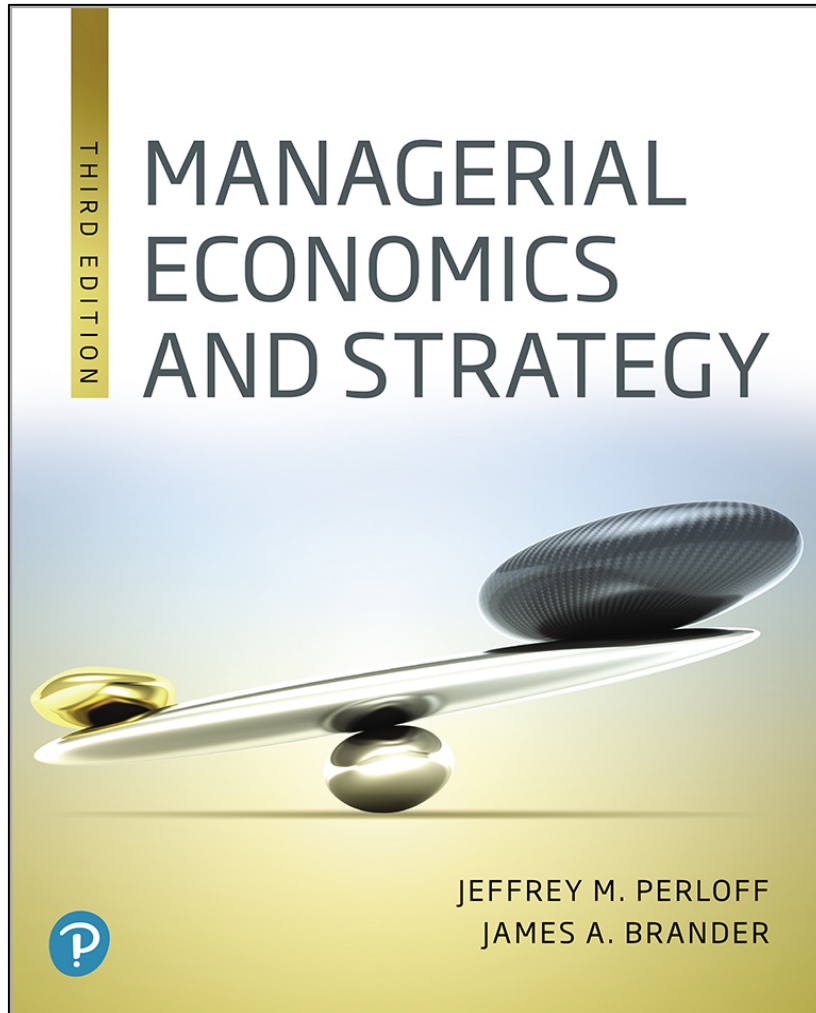


Managerial Economics and Strategy

Third Edition



Chapter 9

Monopoly

Managerial Problem

Brand-Name and Generic Drugs

- Drug firms have patents that expire after 20 years and Congress expects drug prices to fall after it. But, evidence shows that prices went up.
- Why do many brand-name drug companies raise their prices after generic rivals enter the market?

Solution Approach

- We need to understand the decision-making process for a **monopoly**: the sole supplier of a good for which there is no close substitute.

Empirical Methods

- The relevant market structure is **monopoly**, a single seller that sets price or output level to maximize profit where $MC = MR$.
- A monopolist sets its price above its MC (**market power**) and creates a deadweight loss or **market failure due to monopoly pricing**.
- A patent is one form of creating a monopoly, the other is cost.
- To increase profits, a monopoly can use **advertising** and charge an initial low price to create a long-run **network effect**.

Learning Objectives (1 of 2)

9.1 Monopoly Profit Maximization

Show how a monopoly chooses an output level to maximize its profit

9.2 Market Power

Calculate the extent of a monopoly's market power

9.3 Market Failure Due to Monopoly Pricing

Describe how monopoly causes a market failure

Learning Objectives (2 of 2)

9.4 Causes of Monopoly

List the causes of monopoly

9.5 Advertising

Explain how a monopoly uses advertising to increase its profit

9.6 Internet Monopolies: Network Effects and Scale Economies

Discuss the sources of market power for internet firms

9.1 Monopoly Profit Maximization (1 of 8)

Marginal Revenue: $MR = \Delta R / \Delta q$

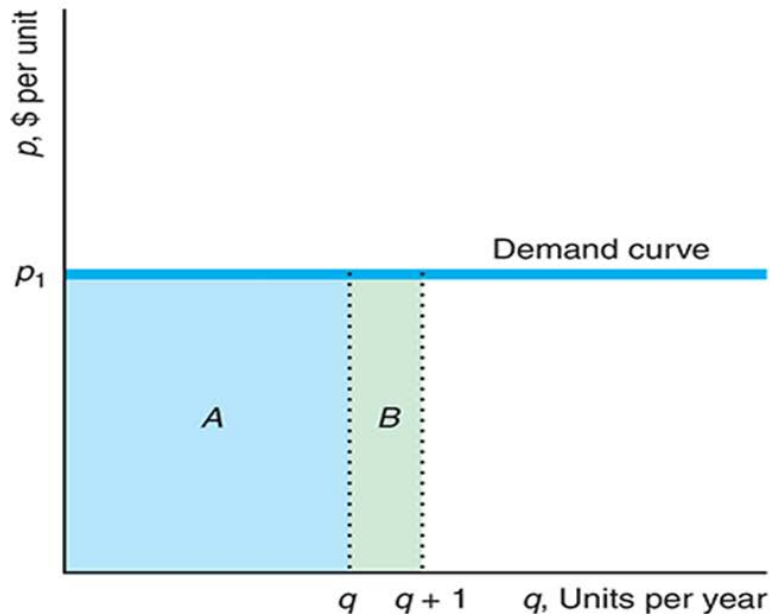
- A firm's **marginal revenue**, MR , is the change in its revenue from selling one more unit.

