

11.203

October 26, 2010

Oligopoly, Day 1

Cournot Duopoly

Bertrand Competition

What is oligopoly?

	Number of Firms	Products Differentiated or Homogeneous	Easy Entry	Distinguished by	Examples
Perfect Competition	Many	Homogeneous	Yes	No price competition	Wheat Textiles
Monopoly	One	A single, unique product	No	Firm can set price, but still constrained by market demand	Natural gas Patented drug
Monopolistic Competition	Many	Differentiated	Yes	Price and quality competition	Restaurants Gas Stations
Oligopoly	Few	Either	Limited	Strategic Behavior	

1. A small number of firms

2. Firms produce an identical product and compete only on price

-or-

Firms produce a differentiated product and compete on price, product quality, and marketing

3. Natural or legal barriers prevent new firms from entering

4. Firms have some control over price and may collude to restrict output and keep prices high

Examples of oligopolies in the US

Battery companies

- Duracell
- Energizer
- Rayovac

Toothpaste

- Colgate
- Crest
- Aquafresh

Cell phone companies

- Verizon Wireless
- T-Mobile
- Sprint
- AT&T

Oil Companies

- BP
- ExxonMobil
- Shell

Car Share

- Zipcar
- City Car Share
- Flexcar

Will firms make economic profit in the long run?

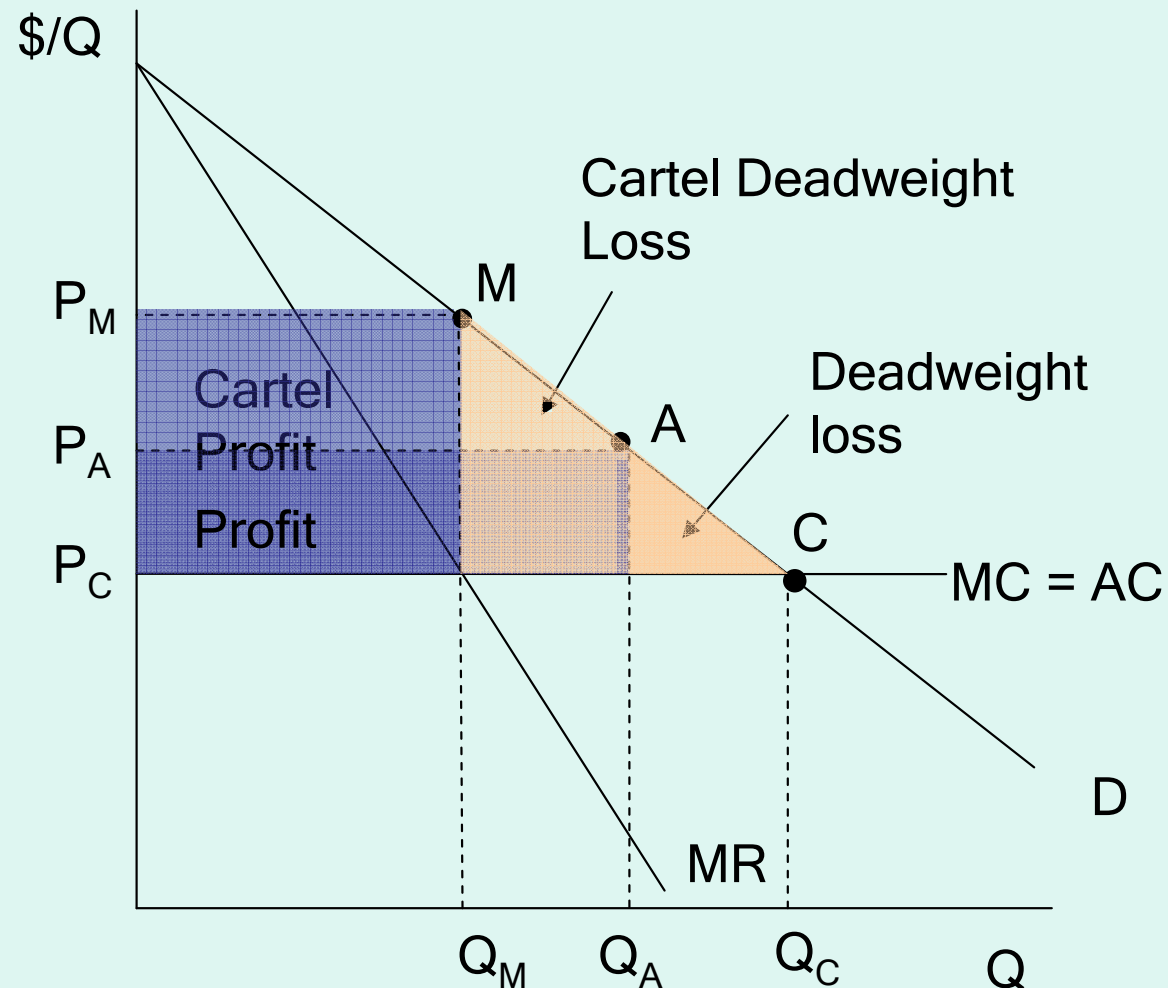
If we assume...

