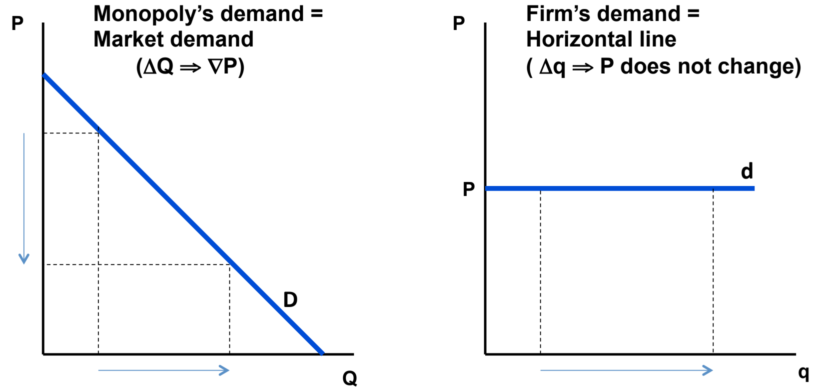
Theory of the Firm

Monopolistic Markets

Monopoly vs. Competition

Monopoly **Perfect Competition**



Monopoly vs. Competition

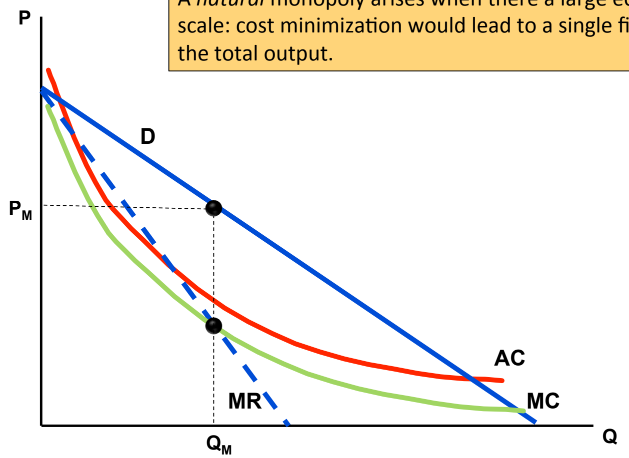
Monopoly	Perfect Competition
• One firm (*market power*)	• Many price-taking firms
• Barriers to entry	• Free entry/exit

Causes of Monopoly

- Natural
  1. Scarcity of a resource: one firm owns a key resource (De Beers' Diamonds)
  2. Technological reasons: existence of large economies of scale relative to the market size -- one firm may serve the demand more efficiently than several firms (water, telephone, …)
- Legal
  1. Licenses (taxis, pharmacies, notaries, …)
  2. Patents (medical drugs, intellectual property, …)

Natural Monopoly

A *natural* monopoly arises when there a large economies of scale: cost minimization would lead to a single firm producing the total output.



Profit Maximization

- First Order Condition:

$$\pi'(q) = 0 \Leftrightarrow MR(q) = MC(q).$$

- Second Order Condition:

$$2p'(q) + qp''(q) - MC'(q) \leq 0$$

- Shutdown Condition: $\pi(q_M) \geq \pi(0)$

The Monopolist's Problem

The revenue function of the monopoly is

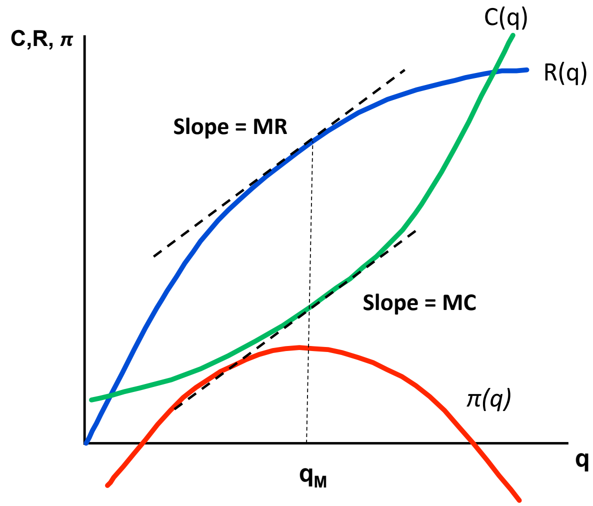
$$R(q) = p(q)q,$$

where p(q) is the INVERSE demand function.

