

**Two extremes: Perfect Competition and Monopoly**

**Perfect competition:** no strategic interaction with producers since they do not have any market power.

**Monopoly:** no strategic interaction between producers since there is only one. (There is strategy between producers and consumers to segment the market).

**Between Monopoly and Perfect Competition**

**Oligopoly:** market where a small number of firms offer similar or identical products. They are interdependent in the sense that the profit earned by each firm depends on the firm's own actions and on the actions of the other firms.

key: there are game theoretic elements with producers the tension between cooperation and self-interest.

They maximize their total profits by forming a cartel and acting like a monopolist.

Cartels are illegal (-antitrust laws that prohibit explicit agreements among oligopolists) but they do operate in some markets. Despite the temptation to collude, cartels tend to collapse. (see via game theory)

**Range of Oligopoly outcomes****Competitive Outcome**

$$P=MC$$

$$Q^* = \text{level that max TS}$$

**Monopoly Outcome**

$$P > MR = MC$$

$$Q^* > Q_m$$

**Possible Oligopoly Outcomes**

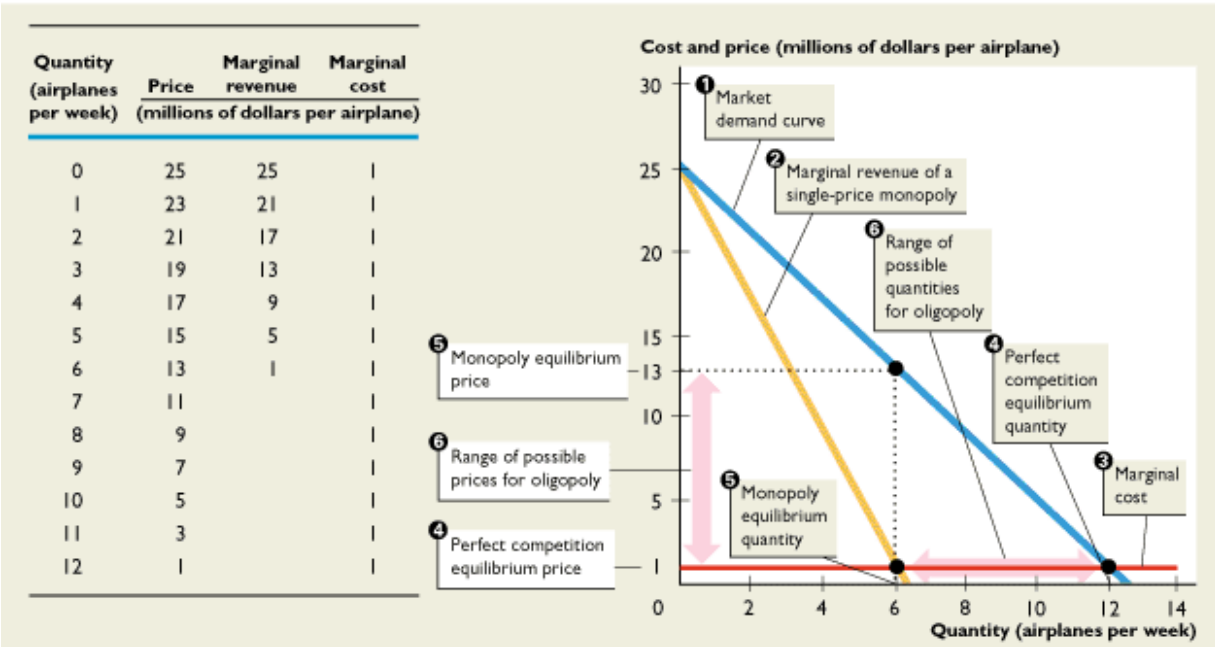
$$Q^* \geq Q_0 \geq Q_m$$

$$P^* \leq P_0 \leq P_m$$

## Cournot (1838)

Small number of firms with identical costs producing a homogeneous product simultaneously choosing output to maximize their profits

Simple case: Duopoly (two) firms producing identical products.  
Face market demand, constant marginal costs, no fixed costs.  
Strategy: choose own level of output ( $q_i$ )  $i = \text{airbus, boeing}$



### ■ Collusion Versus Competition

By limiting production to the monopoly quantity, the firms can maximize joint profits.  
Eg. Joint profits can be \$72 million if the firms produce the monopoly output.

