

# Chapter 11

## Monopoly

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# Monopoly



# Challenge: Pricing the iPad

- Background:
  - In 2010, Apple started selling the first iPad
  - People loved it, and Apple had an effective monopoly on high end tablets despite the \$499 starting price
- Questions:
  - How did Apple set the price of the iPad?



# Monopoly Definition

- 2 key characteristics must be present for a market to be a true monopoly market
  1. There must be a single seller of a good for which there is no good substitute
  2. There must be high barriers to entry that make it difficult for other firms to enter
- Monopoly is often referred to as being a matter of degree on the competition spectrum

# Monopoly Profit Max

- 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
- The monopoly demand curve is the market demand curve
- Monopolists set their own prices given market demand
- Because demand is downward sloping, monopolists set price above the marginal cost to maximize profit

# Monopoly Profit Max

- Like all firms, monopolies maximize profits by setting price or output so that marginal cost equals marginal revenue
- Competitive case:  $MC = MR = p$
- Here price is set not given, so they are price makers

# Monopoly Profit Max

- Monopolies maximize profit by setting price or output so that  $MR = MC$
- Profit function to be maximized by choosing output  $Q$ :

$$\pi(Q) = R(Q) - C(Q)$$

$R(Q)$  is the revenue function,  $C(Q)$  is the cost function

- The necessary condition for profit max:

$$\frac{\delta\pi(Q^*)}{\delta Q} = \frac{R(Q^*)}{\delta Q} - \frac{\delta C(Q^*)}{\delta Q} = 0$$

- The sufficient condition for profit max:

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



# Monopoly Profit Max

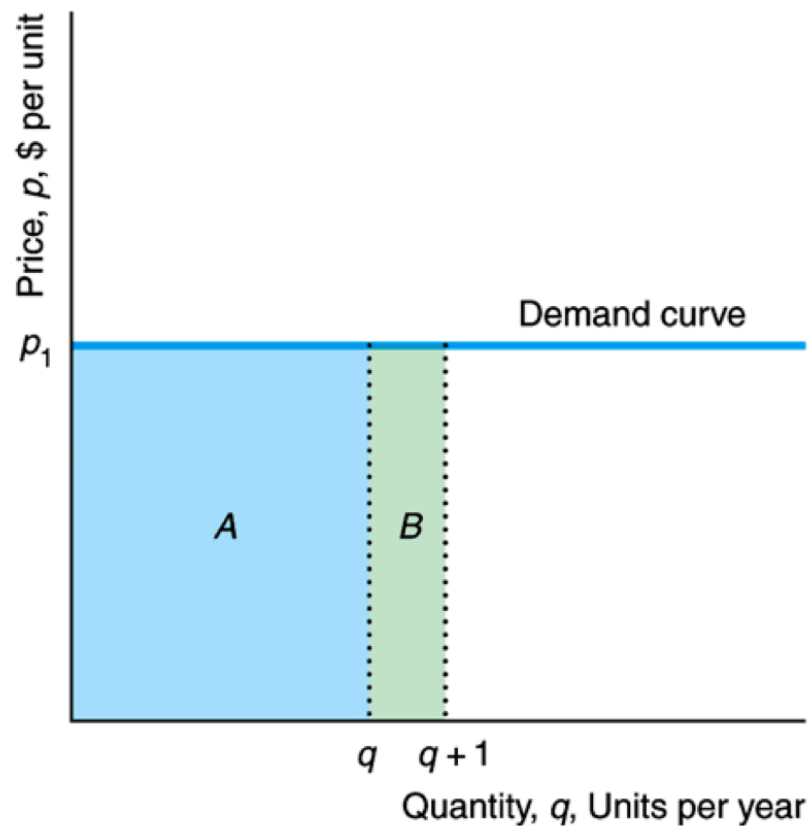
- A firm's MR curve depends on the demand curve
  - MR is also downward sloping and lies below demand
- If  $p(Q)$  is the inverse demand function — shows the price received for selling  $Q$  — then the marginal revenue function is:

$$MR(Q) = \frac{\delta R(Q)}{\delta Q} = \frac{\delta p(Q)Q}{\delta Q} = p(Q)\frac{\delta Q}{\delta Q} + \frac{\delta p(Q)}{\delta Q}Q = p(Q) + \frac{\delta p(Q)}{\delta Q}Q$$

