

# Monopolistic Competition and Oligopoly

EE311

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This lecture note is adapted from the original material prepared by Prof. Chayunt.

# Topics to be Discussed

- Concentration ratio
- Monopolistic Competition
- Oligopoly
  - Kinked-demand curve model
  - Cartels
  - Quantity Competition
  - Quantity Leader
  - Price Competition
  - Dominant Firm

# Concentration Ratio and market structure

- Concentration Ratio is an index that can be used to determine the market structure and competition whether an industry is closer to perfect competition or monopoly
- The index is often based on market shares, assets, or production capacities.

# Absolute Concentration

- Absolute Concentration ratio is a concentration ratio that measures the degree of concentration of a group of largest firms in that industry. The index is denoted by  $CR_N$  where  $N = 1, 2, 3, \dots, 8, \dots$ . The most largest firm
- For the case of  $CR_3$ , it is possible to conclude that
- If  $CR_3 > 67\%$ , that industry is relatively monopolized
- If  $67\% > CR_3 > 34\%$ , that industry is in the intermediate range
- If  $CR_3 < 34\%$ , that industry is relatively competitive

## Concentration ratio for the detergent market in Thailand

|     | 1997 | 1998 | 1999 | 2000 | 2001 |
|-----|------|------|------|------|------|
| CR3 | 0.83 | 0.83 | 0.81 | 0.81 | 0.84 |
| CR4 | 0.98 | 0.99 | 0.96 | 0.96 | 0.97 |

The largest 4 firms in 2007

1. Unilever 65% (Breeze 47%, Omo 18%, Serve 0.3%)
2. Lion 14% (Pao and Pro)
3. Kao 10% (Attack )
4. Colgate Palmolive -> P&G 5% (Fab)

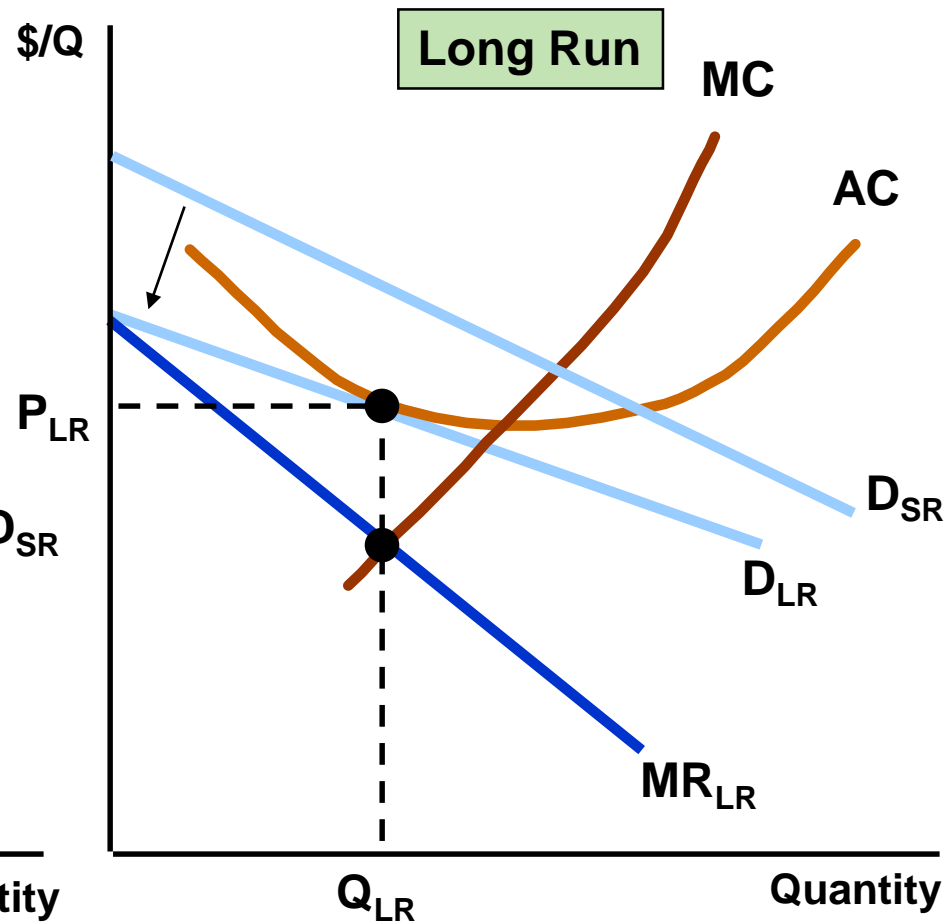
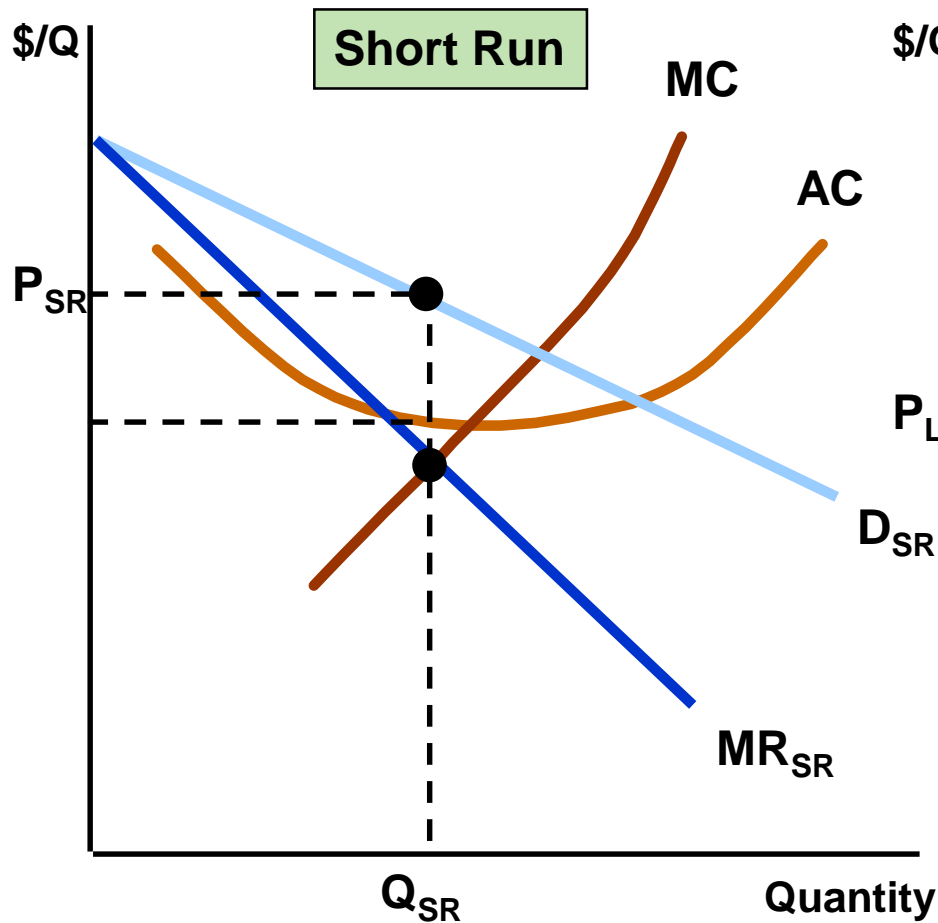
# Monopolistic Competition

- Characteristics
  1. Many firms
  2. Free entry and exit
  3. Differentiated product but highly substitutable products

