Suppose that a hypothetical student, who is a smoker, is studying for a final exam, and finds herself in need of nicotine. The student goes to the convenience store to purchase cigarettes. All brands have an initial price of $3/pack. Suppose further that the price of Marlboro cigarettes increases to $5/pack, whereas all other brands continue to sell for $3/pack. The student is likely to be responsive to this change in price, because there are many substitutes available: if the price of Marlboros is relatively higher, then the student could shift her purchase to Lucky Strikes or Camels, for example.

On the other hand, if the price of all brands of cigarettes increases to $5/pack, then the student is likely to purchase a pack anyway, even though the price has increased. Why? Because the demand for goods like cigarettes is very inelastic (when a smoker needs a smoke, she needs a smoke). The left panel of Figure 8.17 shows that if the price of one specific brand of cigarettes increases, then consumers shift out of the relatively expensive brand and into relatively less expensive brands. The right-hand panel shows the demand for all cigarettes. There, a price increase does not result in a large substitution out of cigarettes, since there are no good substitutes (the student needs nicotine). In the first case, the price difference was large enough to cause the student to make a change. She responded to the change, so her demand for the cigarettes was elastic. In the second case, all brands were assumed to be enough alike to make a switch unnecessary. The purchaser was unresponsive so demand for the product was inelastic. In general, the elasticity of demand depends on the availability of substitutes, or how willing consumers are to switch their purchases to another good.

Quick Quiz 8.15

Which is more elastic (responsive) to changes in price: oranges or apples? How about oranges and fruit?

Plate 8.6 Cigarettes.

Source: Minerva Studio/Shutterstock

The elasticity of demand for narrowly defined goods is greater than for more broadly defined goods, since there are more substitutes available. For example, if the price of blue shirts (narrowly defined) increases, buyers will switch into green shirts, but if the price of all shirts (broadly defined) increases, consumers have few other options. Therefore, the elasticity of demand for blue shirts is greater than the elasticity of demand for all shirts. Next, we turn to calculation of demand elasticities.

The own-price elasticity of demand

The definition of own-price elasticity of demand is:

- ***Own-Price Elasticity of Demand*** = the percentage change in the quantity demanded in response to a percentage change in price.

The formula for calculating the price elasticity of demand at a single point on a demand curve is:

$$E^d = \left(\Delta Q^d / Q^d\right) / \left(\Delta P / P\right) = \left(\Delta Q^d / \Delta P\right) * \left(P / Q^d\right). \tag{8.23}$$

Economists calculate elasticities rather than slopes of demand functions because the slopes of curves are not directly comparable. Recall that it is not possible to graph variables measured in different units in the same quadrant. In Figure 8.18, it appears that purchases of apples are more responsive to price changes than purchases of oranges. Actual calculations of the elasticities are necessary to show if this is the case. The reason is that the units of the graphs are different for apples and oranges.

Compare apples and oranges, by recalling Box 7.3 relating to Florida oranges in the previous chapter.

Elasticities are unitless, and therefore attractive to social scientists who make comparisons among elasticities across all goods. The definition of price elasticity makes this clear:

$$E^d = \left(\Delta Q^d / \Delta P\right) * \left(P / Q^d\right). \tag{8.24}$$

Since the price (P) and quantity demanded (Q^d) appear in the numerator and the denominator, the units of each cancel, leaving no units for an elasticity calculation. Hence, economists use elasticities rather than slopes to measure the responsiveness of consumer purchases to changes in prices and other economic variables. These unitless elasticities allow an unbiased comparison of the response to price changes of apples and oranges.

To summarize the discussion, elasticities represent how responsive consumers are to changes in price. An elastic demand curve represents consumers who are more responsive to price changes, and an inelastic demand curve represents consumers who are less responsive to price changes. The elasticities are comparable across all goods. The major determinant of the elasticity of demand is the availability of substitutes. If substitutes are available, then, when the price of a good increases, consumers buy something else.

The price elasticity of demand explains many market-related situations. For example, gasoline stations in college towns often charge higher prices for gasoline the day before the beginning of Spring Break. On this day, when several thousand students are preparing to leave town, the demand for gasoline is relatively inelastic. Station owners know this, and

Box 8.2 Washington apples

Currently, the State of Washington has over 175,000 acres of irrigated apple orchards located on the eastern slope of the Cascade Mountains. The area produces 10 to 12 billion apples each year. Settlers first planted the orchards in the 1820s. The rich soil from volcanic ash, plentiful sunshine, and arid climate provide excellent growing conditions for tree fruits such as apples and pears. The arid climate results in fewer insect and disease problems, making commercial apple production attractive. Today, the typical apple orchard is 50 acres, but some are up to 3,000 acres. An estimated 35 to 40 thousand pickers work in the fields during the annual apple harvest. US consumers eat an average of 19 pounds of fresh apples each year, compared to about 46 pounds consumed each year by Europeans. More than half of the fresh crop of eating apples grown in the US are from the orchards in Washington State.

Production practices have evolved continuously, as new technologies and new varieties have been developed and adopted. Recently, high-density plantings use dwarf trees to bring apples into production faster, and allow growers to respond more rapidly to changes in consumer tastes and preferences. Smaller trees also reduce the need for labor and equipment during the harvest season. Controlled Atmosphere (CA) storage occurs in large, airtight warehouses with reduced oxygen levels and temperatures held constant at 32–36 degrees Fahrenheit. This allows for a constant supply of fresh apples throughout the year.

Although there are more than 7,500 varieties of apples worldwide, the top nine varieties of apples grown in Washington state include Red Delicious, Golden Delicious, Gala, Fuji, Granny Smith, Braeburn, HoneyCrisp, Cripps Pink, and Cameo. The Red Delicious variety represents about 30 percent of apples grown in the state, but accounts for 48 percent of apples exported to other countries.

Source: Washington State Apple Commission. http://www.bestapples.com/index.aspx

Plate 8.7 Washington apples.
Source: Kissofdeath/Shutterstock

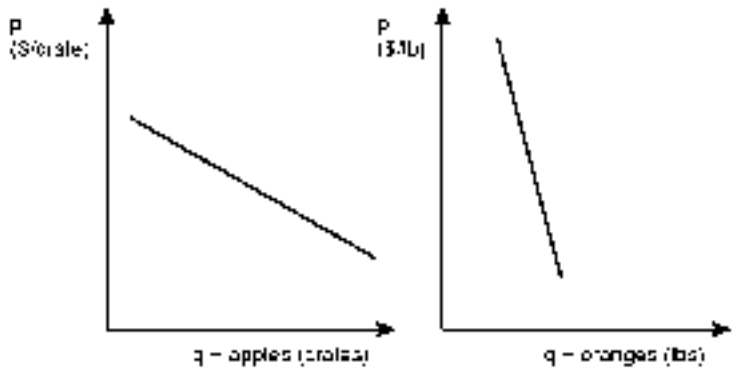

Figure 8.19 Demand for apples and oranges.

increase the price of fuel to take advantage of the fact that the students will pay higher prices in order to fulfill their vacation plans.

Veterinarians often charge higher prices for rich people with poodles than for poor people with mixed-breed mutts. Why? Because wealthier people are more likely to be willing and able to pay higher prices for vet services than poor people are. The elasticity of demand for medical services is lower (more inelastic) for rich persons than for poor.

Airline tickets usually cost more if purchased on the same day as the flight. Why? Because travelers who have not made flight arrangements prior to the day of the flight have an inelastic demand for airline travel. They are flying in response to an emergency or an urgent situation, and are willing to pay higher prices for the flight. The elasticity of demand for airline tickets becomes more inelastic as the day of the flight approaches. Airlines take advantage of this by increasing prices as flight time approaches.

For practice using the elasticity concept, consider the calculation of an arc elasticity of the demand for wheat. The definition of the price elasticity of demand is:

$$E^d = \%\Delta Q^d / \%\Delta P = (\Delta Q^d / \Delta P) * (P / Q^d). \tag{8.25}$$

Calculating the price elasticity of demand requires knowledge of the changes in price and quantity. In words, this is equivalent to the percentage change in quantity demanded that has come in response to a percentage change in price. Suppose that the price of wheat increases from $3/bu to $5 bu, resulting in a decrease in the quantity of wheat demanded from $Q_1 = 20$ billion bushels to $Q_2 = 16$ billion bushels.

$$P_1 = \$3/\text{bu} \qquad Q_1 = 20 \text{ billion bushels} \tag{8.26a}$$

$$P_2 = \$5/\text{bu} \qquad Q_2 = 16 \text{ billion bushels.} \tag{8.26b}$$

$$\Delta P = P_2 - P_1 = 5 - 3 = 2 \tag{8.27a}$$

$$\Delta Q = Q_2 - Q_1 = 16 - 20 = -4. \tag{8.27b}$$

The next step in the calculation requires selection of a price and a quantity to plug into the formula. Which P is correct: P_1 or P_2? Since using either of these prices would yield

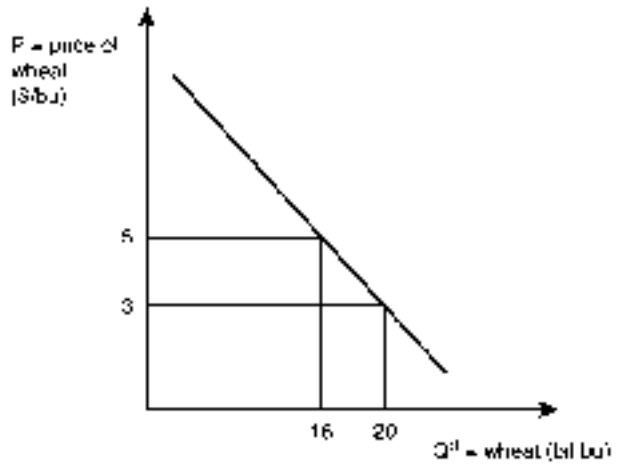

Figure 8.19 The demand for wheat

a different result, use the average price. The arc elasticity formula shows how this happens:

$$E^d = \%\Delta Q^d \div \%\Delta P = \left[(Q_2 - Q_1)/(P_2 - P_1)\right] * \left[(P_2 - P_1)/(Q_1 + Q_2)\right] \quad (8.28)$$

This formula uses the average (or mean) prices and quantities for the price and quantity levels. Since the average price is equal to $[(P_1 + P_2)/2]$, and the average quantity is equal to $[(Q_1 + Q_2)/2]$, the twos cancel out, resulting in Equation 8.28 given above.

The Law of Demand states that if the price increases, consumers will purchase less wheat. Therefore, the sign of the price elasticity of demand will always be negative. The magnitude of the elasticity depends on the availability of substitutes for wheat. Consumers could switch from wheat bread and flour tortillas to corn bread and corn tortillas, for example. The elasticity formula quantifies the responsiveness of consumers to a change in the price of wheat and puts the result pertaining to a change in consumer behavior into a single easily understood number:

$$\begin{aligned} E^d &= (Q_2 - Q_1)/(P_2 - P_1) * (P_1 + P_2)/(Q_1 + Q_2) \\ &= (16 - 20)/(5 - 3) * (3 + 5)/(20 + 16) = -0.44. \end{aligned} \quad (8.29)$$

The Law of Demand states that the sign of the price elasticity of demand must always be negative. The absolute value of the elasticity converts the elasticity to a positive number, as in Equation 8.30:

$$\left| E^d \right| = 0.44 \quad (8.30)$$

This elasticity provides a summary of how much quantity demanded changes given a change in price. The price elasticity relates to the demand curve shown in Figure 8.19. The absolute value less than one (= 0.44) of the price elasticity of wheat indicates that the demand for wheat is relatively inelastic. There are few good substitutes for wheat in this case.

