

Topic 8 Part 1

Monopoly (Chapter 11)

Monopoly

Definition: A **Monopoly Market** consists of a single seller facing many buyers.

The monopolist's profit maximization problem:

$$\text{Max } \pi(Q) = \text{TR}(Q) - \text{TC}(Q)$$

where: $\text{TR}(Q) = QP(Q)$ and
 $P(Q)$ is the (*inverse*) market demand curve.

The monopolist's profit maximization condition:

$$\Delta\text{TR}(Q)/\Delta Q = \Delta\text{TC}(Q)/\Delta Q \quad \text{OR} \quad \text{MR}(Q) = \text{MC}(Q)$$

Monopoly vs Perfect Competition

In perfect competition, there are infinitely many buyers and sellers, selling homogeneous products.

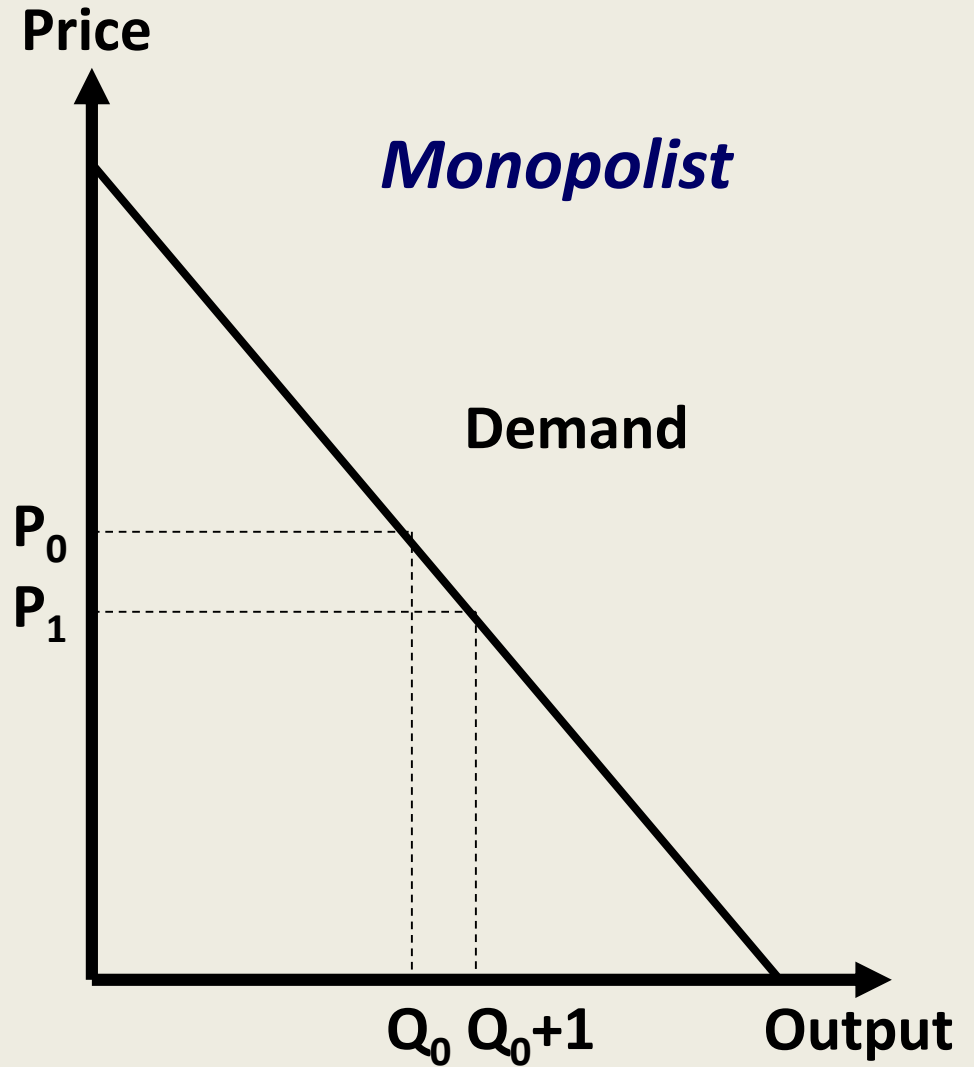
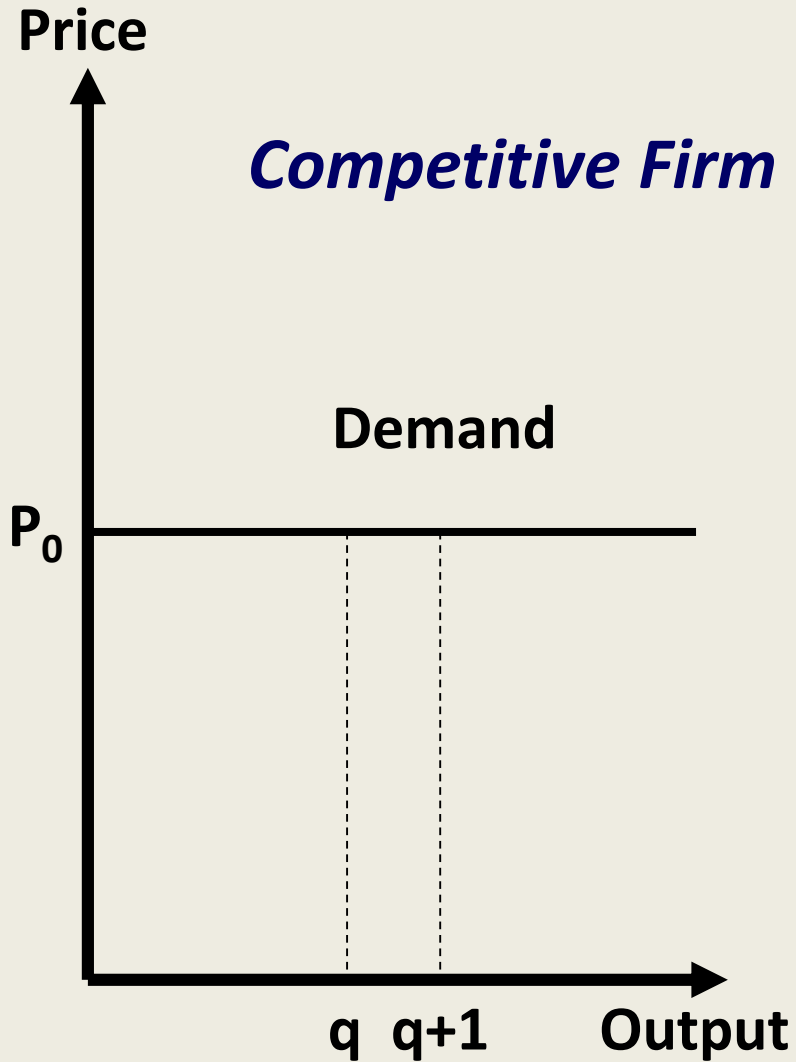
As a result, **perfectly competitive firms are price takers**: they take price as given, and face a perfectly elastic demand curve.

In contrast, **a monopolist is a price maker**. It sets the market price to maximize its profit.

However, we often state the monopolist's profit maximization problem in terms of setting quantity rather than price.

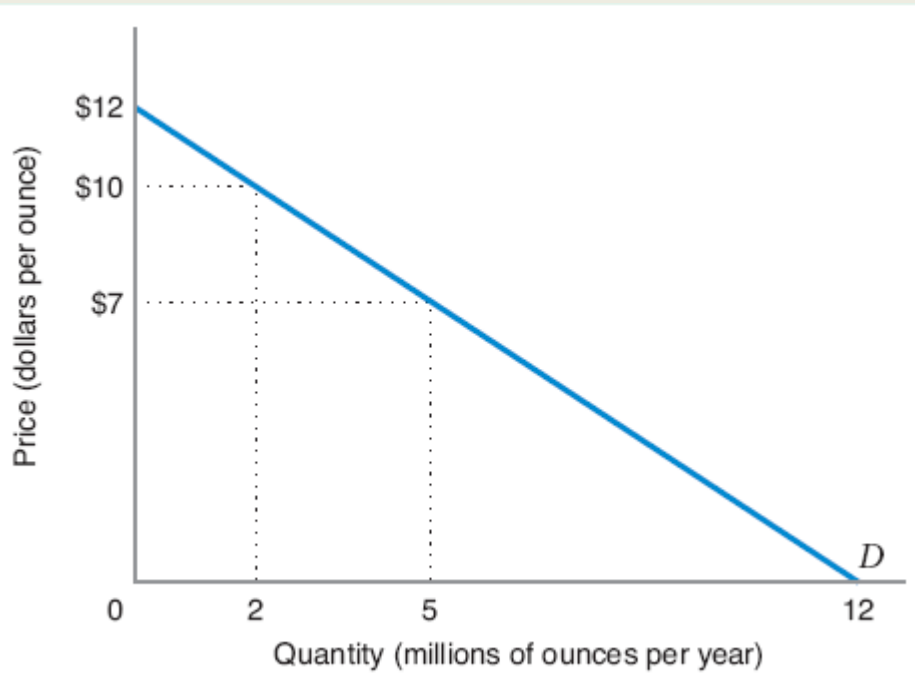
This is because $TR(Q)$ and $TC(Q)$ are functions of Quantity.