Example: barber shops, small restaurants,  
grocery stores



# A Monopolistically Competitive Firm in the Short and Long Run



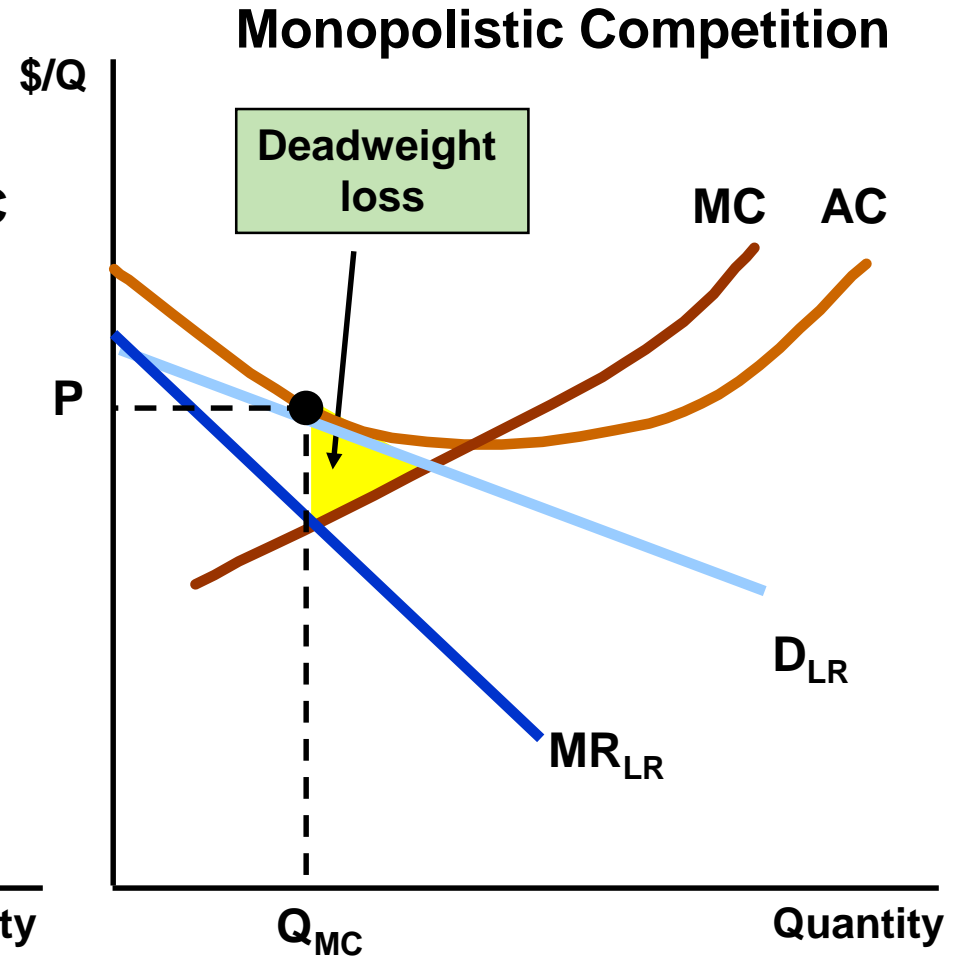
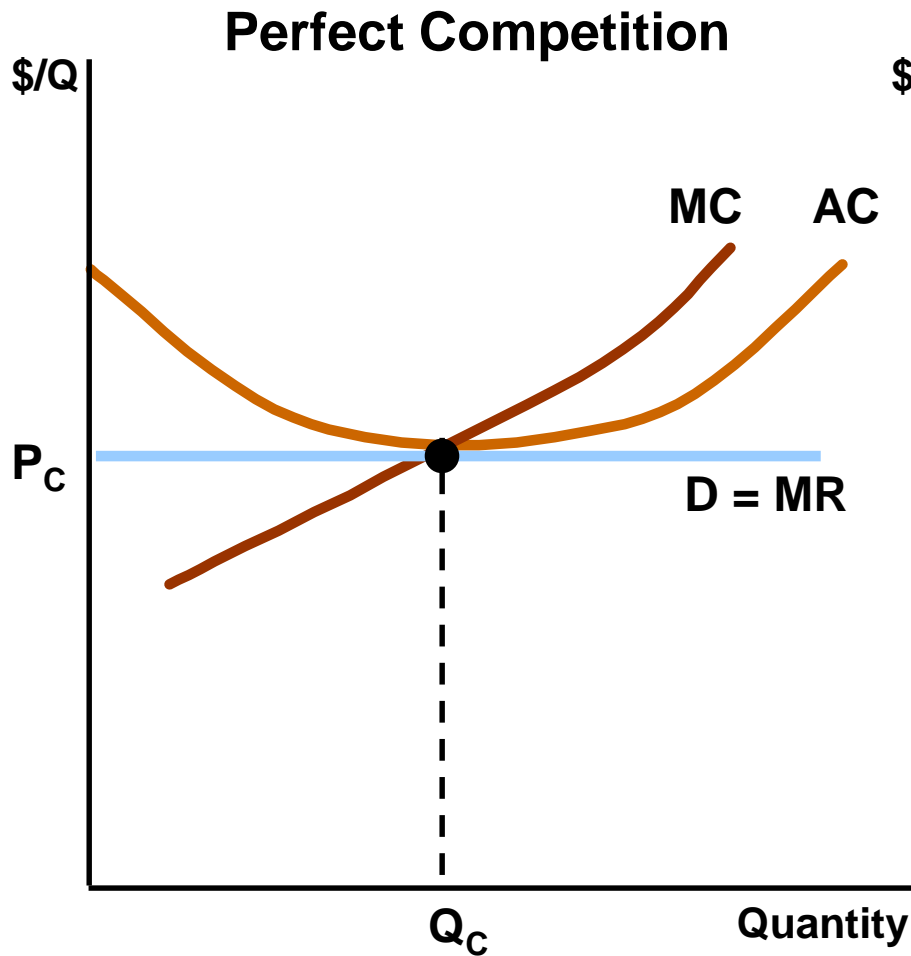
# A Monopolistically Competitive Firm in the Short and Long Run

- Short-run
  - Downward sloping demand – differentiated product
  - Individual demand is relatively elastic – good substitutes compare to the market demand
  - $MR < P$
  - Profits are maximized when  $MR = MC$
  - This firm is making excess profits

# A Monopolistically Competitive Firm in the Short and Long Run

- Long-run
  - Profits will attract new firms to the industry (no barriers to entry)
  - The old firm's demand will decrease to  $D_{LR}$
  - Firm's output and price will fall
  - Industry output will rise
  - Normal profit ( $P = AC$ )
  - $P > MC$  --> some monopoly power

# Monopolistically and Perfectly Competitive Equilibrium (LR)



# Monopolistic Competition & Economic Efficiency

- The monopoly power yields a higher price than perfect competition. If price was lowered to the point where  $MC = D$ , consumer and producer surpluses would increase by the yellow triangle – deadweight loss.
- With no economic profits in the long run, the firm is still not producing at minimum AC and excess capacity exists.

# Monopolistic Competition and Economic Efficiency

- Firm faces downward sloping demand so zero profit point is to the left of minimum average cost
- Excess capacity is inefficient because average cost would be lower with fewer firms
  - Inefficiencies would make consumers worse off

# Monopolistic Competition

- If inefficiency bad for consumers, should monopolistic competition be regulated?
  - Market power relatively small. Usually enough firms to compete with enough substitutability between firms – deadweight loss small
  - Inefficiency is balance by benefit of increased product diversity – may easily outweigh deadweight loss

# Oligopoly – Characteristics

- Small number of firms
- Product differentiation may or may not exist
- Barriers to entry
  - Scale economies
  - Patents
  - Technology
  - Name recognition
  - Strategic action
- Mutually interdependent

