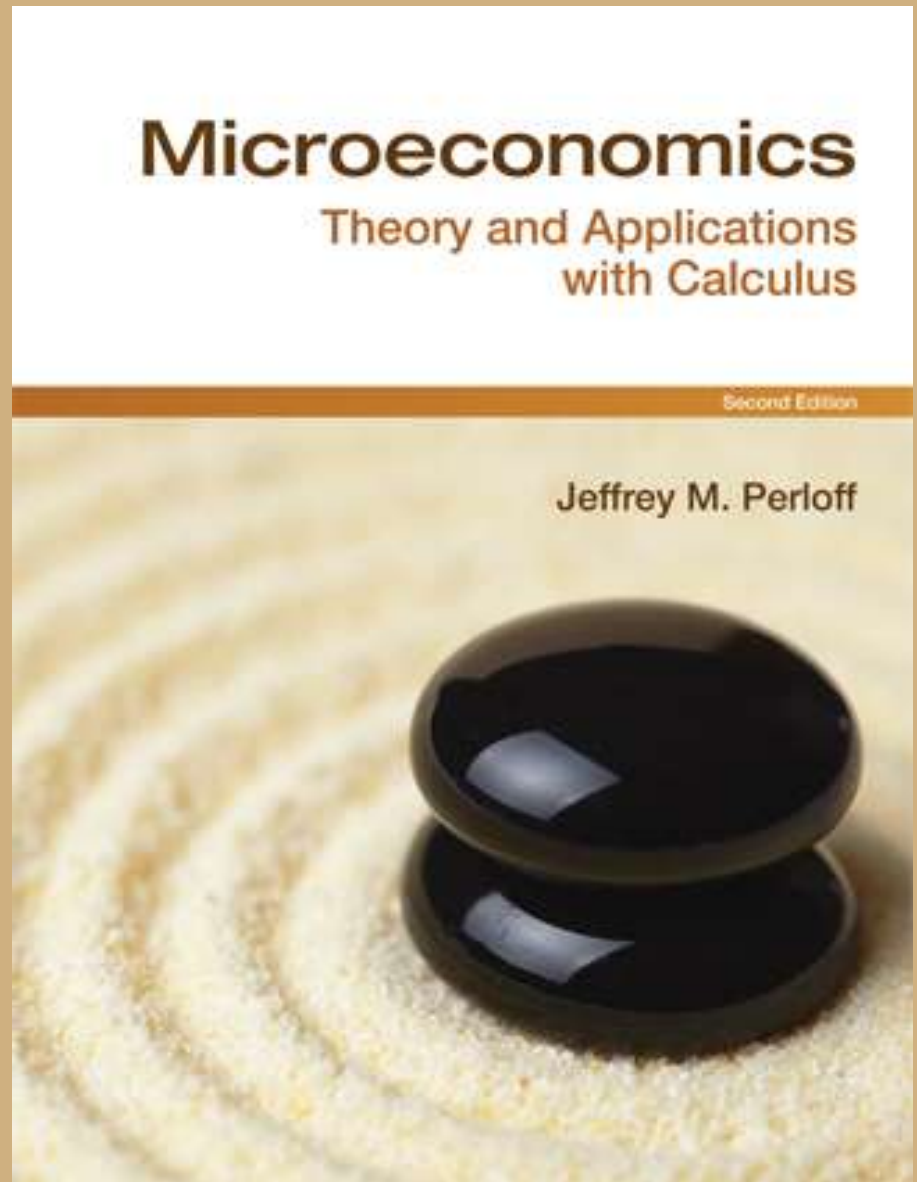


# Chapter 11

## Monopoly

*I think it's wrong that only one company makes the game Monopoly.*

Steven Wright



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# Chapter 11 Outline

- 11.1 Monopoly Profit Maximization
- 11.2 Market Power
- 11.3 Welfare Effects of Monopoly
- 11.4 Taxes and Monopoly
- 11.5 Cost Advantages that Create Monopolies
- 11.6 Government Actions that Create Monopolies
- 11.7 Government Actions that Reduce Market Power
- 11.8 Monopoly Decisions Over Time and Behavioral Economics

# 11.1 Monopoly Profit Maximization

- A ***monopoly*** is the only supplier of a good for which there is no close substitute.
- Monopolies are not price takers like competitive firms
  - Monopoly output is the market output
  - Monopoly demand curve is the market demand curve
  - Monopolists can set their own price given market demand
  - Because demand is downward sloping, monopolists set price above marginal cost to maximize profit.
- Like all firms, monopolies maximize profits by setting price or output so that marginal revenue (MR) equals marginal cost (MC).

