The price of vanilla is bouncing. A kilogram (2.2 pounds) of vanilla beans sold for $50 in 2000, but by 2003 the price had risen to $500 per kilogram. The price soared because a devastating cyclone hit Madagascar, the African nation that leads the world in vanilla production. Three years later in 2006, the price of vanilla beans had sunk to only $25 per kilogram. What caused the price to go from $50 to $500 to $25? As we’ll see in this chapter,
APPLYING THE CONCEPTS

1. How do changes in demand affect prices?
   *Hurricane Katrina and Baton Rouge Housing Prices*

2. What could explain a decrease in price?
   *Ted Koppel Tries to Explain Lower Drug Prices*

3. How does the adoption of new technology affect prices?
   *Electricity from the Wind*

4. How do changes in supply affect prices?
   *The Bouncing Price of Vanilla Beans*

5. How do changes in one market affect other markets?
   *Platinum, Jewelry, and Catalytic Converters*

The answer is “demand and supply.” We’ll use the model of demand and supply, the most popular tool of economic analysis, to explain the bouncing price of vanilla and other market phenomena.
This chapter explores the mechanics of markets. We use the model of demand and supply—the most important tool of economic analysis—to see how markets work. We'll see how the prices of goods and services are affected by all sorts of changes in the economy, including bad weather, higher income, technological innovation, bad publicity, and changes in consumer preferences. This chapter will prepare you for the applications of demand and supply you'll see in the rest of the book.

The model of demand and supply explains how a perfectly competitive market operates. A perfectly competitive market has many buyers and sellers of a product, and no single buyer or seller can affect the market price. The classic example of a perfectly competitive firm is a wheat farmer, who produces a tiny fraction of the total supply of wheat. No matter how much wheat an individual farmer produces, the farmer can't change the market price of wheat.

3.1 THE DEMAND CURVE

On the demand side of a market, consumers buy products from firms. The main question concerning the demand side of the market is: How much of a particular product are consumers willing to buy during a particular period? A consumer who is willing to buy a particular product is willing to sacrifice enough money to purchase it. The consumer doesn't merely have a desire to buy the good, but is willing and able to sacrifice something to get it. Notice that demand is defined for a particular period, for example, a day, a month, or a year.

We'll start our discussion of demand with the individual consumer. How much of a product is an individual willing to buy? It depends on a number of variables. Here is a list of the variables that affect an individual consumer's decision, using the pizza market as an example:

- The price of the product (for example, the price of a pizza)
- The consumer's income
- The price of substitute goods (for example, the prices of tacos or sandwiches)
- The price of complementary goods (for example, the price of lemonade)
- The consumer's preferences or tastes and advertising that may influence preferences
- The consumer's expectations about future prices

Together, these variables determine how much of a particular product an individual consumer is willing and able to buy, the quantity demanded. We'll start our discussion of demand with the relationship between the price and quantity demanded, a relationship that is represented graphically by the demand curve. Later in the chapter, we will discuss the other variables that affect the individual consumer's decision about how much of a product to buy.

The Individual Demand Curve and the Law of Demand

The starting point for a discussion of individual demand is a demand schedule, which is a table of numbers showing the relationship between the price of a particular product and the quantity that an individual consumer is willing to buy. The demand schedule shows how the quantity demanded by an individual changes with the price, ceteris paribus (everything else held fixed). The variables that are held fixed in the demand schedule are the consumer's income, the prices of substitutes and complements, the consumer's tastes, and the consumer's expectations about future prices.

The table in Figure 3.1 shows Al's demand schedule for pizza. At a price of $2, Al buys 13 pizzas per month. As the price rises, he buys fewer pizzas: 10 pizzas at a price of $4, 7 pizzas at a price of $6, and so on, down to only 1 pizza at a price of $10. It's important to remember that in a demand schedule, any change in quantity results from a change in price alone.
The individual demand curve is a graphical representation of the demand schedule. By plotting the numbers in Al's demand schedule—various combinations of price and quantity—we can draw his demand curve for pizza. The demand curve shows the relationship between the price and the quantity demanded by an individual consumer, \textit{ceteris paribus}. To get the data for a single demand curve, we change only the price of pizza and observe how a consumer responds to the price change. In Figure 3.1, Al's demand curve shows the quantity of pizzas he is willing to buy at each price.

Notice that Al's demand curve is negatively sloped, reflecting the \textit{law of demand}. This law applies to all consumers:

\textit{There is a negative relationship between price and quantity demanded, ceteris paribus.}

The words \textit{ceteris paribus} remind us that to isolate the relationship between price and quantity demanded, we must assume that income, the prices of related goods such as substitutes and complements, and tastes are unchanged. As the price of pizza increases and nothing else changes, Al moves upward along his demand curve and buys a smaller quantity of pizza. For example, if the price increases from $8 to $10, Al moves upward along his demand curve from point \( b \) to point \( a \), and he buys only 1 pizza per month, down from 4 pizzas at the lower price. A movement along a single demand curve is called a \textit{change in quantity demanded}, a change in the quantity a consumer is willing to buy when the price changes.

\textbf{From Individual Demand to Market Demand}

The market demand curve shows the relationship between the price of the good and the quantity demanded by all consumers, \textit{ceteris paribus}. As in the case of the individual demand curve, when we draw the market demand curve we assume that the other

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
Point & Price & Quantity of Pizzas per Month \\
\hline
\( a \) & $10 & 1 \\
\( b \) & 8 & 4 \\
\( c \) & 6 & 7 \\
\( d \) & 4 & 10 \\
\( e \) & 2 & 13 \\
\hline
\end{tabular}
\caption{Al's Demand Schedule for Pizzas}
\end{table}
variables that affect individual demand (income, the prices of substitute and complementary goods, tastes, and price expectations) are fixed. In addition, we assume that the number of consumers is fixed.

Figure 3.2 shows how to derive the market demand curve when there are only 2 consumers. Panel A shows Al’s demand curve for pizza, and Panel B shows Bea’s demand curve. At a price of $8, Al’s quantity is 4 pizzas (point a) and Bea’s quantity is 2 pizzas (point b), so the market quantity demanded is 6 pizzas (point c). Each consumer obeys the law of demand, so the market demand curve is negatively sloped.

The market demand equals the sum of the demands of all consumers. In this case, there are only two consumers, so at each price, the market quantity demanded equals the quantity demanded by Al plus the quantity demanded by Bea. At a price of $8, Al’s quantity is 4 pizzas (point a) and Bea’s quantity is 2 pizzas (point b), so the market quantity demanded is 6 pizzas (point c). Each consumer obeys the law of demand, so the market demand curve is negatively sloped.

### QUANTITY OF PIZZA DEMANDED

<table>
<thead>
<tr>
<th>Price</th>
<th>Al +</th>
<th>Bea</th>
<th>Market Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>8</td>
<td>21</td>
</tr>
</tbody>
</table>

▲ FIGURE 3.2
From Individual to Market Demand
The market demand equals the sum of the demands of all consumers. In this case, there are only two consumers, so at each price, the market quantity demanded equals the quantity demanded by Al plus the quantity demanded by Bea. At a price of $8, Al’s quantity is 4 pizzas (point a) and Bea’s quantity is 2 pizzas (point b), so the market quantity demanded is 6 pizzas (point c). Each consumer obeys the law of demand, so the market demand curve is negatively sloped.

The market demand is negatively sloped, reflecting the law of demand. This is sensible, because if each consumer obeys the law of demand, consumers as a group will too. When the price increases from $4 to $8, there is a change in quantity demanded as we move along the demand curve from point f to point c. The movement along the demand curve occurs if the price of pizza is the only variable that has changed.

## 3.2 | THE SUPPLY CURVE

On the supply side of a market, firms sell their products to consumers. Suppose you ask the manager of a firm, “How much of your product are you willing to produce and sell?” The answer is likely to be “it depends.” The manager’s decision about how much to produce depends on many variables, including the following, using pizza as an example:
The Individual Supply Curve

Consider the decision of an individual producer. The starting point for a discussion of individual supply is a supply schedule, a table that shows the relationship between the price of a particular product and the quantity that an individual producer is willing to produce and sell. The supply schedule shows how the quantity supplied by an individual producer changes with the price, ceteris paribus. The variables that are held fixed in the supply schedule are input costs, technology, price expectations, and government taxes or subsidies.

