Monopoly and monopoly behavior

Varian: Intermediate Microeconomics, 8e, chapters 24 and 25

In this lecture you will learn

- how monopoly chooses optimal price/quantity
- what natural monopoly is and how to regulate it
- what the advantages and disadvantages of patents are
- how to profit on different pricing strategies
- what the equilibrium in monopolistic competition looks like

Definition of monopoly

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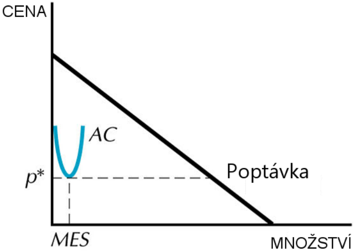
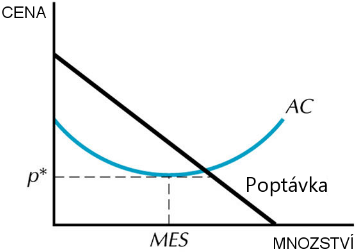
Monopolies can may arise for different reasons:

- exclusive ownership of an important input (diamonds, rubber)
- exclusive licences or franchises (Czech Railways, Czech Post Office)
- patents (pharmaceutical industry, mobile technologies, ...)
- natural monopoly = large MES (network industries)





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Second order condition:

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Profit maximizing monopoly considers output y^* at which

- marginal revenues equal marginal costs,
- *MC* is steeper than *MR*.

Maximizing profits (cont'd)

If a monopoly has negative profits at y^*, it may not produce y^*.

In the SR, monopoly shuts down, i.e. produces $y = 0$ if

$$p(y^*)y^* - c_v(y^*) - F < -F \iff p(y^*) < AVC(y^*),$$

where $c_v(y)$ are variable costs and F fixed costs.

In the LR, monopoly exits the industry if

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CAUTION!
Contrary to competitive firms, monopoly does not have a supply curve, because $p(y^*) > MC(y^*)$ (one price $\rightarrow$ more quantities).

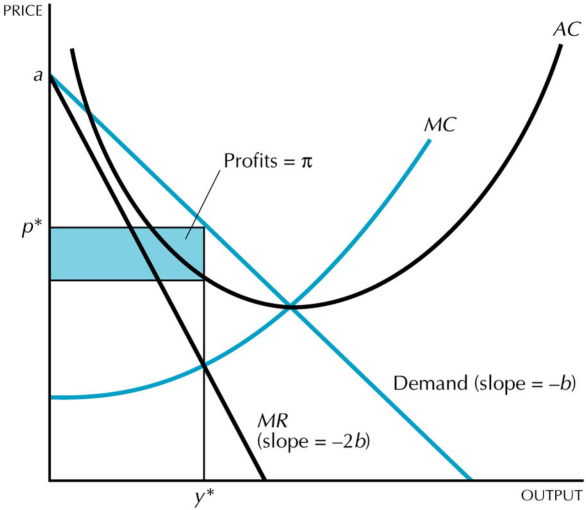
Example – a linear demand curve

Demand:
$p(y) = a - by$

Total revenue:
$r(y) = ay - by^2$

Marginal revenue:
$MR(y) = a - 2by$

Profit:
$\pi = (p(y^*) - AC(y^*))y^*$



Example – optimum of a monopoly in the SR

Demand function: $p(y) = 10 - y$
Cost function: $c(y) = 2y + F$, where $F = 10$

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Would y^* in the LR change if $QF = 20$?
Yes. Monopoly would exit the market.

Elasticity and monopoly markup

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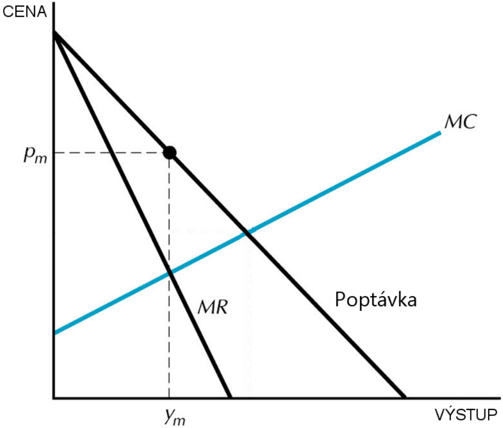
$$\frac{p^*}{MC(y^*)} = \frac{1}{1 - 1/|\epsilon(y^*)|}$$

EXAMPLE: Elasticity for Coke and Dr. Pepper

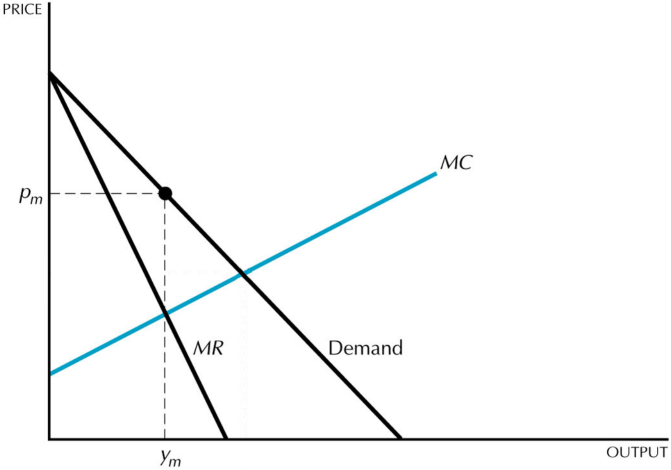
Dubé (JEMS, 2005) – $\epsilon_{Pepsi} = -3{,}07$ and $\epsilon_{Dr.Pepper} = -6{,}03$

If the producers were monopolists: $p/MC = 1{,}48$ (Pepsi) 1,2 (Pepper)



Inefficiency of monopoly

Monopoly: $MR(y_m) = MC(y_m)$



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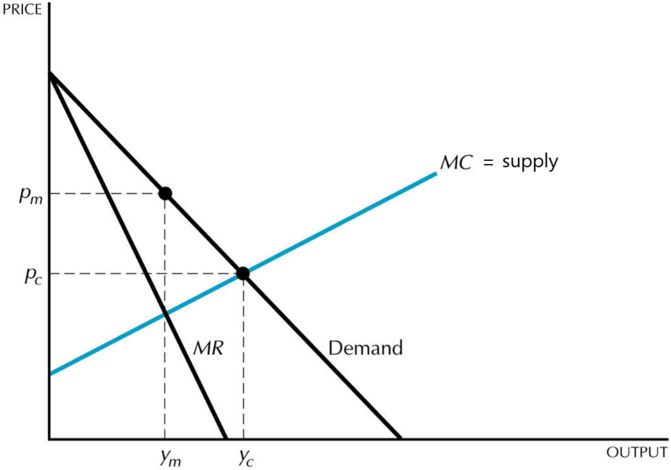
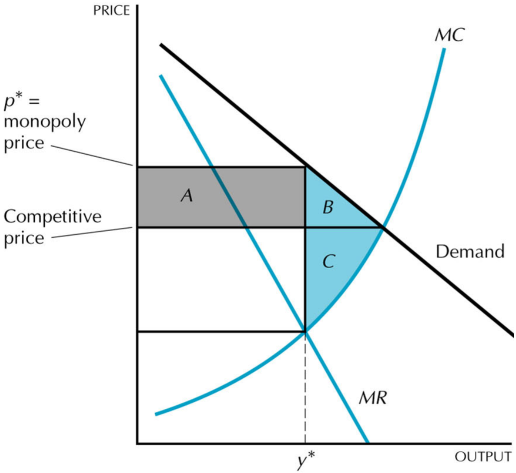
Monopoly: $MR(y_m) = MC(y_m)$
Perfect competition: $p_c = MC(y_c)$