# 11.1 Monopoly Profit Maximization

- Monopolies maximize profits by setting price or output so that marginal revenue (MR) equals marginal cost (MC).
- Profit function to be maximized by choosing output,  $Q$ :
  - $\pi(Q) = R(Q) - C(Q)$ , where
  - $R(Q)$  is the revenue function
  - $C(Q)$  is the cost function
- The necessary condition for profit maximization:

$$\frac{d\pi(Q^*)}{dQ} = \frac{dR(Q^*)}{dQ} - \frac{dC(Q^*)}{dQ} = 0$$

- The sufficient condition for profit maximization:

$$\frac{d^2\pi(Q^*)}{dQ^2} = \frac{d^2R(Q^*)}{dQ^2} - \frac{d^2C(Q^*)}{dQ^2} < 0$$

# 11.1 Monopoly Profit Maximization

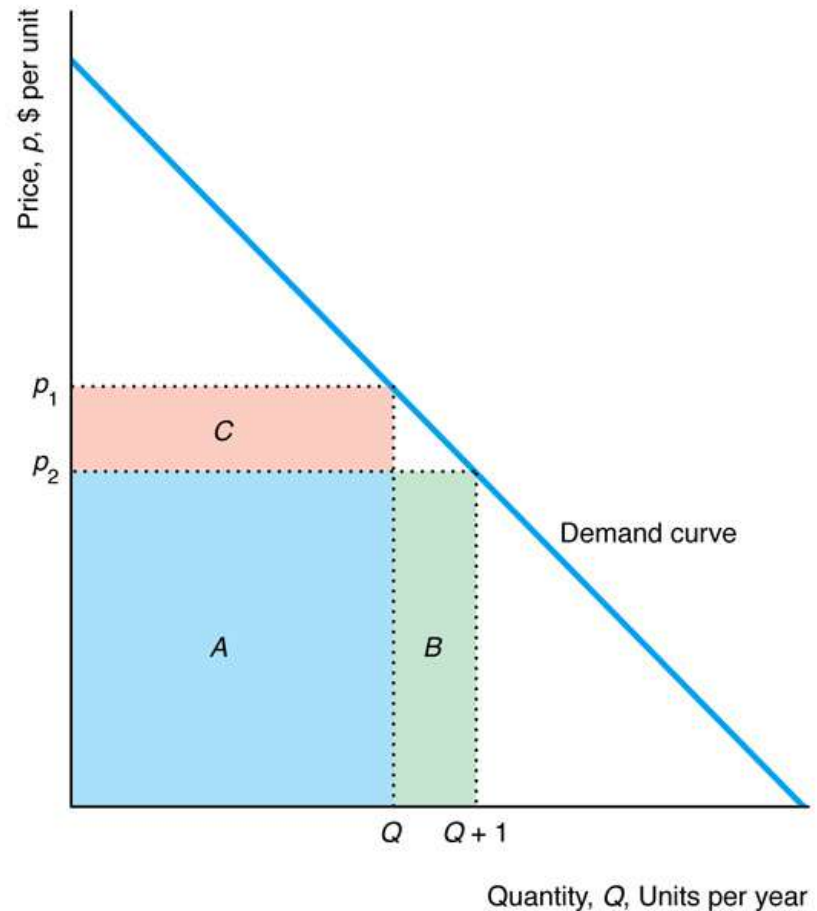
- A firm's MR curve depends on its demand curve.
  - MR is also downward sloping and lies below D
- If  $p(Q)$  is the inverse demand function, which shows the price received for selling  $Q$ , then the marginal revenue function is:

$$MR(Q) = \frac{dR(Q)}{dQ} = \frac{dp(Q)Q}{dQ} = p(Q)\frac{dQ}{dQ} + \frac{dp(Q)}{dQ}Q = p(Q) + \frac{dp(Q)}{dQ}Q$$

- Given a positive value of  $Q$ , MR lies below inverse demand.
- Selling one more unit requires the monopolist to lower the price
  - Price is lowered on the marginal unit **and** all other units sold

# 11.1 Monopoly Profit Maximization

- Monopoly's marginal revenue is less than the price it charges by an amount equal to area C



# 11.1 MR Curve and Price Elasticity of Demand

- We can rewrite MR function so that it is stated in terms of elasticity:

$$MR = p + \frac{dp}{dQ}Q = p + p \frac{dp}{dQ} \frac{Q}{p} = p \left[ 1 + \frac{1}{(dQ/dp)(p/Q)} \right] = p \left( 1 + \frac{1}{\varepsilon} \right)$$