- Firms produce the same product
- All firms face same, constant MC and AC

If firms collude to form a perfect cartel, they act as a monopolist (Q_M, P_M)

If firms compete away profits completely, they act as if in perfect competition (Q_C, P_C)

Usually they reach some point in between (like Q_A, P_A)



In Search of a Nash Equilibrium

- Firms respond to each other's decisions on:
 - How much to produce (quantity)
 - How much to charge (price)
 - How much to advertise
 - and so on
- Example: quantity
 - A Nash equilibrium is the set of each firm's chosen quantities *such that no firm would want to "deviate" (choose a different quantity) given how much its competitors have chosen to produce.*
 - Nash equilibrium = stable outcome
- Named after John Nash

Cournot Duopoly

The Main Assumptions

- Two firms produce the same good
- Firms independently and simultaneously choose how much quantity to produce
- Each firm is myopic; it expects competitor to keep same quantity even after it sets its own quantity

Result: One Nash equilibrium. Neither firm has an incentive to unilaterally reduce or increase production, based on the quantity chosen by its competitor.

Cournot Duopoly Example

Both Firms (A and B) Face Same Costs:

$$MC = \$2$$

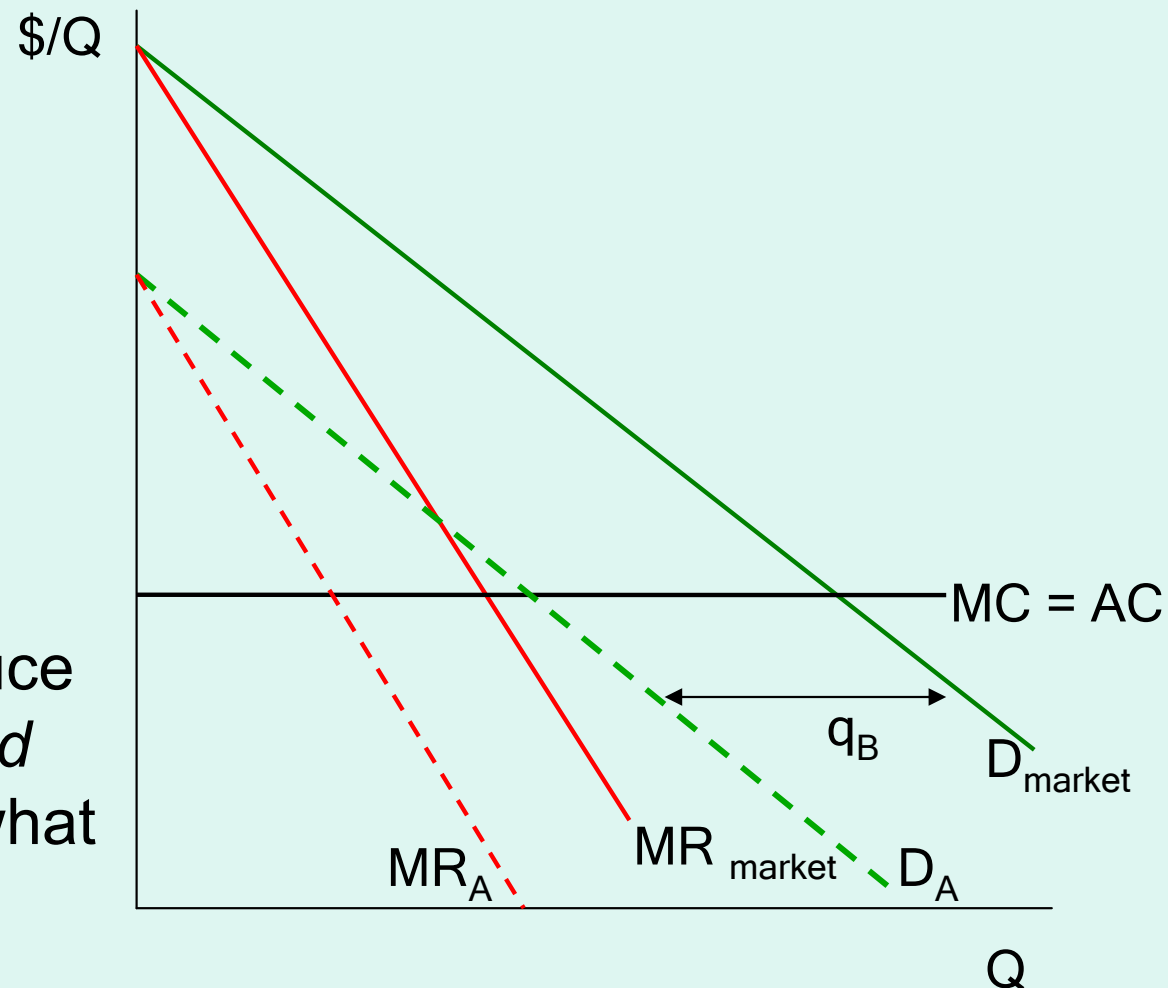
Market Demand Function:

$$P = 122 - Q$$

$$P = 122 - (q_A + q_B)$$

$$P = 122 - q_A - q_B$$

Firm A tries to determine the optimal quantity for it to produce (q_A^*) given its *residual demand* (the market demand, minus what it expects Firm B to produce)



Find the profit maximizing q_A

Firm A and Firm B simultaneously choose their optimal quantities (where $MC = MR_{\text{firm}}$)

For Firm A, begin by finding MR_A :