Inefficiency of monopoly (cont'd)

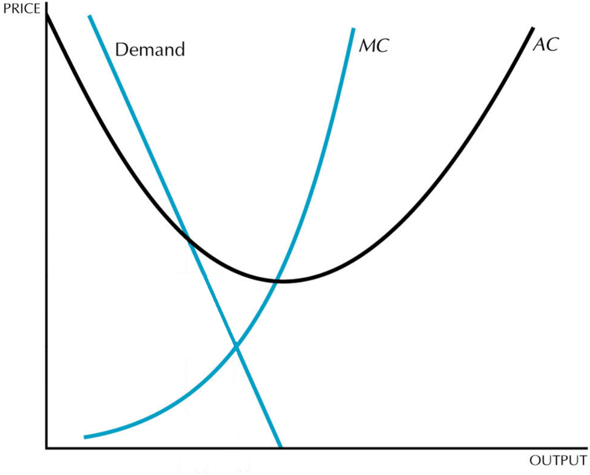
With a reduction from y_C to y_m:

- producer's surplus PS changes by A−C
- consumers' surplus CS reduces by A + B
- total surplus CS + PS reduces by B + C = **deadweight loss**



Natural monopoly

Natural monopoly – one firm can satisfy market demand at lower costs than more firms.



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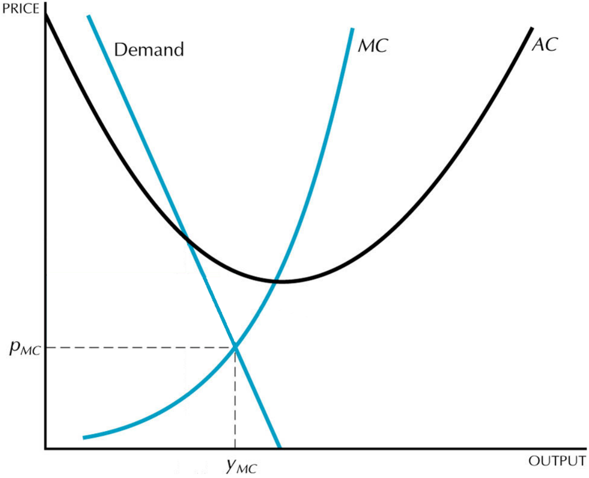

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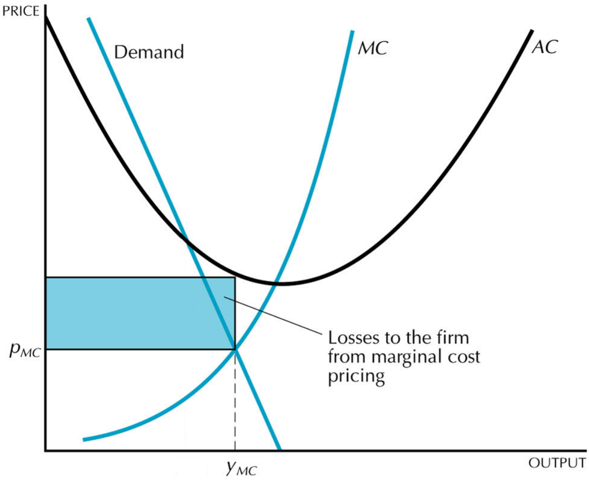

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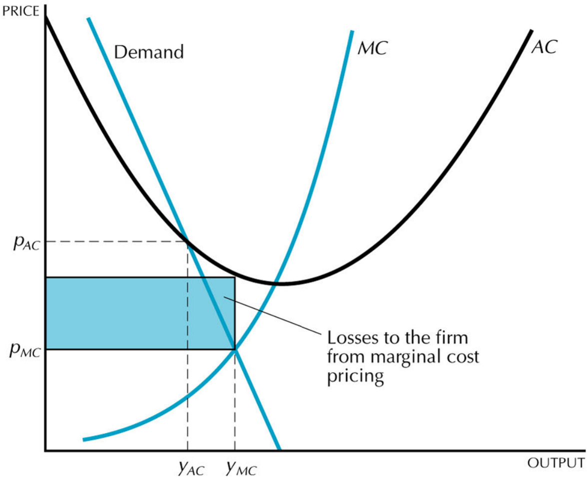
Alternative: set price such that monopoly has zero profit ($p_m = AC$).



APPLICATION: The optimal life of a patent

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Two effects on consumers. The longer the duration,

- the higher the motivation to innovations ($\uparrow$ CS),
- the higher the deadweight loss ($\downarrow$ CS).

In the US the life of a patent is 17 years. Is it optimal?

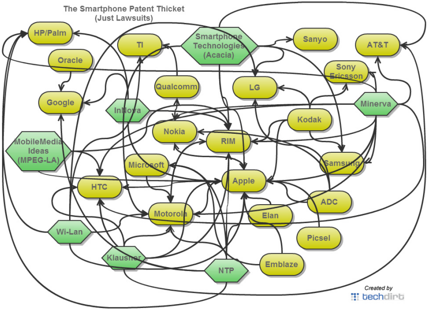
William Nordhaus (*Invention, Growth, and Welfare*, 1969) calculated that for average innovations a patent life of 17 years achieved 90 percent of the maximum possible consumers' surplus.

APPLICATION: „Patent thickets“

Patent thicket – a dense web of overlapping intellectual property rights a firm faces if it wants to commercialize a new technology.

Firms may create a portfolio of patents for strategic purposes.

Each firm’s patents serve as a defense against patent suits.
If e.g. IBM tries to sue HP, HP would do the same to IBM.



Price discrimination

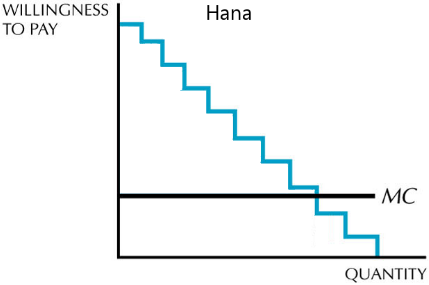
Three types of price discrimination that differ in their assumptions:

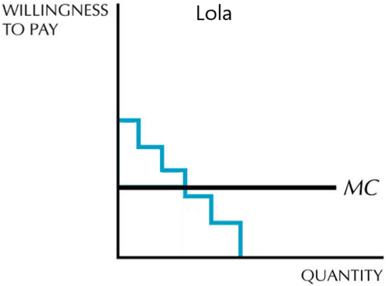
1. **Perfect price discrimination (first-degree p. d.)**
   Monopoly knows the willingness to pay and can sell each unit of product for the maximum price consumers are willing to pay.
2. **Second-degree price discrimination**
   Monopoly knows that consumers differ in their willingness to pay, knows their demands, but cannot tell which consumer is which.
3. **Third-degree price discrimination**
   Monopoly knows demands of different groups of consumers, may charge different prices to different groups, but does not know the willingness to pay for individual units of product.

Example – perfect price discrimination

Hana and Lola are the only buyers in a market with a monopoly with constant MC. Hana has high and Lola low willingness to pay (WTP).

What is the quantity bought by Hana and Lola? What is the profit?





