Market Power: Monopoly

- **monopoly** Market with only one seller.
- **market power** Ability of a seller or buyer to affect the price of a good.

What a monopolist can choose?

I. Price (uniform or discriminating) or output

II. Quality/durability

III. R&D

IV. Advertisement

Uniform pricing rule of a monopolist

The monopolist cannot set both p & q independently.

Max π = pq-c(q) Subject to q = q(p)

P

Max π = pq(p)-c[q(p)]

P

Alternatively:

Max π = pq-c(q) Subject to p = p(q)

q

Max π = p(q)q-c(q)

q

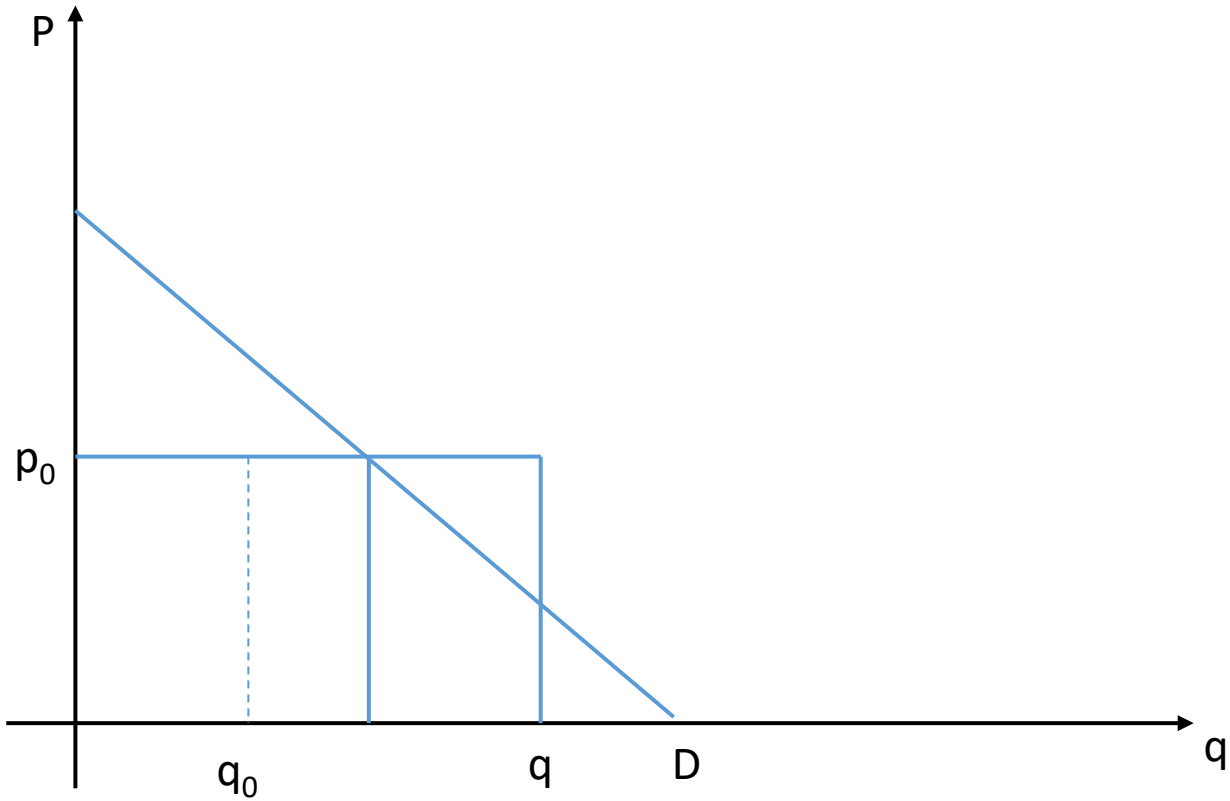
Let p*= argmax π = pq(p)-c[q(p)]

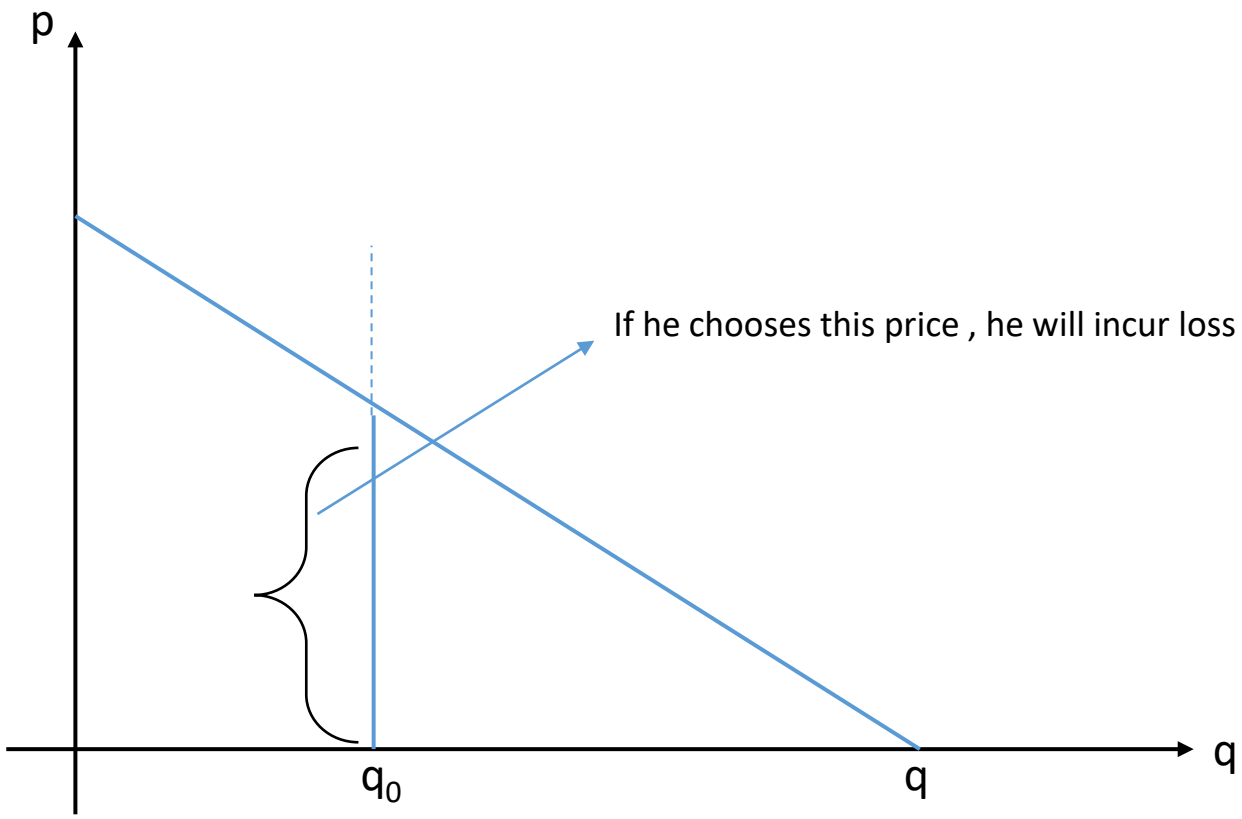
Similarly, q*= argmax π = p(q)q-c(q)

