Oligopoly

Applying game theory to analyse markets with only a few sellers

What can a firm commit to?

- Recall from our discussion of monopoly, that a monopolist who commits to restrict supply can raise price.
- A similar effect occurs in oligopoly.
  - Firms that can make quantity commitments can generate some power over price
  - Even when there is no product differentiation

Cournot duopoly

- Simplifying Assumptions:

  - Duopoly (two firms): $N = 2$

  - Constant marginal costs: both firm 1 and 2 can produce a unit of output at cost, c.

  - Linear Demand: $P = A - B(Q_1 + Q_2)$
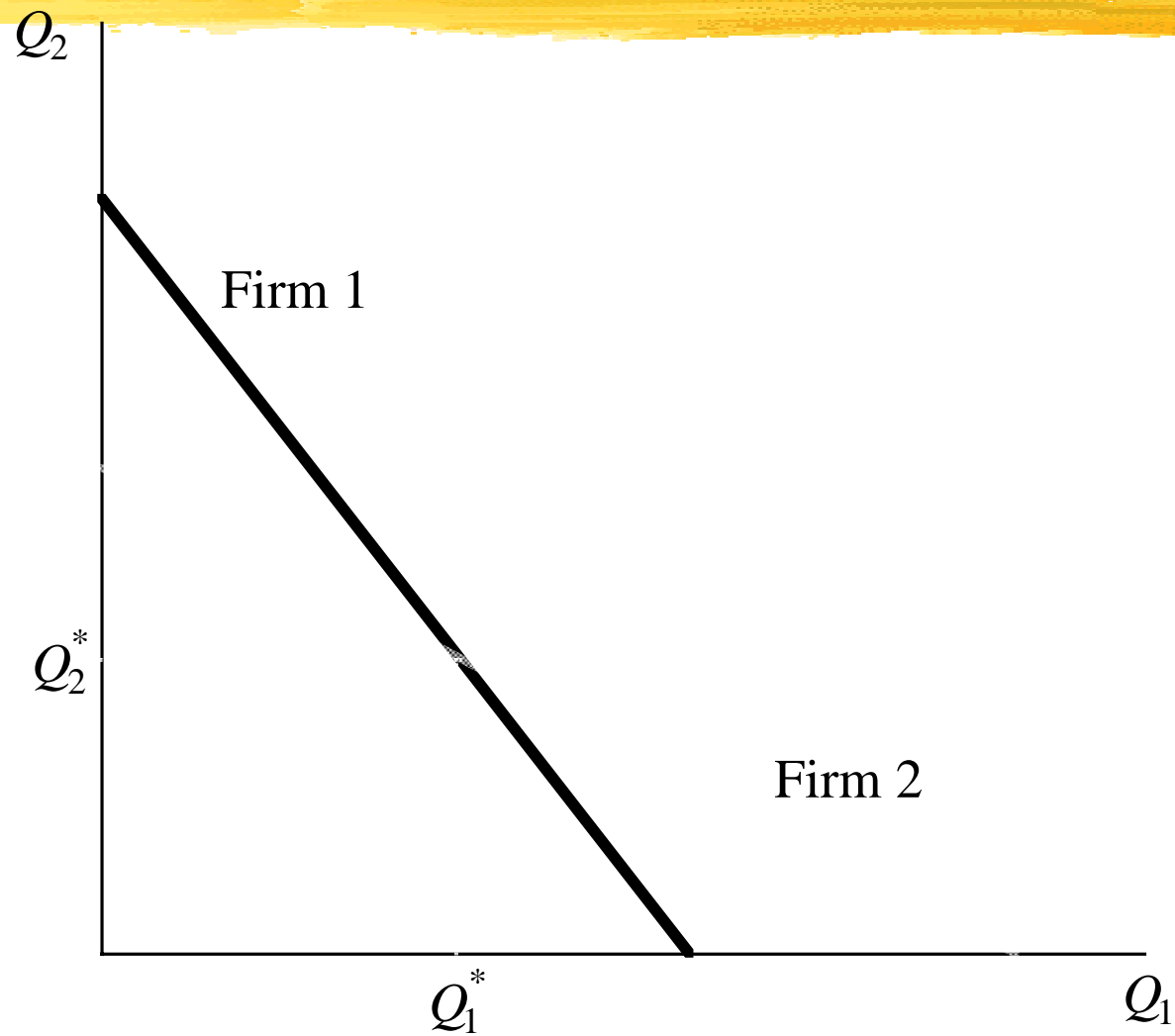
- What quantity does each choose to supply?

Best response (reaction) functions

- Each firm asks, for each possible quantity choice of the other firm, what quantity maximises their profits?