Demand Curve



A Monopoly – Profit Maximizing

The Monopolist's Demand Curve is downward-sloping: the higher P, the lower Q, and vice versa.



- Along the demand curve, different revenues for different quantities
- Profit maximization problem is **the optimal trade-off between volume** (number of units sold) **and margin** (the differential between price).

A Monopoly – Profit Maximizing

- Demand Curve: $P(Q) = 12 - Q$
- Total Revenue: $TR(Q) = Q \times P(Q) = 12Q - Q^2$
- Total Cost: $TC(Q) = \frac{1}{2}Q^2$
- Profit-Maximization: $MR(Q) = MC(Q)$

A Monopoly – Profit Maximizing

Given the inverse demand and MC, what is the profit maximizing Q and P for the monopolist?

$$P = 12 - Q$$

$$MC = Q$$

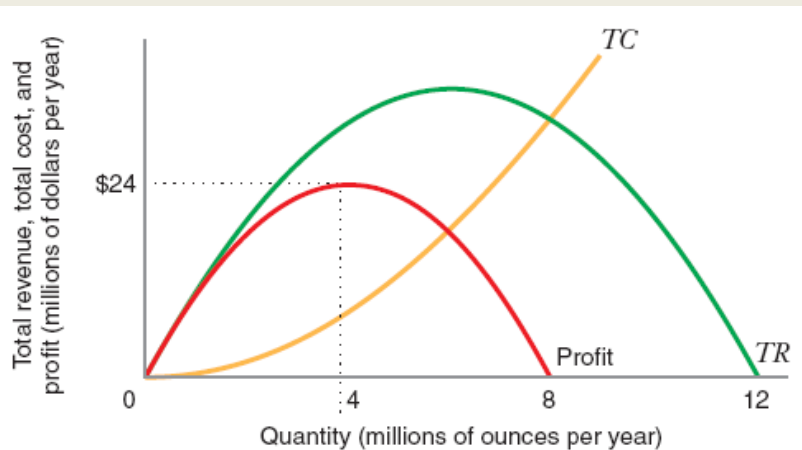
$$MR = 12 - 2Q$$

Setting $MC = MR$; $12 - 2Q = Q$

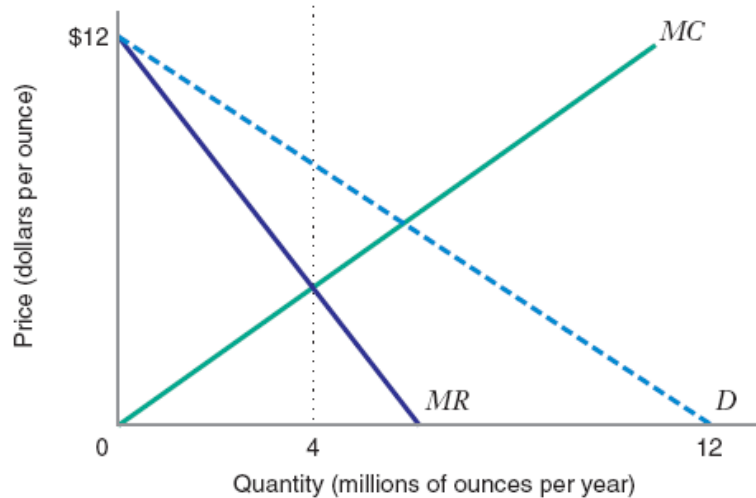
$$Q^* = 4$$

$$P^* = 12 - 4 = 8$$

A Monopoly – Profit Maximizing



(a)



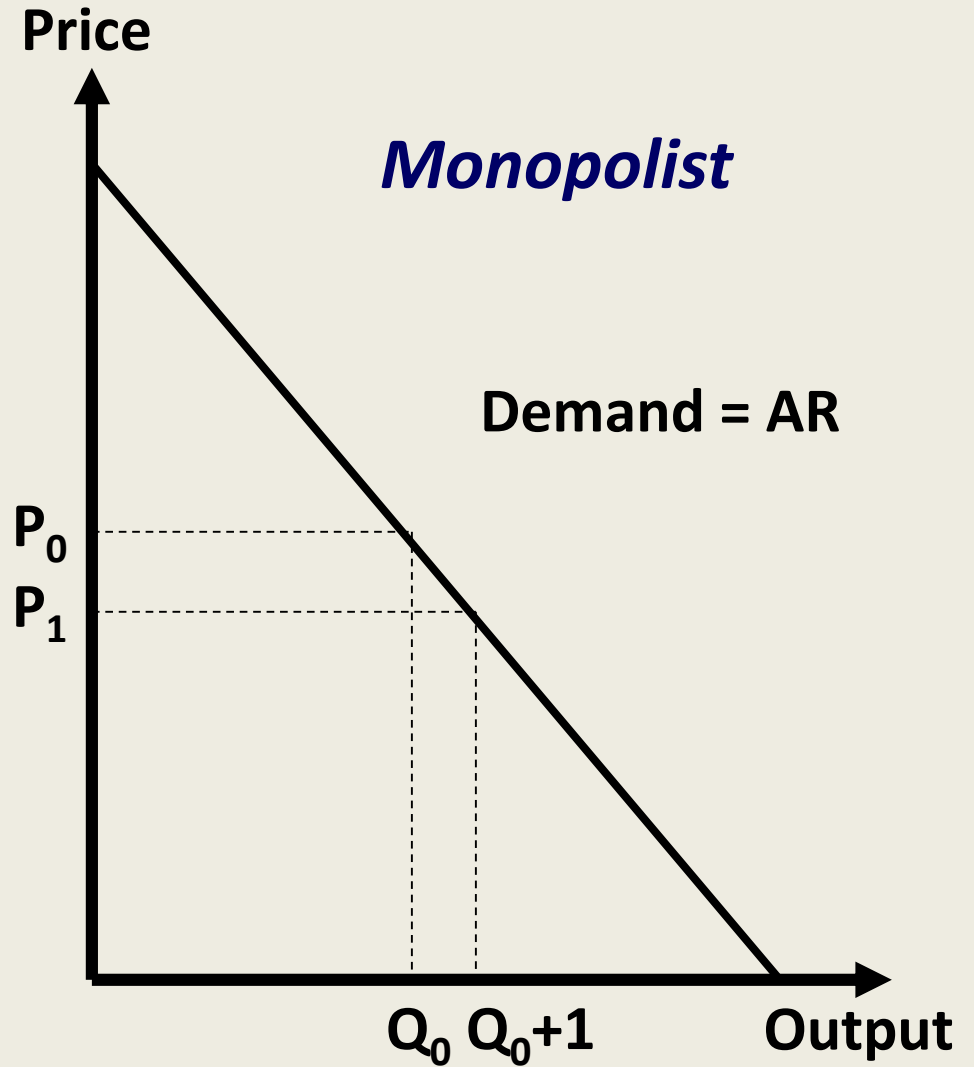
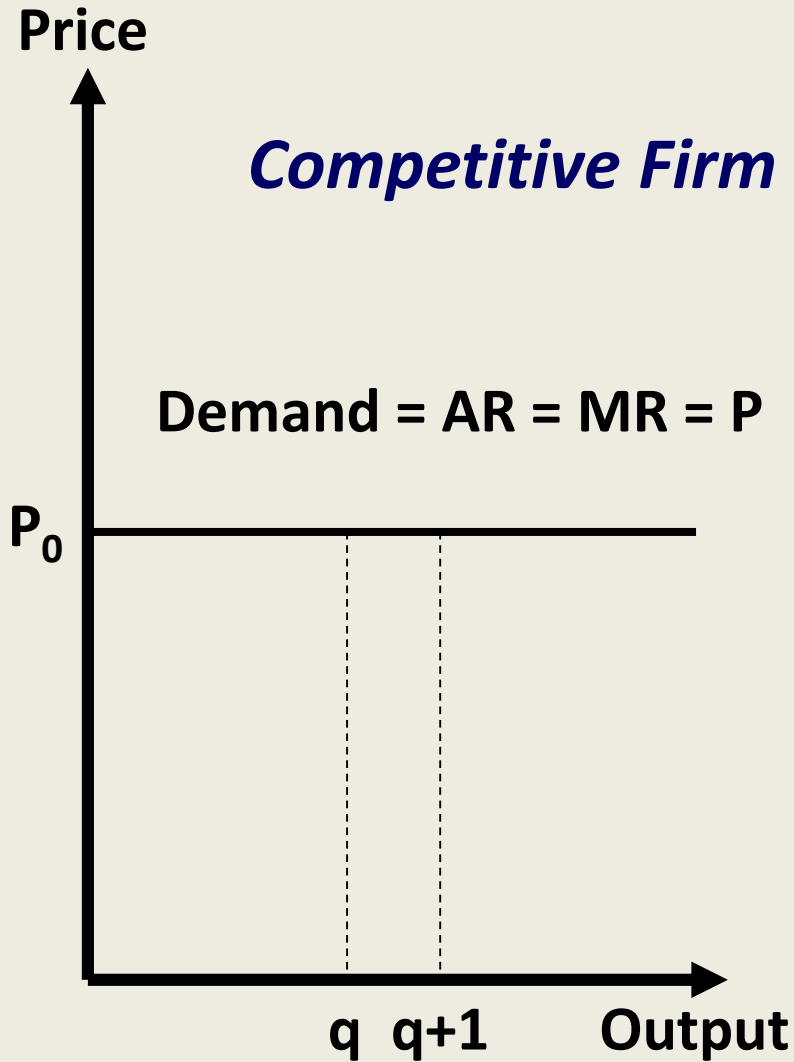
(b)

- As Q increases TC increases, TR increases first and then decreases.
- Profit Maximization is at $MR = MC$.