The table in Figure 3.3 shows the supply schedule for pizza at Lola’s Pizza Shop. At a price of $2, she doesn’t produce any pizzas, indicating that a $2 price is not high enough to cover her cost of producing a pizza. In contrast, at a price of $4 she supplies 100 pizzas per month.

### FIGURE 3.3

The Individual Supply Curve

The supply curve of an individual supplier is positively sloped, reflecting the law of supply. As shown by point a, the quantity supplied is zero at a price of $2, indicating that the minimum supply price is just above $2. An increase in price increases the quantity supplied, to 100 pizzas at a price of $4, to 200 pizzas at a price of $6, and so on.

### INDIVIDUAL SUPPLY SCHEDULE FOR PIZZA

<table>
<thead>
<tr>
<th>Point</th>
<th>Price</th>
<th>Quantity of Pizzas per Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>$2</td>
<td>0</td>
</tr>
<tr>
<td>b</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>c</td>
<td>6</td>
<td>200</td>
</tr>
<tr>
<td>d</td>
<td>8</td>
<td>300</td>
</tr>
<tr>
<td>e</td>
<td>10</td>
<td>400</td>
</tr>
</tbody>
</table>
100 pizzas. In this example, each $2 increase in price increases the quantity supplied by 100 pizzas—to 200 at a price of $6, to 300 at a price of $8, and so on. It’s important to remember that in a supply schedule, a change in quantity results from a change in price alone.

The individual supply curve is a graphical representation of the supply schedule. By plotting the numbers in Lola’s supply schedule—different combinations of price and quantity—we can draw her supply curve for pizza. The individual supply curve shows the relationship between the price of a product and the quantity supplied by a single firm, ceteris paribus. To get the data for a supply curve, we change only the price of pizza and observe how a producer responds to the price change.

Figure 3.3 shows the supply curve for Lola, which shows the quantity of pizzas she is willing to sell at each price. The individual supply curve is positively sloped, reflecting the law of supply, a pattern of behavior that we observe in producers:

There is a positive relationship between price and quantity supplied, ceteris paribus.

The words ceteris paribus remind us that to isolate the relationship between price and quantity supplied we assume that the other factors that influence producers are unchanged. As the price of pizza increases and nothing else changes, Lola moves upward along her individual supply curve and produces a larger quantity of pizza. For example, if the price increases from $6 to $8, Lola moves upward along her supply curve from point c to point d, and the quantity supplied increases from 200 to 300. A movement along a single supply curve is called a change in quantity supplied, a change in the quantity that a producer is willing and able to sell when the price changes.

The minimum supply price is the lowest price at which a product is supplied. A firm won’t produce a product unless the price is high enough to cover the marginal cost of producing it. In the case of pizza, the price must be high enough to cover the cost of producing the first pizza. As shown in Figure 3.3, a price of $2 is not high enough to cover the cost of producing the first pizza, so Lola’s quantity supplied is zero (point a). But when the price rises above $2, she produces some pizzas, indicating that her minimum supply price is just above $2.

Why Is the Individual Supply Curve Positively Sloped?

The individual supply curve is positively sloped, consistent with the law of supply. To explain the positive slope, consider how Lola responds to an increase in price. A higher price encourages a firm to increase its output by purchasing more materials and hiring more workers. To increase her workforce, Lola might be forced to pay overtime or hire workers who are more costly or less productive than the original workers. But the higher price of pizza makes it worthwhile to incur these higher costs.

The supply curve shows the marginal cost of production for different quantities produced. We can use the marginal principle to explain this.

**MARGINAL PRINCIPLE**

Increase the level of an activity as long as its marginal benefit exceeds its marginal cost. Choose the level at which the marginal benefit equals the marginal cost.

For Lola, the marginal benefit of producing a pizza is the price she gets for it. When the price is only $2.00, she doesn’t produce any pizza, which tells us that the marginal cost of the first pizza must be greater than $2.00; otherwise, she would have produced it. But when the price rises to $2.01, she produces the first pizza because now the marginal benefit (the $2.01 price) exceeds the marginal cost. This tells us that the marginal cost of the first pizza is less than $2.01; otherwise, she wouldn’t produce it at a
price of $2.01. To summarize, the marginal cost of the first pizza is between $2.00 and $2.01, or just over $2.00. Similarly, point \( b \) on the supply curve in Figure 3.3 shows that Lola won’t produce her 100\(^{th} \) pizza at a price of $3.99, but will produce at a price of $4.00, indicating that her marginal cost of producing that pizza is between $3.99 and $4.00, or just under $4.00. In general, the supply curve shows the marginal cost of production.

**From Individual Supply to Market Supply**

The market supply curve for a particular good shows the relationship between the price of the good and the quantity that all producers together are willing to sell, *ceteris paribus*. To draw the market supply curve, we assume that the other variables that affect individual supply are fixed. The market quantity supplied is simply the sum of the quantities supplied by all the firms in the market. To show how to draw the market supply curve, we’ll assume that there are only two firms in the market. Of course, a perfectly competitive market has a large number of firms, but the lessons from the two-firm case generalize to a case of many firms.

Figure 3.4 shows how to derive a market supply curve from individual supply curves. In Panel A, Lola has relatively low production costs, as reflected in her relatively low minimum supply price ($2 at point \( a \)). In Panel B, Hiram has higher production costs, so he has a higher minimum price ($6 at point \( f \)). As a result, his supply curve lies above Lola’s. To draw the market supply curve, we add the individual supply curves horizontally. This gives us two segments for the market supply curve:

- **Prices between $2 and $6**: Segment connecting points \( i \) and \( k \). Hiram’s high-cost firm doesn’t supply any output, so the market supply is the same as the individual supply from Lola. For example, at a price of $4 Lola supplies 100 pizzas (point \( b \)) and Hiram does not produce any pizzas, so the market supply is 100 pizzas (point \( j \)).

![Figure 3.4](image)

**$\text{FIGURE 3.4}$**

*From Individual to Market Supply*

The market supply is the sum of the supplies of all firms. In Panel A, Lola is a low-cost producer who produces the first pizza once the price rises above $2 (shown by point \( a \)). In Panel B, Hiram is a high-cost producer who doesn’t produce pizza until the price rises above $6 (shown by point \( f \)). To draw the market supply curve, we sum the individual supply curves horizontally. At a price of $8, market supply is 400 pizzas (point \( m \)), equal to 300 from Lola (point \( d \)) plus 100 from Hiram (point \( g \)).

<table>
<thead>
<tr>
<th>Price</th>
<th>Lola</th>
<th>Hiram</th>
<th>Market Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>200</td>
<td>0</td>
<td>200</td>
</tr>
<tr>
<td>8</td>
<td>300</td>
<td>100</td>
<td>400</td>
</tr>
<tr>
<td>10</td>
<td>400</td>
<td>200</td>
<td>600</td>
</tr>
</tbody>
</table>
Prices above $6: Segment above point \( k \). At higher prices, the high-cost firm produces some output, and the market supply is the sum of the quantities supplied by the two firms. For example, at a price of $8 Lola produces 300 pizzas (point \( d \)) and Hiram produces 100 pizzas (point \( g \)), so the market quantity supplied is 400 pizzas (point \( m \)).

A perfectly competitive market has hundreds of firms rather than just two, but the process of going from individual supply curves to the market supply curve is the same. We add the individual supply curves horizontally by picking a price and adding up the quantities supplied by all the firms in the market. In the more realistic case of many firms, the supply curve will be smooth rather than kinked. This smooth line is shown in Figure 3.5. In this case, we assume that there are 100 firms identical to Lola’s firm. The minimum supply price is $2, and for each $2 increase in price, the quantity supplied increases by 10,000 pizzas.

Why Is the Market Supply Curve Positively Sloped?

The market supply curve is positively sloped, consistent with the law of supply. To explain the positive slope, consider the two responses by firms to an increase in price:

- **Individual firm.** As we saw earlier, a higher price encourages a firm to increase its output by purchasing more materials and hiring more workers.
- **New firms.** In the long run, new firms can enter the market and existing firms can expand their production facilities to produce more output. The new firms may have higher production costs than the original firms, but the higher output price makes it worthwhile to enter the market even with higher costs.