Therefore the problem of the monopolistic firm is

$$\text{Max}_{q\geq 0}\ \pi(q) = p(q)q - C(q).$$

Profit Maximization



Profit Maximization: MR

Marginal revenue is given by

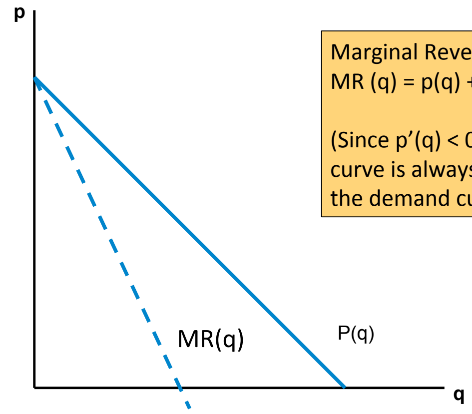
$$MR(q) = \frac{d}{dq}\left(p(q)q\right) = \underset{(+)}{p(q)} + \underset{(-)}{p'(q)}q.$$

The two terms in this expression have a very clear interpretation: the sale of one additional (infinitesimal) unit generates

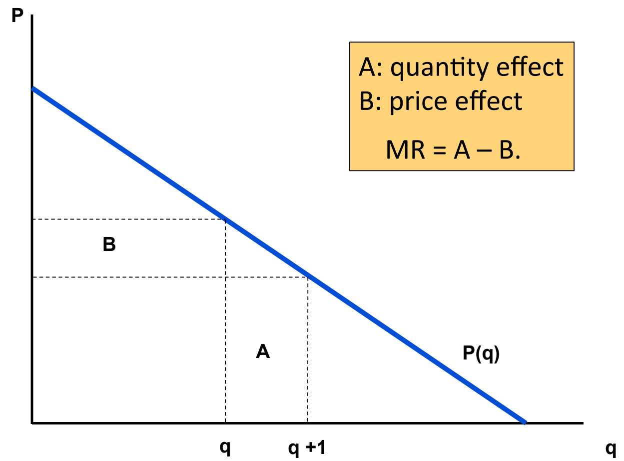
(a) an increase of revenue equal to the price (quantity effect), and

(b) a decrease of revenue equal to the total output times the reduction in price necessary to generate the demand of this additional unit (price effect).

Profit Maximization: MR



Profit Maximization: MR



Profit Maximization: SOC

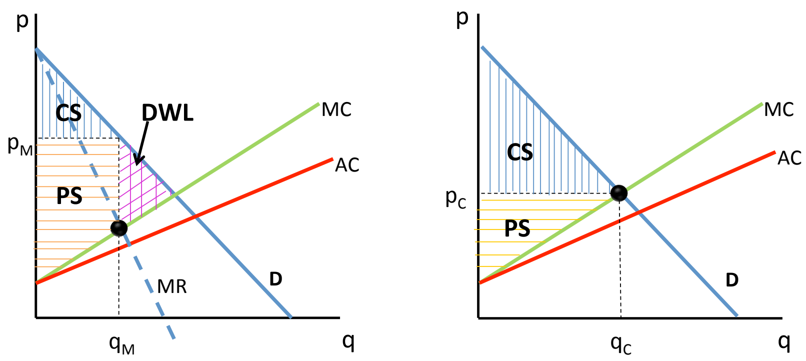
The Second Orden Condition is:

$$2p'(q) + qp''(q) - MC' \leq 0$$

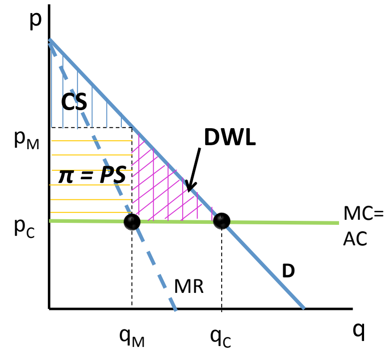
Since p'(q) < 0, the condition C''(q) > 0 (requiring that the firm has diseconomies of scale near the optimal level of output) is no longer required for profit maximization: at the optimal production level the firm may have economies of scale.