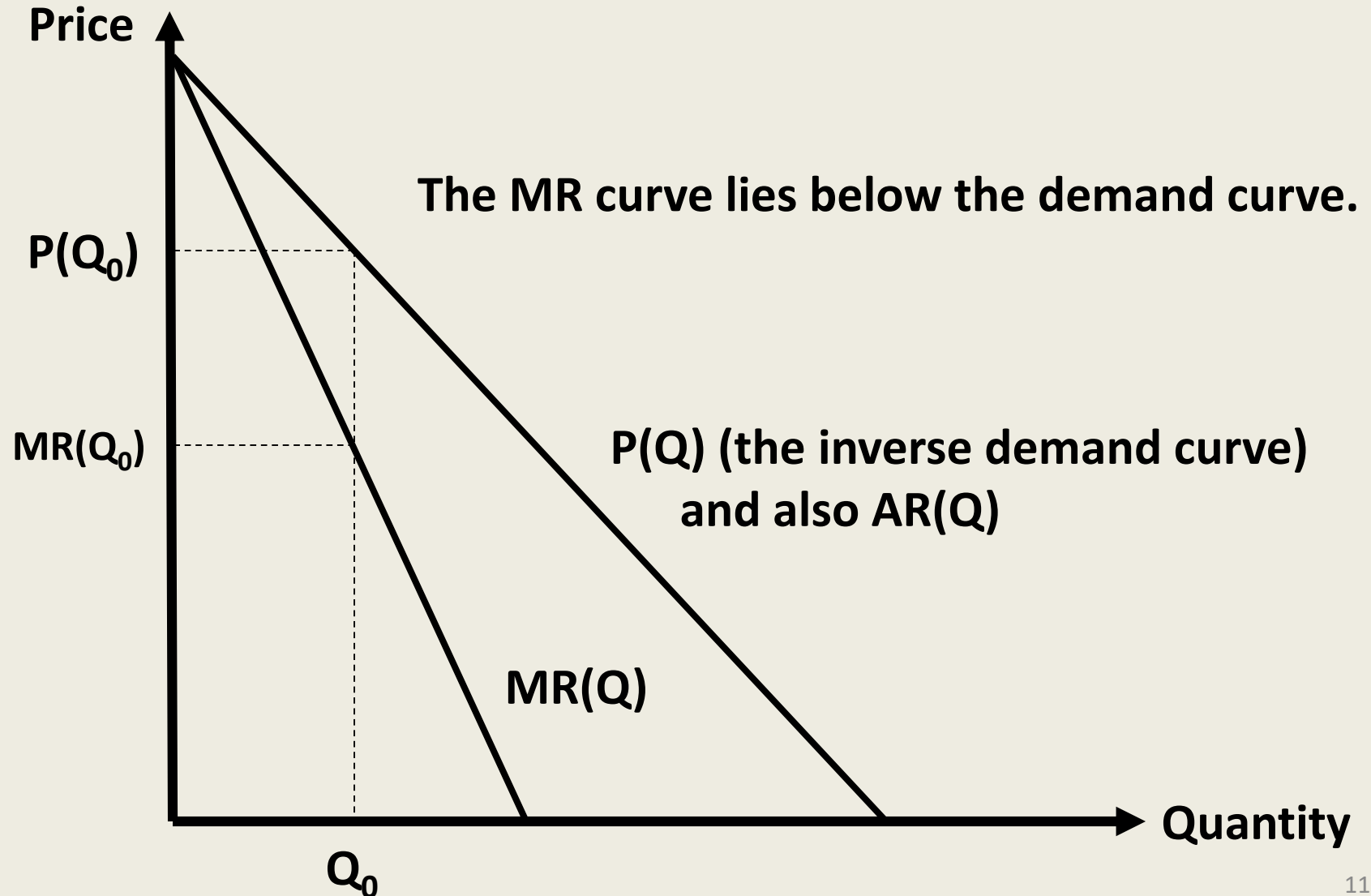
A Monopoly – Profit Maximizing

- $MR > MC$, firms can increase Q and increase profit. **Firms should sell as long as $MR > MC$.**
- $MR < MC$, firms can decrease quantity and increase profit.
- $MR = MC$, firms cannot increase profit.

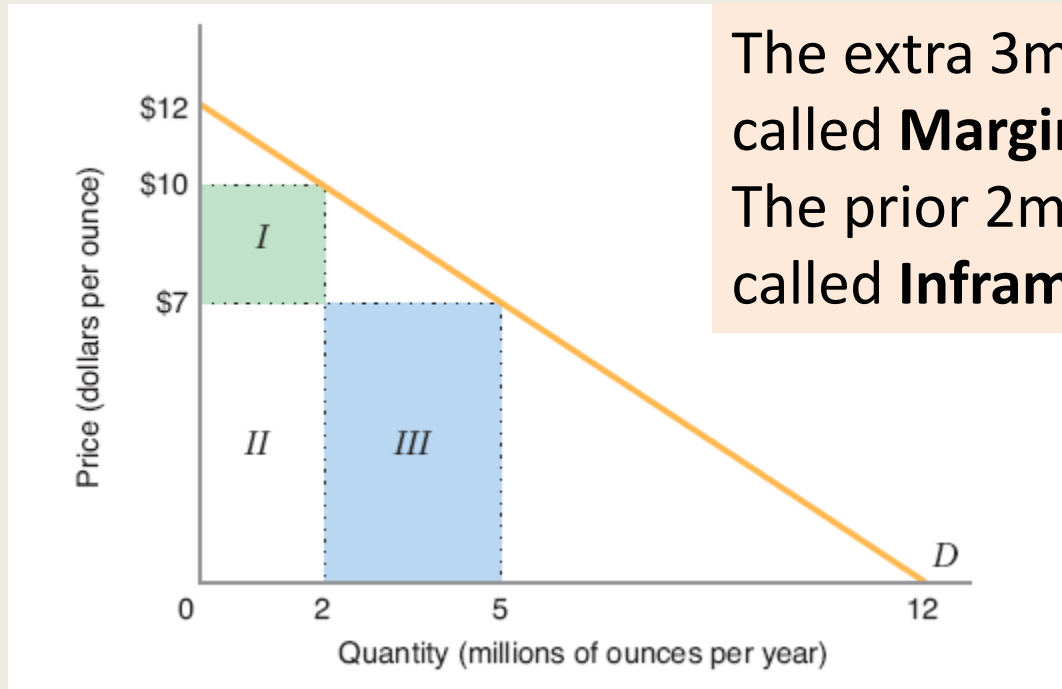
MR and AR



Marginal Revenue Curve and Demand



Marginal Revenue Curve and Demand



The extra 3m ounces is called **Marginal Units**.
The prior 2m ounces is called **Inframarginal Units**.

- To sell more units, a monopolist has to lower the price.
- At the lower P, **the increase in TR** is Area III.
- **The TR sacrificed** is Area I.
- $\Delta TR = \text{Area III} - \text{Area I}$

Marginal Revenue

- Area III = price x change in quantity = $P(\Delta Q)$
- Area I = - quantity x change in price = $-Q(\Delta P)$
- Change in TR = $\Delta TR = P(\Delta Q) + Q(\Delta P)$

$$MR = \frac{\Delta TR}{\Delta Q} = \frac{P\Delta Q + Q\Delta P}{\Delta Q} = P + Q \frac{\Delta P}{\Delta Q}$$

- $\Delta P/\Delta Q$ = slope of the inverse demand curve.

Marginal Revenue

Marginal revenue has two parts:

- **P**: increase in TR due to higher Q, i.e. the marginal units.
- **$Q(\Delta P/\Delta Q)$** : decrease in TR due to lower P of the inframarginal units.

Since **$Q(\Delta P/\Delta Q) < 0$** , **MR is less than the price** any $Q > 0$, i.e. $MR(Q)$ lies below $P(Q)$.