Marginal Revenue and Price

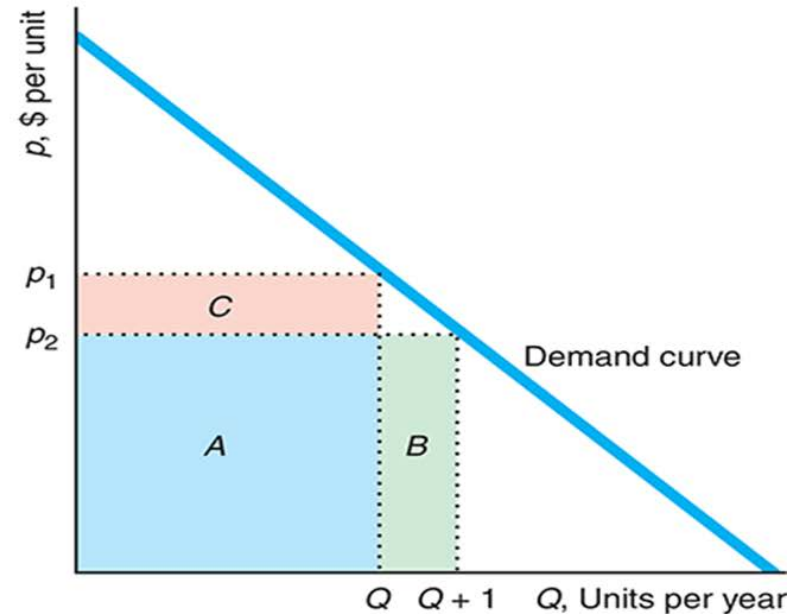
- The MR for a competitive firm
 - In Figure 9.1, panel a, a competitive firm that faces a horizontal demand and $\Delta q=1$. This competitive firm can sell more without reducing price.
 - So, $MR = \Delta R = B = p_1$
- The MR for a monopoly firm
 - In Figure 9.1, panel b, a monopoly faces a downward-sloping market demand and $\Delta q=1$. This monopoly firm can sell more only if price goes down.
 - So, $MR = \Delta R = R_2 - R_1 = B - C = p_2 - C$

Figure 9.1 Average and Marginal Revenue

(a) Competitive Firm



(b) Monopoly



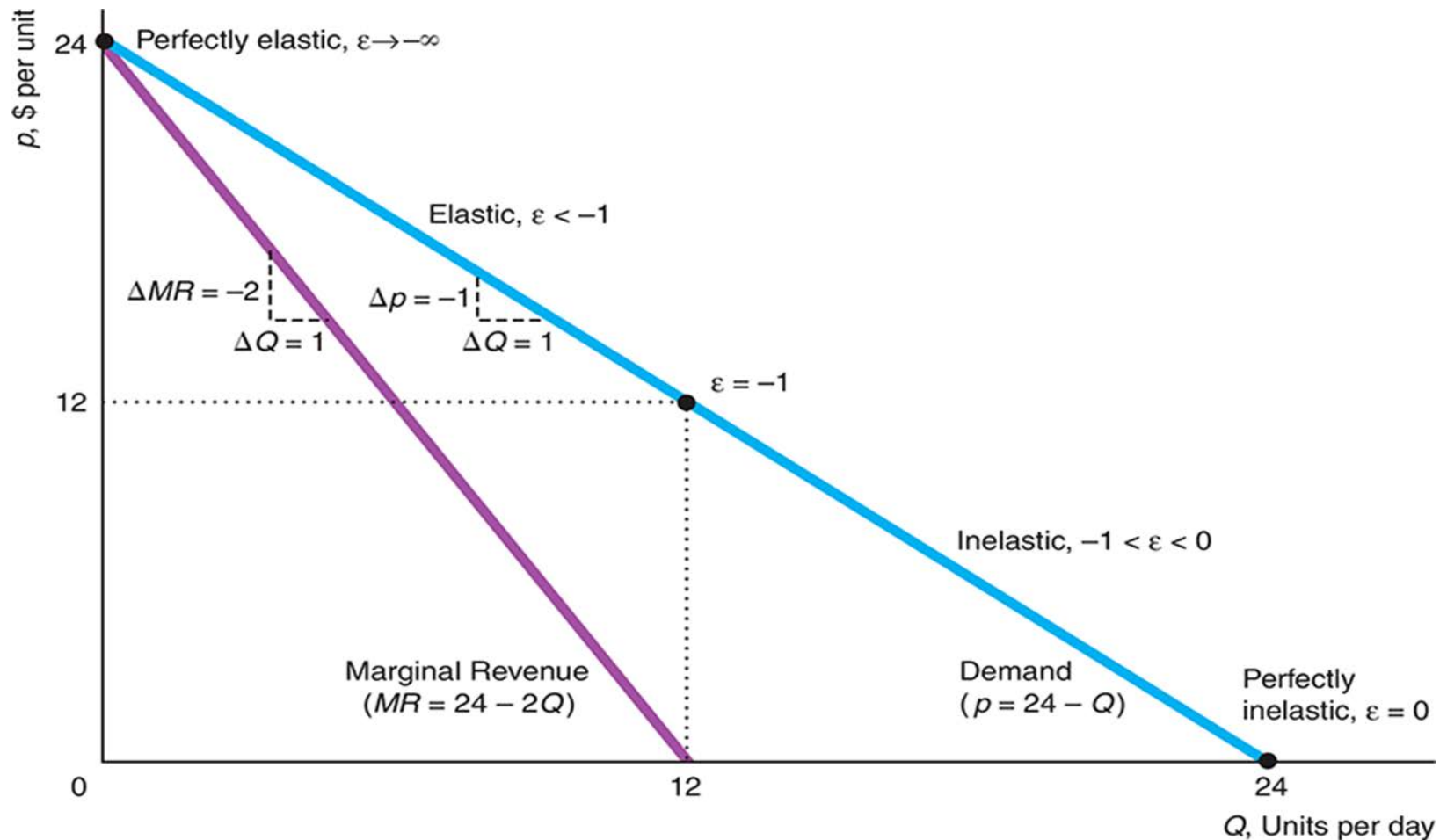
	Initial Revenue, R_1	Revenue with One More Unit, R_2	Marginal Revenue, $R_2 - R_1$
Competition	A	$A + B$	$B = p_1$
Monopoly	$A + C$	$A + B$	$B - C = p_2 - C$