- For Firm 1: Maximise $Q_1 \left[A - B(Q_1 + Q_2) \right] - cQ_1$

$$\text{FOC: } A - B(Q_1 + Q_2) - BQ_1 - c = 0$$

$$\Rightarrow Q_1 = \tfrac{1}{2B}(A - c - BQ_2)$$

Cournot: Graphical Solution

Cournot: Algebraic Solution

- Take two first order conditions:
$$0 = A - c - 2BQ_1 - BQ_2$$
$$0 = A - c - BQ_1 - 2BQ_2$$

- Solve for the two quantities
$$Q_1^* = Q_2^* = \frac{A - c}{3B}$$

- Substitute back into market demand
$$P^* = \tfrac{1}{3}(A + 2c)$$

Cournot: Comments

- Each firm chooses its quantity taking the other firm's choice as given. Quantity choices are *strategic substitutes*.

- Nash equilibrium: neither firm wishes to change

- Allows them to earn a price above marginal cost.

- Can earn positive profits even though the produce the same product.

Quantity commitments

- When is it reasonable to make quantity commitments?
  - actual capacity constraints (make to stock)
  - difficult to change production schedules and respond to demand changes
- When is it unreasonable?
  - quick production response
  - can make to order

Bertrand duopoly

- Firms make choices assuming that other firm will adjust quantity to maintain price

- Homogenous products: outputs are perfect substitutes. Consumers will buy from the firm with the lowest price.

- If two firms set different prices, then one firm gets entire demand. If both

Bertrand: Nash equilibrium

- What if $P_1 = P_2 < c$? Then both firms make a loss.

- What if $P_1 = P_2 > c$? Then either firm can gain entire market by dropping price by a very small amount. This is profitable.

- If $P_1 = P_2 = c$, then if either firm raised price they would make zero profit. If either dropped it, they would make a

Comparing Cournot and Bertrand

- In Bertrand, price competition is much "tougher." Hence, profits are lower.

- In Cournot, quantity commitments allow each firm to exclude buyers. Hence, they have some monopoly power.

Bertrand: Differentiated Products

- Competition between *Time* and *Newsweek*.

    - Quick production cycles: Bertrand
    - Differentiated products -- price not the only variable for consumers

- If *Newsweek* has a price of $3, *Time* can get away with a price above $3.

- As *Newsweek* drops its price, some customers switch. Optimal for *Time*

Bertrand: Reaction Curves
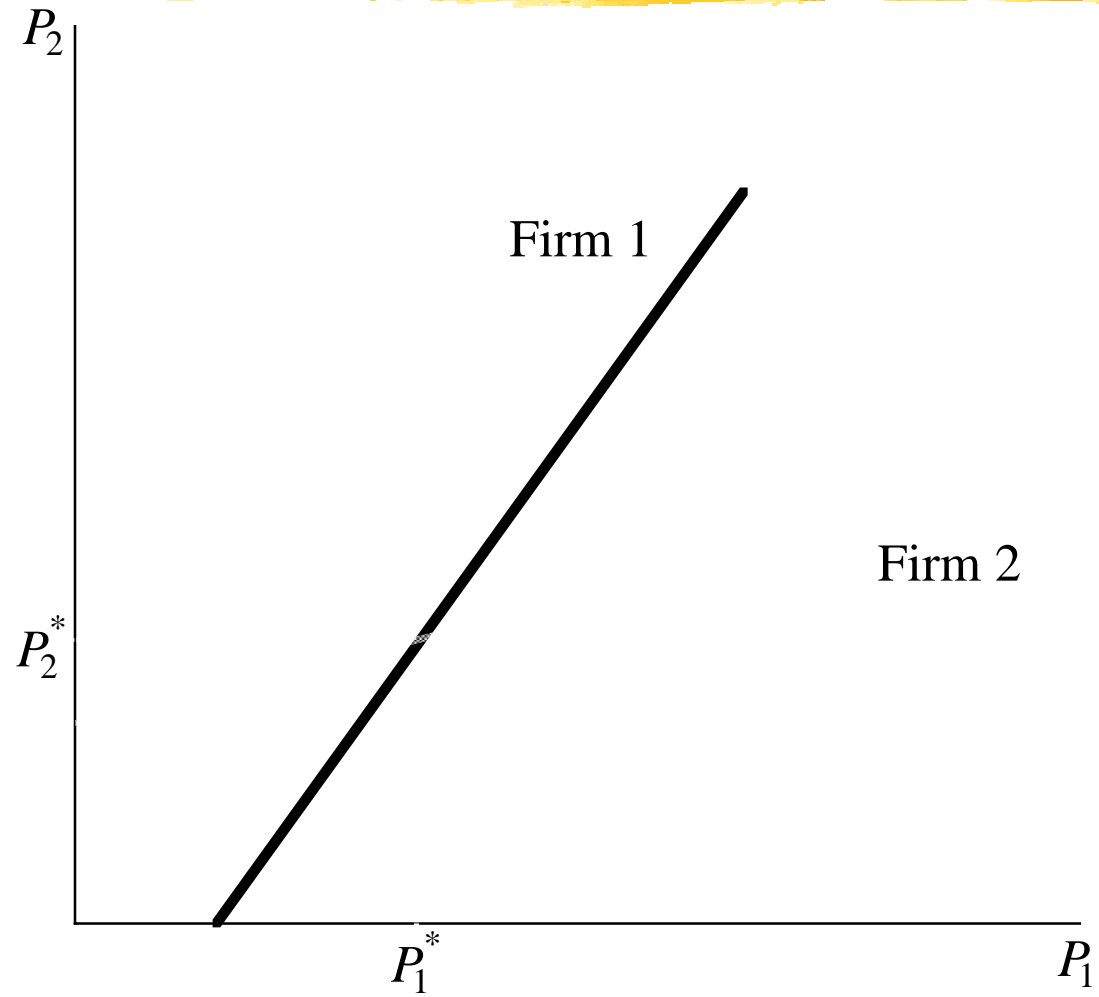
Bertrand: Summary

