LECTURE 3.0

MARKET STRUCTURE

MARKET STRUCTURE - LECTURES

3.0 Market structure

3.1 Perfect competition

3.2 Barriers to entry

3.3 Monopoly and monopolistic competition

3.4 Oligopoly

3.5 Oligopoly – The Cournot model

3.6 Oligopoly – The Bertrand model

3.7 Oligopoly – The Stackleberg model

3.8 Oligopoly - Bertrand models with differentiated products

MARKET STRUCTURE - READING

Chapter 8, “Competitors and Competition” in Besanko et al (2010) *Economics of Strategy (focus on pages 212-229).*

Chapter 2, “Industry Analysis” in Mcafee (2002) *Competitive Solutions* (focus on pages 27-34)

Links to readings or downloads are available in Canvas.

UNDERSTANDING MARKET STRUCTURE

Why is understanding market structure important? It can help us determine:

- Pricing
- Entry and exit decisions
- Product positioning in the price-quality space
- Advertising
- Product design

In each case, the decision will be shaped by the market structure.

MARKET STRUCTURES

Defined by:

- Number and size of buyers, sellers and potential entrants (we think about potential entrants as those firms that pose a credible threat of market entry)
- The degree of product differentiation
- The amount and cost of information about product price and quality.
- Conditions for entry and exit of firms.

MARKET OR INDUSTRY STRUCTURES

McAfee characterizes the alternative market structures as follows, based on the size and number of competitors.

- **Fragmented:** Firms are small and unable to affect market conditions. Similar to perfect competition in which the behaviour of competitors can be considered independent of a firms own actions. Exist in part because of important incentives they provide – think of the owner operator of a restaurant.
- **Dominant firm:** A single firm effectively controls market outcomes. Akin to monopoly. May reflect scale considerations, but are subject to technological change.
- **Tight oligopolies:** A small number of major firms. Examples include Coke and Pepsi; Woolworths and Coles; Boeing and Airbus. The lower number of firms offer opportunities for more cooperation amongst industry players.
- **Loose oligopolies:** A moderate number of firms with few entry or exit barriers. McAfee suggests that examples include major oil companies. As industry grows in numbers, so does the challenge of coordination across players.

LECTURE 3.1

PERFECT COMPETITION

PERFECT COMPETITION

Perfect competition provides a benchmark. It is only a model.

Assumptions:

- Profit maximisation
- Large number of firms
- Perfect information
- Product homogeneity
- No transaction costs
- Price taking (follows from the above)
- Freedom of entry and exit.

PERFECT COMPETITION

These are very strong assumptions. When they do not apply, moving “towards freer” markets need not help.

Perfect competition is not a general statement about the world.

Perfect competition is not a goal for the firm.

Perfect competition offers a convenient benchmark for studying the effects of competitive forces.

- It is a good approximation for understanding market forces in many settings.
- Some industries behave in ways that are very close to perfect competition (e.g. some agricultural, labour, and financial markets).

PERFECT COMPETITION

Price equals marginal cost: follows from profit maximisation and price-taking / homogeneous product

Firms earn normal profits (zero economic profits): follows from free entry and exit

- Note that in the short-run and the long-run the decisions are slightly different because some costs are sunk or unavoidable. In the long-run firms that remain in the industry earn zero economic profit but positive accounting profit.

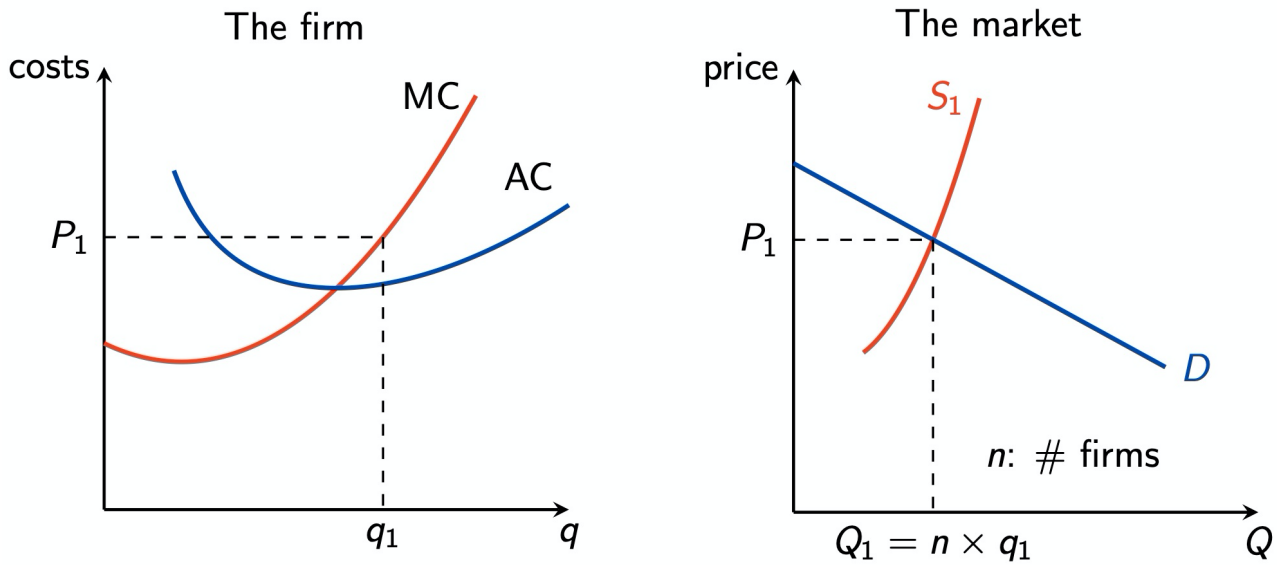
We can solve for a competitive equilibrium

1. profit maximisation determines supply curve for each firm
2. demand and supply determines market price
3. long run equilibrium requires zero economic profits

The three equations allow us to solve for quantity (Q), price (P) and number of firms (N)

