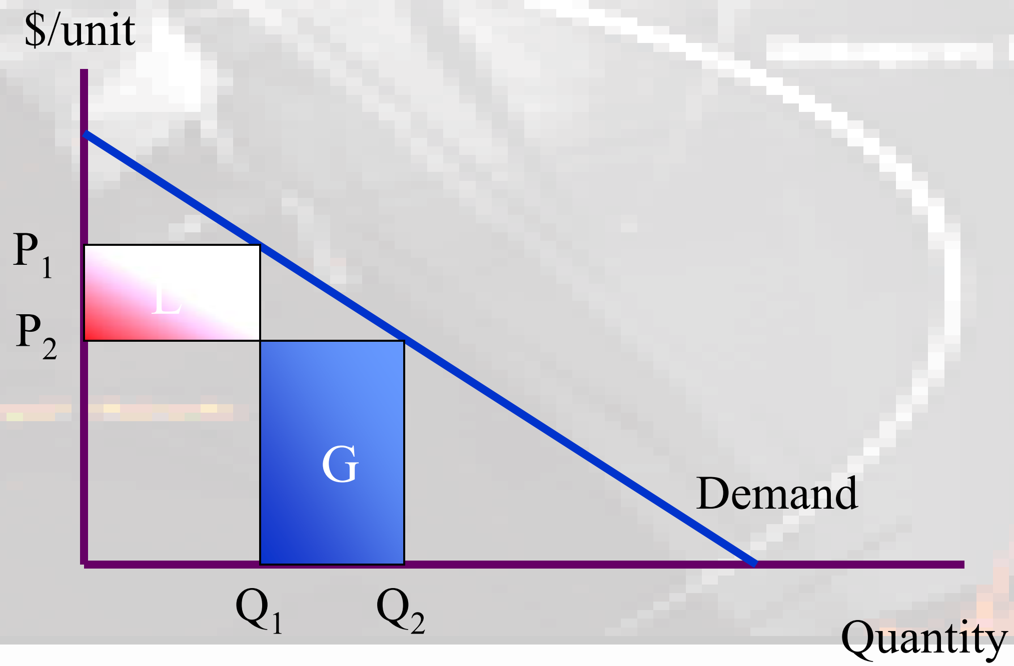
Monopoly: No discrimination

Marginal Revenue

- The only firm in the market
  - market demand is the firm’s demand
  - output decisions affect market clearing price



Monopoly (cont.)

