for the product is as follows:

Industry Demand	
Price	*Quantity*
$9	0
$8	1
$7	2
$6	3
$5	4
$4	5
$3	6
$2	7
$1	8
$0	9

Profits and Costs

- If you price at \$4 and the other team at \$5, then you make all the sales, selling 5 units for a sales revenue of \$20. The other team has zero revenue.

- There is an average cost of \$2 per unit, so your profit π would be

$$\pi = \$20 - (5 \times \$2) = \$10$$

  The other team has zero costs and so zero profits, when you undercut them.

- Your aim is to maximise your team's ***profit.***

The Game

- We will play the pricing game for several rounds.
- Each round, you and your opposing team will simultaneously (and secretly!) choose a price.
- You will have a minute to decide your price.
- Write your price on the slips of paper provided.
- As soon as prices are submitted, I'll collect the prices and show you your profits and the other team's profits.
- Total profits will be calculated at the conclusion of the game.
- Your aim is to maximise your team's ***profit.***

Game Debrief

Questions:

- How did your game evolve?
- What signals did you send? How? Were they effective? Consequences?
- What did the other side do? Why — what did they mean? Your response?
- What patterns of play can you see across the score sheet?

Games Are Interactive

- a newspaper's price fall (e.g.?)
- OPEC members choosing their output
- Qld coal miners selling coal to the Japanese utilities
- a board of directors setting up a stock-option plans for a CEO
- Qantas and Ansett pricing airfares
- Telstra and Optus pricing phone calls
- Pacific Power's investment in new generating capacity
- the Australian Graduate School of Management's hiring decisions
- India v. Pakistan
- a committee's voting on which one of several candidates to promote

Q: *Is there interaction between players?*

Simple Games:

- The Dollar Auction
- The *n*-person Prisoner's Dilemma
- The Ice Cream Sellers
- The Prisoner's Dilemma
- The Battle of the Bismark Sea
- Chicken!
- The Two Monkeys
- The Battle of the Sexes
- The Gift of the Magi
- Bargaining
- Vickrey auction

Further games, from Gardner (pp.):

- Battle of the Networks: 51−54
- Video System Coordination (2P & 3P): 65−66, 86−87, 107−108
- Cigarette Advertising on TV (2P & 3P): 68−69, 108−109
- Matching Pennies: 77−81
- Market Niche (Symm. & Asymm, 2P & 3P): 78−90, 104−106, 112−113
- Everyday Low Pricing — Sears: 92−94
- Competitive Advantage (2P & 3P): 54−56, 104−16
- Stonewalling Watergate: 109−111
- Tragedy of the Commons: 118−125
- Cournot Competition: 140, 202−204
- Bertrand Market Game: 144−147
- Telex versus IBM: 155−162, 223−226
- Conscription: Reluctant Volunteers: 164−165
- Mutually Assured Destruction — MAD: 165−169
- Hawk versus Dove: 217−219
- Caveat Emptor (Buyer Beware): 239−242
- Depositor versus Savings & Loan: 285−287
- Voting Games: 397−418

1.7 Concepts Used:

Best response means the player's best action when faced with a particular action of his or her rival

Nash[1] equilibrium is the outcome that results when all players are simultaneously using their best responses to the others' actions;

thus at an equilibrium all players are doing the best they can, given the others' decisions; that is, all are playing their best responses.

If, conversely, the game is *not* at an equilibrium, then at least one of the players could have done better by acting differently.

∴ A Nash equilibrium is self-reinforcing: given that the others don't deviate, no player has any incentive to change his or her strategy.

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1. John Nash received the Nobel prize in Economics in 1994 for his work done in the early '50s. He is played by Russell Crowe in *A Brilliant Mind*.

Efficiency

An **efficient** outcome is an outcome when there exists no other outcome that each player would prefer. A Pareto-efficient outcome.

An efficient outcome cannot be Pareto dominated by any other outcome.

In a zero-sum game, all outcomes are Pareto efficient, since at least one player is worse off when others are made better off in choosing another outcome.

1.8 Gains from Trade

A voluntary exchange creates gains for both parties. The gains from trade arise from differences between buyer and seller:

- in their endowments (possess)
- in their preferences (like)
- in their productive capacities (do)
- in their expectations (believe)
- in their information (know)

Important in negotiation to explore the possibilities for mutual gain. ("win−win")

In the Prisoner's Dilemma and some other non-zero-sum games:

the outcome of the game is not efficient—
if both players cooperated, they would both be better off; the Nash equilibrium is not Pareto-optimal or efficient.