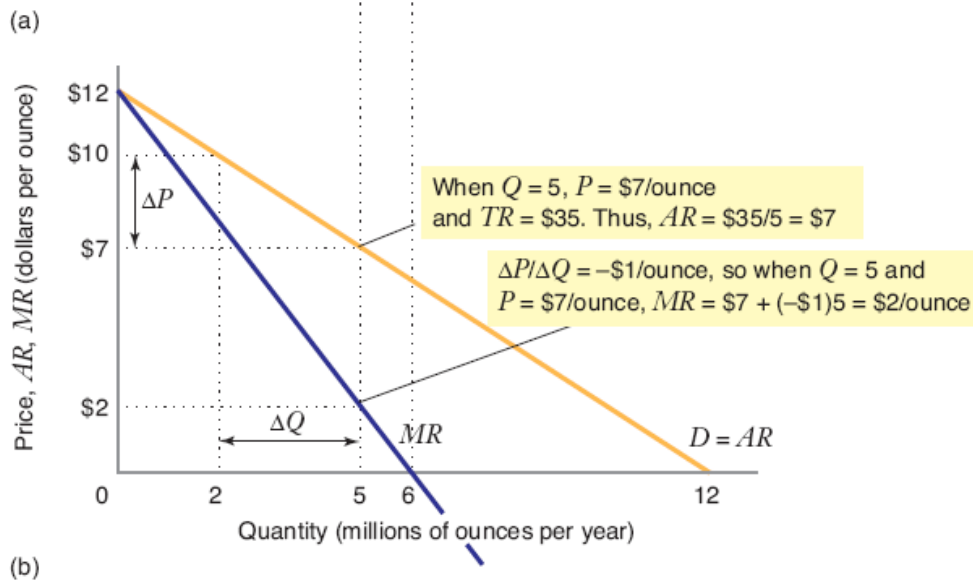
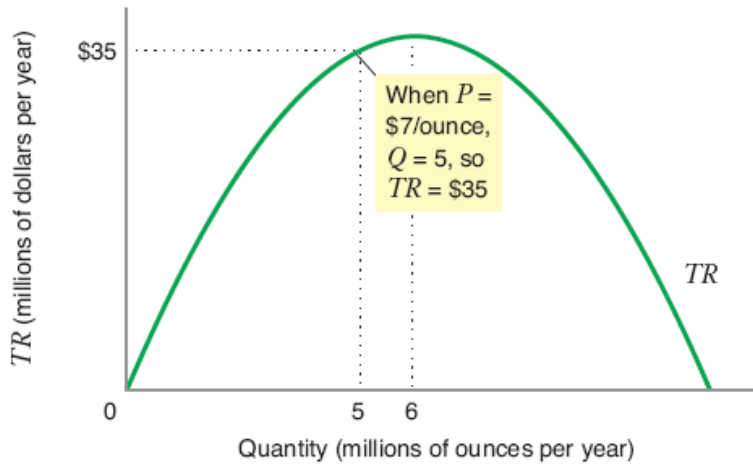
Average Revenue

Since $AR = \frac{TR}{Q} = \frac{P \times Q}{Q} = P$

the monopolist's AR curve coincides with the market inverse demand curve:

$$AR(Q) = P(Q)$$

MR and AR



- The demand curve and the AR curve coincide.
- (For $Q > 0$)
Since $MR < P$, we have $MR < AR$, i.e. MR lies below the demand curve and AR curve.

MR and AR

When P decreases by \$3 per ounce (from \$10 to \$7),
 Q increases by 3 million ounces (from 2 million to 5 million).

$$\frac{\Delta P}{\Delta Q} = -1$$

$$TR = P \times Q = 7 \times 5 = \$35 \text{ million per year}$$

$$AR = \frac{TR}{Q} = \frac{35}{5} = \$7 \text{ per ounce}$$

$$MR = P + Q \frac{\Delta P}{\Delta Q} = 7 + 5(-1) = \$2 \text{ per ounce}$$

MR and AR



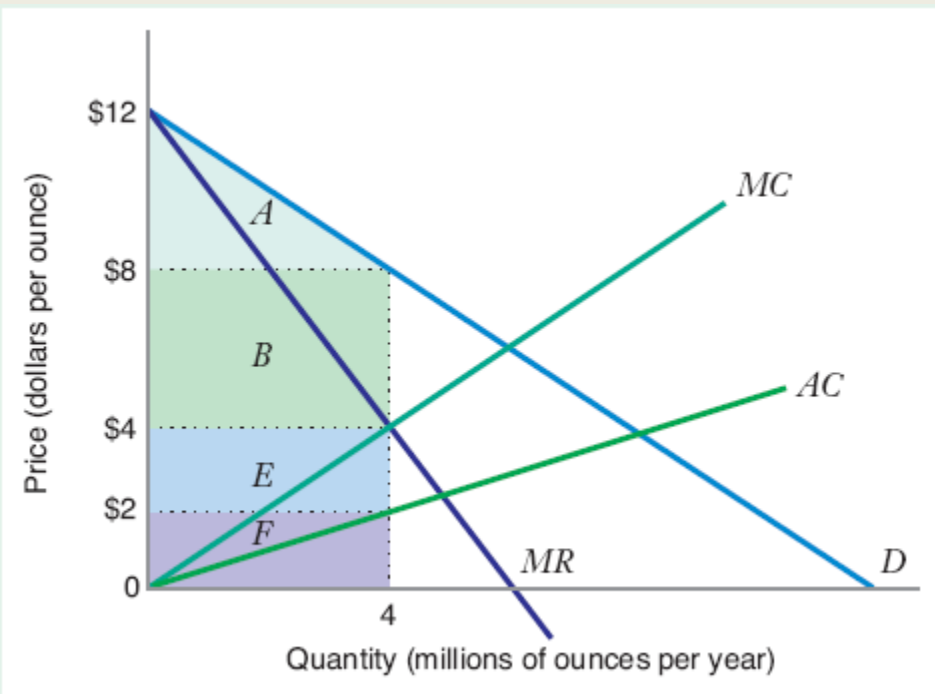
LEARNING-BY-DOING EXERCISE 11.1

Marginal and Average Revenue for a Linear Demand Curve

Suppose that the equation of the market demand curve is $P = a - bQ$.

Problem What are the expressions for the average and marginal revenues curves?

Profit Maximization



- Profit-Maximizing output is at $MR = MC$.
- Monopolist will make 4 million ounces and sells at \$8 per ounce.
- $TR = \text{Areas } B + E + F$.
- Profit ($TR - TC$) is $B + E$.
- Consumer surplus is Area A.

Shutdown Condition

In the short run, the monopolist shuts down if the most profitable price does not cover AVC: $P < AVC$.

In the long run, the monopolist shuts down if the most profitable price does not cover AC: $P < AC$.

Here, P^* exceeds both AVC and AC.

Positive Profits for Monopolist

This profit is positive. Why?

Because the monopolist takes into account the price-reducing effect of increased output so that the monopolist has less incentive to increase output too much.

Profit can remain positive in the long run. Why?

Because we are assuming that there is no possible entry in this industry, so profits are not competed away.

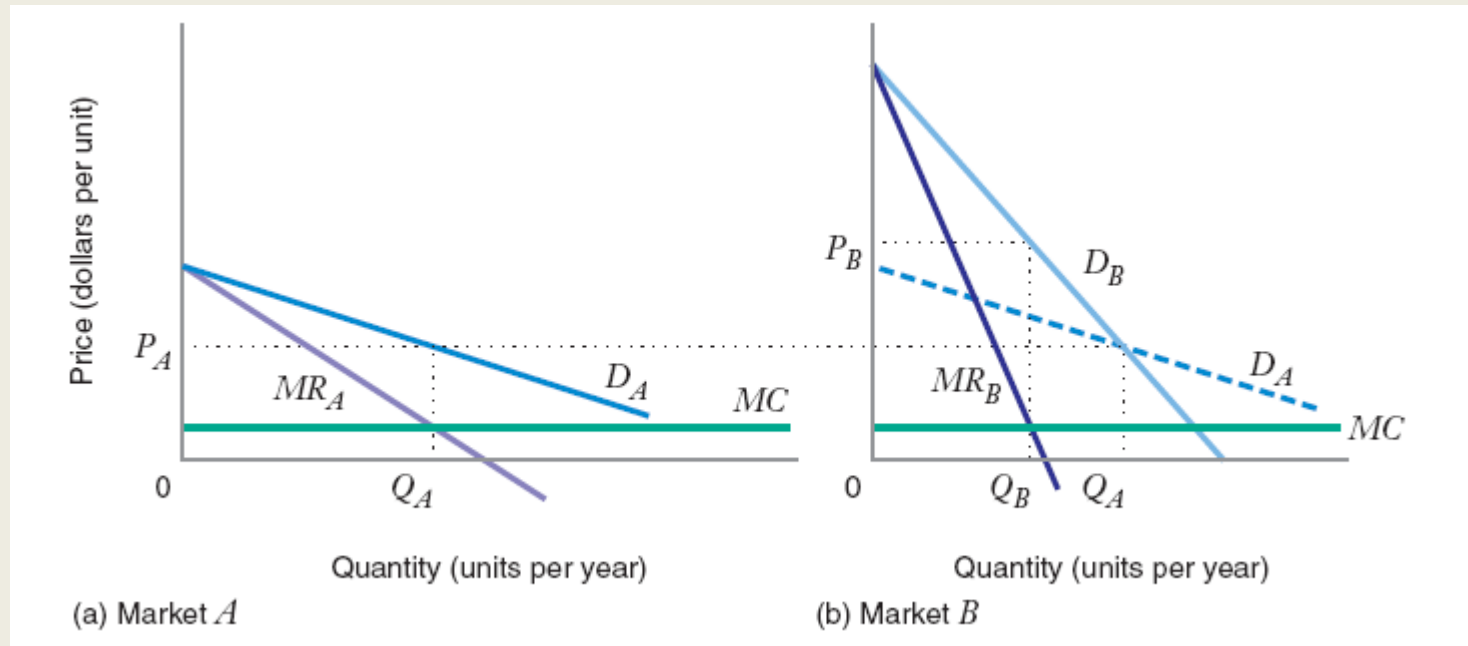
Monopolist's Supply Curve

A monopolist does not have a supply curve (i.e. an optimal output for any exogenously-given price) because price is endogenously-determined by demand: the monopolist picks a preferred point on the demand curve.