Solution:

q* = q(p*)

p* = p(q*)


P
p_0
q_0
q
D
q


p
If he chooses this price , he will incur loss
q_0
q
q

Let the monopolist chooses quantity.

$\max_{q} \pi = p(q)q - c(q)$

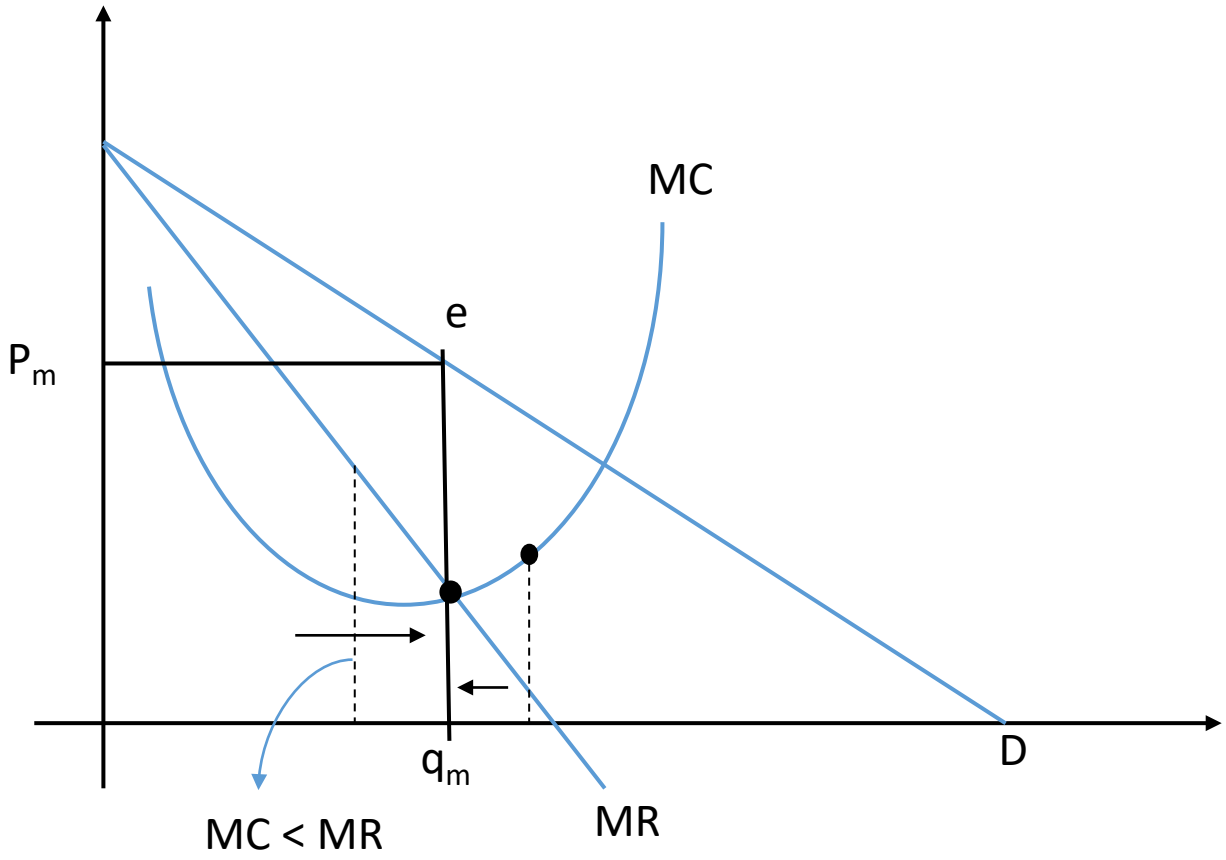
FOC: $R'(q) = C'(q)$

SOC: $R''(q) < C''(q)$

Difference between perfect competition and monopoly:

i. Equilibrium can occur even at the falling part of MC.

ii. $P_m = AR(q_m) > MR(q_m) = C'(q_m) \Rightarrow P_m > C'(q_m) \Rightarrow \pi_m > 0$


MC
e
P_m
q_m
D
MC < MR
MR

- Average Revenue and Marginal Revenue
  - **marginal revenue** Change in revenue resulting from a one-unit increase in output.