9.1 Monopoly Profit Maximization (2 of 8)

The Marginal Revenue Curve

- The monopoly's *MR* curve lies below a downward-sloping *D* curve for every *q*, and *MR* depends on the shape of the *D* curve.
- *MR* Curve for a Linear Demand
 - The *MR* curve is a straight line that starts at the same point on the vertical (price) axis as the *D* curve but has twice the slope. In Figure 9.2, the *D* and *MR* curves have slopes -1 and -2 , respectively.
- *MR* Function: $MR = p + (\Delta q/\Delta Q)Q$
 - The monopolist *MR* function is lower than *p* because the last term is negative.
 - When inverse *D* is $p = 24 - Q$, then $MR = 24 - 2Q$
- ***MR* Function with Calculus:** $MR(Q) = dR(Q)/dQ$
 - When inverse *D* is $p = 24 - Q$, $R(Q) = (24 - Q)Q = 24Q - Q^2$. So, $MR(Q) = 24 - 2Q$

Figure 9.2 Elasticity of Demand and Total, Average, and Marginal Revenue



9.1 Monopoly Profit Maximization (3 of 8)

Marginal Revenue and Price Elasticity of Demand

- The MR at any given quantity depends on the demand curve's height (the price) and shape.
- The shape of the demand curve at a particular quantity is described by the price elasticity of demand, $\varepsilon = (\Delta Q/Q) / (\Delta p/p) < 0$ (percentage change in quantity demanded after a 1 percent change in price).
- MR & Elasticity Relationship: $MR = p(1 + 1/\varepsilon)$
 - This key relationship says MR is closer to price as demand becomes more elastic. Table 9.1 shows this relationship.
 - Where the demand elasticity is unitary, $\varepsilon = -1$, MR is zero.
 - Where the demand curve is inelastic, $-1 < \varepsilon \leq 0$, MR is negative.
 - Where the demand curve is perfectly elastic, $\varepsilon = -\infty$, MR is p .
 - Figure 9.2 shows a linear D with all the elasticity values in Table 9.1.

Table 9.1 Quantity, Price, Marginal Revenue, and Elasticity for the Linear Inverse Demand Function $p = 24 - Q$

Quantity, Q	Price, p	Marginal Revenue, MR	Elasticity of Demand, $\epsilon = -p/Q$	
0	24	24	$-\infty$	↑ more elastic
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	↓ 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	

9.1 Monopoly Profit Maximization (4 of 8)

Choosing Price or Quantity

- Any firm maximizes profit where its MR and MC are equal.
 - Rule for monopoly maximization: $MR(Q) = MC(Q)$
- A monopoly can adjust its price **or** its quantity to maximize profit.
- Monopolist sets one, market decides the other
 - Whether the monopoly sets its price or its quantity, the other variable is determined by the downward sloping market demand curve.
 - The monopoly faces a trade-off between a higher price and a lower quantity or a lower price and a higher quantity.
- Either Maximize Profit
 - Setting price or quantity are equivalent for a monopoly. We will assume it sets quantity.

9.1 Monopoly Profit Maximization (5 of 8)

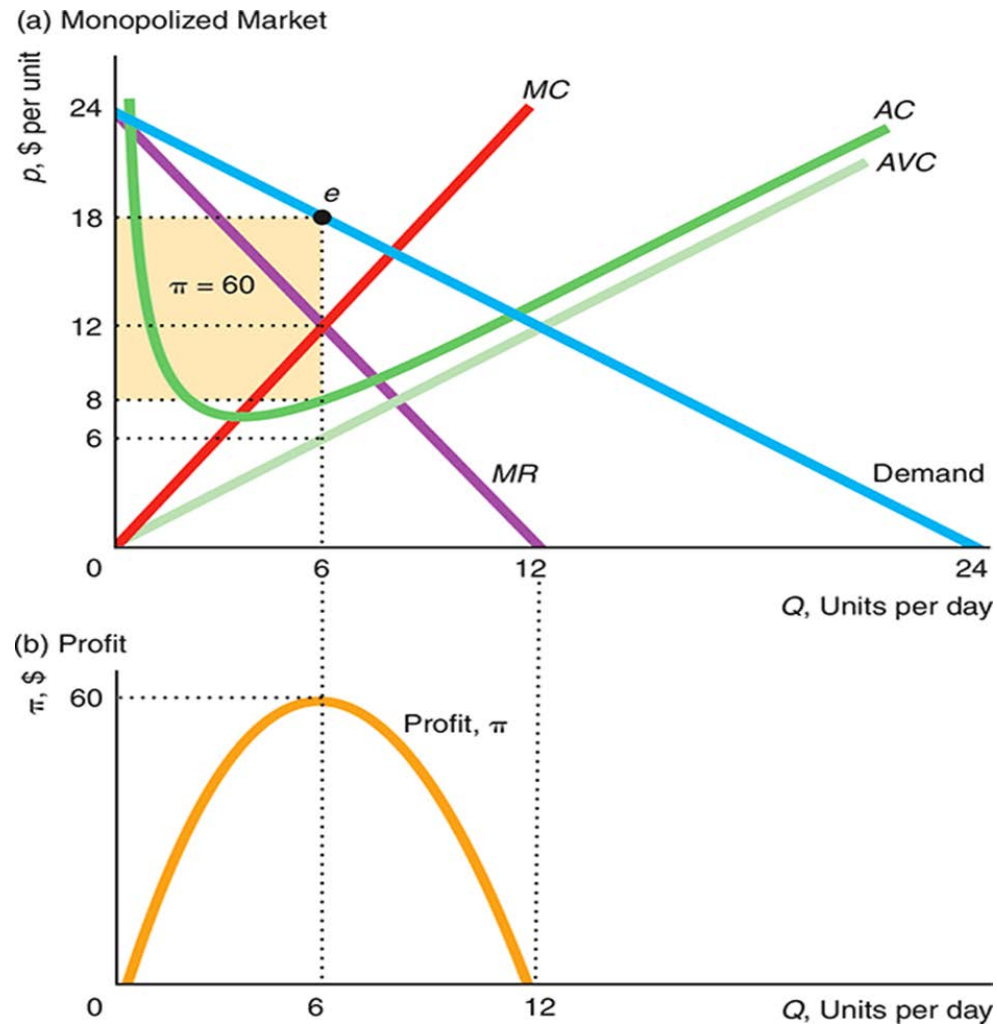
Two Steps to Maximizing Profit

- All profit-maximizing firms use a two-step analysis:
 - 1st, they determine the output Q^* that maximizes profit.
 - 2nd, they decide whether to produce Q^* or shut down.