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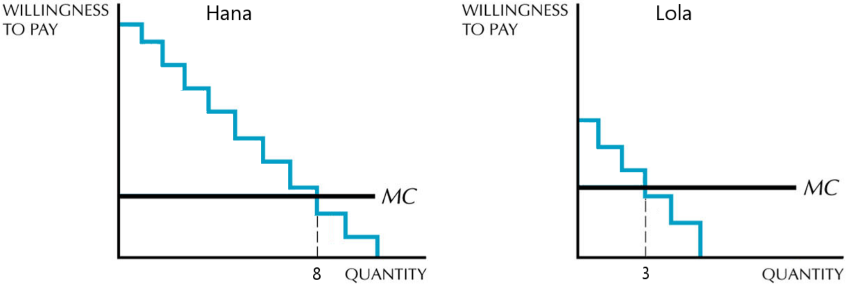

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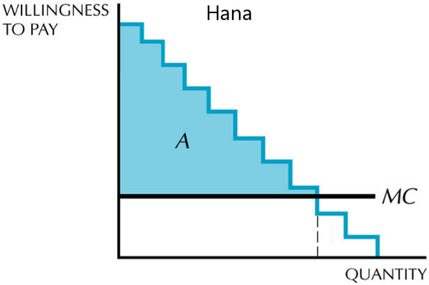

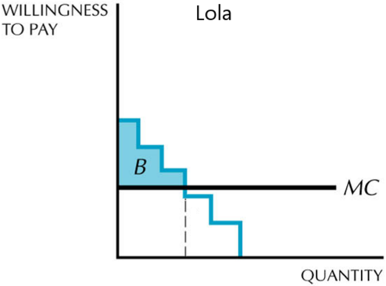

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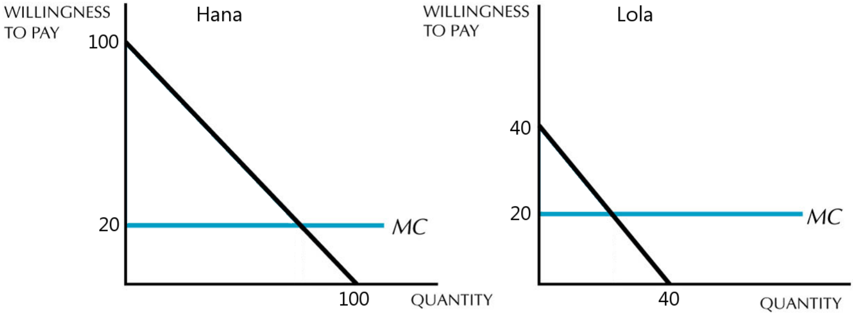
The monopoly's profit from Hana = area A; profit from Lola = B.

Example – perfect p. d. for linear demands

Demands of Hana and Lola: $q_H = 100 - p$ and $q_L = 40 - p$

Quantity q, profit π, surpluses CS and PS and deadweight loss DWL?



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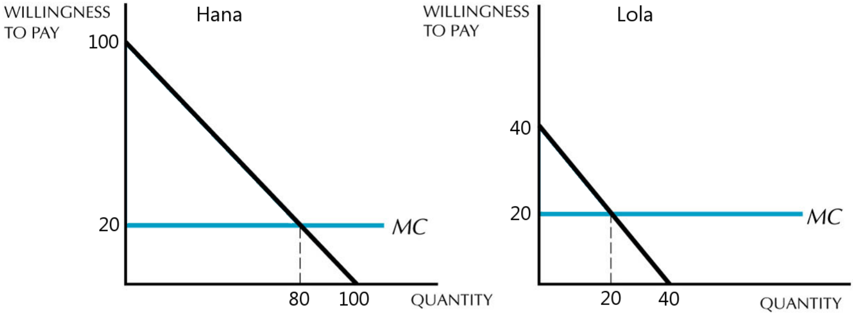

Result:

Quantity: $q = q_V + q_N = (100 - 20) + (40 - 20) = 80 + 20 = 100$

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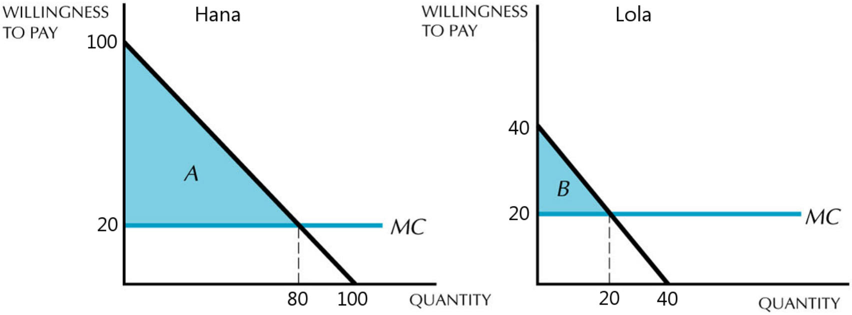

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Profit: $\pi = PS = A + B = \frac{80 \times 80}{2} + \frac{20 \times 20}{2} = 3\,400$

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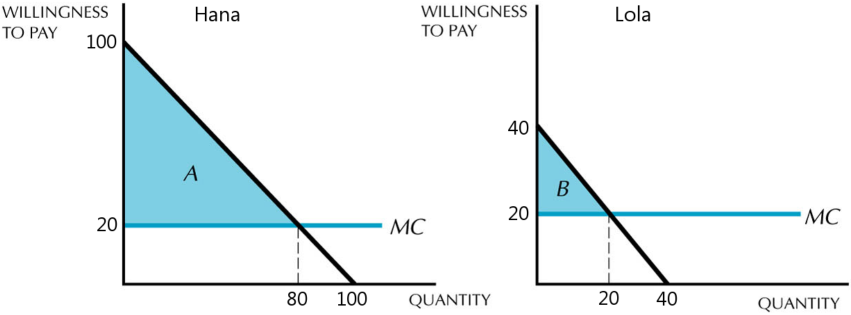

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Consumers' surplus: $CS = 0$, deadweight loss: $DWL = 0$

Real-world examples of perfect price discrimination?

A theoretical concept – does not exist in reality. Imperfect examples:

- markets without posted prices – Asian bazaar, car sales, antique markets, B2B services, ...
- In 2000 Amazon charged different prices to different consumers for the same DVDs. After critique Amazon abandoned this practice.
- System Ding from Soutwest airlines offers individual fares to each customer– but the fares are 30 % below the price of similar flights.
- Priceline (internet airline ticket sales) let the customers to name their price/ willingness to pay. But there was competition in the market. People entered lower than competitive prices. Priceline had to change its business model.

Second degree price discrimination

Second degree price discrimination – the result: price depends on quantity bought by the consumer (also **nonlinear pricing**).

Problem: The monopoly knows that consumers differ in their willingness to pay, but cannot tell the WTP of individual consumers – does not discern consumers with a high WTP.

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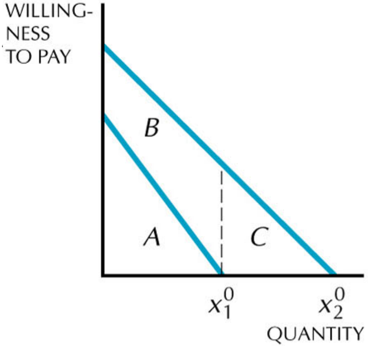
Problem: The monopoly knows that consumers differ in their willingness to pay, but cannot tell the WTP of individual consumers – does not discern consumers with a high WTP.

Solution: The monopoly offers such price-quantity packages that give the consumers an incentive to self select – high WTP customers choose package meant for them.

Example – second-degree price discrimination

The same 2 buyers as in perfect p. d. and zero MC and F.