Like the individual supply curve, the market supply curve shows the marginal cost of production for different quantities produced. In Figure 3.5, the marginal cost of the first pizza is the minimum supply price for the firm with the lowest cost (just over $2.00). Similarly, point \( d \) on the supply curve shows that the 30,000th pizza won’t be produced at a price of $7.99, but will be produced at a price of $8.00. This indicates that the marginal cost of producing the 30,000th pizza is just under $8.00. Like the individual supply curve, the market supply curve shows the marginal cost of production.

### 3.3 Market Equilibrium: Bringing Demand and Supply Together

A market is an arrangement that brings buyers and sellers together. So far in this chapter, we’ve seen how the two sides of a market—demand and supply—work. In this part of the chapter, we bring the two sides of the market together to show how prices and quantities are determined.
When the quantity of a product demanded equals the quantity supplied at the prevailing market price, this is called a **market equilibrium**. When a market reaches an equilibrium, there is no pressure to change the price. For example, if pizza firms produce exactly the quantity of pizza consumers are willing to buy, there will be no pressure for the price of pizza to change. In Figure 3.6, the equilibrium price is shown by the intersection of the demand and supply curves. At a price of $8, the supply curve shows that firms will produce 30,000 pizzas, which is exactly the quantity that consumers are willing to buy at that price.

### Excess Demand Causes the Price to Rise

If the price is below the equilibrium price, there will be excess demand for the product. **Excess demand** (sometimes called a **shortage**) occurs when, at the prevailing market price, the quantity demanded exceeds the quantity supplied, meaning that consumers are willing to buy more than producers are willing to sell. In Figure 3.6, at a price of $6, there is an excess demand equal to 16,000 pizzas: Consumers are willing to buy 36,000 pizzas (point c), but producers are willing to sell only 20,000 pizzas (point b). This mismatch between demand and supply will cause the price of pizza to rise. Firms will increase the price they charge for their limited supply of pizza, and anxious consumers will pay the higher price to get one of the few pizzas that are available.

An increase in price eliminates excess demand by changing both the quantity demanded and quantity supplied. As the price increases, the excess demand shrinks for two reasons:

- The market moves upward along the demand curve (from point c toward point a), decreasing the quantity demanded.
- The market moves upward along the supply curve (from point b toward point a), increasing the quantity supplied.

Because the quantity demanded decreases while the quantity supplied increases, the gap between the quantity demanded and the quantity supplied narrows. The price will continue to rise until excess demand is eliminated. In Figure 3.6, at a price of $8 the quantity supplied equals the quantity demanded, as shown by point a.

In some cases, government creates an excess demand for a good by setting a maximum price (sometimes called a **price ceiling**). If the government sets a maximum price that is less than the equilibrium price, the result is a permanent excess demand for the good. Later in the book, we will explore the market effects of such policies.

![FIGURE 3.6](image)

**Market Equilibrium**

At the market equilibrium (point a, with price = $8 and quantity = 30,000), the quantity supplied equals the quantity demanded. At a price below the equilibrium price ($6), there is excess demand—the quantity demanded at point c exceeds the quantity supplied at point b. At a price above the equilibrium price ($12), there is excess supply—the quantity supplied at point e exceeds the quantity demanded at point d).
**Excess Supply Causes the Price to Drop**

What happens if the price is above the equilibrium price? **Excess supply** (sometimes called a *surplus*) occurs when the quantity supplied exceeds the quantity demanded, meaning that producers are willing to sell more than consumers are willing to buy. This is shown by points $d$ and $e$ in Figure 3.6. At a price of $12, the excess supply is 32,000 pizzas: Producers are willing to sell 50,000 pizzas (point $e$), but consumers are willing to buy only 18,000 pizzas (point $d$). This mismatch will cause the price of pizzas to fall as firms cut the price to sell them. As the price drops, the excess supply will shrink for two reasons:

- The market moves downward along the demand curve from point $d$ toward point $a$, increasing the quantity demanded.
- The market moves downward along the supply curve from point $e$ toward point $a$, decreasing the quantity supplied.

Because the quantity demanded increases while the quantity supplied decreases, the gap between the quantity supplied and the quantity demanded narrows. The price will continue to drop until excess supply is eliminated. In Figure 3.6, at a price of $8, the quantity supplied equals the quantity demanded, as shown by point $a$.

The government sometimes creates an excess supply of a good by setting a minimum price (sometimes called a *price floor*). If the government sets a minimum price that is greater than the equilibrium price, the result is a permanent excess supply. We'll discuss the market effects of minimum prices later in the book.

### 3.4 Market Effects of Changes in Demand

We’ve seen that a market equilibrium occurs when the quantity supplied equals the quantity demanded, shown graphically by the intersection of the supply curve and the demand curve. In this part of the chapter, we’ll see how changes on the demand side of the market affect the equilibrium price and equilibrium quantity.

**Change in Quantity Demanded Versus Change in Demand**

Earlier in the chapter, we listed the variables that determine how much of a particular product consumers are willing to buy. One of the variables is the price of the product. The demand curve shows the negative relationship between price and quantity demanded, *ceteris paribus*. In Panel A of Figure 3.7, when the price decreases from $8 to $6, we move down-

![Figure 3.7](image-url)

**Figure 3.7**

**Change in Quantity Demanded Versus Change in Demand**

(A) A change in price causes a change in quantity demanded, a movement along a single demand curve. For example, a decrease in price causes a move from point $a$ to point $b$, increasing the quantity demanded.

(B) A change in demand, caused by changes in a variable other than the price of the good, shifts the entire demand curve. For example, an increase in demand shifts the demand curve from $D_1$ to $D_2$. 

- **excess supply (surplus)** A situation in which at the prevailing price the quantity supplied exceeds the quantity demanded.
ward along the demand curve from point $a$ to point $b$, and the quantity demanded increases. As noted earlier in the chapter, this is called a change in quantity demanded. Now we’re ready to take a closer look at the other variables that affect demand besides price—income, the prices of related goods, tastes, advertising, and the number of consumers—and see how changes in these variables affect the demand for the product and the market equilibrium.

If any of these other variables change, the relationship between the product’s price and quantity—shown numerically in the demand schedule and graphically in the demand curve—will change. That means we will have an entirely different demand schedule and an entirely different demand curve. In Panel B of Figure 3.7, this is shown as a shift of the entire demand curve from $D_1$ to $D_2$. This shift means that at any price consumers are willing to buy a larger quantity of the product. For example, at a price of $8 consumers are willing to buy 46,000 pizzas (point $c$), up from 30,000 with the initial demand curve. To convey the idea that changes in these other variables change the demand schedule and the demand curve, we say that a change in any of these variables causes a change in demand.

Increases in Demand Shift the Demand Curve

What types of changes will increase the demand and shift the demand curve to the right, as shown in Figure 3.7? An increase in demand like the one represented in Figure 3.7 can occur for several reasons, which are listed in Table 3.1:

- **Increase in income.** Consumers use their income to buy products, and the more money they have, the more money they spend. For a normal good, there is a positive relationship between consumer income and the quantity consumed. When income increases, a consumer buys a larger quantity of a normal good. Most goods fall into this category—including new clothes, movies, and pizza.
- **Decrease in income.** An inferior good is the opposite of a normal good. Consumers buy larger quantities of inferior goods when their income decreases. For example, if you lose your job you might make your own coffee instead of buying it in a coffee shop, rent DVDs instead of going to the theater, and eat more macaroni and cheese. In this case, home-made coffee, DVDs, and macaroni and cheese are examples of inferior goods.
- **Increase in price of a substitute good.** When two goods are substitutes, an increase in the price of the first good causes some consumers to switch to the second good. Tacos and pizzas are substitutes, so an increase in the price of tacos increases the demand for pizzas as some consumers substitute pizza for tacos, which are now more expensive relative to pizza.

### Table 3.1 | Increases in Demand Shift the Demand Curve to the Right

<table>
<thead>
<tr>
<th>When this variable…</th>
<th>increases or decreases…</th>
<th>the demand curve shifts in this direction…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income, with normal good</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Income, with inferior good</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Price of a substitute good</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Price of complementary good</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Consumer preferences for good</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Expected future price</td>
<td>↑</td>
<td></td>
</tr>
</tbody>
</table>

- **change in demand**
  A shift of the demand curve caused by a change in a variable other than the price of the product.

- **normal good**
  A good for which an increase in income increases demand.