Profit-Maximizing Output (1st step)

- Profit is maximized where marginal profit equals zero, or $MR(Q) = MC(Q)$
 - In panel a of Figure 9.3, this occurs at point e, $Q=6$, $p=18$, $\pi=60$. This is the maximum profit in panel b.
 - At quantities smaller than 6 units, the monopoly's $MR > MC$, so its marginal profit is positive. By increasing its output, it raises its profit.
 - At quantities greater than 6 units, the monopoly's $MC > MR$, so its marginal profit is negative. By reducing its output, it raises its profit.
 - A monopoly's profit is maximized in the elastic portion of the demand curve. In panel a, Figure 9.3, the elasticity of demand at point e is -3 .
 - A profit-maximizing monopoly never operates in the inelastic portion of its demand curve.

Figure 9.3 Maximizing Profit



9.1 Monopoly Profit Maximization (6 of 8)

The Shutdown Decision (2nd Step)

- A monopoly shuts down to avoid making a loss in the short run if its price is below its average variable cost at its profit-maximizing quantity q^* (Chapter 7).
- Figure 9.3 illustrates a short run case.
 - $MR = MC$ determines q^* . At this profit-maximizing output, the price is above the average variable cost ($Q^* = 6$, $AVC = \$6$, $p = \$18$, $\pi = \$60$). So, the monopoly chooses to produce and it makes a positive profit ($p > AC$).
 - The shutdown decision in the long run for the monopolist would occur if the price were less than its average cost.

9.1 Monopoly Profit Maximization (7 of 8)

Using Calculus, Output Decision: $d\pi(Q) / dQ = 0$

- By setting the derivative of the profit function with respect to Q equal to zero, we have an equation that determines the profit-maximizing output.
- $d\pi(Q)/dQ = dR(Q)/dQ - dC(Q)/dQ = MR - MC = 0$
- In Figure 9.3, $MR = 24 - 2Q = 2Q = MC$. So, $Q=6$. Substituting $Q = 6$ into the inverse demand function (Equation 9.2), $p = 24 - Q = 24 - 6 = 18$.

Using Calculus, Shutdown Decision

- At $Q = 6$, $AVC = Q^2/Q = 6$, which is less than the price. So, the monopoly does not shut down.
- At $Q = 6$, $AC = (6 + 12 / 6) = 8$, which is less than the price. So, the monopoly makes a profit.

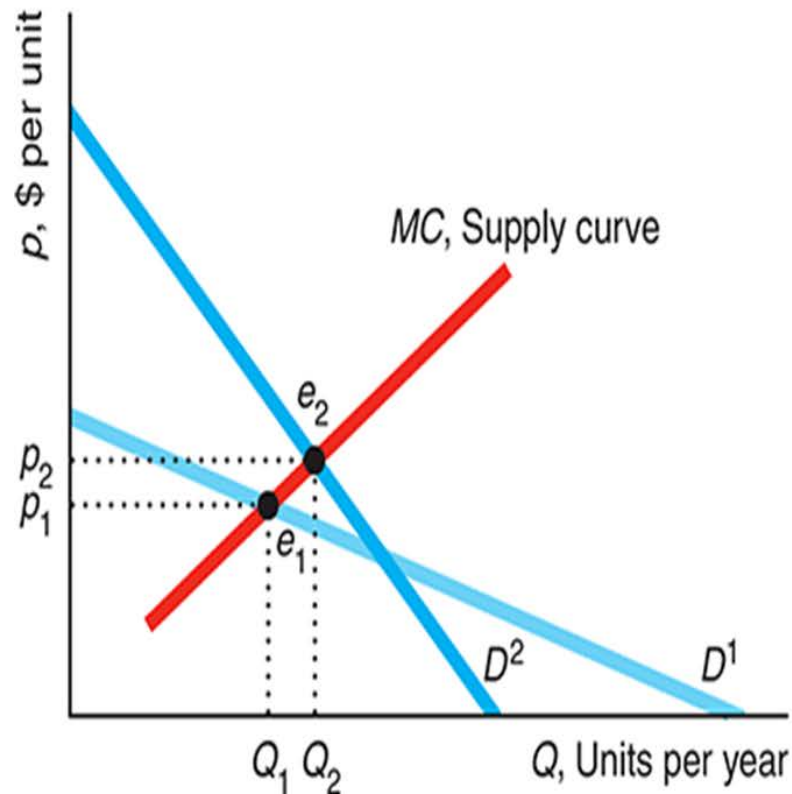
9.1 Monopoly Profit Maximization (8 of 8)

Effects of a Shift of the Demand Curve

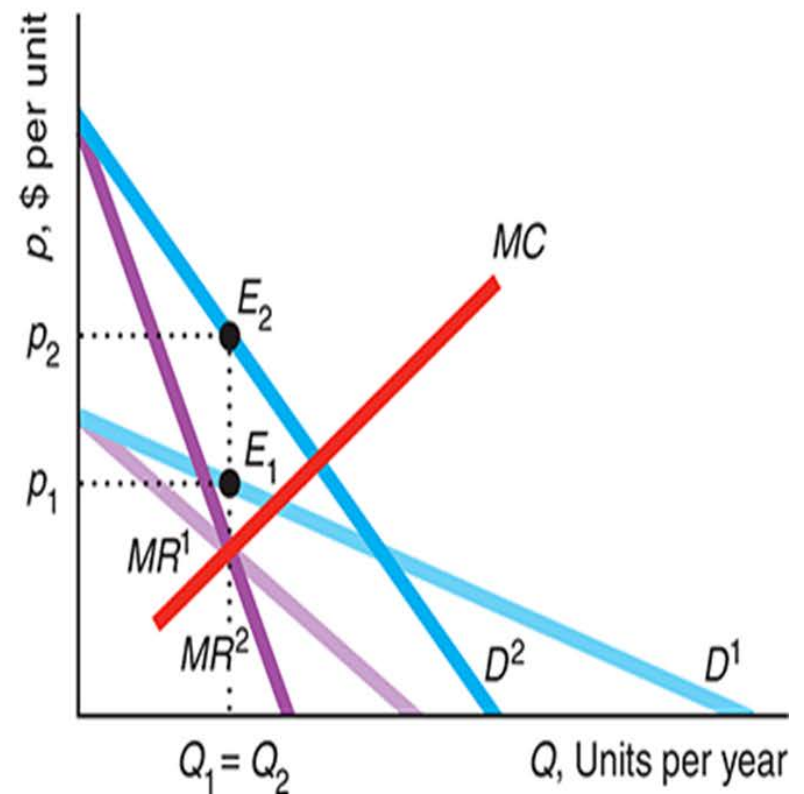
- Competitive Market Case
 - The effect of a shift in demand on a competitive firm's output depends only on the shape of the marginal cost curve.
 - The new equilibrium ($P = MC$) occurs along the marginal cost curve, and for every equilibrium quantity, there is a single corresponding equilibrium price, as illustrated in Figure 9.4, panel a.
- Monopoly Case
 - The effect of a shift in demand on a monopoly's output depends on the shapes of both the marginal cost curve and the demand curve.
 - The new equilibrium ($MR = MC$) may occur at new levels of prices and quantities, or two different prices for the same quantity, or the same price for two different quantities.
 - In Figure 9.4, panel b, the shift of demand from D^1 to D^2 causes the optimum to change from E_1 to E_2 . The monopoly quantity stays the same, but the monopoly price rises (one q associated with 2 prices).

