# Microeconomics, 2nd Edition

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## Chapter 13: Market Structure and Competition

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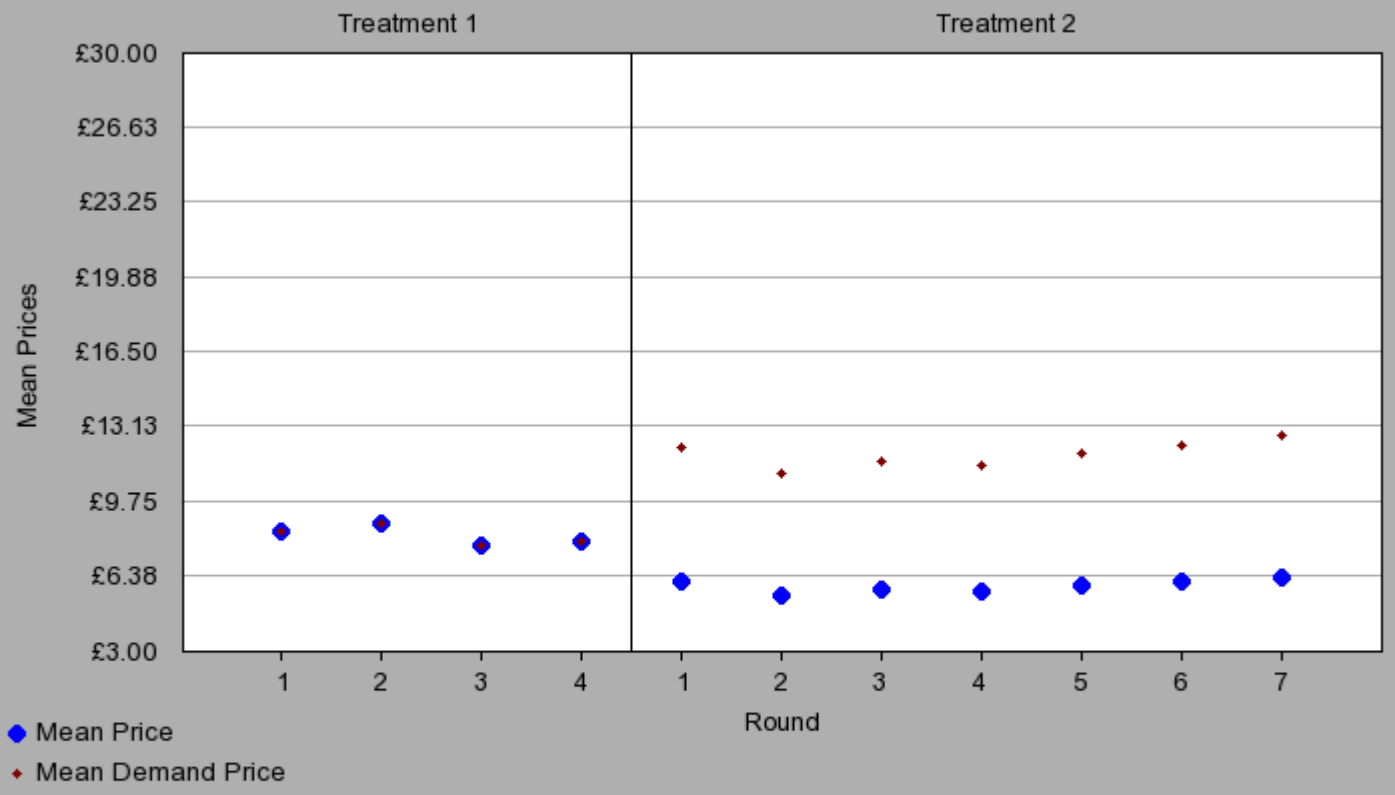
# Bertrand with complements

- Duopoly: both firms set prices $p_1$ and $p_2$
- They produce perfect complements (left and right shoes)
- Demand: $15 - (p_1 + p_2)$
- Marginal cost: 3
- Bad form of competition!




**Treatment 1**

Type = Monopoly, Intercept = £15.00, Slope = 1, Cost = £3.00, Price = [£3.00, £15.00]

Rounds = 4, RepeatPlays = n/a, GroupSize = 1, OwnPace = No, Grouping = Random, Login = n/a, InitialEndow = £0.00, RoundEndow = £0.00

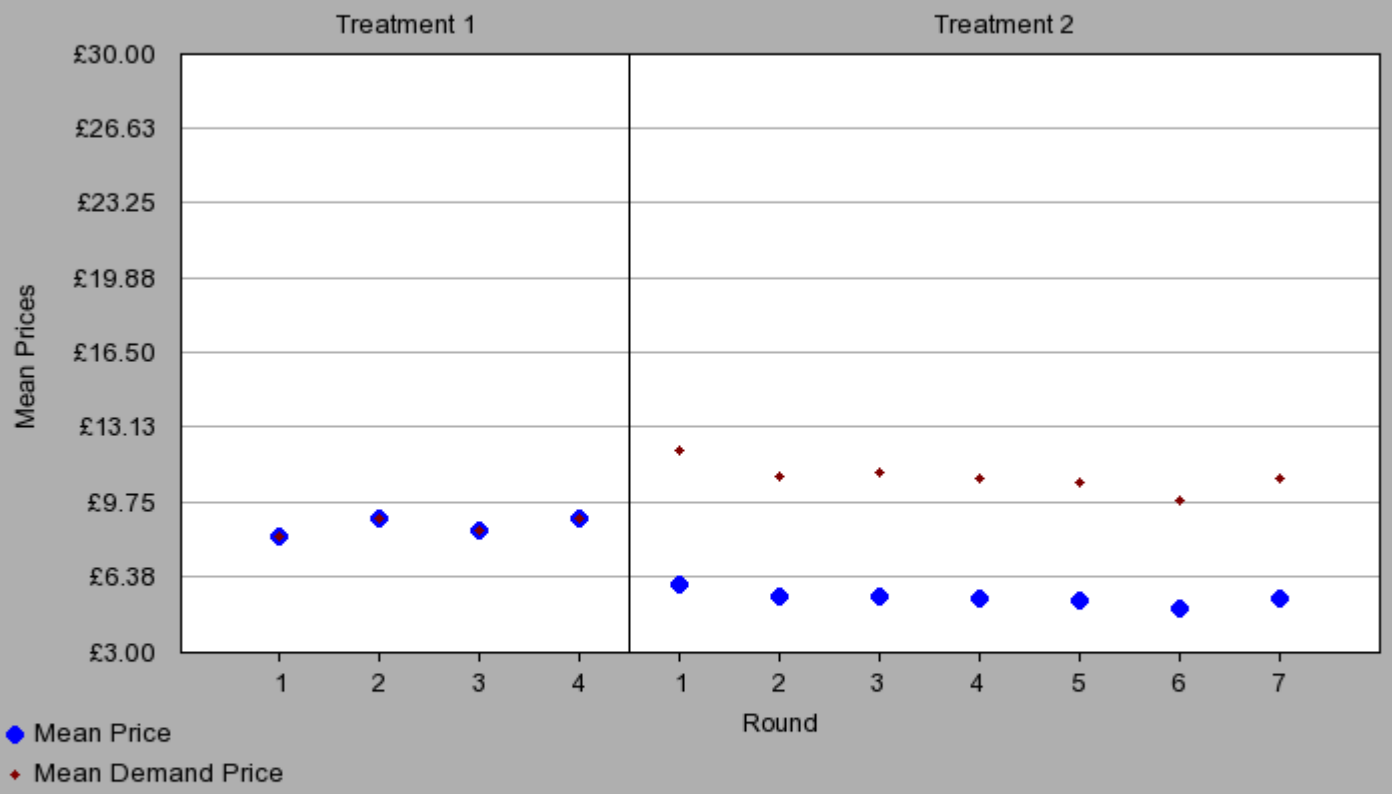
**Treatment 2**

Type = Complementary, Intercept = £15.00, Slope = 1, Cost = £3.00, Price = [£3.00, £15.00]

Rounds = 7, RepeatPlays = n/a, GroupSize = 2, OwnPace = No, Grouping = Random, Login = n/a, InitialEndow = £0.00, RoundEndow = £0.00

# Mean Price and Mean Demand Price

dgb1-abc (Bertrand Market) #6 - 12:40:16 19-Feb-2008




**Treatment 1**

Type = Monopoly, Intercept = £15.00, Slope = 1, Cost = £3.00, Price = [£3.00, £15.00]

Rounds = 4, RepeatPlays = n/a, GroupSize = 1, OwnPace = No, Grouping = Fixed, Login = n/a, InitialEndow = £0.00, RoundEndow = £0.00

**Treatment 2**

Type = Complementary, Intercept = £15.00, Slope = 1, Cost = £3.00, Price = [£3.00, £15.00]

Rounds = 7, RepeatPlays = n/a, GroupSize = 2, OwnPace = No, Grouping = Random, Login = n/a, InitialEndow = £0.00, RoundEndow = £0.00

# Oligopoly

Assume: Many Buyers
Few Sellers

⇨Each firm faces downward-sloping demand because each is a large producer compared to the total market size

⇨There is no one dominant model of oligopoly… we will review several.