- Derivation of the monopolist's marginal revenue

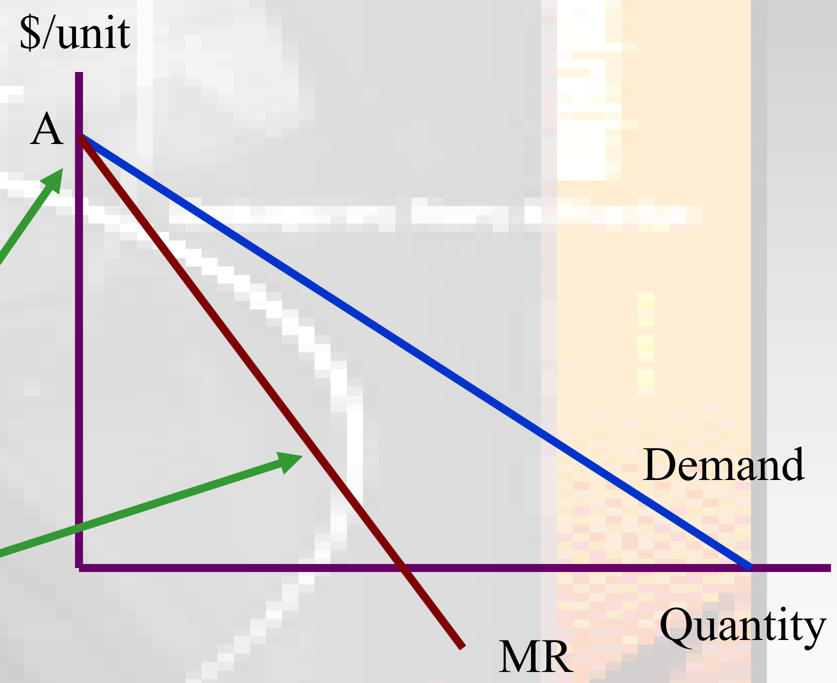
Demand: P = A - B.Q

Total Revenue: TR = P.Q = A.Q - B.Q^2

Marginal Revenue: MR = dTR/dQ

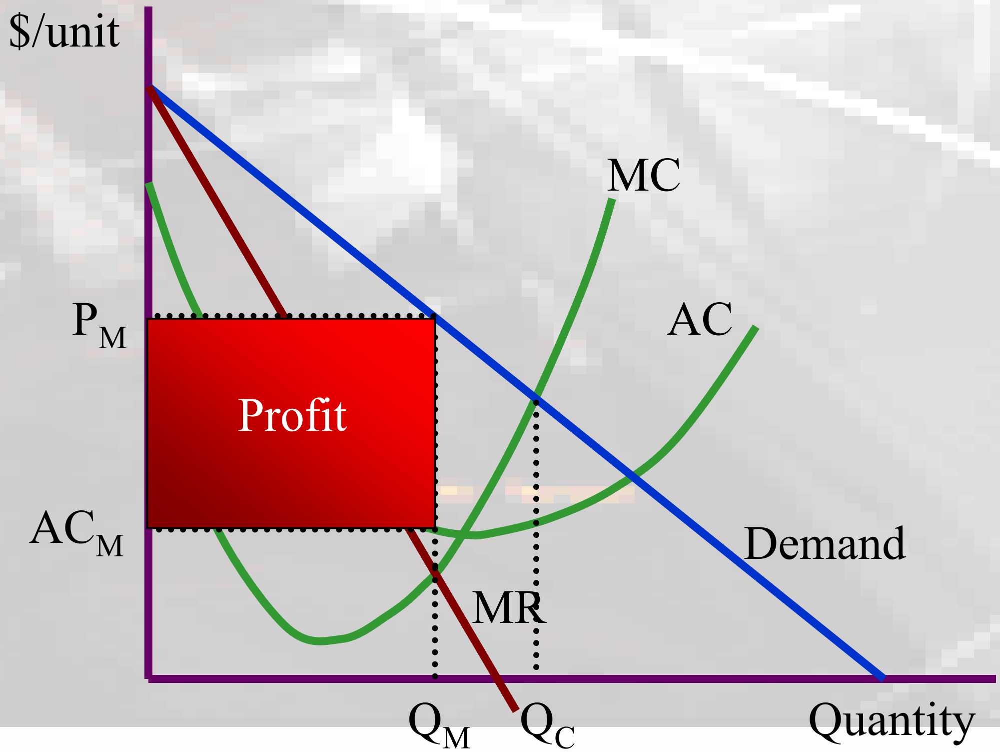
MR = A - 2B.Q

With linear demand the marginal revenue curve is also linear with the same price intercept but twice the slope of the demand curve



Monopoly and Profit Maximization

- The monopolist maximizes profit by equating marginal revenue with marginal cost



Marginal Revenue and Demand Elasticity

Inverse demand: $P(q)$

Totalrevenue $R(q) = P(q)q$

Marginalrevenue: $R'(q) = p + (\partial P / \partial q)q$

$$= p\left(1 + (\partial P / \partial q)\frac{q}{p}\right)$$

$$= p\left[1 - \frac{1}{\varepsilon_d}\right]$$

- *Max profits: MR = MC*

$$p\left(1 - \frac{1}{\varepsilon_d}\right) = MC$$

- *higher elasticity → lower price*

Lerner Index:

$$L = \frac{p - MC}{p} = \frac{1}{\varepsilon_d}$$

Deadweight loss of Monopoly

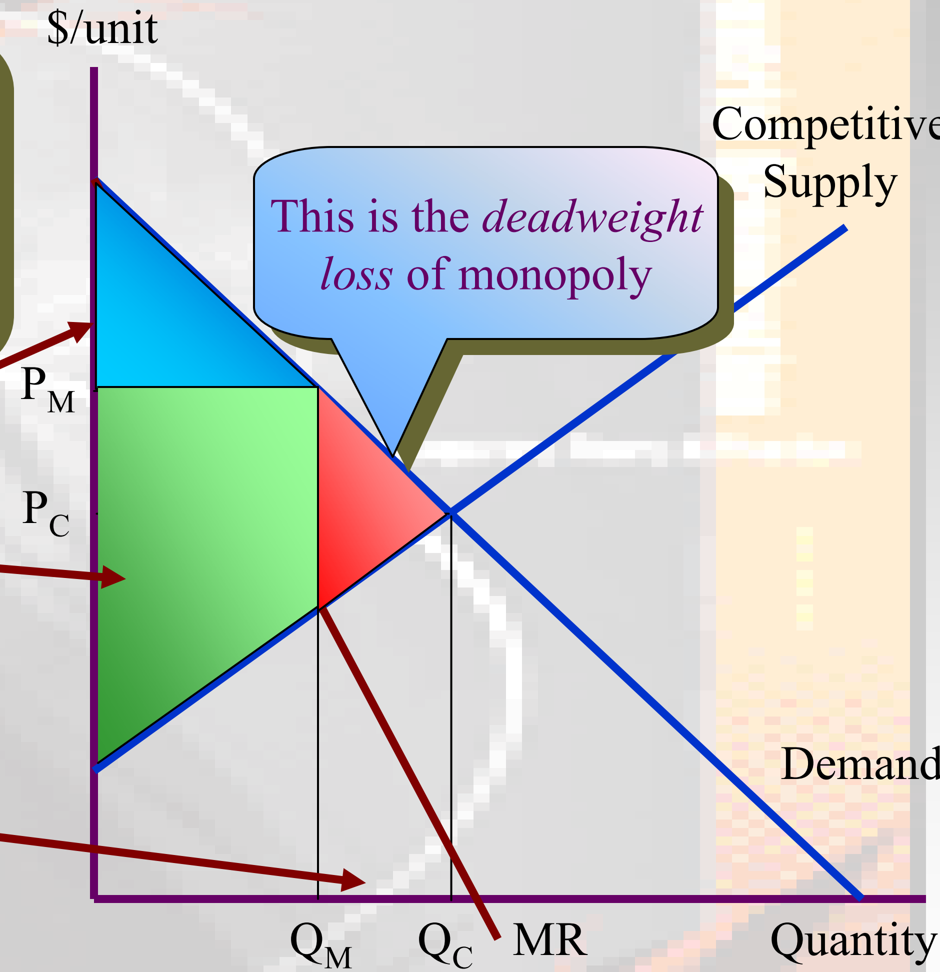
Assume that the industry is monopolized

The monopolist sets MR = MC to give output Q_M

The market clearing price is P_M

Consumer surplus is given by this area

And producer surplus is given by this area



The monopolist produces less surplus than the competitive industry. There are mutually beneficial trades that do not take place: between Q_M and Q_C

Deadweight loss of Monopoly (cont.)

- Why can the monopolist not appropriate the deadweight loss?
  - Increasing output requires a reduction in price
  - *this assumes that the same price is charged to everyone.*
- The monopolist creates surplus
  - some goes to consumers
  - some appears as profit
- The monopolist bases her decisions purely on the surplus she gets, *not* on consumer surplus
- The monopolist undersupplies relative to the competitive outcome
- The primary problem: ***the monopolist is large relative to the market***

Price Discrimination and Monopoly: Linear Pricing

Introduction

- Prescription drugs are cheaper in Canada than the United States
- Textbooks are generally cheaper in Britain than the United States
- Examples of *price discrimination*
  - presumably profitable
  - should affect market efficiency: not necessarily adversely
  - is price discrimination necessarily bad – even if not seen as “fair”?