To see the relationship among total, average, and marginal revenue, consider a firm facing the following demand curve:

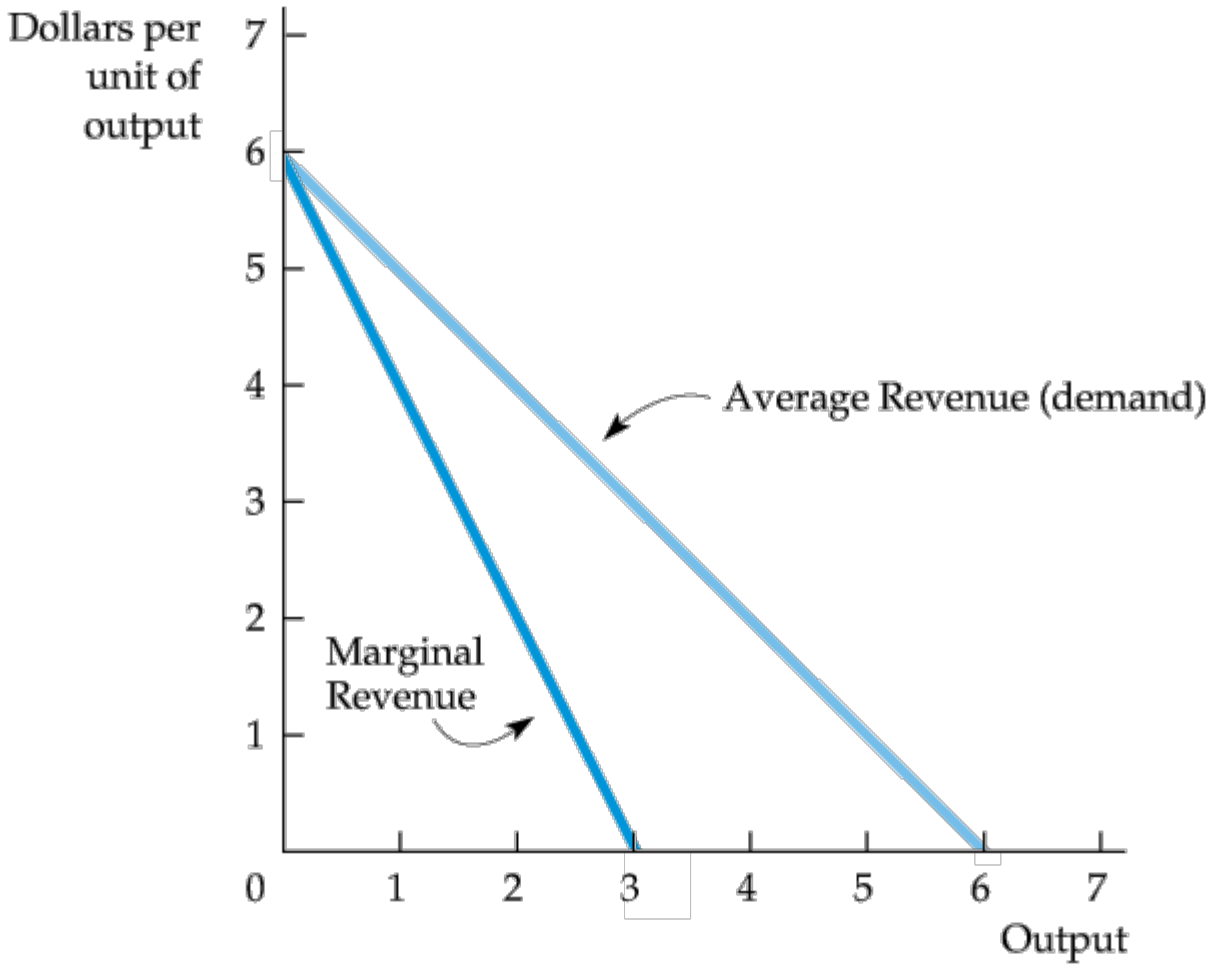
$$P = 6 - Q$$

TABLE 1 Total, Marginal, and Average Revenue

Price (P)	Quantity (Q)	Total Revenue (R)	Marginal Revenue (MR)	Average Revenue (AR)
$6	0	$0	---	---
5	1	5	$5	$5
4	2	8	3	4
3	3	9	1	3
2	4	8	-1	2
1	5	5	-3	1

Average and Marginal Revenue

Average and marginal revenue are shown for the demand curve $P = 6 - Q$.