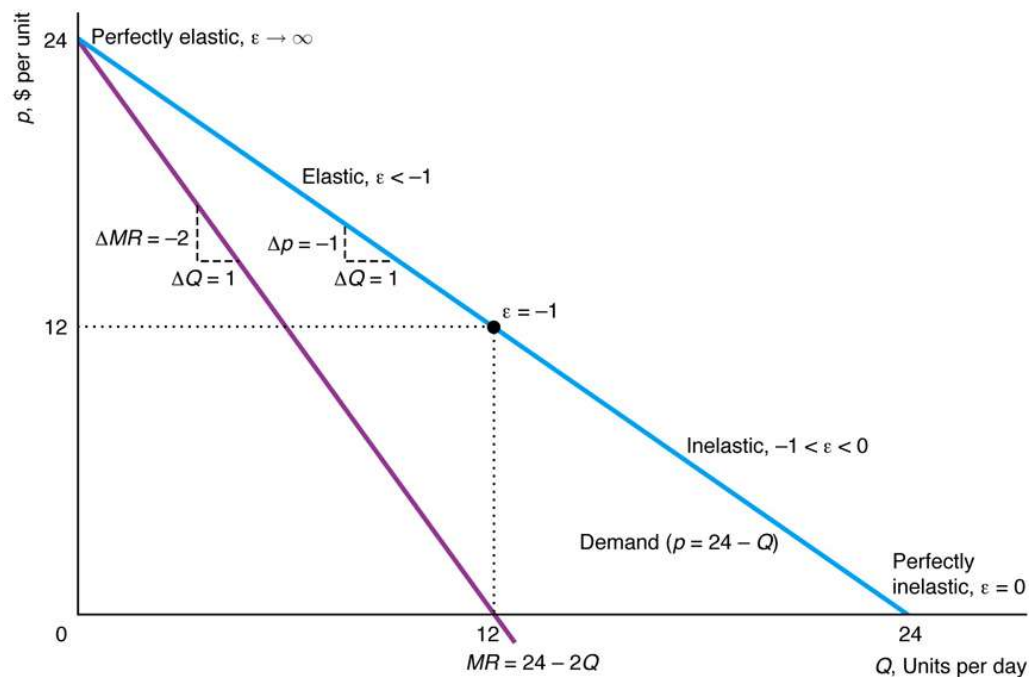
- This makes the relationship between MR, D, and elasticity quite clear.
  - The quantity at which  $MR = 0$  corresponds to the unitary elastic portion of the demand curve.
  - Everywhere that  $MR > 0$ , demand is elastic.
  - Where demand hits the vertical axis,  $MR=P$  and demand is perfectly elastic.

# 11.1 MR Curve and Price Elasticity of Demand

- Relationship for inverse demand function of

$$p(Q) = 24 - Q$$

and marginal revenue function of  $MR(Q) = 24 - 2Q$





# 11.1 Monopoly Example

- Inverse demand function:  $p(Q) = 24 - Q$ 
  - Can be used to find the marginal revenue function:
- Quadratic SR cost function:  $C(Q) = VC(Q) + F = Q^2 + 12$

$$MR(Q) = 24 - 2Q$$

- Can be used to find the marginal cost function:

$$MC(Q) = \frac{dC(Q)}{dQ} = 2Q$$

- Profit-maximizing output is obtained by producing  $Q^*$ :