Feasibility of price discrimination

- Two problems confront a firm wishing to price discriminate
  - *identification*: the firm is able to identify demands of different types of consumer or in separate markets
    - easier in some markets than others: e.g tax consultants, doctors
  - *arbitrage*: prevent consumers who are charged a low price from reselling to consumers who are charged a high price
    - prevent re-importation of prescription drugs to the United States
- The firm then must choose the *type* of price discrimination
  - first-degree or personalized pricing
  - second-degree or menu pricing
  - third-degree or group pricing

Third-degree price discrimination

- Consumers differ by some observable characteristic(s)
- A uniform price is charged to all consumers in a particular group – linear price
- Different uniform prices are charged to different groups
  - "kids are free"
  - subscriptions to professional journals e.g. *American Economic Review*
  - airlines
  - early-bird specials; first-runs of movies

Third-degree price discrimination (cont.)

- The pricing rule is very simple:
  - consumers with low elasticity of demand should be charged a high price
  - consumers with high elasticity of demand should be charged a low price

Third degree price discrimination: example

- Harry Potter volume sold in the United States and Europe
- Demand:
  - United States: $P_U = 36 - 4Q_U$
  - Europe: $P_E = 24 - 4Q_E$
- Marginal cost constant in each market
  - $MC = \$4$

The example: no price discrimination

- Suppose that the same price is charged in both markets
- Use the following procedure:
  - calculate aggregate demand in the two markets
  - identify marginal revenue for that aggregate demand
  - equate marginal revenue with marginal cost to identify the profit maximizing quantity
  - identify the market clearing price from the aggregate demand
  - calculate demands in the individual markets from the individual market demand curves and the equilibrium price

The example (npd cont.)

United States: $P_U = 36 - 4Q_U$ Invert this:

$Q_U = 9 - P/4$ for $P \leq \$36$

Europe: $P_U = 24 - 4Q_E$ Invert

$Q_E = 6 - P/4$ for $P \leq \$24$

Aggregate these demands

$Q = Q_U + Q_E = 9 - P/4$ for $\$36 \geq P \geq$

$Q = Q_U + Q_E = 15 - P/2$ for $P < \$24$

At these prices only the US market is active

Now both markets are active

The example (npd cont.)

Invert the direct demands

$P = 36 - 4Q$ for $Q \leq 3$

$P = 30 - 2Q$ for $Q > 3$

Marginal revenue is

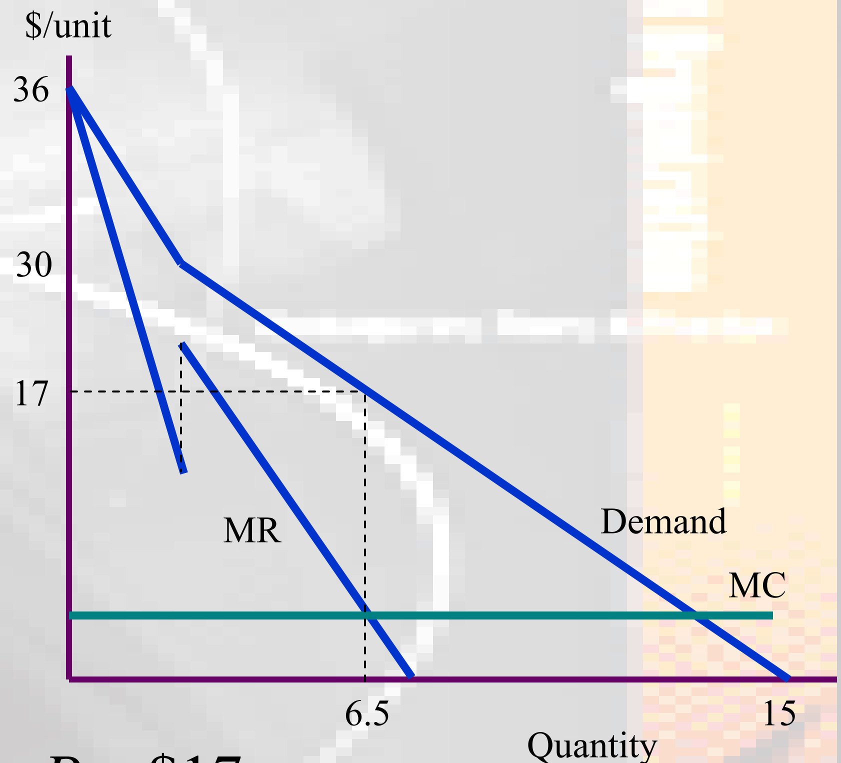
$\text{MR} = 36 - 8Q$ for $Q \leq 3$

$\text{MR} = 30 - 4Q$ for $Q > 3$

Set MR = MC

$Q = 6.5$

Price from the demand curve $P = \$17$



The example (npd cont.)