SHORT-RUN ANALYSIS

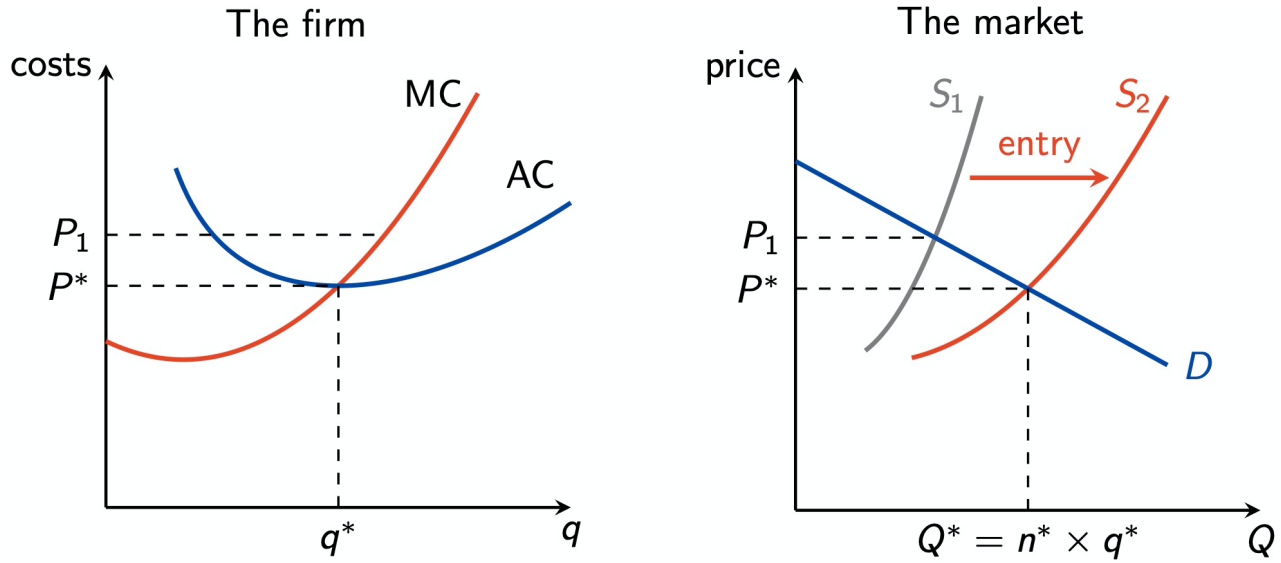
In the short-run, the number of firms is fixed (no entry or exit). Firms can make positive (or negative) profits.



At the market price P_1 > min AC, each firm produces output q_1 and makes positive profit. More firms want to enter the market.

PERFECT COMPETITION

In the long run, we assume free entry. Firms make zero profits.



In the long run, more firms enter. The supply curve shifts right until the market price is such that all firms make zero profit.

PERFECT COMPETITION

Perfect competition is a benchmark. The real lesson is that competitive advantages are transitory.

In the long run:

- Profits tend towards “zero”: each firm earns the market return (remember this refers to economic profits).
- Production is efficient: firms produce at efficient scale (at minimum average cost)
- Efficient allocation of resources: higher or lower output (more or fewer firms) would imply lower efficiency.

LECTURE 3.2

BARRIERS TO ENTRY

BARRIERS TO ENTRY

Barriers to entry are a precursor to market power.

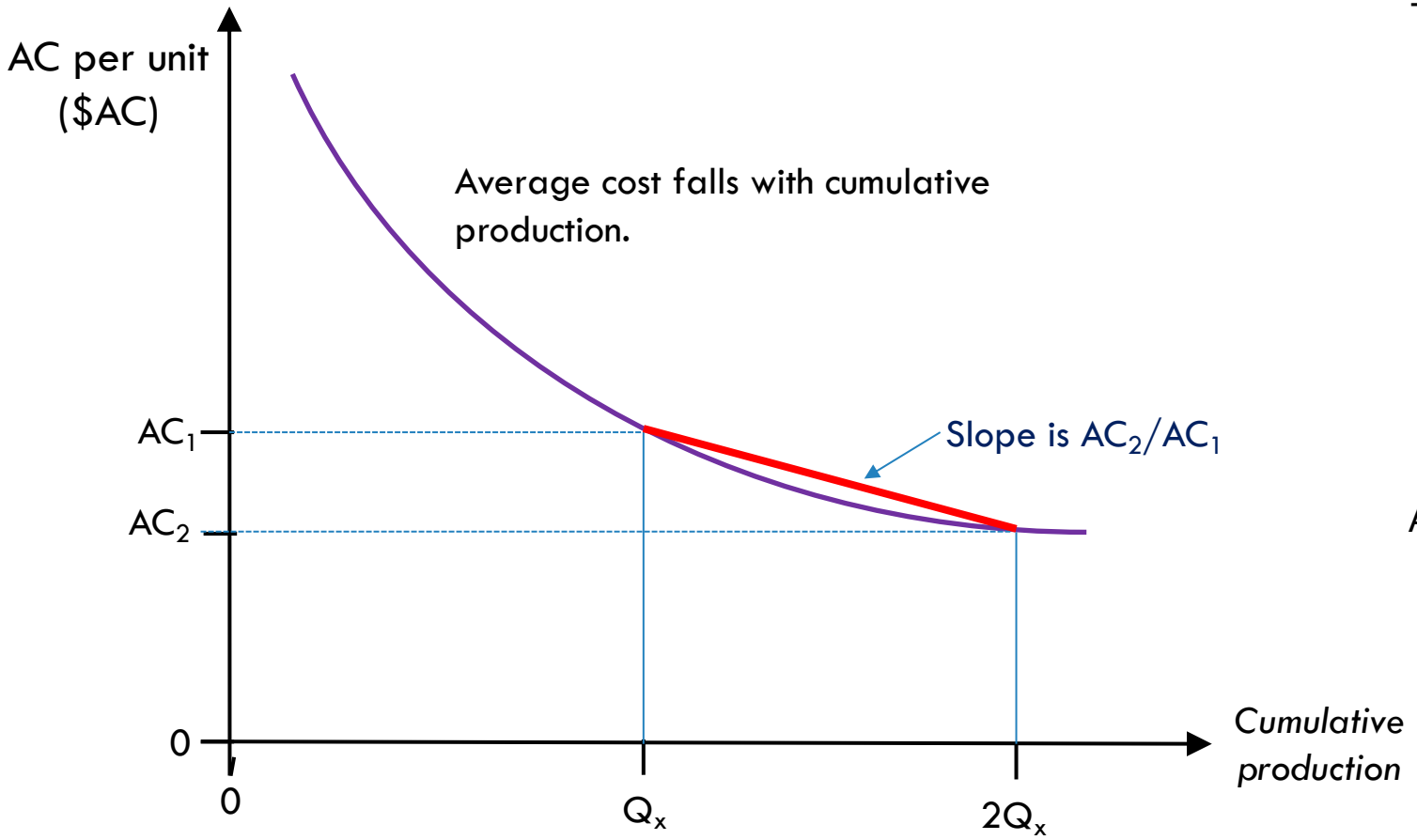
What types of things do represent barriers to entry? First, what might be important for shaping an entry decision?

- Effect of entry on prices – what affects this? Hint: What will incumbent firms do (prices, output) if I enter?
- Incumbent advantages – what might they be or include?
- What if I fail and leave the industry? Are there sunk costs of entry?