⇨Reading: dominant firm (see textbook)

# Cournot Oligopoly

Assume: Firms set outputs (quantities)*
Homogeneous Products
Simultaneous
Noncooperative
Example: Chocolate Easter bunnnies

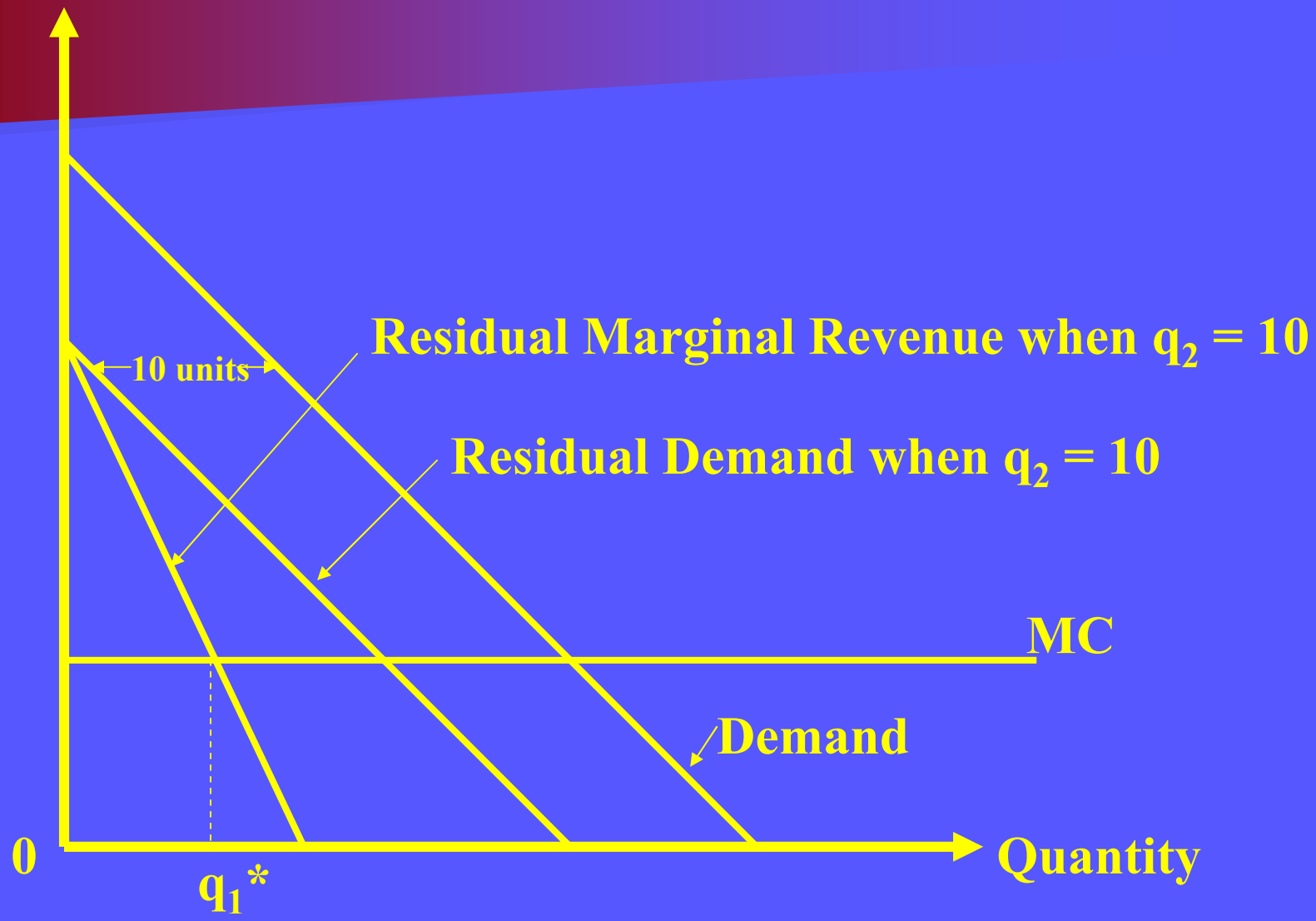
*Definition: In a Cournot game, each firm sets its output (quantity) taking as given the output level of its competitor(s), so as to maximize profits.

Price adjusts according to demand.

*Recall our reasoning from the Bertrand case…*

Residual Demand: Firm i's guess about its rival's output determines its residual demand.

# Example: Residual Demand



Profit Maximization: Each firm acts as a monopolist on its residual demand curve, equating $MR_R$ to MC.

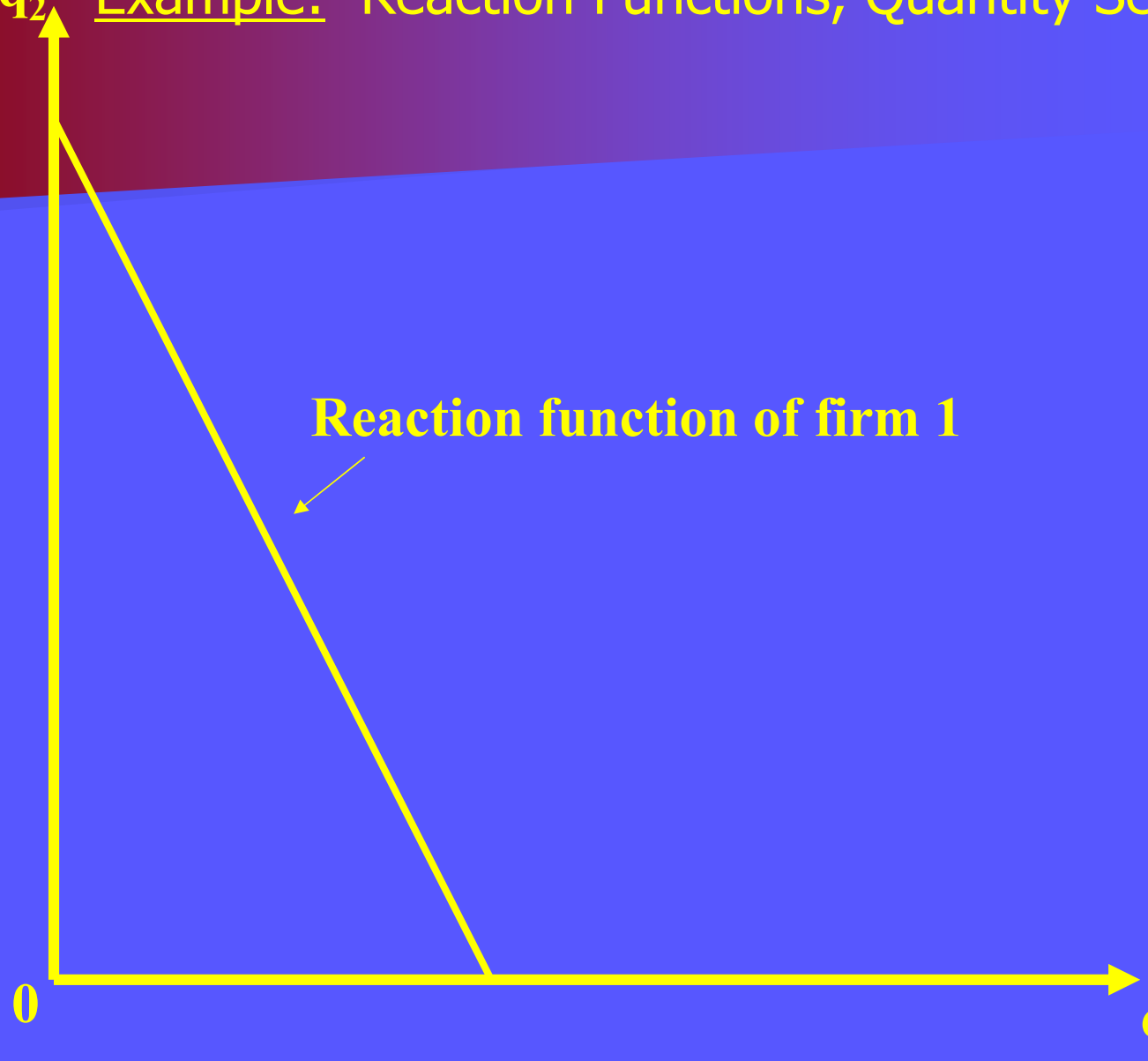
$MR_R = p + q_1(\Delta p/\Delta q) = MC$

Best Response Function:

- The point where (residual) marginal revenue equals marginal cost gives the best response of firm i to its rival's (rivals') actions.

- For every possible output of the rival(s), we can determine firm i's best response. The sum of all these points makes up the best response (reaction) function of firm i.