- **inferior good**
  A good for which an increase in income decreases demand.

- **substitutes**
  Two goods for which an increase in the price of one good increases the demand for the other good.
• **Complements**
  Two goods for which a decrease in the price of one good increases the demand for the other good.

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- **Decrease in price of a complementary good.** When two goods are *complements*, they are consumed together as a package, and a decrease in the price of one good increases the demand for the other good. For example, pizza and lemonade are complementary goods, so a decrease in the price of lemonade decreases the total cost of a lemonade-and-pizza meal, increasing the demand for pizza.
- **Increase in population.** An increase in the number of people means that there are more potential pizza consumers—more individual demand curves to add up to get the market demand curve—so market demand increases.
- **Shift in consumer preferences.** Consumers’ preferences or tastes can change over time. If consumers’ preferences shift in favor of pizza, the demand for pizza increases. One purpose of advertising is to change consumers’ preferences, and a successful pizza advertising campaign will increase the demand for pizza.
- **Expectations of higher future prices.** If consumers think next month’s pizza price will be higher than they had initially expected, they may buy a larger quantity today and a smaller quantity next month. That means that the demand for pizza today will increase.

We can use Figure 3.8 to show how an increase in demand affects the equilibrium price and equilibrium quantity. An increase in the demand for pizza resulting from one or more of the factors listed in Table 3.1 shifts the demand curve to the right, from $D_1$ to $D_2$. At the initial price of $8$, there will be excess demand, as indicated by points $a$ and $b$. Consumers are willing to buy 46,000 pizzas (point $b$), but producers are willing to sell only 30,000 pizzas (point $a$). Consumers want to buy 16,000 more pizzas than producers are willing to supply, and the excess demand causes upward pressure on the price. As the price rises, the excess demand shrinks because the quantity demanded decreases while the quantity supplied increases. The supply curve intersects the new demand curve at point $c$, so the new equilibrium price is $10$ (up from $8$), and the new equilibrium quantity is 40,000 pizzas (up from 30,000).

**Decreases in Demand Shift the Demand Curve**

What types of changes in the pizza market will decrease the demand for pizza? A decrease in demand means that at each price consumers are willing to buy a smaller quantity. In Figure 3.9, a decrease in demand shifts the market demand curve from $D_1$ to $D_0$. At the initial price of $8$, the quantity demanded decreases...
from 30,000 pizzas (point a) to 14,000 pizzas (point b). A decrease in demand like the one represented in Figure 3.9 can occur for several reasons, which are listed in Table 3.2:

- **Decrease in income.** A decrease in income means that consumers have less to spend, so they buy a smaller quantity of each normal good.

- **Decrease in the price of a substitute good.** A decrease in the price of a substitute good such as tacos makes pizza more expensive relative to tacos, causing consumers to demand less pizza.

- **Increase in the price of a complementary good.** An increase in the price of a complementary good such as lemonade increases the cost of a lemonade-and-pizza meal, decreasing the demand for pizza.

- **Decrease in population.** A decrease in the number of people means that there are fewer pizza consumers, so the market demand for pizza decreases.

### Table 3.2 | DECREASES IN DEMAND SHIFT THE DEMAND CURVE TO THE LEFT

<table>
<thead>
<tr>
<th>When this variable...</th>
<th>increases or decreases...</th>
<th>the demand curve shifts in this direction...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income, with normal good</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Income, with inferior good</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Price of a substitute good</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Price of complementary good</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Consumer preferences for good</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Expected future price</td>
<td>↓</td>
<td></td>
</tr>
</tbody>
</table>
• **Shift in consumer tastes.** When consumers’ preferences shift away from pizza in favor of other products, the demand for pizza decreases.

• **Expectations of lower future prices.** If consumers think next month’s pizza price will be lower than they had initially expected, they may buy a smaller quantity today, meaning the demand for pizza today will decrease.

### A Decrease in Demand Decreases the Equilibrium Price

We can use Figure 3.9 to show how a decrease in demand affects the equilibrium price and equilibrium quantity. The decrease in the demand for pizza shifts the demand curve to the left, from \( D_1 \) to \( D_0 \). At the initial price of $8, there will be an excess supply, as indicated by points \( a \) and \( b \): Producers are willing to sell 30,000 pizzas (point \( a \)), but given the lower demand consumers are willing to buy only 14,000 pizzas (point \( b \)). Producers want to sell 16,000 more pizzas than consumers are willing to buy, and the excess supply causes downward pressure on the price. As the price falls, the excess supply shrinks because the quantity demanded increases while the quantity supplied decreases. The supply curve intersects the new demand curve at point \( c \), so the new equilibrium price is $6 (down from $8), and the new equilibrium quantity is 20,000 pizzas (down from 30,000).

### 3.5 Market Effects of Changes in Supply

We’ve seen that changes in demand shift the demand curve and change the equilibrium price and quantity. In this part of the chapter, we’ll see how changes on the supply side of the market affect the equilibrium price and equilibrium quantity.

#### Change in Quantity Supplied Versus Change in Supply

Earlier in the chapter, we listed the variables that determine how much of a product firms are willing to sell. Of course, one of these variables is the price of the product. The supply curve shows the positive relationship between price and quantity, *ceteris paribus*. In Panel A of Figure 3.10, when the price increases from $6 to $8 we move...
along the supply curve from point \(a\) to point \(b\), and the quantity of the product supplied increases. As noted earlier in the chapter, this is called a *change in quantity supplied*. Now we’re ready to take a closer look at the other variables that affect supply—including wages, material prices, and technology—and see how changes in these variables affect the supply curve and the market equilibrium.

If any of these other variables changes, the relationship between price and quantity—shown numerically in the supply schedule and graphically in the supply curve—will change. That means that we will have an entirely different supply schedule and a different supply curve. In Panel B of Figure 3.10, this is shown as a shift of the entire supply curve from \(S_1\) to \(S_2\). In this case, the supply curve shifts downward and to the right:

- The shift to the right means that at any given price (for example, $6), a larger quantity is produced (25,000 pizzas at point \(c\), up from 20,000 at point \(a\)).
- The shift downward means that the price required to generate a particular quantity of output is lower. For example, the new minimum supply price is just over $1 (point \(f\)), down from just over $2 (point \(e\)). Similarly, the price required to generate 20,000 pizzas is $5 (point \(d\)), down from $6 (point \(a\)).

To convey the idea that changes in these other variables change the supply curve, we say that a change in any of these variables causes a *change in supply*.

### Increases in Supply Shift the Supply Curve

What types of changes increase the supply of a product, shifting the supply curve downward and to the right? Consider first the effect of a decrease in the wage paid to pizza workers. A decrease in the wage will decrease the cost of producing pizza and shift the supply curve:

- **Downward shift.** When the cost of production decreases, the price required to generate any given quantity of pizza will decrease. In general, a lower wage means a lower marginal cost of production, so each firm needs a lower price to cover its production cost. In other words, the supply curve shifts downward.
- **Rightward shift.** The decrease in production costs makes pizza production more profitable at a given price, so producers will supply more at each price. In other words, the supply curve shifts to the right.

A decrease in the wage is just one example of a decrease in production costs that shifts the supply curve downward and to the right. These supply shifters are listed in Table 3.3. A reduction in the costs of materials (dough, cheese) or capital (pizza

<table>
<thead>
<tr>
<th>When this variable…</th>
<th>increases or decreases…</th>
<th>the supply curve shifts in this direction…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Price of materials or capital</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Technological advance</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Government subsidy</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Expected future price</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Number of producers</td>
<td>↑</td>
<td></td>
</tr>
</tbody>
</table>
An improvement in technology that allows the firm to economize on labor or material inputs cuts production costs and shifts the supply curve in a similar fashion. The technological improvement could be a new machine or a new way of doing business—a new layout for a factory or store, or a more efficient system of ordering inputs and distributing output. Finally, if a government subsidizes production by paying the firm some amount for each unit produced, the net cost to the firm is lowered by the amount of the subsidy, and the supply curve shifts downward and to the right.

Two other possible sources of increases in supply are listed in Table 3.3. First, if firms believe that next month’s price will be lower than they had initially expected, they may try to sell more output now at this month’s relatively high price, increasing supply this month. Second, because the market supply is the sum of the quantities supplied by all producers, an increase in the number of producers will increase market supply.