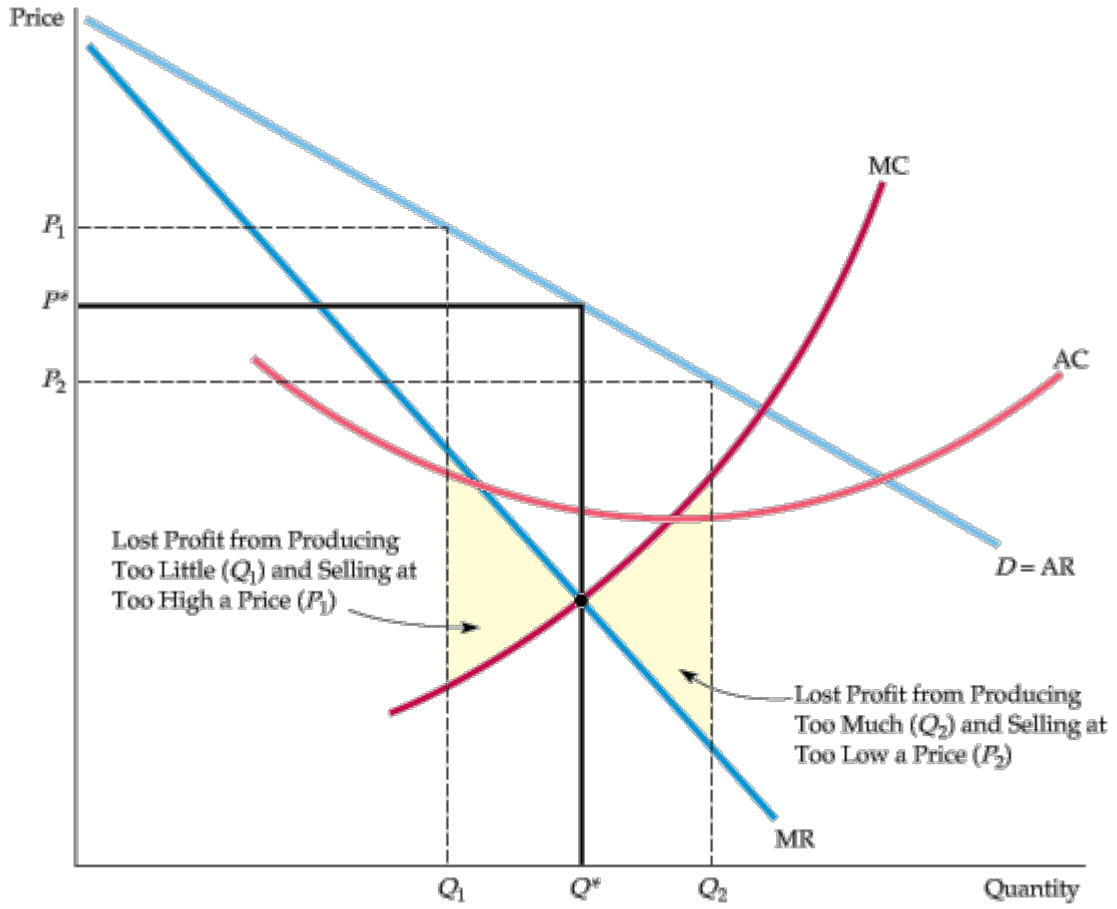
- The Monopolist's Output Decision

Profit Is Maximized When Marginal Revenue Equals Marginal Cost

Q^* is the output level at which MR = MC.

If the firm produces a smaller output—say, Q_1—it sacrifices some profit because the extra revenue that could be earned from producing and selling the units between Q_1 and Q^* exceeds the cost of producing them.

Similarly, expanding output from Q^* to Q_2 would reduce profit because the additional cost would exceed the additional revenue.



Profit Maximization

- An Example

Part **(a)** shows total revenue *R*, total cost *C*, and profit, the difference between the two.

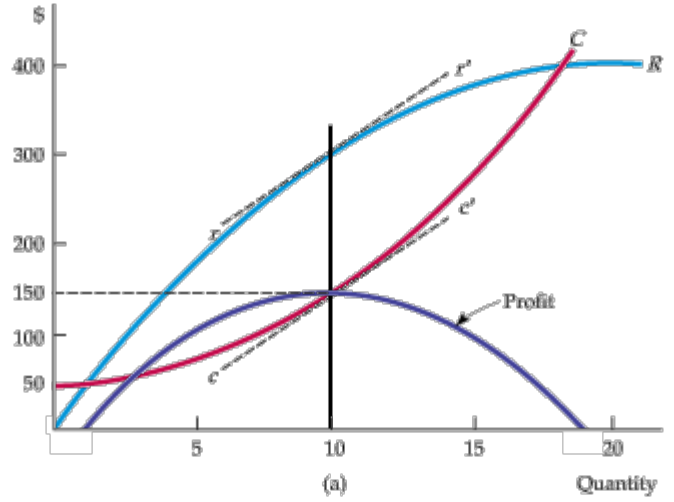
Part **(b)** shows average and marginal revenue and average and marginal cost.

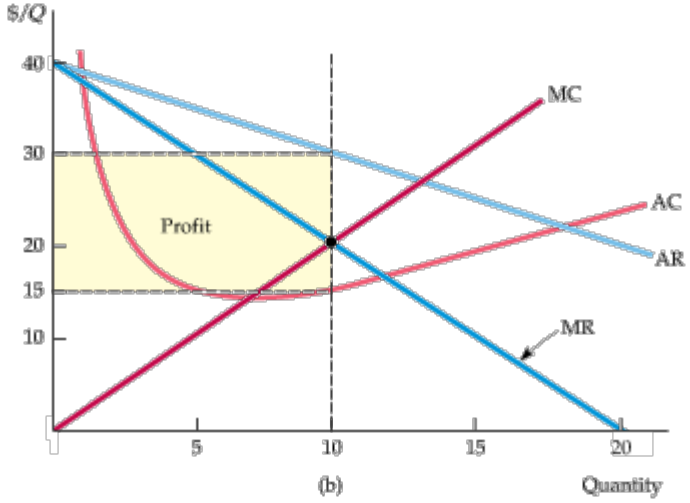
Marginal revenue is the slope of the total revenue curve, and marginal cost is the slope of the total cost curve.

The profit-maximizing output is $Q^* = 10$, the point where marginal revenue equals marginal cost.

At this output level, the slope of the profit curve is zero, and the slopes of the total revenue and total cost curves are equal.

The profit per unit is $15, the difference between average revenue and average cost. Because 10 units are produced, total profit is $150.





Monopoly power:

- **Lerner Index of Monopoly Power**
  Measure of monopoly power calculated as excess of price over marginal cost as a fraction of price.

Max π = p(q)q-c(q)
q

FOC:

$$p + q\frac{\partial p}{\partial q} - c'(q) = 0 \Rightarrow p\left[1 + \frac{q}{p}\frac{\partial p}{\partial q}\right] = c'(q) \Rightarrow p\left(1 - \frac{1}{e_p}\right) = c'(q) \Rightarrow \frac{p - c'}{p} = \frac{1}{e_p}$$

For the competitive firm, price equals marginal cost;

For a monopoly, price exceeds marginal cost.