One could also think of the monopolist choosing output to maximize profits subject to the constraint that price be determined by the demand curve.

Inverse Elasticity Pricing Rule

- Market A: profit-maximizing price is P_A .
- Market B: profit-maximizing price is P_B .
- Demand is less elastic in Market B.



Inverse Elasticity Pricing Rule

We can rewrite the MR curve as follows:

$$MR = P + Q(\Delta P/\Delta Q) = P(1 + (Q/P)(\Delta P/\Delta Q))$$

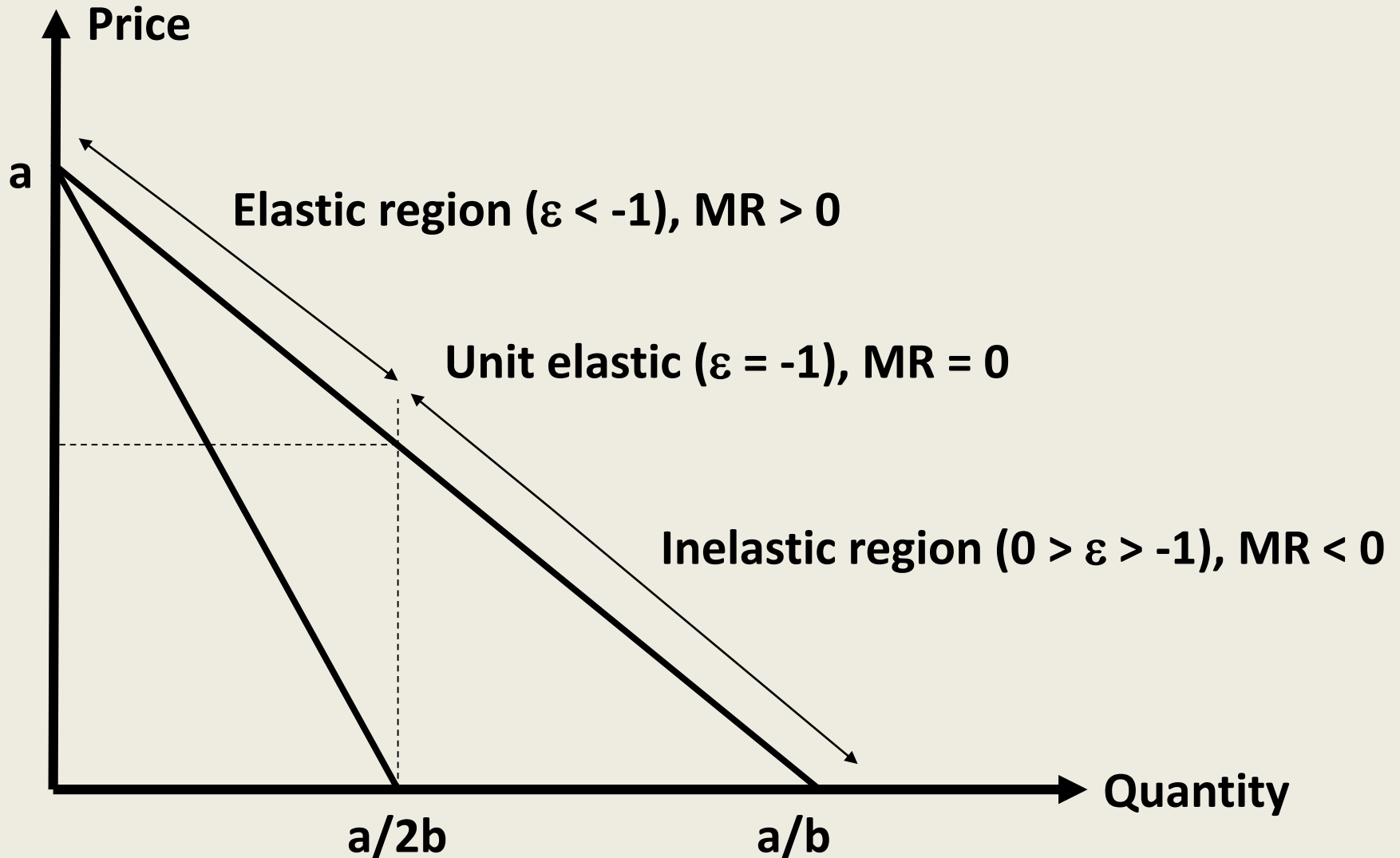
$$MR = P(1 + 1/\varepsilon)$$

where: ε is the price elasticity of demand,
 $(P/Q)(\Delta Q/\Delta P)$

Inverse Elasticity Pricing Rule

Region of Demand Curve	Relationship between	
	Marginal Revenue and $\epsilon_{Q,P}$	Total Revenue and Price
Elastic ($-\infty < \epsilon_{Q,P} < -1$)	$MR > 0$ [because $1 + (1/\epsilon_{Q,P}) > 0$]	The monopolist can increase total revenue by decreasing price (and thereby increasing quantity) by a small amount.
Unitary elastic ($\epsilon_{Q,P} = -1$)	$MR = 0$ [because $1 + (1/\epsilon_{Q,P}) = 0$]	The monopolist's total revenue will not change when price (or quantity) is changed by a small amount.
Inelastic ($-1 < \epsilon_{Q,P} < 0$)	$MR < 0$ [because $1 + (1/\epsilon_{Q,P}) < 0$]	The monopolist can increase total revenue by increasing price (and thereby decreasing quantity) by a small amount.

Elasticity Region of the Demand Curve



Inverse Elasticity Pricing Rule

- Profit maximizing condition:

$$MR(Q^*) = MC(Q^*)$$

$$MC(Q^*) = P^* \left(1 + \frac{1}{\varepsilon_{Q,P}} \right)$$

- Rearranging:

$$\frac{P^* - MC^*}{P^*} = -\frac{1}{\varepsilon_{Q,P}}$$

Inverse Elasticity Pricing Rule

Inverse Elasticity Pricing Rule (IEPR)

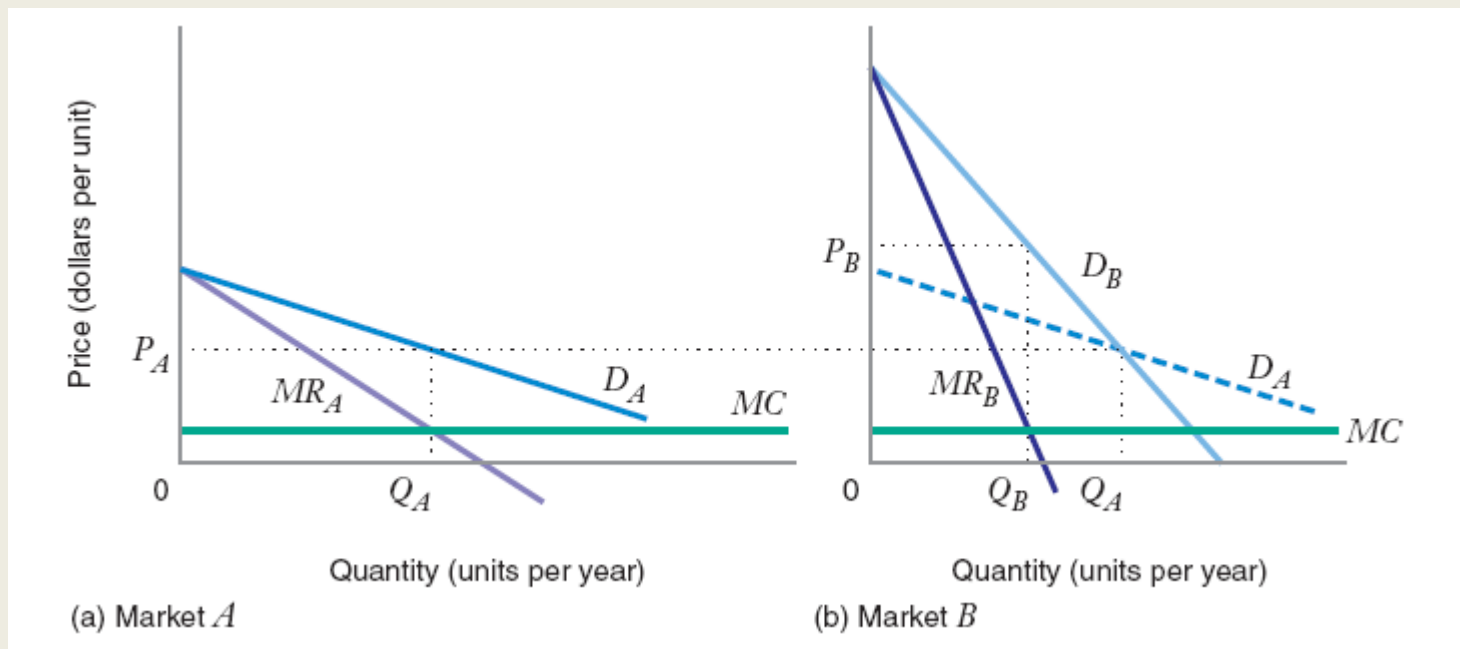
- Monopolist's optimal markup of price above marginal cost expressed as a percentage of price is equal to minus the inverse of the price elasticity of demand.