INCUMBENT ADVANTAGES

- Precommitment contracts - distribution, raw materials etc. Limit opportunities for new entrants in terms of suppliers and customers
- Licenses and patents – legal barriers to entry
- Pioneering brand advantages or switching costs. These are potentially important in case of experience goods that require use to understand quality. Where this can be assessed prior to purchase the advantages of incumbents is lower.
- Learning curve effects (see next 2 slides)

THE PRODUCTION LEARNING CURVE



Think about the magnitude of learning benefits in terms of 'slope', i.e. how much average costs decline as cumulative output doubles.

When cumulative output equals Q_x, average cost of production is AC_1. When cumulative output doubles AC decreases to AC_2, so ratio of ACs is AC_2/AC_1. If AC_1=80 and AC_1=72, slope is -0.90 so doubling output reduces costs by 10 percent

THE PRODUCTION LEARNING CURVE

- Distinct from economies of scale, where average cost falls with **current** output
- Derived from notion of a product life cycle. Products go through a process of introduction, growth, maturity and decline.
- Evidence: ‘median slope of the learning curve is about -0.8’, so a doubling of cumulative output tends to reduce costs by around 20%. That is, AC_2 is around 80 percent of AC_1.
- Potentially has important effects on marginal cost and this should be factored in when considering whether to take on a contract.

BARRIERS TO ENTRY

McAfee lists the following (amongst others) as representing or reinforcing entry barriers:

- Large minimum efficient scale relative to industry size
- Variety of differentiated products in the market meaning that the product space is already filled
- Consumer switching costs and networks
- Brands and reputation
- Limited access to distribution channels
- Limited access to raw materials
- Government regulation

LECTURE 3.3

MONOPOLY AND MONOPOLISTIC COMPETITION

MONOPOLY

Usually think of a single seller facing a downward sloping market demand curve (no close substitutes). Barriers to entry prevent others capturing excess profit.

Marginal revenue curve is also downward sloping.

Monopolists are hypothesised to act as price makers. They maximize profit in the simplest case by choosing the point where:

$$\textit{Marginal Revenue} = \textit{Marginal cost}$$

From an overall welfare perspective, there are better pricing options than this.

MONOPOLISTIC COMPETITION

Monopolistic competition is a hybrid between monopoly and perfect competition.

Characterised by:

- Multiple firms with an assumption that one firm's actions do not affect the actions of other firms. There is no strategic interaction
- Product heterogeneity
- Freedom of entry and exit

Examples include retail shops, books, movies and Thai restaurants in Newtown.

MONOPOLISTIC COMPETITION

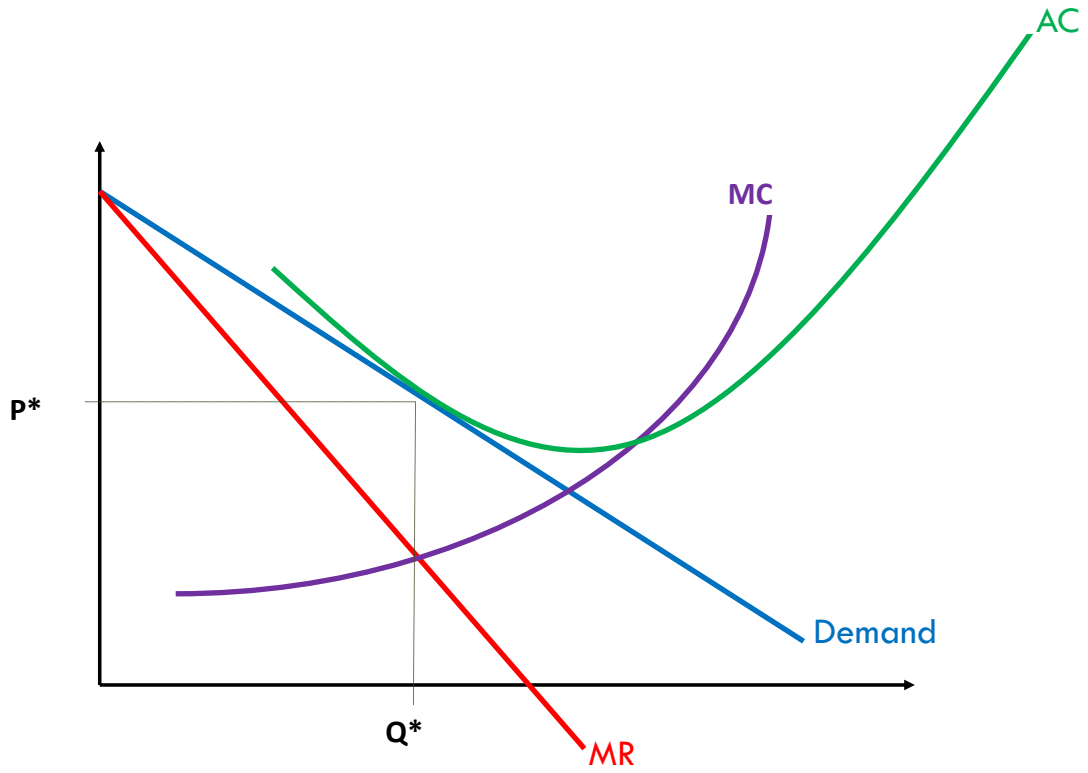
Firms face a downward sloping demand curve and hence have market power.

If firms in the market are generating profit, then you tend to get entry and imitation

In the long run we expect that firms in the industry earn zero economic profit.

This gives rise to the standard monopolistic competition diagram.

MONOPOLISTIC COMPETITION



Firms set output equal to Q* where MR=MC to maximise profits. Price (P*) is derived from the demand curve.

MONOPOLISTIC COMPETITION

A richer model of monopolistic competition distinguishes between vertical and horizontal differentiation:

- Vertical differentiation: Product is unambiguously better or worse than competing products. Example - cleaning power of dishwashing detergent
- Horizontal differentiation: Product is preferred by only some consumers. Example - scent in dishwashing detergent

Consider horizontal differentiation and think about it in a spatial/ geographic sense, i.e. think about a street along which take-away food shops might be located or positioned.

MONOPOLISTIC COMPETITION

MONOPOLISTIC COMPETITION

Suppose that the cost of travelling a kilometer is $0.50.

Further assume that both shops initially charge $5 per item.

Now suppose that Esme drops her prices to $4.00 while Jose does not change his behaviour.

What do you think will happen?

Why?

MONOPOLISTIC COMPETITION

Consider an individual who lives M kilometres from Esme's and therefore (10-M) kilometres from Jose's.

For this consumer the cost of visiting Esme's is: $4 + 0.5M$

For this consumer the cost of visiting Jose's is: $5 + 0.5(10-M)$

These costs are equal when $M = 6$

MONOPOLISTIC COMPETITION

So how many customers will Esme's get now?