- When quantity commitments are not possible, price competition is "tough."

- This means that firms must respond to price cuts by cutting their own prices.

- Product differentiation means that these firms can still earn positive profits and price above marginal

Strategic Commitments

What pre-emptive actions can firms take that improve their competitive position later on

Reputation for toughness

"For many years, Edwin Land's Polaroid corporation purposefully refused to diversify out of the instant photography business. With all its chips in instant photography, it was committed to fight against any intruder in the market.

On April 20, 1976, after twenty-eight years of a Polaroid monopoly on the instant photography market, Eastman Kodak entered the fray: it announced a new instant film and camera. Polaroid responded aggresively, suing Kodak for patent infringement. Edwin Land, founder and chairman, was prepared to defend his turf:

This is our very soul we are involved with. This is our whole life. For them it's just another field.... We will stay in our lot and protect that lot.

The battle ended on October 12, 1990. The court's awarded Polaroid a $909.4 million judgment against Kodak. Kodak was forced to withdraw its instant file and camera from the market. Although Polaroid restored its dominance over the instant photography market, it lost ground to competition from portable videocassette recorders and minilabs that developed and printed conventional film in one hour. Lacking bridges, Polaroid began to feel trapped on a sinking island. With a change in philosophy, the company has begun to branch out into video film and even conventional film." (*from Dixit and Nalebuff*)

Why commitment is important

	Firm 2	
	Aggressive	Soft
Aggressive	12.5, 4.5	16.5, 5
Soft	**15, 6.5**	18, 6

Firm 1

Pre-emption equals commitment

- Firm 1 chooses "soft" and firm 2 chooses "aggressive."
- Firm 1 would prefer these roles were switched.
- Suppose firm 1 can take a pre-emptive action (e.g., expanding capacity) that commits it to being aggressive. Firm 2 will respond by being "soft."
- Being inflexible can have value. Consider "Window's '95"

Incentives to Commit

- Examine situations in which firm 1 (but not 2) is deciding whether to commit:
    - Adopt a process innovation
    - Position a new product
- To have strategic value, these actions must:
    - firm 2 must be aware of it; *and*
    - the action cannot be reversed.

Two Stage Game

Stage 1: Firm 1 decides whether to take action.

Stage 2: Both firms play engage in duopoly competition

Effects of Commitment

- *Direct effect*: holding 2's choices as fixed, what effect does action have on 1's profits?