Responsiveness classifications

The relative magnitude of the price elasticity of demand for different goods provides useful information. For example, the quantity demanded of food remains relatively constant, since food is a physiological necessity. If the price of food increases, most consumers continue to eat approximately the same amount. In more formal terms, the demand for food is inelastic because the quantity demanded does not vary with changes in price. Examples of common goods with inelastic demands include necessities of all types (food, housing, medicines, tobacco, gasoline, toothpaste, newspapers, and the like).

- ***Inelastic Demand*** = a change in price brings about a relatively smaller change in quantity demanded.

Recall the definition of elasticity.

$$E^{d} = \%\Delta Q \quad \%\Delta P. \qquad (8.21)$$

In the case of a good with an inelastic demand, the percentage change in price is greater than the percentage change in quantity demanded ($\%\Delta Q < \%\Delta P$). Therefore, when demand for a good is inelastic, the absolute value of the price elasticity of demand is less than one: $E^{d} < 1$, as shown in Figure 8.20.

The demand for food depicted in Figure 8.20 is inelastic, or relatively unresponsive to a change in price; the magnitude of the elasticity of demand is relatively small. If the price of the good increases by 1 percent, then the quantity demanded will decrease by less than 1 percent.

Consider how consumers respond to changes in the price of expensive meals in upscale restaurants. If the restaurant increases the price of one specific item on the menu, customers will switch away from the relatively high-cost meal and select lower-cost menu items. Since substitutes are available, consumers are responsive to changes in price. Menu items are goods with elastic demand.

- ***Elastic Demand*** = a change in price brings about a relatively larger change in quantity demanded.

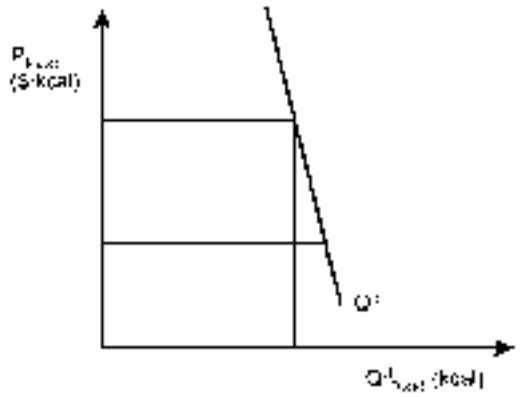

Figure 8.20 Demand for an inelastic good: food

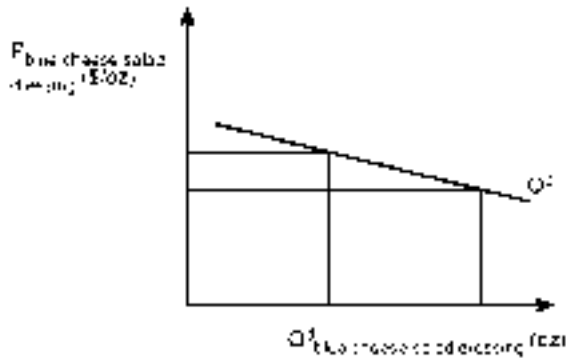

Figure 8.21 Demand for an elastic good: blue cheese salad dressing

A 1 percent increase in the price of a good with an elastic demand results in a greater than 1 percent decrease in the quantity demanded. In the case of elastic demand, $|\varepsilon^d| > 1$, since $\%\Delta Q^d > \%\Delta P$. In a graph of an elastic demand such as for blue cheese salad dressing, the percentage change in quantity demanded is larger than the percentage change in price.

Substitutes exist for the blue cheese salad dressing, so the demand for this item is elastic. Recall that the demand for food as a whole is inelastic, since there are no good substitutes. Even so, there are food items whose demand is elastic, and these might include Florida oranges, Idaho potatoes, McDonald's Big Macs, avocados, and fresh peaches in season.

Quick Quiz 8.16

Explain why each of the goods listed above has an elastic demand.

The third and last category of price elasticity of demand is **Unitary Elastic Demand**.

- *Unitary Elastic Demand* – the percentage change in price brings about an equal percentage change in quantity demanded

Mathematically, the formula for unitary elasticity is:

$$\varepsilon^u = \Delta Q^d / \Delta P * (P_1 + P_2) / (Q_1 - Q_2) = 1 \qquad (8.12)$$

In this case, the quantity demanded of the good falls by the same percentage as the increase in price. Table 8.4 summarizes the three categories of the price elasticity of demand.

The magnitude of the price elasticity depends on the availability of substitutes. Alternative purchases typically become more available over time, resulting in the demand for a particular product becoming more elastic. Consumers become more responsive to changes in prices as time passes. Suppose that the price of electricity increases. An individual consumer cannot typically change sources of electricity in the short run. Therefore, the demand for electricity

Table 8.4 Demand elasticity classifications

Unitary	$\|E^d\| = 1$
Inelastic	$\|E^d\| < 1$
Elastic	$\|E^d\| > 1$

in the short run is inelastic, households purchase the same level of kilowatt-hours (kwh), that is, they are likely to stay at approximately the same level even when prices increase.

Over time, and within some limits, consumers can substitute out of electricity by purchasing natural gas furnaces, water heaters, and kitchen appliances. Some households may even invest in solar power, wind power, and other alternative sources of power. Since consumers have more choices as time passes, the demand for electricity becomes more elastic over time.

The elasticity of demand and total revenue

A business firm's pricing strategy is based on the price elasticity of demand for its product. Consider a firm that is attempting to maximize total revenue ($TR = P*Q$, where P is the per unit price and Q is the quantity sold). Figure 8.22 shows the demand curves for a product with an inelastic demand and a product with an elastic demand. The inelastic demand case suggests that a firm can increase total revenue by decreasing output and increasing price: added revenue from the price increase will outweigh the decrease in output sold. Alternatively, with the help of some familiar equations:

$$TR = PQ. \tag{8.33a}$$

$$\Delta TR = \Delta(PQ) = \Delta P\Delta Q. \tag{8.33b}$$

we can see that when demand is inelastic, as it is in the left graph of Figure 8.22, the positive price increase (ΔP) is larger than the decrease in quantity sold (ΔQ), so reductions in quantity sold result in an increase in total revenue. Given an inelastic demand, a firm will reduce output to increase revenue. Making the product scarce causes total revenue to increase.

The strategy of reducing output backfires for a firm facing an elastic demand: the reduction in quantity would be greater than the price increase, resulting in a decrease in total revenue. This is because the decrease in quantity (ΔQ) is larger than the increase in price (ΔP). This is shown in the right graph of Figure 8.22.

Quick Quiz 8.17

Describe the impacts on total revenue of an agricultural policy that reduces the number of acres of land planted to wheat in the US.

The relationship between the price elasticity of demand and total revenue explains why business firms are so interested in the elasticity of demand for the goods sold by the firm. An effective pricing strategy requires knowledge of how customers will respond to a change in price; it requires knowledge regarding the elasticity of demand for the products it sells.

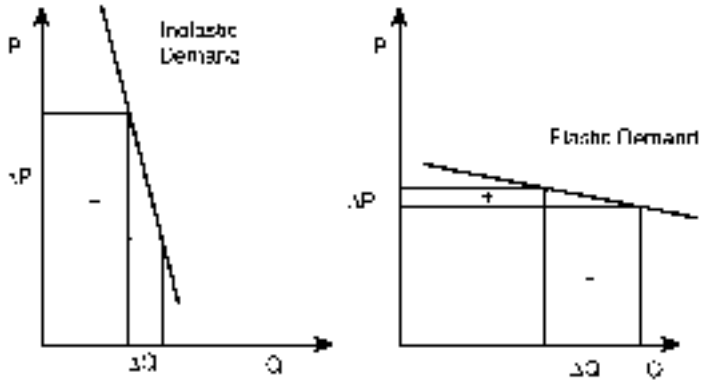

Figure 8.22 Demand for inelastic and elastic goods

Own-price and cross-price demand elasticities

Elasticities of demand are associated with (1) the good's own price, and (2) the price of a related good. Recall that the own-price elasticity of demand measures the responsiveness of the quantity demanded of a good to changes in the price of that good. A related good is one that has an impact on the consumption of another good. The **Cross-Price Elasticity of Demand** measures how the demand of one good changes when the price of a related good changes

- ***Cross-Price Elasticity of Demand*** = a measure of the responsiveness of the quantity demanded of a good to changes in the price of a related good

The cross-price elasticity is written as $E^{d}_{YPY} = \%\Delta Q^{d}_{Y} / \%\Delta P_{Y}$. This formula states that the cross-price elasticity of demand is the percentage change in quantity demanded of good Y, given a percentage change in price of good Y_1. If two goods Y_1 and Y_2 are unrelated, then the change in the price of Y_1 has no effect on the consumption of good Y_2, and the cross price elasticity is equal to zero ($E^{d}_{Y_2 Y_1}$). There are two types of related goods in consumption: **Substitutes** and **Complements**.

- ***Substitutes in Consumption*** = goods that are consumed on an "either or" basis such as wheat bread and white bread.

Corn and milo are substitutes in consumption for feeding cattle. A feedlot operator can purchase either of these two feed grains since they are nearly nutritionally equivalent. If the price of corn increases, then the demand for milo increases, as feedlots substitute out of corn and into milo. Thus, the cross-price elasticity of demand is positive for substitutes:

$$E^{d}_{YPY} = \%\Delta Q^{d}_{Y_2} / \%\Delta P_{Y_1} > 0. \qquad (8.34)$$

Electric appliances (stoves, furnaces, and hot water heaters) and natural gas appliances are frequently substitutes. Most homes in the northern United States have either gas or electric

appliances (sometimes both), depending on the relative prices of natural gas and electricity. Within some limits gasoline and bicycles are substitutes. As the price of gasoline rises, short-distance commuters switch to bicycles.

Complements in Consumption are goods consumed together, for example bread and butter, or biscuits and gravy, or a dress shirt and a necktie.

- ***Complements in Consumption*** = goods that are consumed together (e.g., peanut butter and jelly).

If the price of bread increases, consumers will purchase less bread and, as a consequence, they need less butter. The demand for butter decreases when the price of bread increases. This means that the cross-price elasticity of butter with respect to bread is negative:

$$E^{d}_{Y1Y2} = \%\Delta Q^{d}_{Y2} / \%\Delta P_{Y1} < 0. \tag{8.35}$$

Unrelated goods might include ice cream, houses, and laptops. The number of homes purchased is likely unrelated to the price of ice cream or the price of laptops. Consequently, the price of houses has no impact on the demand for ice cream or the demand for laptop computers. In these cases, the **Cross-Price Elasticity of Demand** is equal to zero.

$$E^{d}_{Y1Y2} = \%\Delta Q^{d}_{Y2} / \%\Delta P_{Y1} = 0. \tag{8.36}$$

The relationship between elasticity and slope

As with supply curves, the elasticity of demand relates to the slope of the demand curve, but is not equal to it. Use caution when comparing the slopes of two demand curves in

Plate 8.8 Peanut butter and jelly.
Source: Jorge Salcedo/Shutterstock

different graphs. The slope may reflect different scales on the horizontal and vertical axes, and thus be misleading. Elasticities across goods are comparable only when the actual elasticities are calculated.

8.7 Change in demand; change in quantity demanded

Earlier in this chapter, data from a consumer equilibrium graph showed that successively lowering the price of macaroni and cheese increased the quantity purchased. This showed that the demand curve is a function of the relationship between price and quantity demanded, *ceteris paribus* (holding all else constant). The demand curve reflects a consumer's willingness and ability to purchase a good at each of several prices for the good.

The demand curve for high-quality Certified Angus Beef (CAB) demonstrates the difference between a change in demand and a change in quantity demanded. A change in the price of beef results in a movement along an existing demand curve. This movement along the curve represents a change in the quantity demanded. If the price of beef decreases while all else is held constant, consumers will eat more beef.