$$\frac{P^* - MC^*}{P^*} = -\frac{1}{\epsilon_{Q,P}}$$

- IEPR tells us about how much P^* the monopolist should charge, given the PED.
- **High PED implies that P^* should be low.**

Inverse Elasticity Pricing Rule

- In Market A, $P^* = P_A$. In Market B, $P^* = P_B$.
- According to IEPR, since Mkt A is more elastic, it should charge lower price.



Inverse Elasticity Pricing Rule



LEARNING-BY-DOING EXERCISE 11.3

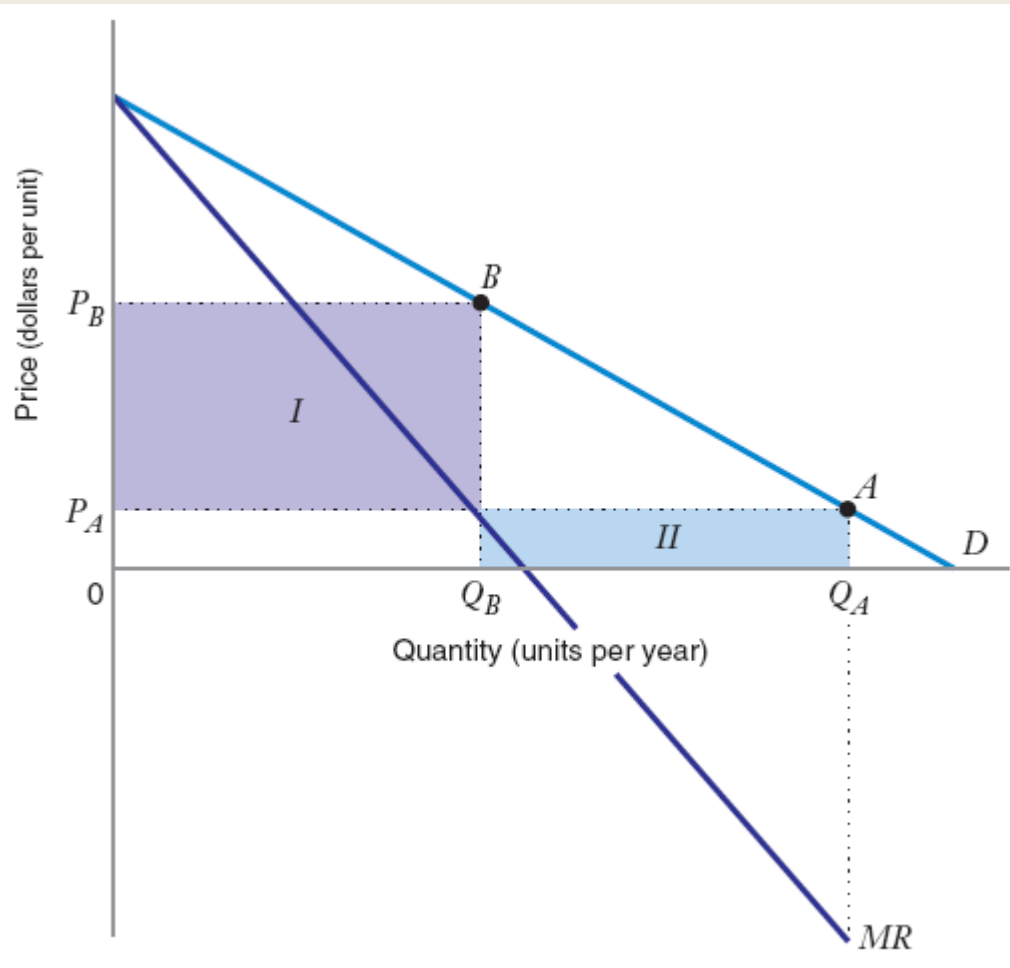
Computing the Optimal Monopoly Price for a Constant Elasticity Demand Curve

The general form of a constant elasticity demand curve is $Q = aP^{-b}$. At every point on such a curve, the price elasticity of demand equals $-b$.⁵ Suppose a monopolist has a constant marginal cost $MC = \$50$.

Problem

- (a) What is the monopolist's optimal price if its constant elasticity demand curve is $Q = 100P^{-2}$?
- (b) What is the monopolist's optimal price if its constant elasticity demand curve is $Q = 100P^{-5}$?

Elasticity Region of the Demand Curve



Monopolist operates at the elastic region of the market demand curve.

Increasing price from P_A to P_B ,
 $\Delta TR = \text{Area I} - \text{Area II}$.

The total cost also goes down because Q is smaller.

As demand becomes more elastic, MR approaches P.

The Lerner Index of Market Power

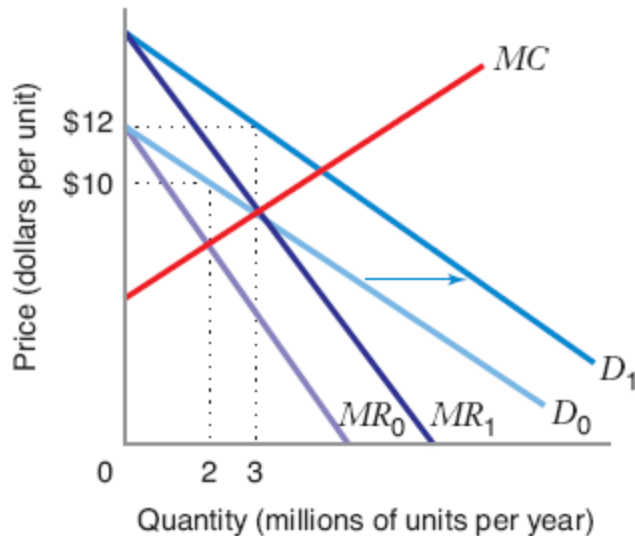
Definition: An agent has **Market Power** if he can affect the market price.

Sometimes, this is thought of as the degree to which a firm can raise price above marginal cost.

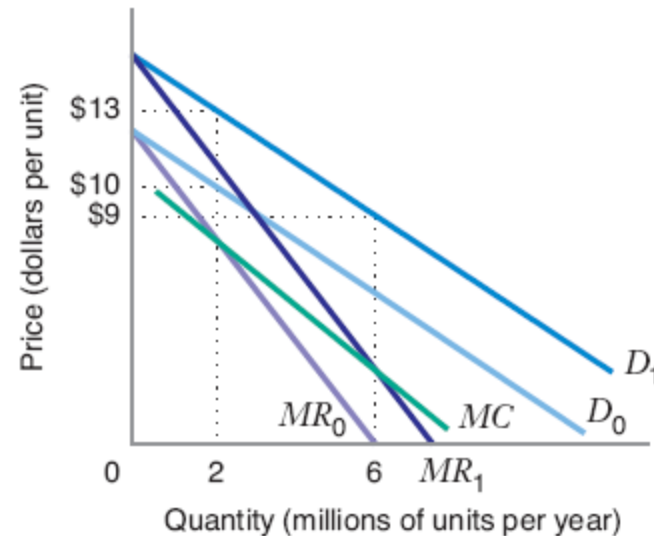
Definition: The **Lerner Index of market power** is the price-cost margin, $(P^* - MC) / P^*$.

This index ranges between 0 (for competitive firms) and 1 (for a monopolist facing a unit-elastic demand).