Substitute price into the individual market demand curves:

$Q_U = 9 – P/4 = 9 – 17/4 = 4.75$ million

$Q_E = 6 – P/4 = 6 – 17/4 = 1.75$ million

Aggregate profit = (17 – 4)x6.5 = $84.5 million

The example: price discrimination

- The firm can improve on this outcome
- Check that MR is not equal to MC in both markets
  - MR > MC in Europe
  - MR < MC in the US
  - the firms should transfer some books from the US to Europe
- This requires that different prices be charged in the two markets
- Procedure:
  - take each market separately
  - identify equilibrium quantity in each market by equating MR and MC
  - identify the price in each market from market demand

The example: (pd cont.)

Demand in the US:

$P_U = 36 - 4Q_U$

Marginal revenue:

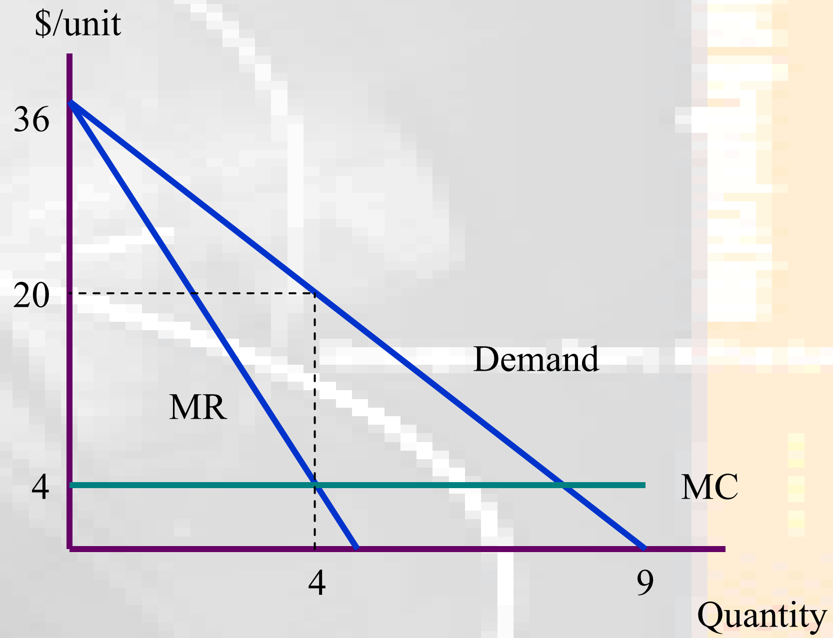
$\text{MR} = 36 - 8Q_U$

$\text{MC} = 4$

Equate MR and MC

$Q_U = 4$

Price from the demand curve $P_U = \$20$



The example: (pd cont.)

Demand in the Europe:

$P_E = 24 - 4Q_E$

Marginal revenue:

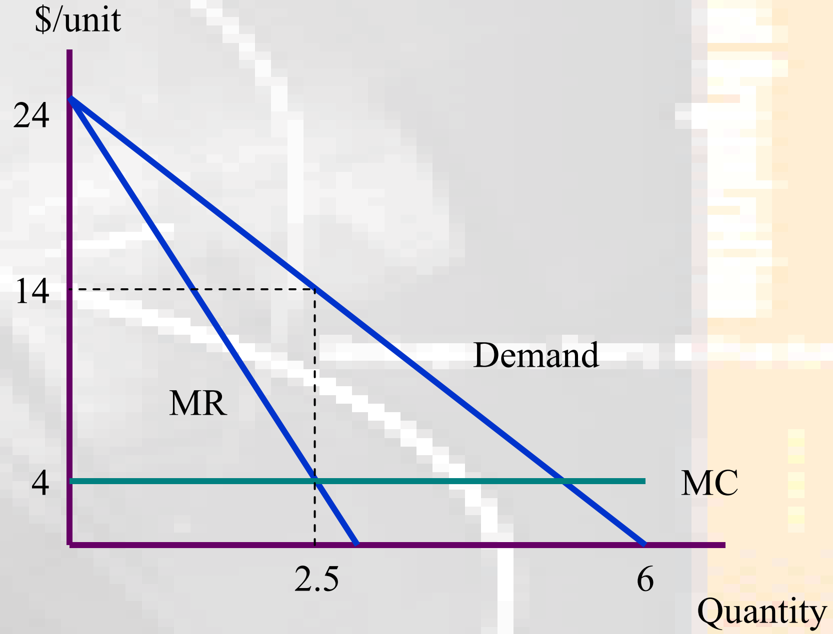
$MR = 24 - 8Q_E$

$MC = 4$

Equate MR and MC

$Q_E = 2.5$

Price from the demand curve $P_E = \$14$



The example (pd cont.)

- Aggregate sales are 6.5 million books
  - the same as without price discrimination
- Aggregate profit is (20 – 4)x4 + (14 – 4)x2.5 = \$89 million
  - \$4.5 million greater than without price discrimination

No price discrimination: non-constant cost

- The example assumes constant marginal cost
- How is this affected if MC is non-constant?
  - Suppose MC is increasing

An example with increasing MC

MC(q)= 2*(q-1)

D market 1

P	q
7	1
5	2

D market 2

P	q
4	1
3	2

No discrimination

p	q	TR	MR	MC	TC
7	1				
5	2				
4	3				
3	4				

An example with increasing MC

D market 1

P	q
7	1
5	2

D market 2

P	q
4	1
3	2

$MC(q)= 2*(q-1)$

Previous solution: p=5, q=2, TC=2, π=8

Anything better?

Consider selling one unit in each market:

p_1= 7, p_2=4 TR=11 and π=9

Where is the difference coming from?

Example (continued)

market 1

p	q	TR	MR
7	1	7	7
5	2	10	3

market 2

p	q	TR	MR
4	1	4	4
3	2	6	2

Key idea: order consumers by MR

q	MR	MC
1	7	0
2	4	2
3	3	4
4	2	8

The optimum is to include only the first two consumers:

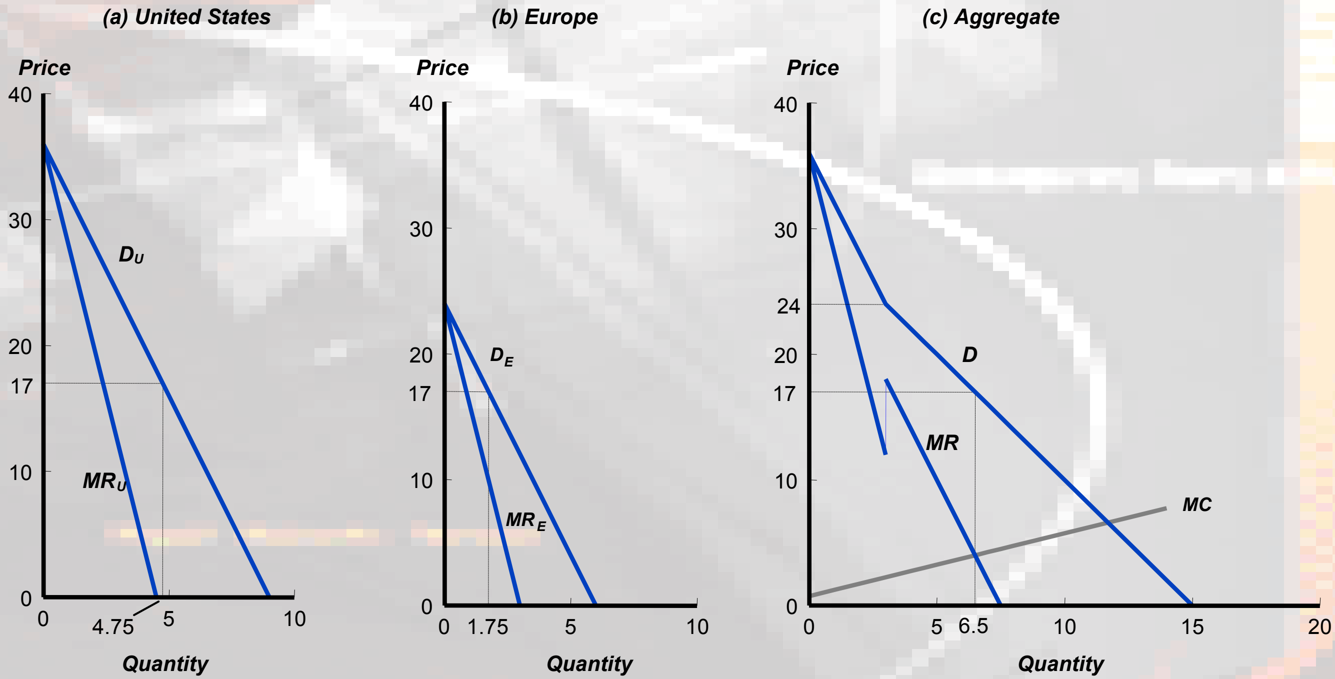
$p_1=7$, $p_2=4$.