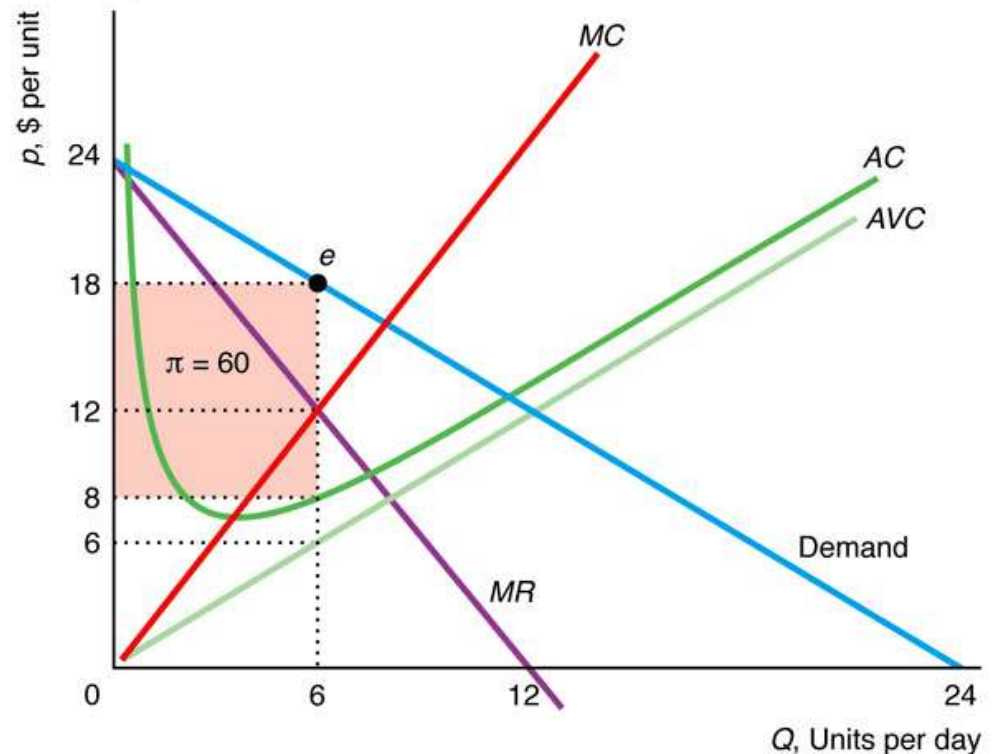
$$MR(Q^*) = 24 - 2Q^* = 2Q^* = MC(Q^*)$$

- Solving this expression reveals  $Q^* = 6$
- The inverse demand function indicates that people are willing to pay  $p = \$18$  for 6 units of output.

# 11.1 Monopoly Example

- The monopolist's profit maximizing choice of output is found where  $MR=MC$  and  $p$  comes from the demand curve.

(a) Monopolized Market



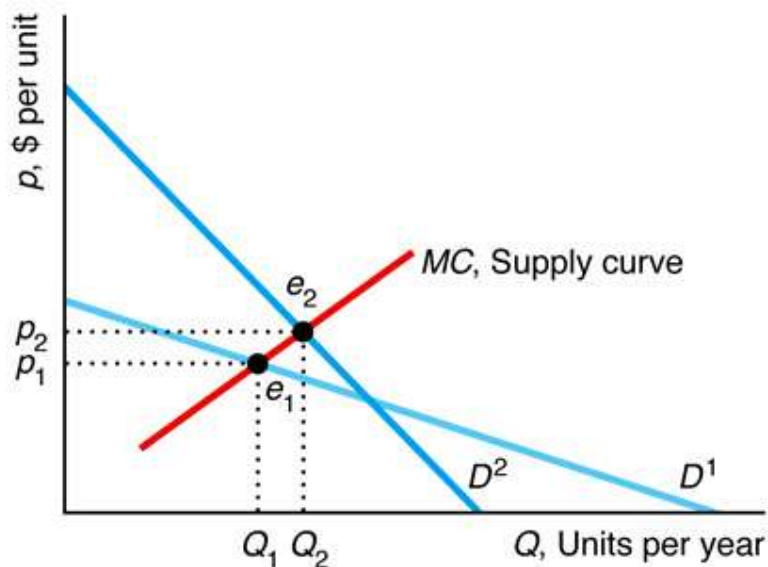
# 11.1 Monopoly Example

- Should a profit-maximizing monopoly produce at  $Q^*$  or shut down?
- As with competitive firms, a monopoly should shut down in the monopolist's price is less than its AVC.
- In our example, AVC at  $Q^*$  of 6 is \$6.
- Because  $p = \$18$  is clearly above \$6, the monopoly in this example should produce in the SR.

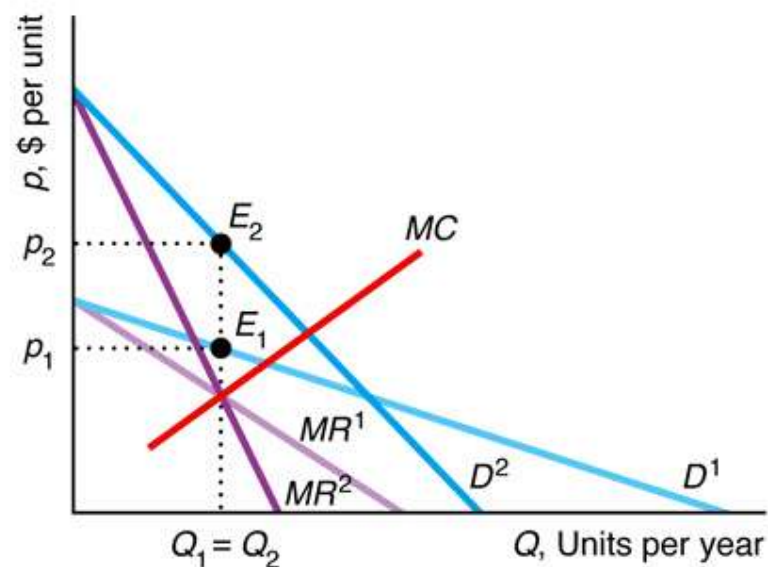
# 11.1 Effects of a Shift of Demand Curve