$$TR_A = q_A * P = q_A (122 - q_A - q_B)$$

$$TR_A = 122 q_A - q_A^2 - q_A q_B$$

$$MR_A = \frac{\partial TR_A}{\partial q_A} = 122 - 2q_A - q_B$$

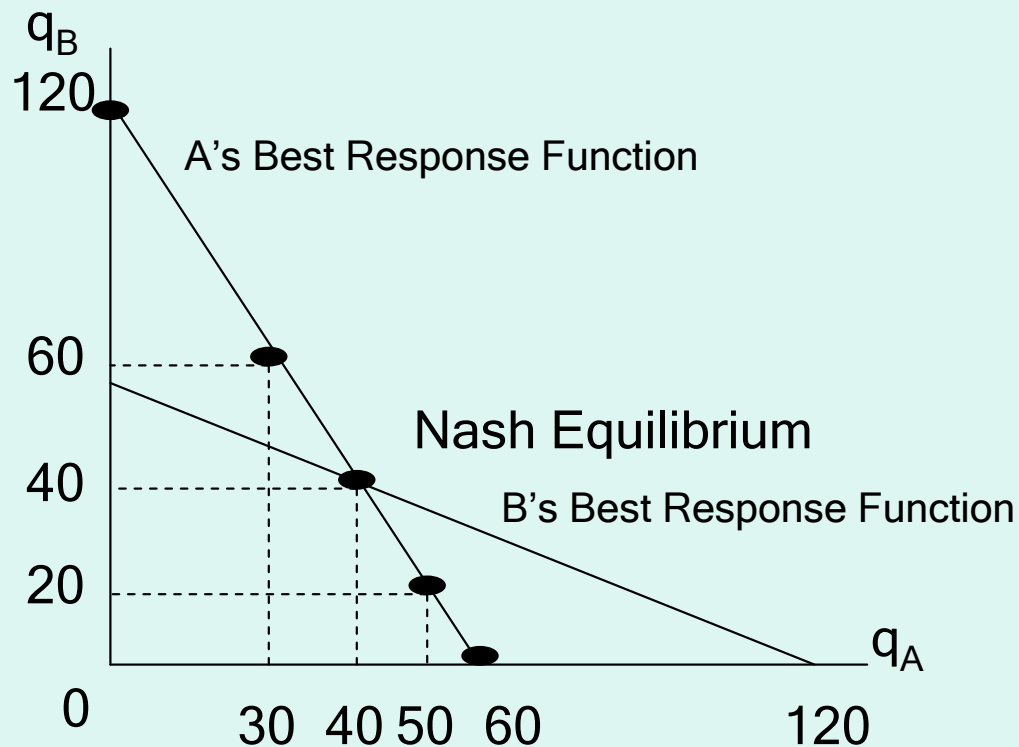
Market Demand:
 $P = 122 - q_A - q_B$

Then set $MC = MR_A$

$$\begin{aligned} MC = 2 & & 2 + 2q_A &= 122 - q_B \\ 2 &= 122 - 2q_A - q_B & 2q_A &= 120 - q_B \\ & & q_A &= \frac{120 - q_B}{2} \end{aligned}$$

Best Response Functions

$$q_A = \frac{120 - q_B}{2}$$



q_B	q_A^*
0	60
20	50