Monopoly Equilibrium

Monopoly | Perfect Competition



Surplus and Profits



Monopoly Equilibrium

In a monopoly, the price is above the competitive price,

$$p_M > p_C,$$

the output is below the competitive output,

$$q_M < q_C,$$

the consumer (producer) surplus is below (above) the competitive surplus

$$CS_M < CS_C \ (PS_M > PS_C),$$

and the total surplus is below the competitive surplus,

$$TS_M < TS_C.$$

Also, there is a Deadweight Loss, $DWL = TS_C - TS_M > 0$.

Lerner Index

First Order Condition for profit maximization is:

$$MR(q) = MC(q).$$

Marginal revenue is

$$MR(q) = p + qp'(q) = p + p\left(\frac{q}{p}\right)p'(q).$$

Lerner Index

We can write the monopoly price as a function of the demand price-elasticity. The demand price-elasticity is

$$\varepsilon = q'(p)\frac{p}{q} = \frac{p}{qp'(q)}.$$

Then,

$$MR = MC \Leftrightarrow p\left(1+\frac{1}{\varepsilon}\right) = MC.$$

Lerner Index

The Lerner index measures monopoly power: it explains the percentage of price that is not due to costs.

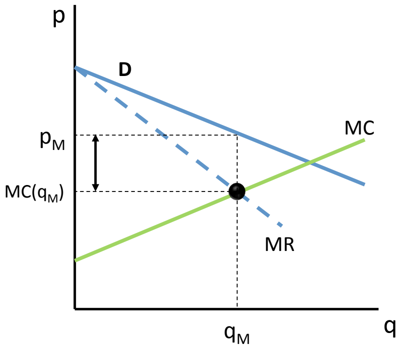
It is defined as

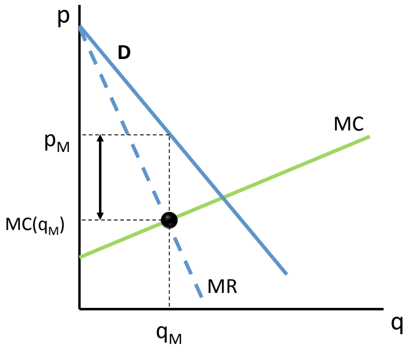
$$L = \frac{p_M - MC(q_M)}{p_M} = -\frac{1}{\varepsilon}.$$

Note that $0 \leq L \leq 1$. ($L = 0$ under perfect competition.)

Lerner Index

If demand is very elastic (Ɛ high), the margin will be small; and vice versa:





Example

A monopolist faces the demand function

$$D(p) = \max\{12 - p, 0\},$$

and its cost function is

$$C(q) = 5+4q.$$

We calculate the monopoly equilibrium, the consumer and producer surpluses and the deadweight loss, the monopoly profits, the Lerner index.

Example

Monopoly Equilibrium. Revenue is

$$R(q) = (12 – q)q = 12q – q^{2.}$$

Hence

$$MR(q) = 12 – 2q.$$

Since MC(q) = 4, the equilibrium output is given by the equation

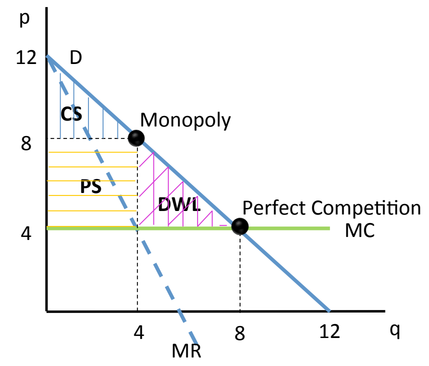
$$MR(q) = MC(q) \Rightarrow 12 – 2q = 4.$$

Thus, $q_M = 4$, and $p_M = 12 – q_M = 12 – 4 = 8$.