As summarized in Table 3.3, the language of shifting supply is a bit tricky. An increase in supply is represented graphically by a shift to the right (a larger quantity supplied at each price) and down (a lower price required to generate a particular quantity). The best way to remember this is to recognize that the increase in “increase in supply” refers to the increase in quantity supplied at a particular price—the horizontal shift of the supply curve to the right.

**An Increase in Supply Decreases the Equilibrium Price**

We can use Figure 3.11 to show the effects of an increase in supply on the equilibrium price and equilibrium quantity. An increase in the supply of pizza shifts the supply curve to the right, from $S_1$ to $S_2$. At the initial price of $8, the quantity supplied increases from 30,000 pizzas (point $a$) to 46,000 (point $b$).

The shift of the supply curve causes excess supply that eventually decreases the equilibrium price. At the initial price of $8 (the equilibrium price with the initial supply curve), there will be an excess supply, as indicated by points $a$ and $b$: Producers are willing to sell 46,000 pizzas (point $b$), but consumers are willing to buy only 30,000 (point $a$). Producers want to sell 16,000 more pizzas than consumers are willing to buy, and the excess supply causes pressure to decrease the price. As the price decreases production costs, decreasing the price required to generate any particular quantity (downward shift) and increasing the quantity supplied at any particular price (rightward shift). An improvement in technology that allows the firm to economize on labor or material inputs cuts production costs and shifts the supply curve in a similar fashion. The technological improvement could be a new machine or a new way of doing business—a new layout for a factory or store, or a more efficient system of ordering inputs and distributing output. Finally, if a government subsidizes production by paying the firm some amount for each unit produced, the net cost to the firm is lowered by the amount of the subsidy, and the supply curve shifts downward and to the right.

**FIGURE 3.11**

An Increase in Supply Decreases the Equilibrium Price

An increase in supply shifts the supply curve to the right: At each price, the quantity supplied increases. At the initial price ($8), there is excess supply, with the quantity supplied (point $b$) exceeding the quantity demanded (point $a$). The excess supply causes the price to drop, and equilibrium is restored at point $c$. To summarize, the increase in supply decreases the equilibrium price to $6 and increases the equilibrium quantity to 36,000 pizzas.
decreases, the excess supply shrinks, because the quantity supplied decreases while the quantity demanded increases. The new supply curve intersects the demand curve at point $c$, so the new equilibrium price is $6 (down from $8) and the new equilibrium quantity is 36,000 pizzas (up from 30,000).

**Decreases in Supply Shift the Supply Curve**

Consider next the changes that cause a decrease in supply. As shown in Table 3.4, anything that increases a firm’s production costs will decrease supply. An increase in production cost increases the price required to generate a particular quantity (an upward shift of the supply curve) and decreases the quantity supplied at each price (a leftward shift). Production costs will increase as a result of an increase in the wage, an increase in the price of materials or capital, or a tax on each unit produced. As we saw earlier, the language linking changes in supply and the shifts of the supply curve is tricky. In the case of a decrease in supply, the *decrease* refers to the change in quantity at a particular price—the horizontal shift of the supply curve to the left.

A decrease in supply could occur for two other reasons. First, if firms believe next month’s pizza price will be higher than they had initially expected, they may be willing to sell a smaller quantity today and a larger quantity next month. That means that the supply of pizza today will decrease. Second, because the market supply is the sum of the quantities supplied by all producers, a decrease in the number of producers will decrease market supply, shifting the supply curve to the left.

**A Decrease in Supply Increases the Equilibrium Price**

We can use Figure 3.12 to show the effects of a decrease in supply on the equilibrium price and equilibrium quantity. A decrease in the supply of pizza shifts the supply curve to the left, from $S_1$ to $S_0$. At the initial price of $8 (the equilibrium price with the initial supply curve), there will be an excess demand, as indicated by points $a$ and $b$: Consumers are willing to buy 30,000 pizzas (point $a$), but producers are willing to sell only 14,000 pizzas (point $b$). Consumers want to buy 16,000 more pizzas than producers are willing to sell, and the excess demand causes upward pressure on the price. As the price increases, the excess demand shrinks because the quantity demanded decreases while the quantity supplied increases.

**Table 3.4 | CHANGES IN SUPPLY SHIFT THE SUPPLY CURVE UPWARD AND TO THE LEFT**

<table>
<thead>
<tr>
<th>When this variable...</th>
<th>increases or decreases...</th>
<th>the supply curve shifts in this direction...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Price of materials or capital</td>
<td>↑</td>
<td></td>
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<tr>
<td>Tax</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Expected future price</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Number of producers</td>
<td>↓</td>
<td></td>
</tr>
</tbody>
</table>
The new supply curve intersects the demand curve at point \( c \), so the new equilibrium price is $10 (up from $8), and the new equilibrium quantity is 24,000 pizzas.

Simultaneous Changes in Demand and Supply

What happens to the equilibrium price and quantity when both demand and supply increase? It depends on which change is larger. In Panel A of Figure 3.13, the increase in demand is larger than the increase in supply, meaning the demand curve shifts by a larger amount than the supply curve. The market equilibrium moves from point \( a \) to point \( b \), and the equilibrium price increases from $8 to $9. This is sensible because an increase in demand tends to pull the price up, while an increase in supply tends to push the price down. If demand increases by a larger amount, the upward pull will be stronger than the downward push, and the price will rise.

We can be certain that when demand and supply both increase, the equilibrium quantity will increase. That’s because both changes tend to increase the equilibrium quantity. In Panel A of Figure 3.13, the equilibrium quantity increases from 30,000 to 44,000 pizzas.

\[\begin{align*}
\text{FIGURE 3.12} \\
\text{A Decrease in Supply Increases the Equilibrium Price}
\end{align*}\]

A decrease in supply shifts the supply curve to the left: At each price, the quantity supplied decreases. At the initial price ($8), there is excess demand, with the quantity demanded (point \( a \)) exceeding the quantity supplied (point \( b \)). The excess demand causes the price to rise, and equilibrium is restored at point \( c \). To summarize, the decrease in supply increases the equilibrium price to $8 and decreases the equilibrium quantity to 24,000 pizzas.

\[\begin{align*}
\text{FIGURE 3.13} \\
\text{Market Effects of Simultaneous Changes in Demand and Supply}
\end{align*}\]

- **(A)** Larger increase in demand. If the increase in demand is larger than the increase in supply (if the shift of the demand curve is larger than the shift of the supply curve), both the equilibrium price and the equilibrium quantity will increase.
- **(B)** Larger increase in supply. If the increase in supply is larger than the increase in demand (if the shift of the supply curve is larger than the shift of the demand curve), the equilibrium price will decrease and the equilibrium quantity will increase.
Panel B of Figure 3.13 shows what happens when the increase in supply is larger than the increase in demand. The equilibrium moves from point $a$ to point $c$, meaning that the price falls from $8$ to $7$. This is sensible because the downward pull on the price resulting from the increase in supply is stronger than the upward pull from the increase in demand. As expected, the equilibrium quantity rises from 30,000 to 45,000 pizzas.

What about simultaneous decreases in demand and supply? In this case, the equilibrium quantity will certainly fall because both changes tend to decrease the equilibrium quantity. The effect on the equilibrium price depends on which change is larger, the decrease in demand, which pushes the price downward, or the decrease in supply, which pulls the price upward. If the decrease in demand is larger, the price will fall because the force pushing the price down will be stronger than the force pulling it up. In contrast, if the decrease in supply is larger, the price will rise because the force pulling the price up will be stronger than the force pushing it down.

### 3.6 PREDICTING AND EXPLAINING MARKET CHANGES

We’ve used the model of demand and supply to show how equilibrium prices are determined and how changes in demand and supply affect equilibrium prices and quantities. Table 3.5 summarizes what we’ve learned about how changes in demand and supply affect equilibrium prices and quantities:

- When demand changes and the demand curve shifts, price and quantity change in the same direction: When demand increases, both price and quantity increase; when demand decreases, both price and quantity decrease.
- When supply changes and the supply curve shifts, price and quantity change in opposite directions: When supply increases, the price decreases but the quantity increases; when supply decreases, the price increases but the quantity decreases.

We can use these lessons about demand and supply to predict the effects of various events on the equilibrium price and equilibrium quantity of a product.