40	40
60	30
120	0

Because both firms face $MC = 2$, symmetric outcome for B

$$q_B = \frac{120 - q_A}{2}$$

Verifying Equilibrium

If B chooses $q_B = 40$, A can do no better than $q_A = 40$ (and vice versa), so this is a Nash Equilibrium

q_B	q_A	Q	P	TR_A	TC_A	Profit_A
40	39	79	\$43	\$1,677	\$78	\$1,599
40	40	80	\$42	\$1,680	\$80	\$1,600
40	41	81	\$41	\$1,681	\$82	\$1,599

Market Demand Function: $P = 122 - Q$

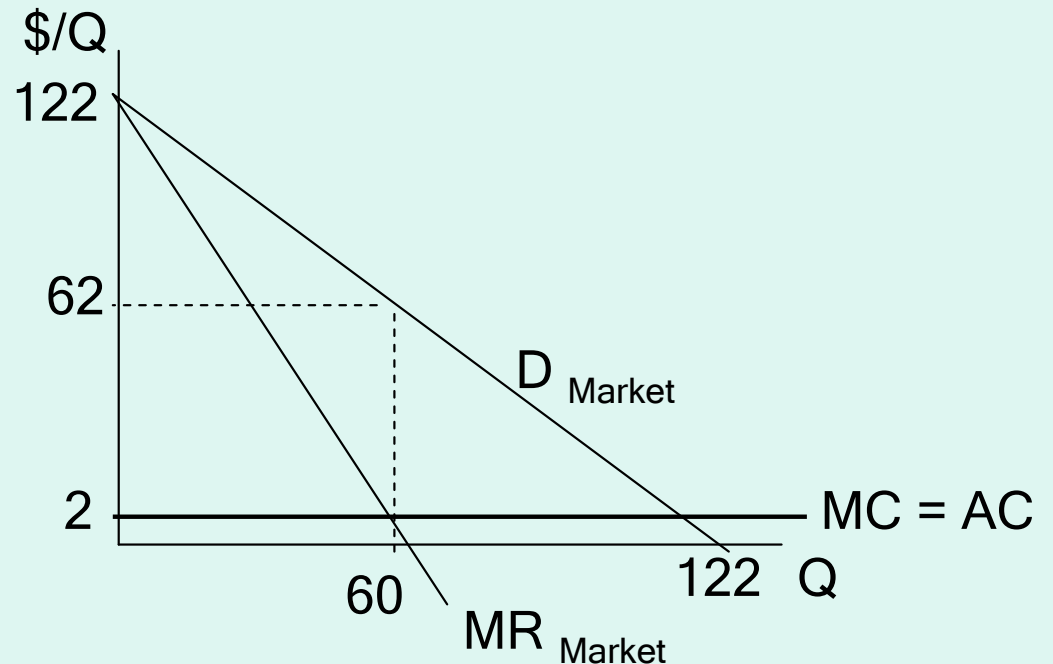
Total Profit:

$$2 * 40 (\$42 - \$2) = \$3,200 \text{ (or } \$1,600 \text{ each)}$$

But if the firms colluded and acted as a perfect cartel (monopoly)...

Total Profit:

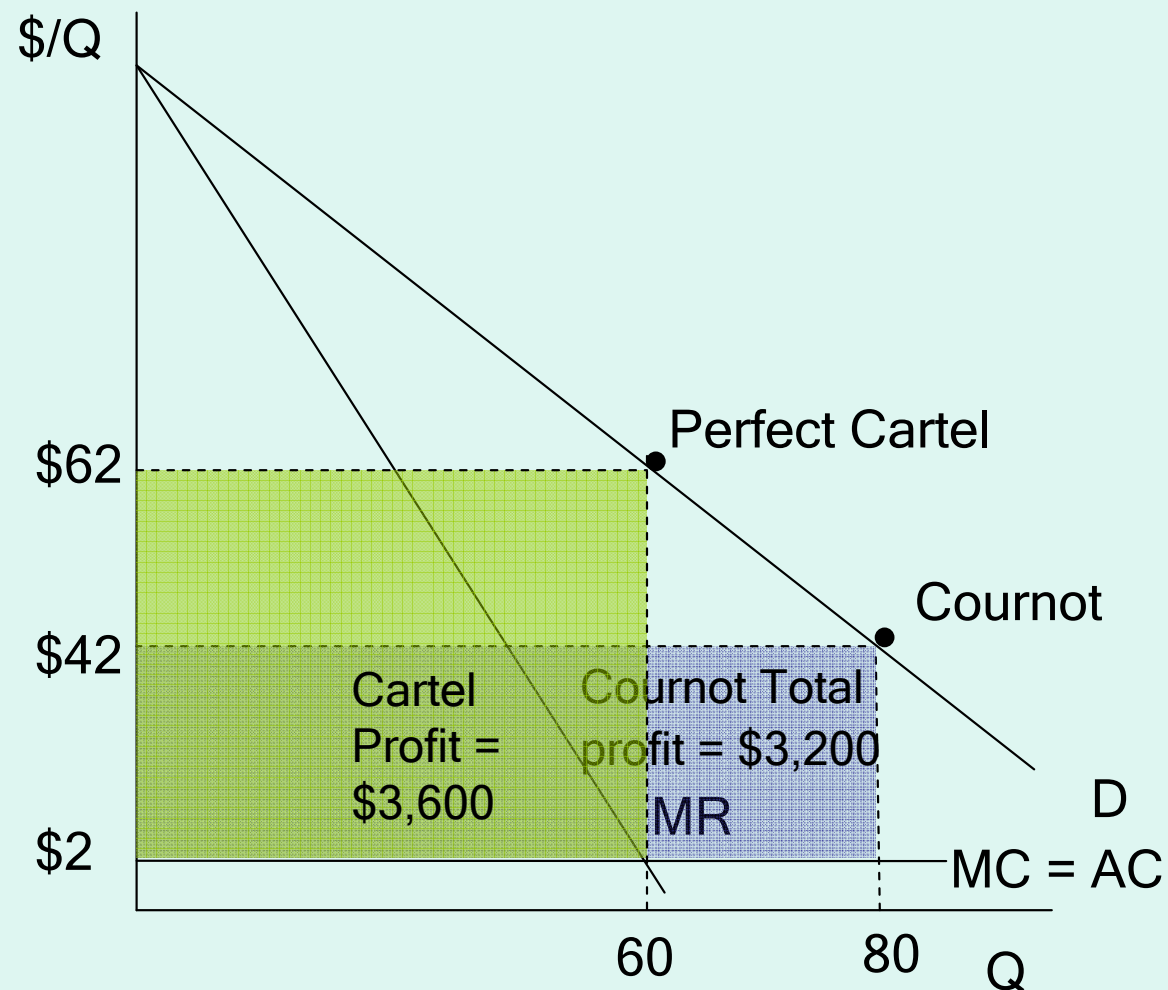
$$60 * (\$62 - \$2) = \$3,600 \text{ (or } \$1,800 \text{ each)}$$