Relative price margin/relative mark up

$$L = (P - \mathrm{MC})/P$$

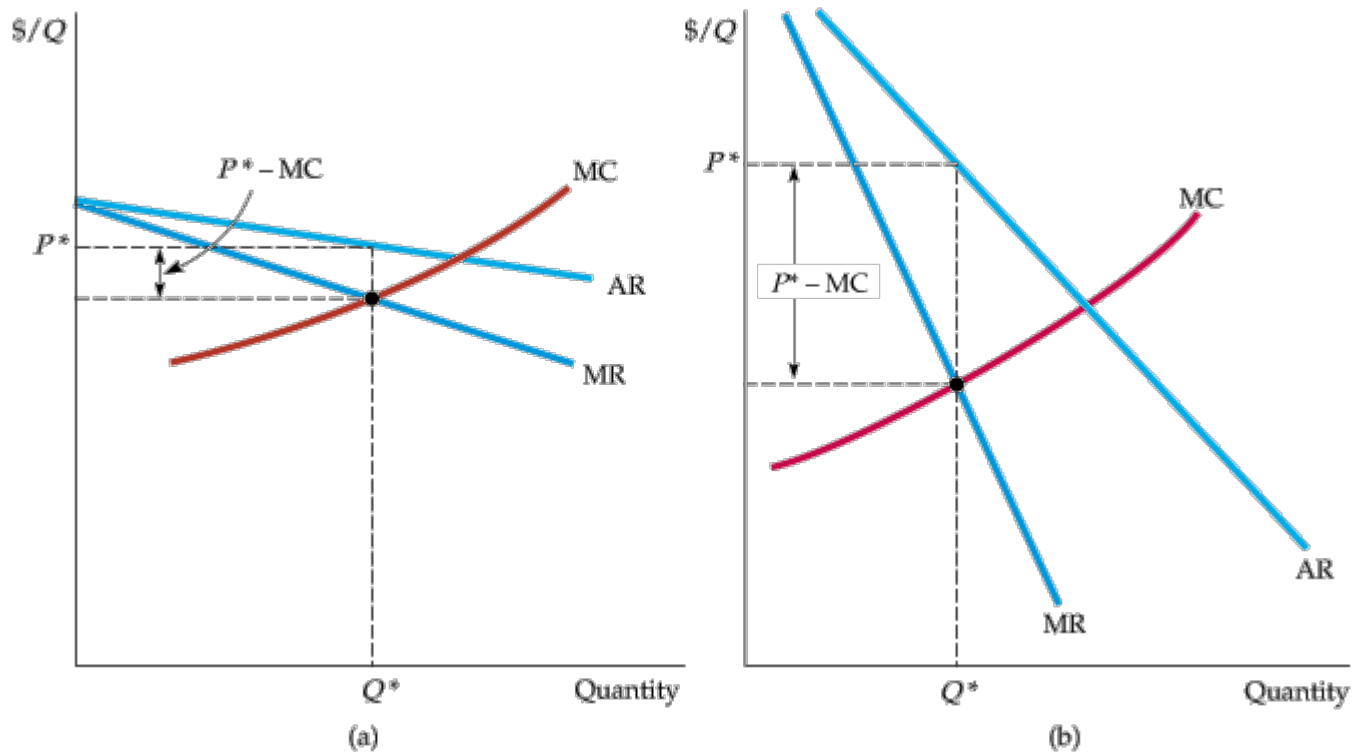
Implication:

i. As long as $e_p < \infty \Rightarrow p > c'(q_m) \Rightarrow$ profit >0 (supernormal profit);

ii. Lerner Index of monopoly power varies inversely with e_p;

iii. As long as MC > 0, at monopolist's equilibrium demand is price elastic.

Elasticity of Demand and Price Markup



The markup $(P - \text{MC})/P$ is equal to minus the inverse of the elasticity of demand facing the firm.

If the firm's demand is elastic, as in **(a)**, the markup is small and the firm has little monopoly power.

The opposite is true if demand is relatively inelastic, as in **(b)**.

- If monopolist chooses price

Max π = pq(p)-c[q(p)]
P

$$\frac{\partial \pi}{\partial p} = 0$$

$$q(p) + pq'(p) - c'(q)q'(p) = 0 \Rightarrow p\left[1 + \frac{1}{p}\frac{q(p)}{q'(p)}\right] = c'(q) \Rightarrow p\left(1 - \frac{1}{e_p}\right) = c'(q) \Rightarrow \frac{p - c'}{p} = \frac{1}{e_p}$$

Supply curve of a MONOPOLY…Does it exist?

Answer is No

Shifts in Demand

Shifting the demand curve shows that a monopolistic market has no supply curve—i.e., ***there is no one-to-one relationship between price and quantity produced.***

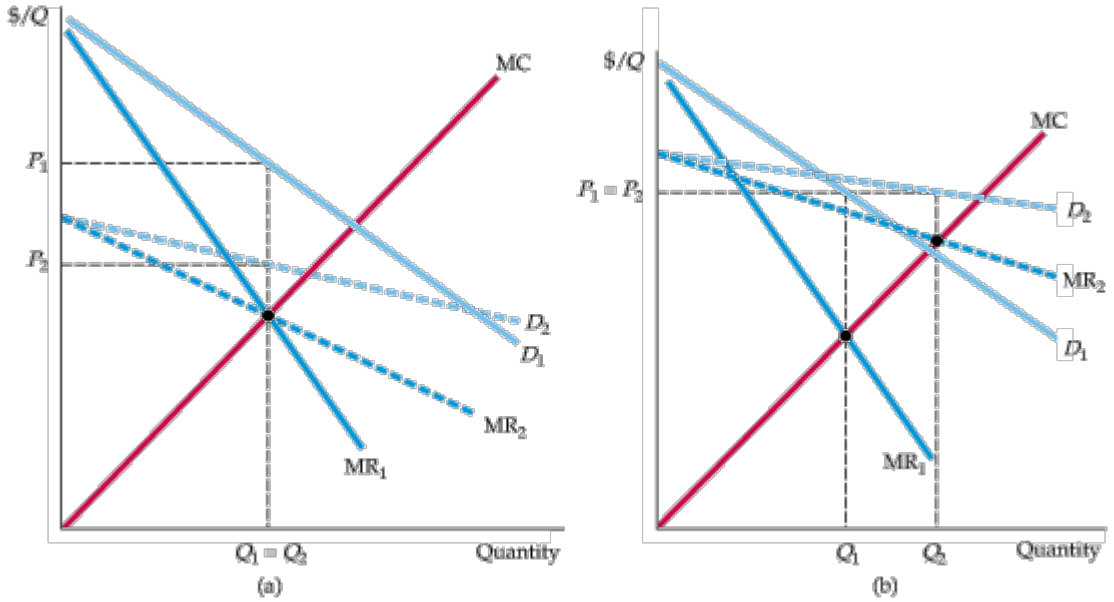
In **(a)**, the demand curve D_1 shifts to new demand curve D_2.