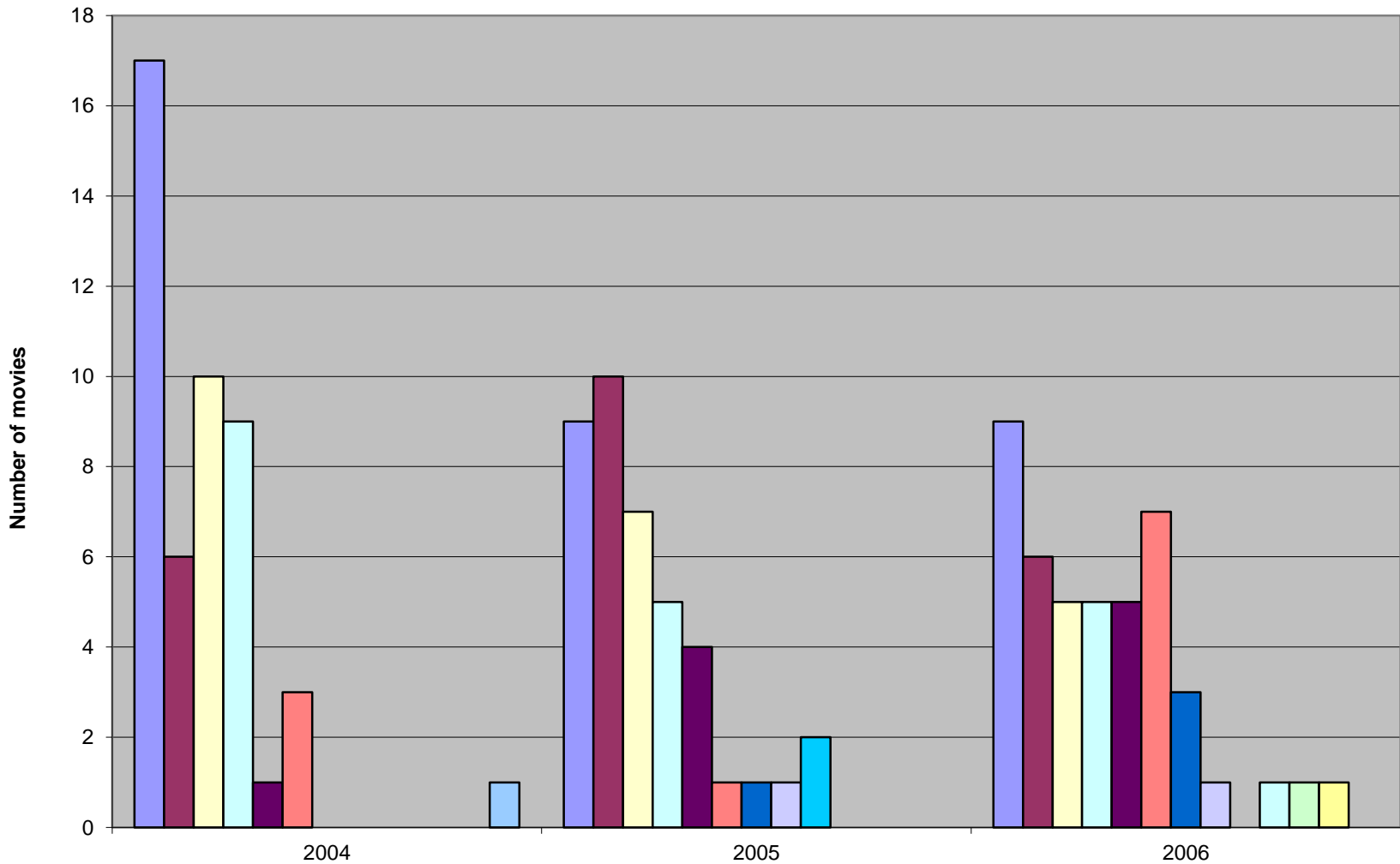


## Application of Economies of scale as barriers to entry

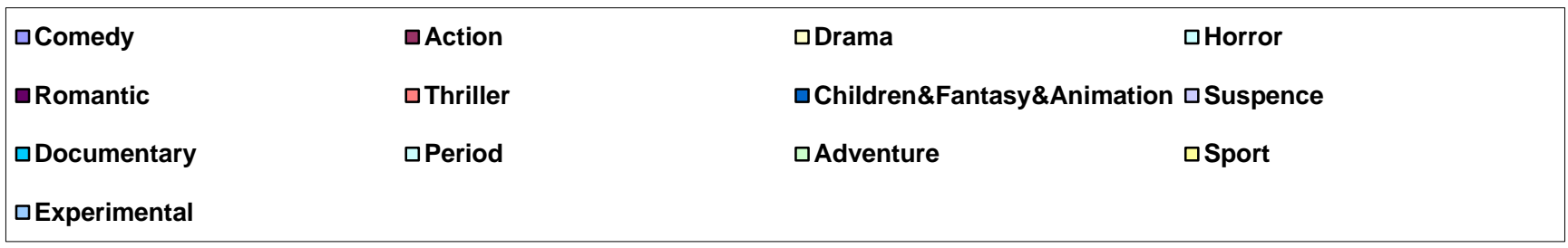
- There are only a few animation movies made in Thailand as compared to those from Japan and the U.S.
- Use the concept of economies of scale and the market size to explain these differences
- Extend this to the normal movies.



# Thai Movies by Genres



ฮา  
เฮียน  
โหด  
หื่น



# Oligopoly

- Mutually interdependent
  - Strategic actions to deter entry
    - Threaten to decrease price against new competitors by keeping excess capacity
  - Rival behavior
    - Because only a few firms, each must consider how its actions will affect its rivals and in turn how their rivals will react.
- Different rival assumptions lead to different models

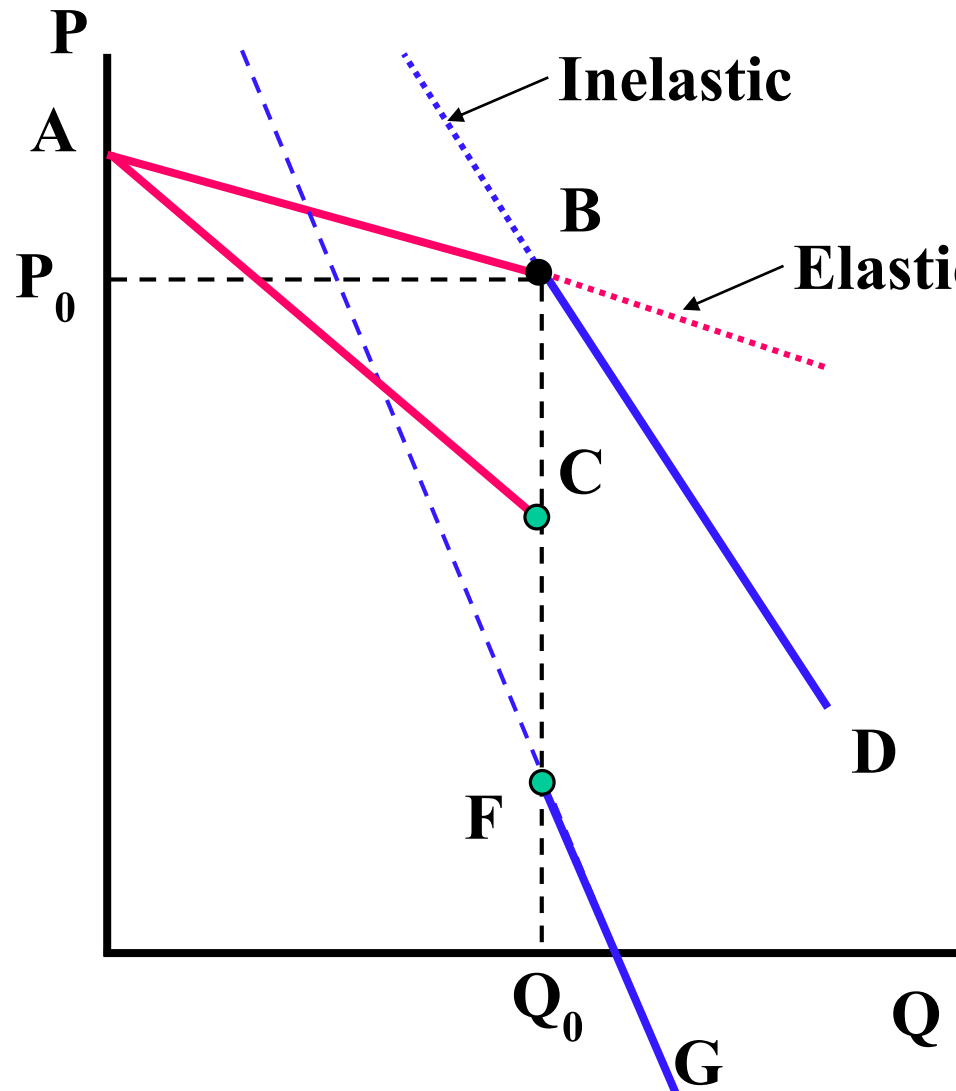
# Kinked Demand Curve Model

- Rival firms respond to direction of price change of a firm differently.
- If a firm decides to decrease its price to attract more customers, other firms will match the price reduction to protect their market share. Hence, it can attract less customers.
- If the firm decides to increase its price instead, no other firms will match the price increase since they will get more customers.