TABLE 14.1 MONOPOLY OUTCOME

	Boeing	Airbus	Market total
Quantity (airplanes a week)	3	3	6
Price (\$ million per airplane)	13	13	13
Total revenue (\$ million)	39	39	78
Total cost (\$ million)	3	3	6
Economic profit (\$ million)	36	36	72

By increasing production, one firm might be able to make an even larger profit and force a smaller profit on to the other firm.

Boeing can increase its economic profit by \$4 million and cause the economic profit of Airbus to fall by \$6 million.

**TABLE 14.2 BOEING INCREASES OUTPUT TO 4 AIRPLANES A WEEK**

	Boeing	Airbus	Market total
Quantity (airplanes a week)	4	3	7
Price (\$ million per airplane)	11	11	11
Total revenue (\$ million)	44	33	77
Total cost (\$ million)	4	3	7
Economic profit (\$ million)	40	30	70

### Airbus Increases Output to 4 Airplanes a Week

For Airbus this outcome is an improvement on the previous one by \$2 million a week. For Boeing, the outcome is worse than the previous one by \$8 million a week.

**TABLE 14.3 AIRBUS INCREASES OUTPUT TO 4 AIRPLANES A WEEK**

	Boeing	Airbus	Market total
Quantity (airplanes a week)	4	4	8
Price (\$ million per airplane)	9	9	9
Total revenue (\$ million)	36	36	72
Total cost (\$ million)	4	4	8
Economic profit (\$ million)	32	32	64

*A dilemma:*

- If both collude, they both produce 3 airplanes and make \$36 million.
- If they both increase production to 4 airplanes a week, they both make \$32 million.
- If only one increases production to 4 airplanes a week, that firm makes \$40 million.
- Game theory provides an answer.

## The Payoff Matrix

		<b>Airbus's strategies</b>	
		4 a week	3 a week
<b>Boeing's strategies</b>	4 a week	\$32m	\$30m
	3 a week	\$40m	\$36m

### Equilibrium of the Duopolists' Dilemma

Both firms produce 4 a week. (If Airbus produces 4, I should produce 4. If airbus produces 3, I should produce 4)

The duopolists fail to cooperate and get a worse outcome than the one that cooperation would deliver. It would be individually rational for each firm to cheat on a collusive agreement and increase output.

*The duopolists find that talk is cheap.* They can promise to follow the cartel agreement, but since they simultaneously choose output there is no way for them to enforce the agreement.

### ----- Refinement of the Cournot game with bribes -----

The question arose in class, "In the case where Boeing made 4 airplanes and earned a profit of \$40 and Airbus made 3 planes with a profit of \$30, couldn't Boeing pay Airbus to not produce the extra plane?"

If that was the case this increases the number of strategies for each firm. The game below just shows the strategies if Boeing only offers the bribe to keep the payoff matrix small. Suppose the optimal bribe would be \$5. That way each firm would be making \$35 million in profit, however we get the same results if we change amount bribed. (If we were to show all the possible bribes and both firms offering bribes the game would be huge!)

B / A	4/week	3/week
4/week	32, 32	40, 30
3/week	30, 40	36, 36
4/week pay bribe	27, 37	35, 35
4/week no pay*	32, 32	40, 30

Recall that the firms can agree to collude, now by either producing the monopoly output, or agree that one firm will produce more and the other will produce less. After the agreement is

set, they play the game where they simultaneously choose a quantity to produce. Then the game ends.

Solving this game we see that the equilibrium is again for both firms to produce 4 planes per week. Again talk is cheap, there is no way to enforce the collusive agreement in this one shot game.