To realise the gains from trade, the players must overcome the game logic. How?

Overcoming the Prisoner's Dilemma.

- *contracting* may support cooperation
- *repetition* and the possibility of retaliation may support cooperation, so long as
  - — the discount rate is not so high that future prospects of retaliation are harmless, and
  - — any player's deviation can be observed

But meeting these conditions does not *guarantee* cooperation.

If there is more than one (efficient) equilibrium,

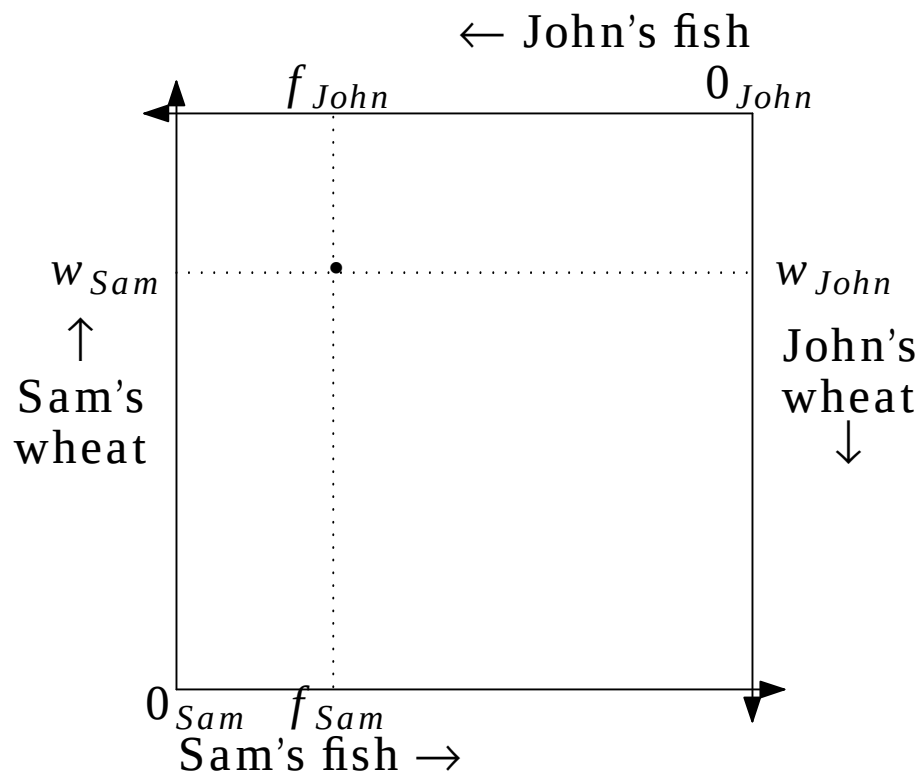
there is still a role for *bargaining* to determine which of these equilibria to achieve,

as in the Battle of the Sexes.

Gains to trade is synonymous with *positive-sum games*,

since at efficient strategy combinations (or Pareto-optimal outcomes) no other combination can make players better off without making at least one player worse off.

Gains to trade.



An Edgeworth Box

1.9 What Have We Learnt?

Rule 1: Look ahead and reason back.

Rule 2: If you have a dominant strategy, then use it.

Rule 3: Eliminate any dominated strategies from consideration, and go on doing so successively.

Rule 4: Look for an equilibrium, a pair of strategies in which each player's action is the best response to the other's.