We can also use the lessons listed in Table 3.5 to explain the reasons for changes in prices or quantities. Suppose we observe changes in the equilibrium price and quantity of a particular good, but we don’t know what caused these changes. Perhaps it was a change in demand, or maybe it was a change in supply. We can use the information in Table 3.5 to work backwards, using what we’ve observed about changes in prices and quantities to determine which side of the market—demand or supply—caused the changes:

- If the equilibrium price and quantity move in the same direction, the changes were caused by a change in demand.
- If the equilibrium price and quantity move in opposite directions, the changes were caused by a change in supply.

<table>
<thead>
<tr>
<th>Change in Demand or Supply</th>
<th>How does the equilibrium price change?</th>
<th>How does the equilibrium quantity change?</th>
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</thead>
<tbody>
<tr>
<td>Increase in demand</td>
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<td>↑</td>
</tr>
<tr>
<td>Decrease in demand</td>
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<td>↓</td>
</tr>
<tr>
<td>Increase in supply</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Decrease in supply</td>
<td>↑</td>
<td>↓</td>
</tr>
</tbody>
</table>
3.7 **APPLICATIONS OF DEMAND AND SUPPLY**

We can apply what we’ve learned about demand and supply to real markets. We can use the model of demand and supply to *predict* the effects of various events on equilibrium prices and quantities. We can also *explain* some observed changes in equilibrium prices and quantities.

**APPLICATION**

**HURRICANE KATRINA AND BATON ROUGE HOUSING PRICES**

**APPLYING THE CONCEPTS #1:** How do changes in demand affect prices?

In the late summer of 2005, Hurricane Katrina caused a storm surge and levee breaks that flooded much of New Orleans and destroyed a large fraction of the city’s housing. Hundreds of thousands of residents were displaced, and about 250,000 relocated to nearby Baton Rouge. The increase in population was so large that Baton Rouge became the largest city in the state, and many people started calling the city “New Baton Rouge.”

Figure 3.14 shows the effects of Hurricane Katrina on the housing market in Baton Rouge. Before Katrina, the average price of a single-family home was $130,000, as shown by point $a$. The increase in the city’s population shifted the demand curve to the right, causing excess demand for housing at the original price. Just before the hurricane, there were 3,600 homes listed for sale in the city, but a week after the storm, there were only 500. The excess demand caused fierce competition among buyers for the limited supply of homes, increasing the price. Six months later, the average price had risen to $156,000 as shown by point $b$. *Related to Exercises 7.1 and 7.6.*


**FIGURE 3.14**

Hurricane Katrina and Housing in Baton Rouge

An increase in the population of Baton Rouge increases the demand for housing, shifting the demand curve to right. The equilibrium price increases from $130,000 (point $a$) to $156,000 (point $b$).
TED KOPPEL TRIES TO EXPLAIN LOWER DRUG PRICES

APPLYING THE CONCEPTS #2: What could explain a decrease in price?

Ted Koppel, host of the ABC news program Nightline, once said, “Do you know what’s happened to the price of drugs in the United States? The price of cocaine, way down, the price of marijuana, way down. You don’t have to be an expert in economics to know that when the price goes down, it means more stuff is coming in. That’s supply and demand.” According to Koppel, the price of drugs dropped because the government’s efforts to control the supply of illegal drugs had failed. In other words, the lower price resulted from an increase in supply. According to the U.S. Department of Justice, the quantity of drugs consumed actually decreased during the period of dropping prices. Is Koppel’s economic detective work sound?

In this case, both the price and the quantity decreased. As shown in the second row of Table 3.5, when both the price and the quantity decrease, that means demand has decreased. For example, in Figure 3.15, a decrease in demand shifts the demand curve to the left, and the market moves from point a (price = $15 and quantity = 400 units per day) to point b (price = $10 and quantity = 300 units per day). Koppel’s explanation (an increase in supply) would be correct if the quantity of drugs increased at the same time that the price decreased. However, because the quantity of drugs consumed actually decreased during the period of dropping prices, Koppel’s explanation is incorrect. Lower demand—not a failure of the government’s drug policy and an increase in supply—was responsible for the decrease in drug prices.

Related to Exercises 7.2 and 7.7.


**FIGURE 3.15**
Ted Koppel and the Falling Price of Drugs
At the same time that the price of cocaine decreased (from $15 to $10), the quantity of cocaine consumed decreased (from 400 to 300 units). Therefore the decrease in price was caused by a decrease in demand, not an increase in supply.
APPLICATION

ELECTRICITY FROM THE WIND

APPLYING THE CONCEPT #3: How does the adoption of new technology affect prices?

In recent years, the supply of electricity generated from wind power has increased dramatically. Between 2000 and 2006, total wind power in the United States increased from 620 megawatts to 9,200 megawatts, enough power to serve the equivalent of 2.4 million households. Over the same period, the price of electricity generated from wind power decreased from 50 cents per kilowatt-hour to 4 cents.

Figure 3.16 shows the changes in the wind electricity market in recent years. Several design innovations, including the replacement of small, rapid rotors with large, slow-moving blades and the development of monitoring systems that change the direction and the angle of the blades to more efficiently harness the wind, have decreased the cost of producing electricity, shifting the supply curve downward and to the right. In Figure 3.16, the shift of the supply curve decreases the equilibrium price and increases the equilibrium quantity.

The innovations in wind generation have made wind power more competitive with conventional power sources such as coal and natural gas. The price of electricity from natural gas and coal is about 2 cents per kilowatt-hour. The producers of wind electricity receive a federal tax credit of almost 2 cents per kilowatt-hour, making the net price of wind power close to the price of conventional power.

Related to Exercises 7.3 and 7.8.

APPLICATION

THE BOUNCING PRICE OF VANILLA BEANS

APPLYING THE CONCEPTS #4: How do changes in supply affect prices?

As we saw in the chapter opener, the price of vanilla beans has been bouncing around a lot. The price was $50 per kilo (2.2 pounds) in 2000, then rose to $500 in 2003, then dropped to $25 in 2006. We can use the model of demand and supply to explain the bouncing price.

Figure 3.17 shows the changes in the vanilla market in recent years. Point a shows the initial equilibrium in 2000, with a price of $50 per kilo. The 2000 cyclone that hit Madagascar, the world’s leading producer, destroyed that year’s crop and a large share of the vines that produce vanilla beans. Although the vines were replanted, new plants don’t bear usable beans for three to five years, so the supply effects of the cyclone lasted several years. In Figure 3.17, the cyclone shifted the supply curve upward and to the left, generating a new equilibrium at point b, with a higher price and a smaller quantity.

In Figure 3.17, the changes between 2003 and 2006 are shown by a shift of the supply curve downward and to the right. In 2006, the vines replanted in Madagascar in 2001 started to produce vanilla beans. In addition, other countries, including India, Papua New Guinea, Uganda, and Costa Rica, entered the vanilla market. The vines planted in these other countries started to produce beans in 2006, so the world supply curve for 2006 lies below and to the right of the original supply curve (in 2000). Given the larger supply of vanilla beans in 2006, the price dropped to about half of its 2000 level, to $25 per kilo. The increase in supply from other countries was facilitated by the development of a sun-tolerant variety of the vanilla plant that allows it to be grown as a plantation crop. The new variety is an example of technological progress. Related to Exercises 7.4 and 7.9.


FIGURE 3.17
The Bouncing Price of Vanilla Beans
A cyclone destroyed much of Madagascar’s crop in 2000, shifting the supply curve upward and to the left. The equilibrium price increased from $50 per kilogram (point a) to $500 per kilogram (point b). By 2005, the vines replanted in Madagascar—along with new vines planted in other countries—started producing vanilla beans, and the supply curve shifted downward and to the right, beyond the supply curve for 2000. The price dropped to $25 per kilogram (point c), half the price that prevailed in 2000. (To represent the large changes in price and quantity, the graph is not drawn to scale.)
APPLICATION

PLATINUM, JEWELRY, CATALYTIC CONVERTERS

APPLYING THE CONCEPTS #5: How do changes in one market affect other markets?

In early 2004, the price of platinum reached $937 per ounce—up from $440 in 1999 and $700 in 2003. The two largest sources of demand for platinum are jewelry and the catalytic converters used in automobiles to control emissions. In recent years, the tightening of emissions standards for automobiles and trucks increased the demand for platinum. In rapidly growing Asian countries, the demand for automobiles increased, and many countries adopted stricter emissions standards. In Latin America, Brazil and Chile recently mandated the use of catalytic converters in their automobiles.