- *Strategic effect*: how does the commitment affect each firm's choices in stage 2?
  - Depends on nature of competition in stage 2
  - How tough is price competition? Bertrand or Cournot
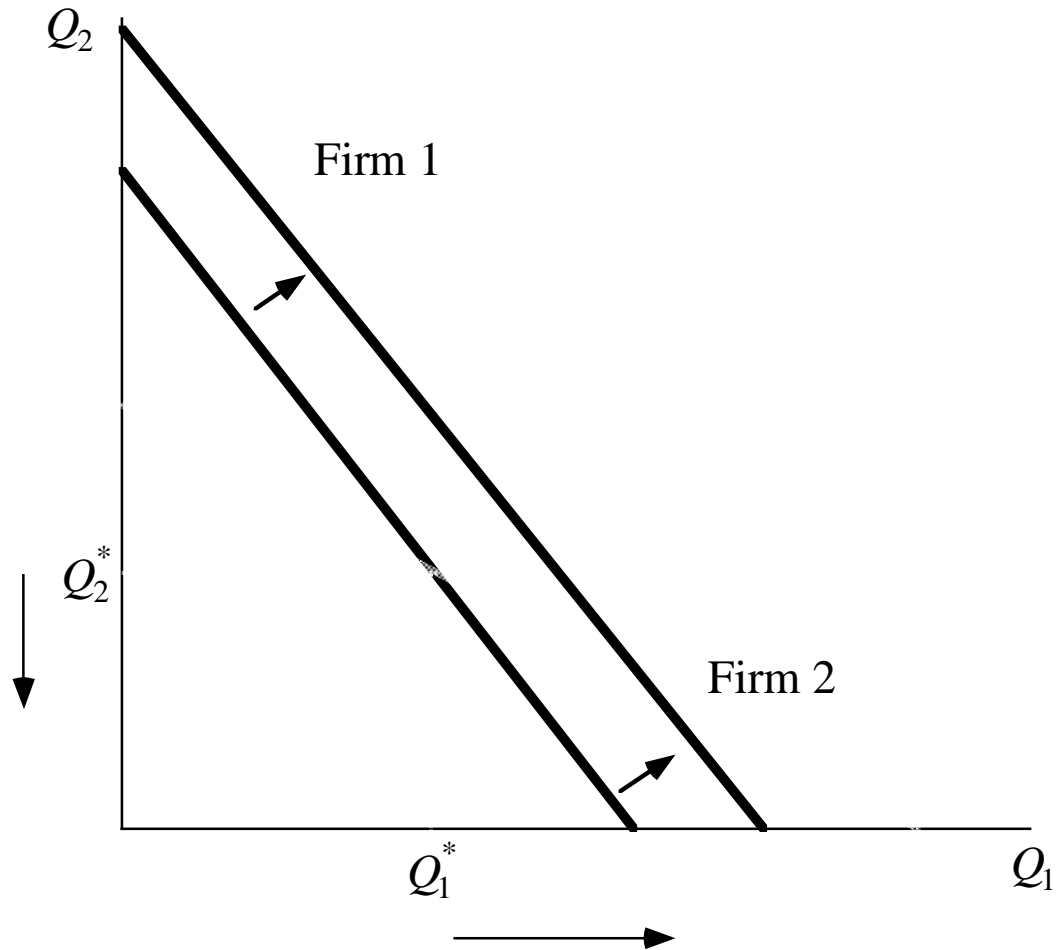
Top-Dog Strategy

Cournot competition in stage 2:

- Suppose the action makes firm 1 "tough."
- That is, firm 1 produces *more* output than otherwise would (e.g., process innovation).
- Positive strategic effect: 2 produces less output, so 1 gets a greater market share. Incentive to take action even with negative direct effects.

Be big and strong to become tough or

Top-Dog Strategy

Lean and Hungry Look

Cournot competition in stage 2:

- Suppose action makes firm 1 "soft."
- Whatever 2 does, firm 1 produces *less* output than it would have otherwise (e.g., decides to sell to another market in which it has a monopoly)
- Negative strategic effect since 2 produces more output. No additional incentive to take action.