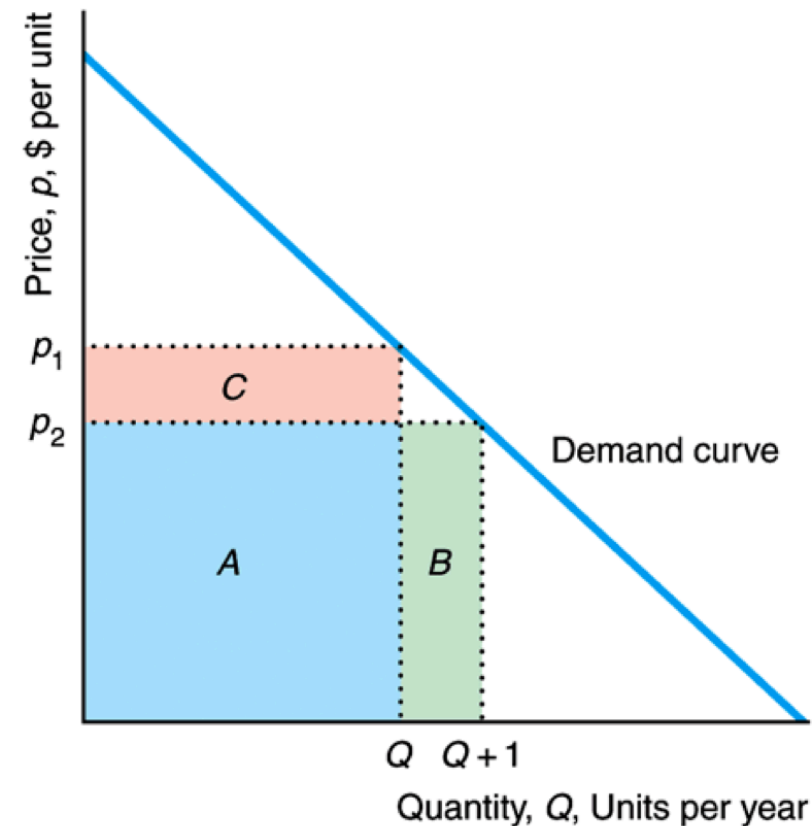
- Given a positive value of  $Q$ , MR lies below inverse demand
- Selling one more unit requires the monopolist to lower the price
  - Price is lowered on the marginal unit and all other units sold