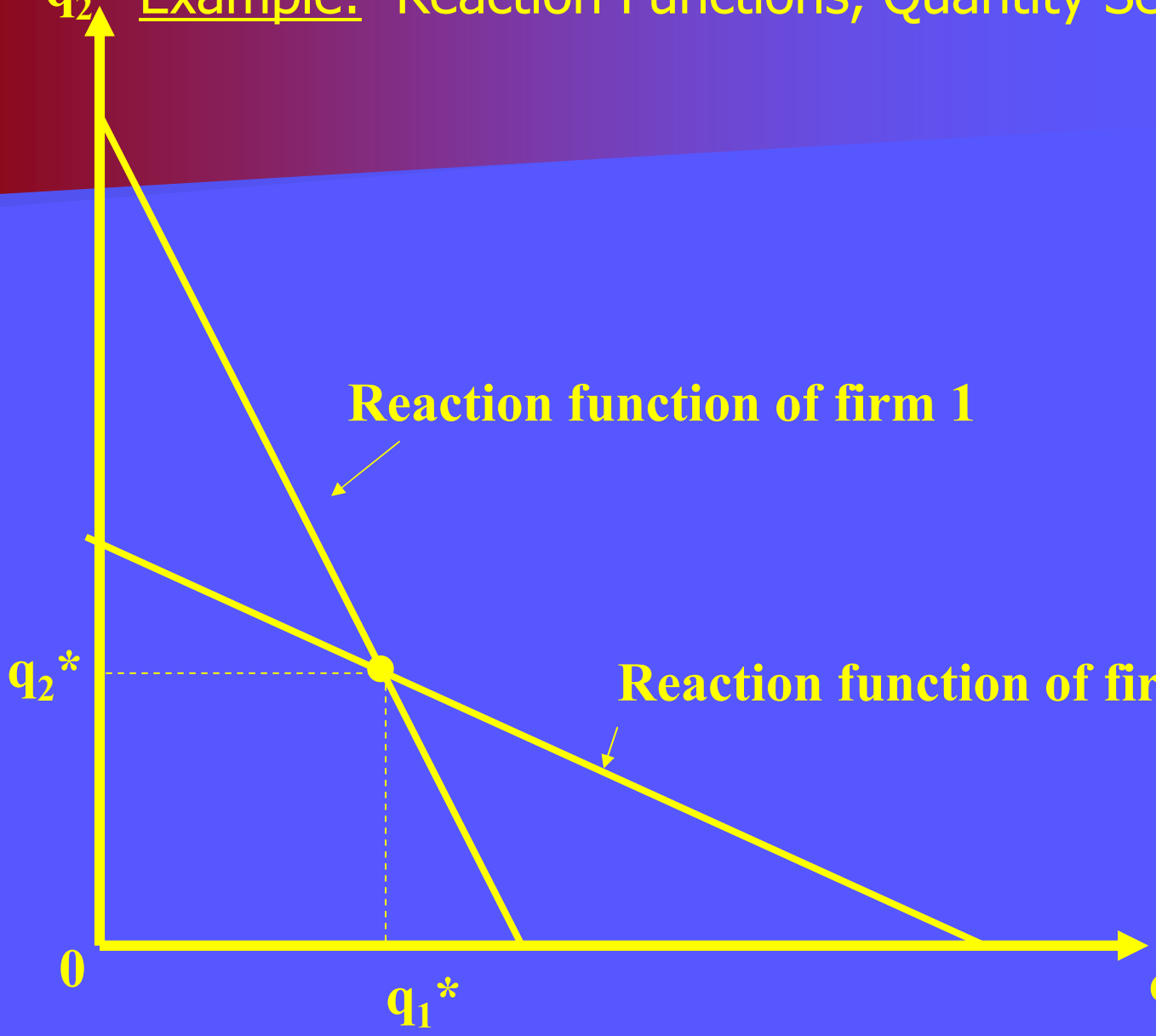
# Example: Reaction Functions, Quantity Setting



# Strategic complements and substitutes

- Cournot: If one firm *raises* her output it is optimal for the other firm to **reduce** her output. ("Strategic substitutes")
- Bertrand: If one firm *raises* her price it is optimal for the other firm to **increase** her output. ("Strategic complement")

# Example: Reaction Functions, Quantity Setting



Equilibrium: No firm has an incentive to deviate in equilibrium in the sense that each firm is maximizing profits given its rival's output.

Example:

$P = 100 - Q_1 - Q_2$
$MC = AC = 10$

*What is firm 1's profit-maximizing output when firm 2 produces 50?*

Firm 1's residual demand:
$P = (100 - 50) - Q_1$

$MR_{50} = 50 - 2Q_1$
$MR_{50} = MC \Leftrightarrow 50 - 2Q_1 = 10$

$Q_1^{50} = 20$

b. *What is the equation of firm 1's reaction function?*

Firm 1's residual demand:

$P = (100 - Q_2) - Q_1$

$MR_r = 100 - Q_2 - 2Q_1$

$MR_r = MC \Leftrightarrow 100 - Q_2 - 2Q_1 = 10$

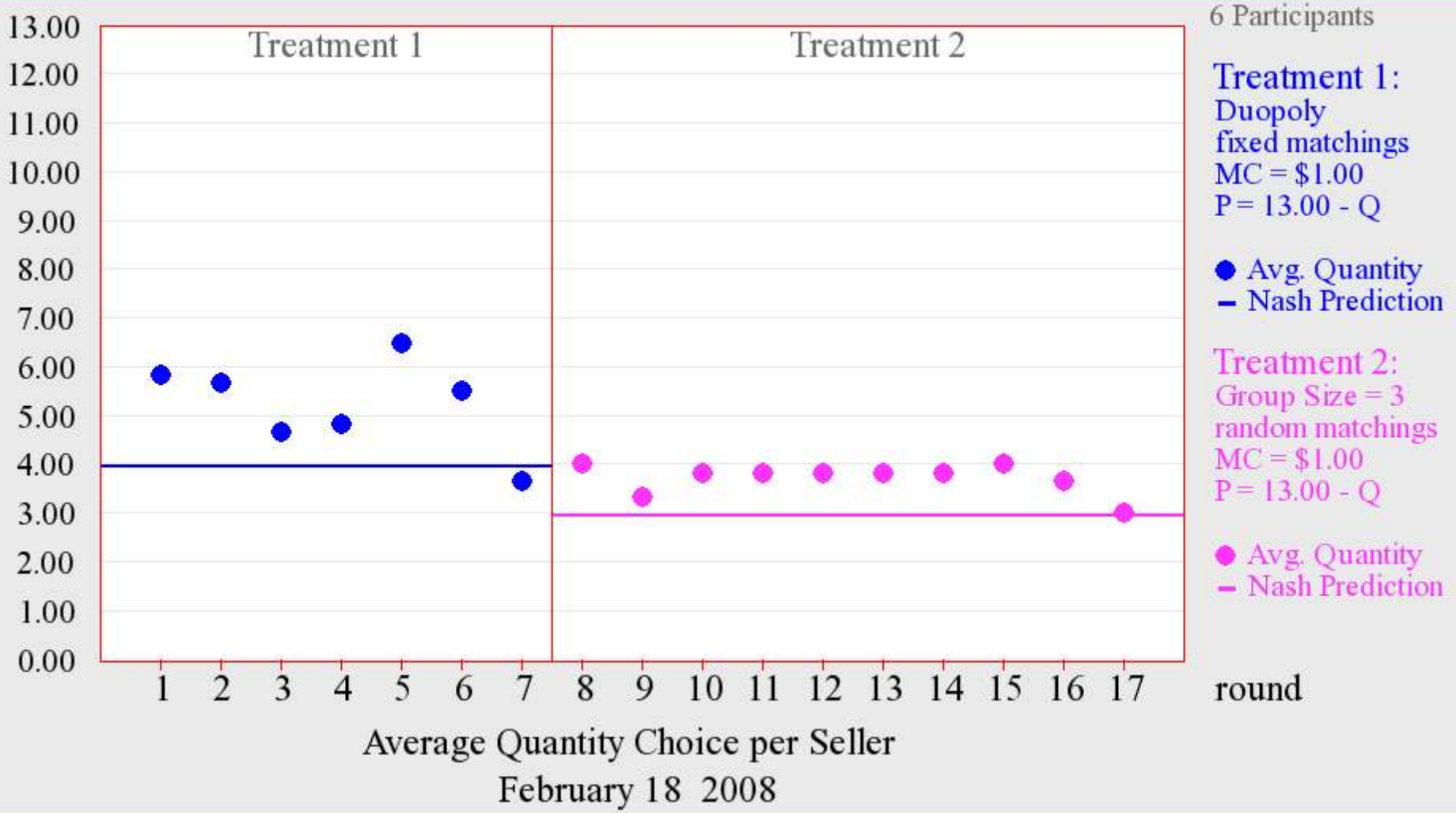
$Q_1^r = 45 - Q_2/2$ *firm 1's reaction function*

c. *Similarly, one can compute that* $Q_2^r = 45 - Q_1/2$. *Now, calculate the Cournot equilibrium.*