- Shifts in demand need not affect monopolist's level of  $Q^*$

(a) Competition



(b) Monopoly



## 11.2 Market Power

- **Market power** is the ability of a firm to charge a price above marginal cost and earn a positive profit.
  - Monopoly has market power; competitive firms do not.
- Market power is related to the price elasticity of demand
  - Recall that
$$MR = p\left(1 + \frac{1}{\epsilon}\right) = MC$$
  - Rewrite as
$$\frac{p}{MC} = \frac{1}{1 + (1/\epsilon)}$$
  - Thus, the ratio of price to MC depends only on the elasticity of demand at the profit maximizing quantity.
- The more elastic the demand curve, the less a monopoly can raise its price without losing sales (and vice versa).

# 11.2 Market Power

- The **Lerner Index** (or price markup) is another way to examine the way in which elasticity affects a monopoly's price relative to its MC.

$$\frac{p - MC}{p} = -\frac{1}{\epsilon}$$

- The Lerner Index ranges from 0 to 1 for a profit-maximizing firm.
  - Competitive firms have a Lerner Index of 0.
  - The Lerner Index gets closer to 1 as a firm has more market power (and faces less elastic demand).

# 11.2 Sources of Market Power

- Elasticity of the market demand curve depends on consumers' tastes and options.
- Demand becomes more elastic (which implies **less** market power for the firm):
  - as better substitutes for the firm's product are introduced
  - as more firms enter the market selling a similar product
  - as firms that provide the same service locate closer to the firm
- As a profit-maximizing monopoly faces more elastic demand, it has to lower its price.
- Examples: Xerox, USPS, McDonald's

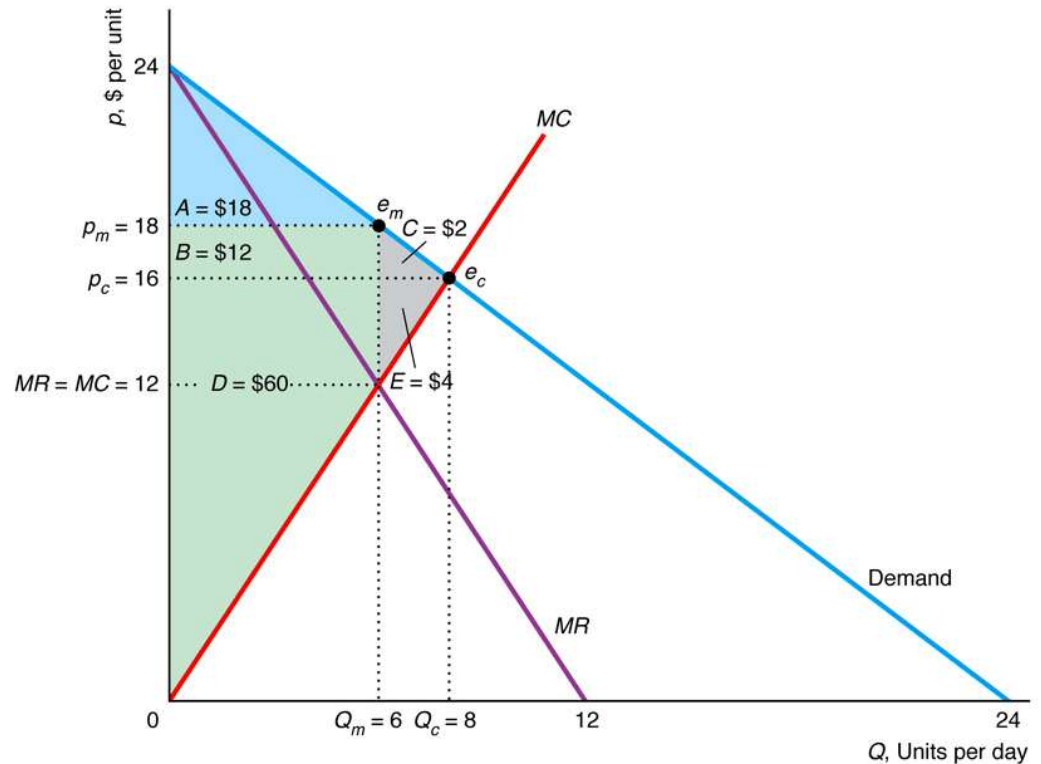
# 11.3 Welfare Effects of Monopoly

- Recall from Chapter 9 that competition maximizes welfare, which is the sum of consumer surplus and producer surplus, because price equals marginal cost.
- By contrast, a monopoly
  - sets price above marginal cost (and above the competitive price)
  - causes consumers to buy less than the competitive level of output
  - generates deadweight loss