# Average and Marginal Revenue

(a) Competitive Firm

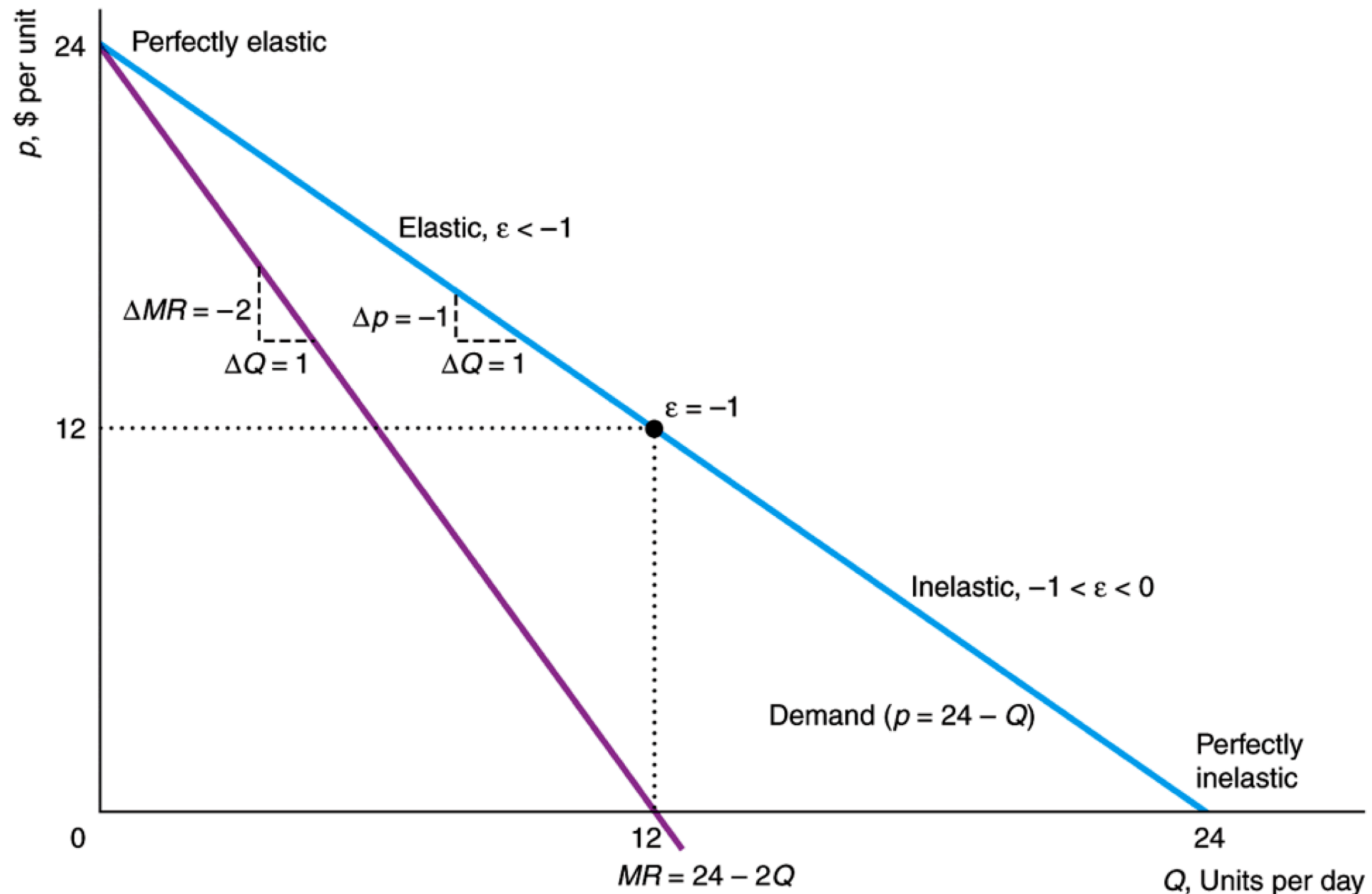


(b) Monopoly



	Initial Revenue, $R_1$	Revenue with One More Unit, $R_2$	Marginal Revenue, $R_2 - R_1$
Competition	$A$	$A + B$	$B = p_1$
Monopoly	$A + C$	$A + B$	$B - C = p_2 - C$

# Elasticity of Demand and Total, Average, and Marginal Revenue



# Deriving a Firm's MR Curve

$$MR = p + \frac{\Delta p}{\Delta Q} \times Q$$

- At a given price, MR equals:  $MR = p(1 + \frac{1}{\epsilon})$
- This means MR is closest to the price (and at its highest level) when elasticity is high
- MR and the different ranges of  $\epsilon$  have a defined relationship
  - MR at point of unitary elasticity ( $\epsilon = -1$ )
  - MR under elastic range is positive
  - MR under inelastic range is negative

# Quantity, Price, MR, and $\epsilon$ for the Linear Inverse Demand Curve: $Q = 24 - p$

Quantity, $Q$	Price, $p$	Marginal Revenue, $MR$	Elasticity of Demand, $\epsilon = -p/Q$	
0	24	24	$-\infty$	more elastic $\uparrow$
1	23	22	-23	
2	22	20	-11	
3	21	18	-7	
4	20	16	-5	
5	19	14	-3.8	
6	18	12	-3	
7	17	10	-2.43	
8	16	8	-2	
9	15	6	-1.67	
10	14	4	-1.4	$\downarrow$ less elastic
11	13	2	-1.18	
12	12	0	-1	
13	11	-2	-0.85	
...	...	...	...	
23	1	-22	-0.043	
24	0	-24	0	

# Selecting the Profit Maximizing Output

- The monopolist, like every other firm, sets  $MR = MC$  to maximize profits
- Also like other types of firms, they must check to make sure producing at  $Q > 0$  is a better option than shutting down