1.10 Summary of Strategic Decision Making

The following **concepts & tools** are introduced:

The Ice-Cream Sellers:

- payoff matrix
- incentives to change — use arrows!
- dominant strategy

The Prisoner's DilemmaThe Capacity Game:

- possibility of repetition
- efficient outcome
- non-zero-sum game
- inefficient equilibria

The Battle of the Bismark Sea: (in SET)

- zero-sum game
- iterated dominant strategy
- Nash equilibrium

Two Monkeys:

- rationality
- weakness may be strength
- efficient equilibria

The Battle of the Sexes: (in SET)

- coordination, not rivalry
- first-mover advantage
- focal points

1.11 Ten Simple Lessons from Rothschild.

1. If you have a *dominant strategy* and no opportunity to agree on another course of action with your opponent, then play that strategy.
2. If you don't have a dominant strategy but your opponent does, and there is no opportunity to agree on another course of action with your opponent, then expect her to play her dominant strategy and do the best you can in the circumstances.
3. If neither you nor your opponent has a dominant strategy, and there is no opportunity to agree on another course of action, then select, and *signal your commitment* to, a clear strategy to encourage your opponent to behave in a way you'd prefer.
4. The only *credible threat* is the one which would be in your interest to carry out, if necessary.
5. *Commitment* to make a threat credible can pay dividends in the long run.

6. An investment can be profit-increasing if it discourages entry, but costly if your potential competitors are lower-cost than you are.
7. Always take your opponent's threat seriously if implementation is his dominant strategy.
8. A credible threat is not always a deterrent.
9. A threat which lacks credibility in the short run may be credible in the long run.
10. A firm which appears to be tying its own hands may actually be tying those of its opponent as well.

1.11.1 Seven issues addressed in Game Theory:

1. What does it mean to choose strategies "rationally" when outcomes depend on the strategies chosen by others and when information is incomplete?
2. In "games" that allow mutual gain (or mutual loss) is it "rational" to cooperate to realise the mutual gain (or to avoid the mutual loss) or is it "rational" to act aggressively in seeking individual gain regardless of mutual gain or loss?
3. If the answers to 2. are "sometimes," then in what circumstances is aggression rational and in what circumstances is cooperation rational?
4. In particular, do continuing relationships differ from one-off encounters (one-night stands?) in this issue?
5. Can moral rules of cooperation emerge spontaneously from the interactions of rational egoists?
6. How well does actual human behaviour correspond to "rational" behaviour in these cases?
7. If it differs, then how? Are people more cooperative than would be "rational?" More aggressive? Both?

1.11.2 Cooperative and Non-cooperative Games

A wholesaler wants to merge with any one of four retailers who jointly occupy a city block. If the merger goes through, the wholesaler and the retailer will make a combined profit of $10 million. The retailers ahev an alternative: they can band together and sell to a real estate company, making a joint profit of $10 million that way. Can the outcome be predicted? If the wholesaler joins a retailer, how should they divide the $10 million?

An inventor and either of two competing manufacturers can make $10 million using the inventor's patent and the manufacturer's factory. If the inventor and one of the manufacturers should manage to get together, how should they share their profit?

— both examples of *Cooperative Games*

Cooperative game theory: what kinds of *coalitions* a group of players will form:

— if different coalitions produce different outcomes?

— if these joint outcomes have to be shared among members?

Non-cooperative game theory: which *strategies* will players choose?

Games:

players' objectives complex:
competing in terms of market shares
a common interest (in high prices)

Noncooperative:

players' choices based only on their perceived self-interest
not based on sharing or fairness

Cooperative Theory:

1. what different groups of players can achieve jointly — coalitions
2. to what extent the joint results can be shared among participating players

Binding Agreements?

1. Problem:
   - if there are gains from cooperation, but
   - if the distribution of these gains doesn't provide sufficient incentives for the coalition of players to conform to the cooperative strategy combination,
   - then there must be an outside institution to force cooperative agreement
   - lest one or more cooperating agents renege

so: assume existence of a mechanism to guarantee cooperative agreements, e.g. *binding agreements*

Coalitions

2. Moreover:

- cannot distribute subjective probabilities, but
- can redistribute monetary payments or private goods.

Coalition can reach a set of payoffs

- by redistributing the joint outcome, or
- by making monetary side payments

Coalitional Form:

- binding agreements possible
- payoffs can be transferred among players
  (how?)

(See Co-opetition later.)

In a strategic interaction, what do we mean by an "equilibrium"?

Where Are We?

1. Strategic interactions.
2. Look forward and reason backwards.
3. Simple games.
4. Pay-off matrix. (strategic or normal form)
   and arrows
5. Dominant strategy;
   iterated dominant strategy.
6. Nash equilibrium.
7. Pure v. mixed strategies.
8. Extensive-form game tree for sequential games.
   (information sets)
9. Bidding in a second-price auction.
10. Efficient (Pareto optimal) outcomes.