Figure 9.4 Effects of a Shift of the Demand Curve

(a) Competition



(b) Monopoly



9.2 Market Power (1 of 6)

Market Power

- A monopoly has market power, which is the ability to significantly affect the market price. In contrast, no single competitive firm can significantly affect the market price.
 - A profit-maximizing monopoly charges a price that exceeds its marginal cost. The extent to which the monopoly price exceeds marginal cost depends on the shape of the demand curve.
- **Common Confusion:** The larger the monopoly, the more it can mark up its price over its cost, which is false.
 - Size doesn't matter. Rather, a profit-maximizing monopoly marks up price over marginal cost more if consumers are less sensitive to price (the demand curve is less elastic).
 - For example, some drugs do not have a large volume of sales but have extremely high prices because they are crucial for a small segment of the population.

9.2 Market Power (2 of 6)

Market Power and the Shape of the Demand Curve

- If the monopoly faces a very inelastic demand curve (steep) at the profit-maximizing quantity, it would lose few sales if it raises its price.
- However, if the demand curve is very elastic (flat) at that quantity, the monopoly would lose substantial sales from raising its price by the same amount.
- Profit-Maximizing Price: $p = [1 / (1 + 1 / \varepsilon)] MC$
 - The monopoly's profit-maximizing price is a ratio times the marginal cost and the ratio depends on the elasticity. In Table 9.2:
 - If $\varepsilon = -1.01$, only slightly elastic, the ratio is 101 and $p = 101 MC$
 - If $\varepsilon = -3$, more elastic, the ratio is only 1.5 and $p = 1.5 MC$
 - If $\varepsilon = -\infty$, perfectly elastic, the ratio shrinks to 1 and $p = MC$
 - Thus, even in the absence of rivals, the shape of the demand curve constrains the monopoly's ability to exercise market power.

Table 9.2 Elasticity of Demand, Price, and Marginal Cost

	Elasticity of Demand, ε	Price/Marginal Cost Ratio, $p/MC = 1/[1 + (1/\varepsilon)]$	Lerner Index, $(p - MC)/p = -1/\varepsilon$
↑ less elastic ↓ more elastic	-1.01	101	0.99
	-1.1	11	0.91
	-2	2	0.5
	-3	1.5	0.33
	-5	1.25	0.2
	-10	1.11	0.1
	-100	1.01	0.01
	$-\infty$	1	0

9.2 Market Power (3 of 6)

Managerial Implication: Checking Whether the Firm Is Maximizing Profit

- A manager can use “ $p / MC = 1 / (1 + 1 / \varepsilon)$ ” to determine whether the firm is maximizing its profit.
 - Many private firms—such as ACNielsen, IRI, and IMS Health—and industry groups collect data on quantities and prices in a wide variety of industries.
 - Firms can use these data to estimate the firm’s demand curve (Chapter 3) and hire consulting firms to estimate the elasticity of demand for their products.
 - If the p/MC ratio does not approximately equal $[1 / (1 + 1 / \varepsilon)]$, then the manager knows that the firm is not setting its price to maximize its profit.

9.2 Market Power (4 of 6)

The Lerner Index or Price Markup: $(p - MC)/p$

- The **Lerner Index** measures a firm's market power: the larger is the difference between price and marginal cost, the larger is the Lerner Index.
 - This index can be calculated for any firm, whether or not the firm is a monopoly.
- Lerner Index and Elasticity: $(p - MC) / p = -1 / \varepsilon$
 - The Lerner Index or price markup for a monopoly ranges between 0 and 1.
- As Table 9.2 illustrates, the Lerner Index for a monopoly increases as the demand becomes less elastic:
 - If $\varepsilon = -1.01$, only slightly elastic, the monopoly markup is 0.99 (99%)
 - If $\varepsilon = -3$, more elastic, the monopoly markup is 0.33 (33%)
 - If $\varepsilon = -\infty$, perfectly elastic, the monopoly markup is zero

9.2 Market Power (5 of 6)

Sources of Market Power



*Of course you could get it done for less
if I weren't the only plumber in town.*