Refrain from commitments that make you
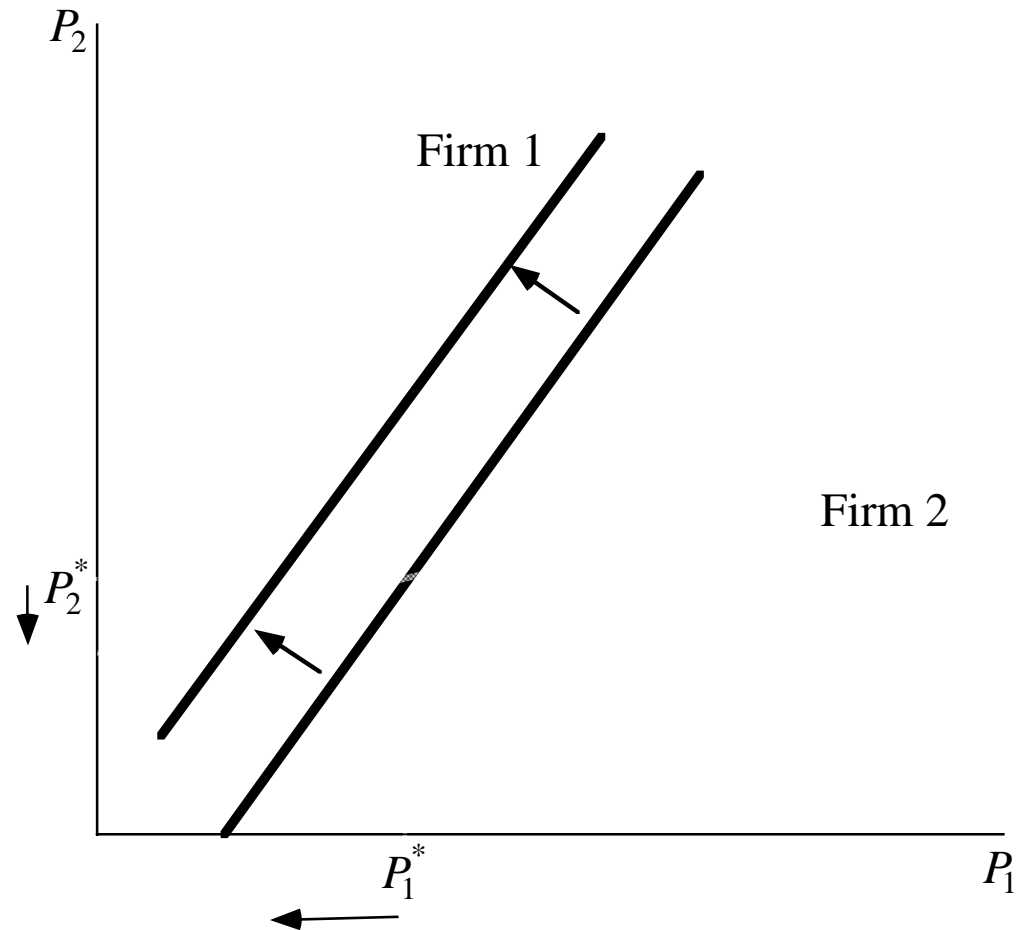
Lean and Hungry Look
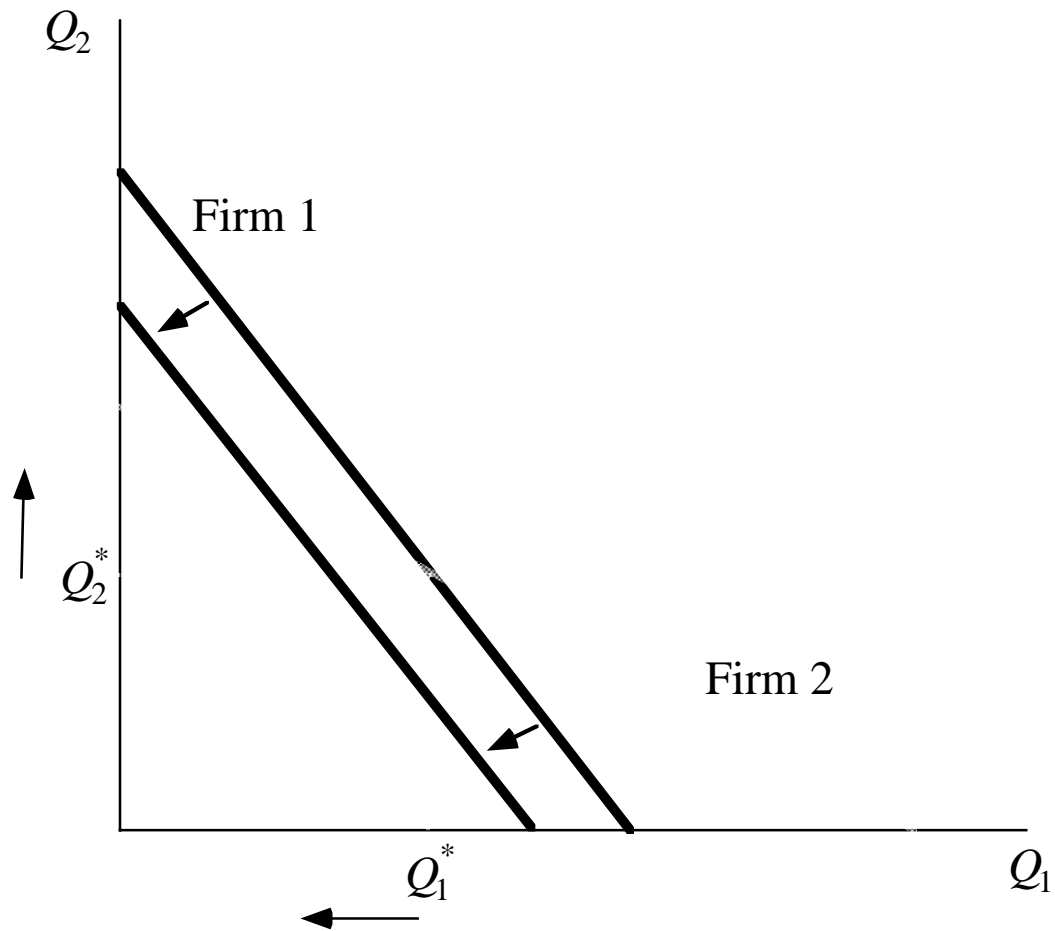
Puppy-dog Ploy

Bertrand competition in stage 2:

- The action makes firm 1 "tough."