Quick Quiz 8.18

Why does the quantity of beef demanded decrease when the price of beef increases?

- ***Change in Quantity Demanded*** = when a change in the quantity of a good purchased is a result of a change in the price of the good. A movement along the demand curve.

The movement along the demand curve is due to a change in the price of the good, or a change in quantity demanded, as depicted in Figure 8.23.

If anything other than the good's own price changes, then there is a shift in demand, known as a **Change in Demand**.

- ***Change in Demand*** = when a change in the quantity of a good purchased is a result of a change in an economic variable other than the price of the good. A shift in the demand curve.

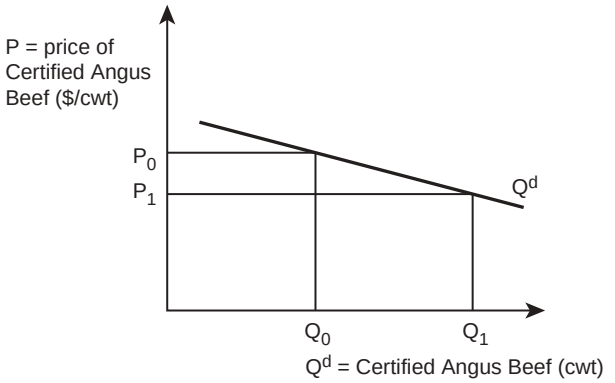

Figure 8.23 Increase in the quantity demanded of Certified Angus Beef.

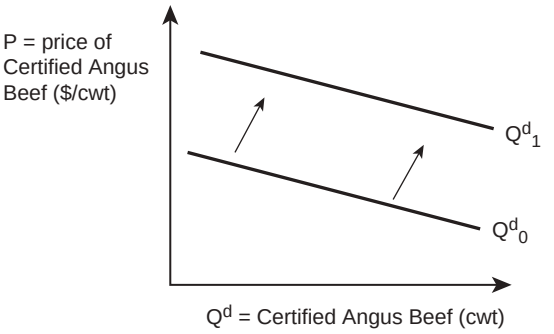

Figure 8.24 An increase in the demand for Certified Angus Beef.

An increase in income causes the entire demand curve to shift out (to the right), since an increase in purchasing power will result in consumers buying more beef at every price. This is a change in demand due to consumers being able to afford to eat more beef, as shown in Figure 8.24.

Examples of demand changes

1. **The Price of Corn and the Demand for Soda**
   What does the price of corn have to do with the price of soda? Corn is a major input in the production of soda (High Fructose Corn Syrup, HFCS, is the sweetener used for most sodas), so as the price of corn increases, the price of soda increases. Does this cause a shift or a movement in demand? It causes a change in the price of soda, so the result is a movement along the demand curve for soda, seen in Figure 8.25.
2. **The Impact of Cold Weather on Cattle**
   Very cold weather can kill or slow the growth of cattle. This "weather event" reduces the number of cattle available for slaughter. This, in turn, results in an increase in the price of beef, which causes a movement along the demand curve, as shown in Figure 8.26.

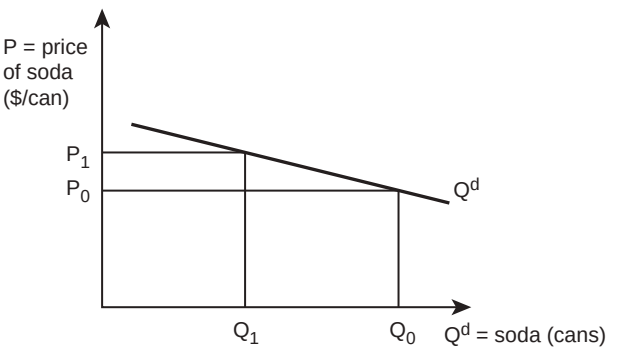

Figure 8.25 A decrease in the quantity demanded of soda.

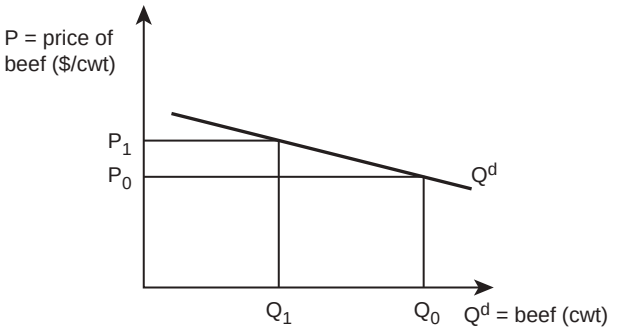

Figure 8.26 A decrease in the quantity demanded of beef.

3. **The Price of Milo's Impact on the Demand for Corn**
   Milo and corn are near perfect substitutes: either grain is suitable for use in a feedlot to fatten cattle. An increase in the relative price of milo results in a movement along the demand curve for milo, and a shift in the demand for corn, or an increase in the demand for corn (Figure 8.27).
4. **College**
   The tuition at public colleges (universities) in the United States is a topic of great concern. Suppose that tuition is considered to be the "price" of a college degree. An increase in tuition will result in a movement along the demand curve, or a change in quantity demanded, as shown in Figure 8.28. Some students will shift out of college and into employment when the price of college increases.
5. **The Effect of a Decrease in Income on the Demand for Veterinary Services**
   If an economic variable other than the price changes, it results in a change in demand, or a shift in the demand curve, as seen in Figure 8.29. If the income level in a community declines, for example, then the purchasing power of individuals and households

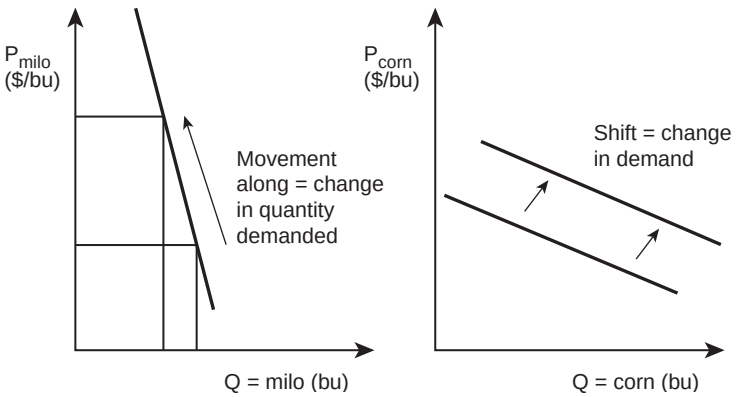

Figure 8.27 Change in demand and change in quantity demanded.

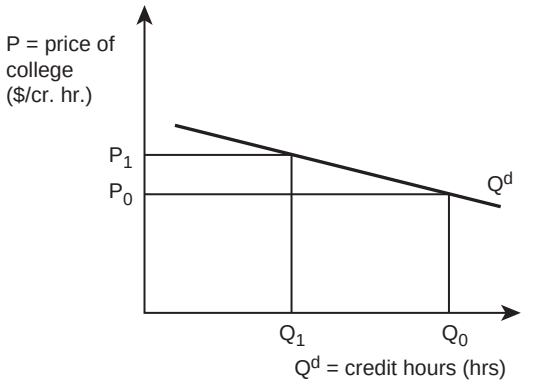

Figure 8.28 An increase in tuition, the price of college.

falls and less money is available to spend on veterinary services. Individuals and families will forego veterinary services such as preventative medicine and annual check-ups. These services may seem "optional" for pets when spendable income is low.

8.8 Determinants of demand

The own price of a good (P_{own}) is the most important determinant of demand. Other determinants of demand include the price of related goods ($P_{related\ goods}$), income (M), tastes and preferences (TP), expectations of future prices (EP), and population (Pop) as written in this demand function:

$$Q^d = f\left(P_{own} \mid P_{related\ goods},\ M,\ TP,\ EP,\ Pop\right). \tag{8.37}$$

There are other determinants as well, but this list includes the most important ones. All need additional discussion. The first demand determinant is the good's own price. The Law of Demand says that if the price of a good increases, then the quantity demanded decreases, *ceteris paribus*.

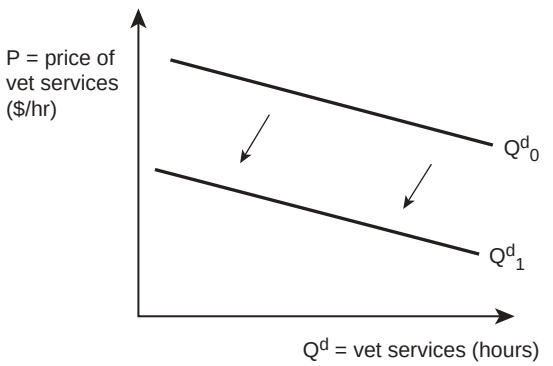

Figure 8.29 A decrease in the demand for veterinary services.

Quick Quiz 8.19

When the price of a good changes, is it followed by a change in demand or a change in quantity demanded?

Prices of related goods

A second determinant of demand appeared under "Own-price and cross-price demand elasticities" above. There it was shown that substitutes in consumption are goods that can be purchased on an "either or" basis. Corn and milo are both feed grains, and are substitutes in the production of beef. Depending on the relative prices of the two grains, feedlot managers will purchase either one. If the price of corn increases, consumers (feedlots) substitute out of corn and into milo. If the price of corn increases, the quantity demanded of corn decreases, and the demand for milo increases.

Complements in consumption are goods that are used together, such as bread and butter. If the price of butter increases, the quantity demanded of butter decreases, and the demand for bread will decline as well.

Income

Changes in income levels have a significant impact on the demand for goods and services. Think of the vast differences between the types of goods that a homeless person consumes compared to the consumption habits of a very wealthy person. Increases in the level of living have a huge impact on the type and magnitude of goods and services that consumers purchase.

The relationship between income and consumption is highly important to agriculture. As the level of living increases, purchases shift from goods such as ramen noodles and macaroni and cheese to steak and roses. The demand for agricultural goods produced in the United States strongly depends on the levels of income in other countries.

Over a century ago, a German statistician named Ernst Engel studied the relationship between income and consumer expenditures. His studies resulted in a functional relationship between income and consumption called the **Engel Curve** and written:

$$Q^{D} = f\left[M, P_{Own}, P_{Substitutes}, P_{C}, P_{S}, Pop\right] \tag{8.38}$$

Box 8.7 US wheat exports

On average, about 120 million metric tons of wheat enter international markets each year. Approximately one-fourth of this total (30 million metric tons) comes from the United States. A metric ton is 1000 kilograms, or approximately 2204 pounds. Much of the wheat exported from the United States goes to low-income nations. In a low-income nation in Sub-Saharan Africa or Asia, incomes are at or near subsistence levels. Therefore, any increase in income increases expenditures on food. When income levels rise in Korea, China, or Pakistan, the US exports more wheat to these countries, increasing the incomes of wheat producers in the United States.

Source: USDA-ERS

- ***Engel Curve*** = the relationship between income and quantity demanded, *ceteris paribus*.

Engel studied the consumption patterns of individuals, which led him to discover a relationship now called **Engel's Law**.

- ***Engel's Law*** = as income increases, the proportion of income spent on food declines, *ceteris paribus*.

Notice that Engel's Law says that the proportion of income spent on food, not the total dollars spent on food. This means that as people become wealthier, they spend more dollars on food, but the proportion of income spent on food increases at a declining rate. Engel's Law has major implications for agriculture. It implies that as income increases, production agriculture decreases in importance relative to the rest of the economy. This is what has happened over the course of US history. In the pre-Revolutionary years, nearly every European who settled in what is now the United States was a farmer. Now, at the beginning of the twenty-first century, less than 2 percent of the US population is engaged in farming. Engel was right. As levels of living in the United States increased, agriculture lost importance as a part of the overall economy.