9.2 Market Power (6 of 6)

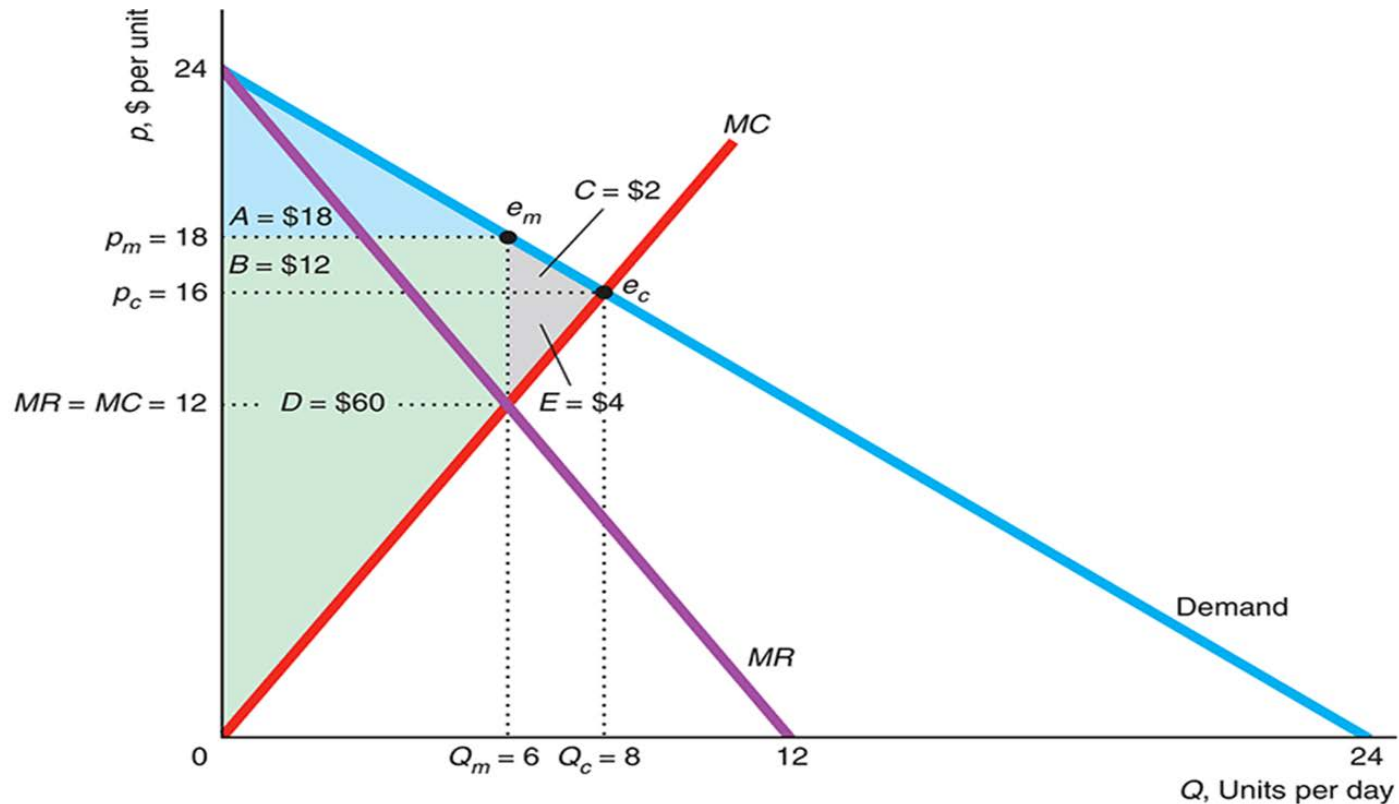
Sources of Market Power

- Market power is determined by the availability of substitutes, number of firms and proximity of competitors.
- Less Power with ...
 - **Less power with better substitutes:** When better substitutes are introduced into the market, the demand becomes more elastic (Xerox pioneered plain-paper copy machines until ...)
 - **Less power with more firms:** When more firms enter the market, people have more choices, the demand becomes more elastic (USPS after FedEx and UPS entered the market).
 - **Less power with closer competitors:** When firms that provide the same service locate closer to this firm, the demand becomes more elastic (Wendy's, Burger King, and McDonald's close to each other).

9.3 Market Failure Due to Monopoly Pricing

- A perfect competitive firm achieves **economic efficiency** (maximizes total surplus, $TS = CS + PS$).
- However, unlike perfect competition, a monopoly is **economically inefficient** because it wastes potential surplus, resulting in a **deadweight loss**.
- The inefficiency of monopoly pricing is an example of **market failure**.
 - Market failure: nonoptimal allocation of goods & services with economic inefficiencies (price is not marginal cost).
- A monopoly sets $p > MC$ causing consumers to buy less than the competitive level of the good. It destroys some of the potential gains from trade. So society suffers a **deadweight loss**.
 - In Figure 9.5, the monopolist's maximizing q and p are 6 and \$18. The competitive values would be 8 and \$16.
 - The deadweight loss of monopoly is $-C - E$. Potential surplus that is wasted because less than the competitive output is produced.

Figure 9.5 Deadweight Loss of Monopoly



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

9.4 Causes of Monopoly (1 of 2)

- Monopoly markets exist mainly because of cost considerations and government policy.

Cost-Based Monopoly

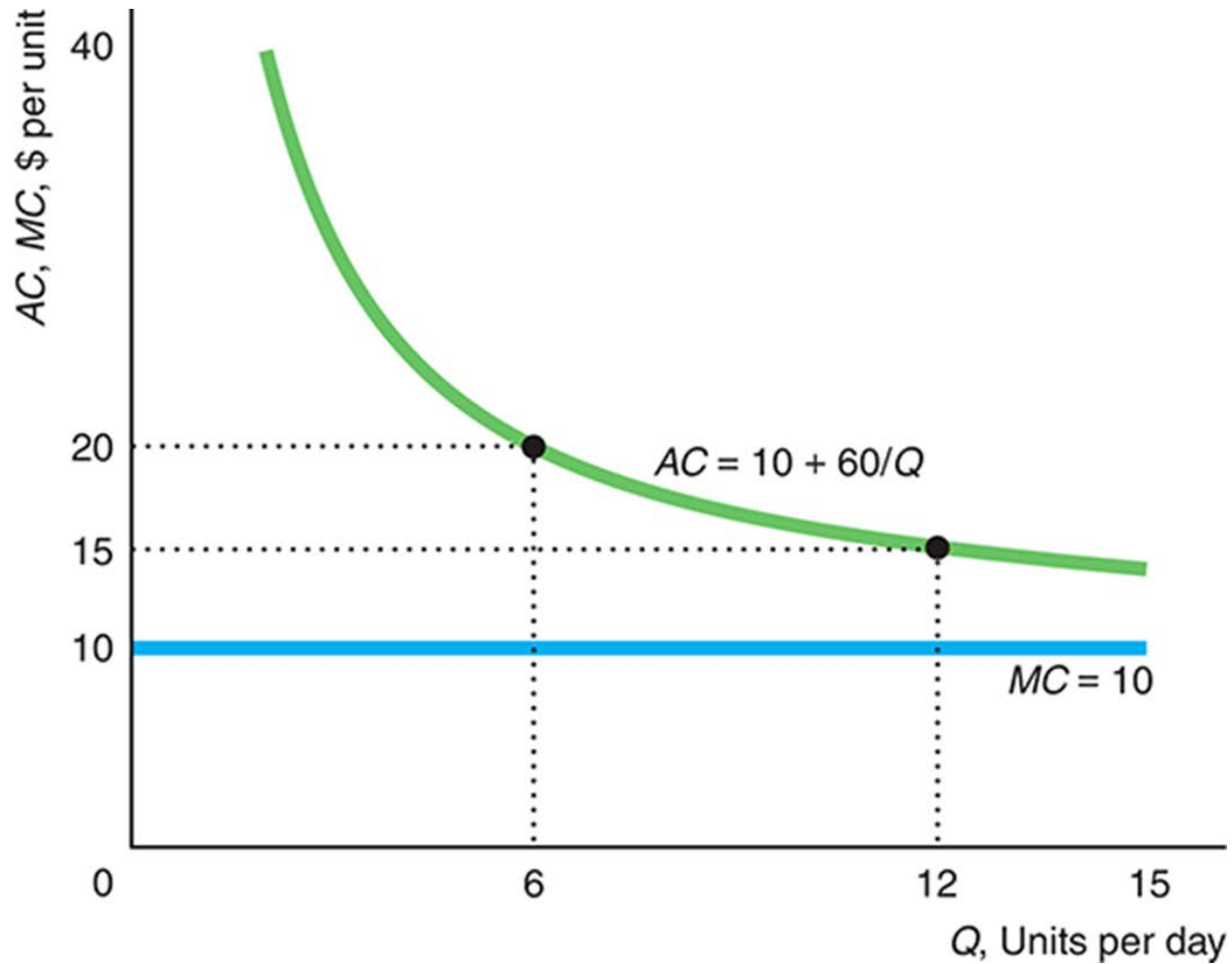
Cost Advantages—A firm with substantial lower costs than potential rivals.