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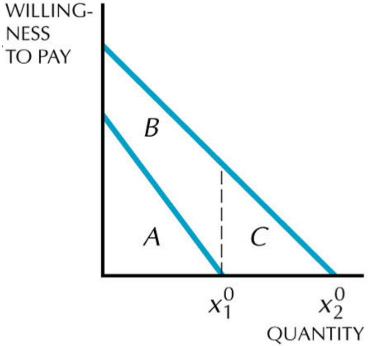

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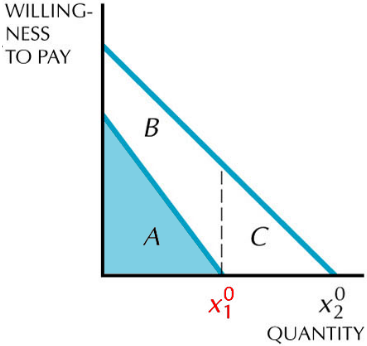

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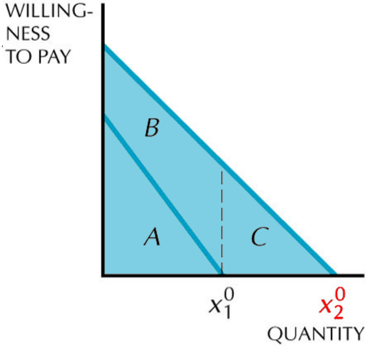

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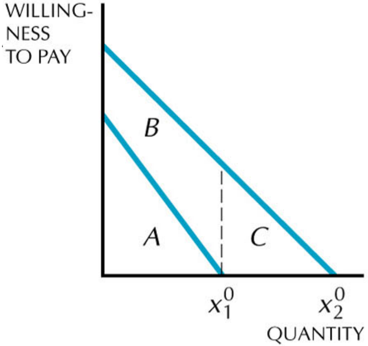

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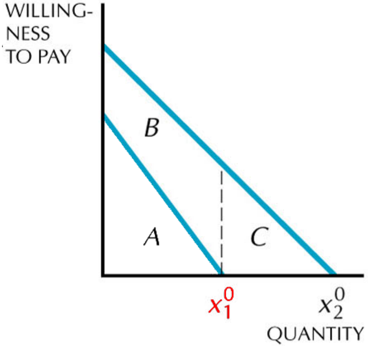

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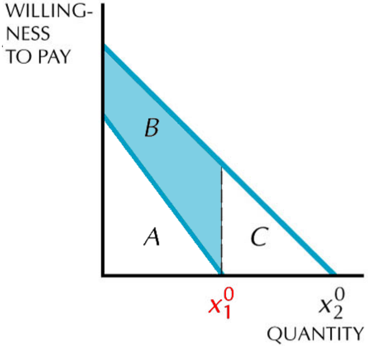
- Lola chooses package 1 and has a CS of 0
- Hana chooses package 1 and has a CS of B



Example – second-degree price discrimination

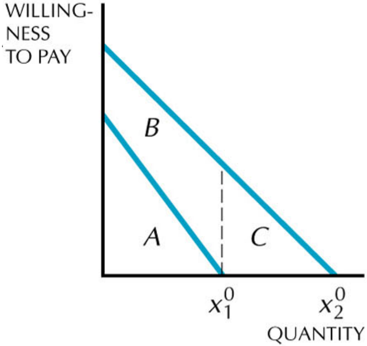
The same 2 buyers as in perfect p. d. and zero MC and F.

Situation 1: First let's assume that the monopoly offers the same package as in the case of perfect discrimination:

- package 1 – quantity x_1^0 for the price A
- package 2 – quantity x_2^0 for the price $A + B + C$

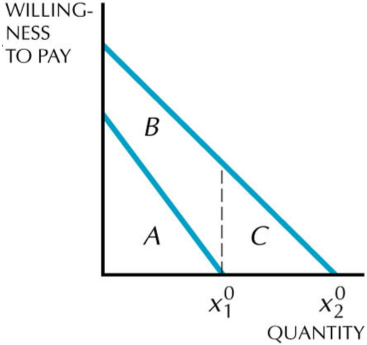
The result of situation 1:

- Lola chooses package 1 and has a CS of 0
- Hana chooses package 1 and has a CS of B
- The monopoly will have a profit of $2A$



Example – second-degree price discrimination (cont'd)

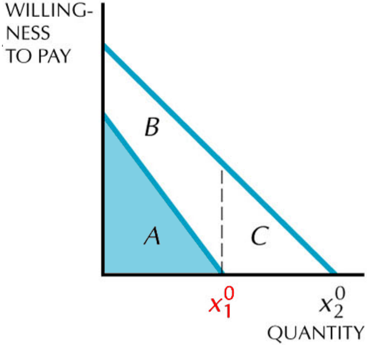
Situation 2: The monopoly offers:



Example – second-degree price discrimination (cont'd)

Situation 2: The monopoly offers:

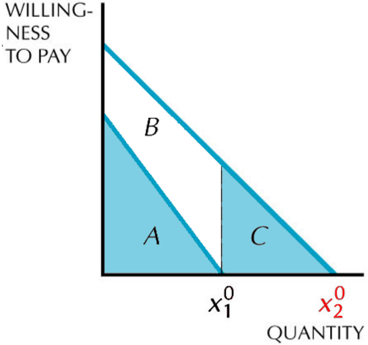
- package 1 – quantity x_1^0 for a price of A



Example – second-degree price discrimination (cont'd)

Situation 2: The monopoly offers:

- package 1 – quantity x_1^0 for a price of A
- package 2 – quantity x_2^0 for a price of $A + C$

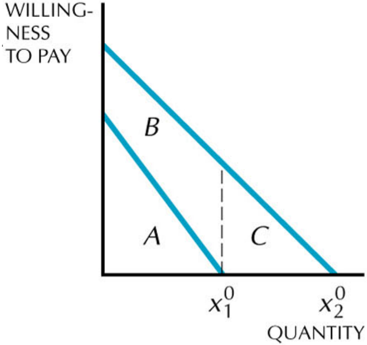


Example – second-degree price discrimination (cont'd)

Situation 2: The monopoly offers:

- package 1 – quantity x_1^0 for a price of A
- package 2 – quantity x_2^0 for a price of $A + C$

The result of situation 2:



Example – second-degree price discrimination (cont'd)

Situation 2: The monopoly offers:

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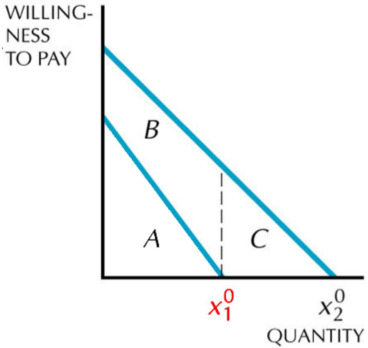
- package 2 – quantity x_2^0 for a price of $A + C$

The result of situation 2:

- Lola chooses package 1 and has a CS of 0



Example – second-degree price discrimination (cont'd)

Situation 2: The monopoly offers:

- package 1 – quantity x_1^0 for a price of A
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The result of situation 2:

- Lola chooses package 1 and has a CS of 0
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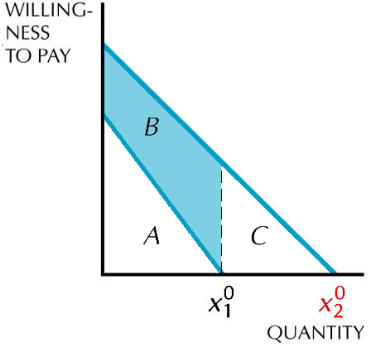