Engel's law can be observed in the hypothetical Engel curve for food in Figure 8.30. The curve shows the relationship between income (M) and the quantity of food purchased (Q^d). Near the origin, where income is equal to zero, a one dollar increase in income likely results in a one dollar increase in expenditures for food, since food is a necessity.

At low levels of income, most of the budget goes for food. As income levels increase, purchases of food continue to increase (the slope of the Engel curve is positive), but at a decreasing rate, reflecting the increasing purchase of nonfood items. At a certain point, food purchases reach a maximum and begin to fall, indicating that wealthy individuals may not spend as high a proportion of their incomes on food as individuals with lower levels of income. Statistical evidence shows that this is true.

Quick Quiz 8.20

Does the Engel curve show that middle-income families purchase less food than low-income families? Explain why or why not.

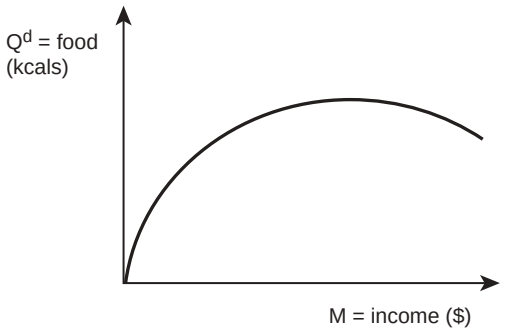

Figure 8.30 An Engel curve for food.

An example introduced in Section 8.5 provides a closer look at Engel's Law by showing the derivation of two Engel curves. The college student in the example purchases only two goods: macaroni and cheese (mac-n-cheese, Y_1), and pizza (Y_2). The student has a weekly income of $40, the price of macaroni and cheese is two dollars per box for (P_1 = $2 box), and the price of pizza is five dollars per pizza pie (P_2 = $5 pie). To summarize:

$$M = \$40 \text{ / week} \tag{8.39a}$$

$$Y_1 = \text{mac-n-cheese} \quad P_1 = \$2 \text{ / box} \tag{8.39b}$$

$$Y_2 = \text{pizza} \quad P_2 = \$5 \text{ / pie.} \tag{8.39c}$$

The objective here is to show how the consumer's equilibrium purchases change with a change in income. This requires increasing the income available for food expenditures from $40/week to $60/week, and then to $80/week, as in Figure 8.31.

The small circles in Figure 8.31 indicate the consumer's equilibrium points at each income level. The student buys more pizza as income is increased. The graph also shows increases in the consumption of macaroni and cheese when income increases from $40/week to $60/week. However, when income increases to $80/week, the purchases of macaroni and cheese decline.

Quick Quiz 8.21

What determines the shape and location of the budget lines drawn for each level of income?

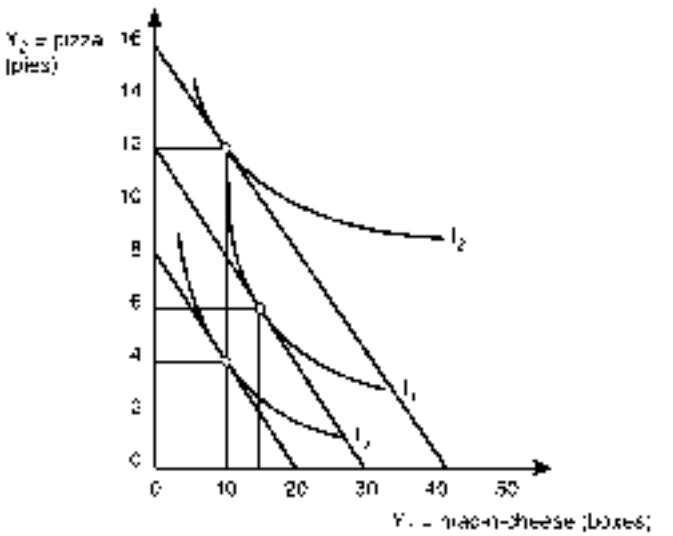

Figure 8.31 Derivation of Engel curves for macaroni and cheese and pizza

Table 8.5 Consumer purchases and income

M Income ($ /week)	Q^d mac-n-cheese (boxes)	Q^d pizza (pies)
40	10	4
60	15	6
80	10	12

The Engel curve depicts the relationship between income and quantity demanded. The data in Table 8.5 form the bases of Engel curves for both macaroni and cheese and pizza, as depicted in Figure 8.32.

Recall that the relationship between income (M) and quantity demanded, holding all else constant, can be written as a mathematical expression:

$$Q^d = f(M, P_{x1}, P_{x2,\ldots,n}, TP, LU, Pop). \tag{8.40}$$

The graph on the right side of Figure 8.32 shows how pizza consumption increases as income increases. The relationship between income and pizza purchases is positive, meaning that increased income leads to increased purchases of pizza. Economists call the type of good whose consumption increases as income increases a **Normal Good**.

- ***Normal Good*** = a good whose consumption increases in response to an increase in income

Normal goods might include such goods as food, clothing, and automobiles. Other goods exhibit decreased consumption levels as income increases: **Inferior Goods**. Inferior goods could include used clothing, or macaroni and cheese. As incomes rise, consumers substitute out of inferior goods and into normal goods.

- ***Inferior Good*** = a good whose consumption declines in response to an increase in income

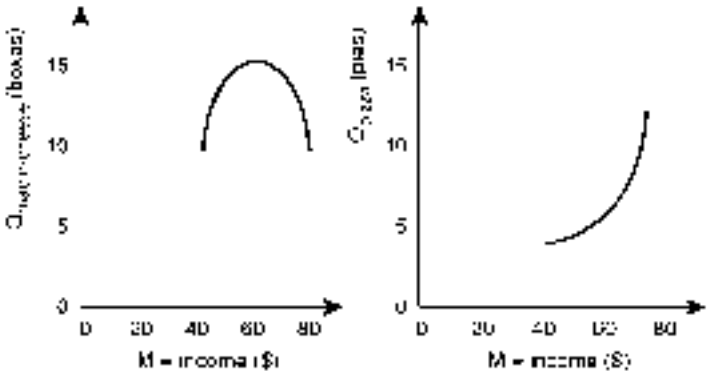

Figure 8.32 Engle curves for macaroni and cheese and pizza.

The left side of Figure 8.32 shows that the consumption of macaroni and cheese increases as income increases from $40 week to $60 week (macaroni and cheese is a normal good in this range), but declines as income rises from $60 to $80 per week (macaroni and cheese is an inferior good in this range). As people earn more money, they first increase their consumption of inexpensive foods (e.g., macaroni and cheese, ramen noodles, spaghetti). When income reaches a certain level, consumers begin to shift out of inexpensive foods and into more expensive foods, such as steak and seafood.

A **Luxury Good** is a good purchased at an increasing rate when income increases. Pizza consumption as shown in Figure 8.32 is an example. A luxury good is a specific type of normal good, since the relationship between income and quantity consumed is positive.

- *Luxury Good* = a good whose consumption increases at an increasing rate in response to an increase in income.

A **Necessity Good** is also a normal good, but one where consumption increases at a decreasing rate as income increases.

- *Necessity Good* = a good whose consumption increases at a decreasing rate in response to an increase in income.

The relationship between income and consumption is crucial to farmers and to other producers of goods or services. Taking food as perhaps the best example, as the level of living increases in low-income nations such as Haiti and Korea, consumers substitute out of less expensive calorie sources, such as grains, and into more expensive sources such as beef and chicken. This increase in meat consumption has a large, positive effect on the incomes of food producers in the United States.

Some meat consumed in Asia originates in the United States. It takes approximately seven pounds of grain to produce one pound of beef. Therefore, increases in Asia's consumption of US meat increases the demand for feed grains, which are major crops produced in the Great Plains region of the US. Any increase in the development of low-income nations that leads to an increase in income will enhance the demand for meat consumption, which in turn will result in an increase in the well-being of producers in the United States.

Economists summarize the relationship between income and consumption with the **Income Elasticity of Demand**.

- *Income Elasticity of Demand* = the percentage change in the demand for a good in response to a one percent change in income.

The mathematical formula for the income elasticity of demand is:

$$E^{M} = \%\Delta Q^{1} \div \%\Delta M = [\Delta Q / Q] \div [\Delta M / M] \qquad (8.41)$$

The formula above is a "point elasticity" that can be used to find the income elasticity of demand at any point on an Engel curve. The arc elasticity formula is:

$$E^{M} = \%\Delta Q^{1} \div \%\Delta M = (\Delta Q \cdot \Delta M) * [M_{1} + M_{2} / Q_{1} + Q_{2}] \qquad (8.42)$$

The income elasticity of demand allows the classification of goods into three categories based on the responsiveness of consumers to changes in their incomes (Table 8.6).

Table 8.6 Good responsiveness to income

Normal Goods	$E^m > 0$	$\%\Delta Q^d > 0$
Luxury Goods	$E^m > 1$	$\%\Delta Q^d > \%\Delta M$ (normal good)
Necessity Goods	$0 < E^m < 1$	$\%\Delta Q^d < \%\Delta M$ (normal good)
Inferior Goods	$E^m < 0$	$\%\Delta Q^d < 0$

The study of the relationship between income and consumption leads to one important conclusion. Agricultural producers and agribusinesses can improve their economic situation by following the saying, "Give the consumers what they want!" As the level of living increases in the United States, consumers will shift out of inferior goods, and into luxury goods. In agriculture, luxury goods include organic fruits and vegetables, free-range chicken, and hormone-free beef.

An economist recommends that agricultural producers and agribusinesses not waste time or effort opposing this type of good, just "Give the consumers what they want!" and revenue will increase. There is a large and increasing demand for expensive agricultural goods in high-value markets. This is related to the changing tastes and preferences of consumers who live in nations that have a high level of living.

Box 8.4 Natural and organic beef

As incomes rise, consumers have increasingly demanded meat products perceived to be healthier and less harmful to the environment. Natural and organic beef products are more popular, and are likely to become even more widespread over time. Currently, natural beef comprises a small but growing percentage of the total beef market, at approximately 5 percent of all beef consumed in the US. Producers of natural beef may use a USDA label if: (1) the product is minimally processed, (2) the product contains no artificial ingredients, and (3) the product contains no preservatives. The company or organization owning the brand name of this beef is responsible for the administration and regulation of these requirements. Natural beef contains no antibiotics or growth hormones.

Organic beef is a much more stringent label, requiring no antibiotics or growth hormones, and no feed that includes non-organic sources such as fertilized pastures or agricultural chemicals such as herbicides. Certification is administered and monitored by the USDA, and requires a great deal of time, effort, and documentation. Natural and organic beef products are more expensive than conventional beef products. Understandably, organic beef is typically much more expensive than natural beef, due to the high cost of acquiring organic feed grain.

Beef cattle producers must carefully weigh the benefits of natural and organic beef (price premiums) with the additional costs of modifying their production practices.

Source: "Natural and Organic Beef." University of Arkansas. FSA3103. http://www.uaex.edu/Other_Areas/publications/PDF/FSA-3103.pdf

Tastes and preferences

The tastes and preferences of consumers are a major determinant of the demand for goods in the US; while this is true, it is also true that tastes and preferences change over time: sometimes quickly. Tobacco provides an example. Tobacco use has dropped dramatically for the entire population in the US, although smoking among young persons is higher now than it was thirty years ago. Food safety has become a much more important determinant of consumer demand for agricultural products, due to outbreaks of salmonella in poultry and *E. coli* in beef. Organic fruits and vegetables are a small but rapidly growing sector of the food market. Consumer tastes and preferences are always changing, based on trends, relative prices, fads, and other factors.