But the new marginal revenue curve MR_2 intersects marginal cost at the same point as the old marginal revenue curve MR_1.

The profit-maximizing output therefore remains the same, although price falls from P_1 to P_2.

In **(b)**, the new marginal revenue curve MR_2 intersects marginal cost at a higher output level Q_2.

But because demand is now more elastic, price remains the same.



- **Effect of Tax**

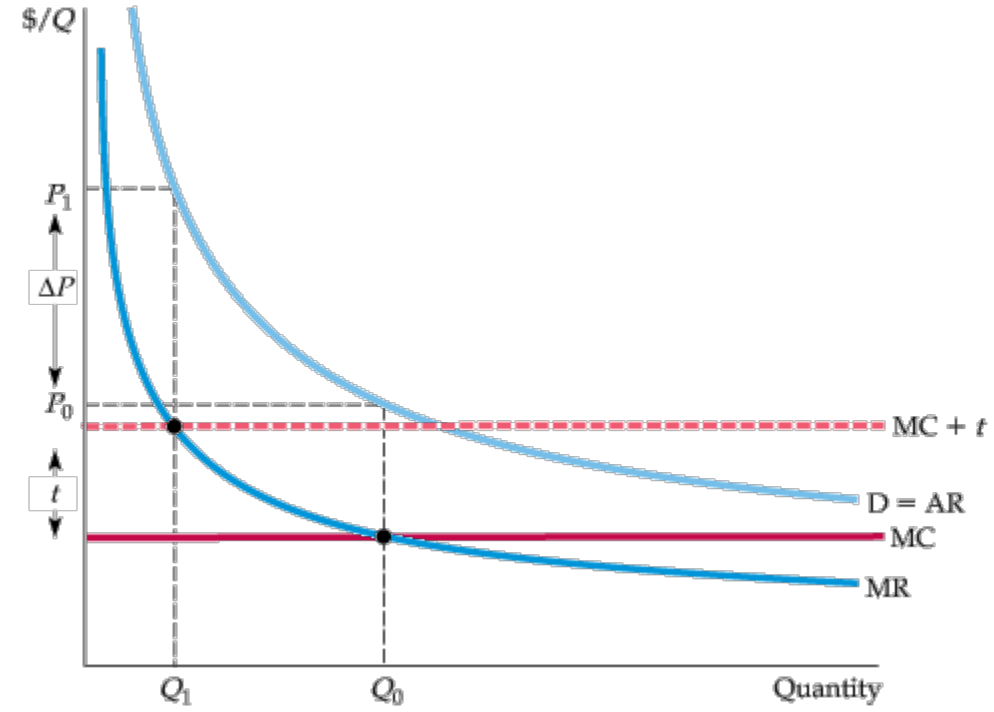
Suppose a specific tax of *t* dollars per unit is levied, so that the monopolist must remit *t* dollars to the government for every unit it sells. If MC was the firm's original marginal cost, its optimal production decision is now given by

$$MR = MC + t$$

Effect of Excise Tax on Monopolist

With a tax *t* per unit, the firm's effective marginal cost is increased by the amount *t* to MC + *t*.

In this example, the increase in price ΔP is larger than the tax *t*.



- **The Multiplant Firm**

Suppose a firm has two plants. What should its total output be, and how much of that output should each plant produce? We can find the answer intuitively in two steps.

- ***Step 1.*** Whatever the total output, it should be divided between the two plants so that *marginal cost is the same in each plant.* Otherwise, the firm could reduce its costs and increase its profit by reallocating production.

- ***Step 2.*** We know that total output must be such that *marginal revenue equals marginal cost.* Otherwise, the firm could increase its profit by raising or lowering total output.

- The Multiplant Firm

We can also derive this result algebraically. Let Q_1 and C_1 be the output and cost of production for Plant 1, Q_2 and C_2 be the output and cost of production for Plant 2, and $Q_T = Q_1 + Q_2$ be total output. Then profit is

$$\pi = PQ_T - C_1(Q_1) - C_2(Q_2)$$

The firm should increase output from each plant until the incremental profit from the last unit produced is zero. Start by setting incremental profit from output at Plant 1 to zero:

$$\frac{\Delta\pi}{\Delta Q_1} = \frac{\Delta(PQ_T)}{\Delta Q_1} - \frac{\Delta C_1}{\Delta Q_1} = 0$$

Here $\Delta(PQ_T)/\Delta Q_1$ is the revenue from producing and selling one more unit—i.e., *marginal revenue*, MR, for all of the firm's output.