# Monopoly Example

- Inverse demand function:  $p(Q) = 24 - Q$ 
  - Revenue function found by Inverse Demand  $\times Q$
  - Can be used to find the marginal revenue function:

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

- Quadratic SR cost function:  $C(Q) = VC(Q) + FC = Q^2 + 12 -$   
use to find MC:

$$MC(Q) = \frac{\delta C(Q)}{\delta Q} = 2Q$$

# Monopoly Example

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

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

$$24 = 4Q^*$$

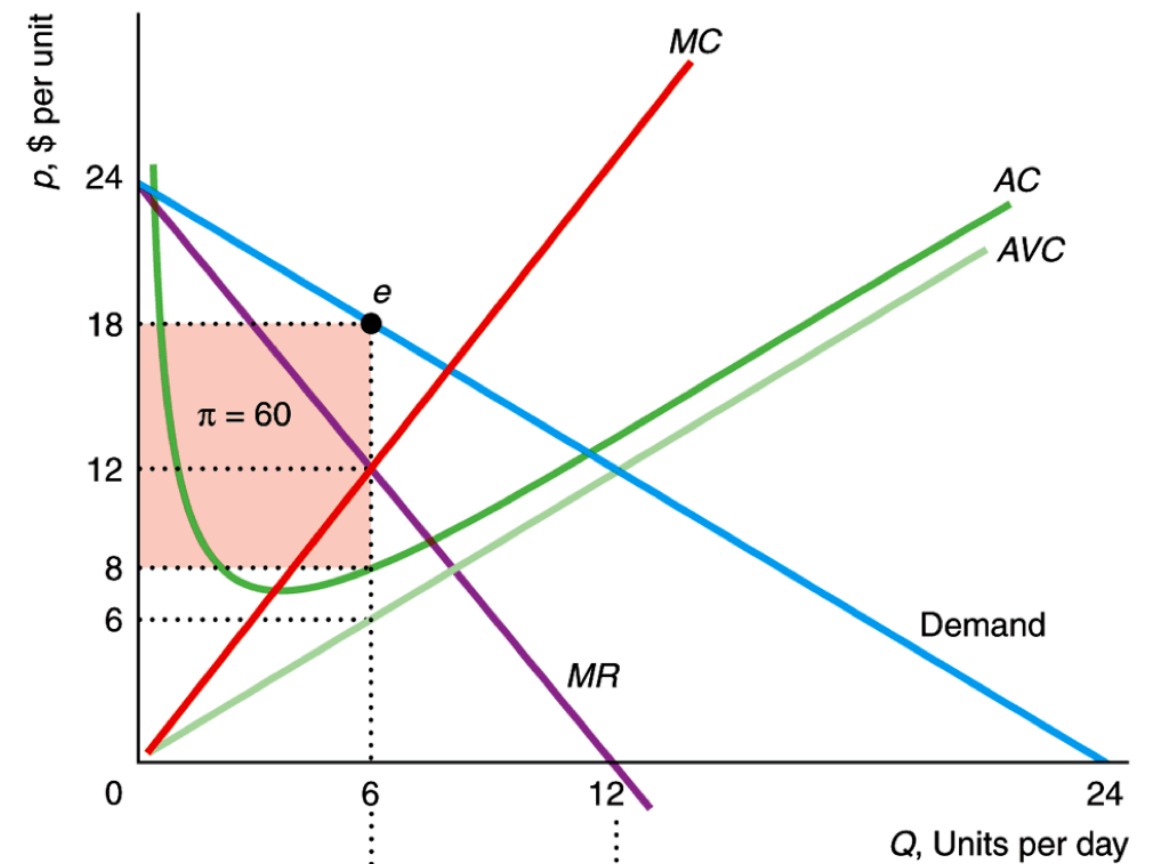
- Solving for  $Q$  we get:  $Q^* = 6$
- The inverse demand function indicates that people are willing to pay  $p = \$18$  for 6 units of output