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

$Q_1^* = 30$
$Q_2^* = 30$
$P^* = 40$

$\pi_1^* = \pi_2^* = 30(30) = 900$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Treatment 2
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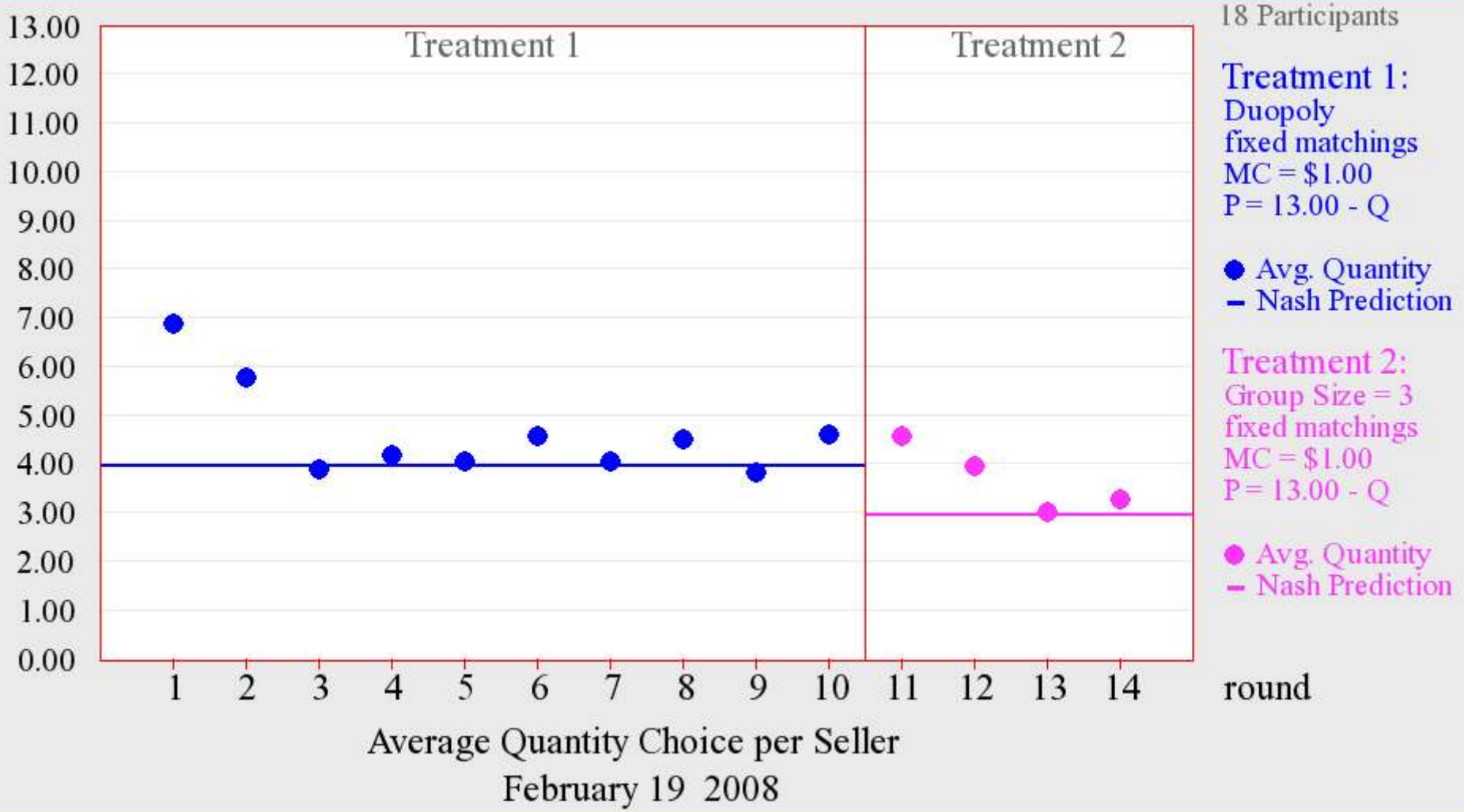
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
round
6 Participants
Treatment 1:
Duopoly
fixed matchings
MC = $1.00
P = 13.00 - Q
Avg. Quantity
Nash Prediction
Treatment 2:
Group Size = 3
random matchings
MC = $1.00
P = 13.00 - Q
Avg. Quantity
Nash Prediction
Average Quantity Choice per Seller
February 18 2008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round
18 Participants
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Nash Prediction
Treatment 2:
Group Size = 3
fixed matchings
MC = $1.00
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Avg. Quantity
Nash Prediction
Average Quantity Choice per Seller
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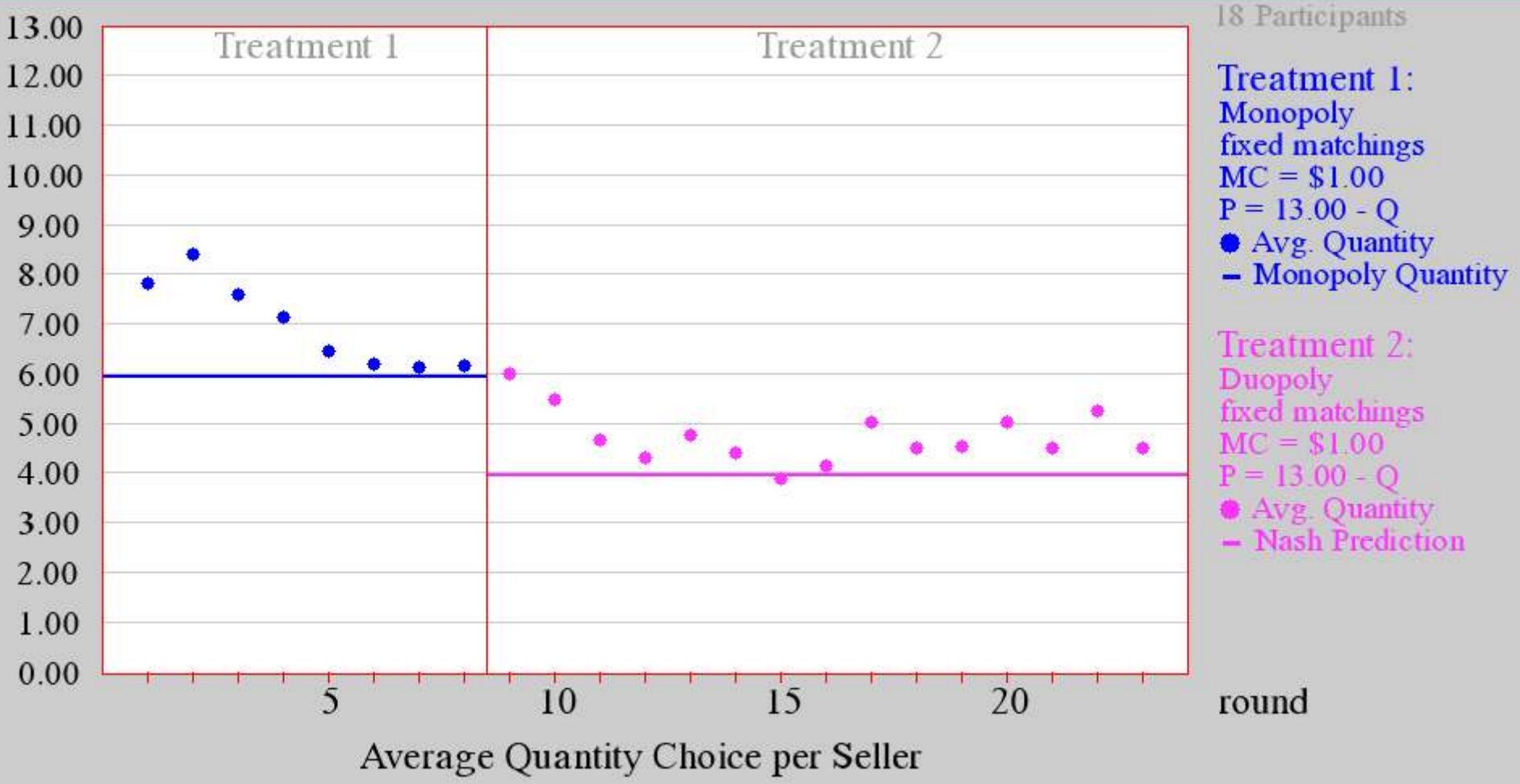
Treatment 1
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round
Average Quantity Choice per Seller
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Treatment 1:
Monopoly
fixed matchings
MC = $1.00
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Avg. Quantity
Monopoly Quantity
Treatment 2:
Duopoly
fixed matchings
MC = $1.00
P = 13.00 - Q
Avg. Quantity
Nash Prediction

# Why Cournot equilibrium?

- Suppose firms try to form a non-binding cartel…
- Two firms, zero marginal costs
- Inverse demand $p=12-q$
- Monopoly output 6, each firm should produce 3 each, price 6, profit 18 each
- Profit to one firm if other produces 3: $(9-q_1)q_1$ maximized at $q_1=4.5$, $p=4.5$
- My profit: 81/4=20.25, other firm gets 3*4.5=13.5

# Imitation vs best reply

- Suppose other firm produces 6,
- I produce 5
- Price 12-9=1, I earn 5, she 6
- If we imitate most successful opponent, we both produce 6, price becomes 0, profits 0 for both
- If I react optimally on 6: profit $(6-q_1)q_1$ maximized at $q_1=3$, p=3 my profit increases to 9, opponents to 18