Comparing Cournot Solution

In the Cournot solution, each firm produces 40 and the market price is \$42. TR = \$3,360 TC = \$160, Total Profit = \$3,200

If firms collude to form a perfect cartel, they act as a monopolist and produce a collective 60 units, charging \$62 per unit. TR = \$3,720 TC = \$120, Total profit = \$3,600



Summary of Cournot Model

- Find each firm's optimal quantity to produce in preemptive response to the quantities chosen (simultaneously) by competitors
 - Can be extended to three or more firms. With more firms, outcome becomes closer to perfect competition equilibrium.
- With constant MC that is identical across firms, firms will produce same quantity and make equal economic profit. *(But MC doesn't have to be the same for firms.)*
- The solution is a Nash equilibrium. No firm has an incentive to “deviate” (change quantity produced) given the quantity the competitor has chosen. However, firms earn less profit than a cartel.

But let's be realistic...

don't firms choose what *price* to charge, rather than what *quantity* to produce?



Bertrand
1822-1900

Main Assumptions of Bertrand Competition

- A fixed number of firms produce a homogeneous product
- Firms simultaneously choose what price they want to charge
- Since consumers can't tell the difference between the two firms' products, they choose based on price

Bertrand Competition

Assume:

- Two firms, Coke and Pepsi, produce a homogenous product
- The firms face a constant marginal cost (and constant average cost), c
- Goods are perfect substitutes, so consumers buy from Coke if $P_{\text{coke}} < P_{\text{pepsi}}$; and they buy from Pepsi if $P_{\text{coke}} > P_{\text{pepsi}}$
- Consumers split their consumption evenly between the two firms if $P_{\text{coke}} = P_{\text{pepsi}}$

Bertrand Paradox

- Each firm will sell at $P = MC$, since if it chooses a higher price its competitor can undercut and get *all the market share* in equilibrium.
- Both firms choose $P = MC$, and neither make economic profit
- Same outcome as perfect competition if products are *perfect* substitutes

Rationale for Bertrand Paradox

Market Demand Function: $Q = 122 - P$

Suppose on Monday $P_{\text{coke}} = P_{\text{pepsi}} = \42
 $Q = 80, Q_{\text{coke}} = 40, Q_{\text{pepsi}} = 40$

But on Tuesday $P_{\text{coke}} = \$41, P_{\text{pepsi}} = \42
 $Q = 81, Q_{\text{coke}} = 81, Q_{\text{pepsi}} = 0$

So what will Pepsi do on Wednesday?

Why does this result rely on products being *perfect substitutes*?

What happens if MC is not constant, but increases with greater output?

So why don't firms just collude to form a perfect cartel and act as a monopolist?

Easier said than done...

- 1) Antitrust regulation
- 2) Firms may cheat the rest of the cartel by lowering prices

We'll discuss this more on Thursday

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11.203 Microeconomics
Fall 2010

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