- Whatever price 2 charges, firm 1 prices *less* than it otherwise would (e.g., process innovation).

- Negative strategic effect: 2 reduces its price. No additional incentives to take action.

Stay soft or weak to avoid an aggressive response

Puppy-dog PIoy

Fat Cat Effect

Bertrand competition in stage 2:

▌ The action makes firm 1 "soft."

▌ Whatever price 2 charges, firm 1 prices *more* than it otherwise would (e.g., 1 horizontally differentiates its product).

▌ Positive strategic effect: 2 increases its price. Possible take action even if direct incentive is negative.

Make a commitment to be soft and not compete hard

Fat Cat Effect
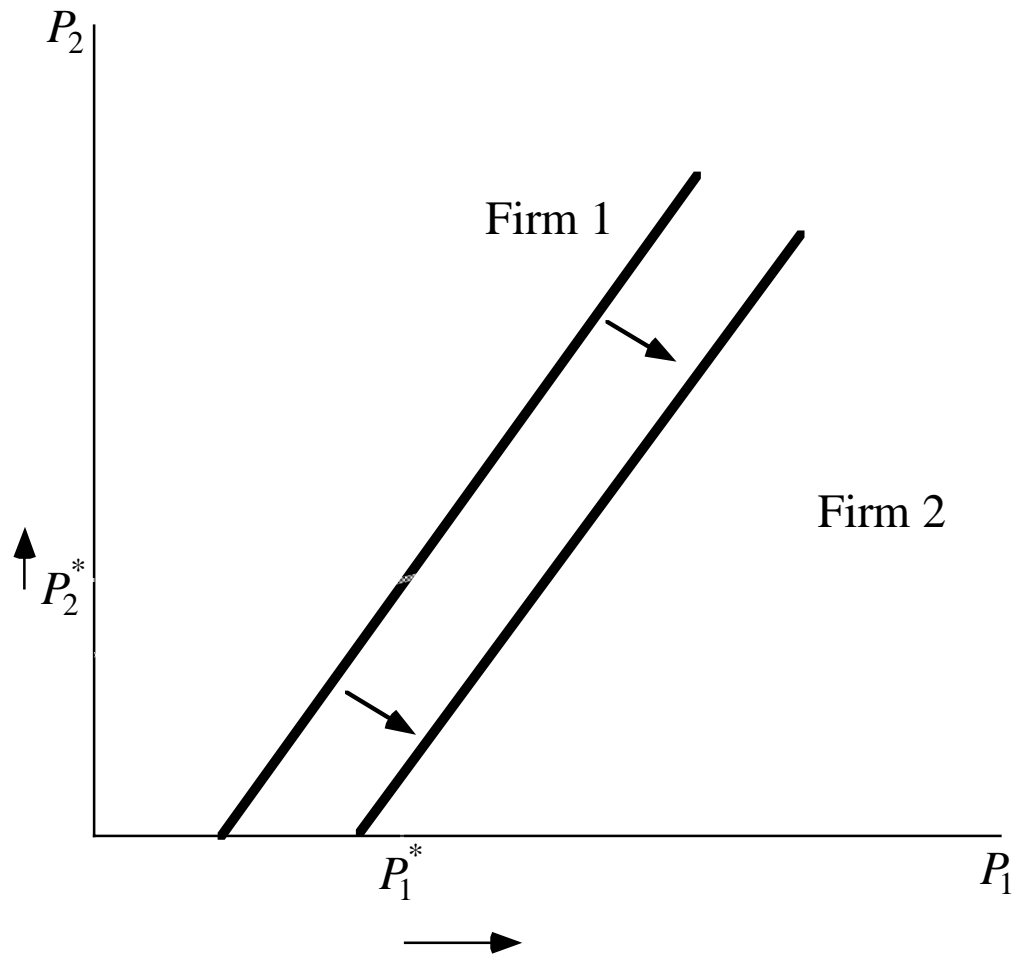
Case: Memory Chips

- Early 1980s: market dominated by US firms
- mid 1980s: Japanese firms (Toshiba, NEC) increased their investment in new capacity (while US firms didn't)
- late 1980s: 80% of market controlled by Japanese firms
- 1990s: massive investments by South Korean firms (Samsung, Hyundai) while the Japanese firms have not invested

Confusopolies

- A confusopoly is a group of companies with similar products who intentionally confuse customers instead of competing on price.