Example

We calculate the Lerner index:

$$LI = (p_M – MC(q_M))/p_M = (8\text{-}4)/8 = 0.5$$



Example

We calculates the consumer and producer surplus and the monopoly's profit:

$CS = 0.5*(12 – p_M)*q_M = 0.5*(12\text{-}8)*4 = 8$;

$PS = (p_M – CMa)*q_M = (8\text{-}4)*4 = 16$;

$\pi(q) = p_M q_M – C(q_M) = 8*4 – (5 + 4*4) = 11$;

Since the competitive equilibrium is $p_C= 4$, $q_C= 8$, we have:

$DWL = 0.5*(p_M – p_C)(q_C – q_M) = 0.5*4*4 = 8.$

Regulating a Monopoly

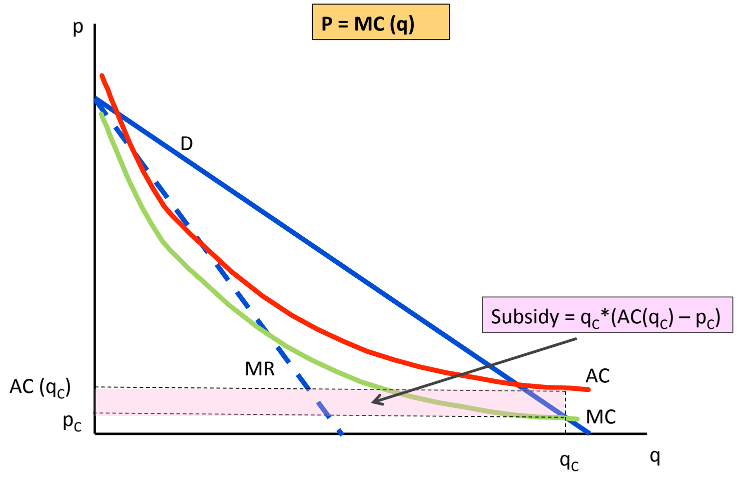
An unregulated monopoly generates a deadweight loss, DWL>0. Can this be avoided?

An obvious solution (if possible – that is, if we know the monopoly's cost function), is to impose a regulated price equal to marginal cost, thus generating the competitive outcome.

This solution may lead to monopoly's losses that would have to be subsidized.

When subsidizing is not possible or convenient (rising the necessary revenue may involve other inefficiencies), an alternative regulated price may be the average cost.

Regulating a Monopoly

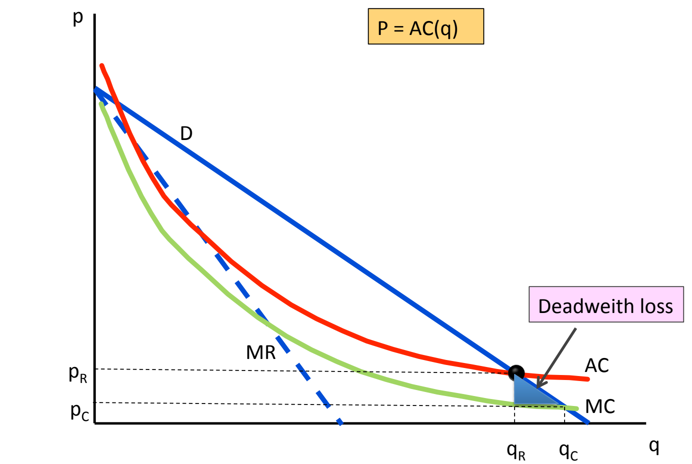


Taxes

In a monopoly, as in a competitive market, introducing a tax causes an increase in prices and a decrease in output, and therefore, a deadweight loss.

The proportion of the tax that is paid for by consumers depends, in a monopoly as well as in a competitive market, of the price elasticity of the demand.

Regulating a Monopoly



Price Caps

Recall that in a competitive market introducing a price cap (i.e., a maximum price at which the good may be traded), reduces the level of output (and creates an excess demand that requires rationing the demand), results in a deadweight loss (reduces the total surplus) and may or may not increase the consumer surplus.

In a monopoly, however, introducing a price cap below the equilibrium price may be an effective instrument to decrease the price and increase the output. Moreover, if the price cap is above marginal cost, then it does not create an excess demand, and results in a greater consumer and total surplus, and smaller deadweight loss.