Table 3.6 shows the changes in the demand for platinum from 1999 to 2004. The demand for platinum for use in catalytic converters more than doubled, from 1.19 million ounces to 2.81 million ounces. The increase in demand increased the equilibrium price of platinum. The other numbers in the table illustrate the laws of demand and supply:

1. **The law of demand for jewelry.** The increase in the price of platinum increased the equilibrium price of platinum jewelry, and consumers responded by purchasing less platinum jewelry. As a result, the amount of platinum used in jewelry decreased, from 2.88 million ounces to 2.20 million ounces.

2. **The law of supply for recycling.** The increase in the price of platinum increased the payoff from recycling used platinum, increasing the quantity of platinum supplied through recycling from 0.42 million ounces to 0.70 million ounces.

What's next for the platinum market? Another potential source of increased demand is the development of fuel cells. This environmentally friendly technology combines oxygen and hydrogen to produce electricity. Platinum is a core material in fuel cells, and if fuel cells emerge as an important source of electricity the resulting increase in the demand for platinum will increase its price.

Related to Exercises 7.5 and 7.10.


<table>
<thead>
<tr>
<th>Table 3.6</th>
<th>SOURCES OF DEMAND FOR PLATINUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source of Demand</td>
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<tr>
<td>Catalytic converters</td>
<td>1.19</td>
</tr>
<tr>
<td>Jewelry</td>
<td>2.88</td>
</tr>
<tr>
<td>Chemical and electrical</td>
<td>0.69</td>
</tr>
<tr>
<td>Other</td>
<td>0.83</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5.59</strong></td>
</tr>
<tr>
<td>Supply from recycling</td>
<td>0.42</td>
</tr>
</tbody>
</table>
SUMMARY

In this chapter, we've seen how demand and supply determine prices. We also learned how to predict the effects of changes in demand or supply on prices and quantities. Here are the main points of the chapter:

1. A market demand curve shows the relationship between the quantity demanded and price, ceteris paribus.
2. A market supply curve shows the relationship between the quantity supplied and price, ceteris paribus.
3. Equilibrium in a market is shown by the intersection of the demand curve and the supply curve. When a market reaches equilibrium, there is no pressure to change the price.
4. A change in demand changes price and quantity in the same direction: An increase in demand increases the equilibrium price and quantity; a decrease in demand decreases the equilibrium price and quantity.
5. A change in supply changes price and quantity in opposite directions: An increase in supply decreases price and increases quantity; a decrease in supply increases price and decreases quantity.

KEY TERMS

change in demand, p. 59
change in quantity demanded, p. 51
change in supply, p. 54
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EXERCISES

3.1 The Demand Curve

1.1 Arrow up or down: According to the law of demand, an increase in price __________ the quantity demanded.

1.2 From the following list, choose the variables that are held fixed in drawing a market demand curve:
   • The price of the product
   • Consumer income
   • The price of other related goods
   • Consumer expectations about future prices
   • The quantity of the product purchased

1.3 From the following list, choose the variables that change as we draw a market demand curve:
   • The price of the product
   • Consumer income
   • The price of other related goods
   • Consumer expectations about future prices
   • The quantity of the product purchased

1.4 The market demand curve is the ________ (horizontal/vertical) sum of the individual demand curves.

1.5 Draw a Demand Curve. Your state has decided to offer its citizens vanity license plates for their cars and wants to predict how many vanity plates it will sell at
different prices. The price of the state’s regular license plates is $20 per year, and the state’s per-capita income is $30,000. A recent survey of other states with approximately the same population (3 million people) generated the following data on incomes, prices, and vanity plates:

<table>
<thead>
<tr>
<th>State</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price of vanity plate</td>
<td>$60</td>
<td>$55</td>
<td>$50</td>
<td>$40</td>
</tr>
<tr>
<td>Price of regular plates</td>
<td>20</td>
<td>20</td>
<td>35</td>
<td>20</td>
</tr>
<tr>
<td>Income</td>
<td>30,000</td>
<td>25,000</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Quantity of vanity plates</td>
<td>6,000</td>
<td>6,000</td>
<td>16,000</td>
<td>16,000</td>
</tr>
</tbody>
</table>

a. Use the available data to identify some points on the demand curve for vanity plates and connect the points to draw a demand curve. Don’t forget ceteris paribus.

b. Suppose the demand curve is linear. If your state set a price of $50, how many vanity plates would be purchased?

3.2 The Supply Curve

2.1 Arrow up or down: According to the law of supply, an increase in price _________ the quantity supplied.

2.2 From the following list, choose the variables that are held fixed when drawing a market supply curve.
   • The price of the product
   • Wages paid to workers
   • The price of materials used in production
   • Taxes paid by producers
   • The quantity of the product purchased

2.3 The minimum supply price is the _________ price at which a product is supplied.

2.4 The market supply curve is the _________ (horizontal/vertical) sum of the individual supply curves.

2.5 Marginal Cost of Housing. When the price of a standard three-bedroom house increases from $150,000 to $160,000, a building company increases its output from 20 houses per year to 21 houses per year. What does the increase in the quantity of housing reveal about the cost of producing housing?

2.6 Imports and Market Supply. Two nations supply sugar to the world market. Lowland has a minimum supply price of 10 cents per pound, while Highland has a minimum supply price of 24 cents per pound. For each nation, the slope of the supply curve is 1 cent per million pounds.

a. Draw the individual supply curves and the market supply curve. At what price and quantity is the supply curve kinked?

b. The market quantity supplied at a price of 15 cents is _________ million pounds. The market quantity supplied at a price of 30 cents is _________ million pounds.

3.3 Market Equilibrium: Bringing Demand and Supply Together

3.1 The market equilibrium is shown by the intersection of the _________ curve and the _________ curve.

3.2 Excess demand occurs when the price is _________ (less/greater) than the equilibrium price; excess supply occurs when the price is _________ (less/greater) than the equilibrium price.

3.3 Arrow up or down: An excess demand for a product will cause the price to _________ As a consequence of the price change, the quantity demanded will _________ and the quantity supplied will _________.

3.4 Arrow up or down: An excess supply of a product will cause the price to _________ As a consequence of the price change, the quantity demanded will _________, and the quantity supplied will _________.

3.5 Interpreting the Graph. The graph below shows the demand and supply curves for CD players. Complete the following statements.

a. At the market equilibrium (shown by point _________), the price of CD players is _________ and the quantity of CD players is _________.

b. At a price of $100, there would be excess _________, so we would expect the price to _________.

c. At a price exceeding the equilibrium price, there would be excess _________, so we would expect the price to _________.

3.6 Draw and Find the Equilibrium. The following table shows the quantities of corn supplied and demanded at different prices.
<table>
<thead>
<tr>
<th>Price per Ton</th>
<th>Quantity Supplied</th>
<th>Quantity Demanded</th>
</tr>
</thead>
<tbody>
<tr>
<td>$80</td>
<td>600</td>
<td>1,200</td>
</tr>
<tr>
<td>90</td>
<td>800</td>
<td>1,100</td>
</tr>
<tr>
<td>100</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>110</td>
<td>1,200</td>
<td>900</td>
</tr>
</tbody>
</table>

a. Draw the demand curve and the supply curve.
b. The equilibrium price of corn is __________, and the equilibrium quantity is __________.

3.5 Market Effects of Changes in Supply

5.1 A change in supply causes a __________ (movement along/shift of) the supply curve. A change in quantity supplied causes a __________ (movement along/shift of) the supply curve.

5.2 Circle the variables that change as we move along the supply curve for pencils and cross out those that are assumed to be fixed:
   - Quantity of pencils supplied
   - Price of wood
   - Price of pencils
   - Production technology

5.3 Arrow up or down: An increase in the price of wood shifts the supply curve for pencils __________; an improvement in pencil-production technology shifts the supply curve for pencils __________; a tax on pencil production shifts the supply curve for pencils __________.

5.4 Arrow up or down: An increase in the supply of a product __________ the equilibrium price and __________ the equilibrium quantity.

5.5 If both demand and supply increase simultaneously, the equilibrium price will increase if the change in __________ is relatively large.