- The Multiplant Firm

The next term, $\Delta C_1/\Delta Q_1$, is *marginal cost* at Plant 1, MC_1. We thus have $MR - MC_1 = 0$, or

$$MR = MC_1$$

Similarly, we can set incremental profit from output at Plant 2 to zero,

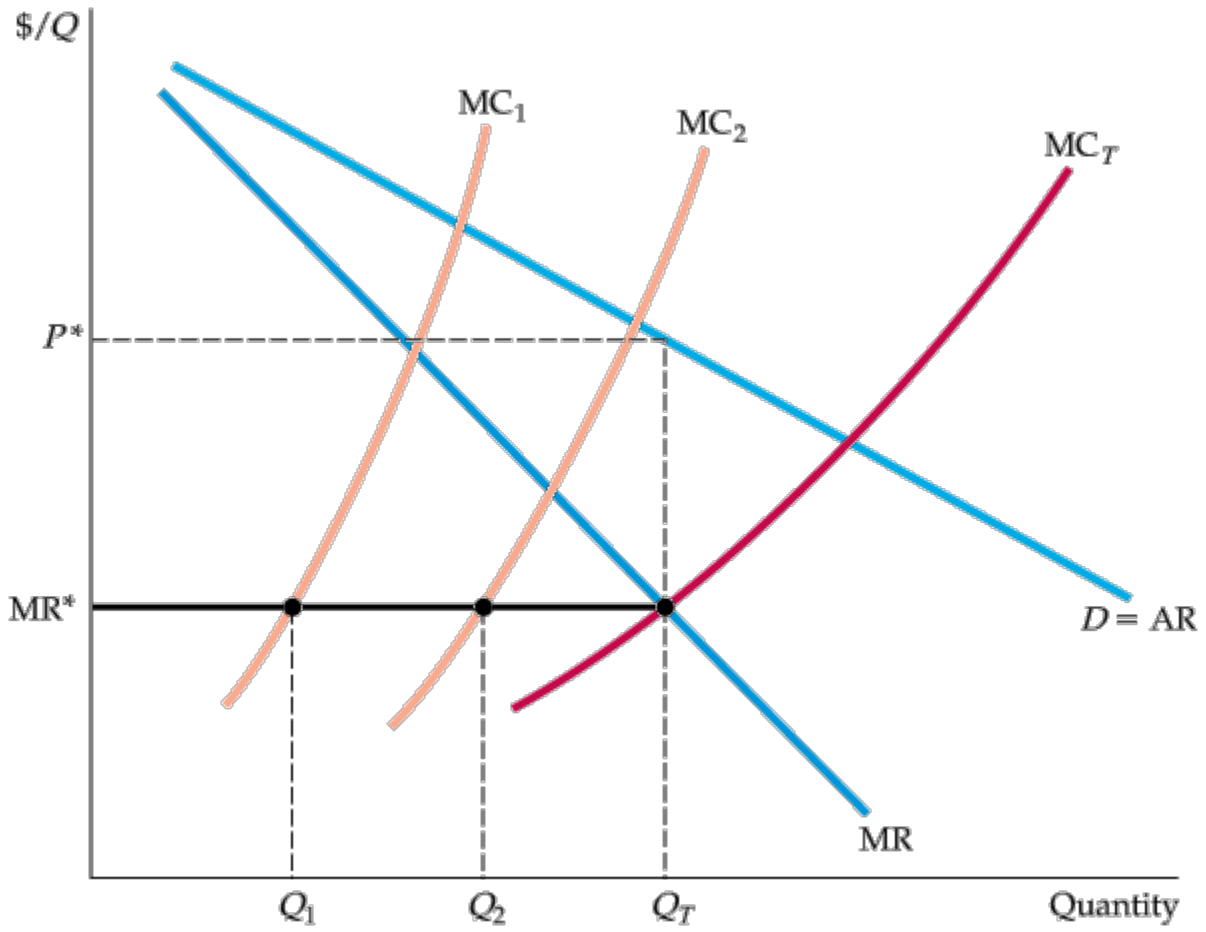
$$MR = MC_2$$

Putting these relations together, we see that the firm should produce so that

$$MR = MC_1 = MC_2 \qquad \textbf{(3)}$$

Production with Two Plants

A firm with two plants maximizes profits by choosing output levels Q_1 and Q_2 so that marginal revenue MR (which depends on *total* output) equals marginal costs for each plant, MC_1 and MC_2.