Expectations of future prices

The expectations of future prices also have an impact on the demand for a good. If the expectation were for the price of gold to increase, would you buy or sell gold? If you could buy gold today at $1000/ounce, and sell it later for $1700/ounce, you could make a huge return on your investment. This is why the expected future prices of agricultural products affect demand today. If the price of a good or commodity is expected to decrease, then the demand for the good will decrease, as consumers wait to purchase until the price decreases. Traders working at the Chicago Board of Trade, the Chicago Mercantile Exchange, and the New York Stock Exchange (NYSE) earn their living by buying and selling goods and commodities; they guess whether the prices will rise or fall and make purchases and sales accordingly. This "futures trading" is a major subject area of agricultural economics.

Population

Population is the final determinant of demand mentioned here. Population growth has a direct and important impact on consumption: more people buy more goods, particularly necessities such as food. The result is similar to an increase in income in low-income nations. If the population of Ethiopia increases, then Ethiopia's demand for wheat will increase.

The last few pages have dealt with the determinants of demand. Chapter 9 uses much of this information to explain how markets operate. The supply and demand curves from this chapter merge into one graph, to aid the study of the interaction between producers and consumers.

8.9 Summary

1. Supply is the amount of a good available in a given location, at a given time, and at a given price.
2. The marginal cost curve above the minimum Average Variable Cost curve is the supply curve of the individual firm.
3. The horizontal summation of all individual supply curves yields the market supply curve.
4. A supply schedule is a table showing the relationship between the price of a good and the quantity of a good supplied.
5. The Law of Supply states that the quantity of goods offered to a market varies directly with the price of a good, *ceteris paribus*.

6. An elasticity is the percentage change in one economic variable with respect to a percentage change in another economic variable.
7. The elasticity of supply is the percentage change in the quantity supplied with respect to a percentage change in price [$E^s = \%\Delta Q^s/\%\Delta P$]. An inelastic supply curve is relatively unresponsive to changes in price ($E^s < 1$); an elastic supply curve is relatively responsive to changes in price ($E^s > 1$); a unitary elastic supply curve is one where a percentage change in price results in an equal percentage change in quantity supplied ($E^s = 1$).
8. The elasticity of supply becomes more elastic as time passes.
9. Elasticities are unitless and can be compared across different goods.
10. The own-price elasticity of supply measures the responsiveness of quantity supplied of a good to changes in the price of that good.
11. The cross-price elasticity of supply measures the responsiveness of quantity supplied of a good to changes in the price of a related good.
12. The change in quantity supplied occurs when the change in quantity of a good sold is a result of a change in the price of a good. Graphically, this is a movement along a supply curve.
13. A change in supply occurs when the change in quantity of a good sold is a result of a change in an economic variable other than the price of a good. Graphically, a shift in the supply curve.
14. Determinants of supply include: (1) input prices, (2) technology, (3) prices of related goods, and (4) the number of sellers.
15. Complements in production are goods that are produced together. Substitutes in production are goods that compete for the same resources in production.
16. Demand is the consumer willingness and ability to pay for a good.
17. The demand curve is a function connecting all combinations of prices and quantities consumed for a good, *ceteris paribus*.
18. The demand schedule presents information on price and quantities purchased.
19. The market demand curve is the horizontal summation of all individual demand curves.
20. The Law of Demand states that the quantity of a good demanded varies inversely with the price of a good, *ceteris paribus*.
21. The price elasticity of demand relates how responsive quantity demanded is to changes in price [$E^d = \%\Delta Q^d/\%\Delta P$]. An inelastic demand curve is one where a percentage change in price results in a relatively smaller percentage change in quantity demanded ($|E^d| < 1$). An elastic demand is one where a percentage change in price results in a larger percentage change in quantity demanded ($|E^d| > 1$). A unitary elastic demand curve is one where the percentage change in price results in an equal percentage change in quantity demanded ($|E^d| = 1$).
22. The own-price elasticity of demand measures the responsiveness of the quantity demanded of a good to changes in the price of the same good.
23. The cross-price elasticity of demand measures the responsiveness of the quantity demanded of a good to changes in the price of a related good.
24. Substitutes in consumption are goods that are consumed "either/or." Complements in consumption are goods that are consumed together.
25. A change in quantity demanded results from a change in the price of a good. A change in quantity demanded is a movement along the demand curve.
26. A change in demand results from a change in an economic variable other than the price of a good. A change in demand is a shift in the demand curve.

27. Demand is determined by: (1) the price of the good, (2) prices of related goods, (3) income, (4) tastes and preferences, (5) expectations of future prices, and (6) population.
28. An Engel curve shows the relationship between consumer income and the quantity of good consumed, *ceteris paribus*. Engel's Law states that as income increases, the proportion of income spent on food declines.
29. The income elasticity of demand is the percentage change in the demand for a good in response to a percentage change in consumer income [$E^m = \%\Delta Q^d/\%\Delta M$].
30. A normal good is one whose consumption increases in response to an increase in income ($E^m > 0$). The consumption of an inferior good declines in response to an increase in income ($E^m < 0$). A luxury good's consumption increases at an increasing rate in response to an increase in income ($E^m > 1$), while a necessity good's consumption increases at a decreasing rate in response to an increase in income ($0 < E^m < 1$).

8.10 Glossary

Arc Elasticity. A formula that measures responsiveness along a specific section (arc) of a supply or demand curve, and measures the "average" price elasticity between two points on the curve.

Change in Demand. When a change in the quantity of a good purchased is a result of a change in an economic variable other than the price of the good. A shift in the demand curve.

Change in Quantity Demanded. When a change in the quantity of a good purchased is a result of a change in the price of the good. A movement along the demand curve.

Change in Quantity Supplied. A change in the quantity of a good placed on the market due to a change in the price of the good. A movement along the supply curve.

Change in Supply. A change in the quantity of a good produced due to a change in one or more economic variables other than the price of the good. A shift in the supply curve.

Complements in Consumption. Goods that are consumed together (e.g., peanut butter and jelly).

Complements in Production. Goods that are produced together (e.g., beef and leather).

Cross-Price Elasticity of Demand. A measure of the responsiveness of the quantity demanded of a good to changes in the price of a related good.

Cross-Price Elasticity of Supply. A measure of the responsiveness of the quantity supplied of a good to changes in the price of a related good.

Demand. Consumer willingness and ability to pay for a good.

Demand Curve. A function connecting all combinations of prices and quantities consumed for a good, *ceteris paribus*.

Demand Schedule. Information on prices and quantities purchased.

Elastic Demand. A change in price brings about a relatively larger change in quantity demanded.

Elastic Supply. A change in price brings about a relatively larger change in quantity supplied.

Elasticity. The percentage change in one economic variable resulting from a percentage change in another economic variable.

Elasticity of Demand. The percentage change in the quantity demanded in response to a percentage change in price.

Elasticity of Supply. The percentage change in the quantity supplied in response to a percentage increase in price.

Engel Curve. The relationship between income and quantity demanded, *ceteris paribus*.

Engel's Law. As income increases, the proportion of income spent on food declines, *ceteris paribus*.

Income Elasticity of Demand. The percentage change in the demand for a good in response to a 1 percent change in income.

Inelastic Demand. A change in price brings about a relatively smaller change in quantity demanded.

Inelastic Supply. A change in price brings about a relatively smaller change in quantity supplied.

Inferior Good. A good whose consumption declines in response to an increase in income.

Law of Demand. The quantity of a good demanded varies inversely with the price of the good, *ceteris paribus*.

Law of Supply. The quantity of goods offered to a market varies directly with the price of the good, *ceteris paribus*.

Luxury Good. A good whose consumption increases at an increasing rate in response to an increase in income.

Market Demand Curve. The relationship between the price and quantity demanded of a good, *ceteris paribus*, derived by the horizontal summation of all individual consumer demand curves for all individuals in the market.

Market Supply Curve. The relationship between the price and quantity supplied of a good, *ceteris paribus*, derived by the horizontal summation of all individual supply curves for all individual producers in the market.

Necessity Good. A good whose consumption increases at a decreasing rate in response to an increase in income.

Normal Good. A good whose consumption increases in response to an increase in income.

Own-Price Elasticity of Demand. The percentage change in the quantity demanded in response to a percentage change in price.

Own-Price Elasticity of Supply. Measures the responsiveness of the quantity supplied of a good to changes in the price of that good.

Substitutes in Consumption. Goods that are consumed on an "either/or" basis (e.g., wheat bread and white bread).

Substitutes in Production. Goods that compete for the same resources in the production process (wheat and barley). Or inputs that can replace each other in the production process (land and fertilizer).

Supply. The relationship between the price of a good and the amount of a good available at a given location and at a given time.

Supply Curve for an Individual Firm. The firm's marginal cost curve above the minimum point on the average variable cost curve.

Supply Schedule. A schedule showing the relationship between the price of a good and the quantity of a good supplied.

Unitary Elastic Demand. The percentage change in price brings about an equal percentage change in quantity demanded.

Unitary Elastic Supply. The percentage change in price brings about an equal percentage change in quantity supplied.

8.11 Review questions

1. The individual firm supply curve is:
   a. the horizontal summation of the market supply curve
   b. the MC curve above the maximum ATC

   c. the MC curve above the minimum ATC
   d. the MC curve above the minimum AVC
2. The market supply curve is:
   a. the MC curve above the minimum ATC
   b. the horizontal summation of all individual firm supply curves
   c. the vertical summation of all individual firm supply curves
   d. not enough information provided to answer
3. The Law of Supply states that:
   a. producers will always maximize profits
   b. the price of a good and quantity supplied have a positive relationship
   c. supply equals demand
   d. the Law of Diminishing Returns affects supply
4. An elasticity measures:
   a. how prices affect inflation
   b. the Law of Supply
   c. how economics influences the stock markets
   d. how responsive one variable is to another variable
5. Relative to the elasticity of apples, the elasticity of fruit is:.
   a. more elastic
   b. less elastic
   c. the same level of elasticity
   d. not enough information provided to answer
6. If the price of a good increases 1 percent, and quantity supplied increases 2 percent, then the supply of the good is:
   a. elastic
   b. inelastic
   c. unitary elastic
   d. cannot tell from the information given
7. If a change in the price of apples results in a change in the quantity supplied of oranges, then the goods are:
   a. own-price elastic
   b. cross-price elastic
   c. related
   d. unrelated
8. If the price of fish increases, then there is a change in:
   a. the supply of fish
   b. the quantity supplied of fish
   c. the amount of fish sold
   d. cannot tell from the information given
9. Each of the following is a determinant of supply except:
   a. number of sellers
   b. technology
   c. tastes and preferences
   d. input prices
10. An individual demand curve for pizza can be derived with the following:
   a. prices of pizza, one other good, and income
   b. price of pizza and two other goods

c. income
d. price of pizza

11. If the price of milo increases:
    a. consumers will buy more milo
    b. consumers will buy less milo
    c. consumers will buy the same amount of milo
    d. cannot tell with the information given
12. Which has the least elastic demand curve?
    a. apples
    b. fruit
    c. food
    d. oranges
13. If a firm faces an inelastic demand curve, then it will desire to:
    a. maintain output at the current level
    b. increase output to increase revenue
    c. decrease output to increase revenue
    d. purchase more inputs
14. If the price of pork increases, then the following will result:
    a. a change in pork demand and a shift in pork demand
    b. a change in pork demand and a movement along the pork demand curve
    c. a change in quantity of pork demanded and a shift in pork demand
    d. a change in quantity of pork demanded and a movement along the pork demand curve
15. If the price of gold is expected to increase in the future, then:
    a. the demand for gold will increase today
    b. the demand for gold will decrease today
    c. the quantity demanded of gold will increase today
    d. the quantity demanded of gold will decrease today
16. The income elasticity of demand for food is:
    a. $0 < E^m < 1$
    b. $E^m < 0$
    c. $E^m > 1$
    d. $E^m = 0$

Plate 9.1 Markets.
Source: Joel Shawn/Shutterstock

9 Markets

Synopsis

Markets bring buyers and sellers together to exchange goods and services. Markets provide efficient, self-correcting institutions that provide goods that producers want to sell and consumers want to buy. In this chapter, market equilibrium and mathematical models of supply and demand are introduced and explained. Comparative statics lead to the analysis and understanding of changes in supply and demand. The models explained here provide timely, important, and interesting explanations of real-world events. Price policies including price supports and price ceilings are analyzed, with real-world examples highlighting the consequences of agricultural price policies in low-income and high-income nations.