5.6 Effect of Weather on Prices. Suppose a freeze in Florida wipes out 20 percent of the orange crop. How will this affect the equilibrium price and quantity of Florida oranges? Illustrate your answer with a graph.

5.7 Immigration Control and Prices. Consider the market for raspberries. Suppose a new law outlaws the use of foreign farm workers on raspberry farms, and the wages paid to farm workers increase as a result. Use a demand and supply graph to predict the effects of the higher wage on the equilibrium price and quantity of raspberries. Arrow up or down: The equilibrium price of raspberries will __________, and the equilibrium quantity will __________.

5.8 Market Effects of Import Ban. Consider the market for shoes in a nation that initially imports half the shoes it consumes. Use a demand and supply graph to predict the market effect of a ban on shoe imports. Arrow up or down: The equilibrium price will __________, and the equilibrium quantity will __________.

5.9 Market Effects of a Tax. Consider the market for fish. Use a demand and supply graph to predict the effect of a tax paid by fish producers of $1 per pound of fish. Use a demand and supply graph to predict the market effect of the tax. Arrow up or down: The equi-
5.10 Innovation and the Price of Mobile Phones. Suppose that the initial price of a mobile phone is $100 and that the initial quantity demanded is 500 phones per day. Use a graph to show the effects of a technological innovation that decreases the cost of producing mobile phones. Label the starting point with “a” and the new equilibrium with “b.”

4.6 Predicting and Explaining Market Changes

6.1 Fill the blanks in the following table. Note that the ordering of the first column has been scrambled.

<table>
<thead>
<tr>
<th>Change in Demand or Supply</th>
<th>How does the equilibrium price change?</th>
<th>How does the equilibrium quantity change?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease in demand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decrease in supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in demand</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.2 When ________ (supply/demand) changes, the equilibrium price and equilibrium price change in the same direction. When ________ (supply/demand) changes, the equilibrium price and equilibrium price change in opposite directions.

6.3 Suppose the equilibrium price of accordions recently increased while the equilibrium quantity decreased. These changes were caused by a(n) ________ (increase/decrease) in ________ (supply/demand).

6.4 Suppose the equilibrium price of housing recently increased, and the equilibrium quantity increased as well. These changes were caused by a(n) ________ (increase/decrease) in ________ (supply/demand).

6.5 What Caused the Higher Gasoline Price? In the last month, the price of gasoline increased by 20 percent. Your job is to determine what caused the increase in price, a change in demand or a change in supply. Ms. Info has all the numbers associated with the gasoline market, and she can answer a single factual question. (She cannot answer the question: “Was the higher price caused by a change in demand or a change in supply?”)

a. What single question would you ask?

b. Provide an answer to your question that implies that the higher price was caused by a change in demand. Illustrate with a complete graph.

c. Provide an answer to your question that implies that the higher price was caused by a change in supply. Illustrate with a complete graph.

6.6 Rising Price of Used Organs. Over the last few years, the price of used organs (livers, kidneys, hearts) has increased dramatically. Why? What additional information about the market for used organs would allow you to prove that your explanation is the correct one?

6.7 The Price of Summer Cabins. As summer approaches, the equilibrium price of rental cabins increases and the equilibrium quantity of cabins rented increases. Draw a demand and supply graph that explains these changes.

6.8 Simplest Possible Graph. Consider the market for juice oranges. Draw the simplest possible demand and supply graph consistent with the following observations. You should be able to draw a graph with no more than 4 curves. Label each of your curves as “supply” or “demand” and indicate the year (1, 2, or 3).

6.9 Zero Price for Used Newspapers. In 1987, you could sell a ton of used newspaper for $60. Five years later, you couldn’t sell them at any price. In other words, the price of used newspapers dropped from $60 to zero in just 5 years. Over this period, the quantity of used newspapers bought and sold increased. What caused the drop in price? Illustrate your answer with a complete graph.

4.7 Applications of Demand and Supply

7.1 Arrow up or down: Hurricane Katrina ________ the demand for housing in Baton Rouge, so the price of housing ________ and the quantity of housing ________. (Related to Application 1 on page 68.)

7.2 Ted Koppel’s analysis of the drug market was incorrect because he failed to notice that the ________ of drugs decreased at the same time that the ________ of drugs decreased. (Related to Application 2 on page 69.)

7.3 Innovations in wind technology decrease the price of electricity from wind from 50 cents per kilowatt-hour to ________ cents. (Related to Application 3 on page 70.)

7.4 Arrow up or down: The development of a sun-tolerant variety of the vanilla plant ________ the supply of vanilla and ________ its price. (Related to Application 4 on page 71.)

7.5 Arrow up or down: The increase in the price of platinum ________ recycling of used platinum and ________ the quantity of platinum used for jewelry. (Related to Application 5 on page 72.)

7.6 Katrina Victims Move Back. Suppose that 5 years after Hurricane Katrina, half the people who had
relocated to Baton Rouge move back to a rebuilt New Orleans. Use a demand and supply graph of the Baton Rouge housing market to show the market effects of the return of people to New Orleans. (Related to Application 1 on page 68.)

7.7 Decrease in the Price of Heroin. Between 1990 and 2003, the price of heroin decreased from $235 per gram to $76. Over the same period, the quantity of heroin consumed increased from 376 metric tons to 482 metric tons. Use a demand and supply graph to explain these changes in price and quantity. (Related to Application 2 on page 69.)

7.8 Electricity from Fuel Cells. Suppose that initially the cost of the capital required to generate electricity from fuel cells is $4,500 per kilowatt capacity, compared to $800 per kilowatt capacity for a diesel generator. The goal of the U.S. Department of Energy (DOE) is to cut the cost of fuel-cell generators to $400 per kilowatt capacity. Consider the market for electricity from fuel cells. Use a demand and supply graph to show the effects of meeting the DOE goal on the price and quantity of electricity from fuel cells. (Related to Application 3 on page 70.)

7.9 Artificial Versus Natural Vanilla. An artificial alternative to natural vanilla is cheaper to produce but doesn’t taste as good. Suppose the makers of artificial vanilla discover a new recipe that improves its taste. Use a demand and supply graph to show the effects on the equilibrium price and quantity of natural vanilla. (Related to Application 4 on page 71.)

7.10 Platinum Price and Jewelry. Consider the market for platinum jewelry. Use a demand and supply graph to illustrate the following statement: “The increase in the price of platinum increased the price of platinum jewelry, and consumers responded by purchasing less platinum jewelry.” (Related to Application 5 on page 72.)

ECONOMIC EXPERIMENT

Market Equilibrium

This simple experiment takes about 20 minutes. We start by dividing the class into two equal groups: consumers and producers.

- The instructor provides each consumer with a number indicating the maximum amount he or she is willing to pay (WTP) for a bushel of apples: The WTP is a number between $1 and $100. Each consumer has the opportunity to buy 1 bushel of apples per trading period. The consumer’s score for a single trading period equals the gap between the WTP and the price actually paid for apples. For example, if the consumer’s WTP is $80 and he or she pays only $30 for apples, the consumer’s score is $50. Each consumer has the option of not buying apples. This will be sensible if the best price the consumer can get exceeds the WTP. If the consumer does not buy apples, his or her score will be zero.

- The instructor provides each producer with a number indicating the cost of producing a bushel of apples (a number between $1 and $100). Each producer has the opportunity to sell 1 bushel per trading period. The producer’s score for a single trading period equals the gap between the selling prices and the cost of producing apples. So if a producer sells apples for $20, and the cost is only $15, the producer’s score is $5. Producers have the option of not selling apples, which is sensible if the best price the producer can get is less than the cost. If the producer does not sell apples, his or her score is zero.

Once everyone understands the rules, consumers and producers meet in a trading area to arrange transactions. A consumer may announce how much he or she is willing to pay for apples and wait for a producer to agree to sell apples at that price. Alternatively, a producer may announce how much he or she is willing accept for apples and wait for a consumer to agree to buy apples at that price. Once a transaction has been arranged, the consumer and producer inform the instructor of the trade, record the transaction, and leave the trading area.

Several trading periods are conducted, each of which lasts a few minutes. After the end of each trading period, the instructor lists the prices at which apples sold during the period. Then another trading period starts, providing consumers and producers another opportunity to buy or sell apples. After all the trading periods have been completed, each participant computes his or her score by adding the scores from the trading periods.