# Finding a Monopoly's Inverse Demand and MR

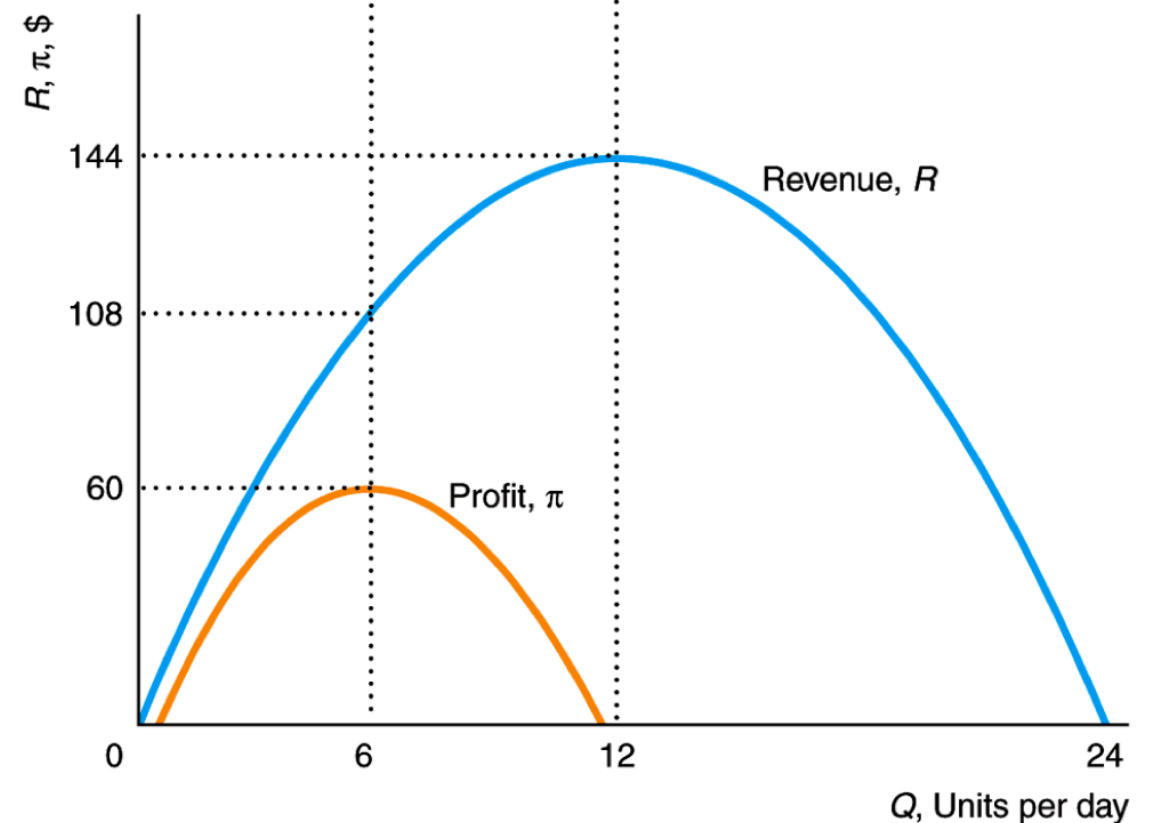
- If a monopoly faces the demand function  $Q = 25 - \frac{1}{4}p^2$ :
  1. Find the inverse demand
  2. Find MR
- If the cost function is  $C(Q) = Q^2 + 2Q + 150$ :
  3. Find MC
  4. Find the profit maximizing  $Q^*$  that the monopoly would choose to operate at by setting  $MR = MC$

# Maximizing Profit

(a) Monopolized Market



(b) Profit, Revenue



# Question

- Can monopolies charge whatever price they want for their good?

# Monopoly Example

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



# Mathematical Approach

- Take the expression for MC that is either given or easily derived from the cost curve and set it equal to MR
- MR will either be given or easily determined from the rules we went over
- The Q that equates MR and MC will be the monopoly's output level
  - This Q goes into the demand curve (not MR or MC curve) to find the market price

# Competition v. Monopoly in Setting Output

- Differences:
  - The firm's supply curve is no longer equal to the portion of their MC curve above the minimum of the AVC curve
  - MR used to be equal to  $p$ , but now MR is always less than  $p$
- Similarities:
  - Firms still use  $MR = MC$  profit max rule
  - Shut-down rule still the same

# Measuring Market Power

- Any firm that is not a price taker has market power
- **Market power**: the ability to raise price above MC without losing all their business
- However, monopoly is not a condition that is binary — it's a matter of degree
- The degree to which a monopolist can raise price while still retaining sales reflects their market power