9.0 Introduction

Prices of goods and services make up the heart and soul of a free market economy. Producers who understand how and why the prices of goods and resources change over time can use this information to increase profitability. Consumers make better choices if they understand market forces that determine price changes. This chapter describes and explains how buyers and sellers interact in markets: the foundation of a market-based economic system.

9.1 What is a market?

A **Market** is an institution or a process that allows buyers and sellers to interact. A market is not necessarily a **Marketplace**, which is a physical location where buyers and sellers go to exchange goods. It can be a farmer's market, or the commodity trading pits of the Chicago Board of Trade.

- ***Marketplace*** = a physical location where buyers and sellers meet to trade goods.

A **Market** can be located in a physical space such as a shopping mall in Salt Lake City, Utah, but it need not be. Buying and selling goods on the Internet from a firm such as Amazon or eBay makes the Internet into a market, even though the buyers and sellers are not in the same physical location and may never exchange a word. A market appears wherever there is interaction between buyers and sellers of a good:

- ***Market*** = the interaction between buyers and sellers.

This interaction between buyers and sellers determines the price of a good, and the quantity of the good that changes hands. One key feature of markets is that they are voluntary. Individual buyers and sellers determine quantities and prices. The next section describes how the voluntary actions of numerous producers and consumers lead to equilibrium in a market.

Please keep in mind that this chapter's lessons relating to supply, demand, and prices are presented under the assumption that all other economic conditions are held constant during the negotiations over potential prices and quantities of the good being traded. This assumption, called the *ceteris paribus* assumption, was presented in Chapter 1 and has been mentioned frequently in each successive chapter. The assumption is necessary to allow focusing attention on a single item of interest, which in economics is almost always the price or quantity of a good. Using this assumption simplifies the complicated real world, making it easier to understand.

9.2 Market equilibrium

Markets work by bringing together producers who desire to sell their product at the highest possible price, and consumers who desire to purchase goods at the lowest possible price. Although the goals of buyers and sellers are opposite from one another, voluntary trades allow for the objectives of both groups to be met. This section describes how the behavior of numerous individual buyers and sellers converge on a price or quantity from which there is no tendency to change, or **Equilibrium**.

- ***Equilibrium*** = a point from which there is no tendency to change.

The market supply and market demand curves derived in Chapter 8 appear together on a single graph in Figure 9.1. The market supply curve (Q^s) is the horizontal sum of all of the individual firms' supply curves. It represents the quantity of a good that all producers taken together are willing and able to offer for sale at each of a series of prices. The voluntary nature of the supply curve is evidence that firms freely offer a quantity of a good to the market in order to maximize their profits.

The market demand curve (Q^d) depicts the horizontal sum of all individual consumer demand curves. Individual demand curves show the quantity of a good that a consumer is willing and able to pay for at each of a range of prices. The market demand curve stems from the voluntary behavior of many consumers seeking to maximize their individual levels of satisfaction.

The **Market Equilibrium** occurs at the intersection of the supply curve and the demand curve at point E in Figure 9.1. At this point, the quantity supplied (Q^s) by firms at a given price is equal to the quantity demanded (Q^d) by consumers at the same price.

- ***Market Equilibrium*** = the point where the quantity supplied by producers at a given price is equal to the quantity demanded by consumers at that same price.

At point E (and only at point E), the following market equilibrium condition holds:

$$Q^* = Q^s = Q^d. \tag{9.1}$$

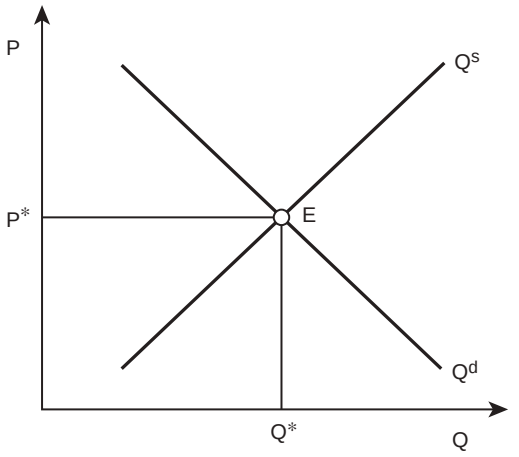

Figure 9.1 Market equilibrium.

Only one price equates the quantity of a good supplied by producers with the quantity purchased by consumers. This price is the **Equilibrium Price**, shown by point P* in Figure 9.1.

- ***Equilibrium Price*** **=** the price at which the quantity supplied equals the quantity demanded.

The equilibrium price is also the **Market Price**, since it is the price determined in the market and agreed to by buyers and sellers.

- ***Market Price*** = the price where quantity demanded is equal to quantity supplied.

The **Equilibrium Quantity** is Q*, where the quantity supplied is identical to the quantity demanded.

- ***Equilibrium Quantity*** = the point where quantity supplied is equal to quantity demanded.

The intersection of supply and demand determines the market equilibrium. Why not another price or quantity? Every price other than P* is not an equilibrium price, and every quantity other than Q* is not an equilibrium quantity. Any point other than point E in Figure 9.1 is a **Disequilibrium** point unsatisfactory to either buyers or sellers or both. In disequilibrium, freely operating market forces come into play to cause the market to move toward the equilibrium point, E.

- ***Disequilibrium*** = a market situation in which the market price does not equalize supply and demand.

The voluntary behavior of buyers and sellers will result in a movement toward equilibrium (point E), where the quantity supplied equals the quantity demanded. Consider the hypothetical market for wheat depicted in Figure 9.2.

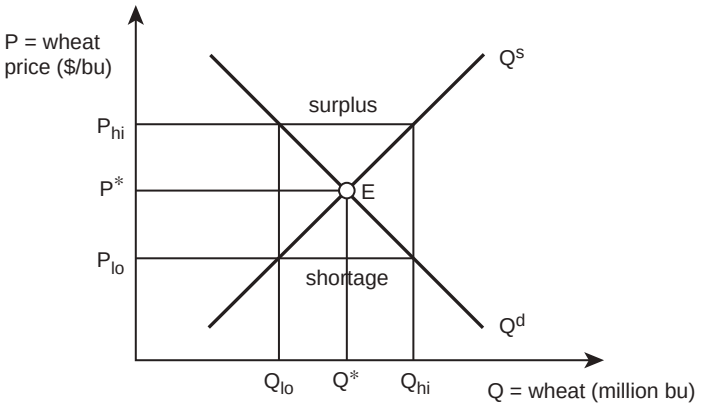

Figure 9.2 Market forces in a wheat market.

The supply curve in the wheat market (Q^s) shows the quantity of wheat that wheat producers will offer for sale at each of a range of prices. Intuitively, the supply curve represents the cost of wheat production. Low-cost producers are located to the left, where the supply curve is low, and high-cost producers are located to the right, at higher prices.

Quick Quiz 9.1

How is the supply curve for wheat derived for an individual firm? For the industry?

The demand curve for wheat (Q^d) shows the quantity of wheat that buyers will buy at each of a range of prices. In the wheat market, the major consumers are millers who purchase wheat then grind it into the flour used for baking bread or tortillas. The demand curve for this wheat represents the consumers' willingness and ability to pay for it. Scarcity causes the demand curve to slope downward from left to right. As more wheat becomes available, millers offer lower prices to meet their needs for wheat.

Quick Quiz 9.2

How is the demand curve for wheat derived?

Quick Quiz 9.3

Why is everything other than price (and quantity) held constant in a graph of supply and demand? How does this simplification affect the study of the market for wheat?

The price of wheat always gravitates toward the equilibrium point, E. Suppose that the price of wheat is P_{hi}. At this relatively high price of wheat, the Law of Demand indicates that consumers (flour millers) will purchase only a small quantity of the grain. Specifically, at price P_{hi}, they will purchase Q_{lo} million bushels of wheat. Wheat suppliers, however, expand wheat production when the price of wheat is high. They will provide Q_{hi} million bushels to the market when the price reaches P_{hi}. At price P_{hi}, the quantity supplied (Q_{hi}) exceeds the quantity demanded (Q_{lo}). This situation yields a **Surplus**, which is the horizontal distance between Q_{hi} and Q_{lo} in Figure 9.2.

- ***Surplus*** = a market situation in which producers are willing to supply more of a good than consumers are willing to purchase at a given price $\left(Q^s > Q^d\right)$.

A surplus occurs at any price higher than the equilibrium price (P*). In a surplus situation, there is more wheat available for sale than flour millers are willing to purchase. Consider the manager of a grain elevator (the grain storage facility) somewhere in the Northern Great Plains. A larger-than-usual harvest has resulted in a full elevator and a huge pile of wheat "stored" on the ground. No millers are buying any wheat at the current high price (P_{hi}). Pressure develops for the elevator manager to sell the wheat as quickly as possible, since rain or moisture will cause the wheat grains to sprout, which lowers the value of the wheat. What does the manager do? She lowers the price of wheat to sell it.

As the price of wheat drops from P_{hi}, suppliers (wheat producers and elevators) reduce the quantity of wheat offered to the market, and consumers increase the quantity demanded of wheat as shown along the demand curve. Suppliers lower the price of a good until they are able to sell their product, and eliminate the surplus. The price continues to drop until the quantity of wheat supplied (Q^s) comes in line with the quantity of wheat demanded (Q^d). This occurs only at the equilibrium price (P*) and the equilibrium quantity ($Q^* = Q^s = Q^d$).

Plate 9.2 Wheat surplus.
Source: Carroteater/Shutterstock

This story holds true not only for wheat crops, but also for any good or service. If the price of a good is greater than the equilibrium price, producers (sellers) will continue to lower the price until the market price is the equilibrium price. Any price higher than P* is a disequilibrium price, since there is a tendency to move toward the equilibrium point (E). Once at equilibrium, there is no tendency to change, since quantity supplied is equal to quantity demanded and there is no surplus. Buyers and sellers agree on quantity and price.

If the price of wheat falls to $P_{lo,}$ wheat suppliers will cut back production to Q_{lo}, and wheat consumers (millers) will increase quantity demanded to Q_{hi}. This situation results in a **Shortage**, since the quantity demanded (Q_{hi}) is greater than the quantity supplied (Q_{lo}). The shortage is the horizontal distance between Q_{lo} and Q_{hi} in Figure 9.2.

- ***Shortage*** = a market situation in which consumers are willing and able to purchase more of a good than producers are willing to supply at a given price ($Q^s < Q^d$).

Shortages occur at all prices below the equilibrium price (P*). Suppose a flour miller has contracted with several bread bakers for a large quantity of flour. At the price P_{lo}, the miller is unable to acquire any wheat, due to the shortage. What should he do? Offer a higher price to increase the amount of wheat available. The increase is shown along the supply curve. As the price increases, the quantity demanded decreases along the demand curve. The price will continue to be "bid up" by wheat consumers until it reaches the equilibrium point E, and the shortage disappears. This occurs in the market for wheat, and in the market for any good or service where a shortage occurs. Any price below P* is a disequilibrium price. The independent actions of buyers and sellers cause the price to gravitate toward its equilibrium point.