No price discrimination: non-constant cost

- More general linear demand case
- No price discrimination procedure
  - Calculate aggregate demand
  - Calculate the associated MR
  - Equate MR with MC to give aggregate output
  - Identify price from aggregate demand
  - Identify market demands from individual demand curves

The example again

Applying this procedure assuming that MC = 0.75 + Q/2 gives: $0.75+Q/2 = 30 - 4Q \rightarrow Q = 6.5$

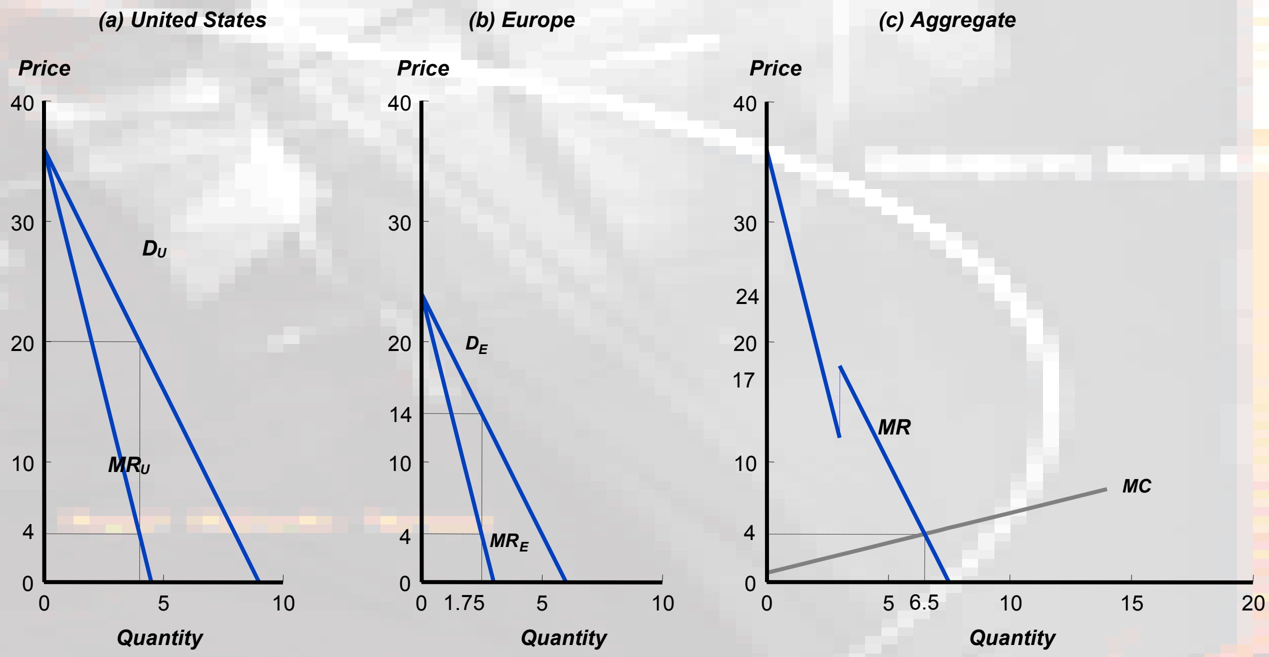


Price discrimination: non-constant cost

- With price discrimination the procedure is
  - Identify marginal revenue in each market
  - Aggregate these marginal revenues to give aggregate marginal revenue
  - Equate this MR with MC to give aggregate output
  - Identify equilibrium MR from the aggregate MR curve
  - Equate this MR with MC in each market to give individual market quantities
  - Identify equilibrium prices from individual market demands

The example again

Applying this procedure assuming that MC = 0.75 + Q/2 gives:



Necessary conditions for optimal prices

Above procedure:

1. Invert MR functions
2. Add them up
3. Replace MR by MC

$Q_U = 36/8 - MR/8$

$Q_E = 24/8 - MR/8$

$Q = 60/8 - 2MR/8$

$= 60/8 - 2/8(0.75 + Q/2)$

$Q = 6.5,\ MC = 4,\ Q_U = 4,\ Q_E = 2.5$

General necessary conditions (for continuous demands)
Equate marginal revenues in both markets
Equate those marginal revenues to marginal cost

$MR_U = 36 - 8Q_U \quad = 24 - 8Q_E = MR_E$

$MC = 0.75 + (Q_U + Q_E)/2 = 24 - 8Q_E$ (could have used MR_U instead)

Some additional comments

- With linear demands:
  - price discrimination results in the same aggregate output as no price discrimination
  - price discrimination always increases profit
- For any demand specifications two rules apply
  - marginal revenue must be equalized in each market
  - marginal revenue must equal aggregate marginal cost

Price discrimination and elasticity

- Suppose that there are two markets with the same MC
- MR in market *i* is given by $MR_i = P_i(1 - 1/\eta_i)$