# Kinked Demand Curve Model

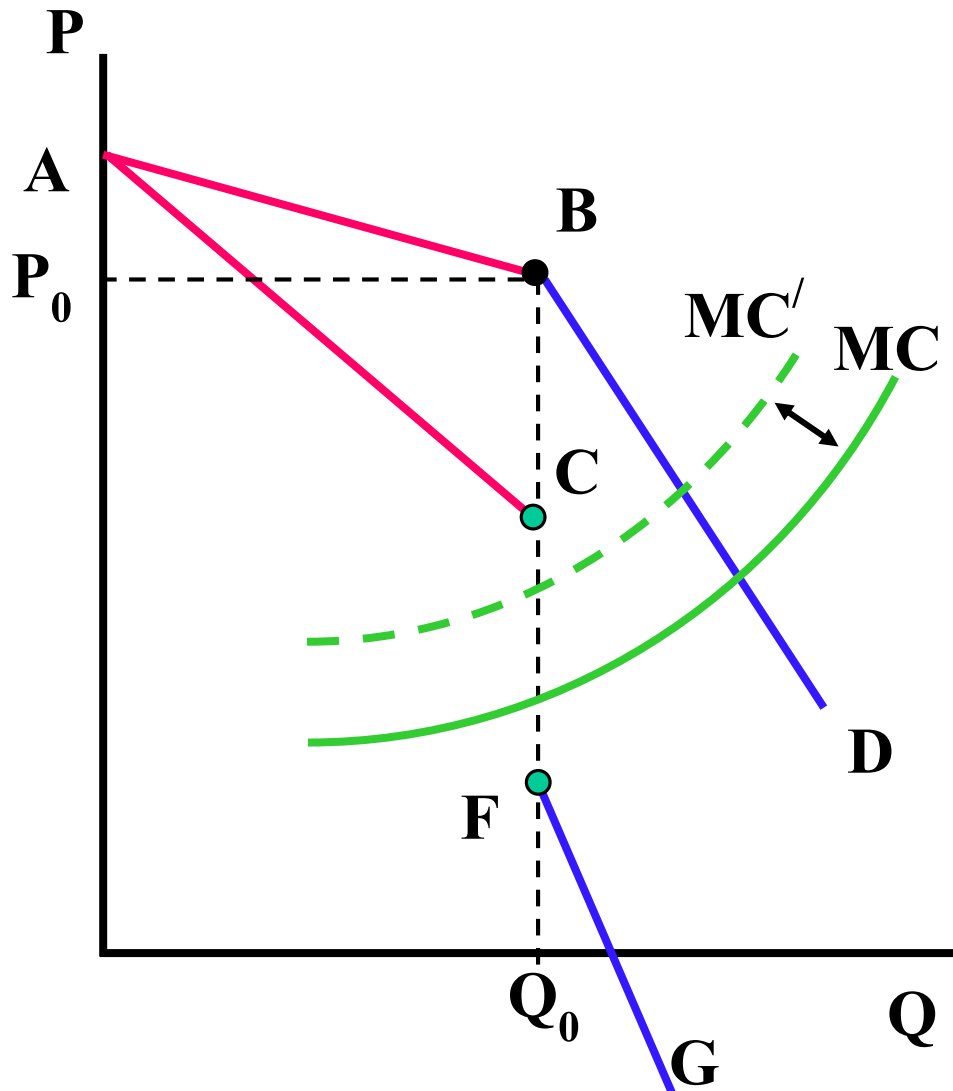
- The demand facing by a firm when it tries to decrease the price is inelastic.
- The demand facing by a firm when it tries to increase the price is elastic.
- Its demand curve is kinked at the original price and given by line ABD.
- The corresponding MR curve is given by line ACFG with a gap between CF.

# Kinked Demand Curve Model



- Demand curve above  $P_0$  is elastic because no other firm matches the price increase.
- Demand curve below  $P_0$  is inelastic because all other firms match the price decrease.
- MR curve is  $ACFG$ .

# Kinked Demand Curve Model



- Suppose MC passes between the gap CF, equilibrium price and quantity will be  $P_0$  and  $Q_0$ .
- A small change in MC will not change the equilibrium price.
  - Price is sticky at  $P_0$ .

# Kinked Demand Curve Model

## Criticism:

- Empirical evidence does not support “sticky price” conclusion.
- Changing price tag every time that the cost change is not practical and may create confusion → infrequent change in price does not need to be explained by kinked demand curve.
- No explanation is given how  $P_0$  is chosen at the first place.
- Need new models that can explain better.

# Model summary

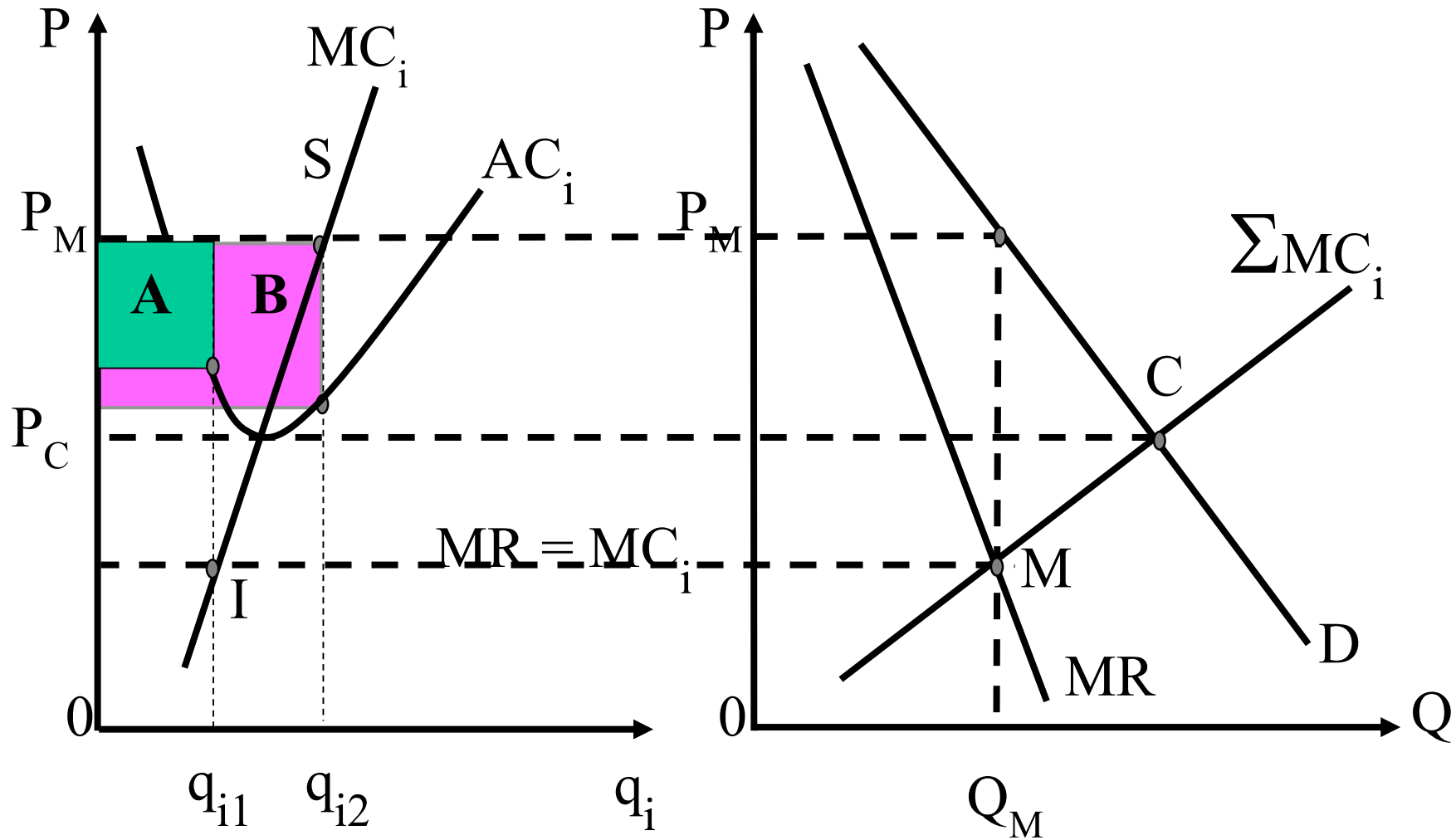
|               | <b>Non Cooperative</b>    |                                | <b>Cooperative</b>              |
|---------------|---------------------------|--------------------------------|---------------------------------|
| <b>Leader</b> | <b>Quantity strategy</b>  | <b>Price strategy</b>          | <b>Collusion or<br/>Cartels</b> |
| <b>No</b>     | <b><u>Cournot</u></b>     | <b><u>Bertrand</u></b>         |                                 |
| <b>yes</b>    | <b><u>Stackelberg</u></b> | <b><u>Price Leadership</u></b> |                                 |

## Cooperative oligopoly: Cartels

- Producers in a cartel explicitly agree to cooperate in setting prices and output.
- Typically only a subset of producers are part of the cartel and others benefit from the choices of the cartel
- If demand is sufficiently inelastic and cartel is enforceable, prices may be well above competitive levels
- Example: OPEC



# Cartels: profits and an incentive to cheat

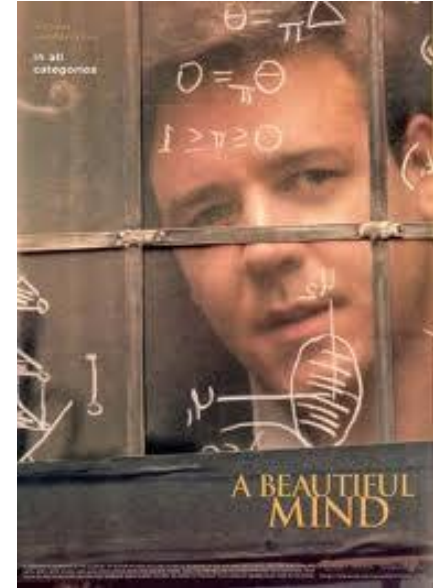


# Cartels

- To be successful:
  - Total demand must not be very price elastic
  - Tempting to cheat by lowering price to capture larger market share
  - less possibilities of substitutes
  - Either the cartel must control nearly all of the world's supply or the supply of non-cartel producers must not be price elastic