Example – second-degree price discrimination (cont'd)

Situation 2: The monopoly offers:

- package 1 – quantity x_1^0 for a price of A
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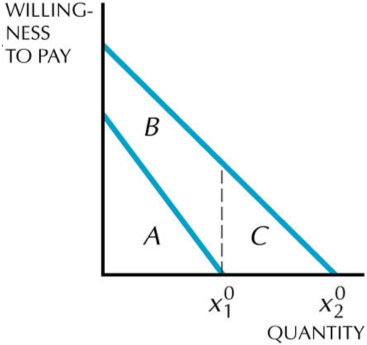
The result of situation 2:

- Lola chooses package 1 and has a CS of 0
- Hana chooses package 2 and has a CS of B
- Compared to situation 1, monopoly increases its profit to $2A + C$



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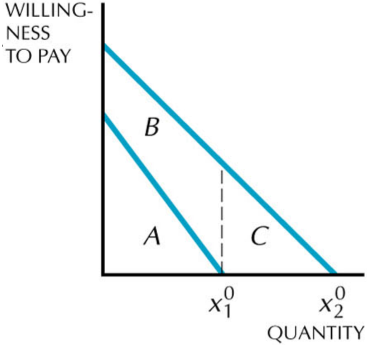
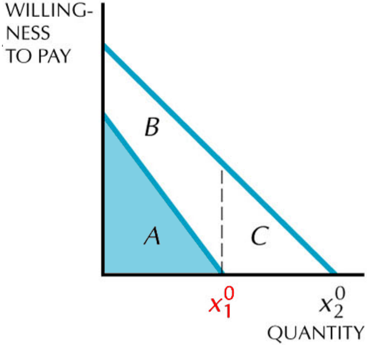


Example – second-degree price discrimination (cont'd)

Situation 3: Compared to situation 2, the monopoly:

- reduces the quantity in package 1 and the price by the triangle area y



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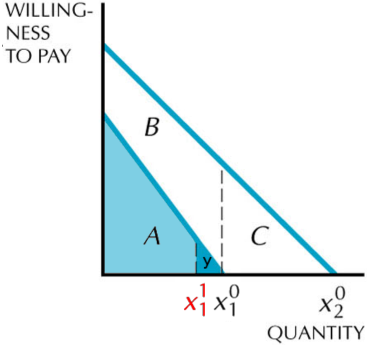
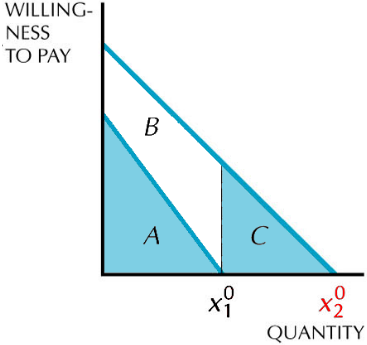


Example – second-degree price discrimination (cont'd)

Situation 3: Compared to situation 2, the monopoly:

- reduces the quantity in package 1 and the price by the triangle area y
- increases the price of package 2 (quantity x_2 unchanged) by the area x



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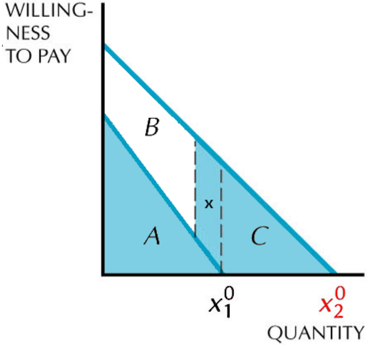

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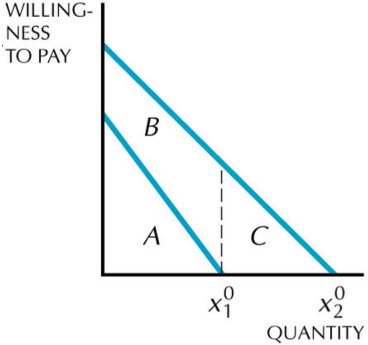

Example – second-degree price discrimination (cont'd)

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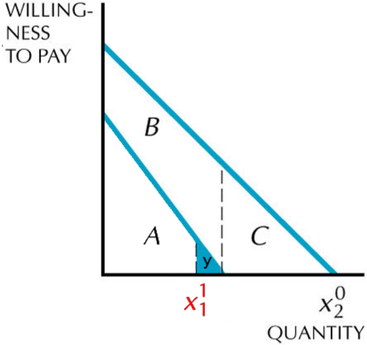
The result of situation 3:

- Lola chooses package 1 and has a CS of 0



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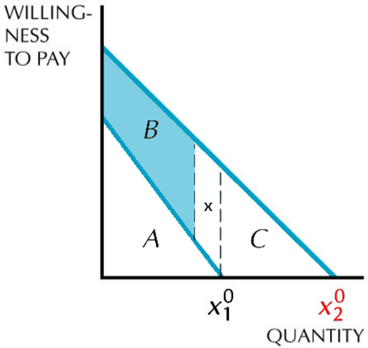
- Lola chooses package 1 and has a CS of 0
- Hana chooses package 2 and her CS falls by x



Example – second-degree price discrimination (cont'd)

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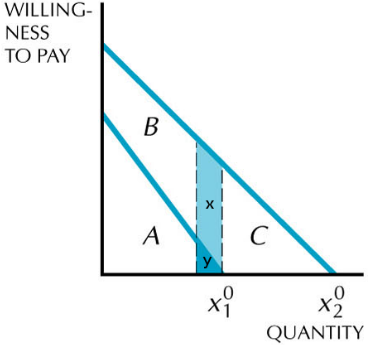
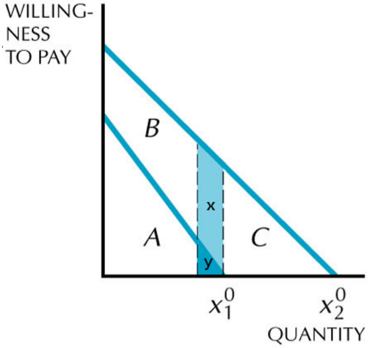
The result of situation 3:

- Lola chooses package 1 and has a CS of 0
- Hana chooses package 2 and her CS falls by x
- Compared to situation 2 the monopoly's profit increases by $x - y$



Example – second-degree price discrimination (cont'd)

Profit maximization:



Example – second-degree price discrimination (cont'd)

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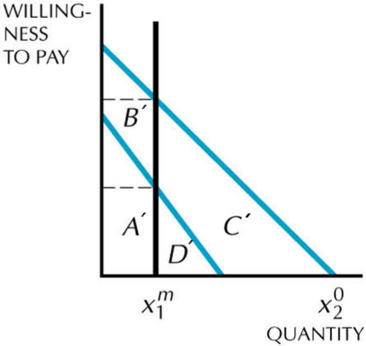
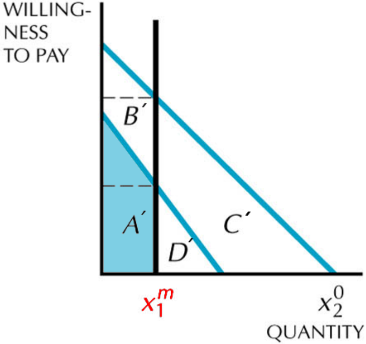


Example – second-degree price discrimination (cont'd)

Profit maximization: The monopoly reduces the quantity x_1 to x_1^m, where the rise in profit from Hana equals the loss from Lola:

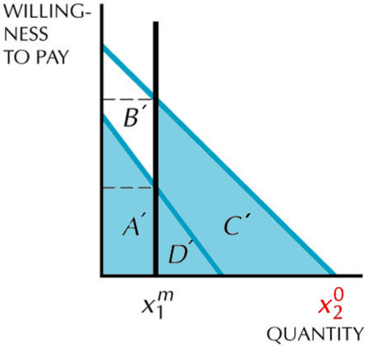
- package 1 – quantity x_1^m for a price A'



Example – second-degree price discrimination (cont'd)

Profit maximization: The monopoly reduces the quantity x_1 to x_1^m, where the rise in profit from Hana equals the loss from Lola:

- package 1 – quantity x_1^m for a price A'
- package 2 – quantity x_2^0 for a price $A' + C' + D'$



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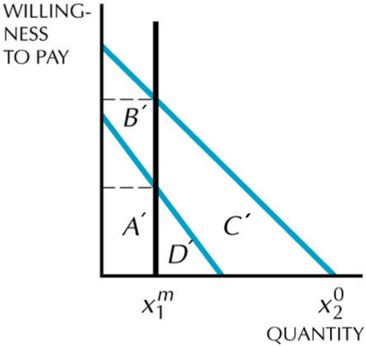

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The result of profit maximization:

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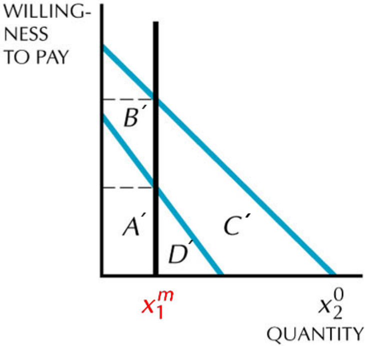

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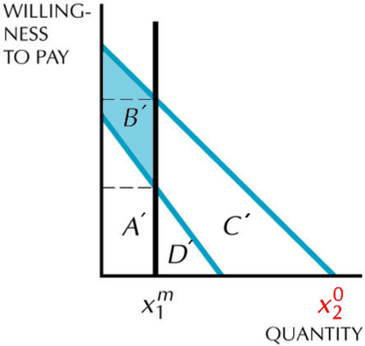

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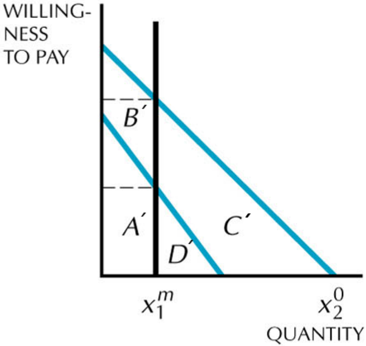
The result of profit maximization:

- Lola chooses package 1 and has a CS of 0
- Hana chooses package 2 and has a CS of B'
- The monopoly's profit increases further to $2A' + C' + D'$



Example – second-degree price discrimination (cont'd)

Two general conclusions:

1. Consumers with a high willingness to pay profit from the presence of consumers with a low willingness to pay. The monopoly cannot take their entire CS because they would start buying the product aimed at low-WTP consumers.
2. Even consumers with a low WTP may be better of with price discrimination than otherwise. If monopoly was not allowed to price discriminate, it might supply only to consumers with a high WTP.

Third-degree price discrimination

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Examples:

- student discounts with ISIC
- different prices for different nationalities (books, pills, entrance)
- discounts based on the place of residence (Disneyland)

Third-degree price discrimination (cont'd)

Assume that monopoly divides the consumer in two groups (markets) and arbitrage is not possible.

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Inverse demands in markets 1 and 2: $p_1(y_1)$ and $p_2(y_2)$
Cost function of the monopoly: $c(y_1 + y_2)$

Monopoly maximizes profit

$$\max_{y_1, y_2} p_1(y_1)y_1 + p_2(y_2)y_2 - c(y_1 + y_2)$$

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First order conditions:

$$MR_1(y_1) = MC(y_1 + y_2)$$

$$MR_2(y_2) = MC(y_1 + y_2)$$

In the optimum, MC equal MR in both markets.

Example – third-degree price discrimination

Demand in market 1: $D_1(p_1) = 100 - p_1 \iff p_1(y_1) = 100 - y_1$
Demand in market 2: $D_2(p_2) = 100 - 2p_2 \iff p_2(y_2) = 50 - y_2/2$
Cost function of the monopoly: $C(y_1 + y_2) = 20(y_1 + y_2)$

Optimal quantities and prices in both markets and monopoly profit?

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Monopoly profit: $\pi = 60 \times 40 + 35 \times 30 - 20(40 + 30) = 2\,050$

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Monopoly charges only one price $\implies$ faces market demand:

$$D(p) = D_1(p_1) + D_2(p_2) = 200 - 3p \iff p(y) = \frac{200}{3} - \frac{y}{3}$$

Next, problem of monopoly – result: $y = 70$, $p = 43\frac{1}{3}$, $\pi = 1\,633\frac{1}{3}$

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- price between p_1 and p_2 – sells more in market 1 and less in market 2
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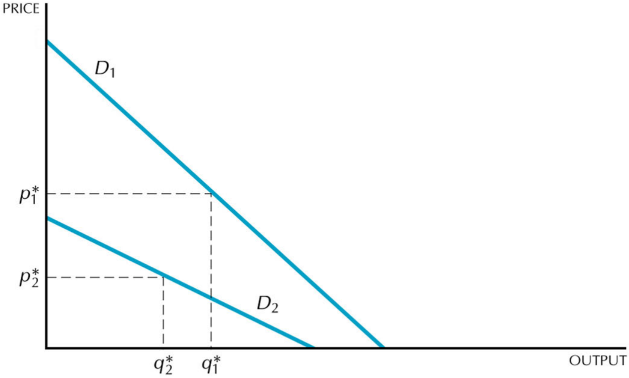
Is price third-degree price discrimination always bad?

A specific example with a kinked marked demand

Linear demands in both markets and zero marginal costs:

- With price discrimination: monopoly sells in both markets.



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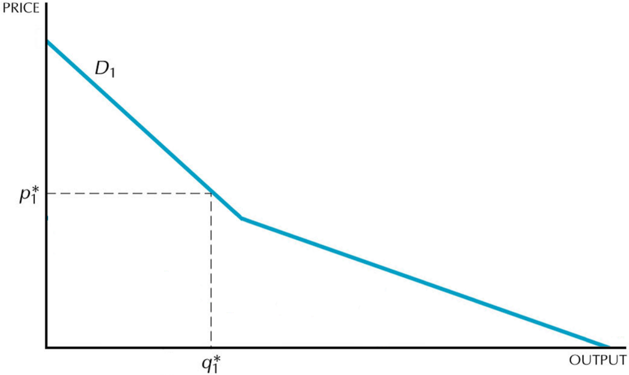

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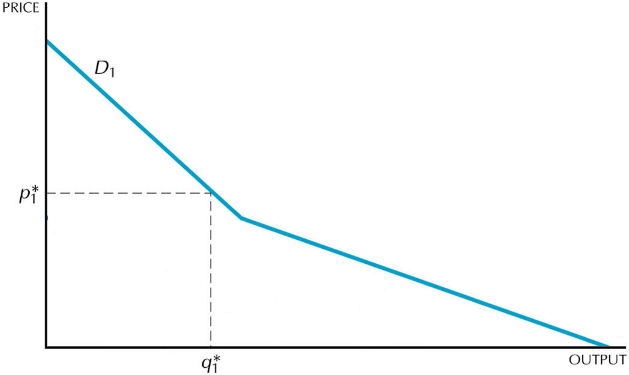
Consumers better off than with price discrimination.