# 11.3 Welfare Effects of Monopoly

- The competitive equilibrium,  $e_c$ , has no DWL, while the monopoly equilibrium,  $e_m$ , has  $DWL = C + E$ .



	Competition	Monopoly	Change
Consumer Surplus, CS	$A + B + C$	$A$	$-B - C = \Delta CS$
Producer Surplus, PS	$D + E$	$B + D$	$B - E = \Delta PS$
Welfare, $W = CS + PS$	$A + B + C + D + E$	$A + B + D$	$-C - E = \Delta W = DWL$

# 11.4 Taxes and Monopoly

- Taxes (ad valorem and specific) affect monopoly differently than a competitive industry:
  1. Tax incidence on consumers (the change in the consumers' price divided by the change in the tax) can exceed 100% in a monopoly market but not a competitive market.
  2. If tax rates  $\alpha$  and  $\tau$  are set so that the after-tax output is the same with either type of tax, the government raises the same amount of tax revenue in a competitive market using either type of tax, but raises more revenue using an ad valorem tax than a specific tax under monopoly.

# 11.4 Taxes and Monopoly

- Comparative Statics (of specific tax,  $\tau$ )
  - Before-tax cost function is  $C(Q)$
  - After-tax cost function is  $C(Q) - \tau Q$
  - Necessary condition for maximizing after-tax profit:

$$\frac{dR(Q)}{dQ} - \frac{dC(Q)}{dQ} - \tau = 0$$

- Derivative (with respect to  $\tau$ ) of the sufficient condition for maximizing after-tax profit:

$$\frac{dQ}{d\tau} = \frac{1}{\frac{d^2R}{dQ^2} - \frac{d^2C}{dQ^2}}$$

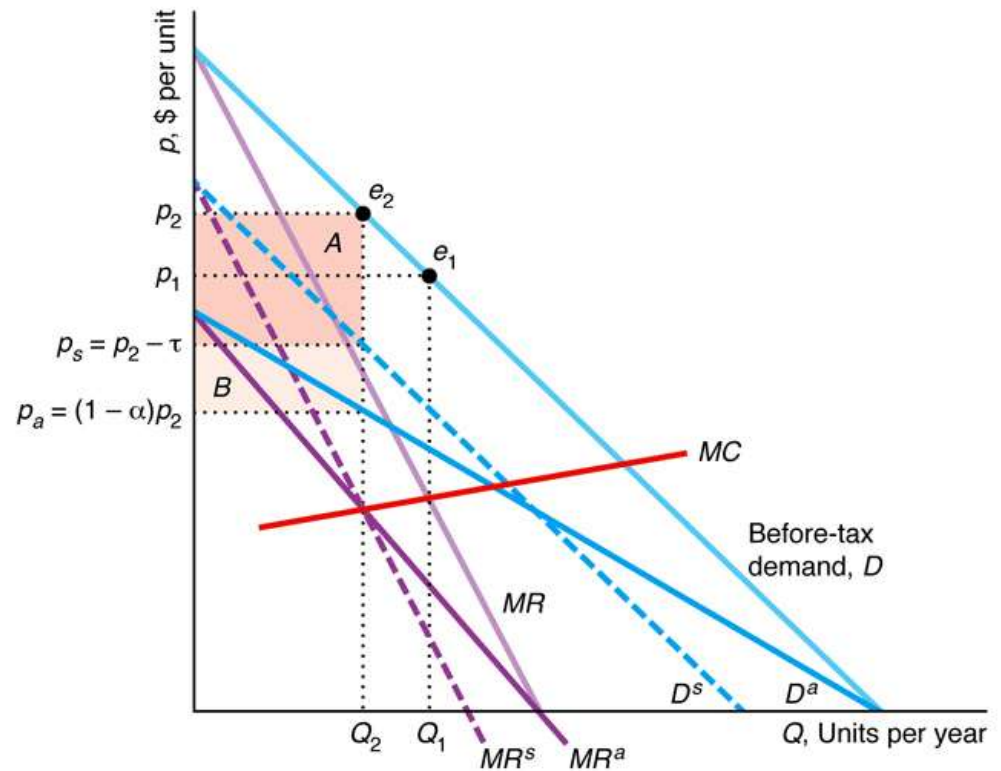
- As the specific tax rises, the monopoly reduces its output.
- Downward sloping means the monopoly raises its price.