Comparative Statics – Shifts in Demand



(a)



(b)

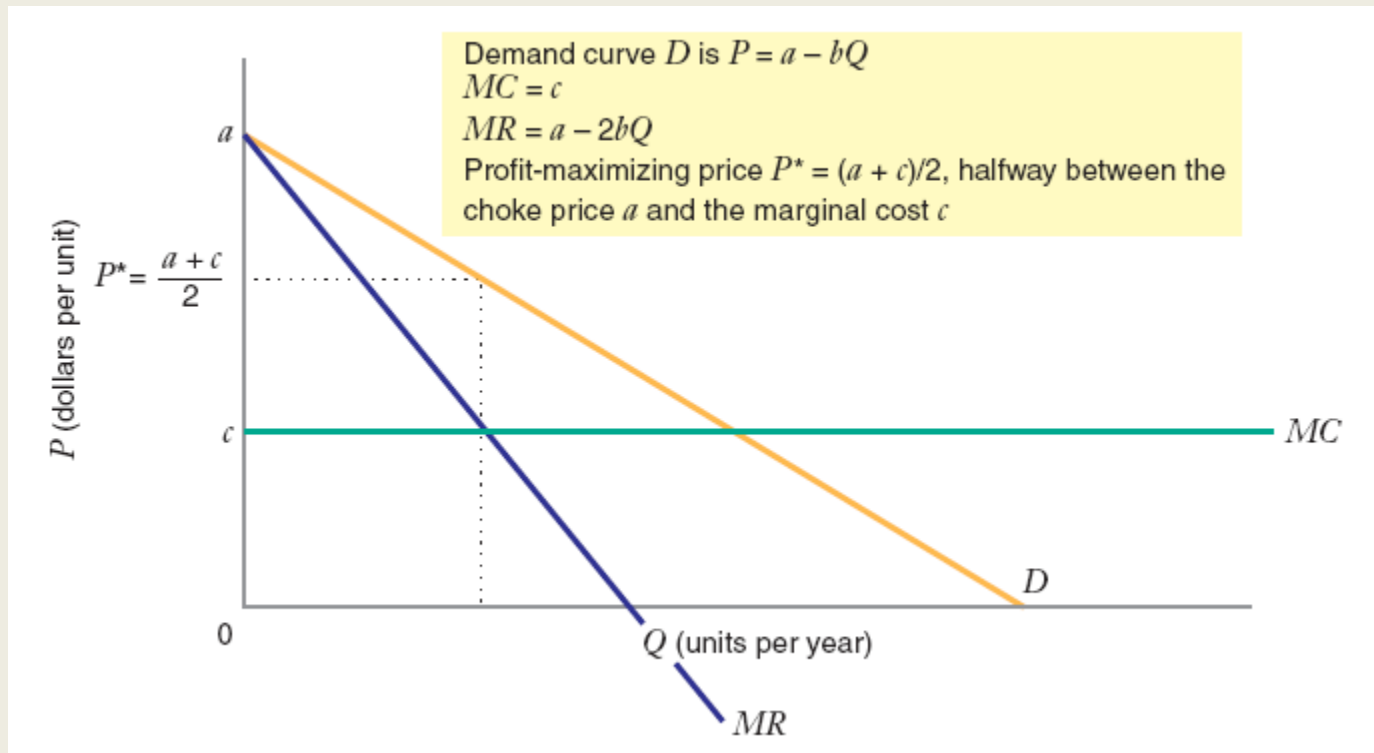
Rightward shift in the demand curve causes an increase in profit-maximizing quantity.

- (a) MC increases as Q increases
- (b) MC decreases as Q increases

Comparative Statics – Midpoint Rule

For a constant MC, P^* is found using the midpoint rule:

P^* is halfway between the vertical intercept of the demand curve a (choke price) and vertical intercept of the MC curve c .



Comparative Statics – Midpoint Rule

LEARNING-BY-DOING EXERCISE 11.5



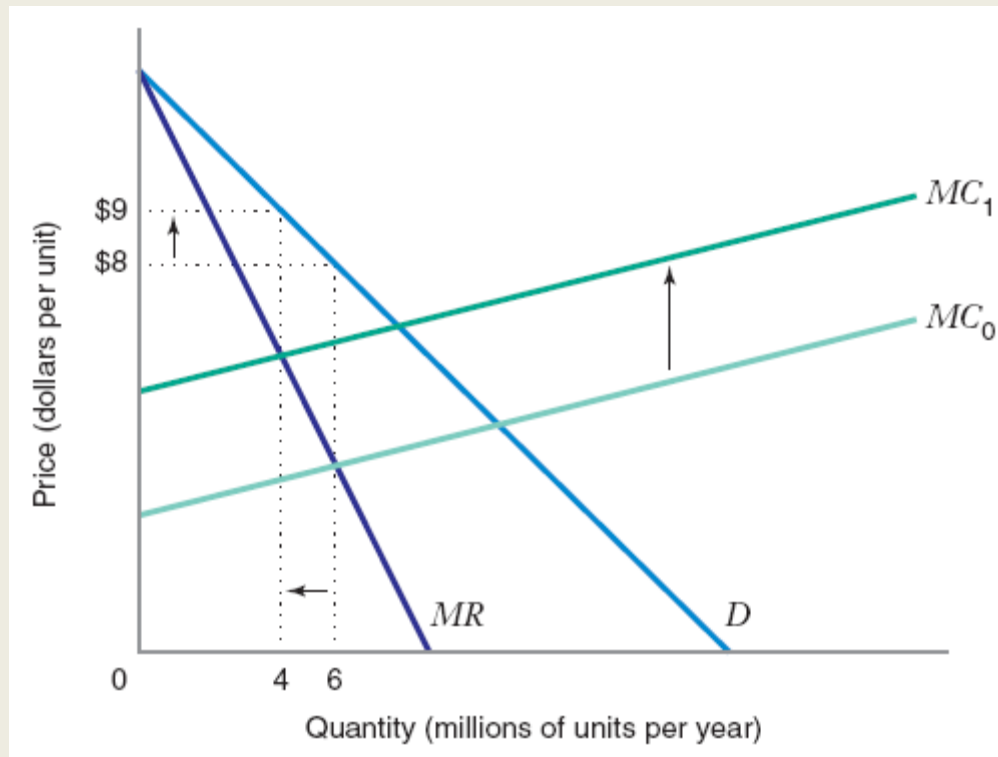
Computing the Optimal Price Using the Monopoly Midpoint Rule

Suppose a monopolist faces a linear market demand curve $P = a - bQ$ and has a constant marginal cost $MC = c$ (as illustrated in Figure 11.11).

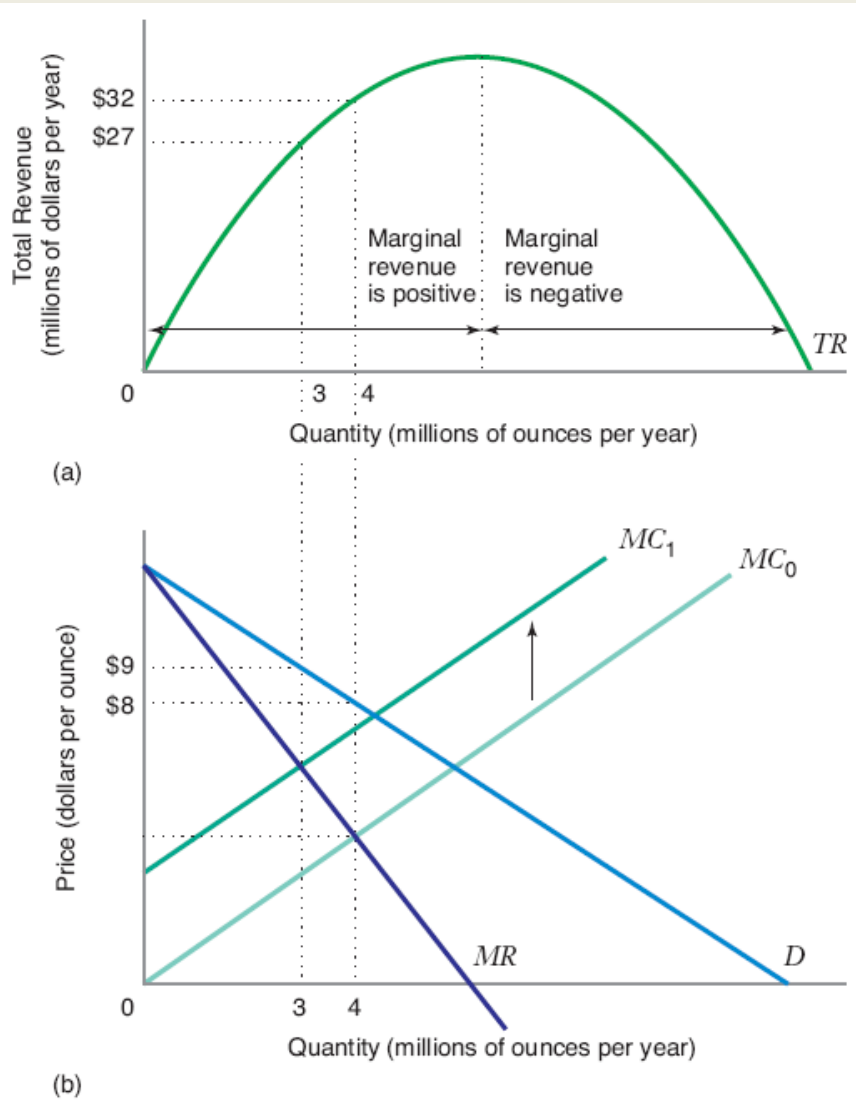
Problem What is the monopolist's profit-maximizing quantity and price?