How about Jose's?

What might affect the number of customers each shop gets as the price differential changes? Think about what costs are driving behaviour.

Consider another case of horizontal differentiation with *idiosyncratic preferences* – tastes differ from one individual to the next depending on location (e.g. clothes).

How important do you think search costs are, i.e. the cost associated with finding about alternatives might be for this model?

THE ENTRY DECISION

Firms in monopolistically competitive markets set price above marginal cost.

Consider if there are 10 firms in an industry each with AC=MC=$10 and a fixed cost of $120.

Each firm sells a horizontally differentiated product with elasticity of demand equal to η=2 so the profit maximizing price for each firm is $20.

Recall the expression for MR that we showed in Lecture 1:

$$MR = p\left[1 - \frac{1}{\eta}\right] = \mathrm{MC}$$

So in this case with MC=10, p*=20.

Assume market demand of 240 is evenly distributed across firms (24 each). Revenues for each firm is $480, costs $360 and profits $120. But profits lead to….entry.

THE ENTRY DECISION

Entry keeps occurring until profits are dissipated.

Assume that the own price elasticity of demand is unchanged.

In the long-run we would expect to see 20 firms in the industry, each selling 12 units and earning zero economic profit.

$$\pi = Revenue - variable\ costs\ - fixed\ costs$$

$$0 = \frac{240}{N}(20) - \frac{240}{N}(10) - 120$$

$$N = 20$$

Some have argued that monopolistic competition is wasteful, in part because when new firms enter each incurs additional fixed costs that can be avoided if the incumbents simply remain.

LECTURE 3.4

OLIGOPOLY

OLIGOPOLY

Characterized by:

- ‘Few’ firms amongst which there is strategic interaction
- Products may be homogeneous or there may be heterogeneity
- Barrier to entry

Classic examples include industries like automobiles, steel, cereal and airlines.

There are many different types of oligopoly. How do we model this strategic interaction?

Number of ways, with the simplest being the following ….

OLIGOPOLY – *NASH EQUILIBRIUM*

Consider the following pricing game for WonCo and TuInc.

		TuInc	
		Price Low	**Price High**
WonCo	**Price Low**	**$20, $40**	**$40, $0**
	Price High	**$200, $250**	**$400, $200**

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OLIGOPOLY

The Nash Equilibrium in the above game represent the non-cooperative solution in that each firms makes its best choice (maximize profits) given the behaviour of the other firm.

Note that the outcome above does not represent the best outcome for the firms….

Why?

How might a better outcome be achieved?

Would it work? Why or why not?

LECTURE 3.5

OLIGOPOLY – THE COURNOT MODEL

OLIGOPOLY – THE COURNOT MODEL

Assumptions:

- homogeneous product
- firms compete by choosing quantity simultaneously
- the market price clears the market
- firms interact in a single period
- no entry

We solve for a Nash equilibrium to a simultaneous game. Each firm chooses optimal output given their rivals' output. No firm will have an incentive to change its output decision given the other firms' choice.

OLIGOPOLY – THE COURNOT MODEL

In a Nash equilibrium (NE) each firm maximises profits given the strategies (outputs) of their rivals

Steps to solve for the Nash equilibrium

1. work out the objective function (profits) for each firm

$$\pi_i(q_1, q_2, \dots) = q_i P(q_1 + q_2) - C(q_i)$$

2. optimisation: derive reaction functions for each firm
   - profit maximisation given rival output → reaction functions
3. solve simultaneously for each reaction function → equilibrium prices and quantities
   - in a Nash equilibrium, each firm must operate on their reaction function

OLIGOPOLY – THE COURNOT MODEL

Start with a simple example in which two firms (A & B) have constant marginal cost equal to zero:

$$MC_A = Mc_B = 0$$

The industry demand curve is given by:

$$P = 100 - Q$$

Industry output equals the sum of each firms output so:

$$Q_A + Q_B = Q$$

The anticipated or residual demand curve for firm A is given by:

$$P_A = (100 - \overline{Q_B}) - Q_A$$

OLIGOPOLY – THE COURNOT MODEL

The MR curve for firm A is given by:

$$MR_A = (100 - \overline{Q_B}) - 2Q_A$$

(This is because $Revenue_A = P_A Q_A = \big((100 - \overline{Q_B}) - Q_A\big)Q_A$. Take the derivative to get marginal revenue.)

The usual profit maximizing rule applies so we set marginal revenue equal to marginal cost to give:

$$0 = (100 - \overline{Q_B}) - 2Q_A$$

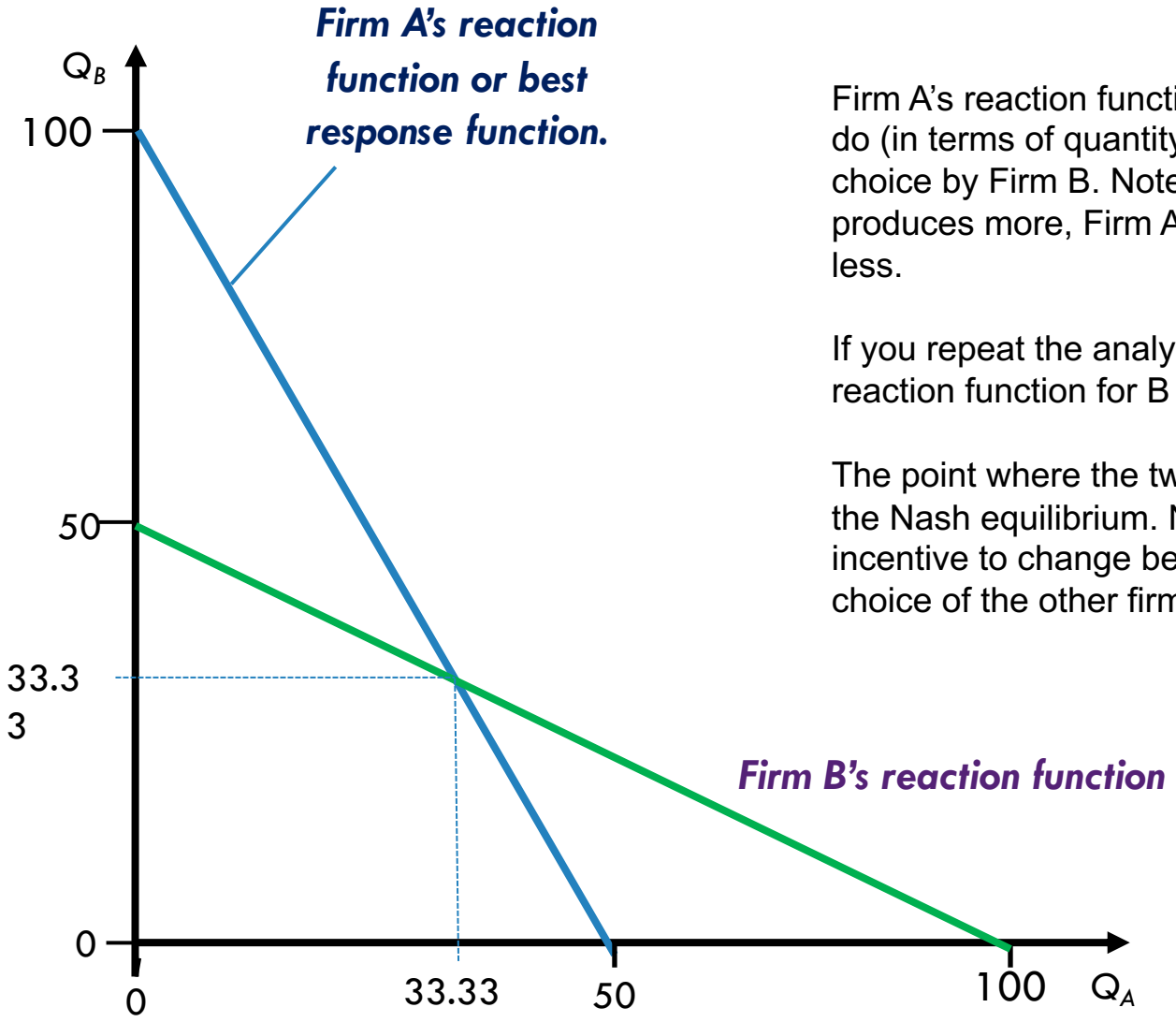
Or

$$Q_A = 50 - 0.5Q_B$$

Or

$$Q_B = 100 - 2Q_A$$

Which represents the firm A's ***reaction function.***



Firm A's reaction function tells us what Firm A should do (in terms of quantity choice) in response to a choice by Firm B. Note that here when firm B produces more, Firm A's best response is to produce less.

If you repeat the analysis you get an analogous reaction function for B (shown in green).

The point where the two curves intersect represents the Nash equilibrium. Neither A nor B will have any incentive to change behaviour (output) given the choice of the other firm.

OLIGOPOLY – THE COURNOT MODEL

We can solve the Cournot model with many firms.

- If firms have the same cost functions, it is easier to use symmetry rather than solving n equations in n unknowns

What can we say about the outcome of the Cournot model?

- Output is lower and price higher than what it would be under perfect competition.
- Output is higher and price lower than what it would be under monopoly.

COMMITMENT

Consider a commitment such as adopting a product innovation that reduces variable production cost or one about positioning a product in the market. Assume that is such that ***rivals are aware*** of it and it ***cannot be reversed and is therefore credible.***

Consider the following timing:

- ***Stage 1*** – firm A makes commitment.
- **Stage 2** – firms compete through quantity choices (Cournot).

Assume new equilibrium is reached quickly.

COMMITMENT

We can distinguish between:

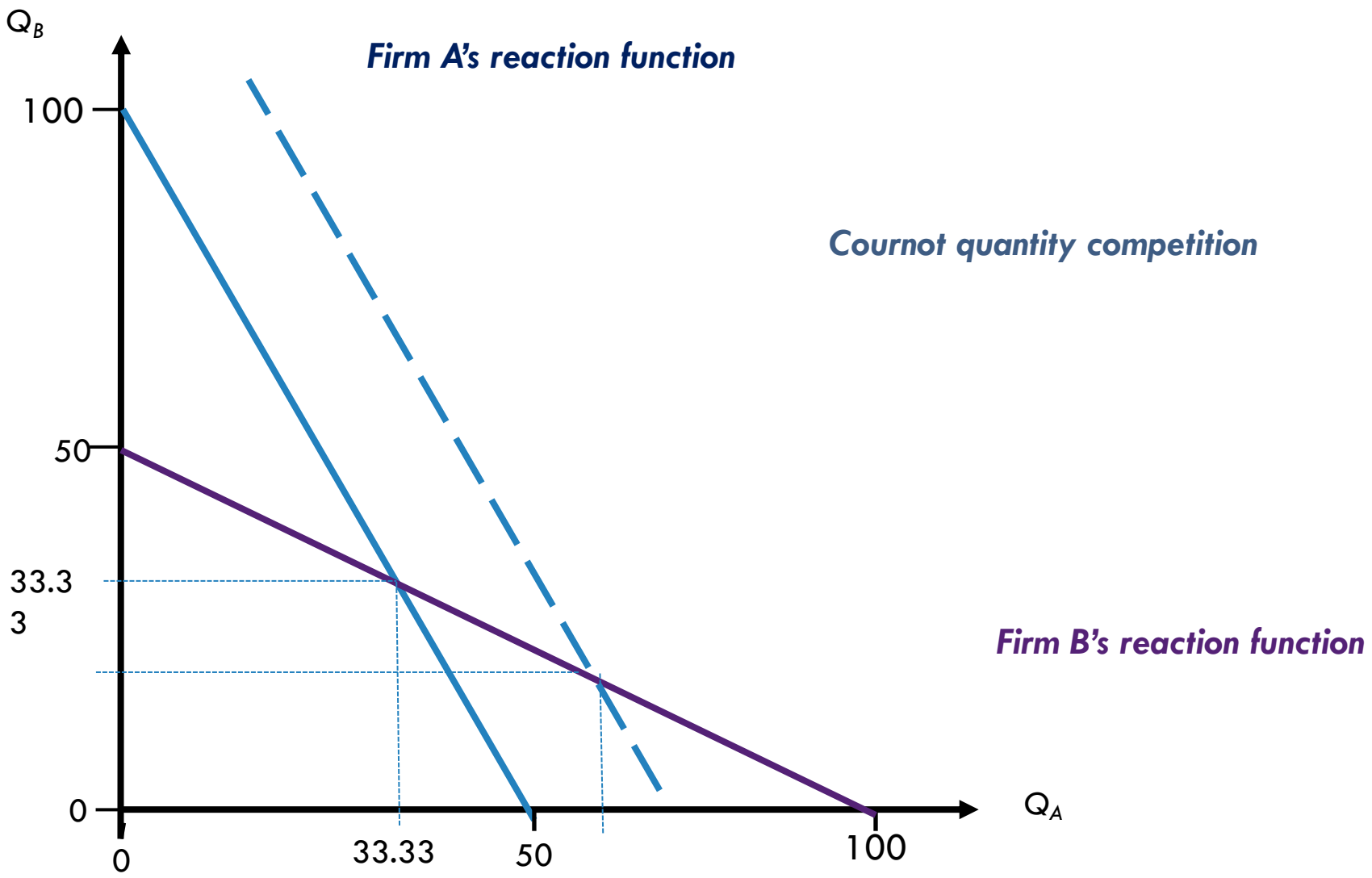
- **Tough commitments** – those that are bad for competitors. For example, the expansion of production facilities in a Cournot model.
- **Soft commitments** – those that are good for competitors. For example, the elimination of production facilities in a Cournot model.