# 11.4 Taxes and Monopoly

- Tax Incidence on Consumers
  - Consumer price may rise by an amount greater than the tax.
  - Assume constant marginal cost,  $m$ , and inverse demand function with constant elasticity,  $\varepsilon$ ,  $p = Q^{1/\varepsilon}$ 
    - Maximize profit by equating after-tax marginal cost and marginal revenue:
$$m + \tau = \left(1 + \frac{1}{\varepsilon}\right)Q^{1/\varepsilon}$$
    - Substituting for  $Q$  in inverse demand yields the price set by monopoly:
$$p = \frac{m + \tau}{1 + 1/\varepsilon}$$
- Differential with respect to  $\tau$  is greater than one because monopoly operates on elastic portion of demand curve.

# 11.4 Taxes and Monopoly

- Governments typically use an ad valorem tax rather than a specific tax because the tax revenue is greater.



# 11.5 Cost Advantages that Create Monopolies

- Sources of cost advantages:
  1. Control of an **essential facility**, a scarce resource that a rival firm needs to use to survive
    - Example: owning the only quarry in a region generates a cost advantage in the production of gravel
  2. Use of **superior technology** or a better way of organizing production
    - Example: Henry Ford's assembly lines and standardization
  3. **Protection from imitation** through patents or informational secrets
    - Secrets are more common in new and improved processes; patents more common with new products

# 11.5 Cost Advantages that Create Monopolies

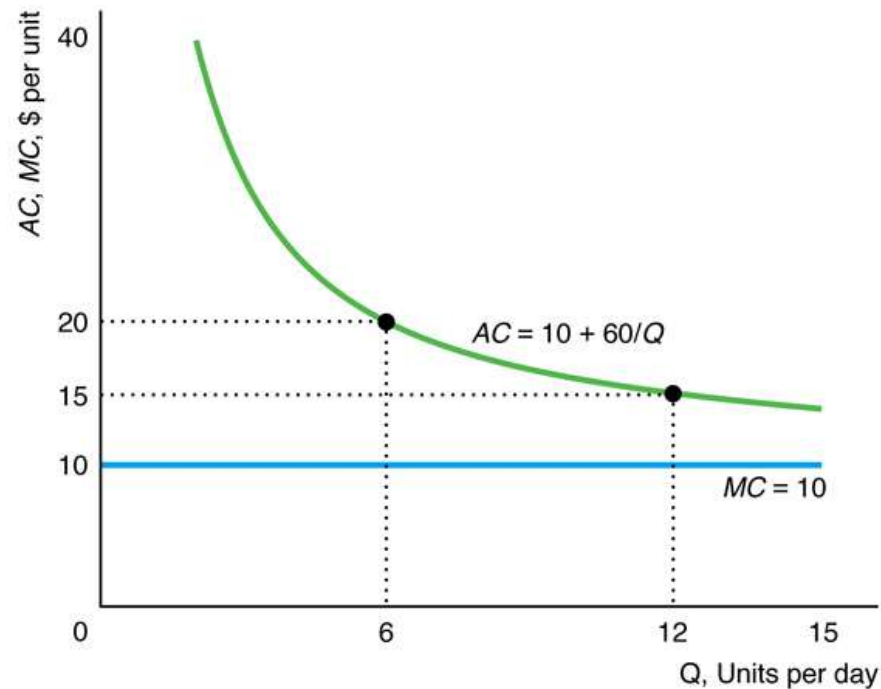
- A market has a ***natural monopoly*** if one firm can produce the total output of the market at lower cost than several firms could.

$$C(Q) < C(q_1) + C(q_2) + \dots + C(q_n)$$

- where  $Q = q_1 + q_2 + \dots + q_n$  for  $n > 1$  firms
- Examples: public utilities such as water, gas, electric, and mail delivery
- Natural monopolies may have high fixed costs, but low and fairly constant marginal costs.

# 11.5 Cost Advantages that Create Monopolies

- A natural monopoly has economies of scale at all levels of output, so average costs fall as output increases.