# Non cooperative Oligopoly

- Defining Equilibrium
  - Firms are doing the best they can and have no incentive to change their output or price
  - All firms assume competitors are taking rival decisions into account.
- Nash Equilibrium
  - Each firm is doing the best it can *given what its competitors are doing.*
  - Each firm correctly assumes its competitor's strategy.
- We will focus on **duopoly**



# The Cournot Model

- Assumptions
- homogeneous goods
- each firm treats the output of its competitors as fixed\*
- all firms decide simultaneously how much to produce\*
- Firm will adjust its output based on what it thinks the other firm will produce\*
- Note: \* important assumptions

# Cournot Equilibrium

- Each firm correctly assumes how much its competitor will produce and sets its own production level accordingly.
- It says nothing about the dynamics of the adjustment process.
- Cournot equilibrium is an example of a Nash equilibrium (Cournot-Nash Equilibrium)

# An Example of the Cournot Equilibrium

- The Linear Demand Curve
  - Two firms face linear market demand curve
  - Market demand is  $P = 100 - Q$
  - $Q$  is total production of both firms:
$$Q = Q_1 + Q_2$$
  - Both firms have  $MC_1 = MC_2 = 10$  for simplicity

# The Cournot Model: Example

- To maximize profits, Firm 1 will choose  $Q_1$  that make  $MR=MC$

- Total Revenue:

$$\begin{aligned}TR_1 &= PQ_1 = (100 - Q_1 - Q_2)Q_1 \\ &= 100Q_1 - (Q_1)^2 - Q_1Q_2\end{aligned}$$

- Marginal Revenue:

$$MR_1 = dR_1/dQ_1 = 100 - 2Q_1 - Q_2$$

## The Cournot Model: Example

- Set  $MR_1 = MC_1 = 10$ ,

$$100 - 2Q_1 - Q_2 = 10$$

$$Q_1 = 45 - (Q_2 / 2)$$

This equation is the Firm 1's Reaction Curve.

Similarly, Firm 2's Reaction Curve is

$$Q_2 = 45 - (Q_1 / 2)$$

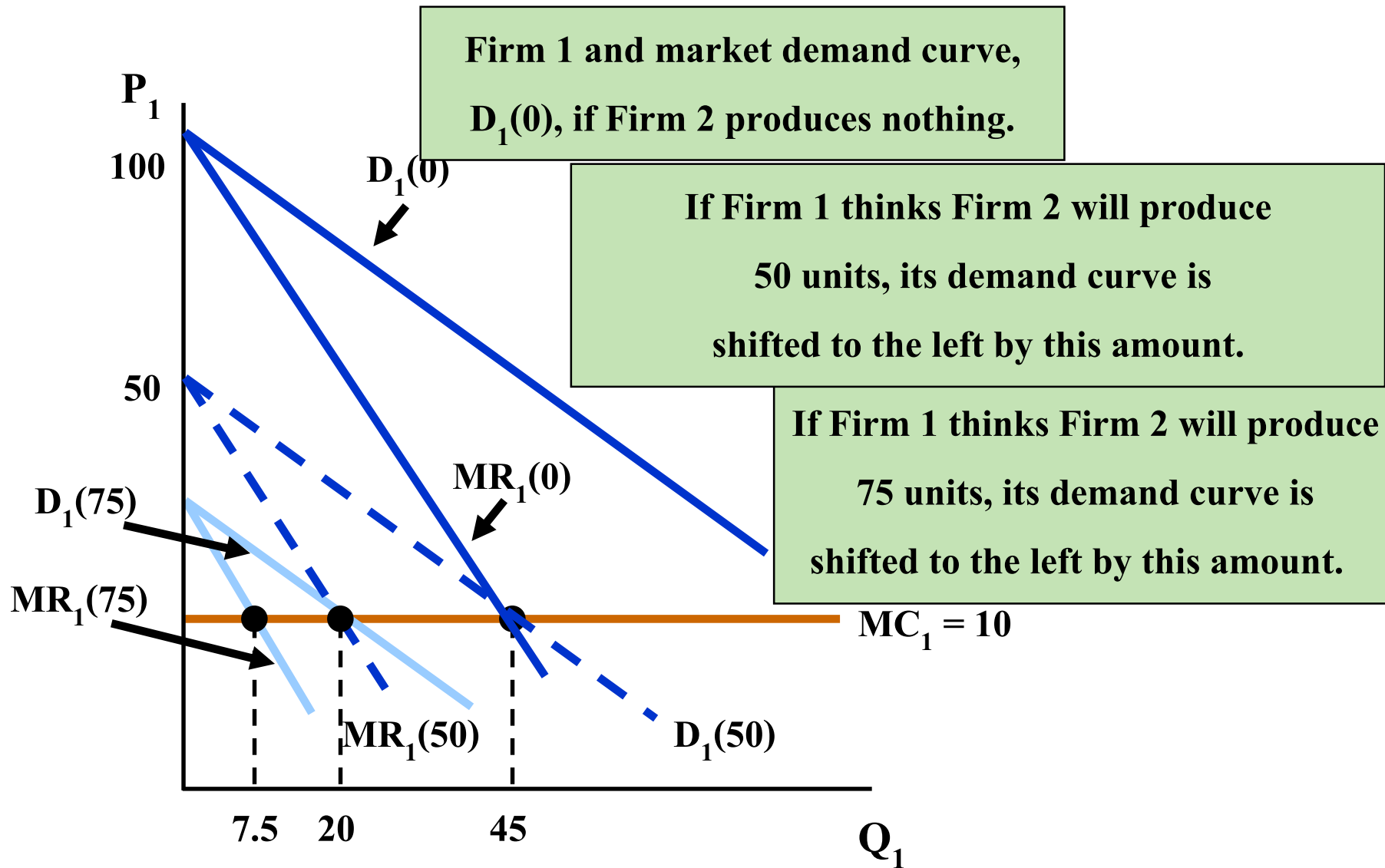
# The Cournot Model

- The Reaction Curve
  - The relationship between a firm's profit-maximizing output and the amount it thinks its competitor will produce.
  - A firm's profit-maximizing output is a decreasing schedule of the expected output of Firm 2.