# Dominant firm

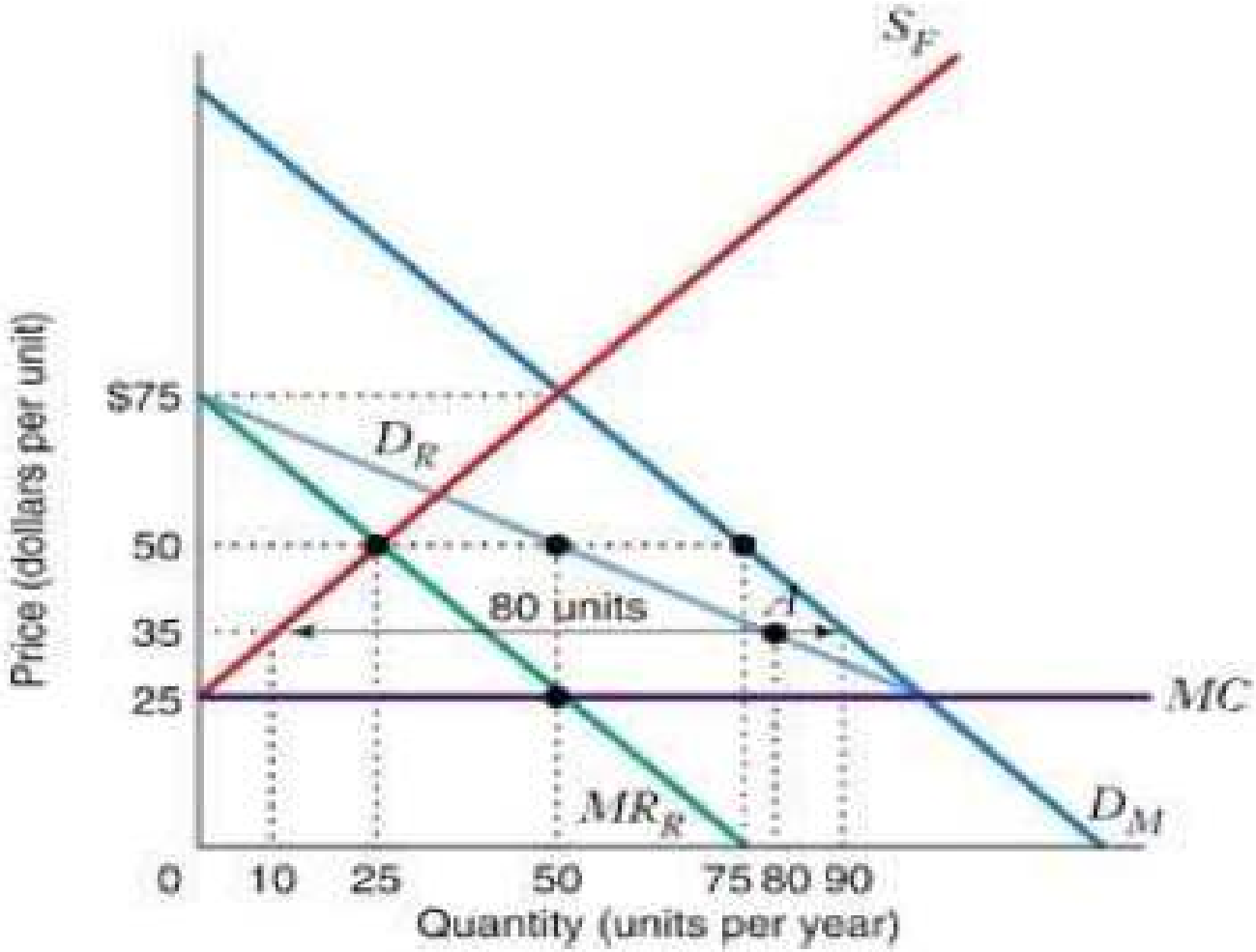
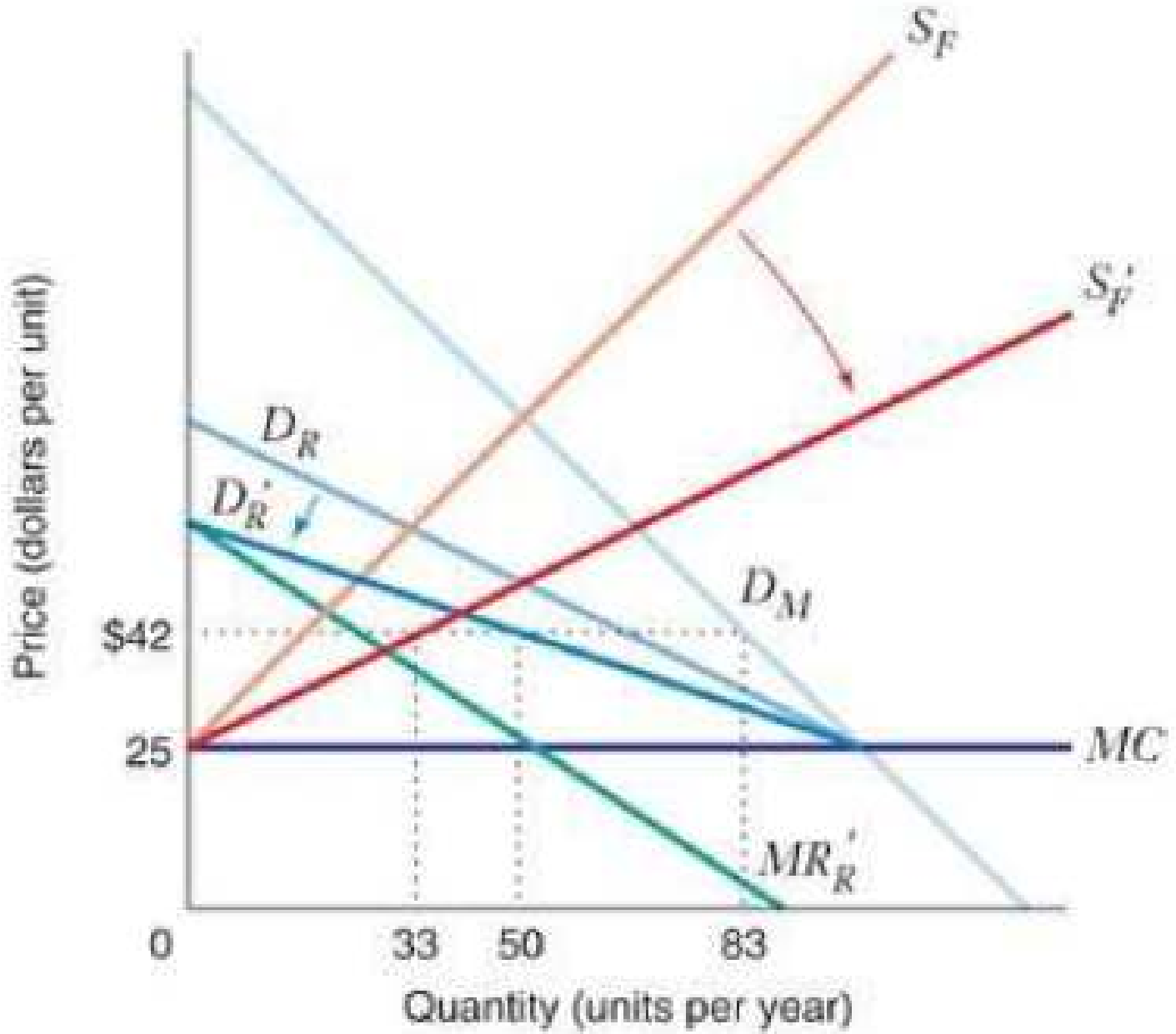



**FIGURE 13.7** Dominant Firm Market


$S_F$
$S_F'$
$D_R$
$D_R'$
$D_M$
$MR_R'$
MC
$42
25
0
33
50
83
Price (dollars per unit)
Quantity (units per year)

## (Chamberlinian) Monopolistic Competition

Market Structure:
- Many Buyers
- Many Sellers, each firm negligible
- Free entry and Exit, zero profits
- Product Differentiation
- Each firm faces a downward sloping demand curve

Example: Restaurants, Local markets for doctors

⇨When firms have horizontally differentiated products, they each face downward-sloping demand for their product because a small change in price will not cause ALL buyers to switch to another firm's product.

⇨Monopolistic Competition in the Short Run: (fixed number of firms)

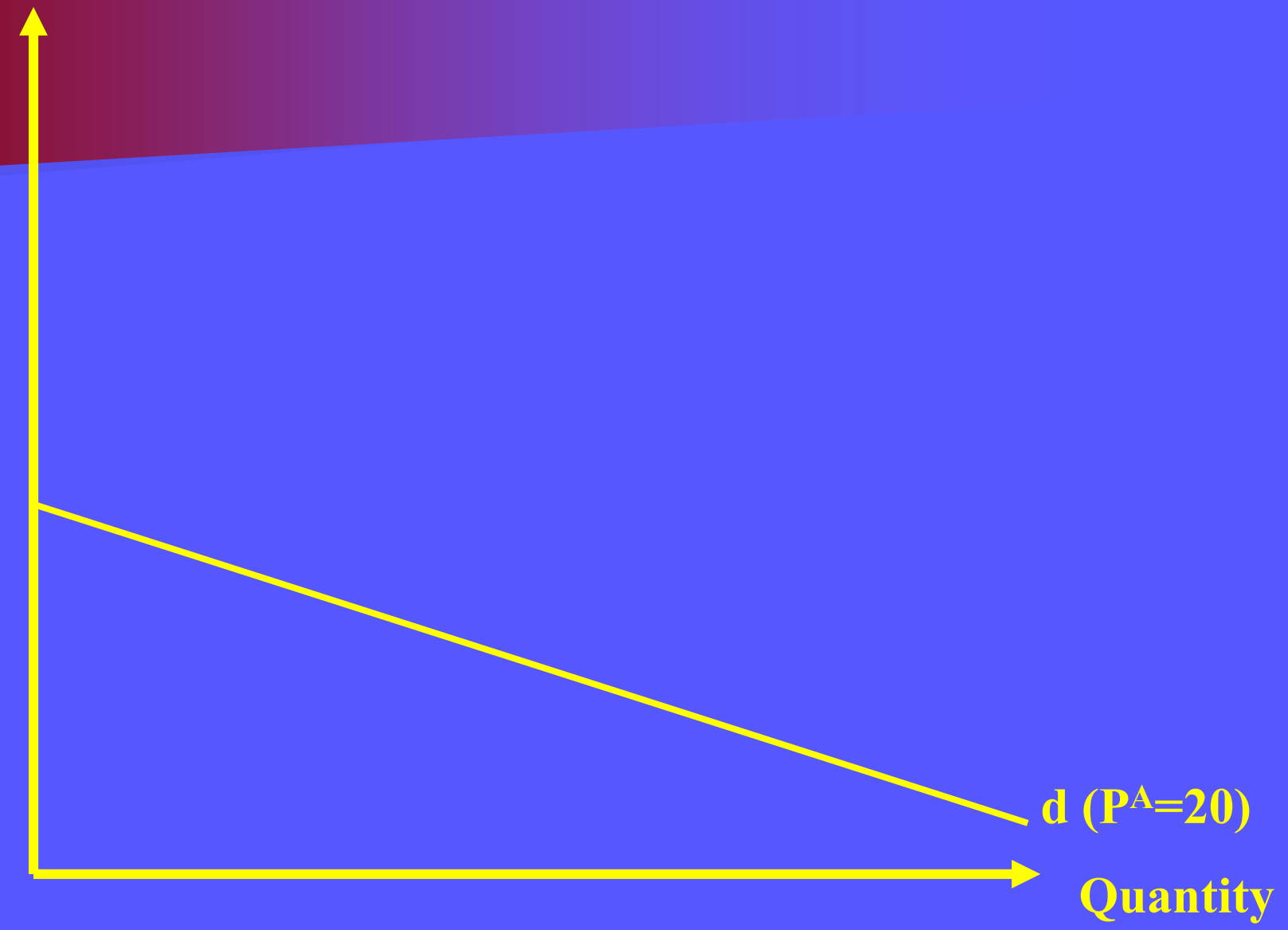
1. Each firm is small => each takes the observed "market price" as given in its production decisions.