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How do prices depend on price elasticities $\epsilon_1(y_1)$ and $\epsilon_2(y_2)$?

First-order conditions can be written as

$$MR_1(y_1) = p_1(y_1)\left(1 - \frac{1}{|\epsilon_1(y_1)|}\right) = MC(y_1 + y_2)$$

$$MR_2(y_2) = p_2(y_2)\left(1 - \frac{1}{|\epsilon_2(y_2)|}\right) = MC(y_1 + y_2).$$

If $p_1 > p_2$, then:

$$1 - \frac{1}{|\epsilon_1(y_1)|} < 1 - \frac{1}{|\epsilon_2(y_2)|} \quad \text{and thus} \quad |\epsilon_1(y_1)| < |\epsilon_2(y_2)|$$

The market with a less elastic demand will have higher prices.
Intuition: Less price-sensitive consumers pay higher prices.

CASE: Price discrimination in Disneyland

Why do people living close to Disneyland pay less for the entrance?

CASE: Price discrimination in Disneyland

Why do people living close to Disneyland pay less for the entrance?

They are more price elastic. Lower price might induce more visits.

Two-part tariff

Two-part tariff consists of

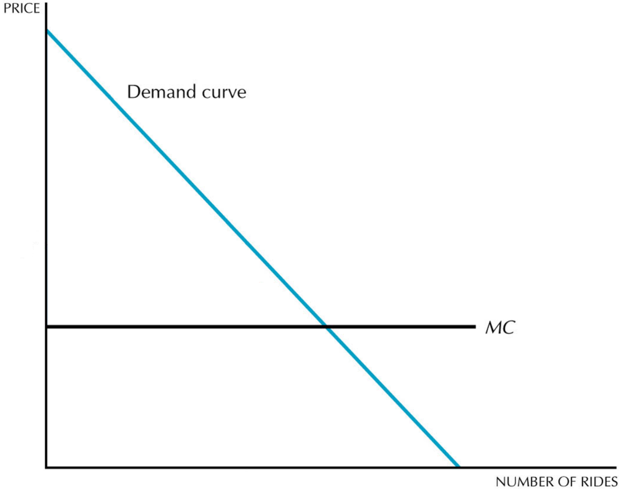
- a fixed fee
- price for one unit of product

Examples:

- amusement park (entrance fee + price per ride)
- tennis club (yearly membership + price per hour)

Example – Disneyland dilemma

Assumptions: only 1 attraction. 1 visitor with WTP corresponding to the demand in graph. A monopoly with constant *MC* for rides.



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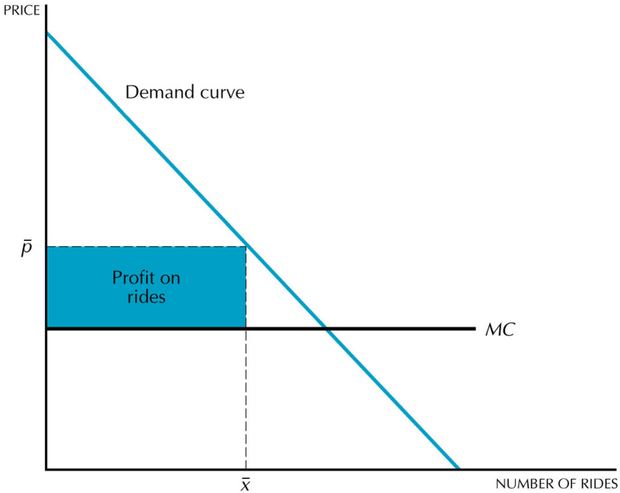
At $\bar{p}$, the revenue from rides is $\bar{p}\bar{x}$.



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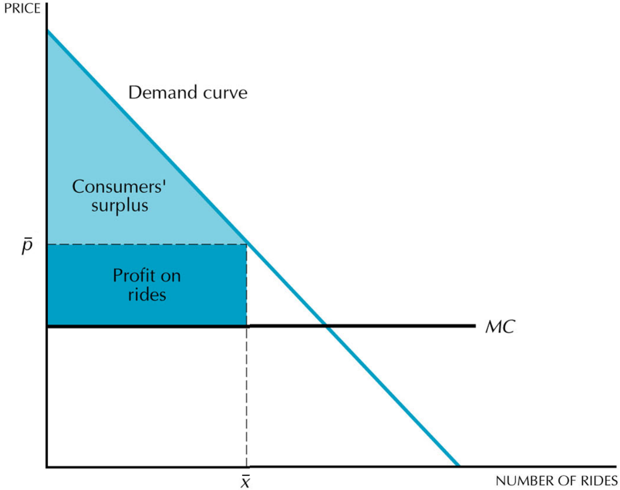
Entrance fee $= CS$



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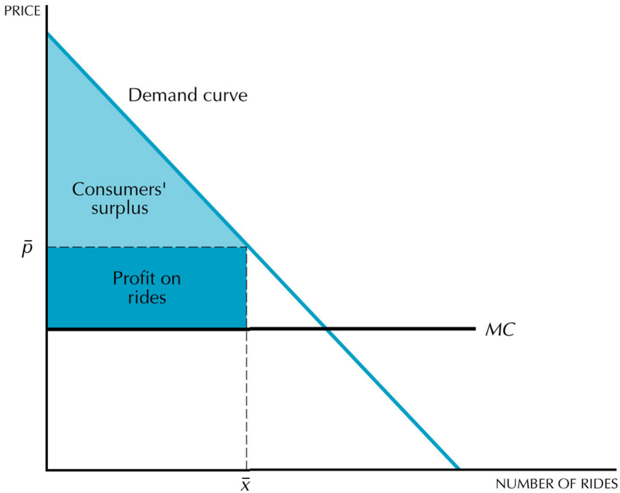
Entrance fee $=$ CS

Monopoly profit $=$ profit on rides $+$ CS



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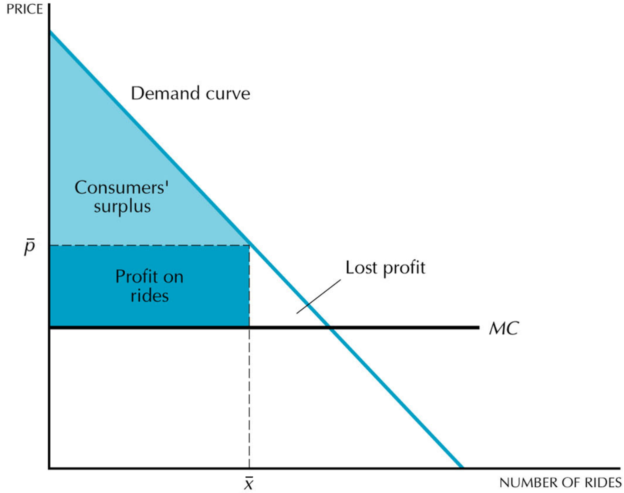
At $\bar{p}$, the revenue from rides is $\bar{p}\bar{x}$.