TOUGH COMMITMENTS

For a tough commitment, firm A will produce more than if it had not made commitment. That is, a rightward shift in the reaction function.

The effect will be to see firm B respond by reducing its own output causing market price to be higher. The beneficial strategic effect could outweigh the negative direct effect. Note that the direct effect here is negative – the NPV in the absence of a response is negative.

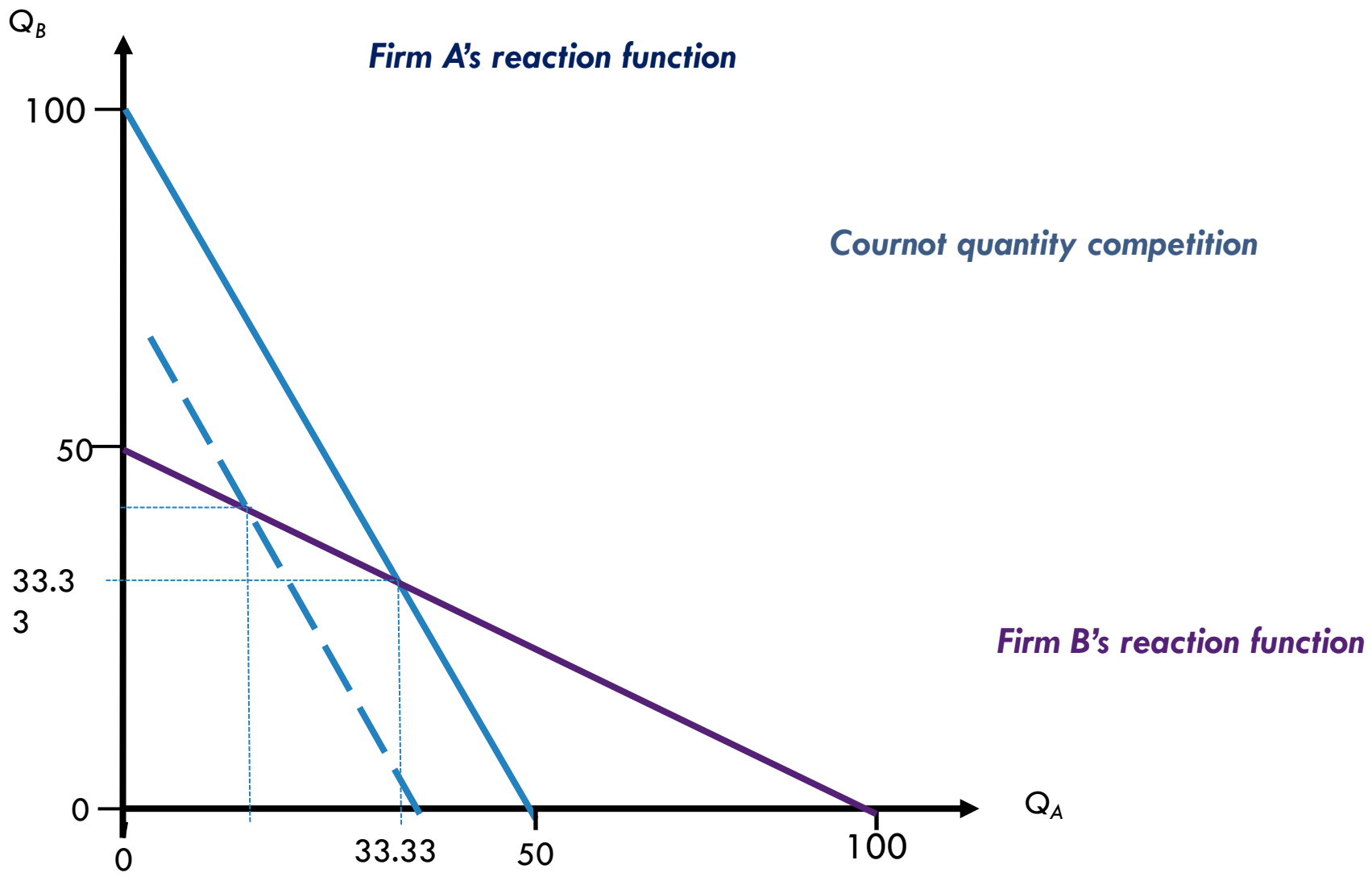
If the strategic effect outweighs the negative direct effect, the firm should go ahead and make a commitment.


Q_B
Firm A's reaction function
100
50
33.3
3
0
0
33.33
50
100
Q_A
Cournot quantity competition
Firm B's reaction function

SOFT COMMITMENTS

Suppose that a firm enters another market and in doing so raises its cost of production. Firm A will produce less than if it had not made commitment. That is, a leftward shift in the reaction function. The effect will be to see firm B respond by increasing its own output. There is a negative strategic effect here.

Firm should go ahead and make commitment only if the beneficial effect (entry into new market) exceeds negative strategic effect.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0
33.33
50
100
Q_A
Cournot quantity competition
Firm B's reaction function

LECTURE 3.6

OLIGOPOLY – THE BERTRAND MODEL

THE BERTRAND MODEL

Assumptions

- firms compete by simultaneously choosing prices
- firms interact in a single period
- homogeneous product
- rationing rule:
  - $p_i < p_j \; \forall j \Rightarrow$ firm *i* captures whole market
  - $p_i = p_j \; \forall \; j \Rightarrow$ firms share the market equally

The key in the Bertrand model is that each firm chooses a level of ***price*** assuming that the ***price*** of rivals / competitors are given or fixed.

THE BERTRAND MODEL

Start with a simple example in which each firm (A & B) has positive marginal cost equal to 10. What does the market outcome (or Nash Equilibrium) look like?

Suppose that firm A is setting price equal to P_A. What should firm B do?

Set $P_B = P_A - \varepsilon$.

Then: A responds by setting $P_A = P_B - \varepsilon$

The end result: $P_A = P_B = MC$

In this Nash Equilibrium, neither firm will have an incentive to change its pricing decision given the other firms choice.

The discussion here is premised on an (implicit) assumption that the products being sold are homogeneous. We will come back to differentiated products later this week.

THE BERTRAND MODEL

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THE BERTRAND MODEL

In the unique Nash equilibrium firms set price equal to marginal cost. i.e. firms earn no economic profits, even with only two firms!