2. Since market price may not stay given, the firm's *perceived* demand may differ from its *actual* demand.

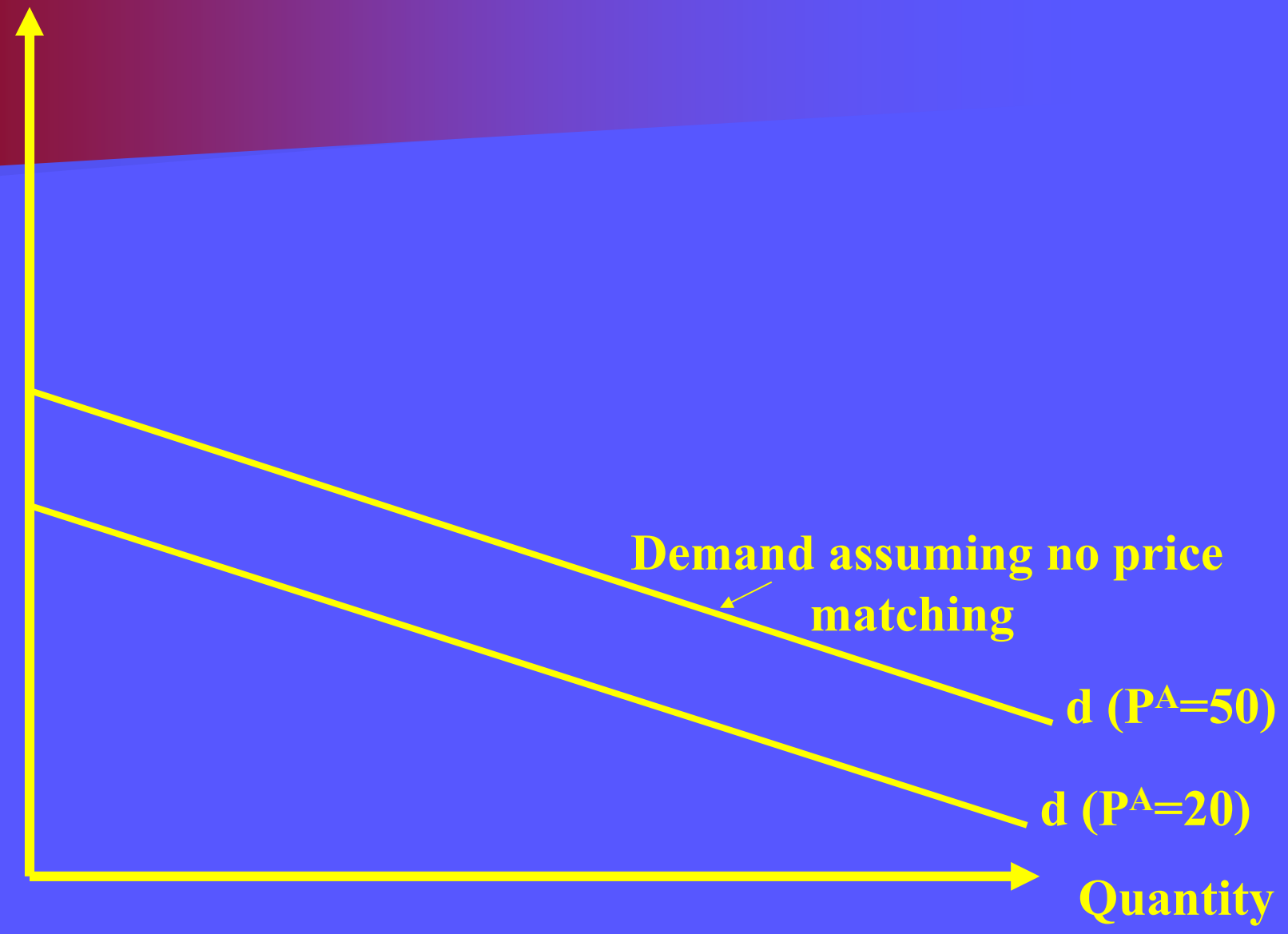
3.If all firms' prices fall the same amount, no customers switch supplier but the total market consumption grows.

4. If only one firm's price falls, it steals customers from other firms *as well as* increases total market consumption

## Example: Perceived Demand and Actual Demand



## Example: Perceived Demand and Actual Demand



## Example: Perceived Demand and Actual Demand

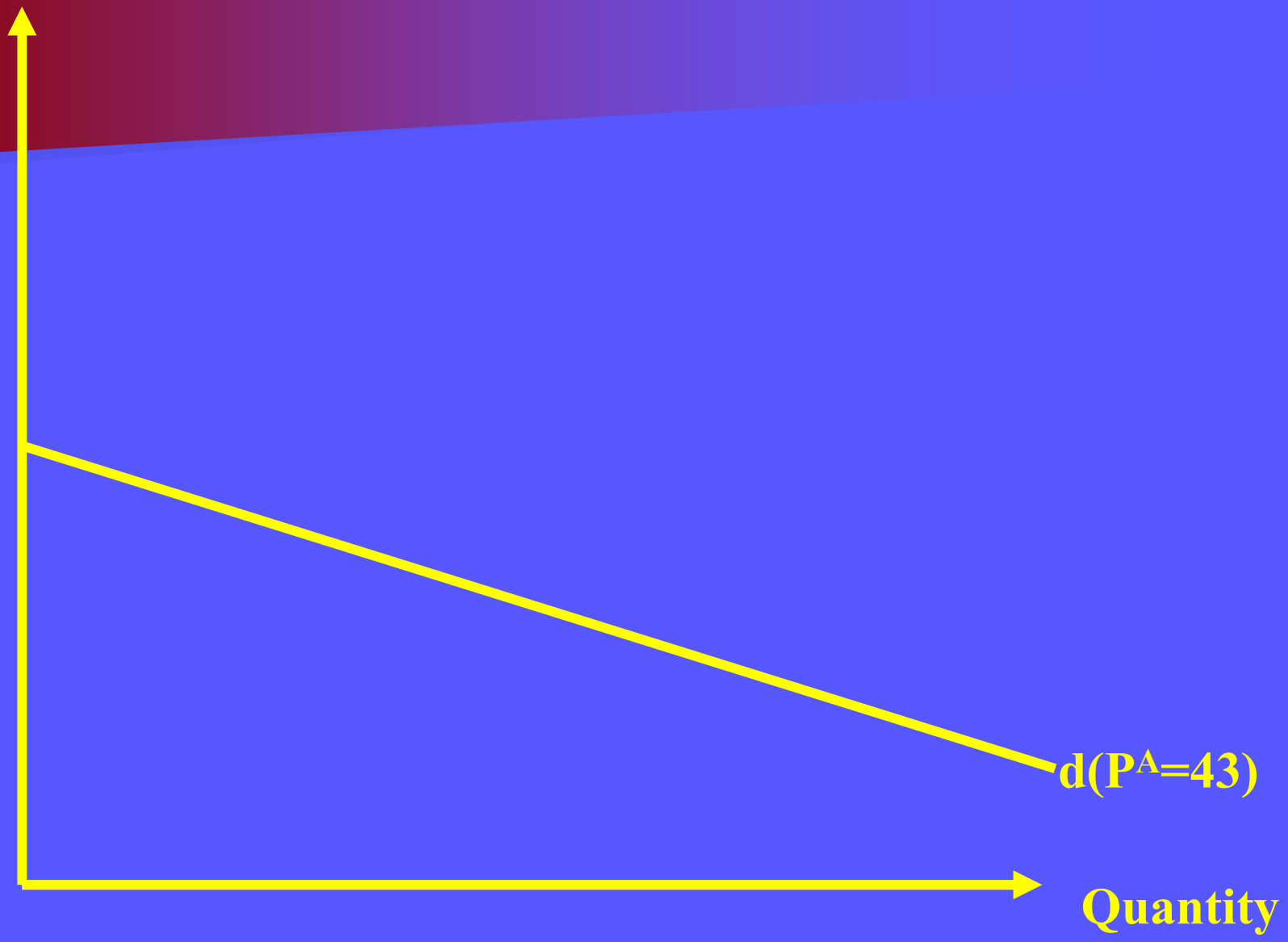
The market is in equilibrium if…

⇨each firm maximizes profit taking the *average* market price as given

⇨each firm can sell the quantity it desires at the *actual* average market price that prevails