- A response to a reduction in entry barriers

- Recognition that price wars are costly

Existing Confusopolies

- Telephone service
  - who is cheaper, Optus or Telstra?
- Insurance
- Mortgage loans
- Banking
- Financial services

Coming soon ... energy, airlines, water

Dynamic Pricing Rivalry

What happens when strategic interaction occurs over time

Anticipating Price Changes

- In Bertrand competition, if price is high individual firms have an incentive to lower price and capture market share.

- But then rivals respond and so no additional profits are made
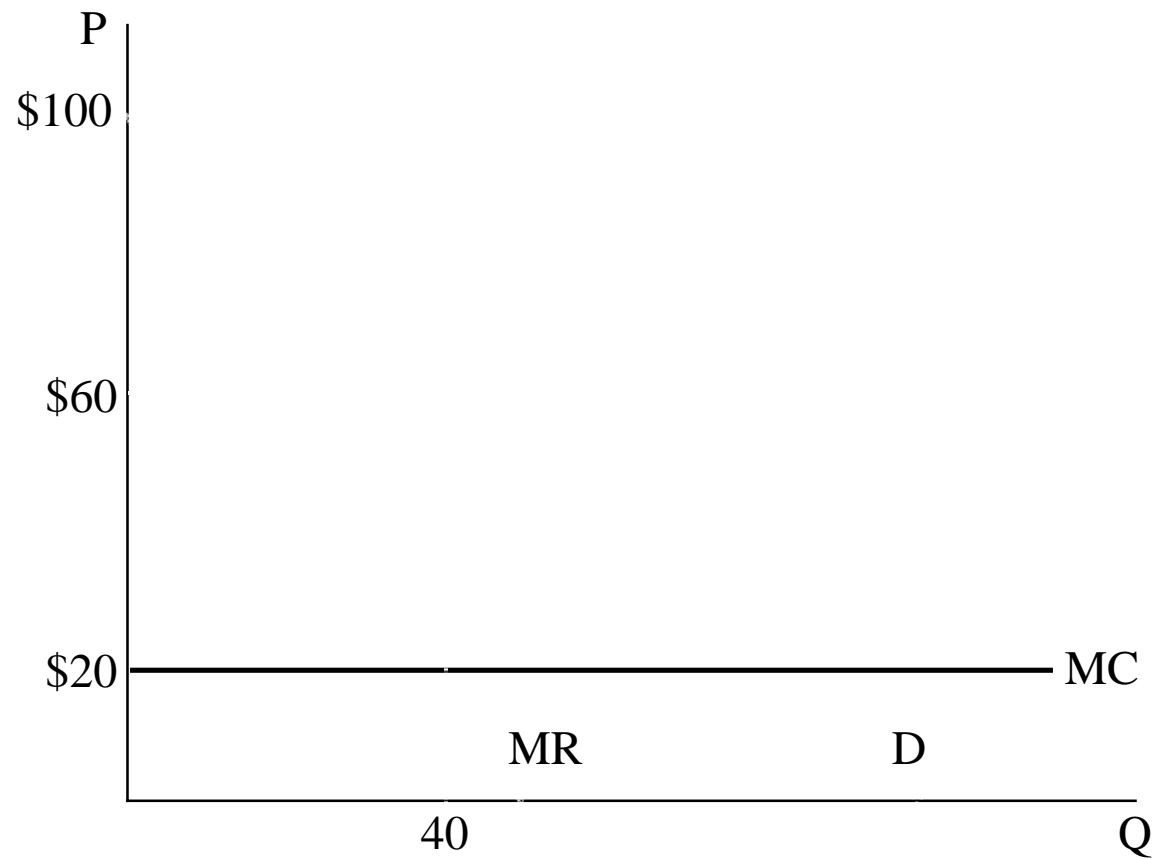
- Why don't they anticipate these reactions?

Dynamics in Pricing

Suppose …

- Mature industry with stable demand
- Two firms with access to same technology, etc., with constant marginal cost
- Produce homogenous goods
- Can't make quantity commitments.

Example: Act Like a Monopolist

P

$100

$60

$20 ————————————————————— MC

         MR   D

40   Q

Collusion Outcome

- Under cooperative pricing, both firms should choose a price of $60 and sell 20 units per year each.

- They earn $800 in profit each

- Under Bertrand competition, price equals marginal cost (= $20) and each earns zero profits.

Prisoners' Dilemma Bertrand Style

Firm 2

	$P_2 = \$40$	$P_2 = \$60$
$P_1 = \$40$	**$0, $0**	$1200, -$400
$P_1 = \$60$	-$400, $1200	$800, $800

Firm 1

A Conversation Among Oligopolists

As reported in the *New York Times* and reprinted in the text, a phone call from Robert Crandall of American Airlines to Howard Putnam of Braniff Ailines took place on February 21, 1982. The call was recorded by Mr. Putnam.