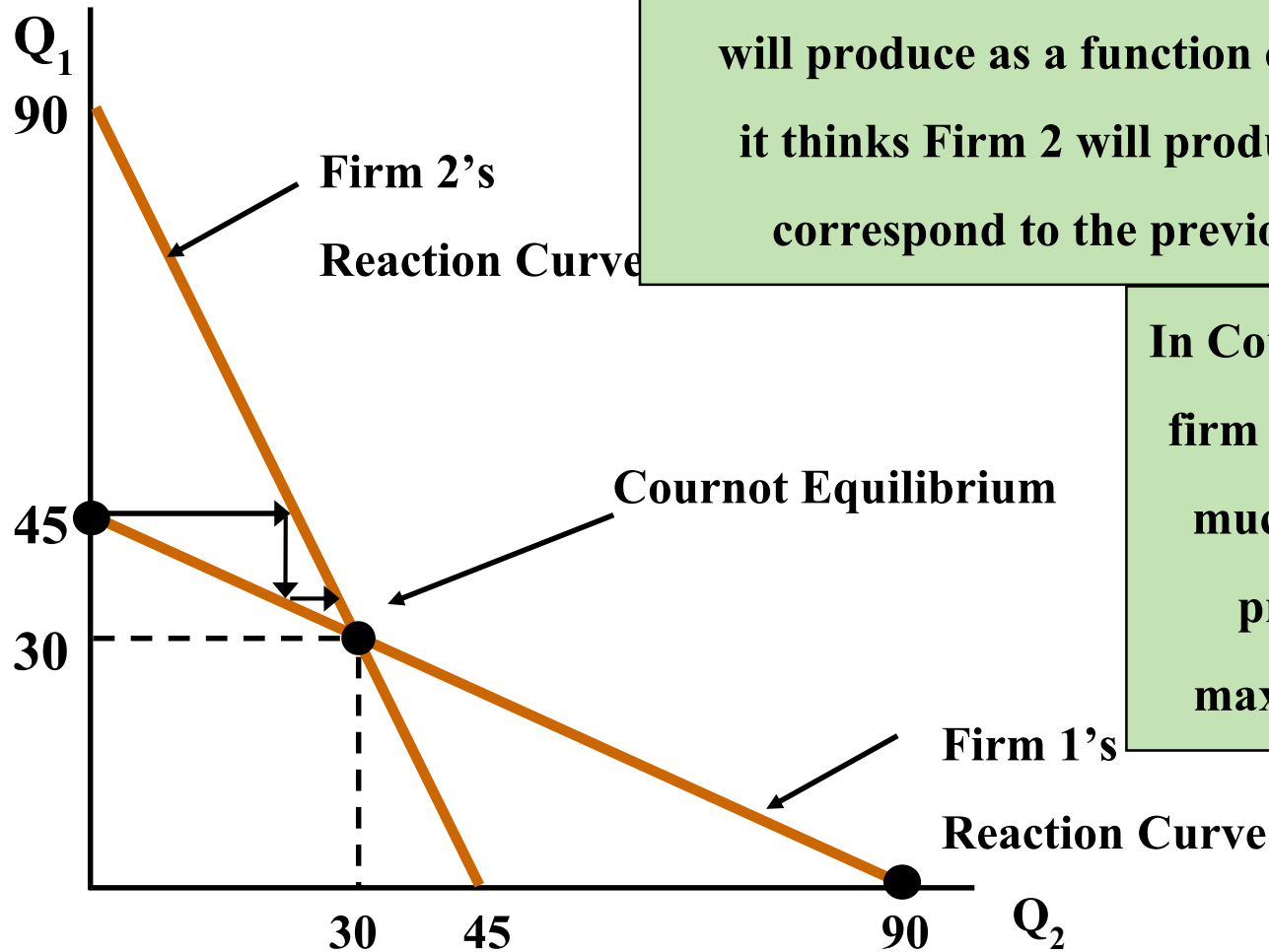
## Firm 1's Output Decision

| $Q_2$     | $MR_1 = 100 - 2Q_1 - Q_2$      | $Q_1^* = 45 - Q_2/2$ |
|-----------|--------------------------------|----------------------|
| <b>0</b>  | <b><math>100 - 2Q_1</math></b> | <b>45</b>            |
| <b>50</b> | <b><math>50 - 2Q_1</math></b>  | <b>20</b>            |
| <b>75</b> | <b><math>25 - 2Q_1</math></b>  | <b>7.5</b>           |
| <b>90</b> | <b><math>10 - 2Q_1</math></b>  | <b>0</b>             |

# Firm 1's Output Decision



# The Cournot Model: Example



Firm 1's reaction curve shows how much it will produce as a function of how much it thinks Firm 2 will produce. The x's correspond to the previous model.

In Cournot equilibrium, each firm correctly assumes how much its competitors will produce and thereby maximize its own profits.

## The Cournot Model: Example

- The Cournot Equilibrium can be solve by substituting  $Q_1$  into  $Q_2$

$$Q_1 = 45 - \frac{1}{2}(45 - \frac{Q_1}{2}) \Rightarrow Q_2 = Q_1 = 30$$

$$Q = Q_1 + Q_2 = 60, \quad P = 100 - Q = 40$$

$$\pi_1 = (40 - 10)30 = 900 = \pi_2$$

## Collusion: Example

- Profit Maximization with Collusion

$$TR = PQ = (100-Q)Q = 100Q - Q^2$$

$$MR = dTR/dQ = 100 - 2Q$$

$$MR = MC = 10$$

$$Q = 45, P = 55$$

$$\pi = (55-10)45 = 2025,$$

$$\pi_1 = \pi_2 = 1012.5$$

# Profit Maximization w/Collusion

- Contract Curve or Collusion Curve
  - $Q_1 + Q_2 = 45$ 
    - Shows all pairs of output  $Q_1$  and  $Q_2$  that maximizes total profits
  - $Q_1 = Q_2 = 22.5$ 
    - Less output and higher profits than the Cournot equilibrium

## Competitive solution

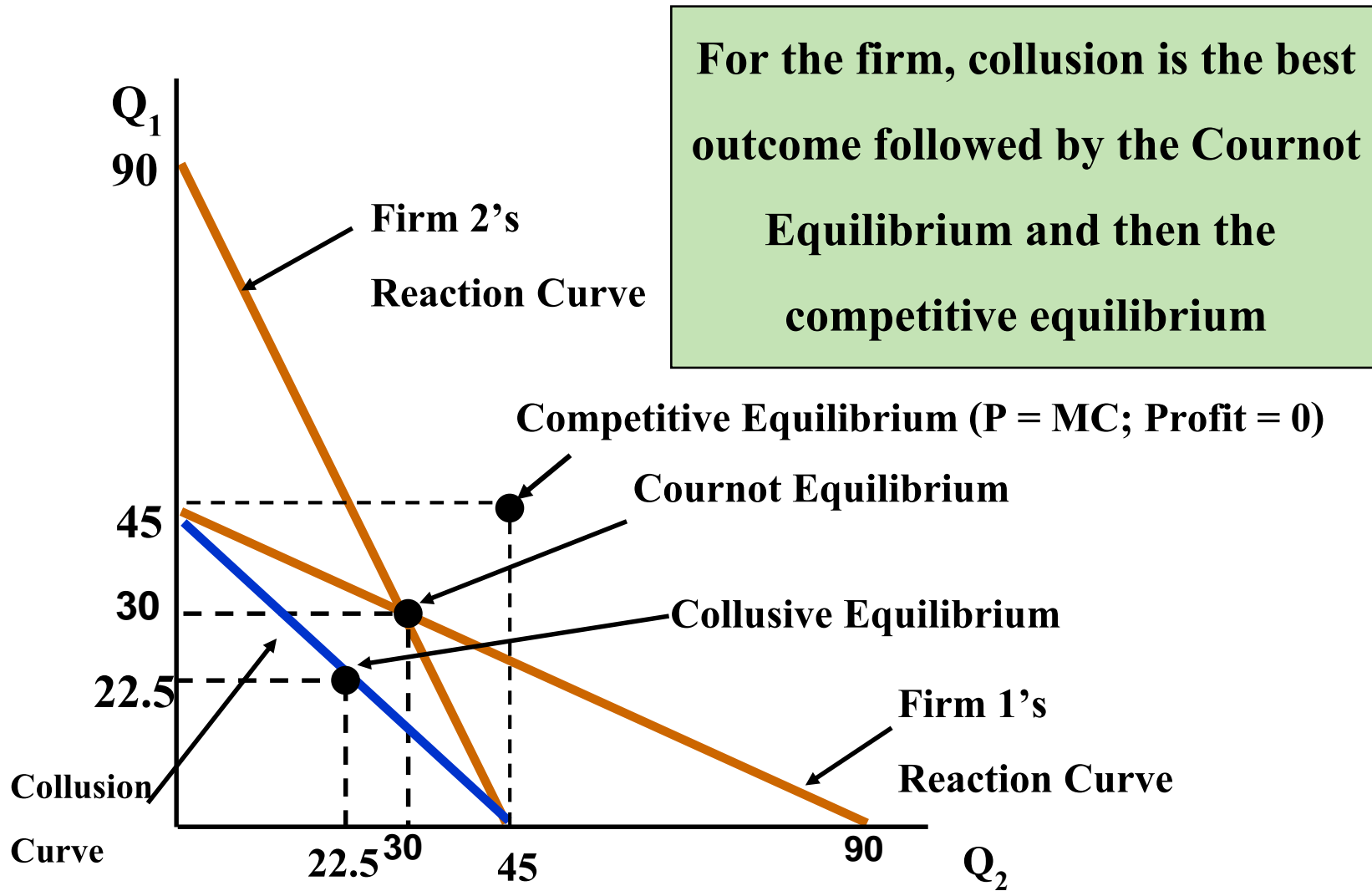
- Firms in a perfectly competitive market should maximize profits at  $P = MC = 10$

$$10 = 100 - Q \rightarrow Q = 90$$

$$Q_1 = Q_2 = 45$$

- Total output is higher than that in the Cournot case and the profit is normal

# Duopoly Example



# First Mover Advantage – The Stackelberg Model

- homogeneous goods
- one firm sets its output before other firm does.\*
- simplify assumptions
  - $MC = 10$
  - Market demand is  $P = 100 - Q$  where  $Q$  is total output
  - Firm 1 sets output first and Firm 2 then makes an output decision seeing Firm 1 output

# First Mover Advantage – The Stackelberg Model

- Firm 1
  - Must consider the reaction of Firm 2
- Firm 2
  - Takes Firm 1's output as fixed and therefore determines output with the Cournot reaction curve:  $Q_2 = 45 - \frac{1}{2}Q_1$
- Method 1: Find residual demand for firm 1 is
$$P_R = 100 - Q_1 - (45 - \frac{1}{2}Q_1) = 55 - \frac{1}{2}Q_1$$