Resolutions:

- the high priced firm may have some residual demand
    - capacity constraints
    - consumer loyalty
    - limited product comparability
- price commitment
- repeated games
- product differentiation

LECTURE 3.7

OLIGOPOLY – THE STACKLEBERG MODEL

THE STACKLEBERG MODEL

In the Cournot model, firms choose output simultaneously

- but firms might move sequentially instead of simultaneously: e.g. one firm entered the market first, one firm is a recognised industry leader

The Stackelberg model

- sequential quantity competition
- firms produce identical products
- a leader is able to commit to output before the follower(s)
- followers choose output to maximise profits after observing the leader's output
- no entry

We will look for a sub-game perfect Nash equilibrium.

PEPSI V COCA COLA

Pepsi announces that it will wait to see how much Coke ships before determining its quantity.

Pepsi's executives argue that waiting will give Pepsi more information.

Is this a good idea?

THE STACKLEBERG MODEL

After the leader moves, competitors learn the leader's strategy and respond to it

This gives the leader an incentive to produce more:

- the extra units produced by the leader reduce the residual demand of its competitors
- this reduces the incentive for rivals to produce
- the reduced output of rivals increases the leader's profit
- the leader considers this effect when choosing output

This is called the first mover advantage in the Stackelberg model.

THE STACKLEBERG MODEL

The dominant firm is the Stackleberg leader (call this firm A) and others are the Stackleberg followers (the B firms).

Like Cournot, this is a model in which the choice variable is quantity.

Industry output equals the sum of each firm's output:

$$Q_A + Q_B = Q$$

and

$$MC_A = MC_B$$

THE STACKLEBERG MODEL

In the Stackleberg model we will consider the choice of the follower first. We solve this game backwards.

When the follower makes its decision it takes the decision of the leader as given and chooses a level of output to maximise profit:

$$\max_{Q_B} P(Q_A, Q_B)Q_B - Q_B c_B$$

In effect the follower will choose a level of output such that marginal revenue equals marginal cost. Importantly:

$$Q_B = f(Q_A)$$

THE STACKLEBERG MODEL

This expression $Q_B = f(Q_B)$ is called a reaction function

We can now consider the leaders problem, which involves choosing a level of output to maximise profit taking into account how the follower will behave.

That is, the leader must:

$$\max_{Q_A} P(Q_A, Q_B)Q_A - Q_A c_A$$

Or

$$\max_{Q_A} P\big(Q_A, f(Q_A)\big)Q_A - Q_A c_A$$

THE STACKLEBERG MODEL

Consider the following demand and cost conditions:

- demand: $P(Q) = 40-Q$, where $Q = Q_1+Q_2$
- costs: $C(Q_i) = 4Q_i$, $i = 1, 2$

By backward induction, we first solve Firm 2's problem:

- Firm 2 chooses an optimal output given the output of Firm 1. This is equivalent to finding the reaction function in the Cournot model

Profits: $\pi_2 = (40-Q_1-Q_2)Q_2-4Q_2$

Solve FOCs to find the reaction function:

$$0 = 40-Q_1-2Q_2-4$$

$$Q_2 =18-Q_1/2 \equiv r_2(Q_1)$$

THE STACKLEBERG MODEL

What about Firm 1?

Firm 1 is committed to Q_1 when Firm 2 produces, but Firm 1 chooses Q_1 strategically

$$\pi_1(Q_1, Q_2) = P(Q_1, Q_2)Q_1 - C(Q_1)$$
$$\pi_1(Q_1) = P(Q_1, R(Q_1))Q_1 - C(Q_1)$$
$$= (40 - (Q_1 + 18 - Q_1/2))Q_1 - 4Q_1$$
$$= 18\,Q_1 - Q_1^2/2$$

- Firm 1's first order conditions then give: $0 = 18 - Q_1 \Rightarrow Q_1 = 18$
- Substitute into Firm 2's reaction function:

$$Q_2 = 18 - \frac{Q_1}{2} = 9$$

STACKLEBERG VS COURNOT

Contrast this result with what we would have found under the Cournot model.

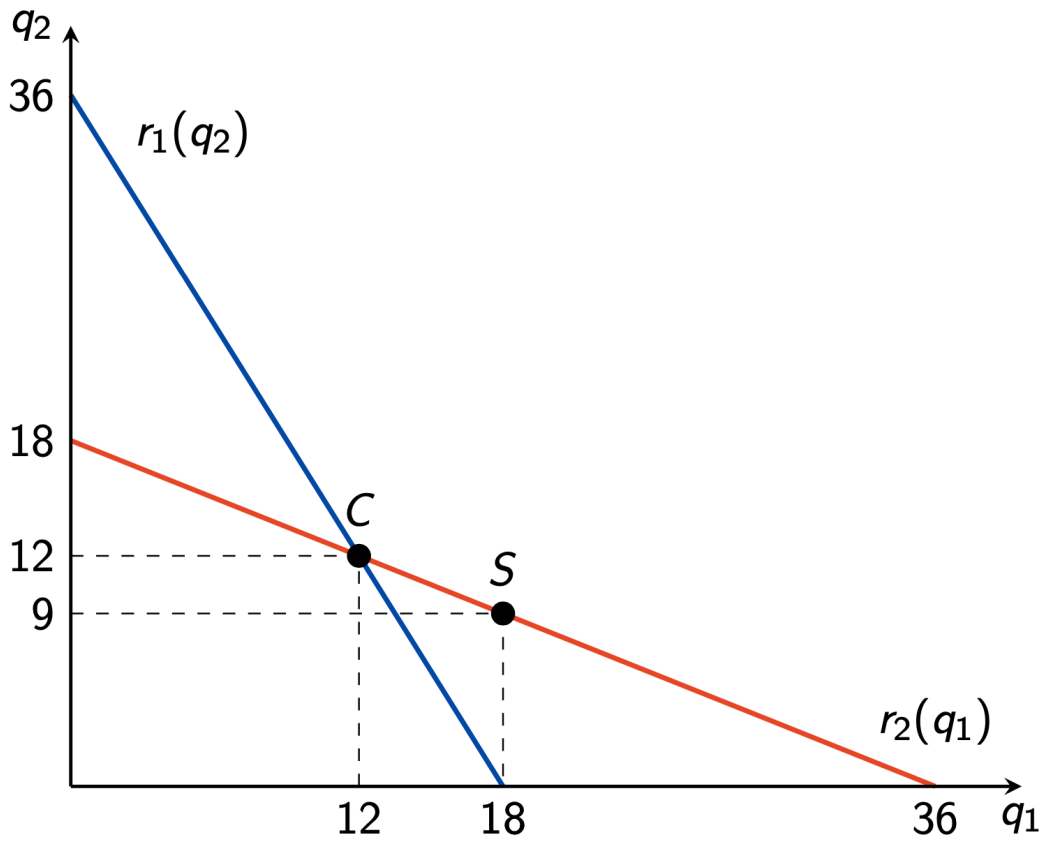
Under Cournot, Firm 1 has an equivalent reaction function to Firm 2:

$$Q_1 = 18 - \frac{Q_2}{2}$$

Substitute in Firm 2's reaction function:

$$Q_1 = 18 - \frac{\left(18 - \frac{Q_1}{2}\right)}{2} = 12 = Q_2$$

STACKLEBERG VS COURNOT



THE STACKLEBERG MODEL

What is going on here?