Mr. Crandall: I think it's dumb as hell for Christ's sake, all right, to sit here and pound the @!#$%&! out of each other and neither one of use making a @!#$%&! dime.

Mr. Putnam: Well...

Mr. Crandall: I mean, you know, goddam, what the hell is the point of it?

Mr. Putnam: But if you're going to overlay every route of American's on top of every route that Braniff has -- I just can't sit here and allow you to bury us without giving out best effort.

Mr. Crandall: Oh sure, but Eastern and Delta do the same thing in Atlanta and have for years.

Mr. Putnam: Do you have a suggestion for me?

Mr. Crandall: Yes, I have a suggestion for you. Raise your goddam fares 20 percent. I'll raise mine the next morning.

Mr. Putnam: Robert, we...

Mr. Crandall: You'll make more money and I will, too.

Mr. Putnam: We can't talk about pricing!

Mr. Crandall: Oh @!#$%&!*, Howard. We can talk about any goddam thing we want to talk about.

■   Adam Smith (*Wealth of Nations*): "People of the same trade seldom meet together..."

Collusion Among Oligopolists

- Oligopolists often try to collude to increase their profits. They do so by acting jointly as a monopoly and splitting up the profits. A group of firms that explicitly colludes is called a *cartel*. OPEC is a cartel. Cartels are illegal in Australia and elsewhere.

- If two firms who otherwise would be in Bertrand competition, agree to keep prices high, this would be collusion. Cournot competitors would agree to restrict quantities.

- If cartels are illegal, firms cannot collude openly. But they face problems of self-enforcement, coordination and entry.

Can Firms Cooperate?

Chamberlin: with only a few firms, each will recognise the folly of price wars -- by anticipating retaliation if they cut their price, firms will learn to collude.

- If, for historic reasons, the current price is $40 and a shock occurs, what will happen? Could Firm 1 raise its price to $60? If they do and the other doesn't, they face earning zero.

Can Firms Collude Implicitly?

- Suppose prices can be adjusted in a short period of time (e.g., a week). Firm 1 will know immediately if 2 hasn't lifted its price and can change its decision. Moreover, if it looks forward to 2's decision, it will see that 2 has reason to follow suit.

The Long-Run Equation

■ To see this suppose that each firm has a 10% discount rate on future profits -- corresponding to 0.2% per week. Firm 1 can reason:

If 2 sticks with $40, this will be learnt quickly, so 2 will anticipate 1 dropping its price back to $40. This means that 2's present value of discounted weekly profits will be:

$$23.08 + \frac{11.54}{(1.002)} + \frac{11.54}{(1.002)^2} + \frac{11.54}{(1.002)^3} + ... = \$5,793$$

The Long-Run Equation

If 2 follows and raises its price to $60, each earns an annual profit of $800 (weekly = $15.38). Therefore, 2 earns:

$$15.38 + \frac{15.38}{(1.002)} + \frac{15.38}{(1.002)^2} + \frac{15.38}{(1.002)^3} + \ldots = \$7,705$$

Better off keeping price high!

Local Conflicts

- 1994: Murdoch's *New York Post* tested a cut in prices to 25c in part of New York. It was very effective in raising market share.

- Led to the *Daily News* raising its price from 40 to 50 cents everywhere!

- Before going down to 25c the *Post* had raised its price to 50c everywhere.

The Card Game Again ...

- Same as original version: equal number of red and black cards.

- But one student has to leave early. The lecturer offers them a "best price" clause: agreeing to give the student the best deal given to any other student.

- What happens?

… Change in Bargaining Power

- The best deal is not really "best"!
- Now the lecturer is a tougher negotiator. In working for an extra dollar with an individual student, the lecturer knows this may mean a lower price for the absent student.
- The lecturer will end up with more than the $10.

"Most-Favoured Customer" Clause

- Manufacturers of antiknock petrol additives (Du Pont, Ethyl) were brought before the US Federal Trade Commission for using MFCs.

- The seller will pay buyers the best price they pay to anyone.

- Commits to not offering selective discounts to attract customers from rivals

- Lowers the gain from cheating on price collusion.

Other Facilitating Practices

- "Meet the competition" clauses
  - Benefits if adopted by other firms
- "Take-or-pay" contracts
  - convert variable to fixed costs
  - if rivals escalate competition, you will commit yourself to a tough price war
- "Loyalty" awards
  - frequent flyer points
  - credit card benefits (e.g., GM Card)