Comparative Statics – Shifts in MC

When MC shifts up, Q^* falls and P^* increases.



Comparative Statics – Shifts in MC



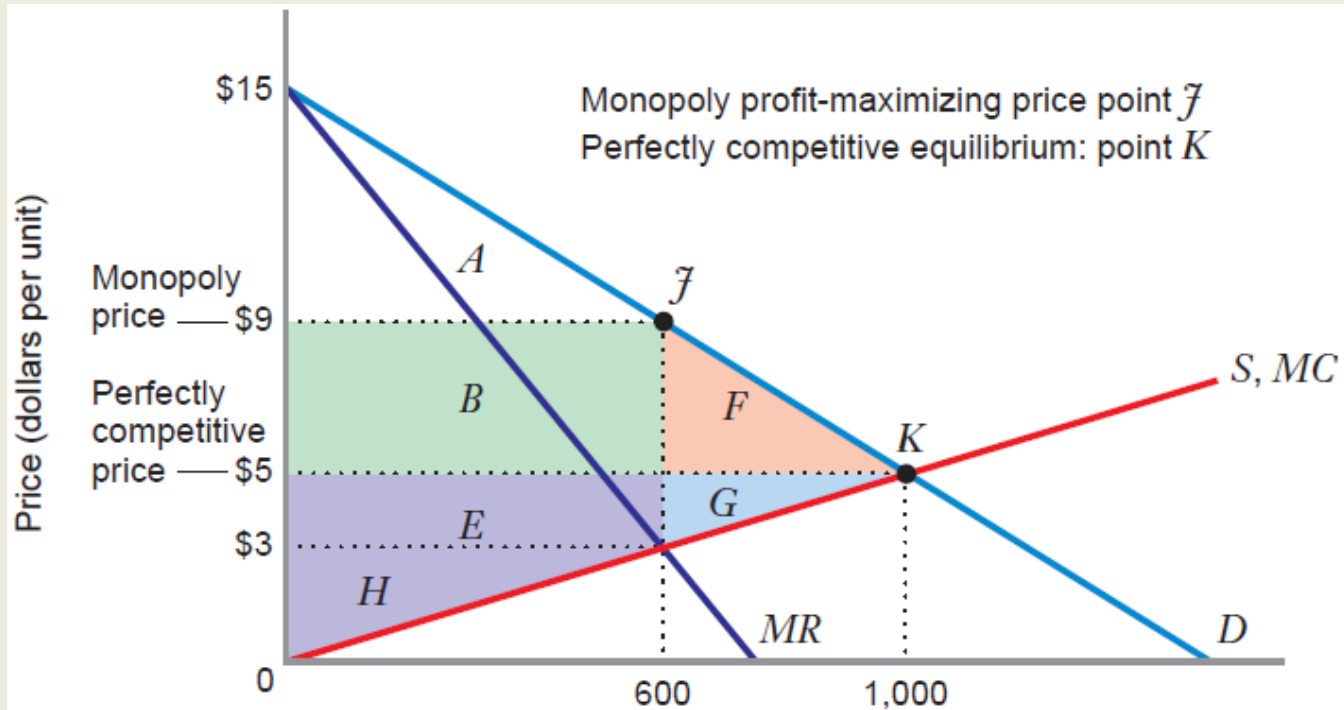
- Upward shift of MC decreases the profit maximizing monopolist's total revenue.
- Downward shift of MC increases the profit maximizing monopolist's total revenue.

The Welfare Economies of Monopoly

Since the monopoly equilibrium output does not, in general, correspond to the perfectly competitive equilibrium, **it entails a dead-weight loss.**

Suppose that we compare a monopolist to a competitive market, where the supply curve of the competitors is equal to the marginal cost curve of the monopolist.

The Welfare Economies of Monopoly



	Perfect Competition	Monopoly	Impact of Monopoly
Consumer surplus	$A + B + F$	A	$-B - F$
Producer surplus	$E + G + H$	$B + E + H$	$B - G$
Net economic benefit	$A + B + E + F + G + H$	$A + B + E + H$	$-F - G$

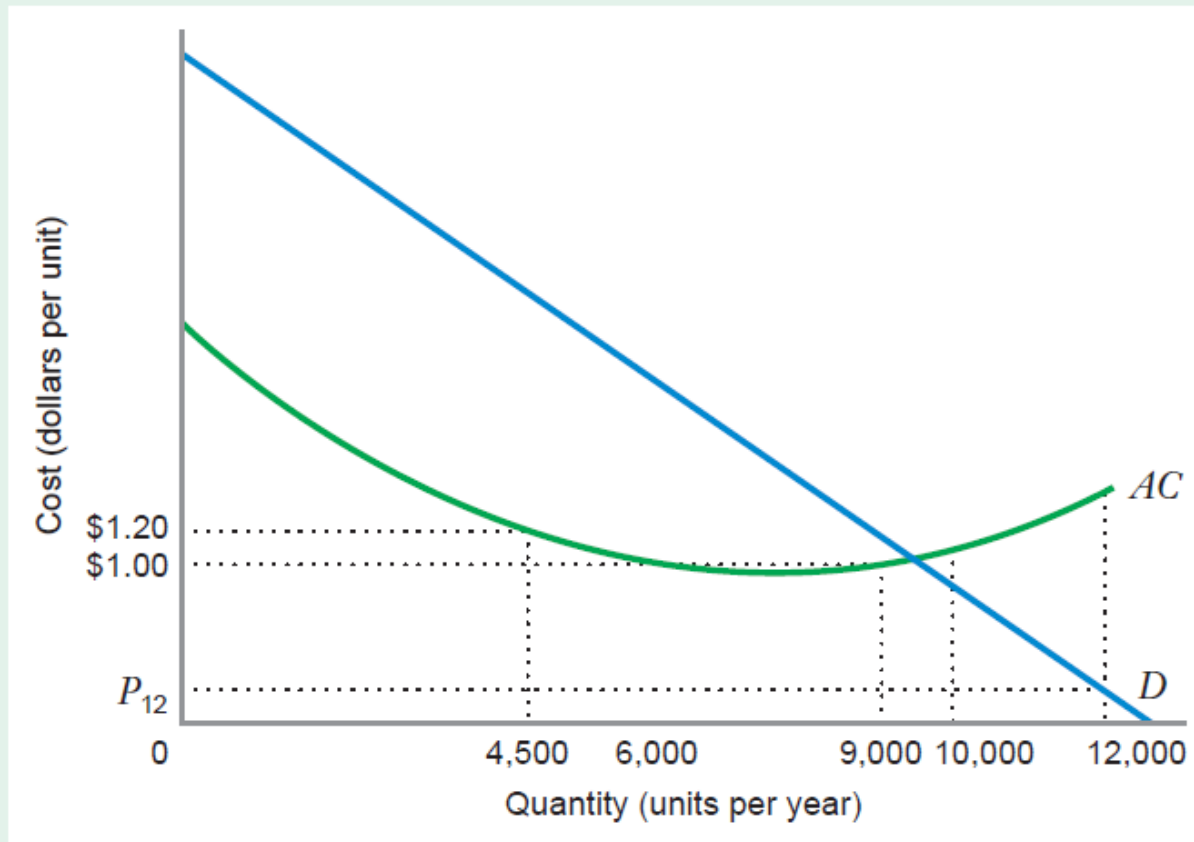
Why does Monopoly exist?

Definition: A market is a **natural monopoly** if the total cost incurred by a single firm producing output is less than the combined total cost of two or more firms producing this same level of output among them.

Why does Monopoly exist?

FIGURE 11.17 Natural Monopoly Market

Any output level less than 10,000 units per year can be produced most cheaply by a single firm. For example, a single firm can produce an output of 9,000 units for an average cost of \$1 per unit. Two firms, each producing 4,500 units, would incur an average cost of \$1.20 per unit. Two firms could produce 12,000 units at a lower total cost than one firm could. However, this level of output would not be profitable because the price P_{12} at which 12,000 units would be demanded is less than the minimum level of average cost.



Why does Monopoly exist?

Definition: **Barriers to Entry** are factors that allow an incumbent firm to earn positive economic profits while making it unprofitable for newcomers to enter the industry.

1. **Structural Barriers to Entry** – occur when incumbent firms have cost or demand advantages that would make it unattractive for a new firm to enter the industry
2. **Legal Barriers to Entry** – exist when an incumbent firm is legally protected against competition
3. **Strategic Barriers to Entry** – result when an incumbent firm takes explicit steps to deter entry