Price

## Example: Short Run Chamberlinian Equilibrium



Price

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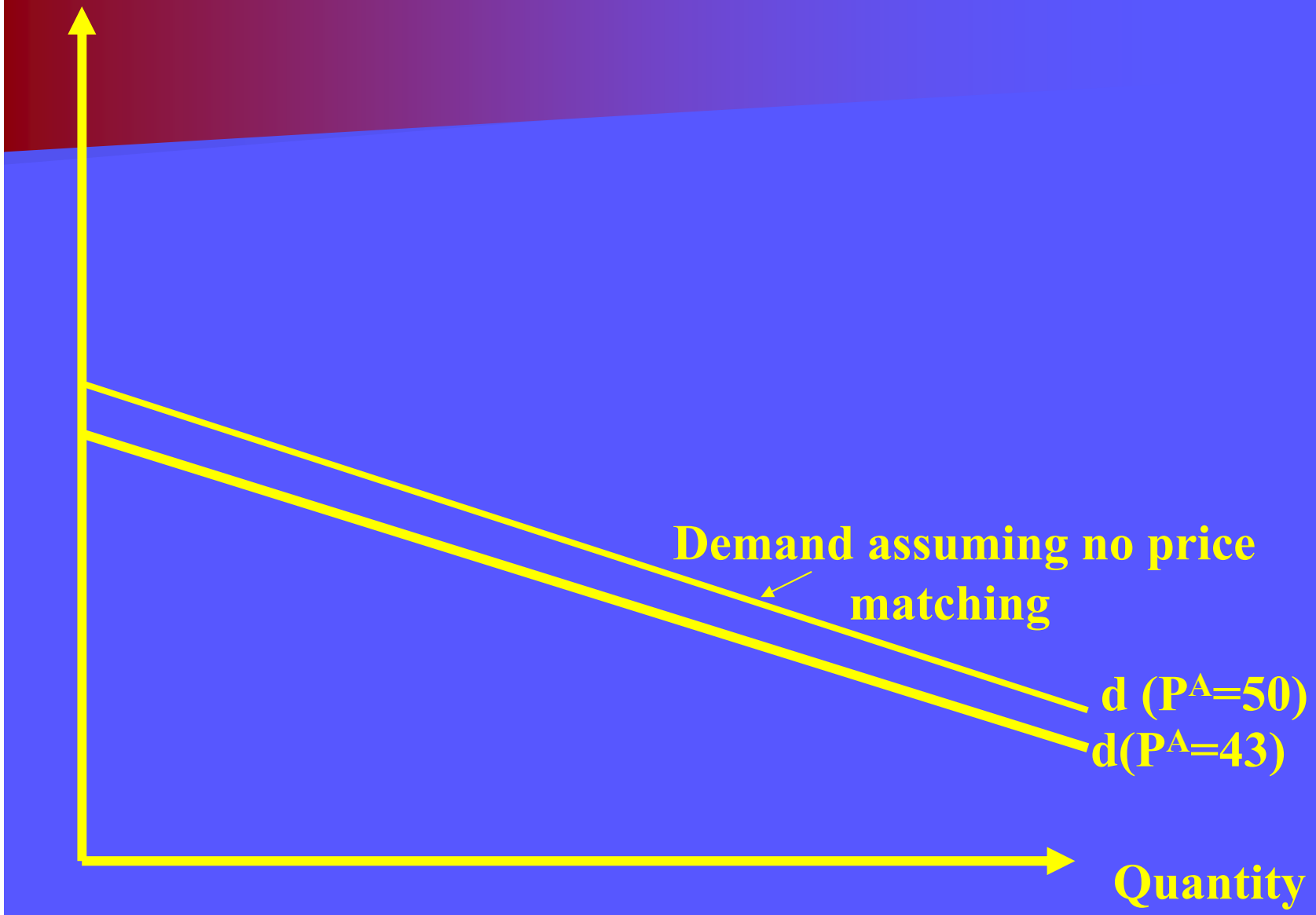

Price

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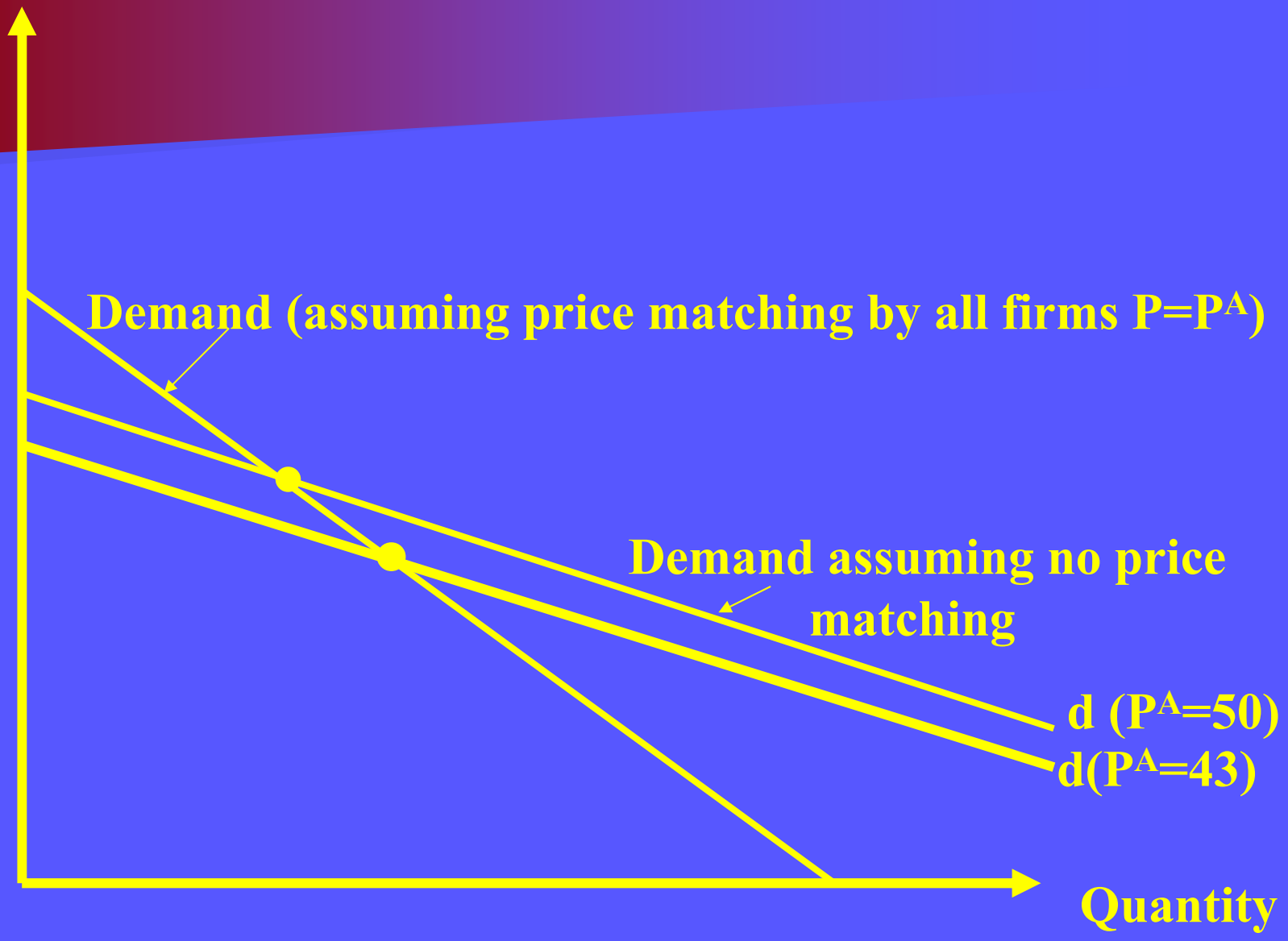
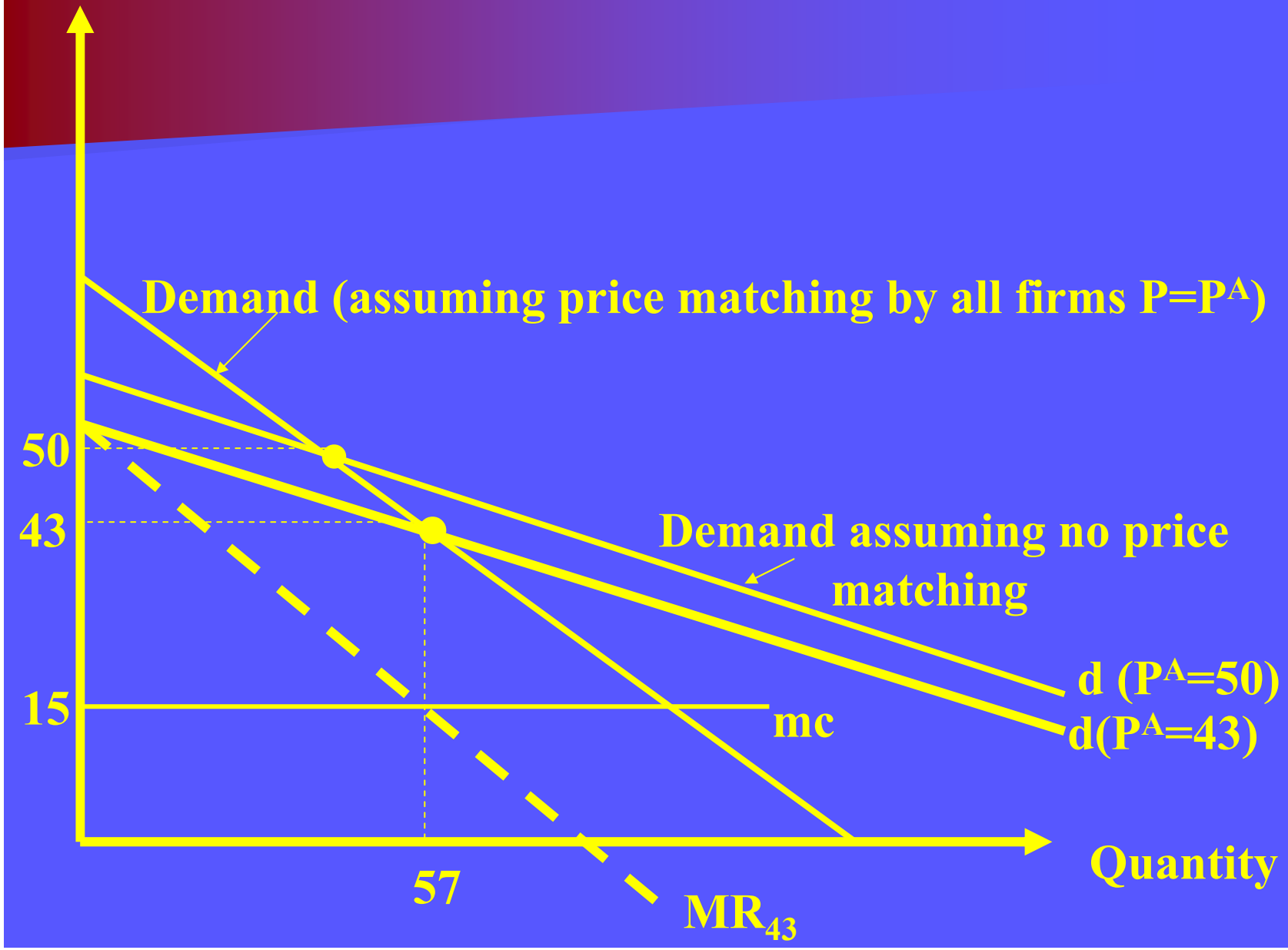