- A low-cost firm is a monopoly if it sells at a price so low that other potential competitors with higher costs would lose money. No other firm enters the market.
- The sources of it are superior technology, better production methods, control of either an essential facility or a scarce resource.

Natural Monopoly—A firm may produce the total output of the market at lower cost than two or more firms could.

- $C(Q) < C(q_1) + C(q_2) + \dots + C(q_n)$, where $Q = q_1 + q_2 + \dots + q_n$ is the sum of the output of any n firms where $n \geq 2$ firms.
- The reason is **economies of scale**: a natural monopoly has an strictly declining average cost curve (Figure 9.6).
- When just one firm is the cheapest way to produce any given output level, governments often grant monopoly rights to **public utilities** of water, gas, electric power, or mail delivery.

Figure 9.6 Natural Monopoly



9.4 Causes of Monopoly (2 of 2)

Government Creation of Monopoly

- Governments grant a license, monopoly rights, or patents

Barriers to Entry

- Governments create monopolies either by making it difficult for new firms to obtain a **license** to operate or by explicitly granting a **monopoly right** to one firm, thereby excluding other firms.
- By **auctioning a monopoly** to a private firm, a government can capture the future value of monopoly earnings. However, for political or other reasons, governments frequently do not capture all future profits.

Patents

- A **patent** is an exclusive right granted to the inventor of a new and useful product, process, substance, or design for a specified length of time.
 - The length of a patent varies across countries, although it is now 20 years in the United States.

9.5 Advertising (1 of 2)

- Advertising is only one way to promote a product.
- A firm advertises to raise its profit. A successful advertising campaign shifts the monopolist market demand curve outward and makes it less elastic. This allows the monopolist to sell more units at a higher price.
 - In Figure 9.7, after successful advertising D_2 is to the right and it is less elastic than D_1 .