# Market Power & Price Elasticity of Demand

- The ability of a monopolist to raise their price without losing all their customers will depend on how price sensitive consumers in the market are
  - This is captured by the price elasticity of demand
- When consumers have inelastic demand, this creates more market power for the monopoly
- When consumers have elastic demand, market power will be small

# The Lerner Index

- One common measure of a monopoly's strength is their **Lerner Index Score**

$$\text{Lerner Index} = \frac{p - MC}{p} = -\frac{1}{\epsilon}$$

- This captures the size of the price markup above the MC
  - Competitive firms have a Lerner Index = 0
  - The Lerner Index goes to 1 as a firm gets more power

# Sources of Market Power

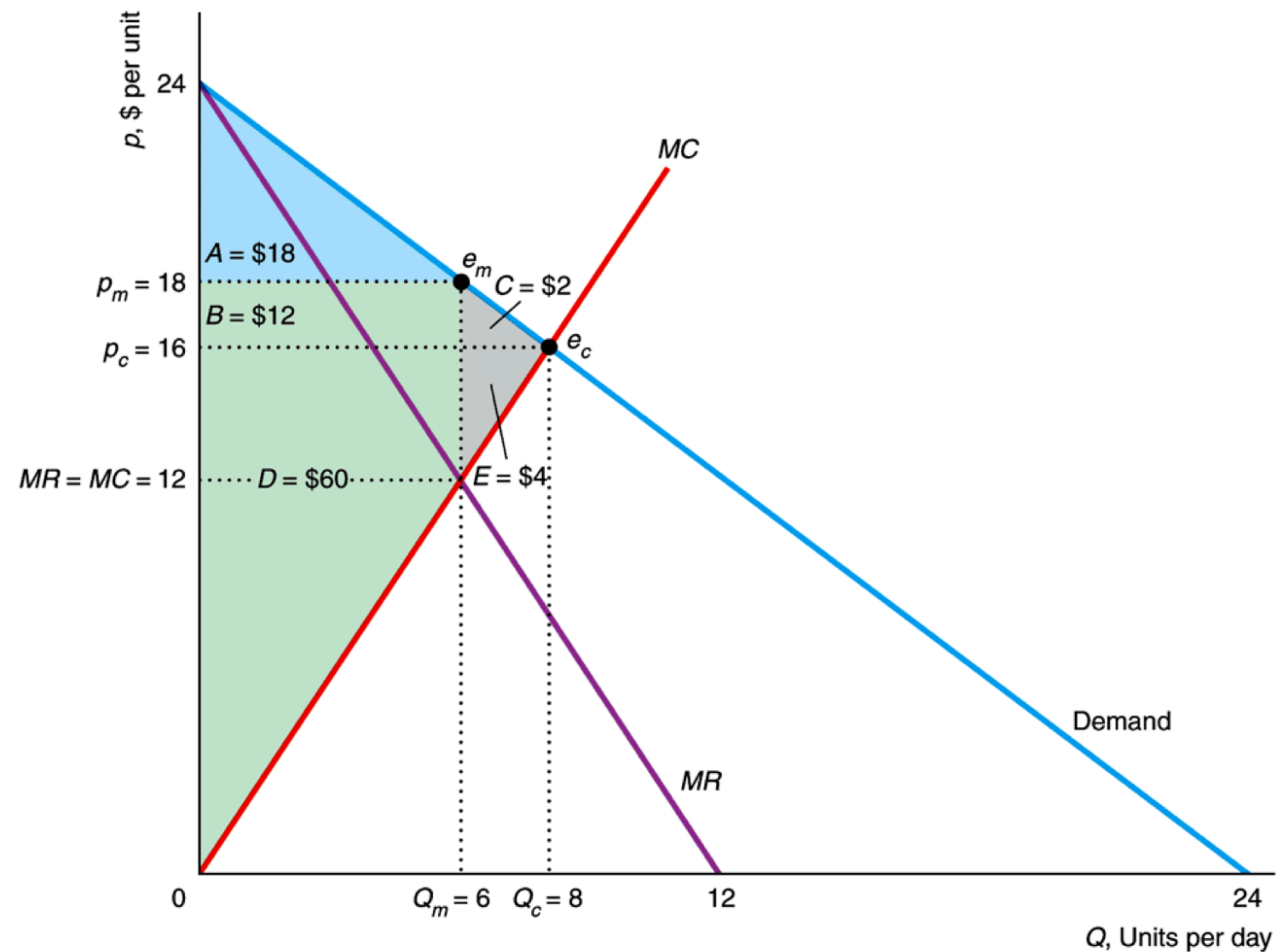
- Ceteris paribus, firms have less market power as:
  - Better substitutes are introduced
  - Other firms enter the market and produce the same good
  - Other firms locate more closely to them geographically