# Example: Short Run Chamberlinian Equilibrium



## Example: Computing A Short-Run Monopolistically Competitive Equilibrium

MC = $15

N = 100

$Q = 100 - 2P + P^A$

Where: $P^A$ is the average market price
N is the number of firms

a. *What is the equation of $d_{40}$? What is the equation of D?*

$d_{40}$: $Q^d = 100 - 2P + 40 = 140 - 2P$

D: Note that $P = P^A$ so that

$$Q^D = 100 - P$$

b. *Show that $d_{40}$ and D intersect at P = 40*

$P = 40 \Rightarrow Q^d = 140 - 80 = 60$

$Q^D = 100 - 40 = 60$

c. *For any given average price, $P^A$, find a typical firm's profit maximizing quantity*

Inverse (perceived) demand:

$P = 50 - (1/2)Q + (1/2)P^A$

$\Rightarrow MR = 50 - Q + (1/2)P^A$

$\Rightarrow MR = MC \Rightarrow 50 - Q + (1/2)P^A = 15$

$\Rightarrow Q^e = 35 + (1/2)P^A$

$\Rightarrow P^e = 50 - (1/2)Q^e + (1/2)P^A$

$P^e = 32.5 + (1/4)P^A$

d. *What is the short run equilibrium price in this industry?*

In equilibrium, $P^e = P^A$ so that

$$100 - P^A = 35 + (1/2)P^A$$

$$P^A = 43.33$$
$$Q^e = 56.66$$
$$Q^D = 56.66$$

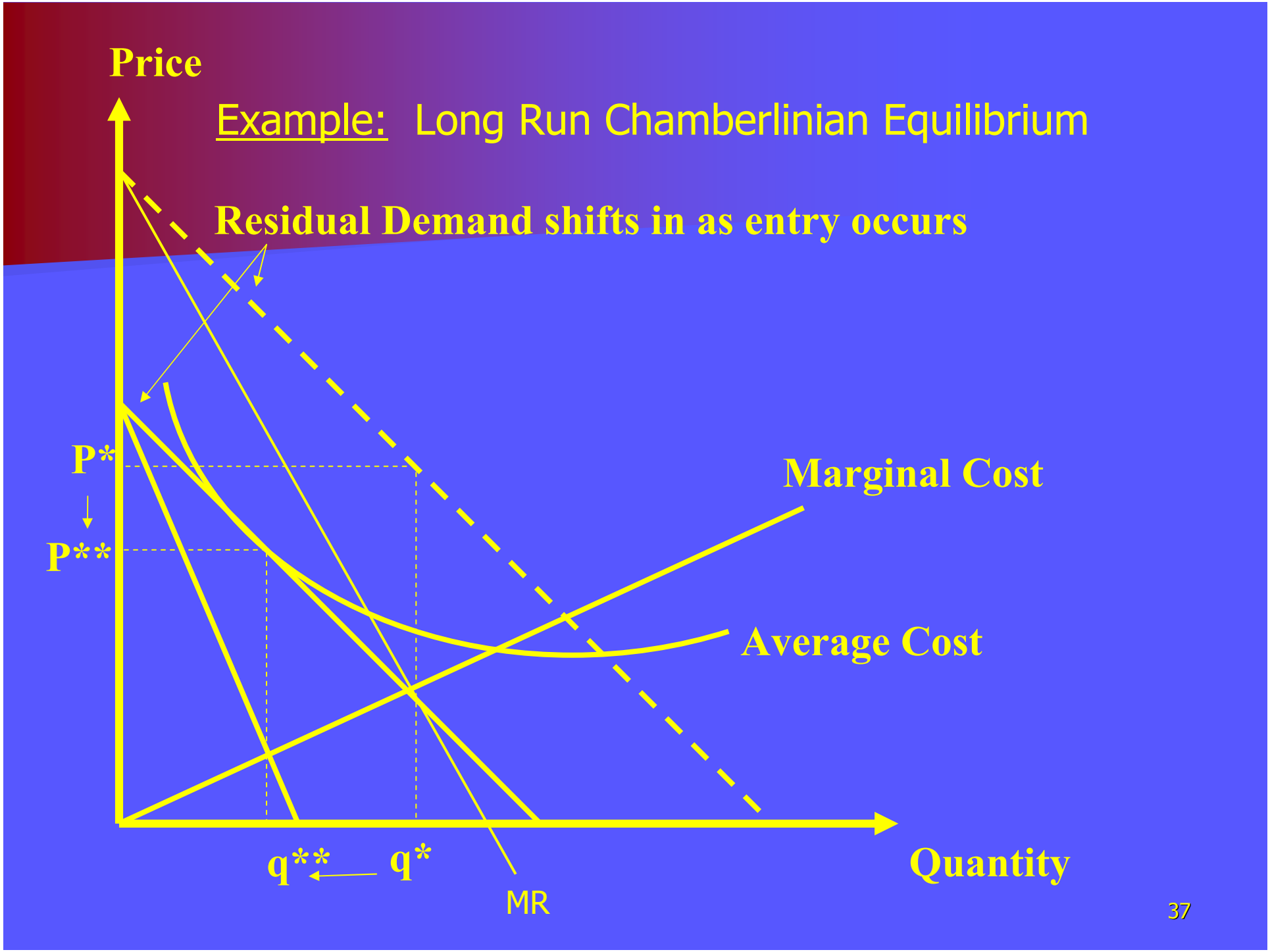
⇨Monopolistic Competition in the Long Run

At the short run equilibrium P $\geq$ AC so that each firm may make positive profit.

Entry shifts d and D left until average industry price equals average cost.

This is long run equilibrium is represented graphically by:

- MR = MC for each firm
- D = d at the average market price
- d and AC are tangent at average market price


Price
Example: Long Run Chamberlinian Equilibrium
Residual Demand shifts in as entry occurs
P*
P**
Marginal Cost
Average Cost
q**
q*
MR
Quantity

# Comparison of Cournot, Bertrand and Monopoly Equilibria

a. *P > MC for Cournot competitors, but P < $P^M$:*

If the firms were to act as a monopolist (perfectly collude), they would set market MR equal to MC:

$$P = 100 - Q$$
$$MC = AC = 10$$

$$MR = MC \Rightarrow 100 - 2Q = 10 \Rightarrow Q^M = 45$$

$$P^M = 55$$
$$\Pi^M = 45(45) = 2025$$
$$\Pi^c = 1800$$

A perfectly collusive industry takes into account that an increase in output by one firm depresses the profits of the other firm(s) in the industry. A Cournot competitor takes into account the effect of the increase in output on its own profits only.

Therefore, Cournot competitors "overproduce" relative to the collusive (monopoly) point.
Further, this problem gets "worse" as the number of competitors grows because the market share of each individual firm falls, increasing the difference between the private gain from increasing production and the profit destruction effect on rivals.

Therefore, the more concentrated the industry in the Cournot case, the higher the price-cost margin.

## 2. *Homogeneous product Bertrand resulted in zero profits, whereas the Cournot case resulted in positive profits. Why?*

The best response functions in the Cournot model slope *downward*. In other words, the more aggressive a rival (in terms of output), the more passive the Cournot firm's response.

The best response functions in the Bertrand model slope *upward*. In other words, the more aggressive a rival (in terms of price) the more aggressive the Bertrand firm's response.

Cournot: Suppose firm j raises its output…the price at which firm i can sell output *falls*. This means that the incentive to increase output *falls* as the output of the competitor *rises*.

Bertrand: Suppose firm j raises price…the price at which firm i can sell output *rises*. As long as firm i's price is less than firm j's, the incentive to increase price will depend on the (market) marginal revenue.

# Summary

1. Market structures are characterized by the number of buyers, the number of sellers, the degree of product differentiation and the entry conditions.

2. Product differentiation *alone* or a small number of competitors *alone* is not enough to destroy the long run zero profit result of perfect competition. This was illustrated with the Chamberlinian and Bertrand models.

3. (Chamberlinian) monopolistic competition assumes that there are many buyers, many sellers, differentiated products and free entry in the long run.

4. Chamberlinian sellers face downward-sloping demand but are price takers (i.e. they do not perceive that their change in price will affect the average price level). Profits may be positive in the short run but free entry drives profits to zero in the long run.

5. Bertrand and Cournot competition assume that there are many buyers, few sellers, and homogeneous or differentiated products. Firms compete in price in Bertrand oligopoly and in quantity in Cournot oligopoly.

6. Bertrand and Cournot competitors take into account their strategic interdependence by means of constructing a best response schedule: each firm maximizes profits *given* the rival's strategy.

7. Equilibrium in such a setting requires that all firms be on their best response functions.

8. If the products are homogeneous, the Bertrand equilibrium results in zero profits. By changing the strategic variable from price to quantity, we obtain much higher prices (and profits). Further, the results are sensitive to the assumption of simultaneous moves.

9. This result can be traced to the slope of the reaction functions: upwards in the case of Bertrand and downwards in the case of Cournot. These slopes imply that "aggressivity" results in a "passive" response in the Cournot case and an "aggressive" response in the Bertrand case.