At any price other than the equilibrium price, market forces (the behavior of buyers and sellers) will bring the price back into equilibrium at the market equilibrium price and quantity. Walmart behaves in a similar way. It places items on sale by lowering price when a store has a surplus (price too high) in its inventory. Walmart does not reorder this item. If the shelves are empty, Walmart shoppers request more of the good, because they cannot purchase the quantity desired. There is a shortage (price too low), and Walmart increases the price and reorders more of the good until the equilibrium is reached. In this simple way, Walmart has become the most successful retailer in the world by using simple economic principles.

This simple supply and demand model can help predict price movements in the economy. Individuals who become reasonably expert at such predictions often become grain merchandisers, commodity traders, or stockbrokers. The individuals in these professions often use simple and intuitive supply and demand models to "buy low and sell high." Even in other businesses, the tools related to supply and demand are useful in determining how market forces will affect the price and quantity of inputs and outputs.

9.3 Comparative statics

The study of markets provides managers of business firms with a powerful method of understanding and analyzing how prices of the firm's inputs and outputs change over time. This knowledge can lead to improved decision making, and higher levels of profit for the firm. The interaction of supply and demand results in an equilibrium market price and quantity. The study of the impacts of changes in supply and demand relationships is called **Comparative Statics**, a method of comparing one equilibrium point with another.

- ***Comparative Statics*** = a comparison of market equilibrium points before and after a change in an economic variable.

The study begins with the impacts of changes in demand, then moves to changes in supply, and, finally, to simultaneous changes in both supply and demand. Careful consideration of these comparative static examples provides useful insight into analyzing any economic policy, change, or situation.

Changes in demand

The large and enduring increases in China's per capita income are likely to continue to have a positive impact on the demand for beef and grain produced in the United States. Consumers with increasing income levels tend to substitute out of inexpensive calorie sources such as grains, and into more expensive sources such as beef and seafood. Figure 9.3 shows this increase in demand.

The outward shift in the demand curve (from Q^d_0 to Q^d_1) is a change in demand (not a change in quantity demanded), since the source of the change is a nonprice variable (the increase in per capita income in China). The equilibrium point in Figure 9.3 changes from E_0 to E_1 because of the change in demand. As the demand curve shifts upward and to the right, it sweeps across the supply curve from one equilibrium point to another. The change increases the price of beef from P^*_0 to P^*_1, causing a change in quantity supplied, or a movement along the supply curve, as shown in Figure 9.3.

A SHIFT IN DEMAND RESULTS IN:
(1) A CHANGE IN DEMAND, and
(2) A CHANGE IN QUANTITY SUPPLIED.

An increase in demand, as shown in Figure 9.3, results in an increase in the equilibrium price and quantity of beef. Any economic variable that increases demand for a good will result in a higher price and a larger quantity of the good moving through the market. This could be

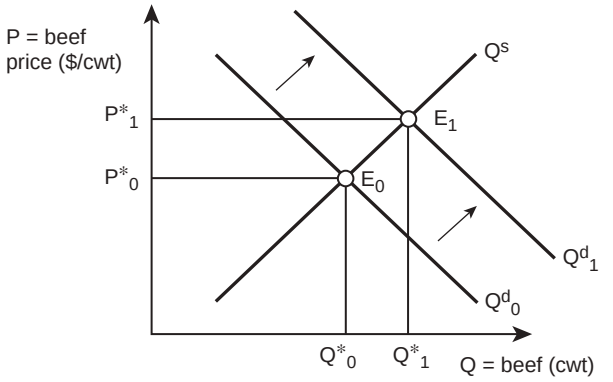

Figure 9.3 An increase in the demand for beef.

due to an increase in income or population, an expectation that the good's price will increase even more in the future, or a change in consumer tastes and preferences, to name a few possible sources of increases in demand.

Box 9.1 The substitution of beef, pork, and chicken in the US

To what extent do consumers actually "substitute," or switch from one meat product to another? This question was researched using data from US consumers in 1995 by Brester and Schroeder. Price elasticities for the own prices and cross prices were estimated for beef, pork, and poultry. The results show that meats are most responsive to changes in their own price, with elasticities ranging from –0.33 (poultry) to –0.69 (pork). This means that if the price of meat increases by 1 percent, the quantity demanded of the meat will decrease by the percentage shown in the table. Cross-price elasticities measure the responsiveness of consumers to a change in the price of a related good. The substitution between meats is relatively small in percentage terms; however, the dollar value of the substitution is large, since even small elasticities can have large aggregate effects in high-volume commodity markets.

Price elasticities of meat demand

	P_{beef}	P_{pork}	$P_{poultry}$
Q_{beef}	–0.56	0.10	0.05
Q_{pork}	0.23	–0.69	0.04
$Q_{poultry}$	0.21	0.07	–0.33

Source: Brester, Gary W. and Schroeder, Ted C. (1995)."The Impacts of Brand and Generic Advertising on Meat Demand." *American Journal of Agricultural Economics* 77(4): 969–979.

A decrease in demand will have the opposite results. The demand curve will shift to the left, causing a decrease in both the equilibrium price and quantity traded of the good. A decrease in the relative price of chicken causes consumers to substitute out of other meats and into chicken. This results in a decrease in the demand for beef, as shown in Figure 9.4.

Again, the shift in the demand curve represents a change in demand and a change in quantity supplied (movement along the supply curve). The equilibrium price and quantity of beef decrease in this situation.

Supply changes

Petroleum products are a major input in the production of agricultural products such as corn. An increase in the price of petroleum stemming from increases in demand from growing economies such as China and India will be accompanied by higher costs of production faced by domestic US producers. The corn producers' marginal cost curves will shift upward due to this increase in the price of petroleum products. The market supply curve shown in Figure 9.5 is the horizontal sum of all individual firms' marginal cost curves.

Plate 9.3 Beef demand.
Source: Marc Dietrich/Shutterstock

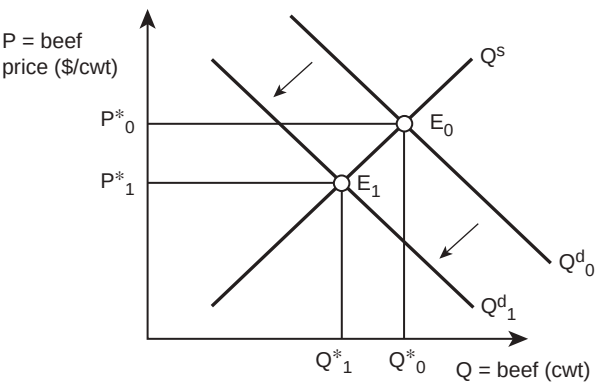

Figure 9.4 A decrease in the demand for beef.

This leftward shift in the supply curve is a change in supply (not a change in quantity supplied), since the source of the change is a nonprice variable (an increase in the price of an input rather than a change in the price of corn). The equilibrium point changes from E_0 to E_1 because of the change in supply. As the supply curve shifts upward and to the left, it moves

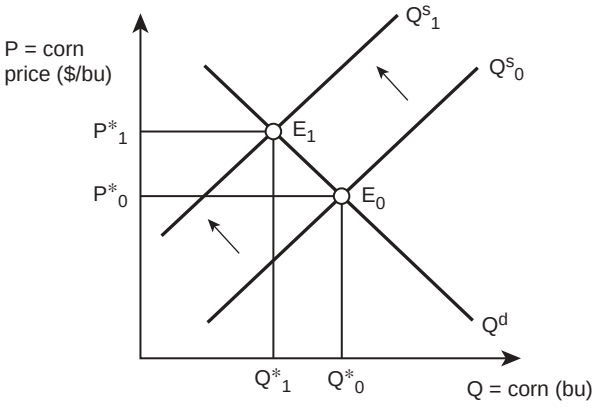

Figure 9.5 A decrease in the supply of corn.

across the demand curve from the original equilibrium point to a new equilibrium point. This increases the price of corn from P^*_0 to P^*_1, and as a result causes a change in quantity demanded, or a movement along the demand curve, as shown in Figure 9.5.

A SHIFT IN SUPPLY RESULTS IN:
(1) A CHANGE IN SUPPLY, and
(2) A CHANGE IN QUANTITY DEMANDED.

The shift in supply in Figure 9.5 is a decrease in supply, since at every price the quantity of corn supplied decreases. This can lead to confusion, since the upward shift in the supply curve represents a decrease in supply. The quantity axis measures the "increase" or "decrease" in supply. The corn supply curve shifted to the left, reflecting a decrease in supply. This decrease in supply resulted in an increase in the equilibrium price, and a decrease in the equilibrium quantity of corn. Any economic variable that decreases the supply of a good will result in a higher price and lower quantity of the good bought and sold. This type of shift could be due to a number of things, including an increase in the cost of an input, a tax on corn production, or bad weather that has a negative impact on growing conditions.

An increase in supply will have the opposite effects: the supply curve will shift downward and to the right, causing a decrease in the equilibrium price, and an increase in the equilibrium quantity of the good. If plant geneticists develop a new variety of corn that yields more bushels per acre than older corn varieties, this technological change results in an increase in supply, or a rightward shift in the supply curve, shown in Figure 9.6.

Again, the shift in the supply curve represents a change in supply and a change in quantity demanded (movement along the demand curve). The equilibrium price decreases and the equilibrium quantity of corn increases in this situation. Changes in the production of a good affect the market price and quantity of a good.

Plate 9.4 Corn supply.
Source: Fotokostic/Shutterstock

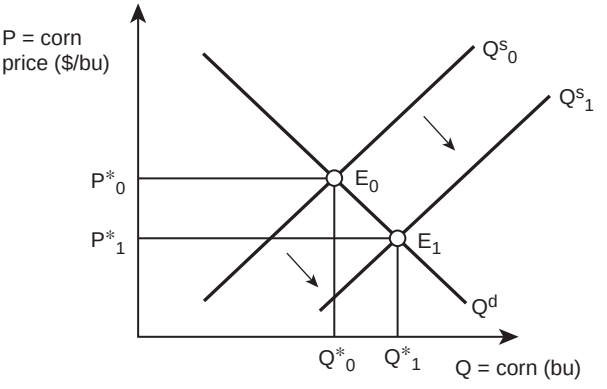

Figure 9.6 An increase in the supply of corn.

Box 9.2 African agriculture and food aid

In the 1960s, most Sub-Saharan African nations were food exporters; today, most of these nations import millions of tons of food each year. Much of the world's hunger and poverty are concentrated in Sub-Saharan Africa. Cereal yields have declined since the 1970s, and are now approximately one-third of those in South Asia. Agriculture in Sub-Saharan Africa is subject to conflict, drought, a lack of government commitment

to agriculture, and decreasing international aid. This tragic situation provides the opportunity for one of the greatest future increases in the welfare of humanity.

Environmental challenges include poor soil quality in many regions, and drought. In Asia, irrigation provided the foundation for the introduction of high-yielding cereal varieties. In Africa, 96 percent of available arable land lacks irrigation. International aid to Africa has dropped since the 1980s, when a shift occurred in aid away from agriculture toward health, education, and governance. The World Bank has contributed to African agriculture, but the strategy has been criticized for its lack of political support in recipient nations.

Some critics have emphasized that African governments have become too dependent on international food aid. Between 1981 and 2000, national government funding for agricultural science fell by 27 percent in Africa, and many governments in Sub-Saharan Africa allocate less than 1 percent of their national budgets to the sector. This could be due to a reliance on international aid. A successful strategy for increasing Africa's food production is likely to include the development of high-yielding crops, enhanced training in agricultural science, increased government commitment to agriculture, and enhanced efficiency of agricultural markets and infrastructure.