Taxes and Price Cap: an Example

Consider a monopolist whose cost function is

$$C(q) = 5+4q$$

facing the demand

$$D(p) = max\{12 – p, 0\}.$$

The monopoly output is the solution to the equation

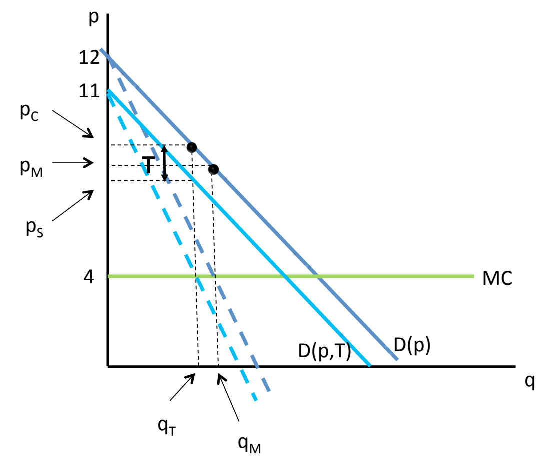
$$12\text{-}2q = 4$$

Therefore $q_M = 4$, and $p_M = 8$.

1. Suppose we introduce a tax T=1 €/unit.

Demand: *$D(p,T)=max\{12 – (p+T), 0\}$.*
Revenue: $R(q,T) = (12 – q – T)q = 12q – q^2 – Tq$.
Marginal Revenue: $MR(q) = 12 – 2q – T$.

Monopoly:Taxes



Monopoly: Taxes

The equation MR(q) = MC(q) is now

$$12 – 2q – T = 4$$

Hence output is $q_M(T) = 4 – T/2$, the consumer price is $p_M(T) = 8 + T/2$, and

monopoly price = $8 + T/2 – T = 8 – T/2$.

That is, the tax burden is shared equally between the consumers and the monopoly.

Monopoly: Taxes

$MR(q) = MC(q) \Rightarrow 12 – 2q – T = 4 \Rightarrow q(T) = 4 – T/2$.

With the taxe T, the price paid by the consumer and the price received by monopoly are not the same:

Price paid by consumer = $12 – q(T) = 8 + T/2$
Price received by monopoly = $8 + T/2 – T = 8 – T/2$.

In this case, the tax burden is shared equally between the consumers and the monopoly.

Taxes and Price Cap: an Example

2. Suppose we introduce a price cap $p^+ < 8 = p_M$.
The price cap changes de revenue function of the monopoly

$$R(p^+,q) = \begin{cases} 12-q & \text{if } 12 - q \le p^+ \\ p^+ q & \text{if } 12 - q > p^+ \end{cases}$$

The Marginal Revenue is:

$$MR(p^+,q) = \begin{cases} 12-2q & \text{if } 12 - q \le p^+ \\ p^+ & \text{if } 12 - q > p^+ \end{cases}$$

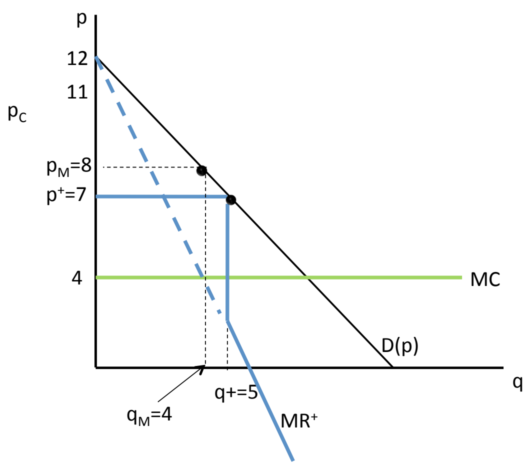
Para p+ = 7, the equilibrium is q = 5 and p = p^+ =7 (see the graph in the page).

Price Discrimination

So far, we have assumed that the monopoly charges the same price for each unit.

We now discuss how the monopoly may increase its profit by charging different prices to different consumers with different WILLINGNESS TO PAY.

Monopoly:Taxes



Price Discrimination

- First degree: the monopoly sells each infinitesimal unit at the maximum price a consumer is willing to pay. With this pricing policy we obtain

  CS=0, PS = TS = maximum surplus, DWL=0.