Entrance fee = CS

Monopoly profit = profit on rides + CS

Profit not maximized – lost profit = deadweight loss

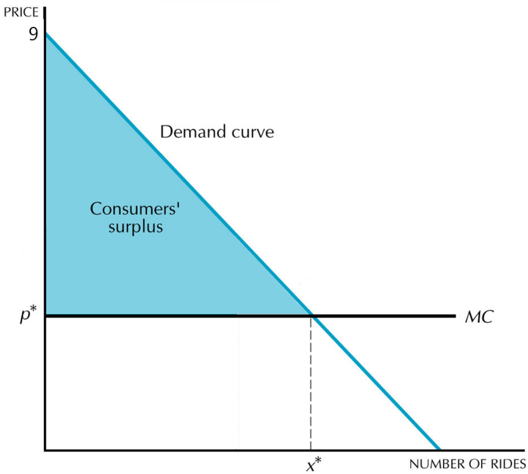


Example– Disneyland dilemma (cont'd)

At the price $p^* = MC$, CS is maximal and profit on rides zero.
Profit of monopoly is maximal, no deadweight loss.

The optimal two-part tariff:

- price $p^* = MC$
- fixed fee $= CS$



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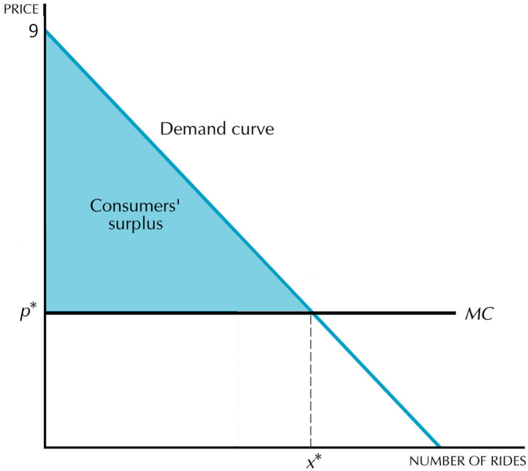

Numerical example:

Inverse demand: $p = 9 - x$
Marginal cost: $MC = 3$

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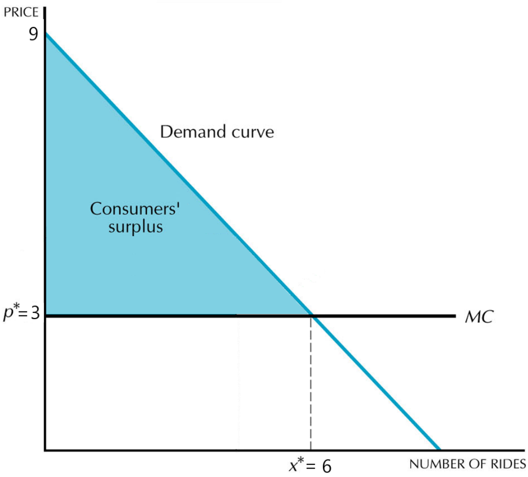

Numerical example:

Inverse demand: $p = 9 - x$
Marginal cost: $MC = 3$

Solution:

Price: $p^* = MC = 3$
Fixed fee: $\frac{6 \times 6}{2} = 18$

Bundling

Firms often sell products in bundles

Examples:

- computer with operating system
- magazine (bundle of articles)
- MS Office (Word, Excel, PowerPoint)
- ...

Example – sell product in bundles or separately?

2 customers (A and B) with a different willingness to pay (table)

2 products – word processor W and spreadsheet program E

Monopoly costs: marginal costs $MC = 0$ and fixed costs $F = 100$:

Will monopoly sell W and E separately or in a bundle (1+1)?

customer/product	word processor (W)	spreadsheet program (E)
A	120 $	100 $
B	100 $	120 $

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Result:

Separately:

- optimal prices W and E:
  $p^*_W = 100\$$ and $p^*_E = 100$ $
- profit: $\pi = 2p^*_W + 2p^*_E - F =$
  $4 \times 100 - 100 = 300$ $

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- profit: $\pi = 2p_W^* + 2p_E^* - F = 4 \times 100 - 100 = 300$ $

Bundle (1+1):

- optimal price of bundle: $p_{W+E}^* = 220$
- profit: $\pi = 2p_{W+E}^* - F = 2 \times 220 - 100 = 340$ $

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Bundle (1+1):

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- profit: $\pi = 2p_{W+E}^* - F = 2 \times 220 - 100 = 340$ $

The monopoly has a higher profit from bundling.

Monopolistic competition

Assumptions:

(1) a large number of independent firms with a differentiated product
(2) free entry and exit

Examples:

- market for clothes and shoes
- many food markets
- market with books, movies, manazines

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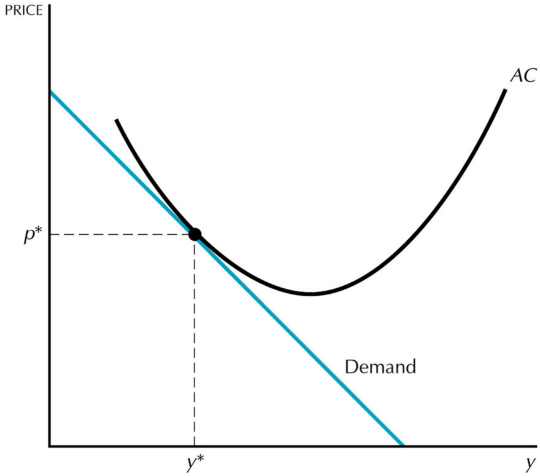
Condition (1) $\implies$ Each firm in a situation of a monopoly:

- each firm faces a downward-sloping demand
- each firm's choice of quantity/price has no impact on other firms

Condition (2) $\implies$ Firms in the LR enter the profitable market (or exit the market in loss). $\implies$ The firm's demand becomes flatter and lower (steeper and higher). This process lasts until the profit is 0.

Monopolistic competition – equilibrium in the LR

In the LR, the equilibrium quantity y^* is such that $D(y^*) = LAC(y^*)$.

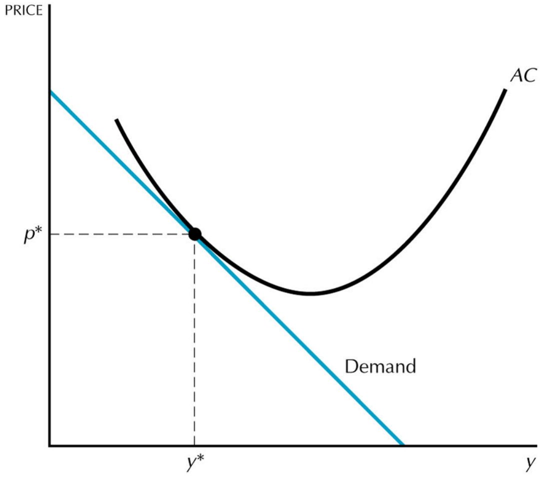


Monopolistic competition – equilibrium in the LR

In the LR, the equilibrium quantity y^* is such that $D(y^*) = LAC(y^*)$.

The long-run equilibrium has two properties:

1. positive DWL, even though profits are 0
2. firms have **excess capacity** – operate to the left of minLAC



What should you know?

- Monopoly maximizes profit at a quantity q^*, at which $MC = MR$.
- The higher the elasticity of demand at q^*, the lower p/MC.
- Monopoly does not have supply curve.
- Monopoly is inefficient – it creates deadweight loss.
- Natural monopoly satisfies demand at lower AC than more firms.
- Natural monopoly selling efficient quantity will be probably in loss.

What should you know? (cont'd)

- Perfect price discrimination leads to the efficient outcome.
- Monopoly using third-degree p. d. charges a higher price in the less elastic market.
- Consumers may benefit from price discrimination – monopoly might be willing to sell to low-WTP consumers.
- With the same demand, a two-part tariff leads to the same result as perfect price discrimination.
- Monopolistically competitive firms are in a similar situation as monopoly, but they have zero profits in the LR.