THE SOCIAL COSTS OF MONOPOLY POWER

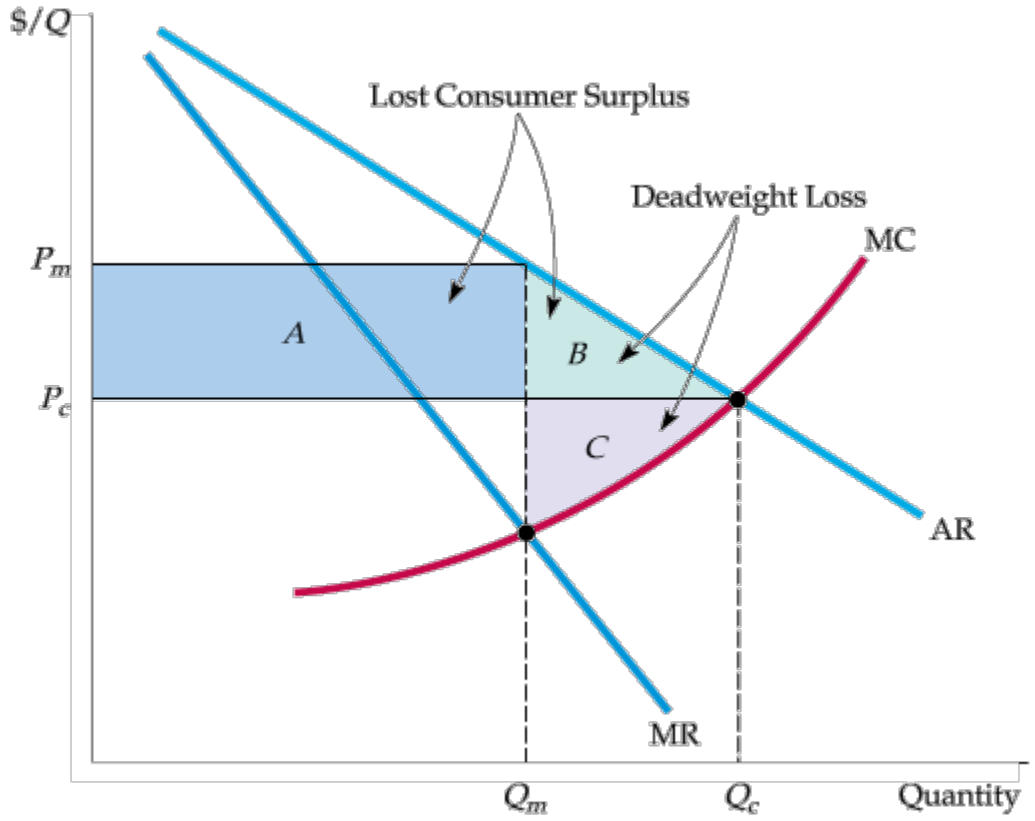
Deadweight Loss from Monopoly Power

The shaded rectangle and triangles show changes in consumer and producer surplus when moving from competitive price and quantity, P_c and Q_c,

to a monopolist's price and quantity, P_m and Q_m.

Because of the higher price, consumers lose $A + B$

and producer gains $A - C$. The deadweight loss is $B + C$.

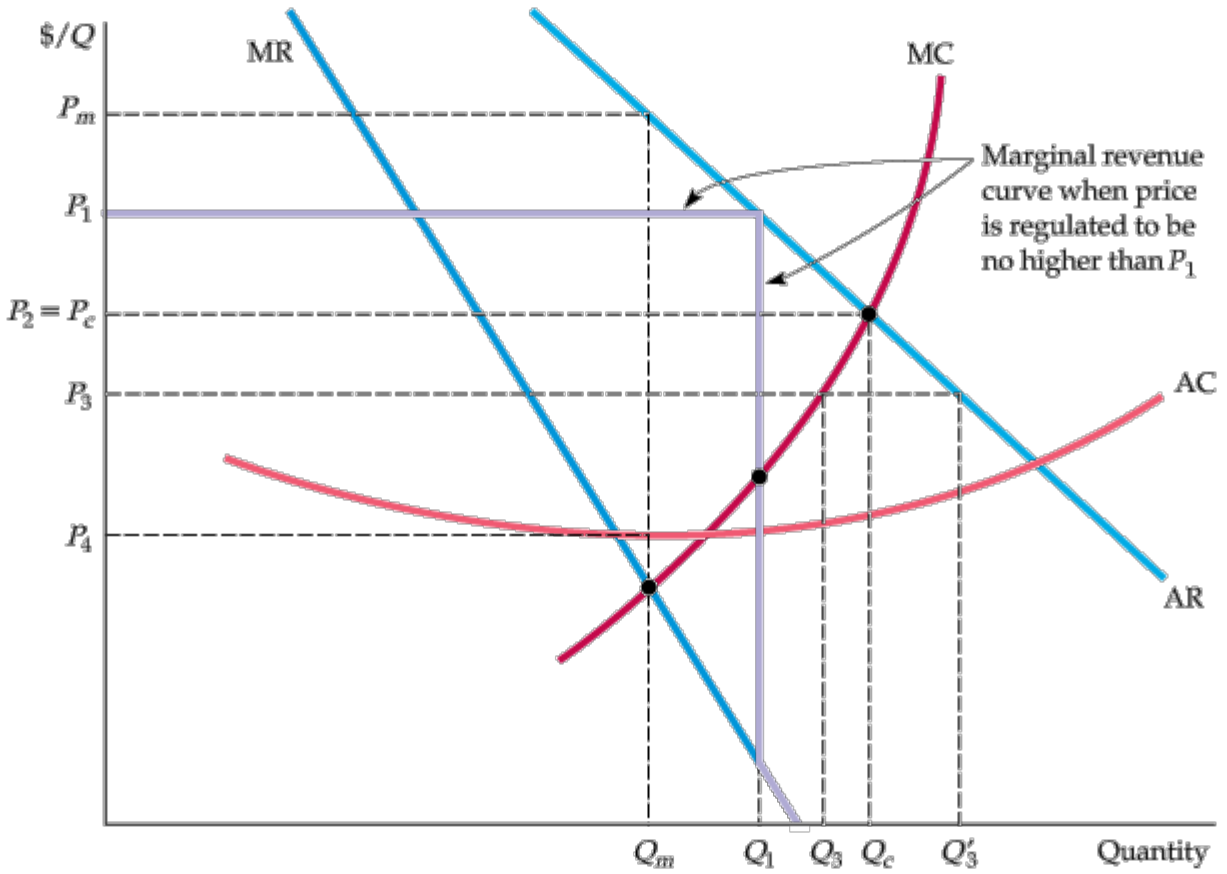


- Price Regulation in Monopoly

Price Regulation

When price is lowered to P_c, at the point where marginal cost intersects average revenue, output increases to its maximum Q_c. This is the output that would be produced by a competitive industry.

Lowering price further, to P_3 reduces output to Q_3 and causes a shortage, $Q'_3 - Q_3$.



- Natural Monopoly

Firm that can produce the entire output of the market at a cost lower than what it would be if there were several firms.

Regulating the Price of a Natural Monopoly

A firm is a natural monopoly because it has economies of scale (declining average and marginal costs) over its entire output range.

If price were regulated to be P_c the firm would lose money and go out of business.

Setting the price at P_r yields the largest possible output consistent with the firm's remaining in business; excess profit is zero.