## First Mover Advantage – The Stackelberg Model

- Method 1: Find residual demand for firm 1 is

$$P_R = 100 - Q_1 - (45 - \frac{1}{2}Q_1) = 55 - \frac{1}{2}Q_1$$

$$TR_R = 55Q_1 - \frac{1}{2}Q_1^2$$

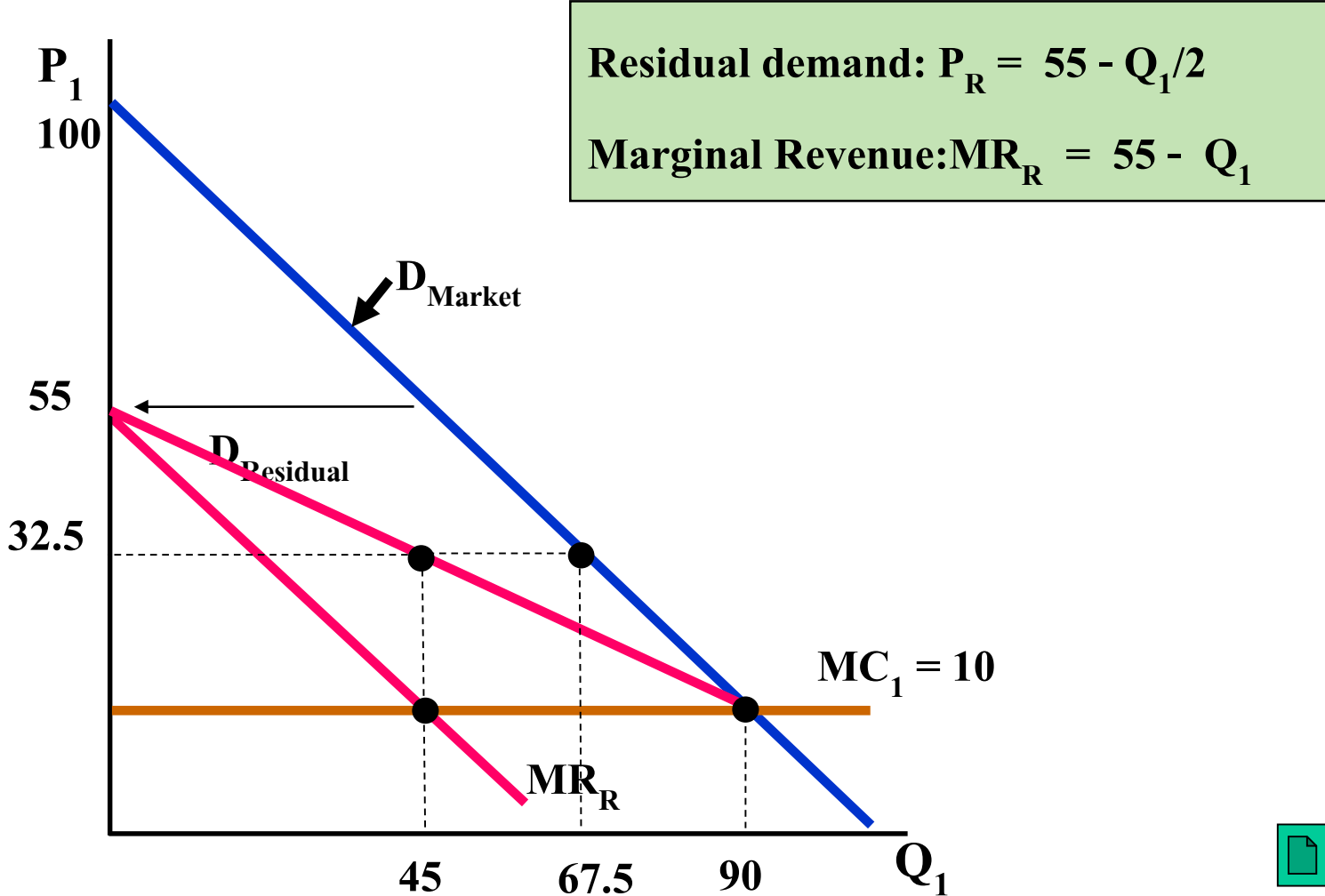
$$MR_R = 55 - Q_1$$

Then equate  $MR_R = MC = 10$  to find  $Q_1$

$$55 - Q_1 = 10$$

$$Q_1 = 45, Q_2 = (45 - 45/2) = 22.5$$

# First Mover Advantage – The Stackelberg Model



# First Mover Advantage – The Stackelberg Model

- Method 2: Firm 1 try to maximize profit by choosing  $Q_1$  so that:

$$MR = MC = 10$$

$$TR_1 = PQ_1 = 100Q_1 - Q_1^2 - Q_2Q_1$$

- Firm 1 knows firm 2 will choose output based on its reaction curve. We can use firm 2's reaction curve as  $Q_2$

## First Mover Advantage – The Stackelberg Model

- Using Firm 2's Reaction Curve for  $Q_2$ :

$$\begin{aligned}TR_1 &= PQ_1 = 100Q_1 - (Q_1)^2 - Q_1Q_2 \\ &= 100Q_1 - (Q_1)^2 - Q_1[45 - \frac{1}{2}Q_1] \\ &= 55Q_1 - \frac{1}{2}Q_1^2\end{aligned}$$

$$MR_1 = dR_1/dQ_1 = 55 - Q_1$$

- $MR_1 = MC = 10$ :  $Q_1 = 45$ ,  $Q_2 = (45 - 45/2) = 22.5$
- $Q = 45 + 22.5 = 67.5$ ,  $P = 100 - 67.5 = 32.5$

$$\pi_1 = (32.5 - 10)45 = 1,012.5, \pi_2 = (32.5 - 10)22.5 = 506.25$$

# First Mover Advantage – The Stackelberg Model

- Conclusion
  - Going first gives firm 1 the advantage
  - Firm 1's output and profit are twice as large as firm 2's
- Going first allows firm 1 to produce a large quantity. Firm 2 must take that into account and produce less unless wants to reduce profits for everyone

# Price Competition: Bertrand

- a homogeneous good
- each firm treats the price of its competitors as fixed\*
- all firms decide simultaneously what price to charge\*
- simplify assumptions
  - Market demand is  $P = 100 - Q$  where  $Q = Q_1 + Q_2$
  - $MC_1 = MC_2 = \$10$



## Price Competition: Bertrand

- For Bertrand, since good is homogeneous, consumers will buy from lowest price seller
  - If firms charge different prices, consumers buy from lowest priced firm only
  - If firms charge same price, consumers are indifferent who they buy from
  - The equilibrium price can't be lower than MC since firms can't survive
  - The equilibrium price can't be higher than MC since one of them can under cut the price.

## Price Competition: Bertrand

- Nash equilibrium is competitive output since have incentive to cut prices
- Both firms set price equal to MC
  - $P = MC; P_1 = P_2 = \$10$
  - $Q = 90; Q_1 \text{ \& } Q_2 = 45$
- Both firms earn zero profit
- Can show the Cournot equilibrium is  $Q_1 = Q_2 = 30$  and market price is \$40 giving each firm a profits of \$900.
- The Bertrand model demonstrates the importance of the strategic variable: price versus output

## Bertrand Model – Criticisms

- When firms produce a homogenous good, it is more natural to compete by setting quantities rather than prices.
- Even if the firms do set prices and choose the same price, what share of total sales will go to each one?
  - It may not be equally divided.

## Price Competition – Differentiated Products

- Market shares are now determined not just by prices, but by differences in the design, performance, and durability of each firm's product.
- In these markets, more likely to compete using price instead of quantity

## Price Competition – Differentiated Products

- Duopoly with fixed costs of \$20 but zero variable costs
  - Firms face the same demand curves
    - Firm 1's demand:  $Q_1 = 12 - 2P_1 + P_2$
    - Firm 2's demand:  $Q_2 = 12 - 2P_2 + P_1$
  - Quantity that each firm can sell decreases when it raises its own price but increases when its competitor charges a higher price

## Price Competition – Differentiated Products

- Firms set prices at the same time, assuming fixed cost = 20
- Firm 1:  $\pi_1 = P_1 Q_1 - 20$   
 $= P_1(12 - 2P_1 + P_2) - 20$   
 $= 12P_1 - 2P_1^2 + P_2P_1 - 20$

## Price Competition – Differentiated Products

- If  $P_2$  is fixed:

Firm 1's profit maximizing price =

$$d\pi_1/dP_1 = 12 - 4P_1 + P_2 = 0$$

Firm 1's reaction curve =

$$P_1 = 3 + \frac{1}{4} P_2$$

Firm 2's reaction curve =

$$P_2 = 3 + \frac{1}{4} P_1$$

# Price Competition – Differentiated Products

- Bertrand equilibrium

$$P_1 = 3 + (3 + P_1/4)/4$$

$$P_1 = P_2 = 4,$$

$$Q_1 = Q_2 = 8,$$

$$\pi_1 = \pi_2 = 12$$

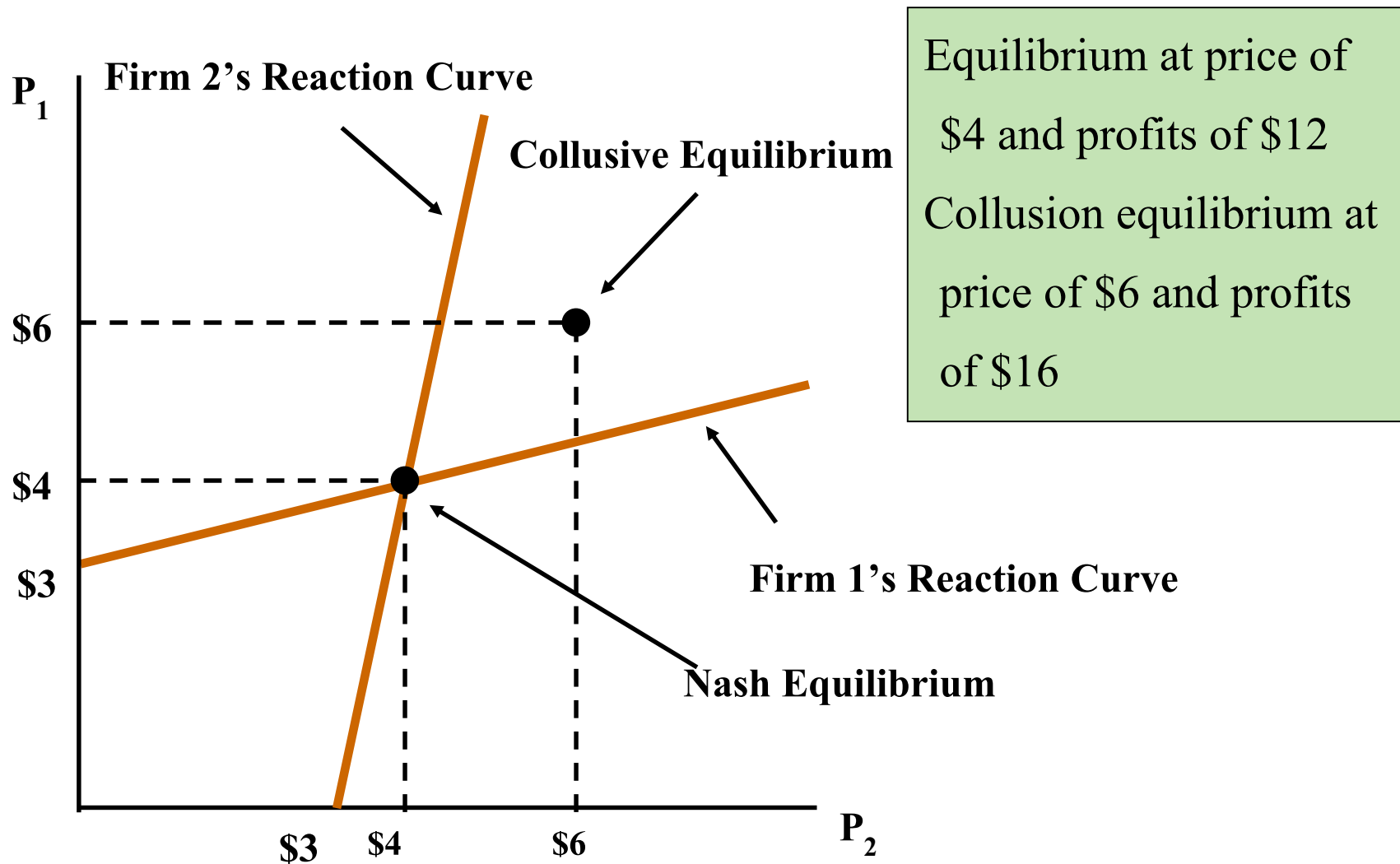
## Nash Equilibrium in Prices

- What if both firms collude
  - They both decide to charge the same price that maximized both of their profits
  - Firms will charge \$6 and will be better off colluding since they will earn a profit of \$16

$$\pi = 24P - 4P^2 + 2P^2 - 40 = 24P - 2P^2 - 40$$

$$d\pi/dP = 24 - 4P = 0, P = 6$$

# Nash Equilibrium in Prices



## Price Signaling and Price Leadership

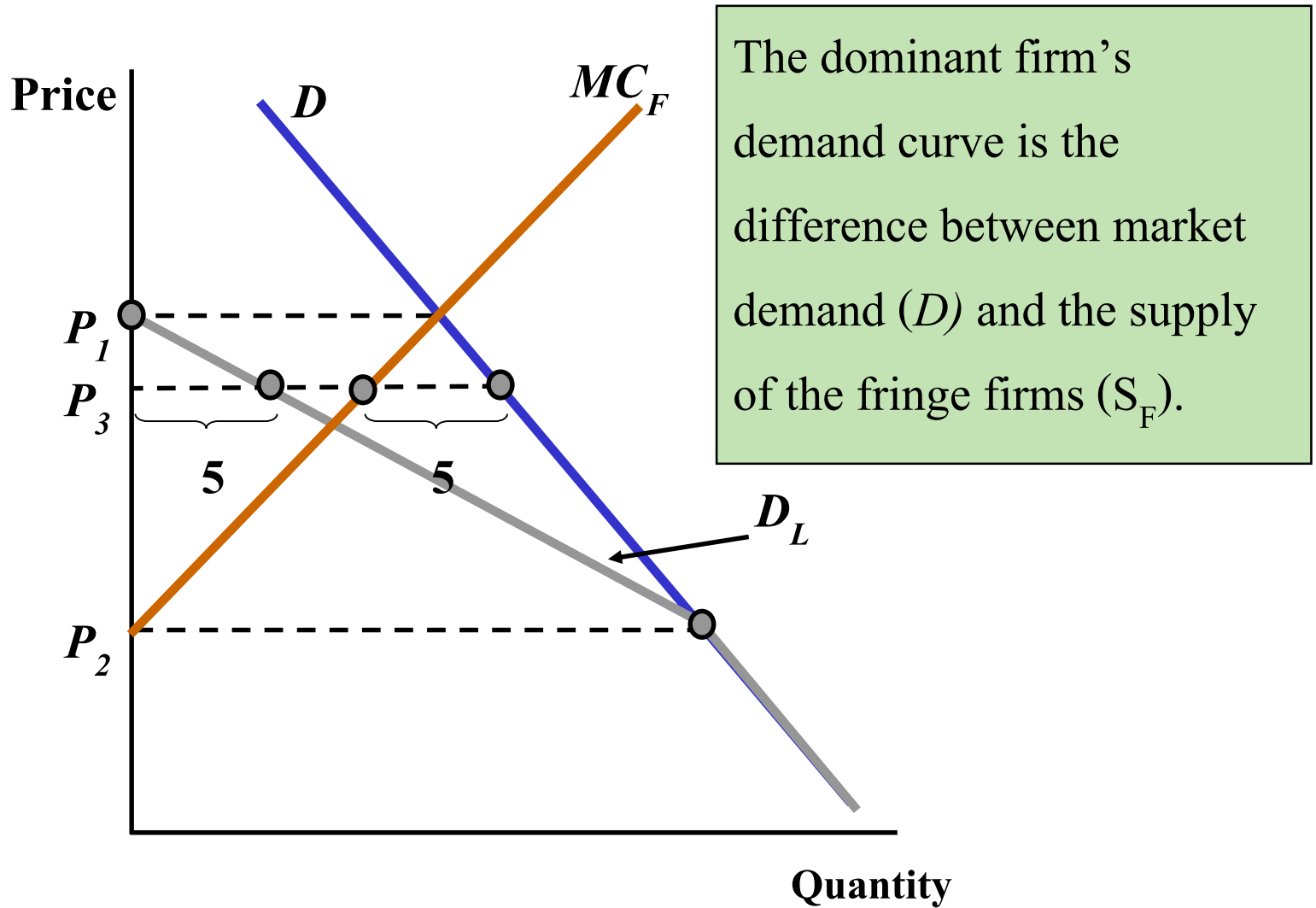
- The Dominant Firm Model (OPEC v.s. Non-OPEC)
  - In some oligopolistic markets, one large firm has a major share of total sales, and a group of smaller firms supplies the remainder of the market.
  - The large firm might then act as the dominant firm, setting a price ( $P_L$ ) that maximizes its own profits.
  - The fringe firm takes  $P_L$  as given and sell at  $MC = P_L$

<http://peak-oil.org/peak-oil-reference/peak-oil-data/production-and-peak-dates-by-country/>

# The Dominant Firm Model

- Dominant firm must determine its demand curve,  $D_L$ .
  - Difference between market demand and the MC of the follower.
- To maximize profits, dominant firm produces  $Q_L$  where  $MR_L$  and  $MC_L$  cross.
- At  $P^*$ , fringe firms sell  $Q_F$  and total quantity sold is
$$Q_T = Q_L + Q_F$$

# Price Setting by a Dominant Firm



# Price Setting by a Dominant Firm