\* The last row of the game can be removed since it is actually the identical strategy to 4/week

----- we return to the original game below -----

### Using equations:

Assume each firm can produce as much as they like at a constant MC \$c per unit.  
From the demand equation we can form the price equation:  $P = a - bQ$

**a = the price where quantity demanded is zero (intercept)**

**b = slope of the line**

### Perfectly competitive industry

Rule: set  $P = MC$

$$P = a - bQ \quad MC = \$c$$

$$\rightarrow c = a - bQ \quad \rightarrow Q^* = (a - c)/b$$

In the example with Boeing and Airbus:

$$P = 25 - 2Q \quad MC = \$1$$

$$\rightarrow 1 = 25 - 2Q \quad \rightarrow \underline{Q^* = (25 - 1)/2 = 12}$$

### Monopoly

Rule: set  $MR = MC$  and MR has twice slope of P

$$P = a - bQ$$

$$\rightarrow MR = a - 2bQ \quad \rightarrow c = a - 2bQ \quad \rightarrow Q_m = (\frac{1}{2})(a-c)/b$$

Using the example above:

$$MR = 25 - 4Q \quad \rightarrow 1 = 25 - 4Q \quad \rightarrow \underline{Q_m = (\frac{1}{2})(25 - 1)/2 = 6}$$

### Duopoly:

Total quantity supplied:  $Q = q_1 + q_2$  where  $q_i$  = quantity supplied by firm  $i$ .  $i = 1, 2$

$$P = a - b(q_1 + q_2)$$

Rule: use game theory. What is the best response to other firm's output?

Using calculus

$$NE: q_1^* = q_2^* = (1/3)(a-c)/b$$

$$Q_{\text{Cournot}} = q_1^* + q_2^* = (2/3)(a-c)/b$$

$$Q_m < Q_c < Q^* \quad \rightarrow \quad P_m > P_c > P^*$$

Using the example above:

$$Q_c = (2/3)(25 - 1)/2 = 8$$

$$Q_m = 6 < Q_c = 8 < Q^* = 12$$

If we generalize to  $n$  oligopoly firms choosing own quantity:

$$Q_{\text{Cournot}} = (n/n+1)(a - c)/b$$

As the number of firms increase the closer we get to perfect competition.

Cournot showed that out of an oligopoly, we'll get an output between monopolists and perfect competition. Empirical evidence, prices seems to be higher in an oligopoly.

### **Bertrand (1883)**

However, do firms choose output? In the real world, the firms tend to set prices. Then produce as much as they need to meet market demand. Cournot set up is wrong.

Set up the same as Cournot, but firms simultaneously choose price.

Price is the strategic variable, not quantity.

Boeing and Airbus choose their own airplane price:  $P_i$ , where  $i = \text{airbus, boeing}$

Again: constant MC, no fixed costs.

→ If one firm has a lower price than their rival, with identical products, consumers will buy from the low price firm

→ If firms charge the same price, the market is split in half

If we change the nature of the game, by choosing prices, firms have the incentive to undercut price, until  $P_B = P_A = P^*$

Going from monopoly to duopoly, prices drop to MC.

$$Q_m < Q_{\text{bertrand}} = Q^*$$

$$P_m > P_{\text{bertrand}} = P^*$$

### ***Bertrand Paradox.***

In the real world, firms with market power generally choose prices. We noted that one monopolistic producer reaped large economic profits. By adding one more firm, we go to the other extreme where  $P = MC$  and zero economic profit. What's going on?

Alternatively, in the real world, firms choose prices, but we rarely observe oligopoly firms charging  $p = MC$ . How do we resolve this?

4 resolutions to Bertrand's Paradox: how oligopoly firms choosing price can charge  $p > MC$

- Product differentiation.
  - o Xbox 360 and PS3 and Wii, all capture different parts of the market
- Capacity Constraints.
  - o In one time period, Boeing can only produce so many airplanes, some orders will be taken by Airbus.
- Collusion via Low-Price Guarantees.
  - o Changes incentives to cut prices.
  - o Best Buy and Circuit City. offers: *"If you find a lower price, we beat it by 10%"*
  - o If BB breaks the collusive agreement by lowering prices, they will not get the sale, customers will go to CC and pay 10% below BB's price.
  - o BB not happy b/c not selling even with lower price, CC not happy b/c have to sell at an even lower price.
  - o With both offering low price guarantees, both are hurt by lowering prices. So the guaranteed low price offered to the consumers is a collusively higher price than MC.
- Collusion by repeated interaction

*Next time we'll examine how repeated interaction results in Bertrand Oligopolists charging a price higher than MC and how repeated interaction results in Cournot Oligopolists setting a level of quantity produced equal to the monopoly level of output.*