# 11.6 Government Actions that Create Monopolies

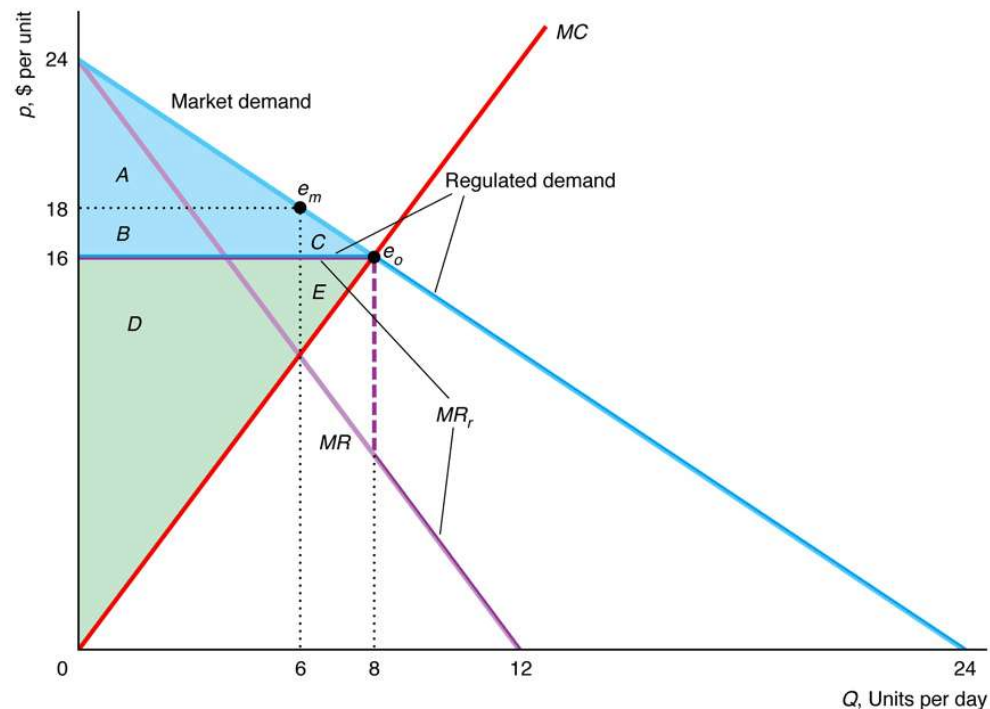
- Governments typically create monopolies in 1 of 3 ways:
  1. By making it difficult for new firms to obtain a license to operate
    - Example: U.S. cities require new hospitals to secure a certificate of need to demonstrate the need for a new facility
  2. By granting a firm the rights to be a monopoly
    - Example: public utilities operated by private company
  3. By auctioning the rights to be a monopoly
    - Example: selling government monopolies to private firms (privatization)

# 11.7 Government Actions that Reduce Market Power

- Governments limit monopolies' market power in various ways:
  - 1.Optimal Price Regulation:** government regulates the monopoly by imposing a price ceiling that is equal to the competitive price, which eliminates DWL.
  - 2.Nonoptimal Price Regulation:** government-imposed price ceiling is not set at the competitive level, which reduces but does not eliminate DWL.
  - 3.Increasing Competition:** allowing/encouraging market entry by new domestic firms and ending import bans that kept out international firms.

# 11.7 Government Actions that Reduce Market Power

- With optimal price regulation, the government imposes a price ceiling that is equal to the competitive price.



	Monopoly Without Regulation	Monopoly with Optimal Regulation	Change
Consumer Surplus, CS	A	A + B + C	B + C = $\Delta$ CS
Producer Surplus, PS	B + D	D + E	E - B = $\Delta$ PS
Welfare, W = CS + PS	A + B + D	A + B + C + D + E	C + E = $\Delta$ W
Deadweight Loss, DWL	-C - E	0	C + E = $\Delta$ DWL

# 11.8 Monopoly Decisions Over Time and Behavioral Economics

- In some markets, today's decisions affect demand or cost in the future.
- Some monopoly decisions may maximize LR profit but not SR profit.
  - Example: low introductory pricing to build up customers
- Why would consumers' demand in the future depend on a monopoly's actions in the present?

# 11.8 Monopoly Decisions Over Time and Behavioral Economics

- A good has a **network externality** if one person's demand depends on the consumption of a good by others.
  - With a **positive** network externality, value to the consumer grows as the number of units sold increases (e.g. telephones, ATMs)
  - With a **negative** network externality, value to the consumer grows as fewer people possess the good (e.g. numbered paintings)
- A **bandwagon effect** is a popularity-based explanation for a positive network externality (e.g. iPod, UGG boots).
- A **snob effect** is an explanation for a negative network externality (e.g. original painting by an unknown artist).

# Figure 11.3

## Maximizing Profit