- Second degree: The monopoly uses NON-LINEAR pricing policies: for example, volume discounts. This type of discrimination is very common in water, electricity, telephone and internet supplies.

Third Degree Price Discrimination

The monopoly tries to segment the market (by geographical criteria, by customers' features, etc.), and charges different prices to each "market segment."

Example: There are two groups of consumers, 1 and 2, whose demands are $D_1(p_1)$ and $D_2(p_2)$.

Third Degree Price Discrimination

The monopolist chooses q_1 and q_2 to maximize the total profits:

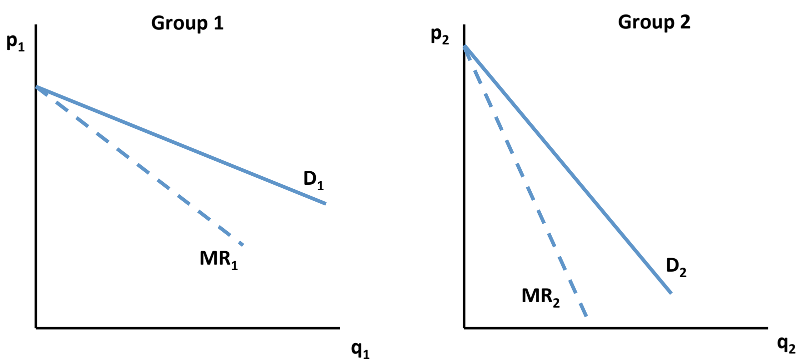
$$\pi(q_1,q_2) = R_1(q_1) + R_2(q_2) - C(q_1+q_2)$$
$$= p_1(q_1)\, q_1 + p_2(q_2)\, q_2 - C(q_1+q_2)$$

FOC:

$$MR_1(q_1) = MC(q_1+q_2)$$
$$MR_2(q_2) = MC(q_1+q_2).$$

Third Degree Price Discrimination

$\varepsilon_2 > \varepsilon_1$



Third Degree Discrimination

In terms of elasticities:

$$p_1(1+1/\varepsilon_1) = p_2(1+1/\varepsilon_2) = MC(q_1+q_2)$$

Therefore

$$p_1/p_2 = (1+1/\varepsilon_2)/(1+1/\varepsilon_1) < 1;$$

and

$$p_1 < p_2;$$

That is, monopoly price is lower in the market with a more elastic demand.

Third Degree Price Discrimination: Example

Suppose a monopoly produces a good with costs

$$C(q) = q^2/2,$$

and faces two markets with demands

$$D_1(p_1) = \max\{20 - p_1, 0\}$$

and

$$D_2(p_2) = \max\{60 - 2p_2, 0\}.$$

Determine the quantities, prices and total profits under third degree price discrimination, and without price discrimination.

Third Degree Price Discrimination: Example

(a) Third degree discrimination:

$MC(q_1+q_2) = q_1+q_2$

$R_1 = 20q_1 - q_1^2 \Rightarrow MR_1 = 20 - 2q_1$

$R_2 = 30q_2 - 0.5*q_2^2 \Rightarrow MR_2 = 30 - q_2$

Equilibrium:

$20 - 2q_1 = 30 - q_2 = q_1+q_2$

Solving, we obtain $q_1 = 2$, $q_2 = 14$, $p_1 = 18$ and $p_2 = 23$.

Monopoly profits are $\pi = 18*2 + 14*23 - C(2+14) = 230$.

Third Degree Price Discrimination: Example

(b) Without price discrimination: the aggregate demand is

$$D(p) = \begin{cases} 80 - 3p & \text{if } p \le 20 \\ 60 - 2p & \text{if } 20 < p \le 30 \\ 0 & \text{if } p > 30 \end{cases} \Rightarrow p(q) = \begin{cases} \dfrac{80-q}{3} & \text{if } 20 \le q \le 80 \\ 30 - \dfrac{q}{2} & \text{if } q < 20 \\ 0 & \text{if } q > 80 \end{cases}$$

Monopoly equilibrium: $MR(q) = MC(q)$

Solving, we obtain $q_M = 15$, $p_M = 22.5$.

Monopoly profits are: $\pi = 84.375$.