  - where η_i is (absolute value of) elasticity of demand
- From rule 1 (above)
  - $MR_1 = MR_2$
  - so $P_1(1 - 1/\eta_1) = P_2(1 - 1/\eta_2)$ which g

$$\frac{P_1}{P_2} = \frac{(1 - 1/\eta_2)}{(1 - 1/\eta_1)} = \frac{\eta_1\eta_2 - \eta_1}{\eta_1\eta_2 - \eta_2}.$$

Price is lower in the market with the higher demand elasticity

Third-degree price discrimination (cont.)

- Often arises when firms sell *differentiated products*
  - hard-back versus paper back books
  - first-class versus economy airfare
- Price discrimination exists in these cases when:
  - "two varieties of a commodity are sold by the same seller to two buyers at different *net* prices, the net price being the price paid by the buyer corrected for the cost associated with the product differentiation." (Phlips)
- The seller needs an easily observable characteristic that signals willingness to pay
- The seller must be able to *prevent arbitrage*
  - e.g. require a Saturday night stay for a cheap flight

Product differentiation and price discrimination

Suppose there are two types of travellers:

Business (B)
Tourists (T)
Additional cost for first class = 100

(1) Both first class:
P=250, profit=150*N
(2) Both Coach:
P=200, profit = 200*N
(3) Separate:
PC = 200
PB=?

For example: $NB = 50$, $NT = 200$
(1) 150*250=37,500
(2) 200*250=50,000
(2) 200*200+400*50=60,000

Utilities:

	B	T
Coach	500	200
First Class	800	250

If $P_B - P_C > 300$, B will choose coach.

Possibility of arbitrage puts limits on P_B.

U_{BC} : utility B flying coach

U_{BF} : utility B flying first

$p_F - p_C < U_{BF} - U_{BC}$

Known as *self-selection or no-arbitrage constraint*

Other mechanisms for price discrimination

- Impose restrictions on use to control arbitrage
  - Saturday night stay
  - no changes/alterations
  - personal use only (academic journals)
  - time of purchase (movies, restaurants)
- "Crimp" the product to make lower quality products
  - *Mathematica*®
- Discrimination by location