- Firm 1 wants to produce more to discourage Firm 2 from producing. How much more depends on the slope of demand and the slope of the reaction function.

Questions

- Is Firm 1 operating on their reaction function?
- Would Firm 1 be better off changing their output after observing Q_2?
- What if Firm 2 anticipates this?

THE STACKLEBERG MODEL

Players can benefit from the ability to commit

- the leader has a “first-mover advantage”
- the leader produces more than the Cournot equilibrium output
- the leader receives a larger market share and higher profits

The follower

- produces less than the Cournot equilibrium output
- receives a smaller market share and lower profits

LECTURE 3.8

OLIGOPOLY - BERTRAND MODELS WITH DIFFERENTIATED PRODUCTS

BERTRAND MODELS WITH DIFFERENTIATED PRODUCTS

If both firms are producing identical products the price chosen must be the same.

What happens when there is Bertrand Price competition when firms produce differentiated products?

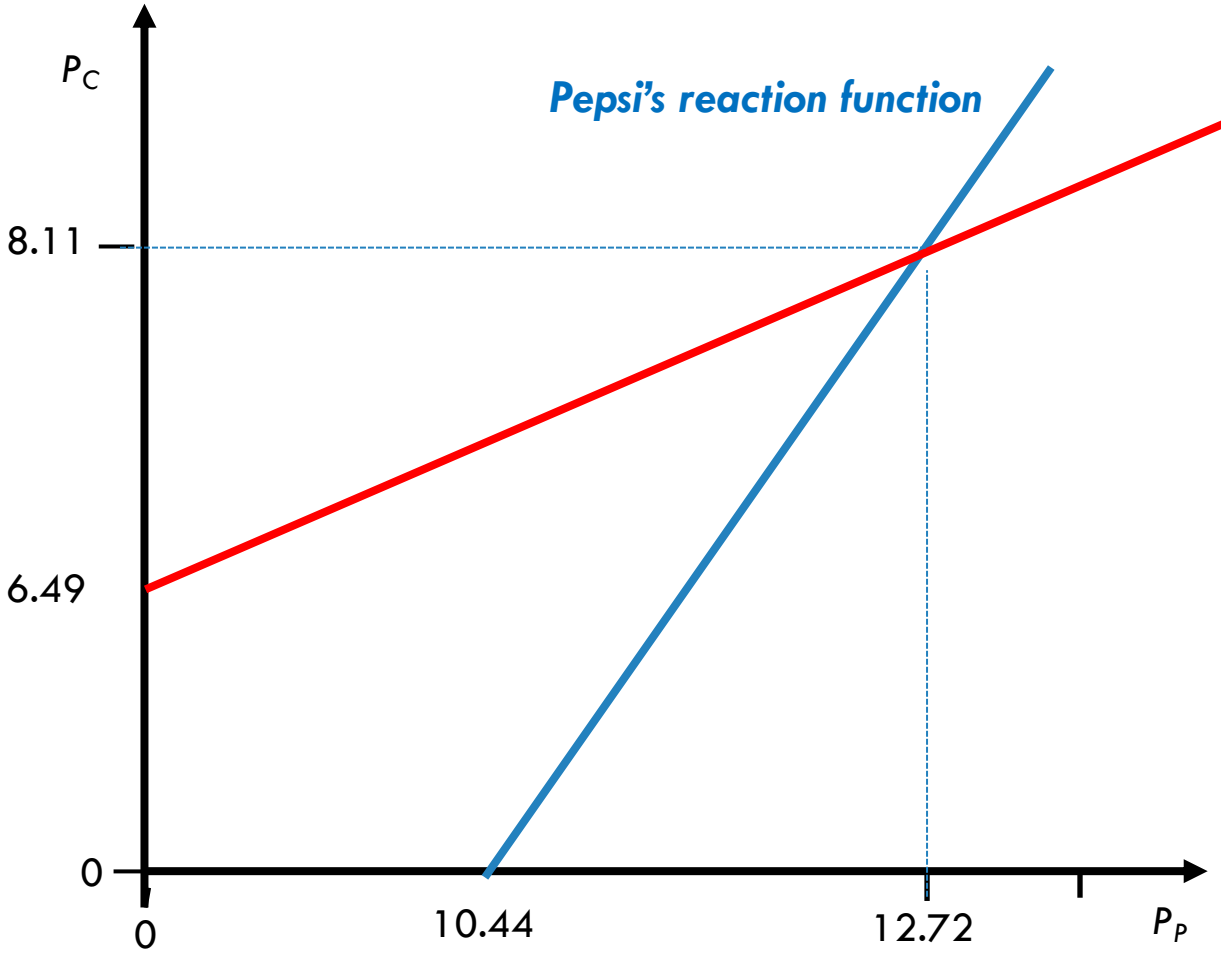
Think about Coca Cola and Pepsi for example and assume:

$$Q_P = 64.32 - 3.98P_P + 2.25P_c$$
$$Q_c = 49.52 - 5.48P_c + 1.40P_P$$

- Further, assume that:

$$MC_P = 3.96$$
$$MC_c = 4.96$$

BERTRAND MODELS WITH DIFFERENTIATED PRODUCTS



The reaction functions or best response curves look like this.

The lower the price their rival charges, the lower the price they want to charge.

Unlike Cournot equilibrium, they respond aggressively to aggressive behaviour by their rival.

OLIGOPOLY – SUMMARY

Market outcomes are very sensitive to whether firms compete in prices or quantities.

- There is a close relationship between the Bertrand and Cournot models if firms also get to choose their capacity.

Which is more realistic in a particular industry depends on

- if capacity and output can be easily adjusted: the Bertrand model may be a better approximation. Bertrand competition might be thought of as a situation where firms are not capacity constrained and can meet demand at whatever price emerges.
- if output and capacity are difficult to adjust: then the Cournot model may be a better approximation. Think about Cournot oligopolists competing as ‘capacity constrained price setters’. That is, they choose a price to sell all after having chosen a capacity.

In general, to model firm interaction, we may wish to have firms

- choose the least flexible (hardest or slowest to adjust) action first
- choose the most flexible action last