# Welfare Effects of Monopoly

- Having defined welfare as the sum of consumer and producer surplus, we can see monopolies reduce social welfare
- Compared to a competitive market, monopolies do not maximize social welfare

# Deadweight Loss of Monopoly



	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, $W = CS + PS$	$A + B + C + D + E$	$A + B + D$	$-C - E = \Delta W = DWL$

# Why Monopolies Exist

- 2 reasons why markets become monopolized:
  1. Market related cost advantages
  2. Government regulation creates it

# Cost Advantages

- Cost advantages can occur for many reasons
  1. Control of an essential facility — a scarce resource that a rival firm needs to survive (e.g. owning a quarry in a region generates a cost advantage for gravel)
  2. Use of superior production technology or organization (e.g. Henry Ford's assembly lines and standardization)
  3. Protection from imitation through patents or informational secrets

# Natural Monopoly

- **Natural monopoly:** a situation where a single firm can produce the entire market output at the lowest possible cost
- 2 conditions must be met to have a natural monopoly situation occur in the real world
  1. High fixed costs
  2. Constant or decreasing MC (i.e. the opposite of what tends to happen at extremely high levels of production for most types of goods)

# Natural Monopoly Example

- Most people think of public utilities — electric, gas, water/ sewer service, cable
- Computer operating systems another good example



# Government Actions that Create Market Power

- Barriers to entry that prevent additional firms from entry:
  - Issuing licenses that are difficult to obtain
  - Granting exclusive production rights
  - Auctioning off exclusive production rights
- **Patents:** exclusive right to sell a product or use a particular technology for a length of time
  - The good side: patents stimulate research
  - Bad: create deadweight loss

# Government Actions that Create Monopolies

1. Make it difficult for new firms to obtain licenses to operate
  - U.S. cities require new hospitals to secure a certificate of need to show need for new facility
2. Granting the firm rights to be a monopoly
  - Public utilities operated by private companies
  - Patents
3. Auctioning the rights to be a monopoly
  - Selling government monopolies to private firms (privatization)

# Government Acting to Deal with Market Power

- In the case of strong market power, governments face 2 options:
  1. Destroy the market power by breaking up the monopoly into smaller pieces and forcing competition around them
    - antitrust
  2. Regulate the price the monopoly is allowed to charge directly (try to turn them into a price taker)
    - This involves use of oversight agencies who monitor the monopoly and work to estimate the optimal prices that they should be allowed to charge

# How Do Governments Regulate Price?

1. **Optimal price regulation:** government imposes a price ceiling that is equal to the competitive price, eliminating DWL
2. **Non-optimal price regulation:** government imposes a price ceiling that is not set at the competitive level, which reduces but does not eliminate the DWL
3. **Increasing competition:** allowing/encouraging market entry by new domestic firms and ending import bans that kept out international firms

# Problems with Optimal Price Regulation

- Main problem: the monopoly is forced out of business if the price is set at the socially efficient level
- Additional problems:
  - Unknown MC curve: the monopoly is the best source of their cost info and they don't want to give it away
  - The regulated industry/firm has incentive to exert influence over the regulators

# Monopoly Decisions Over Time and Behavioral Econ

- A good has a **network externality** if one person's demand depends not the consumption of a good by others
  - With a **positive network externality**, value to consumer grows as the of units sold increases (e.g. telephones, online platforms)
  - With a **negative network externality**, value to the consumer grows as fewer people posses the good (e.g. paintings)
- A **bandwagon effect** is a popularity-based explanation for a positive network externality — social networks
- A **snob effect** is an explanation for a negative network externality — people like bragging about their art collection