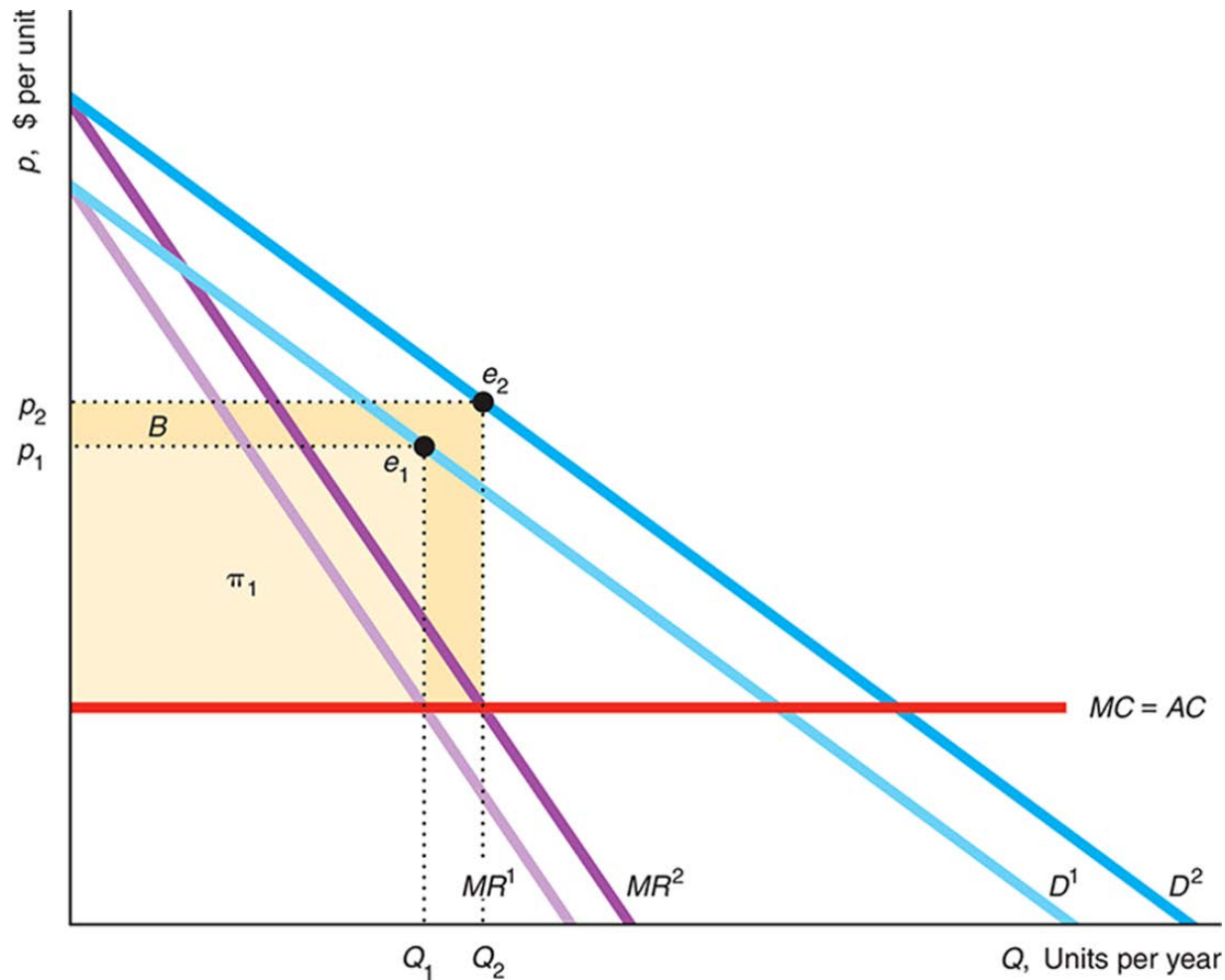
Deciding Whether to Advertise

- Do it only if firm expects **net profit** (gross profit minus the cost of advertising) to increase.
 - In Figure 9.7, gross profit is B . Only if its cost of advertising is less than B , its net profit rises and advertising should be done.

How Much to Advertise

- Do it until its marginal benefit (gross profit from one more unit of advertising or marginal revenue from one more unit of output) equals its marginal cost.

Figure 9.7 Advertising



9.5 Advertising (2 of 2)

Using Calculus for Optimal Advertising:

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

- Profit equals revenue minus cost. Advertising, A , is a fixed cost and affects revenue, R . $R(Q, A) = p(Q, A)Q$. The monopoly maximizes its profit by choosing Q and A .
- First Order Condition: $\partial\pi(Q, A) / \partial Q = 0$
 - $\partial R(Q, A) / \partial Q - \partial C(Q) / \partial Q = 0$
 - The monopoly should set its output so that $MR = MC$
- First Order Condition: $\partial\pi(Q, A) / \partial A = 0$
 - $\partial R(Q, A) / \partial A - 1 = 0$
 - The monopoly should advertise to the point where its marginal revenue or marginal benefit from the last unit of advertising, $\partial R / \partial A$, equals the marginal cost of the last unit of advertising, \$1.

9.6 Internet Monopolies: Network Effects and Scale Economies (1 of 6)

Network Externalities

- A good has a network externality if one person's demand depends on the consumption of a good by others.
- If a good has a **positive network externality**, its value to a consumer grows as the number of units sold increases.
- Network externalities are an important source of monopoly power.
 - Classic example: When the phone was introduced, potential adopters had no reason to subscribe for phone service unless their family and friends did. Why pay for phone service if you have no one to call? For Bell's phone network to succeed, it had to achieve a critical mass of users—enough adopters so that others wanted to join. Had it failed to achieve this critical mass, demand would have withered and the network would have died

9.6 Internet Monopolies: Network Effects and Scale Economies (2 of 6)

Managerial Implication: Introductory Prices

- Managers of firms that want to sell goods and services with network externalities often initially sell them at a low introductory price to obtain a critical mass. By doing so, the manager maximizes long-run profit but not short-run profit.
 - Assume a monopolist sells goods for only two periods. The manager should charge a low introductory price in the first period if the reduction in first-period profit is less than the extra profit in the second period. So, total profit is maximized.
 - Introductory prices is profitable for many firms. A 2018 Google search found over a million web pages touting an introductory price.
- A closely related strategy used for many internet services is to start by offering a free version, then, after creating a large enough user base, offer a premium version at a positive (and profitable) price, like Yahoo! mail.

9.6 Internet Monopolies: Network Effects and Scale Economies (3 of 6)

Behavioral Network Externalities

- Network externalities depend on the size of the network because customers want to interact with each other.
- Behavioral economics studies how consumers' behavior depends on beliefs or tastes that can be explained by psychological and sociological theories.
- Positive network externality
 - consumers sometimes want a good because “everyone else has it.”
 - **bandwagon effect**—A person places greater value on a good as more and more people possess it.
- Negative network externality
 - **snob effect**—A person places greater value on a good as fewer and fewer people possess it.

9.6 Internet Monopolies: Network Effects and Scale Economies (4 of 6)

Two-Sided Markets

- A **two-sided market** or **two-sided network** is an economic platform that has two or more user groups that provide each other with network externalities. There are two common types.
 - Economic platforms match sellers with buyers. For instance, Airbnb (short-term rentals), Lyft (driver service), and [Monster.com](https://www.monster.com) (an employment site).
 - Innovation platforms provide a technology upon which other firms can build and customers use. For instance, Google's Android operating system for cell phones and the internet itself.
- Many noninternet industries also have two-sided networks.
 - Both cardholders and merchants use credit cards. Gamers and game developers link using video-game consoles. Doctors and patients connect through health maintenance organizations and hospitals.

9.6 Internet Monopolies: Network Effects and Scale Economies (5 of 6)

Natural Monopoly on the Internet

- Many internet services require a large up-front fixed cost but have a low marginal cost, sometimes nearly zero. As a result, such firms have downward-sloping average cost curves, reflecting economies of scale. A monopoly or near-monopoly may emerge after a brief period of internet competition.
 - Google is an example of such natural monopoly. Google services are free to users, has a large user base that attracts advertisers and earns substantial profits. Any potential competitor providing an identical service would struggle to cover its fixed costs.
 - Facebook benefits from both a natural monopoly cost structure and network externalities.

9.6 Internet Monopolies: Network Effects and Scale Economies (6 of 6)

Disruptive Technologies

- The internet facilitates the introduction of disruptive technologies (Chapter 7) with strong network externalities and economies of scale.
- Because these new internet technologies have network externalities, low marginal costs, and decreasing average cost curves, they often can drive out existing technologies.
 - Amazon is driving many traditional bookstores out of business.
 - Online news is driving print newspapers out of business.
 - Streaming movies killed off most of the movie videotape/CD/Blu-ray rental stores.
 - Streaming music has largely eliminated record-CD sales.

Managerial Solution

Brand-Name and Generic Drugs

- Drug firms have patents that expire after 20 years and Congress expects drug prices to fall after it. But, evidence shows that prices went up.
- Why do many brand-name drug companies raise their prices after generic rivals enter the market?

Solution

- When generic drugs enter the market after the patent expires, the demand curve facing the brand-name firm shifts to the left, and rotates to become less elastic at the original price.
- Price sensitive consumers switch to the generic, but loyal customers prefer the brand-name drug (familiar and secure product for them).
- Elderly and patients with generous insurance plans fit this group.

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