Food aid plays a unique role in reducing hunger and poverty. When famine or persistent hunger occurs, international food aid can be used to provide food to those in need. The provision of calories to hungry individuals provides a life-saving benefit that is difficult to fault. However, food aid has costs as well as benefits. The supply of large amounts of food to a given location shifts the supply curve of food to the right, decreasing the price of food. While this is a benefit to food consumers, it lowers the food price, and thus the incentive for local producers to produce more food. Food aid can save lives in the short run, but it can decrease food availability and result in continuing dependence on food aid in the long run. Many experts promote income assistance or food vouchers, which would allow food to be purchased within Africa, instead of shipped from the US or the EU. This would increase the demand for food, based on an increase in purchasing power, resulting in upward price pressure, and increasing the incentive for local food production.

Sources: Hanson, Stephanie (2008). Backgrounder: African Agriculture. Council of Foreign Relations. May 28. Retrieved July 25, 2012.
Paarlberg, Robert (2008). *Starved for Science: How Biotechnology is Being Kept Out of Africa*. Harvard University Press.

Simultaneous supply and demand changes

Examples in the previous two sections focused on one change at a time. In the real world, supply and demand curves are constantly changing, being pushed and pulled by changes in a large number of economic forces occurring simultaneously throughout the economy and the world. In agricultural markets, supply and demand shift due to weather, input and product prices, exports, imports, expectations regarding the future, and numerous other factors. This section considers the situation when supply and demand change simultaneously. In some ways, this is more realistic than the response to changes in a single variable.

The production of agricultural products has grown over time, due to the introduction of many new foods, changes in tastes, and technological change. Consumption of food and fiber has also grown because of increases in population and increased family income. These changes are shown in the same graph, in Figure 9.7.

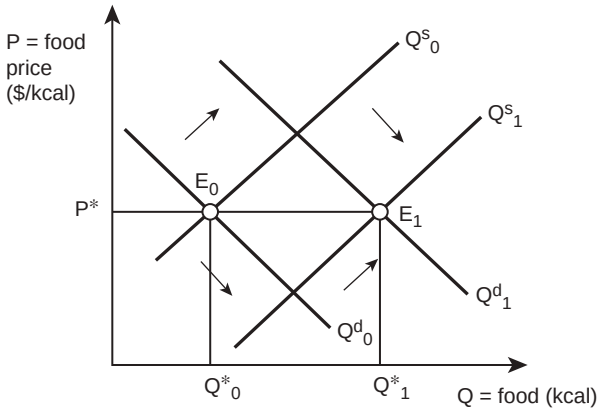

Figure 9.7 Increases in the supply and demand of food.

If the supply and demand curves shift by equal quantities over time, the equilibrium changes from E_0 to E_1, as shown in Figure 9.7. In this situation, the equilibrium price remains constant at P*, while the equilibrium quantity increases from Q^*_0 to Q^*_1.

Figure 9.8 shows the case appropriate to most agricultural markets in the United States, where increases in production have outpaced increases in consumption. When supply growth outpaces demand growth, the equilibrium price of food decreases, and the equilibrium quantity of food increases. In US agriculture since the mid-1940s, the price of agricultural products has decreased in relation to most other goods. During the same period, the output of agricultural commodities has increased tremendously due to the huge productivity gains associated with mechanization, chemical and fertilizer use, and plant and animal breeding. These long-term forces taken together have made consumers better off, since more food and fiber is available at a lower price. If demand increases at a faster rate than supply, then the equilibrium price will increase, reflecting the increase in scarcity of the good.

Quick Quiz 9.4

Graph a situation where the demand of a good increases faster than the supply for the good. What happens to the equilibrium price and quantity of the good?

9.4 Price policies

In many nations, including the United States, the government intervenes in agricultural markets in response to political pressure from either agricultural producers or consumers of food and fiber. The government has the authority to legislate the retail prices of food and agricultural commodities. If the government believes that the market price of an agricultural product is too low, it can pass a law that mandates a **Price Support** for the good. Since this policy

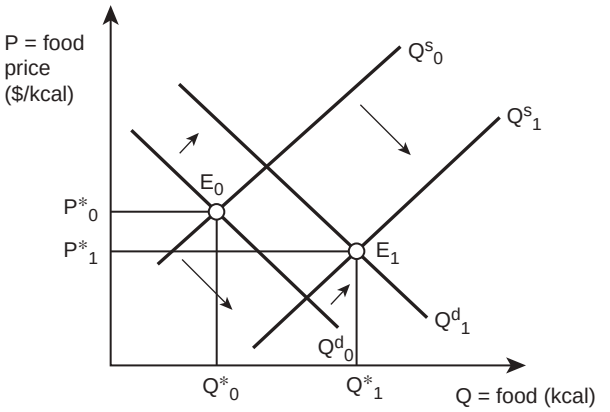

Figure 9.8 Supply increase outpaces demand increase.

increases the price, it will be promoted by producers. On the other hand, if the government believes that the market price of a good is too high, it can put a **Price Ceiling**, likely sponsored by consumers. This form of government intervention has been common in agricultural markets for many years.

Price supports

When the prices of agricultural goods are low, producers often place pressure on politicians to "do something about low commodity prices." A common reaction of governments is to pass a law that sets a **Price Support**, or a minimum price, below which the market price cannot go. In recent years, price support policies have been used to increase the prices of milk, grains, cotton, and other agricultural products both in the US and in nations throughout the world.

- ***Price Support*** = a minimum price set by the government for a specified good or service.

When a price is higher than the market price, a surplus results, as above in Figure 9.2. The government must enforce this market price intervention, otherwise the surplus would quickly set in motion market forces that would take the market back to the equilibrium point, where the quantity supplied equals the quantity demanded.

Quick Quiz 9.5

What causes this surplus?

Figure 9.9 shows a hypothetical price support for wheat, which in this example is higher than the equilibrium market price ($P^s > P^*$).

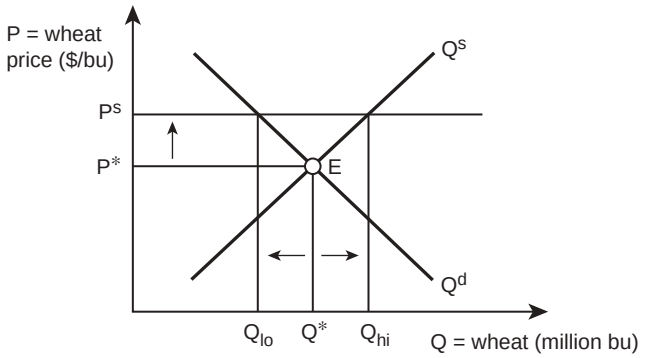

Figure 9.9 A price support for wheat.

A federal law saying that all wheat must be sold at a price at or above the price support level would force an increase in the price of wheat as shown in Figure 9.9. This increase in price results in an increase in quantity supplied, as producers respond to the price incentive to produce more wheat, and move upward along the supply curve. This is a change in quantity supplied, rather than a change in supply, since the price is the cause of the change. Similarly, the price rise causes a decrease in quantity demanded, due to consumers' response to the increase in price. The consumers' action causes movement along the demand curve.

If free markets were allowed to operate, the surplus ($Q^s > Q^d$) would result in downward pressure on the price of wheat until the original equilibrium is reached. Moreover, the government must enforce this price support by removing the surplus if it expects to maintain the price at P^s. The government must stand ready to purchase any quantity of wheat at the price support level, to keep producers from lowering the price. The government purchases the entire surplus ($Q_{hi} - Q_{lo}$), and removes this wheat from the market. The government has several options regarding the use or disposal of the surplus wheat. These include:

1. Give it away to US consumers through domestic food programs,
2. Give it away to foreign consumers through food aid programs,
3. Export the wheat to consumers in other nations (perhaps at a below-market price), or
4. Destroy the wheat (e.g., dump it in the ocean).

At various times, the US government has practiced each of the four strategies. Domestic food programs include school breakfasts and school lunches.

Note that if the price support (P^s) were lower than the equilibrium market price (P^*), the government would take no action. This is because the law requires the purchase of wheat at or above the price support level, and since the market price is above the price support level, the law is not in effect, or not "binding."

The price support is good for wheat producers, since they receive a higher-than-market-equilibrium price for a larger-than-market-equilibrium number of bushels produced. The price support hurts consumers, since they must pay a price higher than the equilibrium market price. Moreover, the consumers as taxpayers are made worse off, since they must provide the money used to purchase the surplus and then find some way to deal with what they have purchased.

Between 1933 and 1996, the United States had a complicated system of price supports. Price supports became damaging for US agriculture in the mid-1990s because the price supports raised the price of agricultural goods above the free-market, world price level. Since over half of all wheat and feed grains produced in the United States is exported, the price supports were making US food products expensive relative to exports from other nations. The US was losing export opportunities with other nations, due to its artificially high prices for food and feed grains. Modifications in the commodity price laws in 1996 brought US agriculture closer to a free market. Price supports remain, but they are minimum prices put in place to protect producers in times of low commodity prices, to act as a "safety net" that saves producers from low prices.

Price ceilings

At times, food prices increase, and in times of economic recession or depression, governments may intervene in the attempt to keep food affordable. In such a circumstance, a "ceiling" on food prices can protect consumers from excessively high food prices. **Price ceilings** are a government-mandated maximum price.

- ***Price Ceiling*** = a maximum price set by the government for a specified good or service.

When prices rise rapidly, consumers often pressure their legislators to "do something about the high prices." In the 1970s, food prices rose rapidly, creating pressure for the government to help the consumer through market price interventions. President Richard Nixon placed price ceilings on beef and many other food products. Figure 9.10 shows the impacts of such a price ceiling on meat producers and consumers.

With the imposition of the price ceiling on meat, producers and consumers cannot buy or sell meat at any price above the maximum price (P_{max}). If the price ceiling were set at a price greater than the equilibrium price, nothing would happen. When the price ceiling (P_{max}) is set below the market price (P*), however, it has consequences. The price decrease causes movements along both the supply and demand curves.

At a lower price, consumers purchase more meat due to the Law of Demand, resulting in an increase in quantity demanded from Q* to Q_{hi}. Producers reduce the quantity of meat

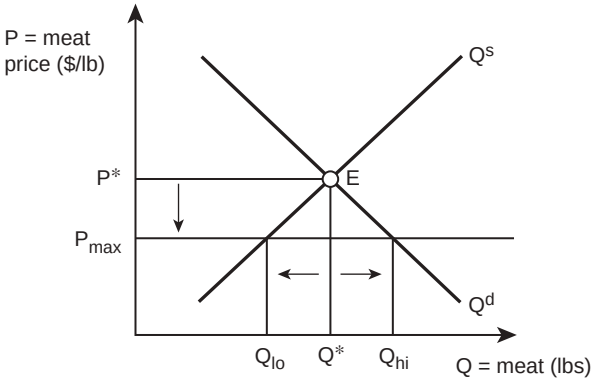

Figure 9.10 A price ceiling for meat.

supplied at the lower price. The result is a reduction in meat supplied from Q* to Q_{lo}. This creates a shortage ($Q^s < Q^d$).

This form of government intervention is interesting because the policy may or may not make consumers better off than they were prior to the mandated price ceiling. The reason is that there is less meat available to consumers at the low price of P_{max}. Profit-maximizing producers will decrease the supply of meat at the lower price, creating a shortage. If the law does not allow price increases, then the shortage will not self-correct through a process of consumers bidding up the price back to the equilibrium level, where the quantity supplied equals the quantity demanded.

When the price ceiling is in place, the consumers who are able to purchase meat are better off, because they pay a lower price for meat. However, there is a group of consumers who are unable to locate and purchase meat due to the shortfall in production. This group of consumers is worse off because the policy restricts their access to meat.

Markets are enormously useful and adaptable institutions. Government intervention into markets typically has unanticipated consequences which distort the market mechanism. In the case of the price support, put in place to assist producers, the taxpayers and consumers must pay a large sum of money to the recipients of the price support. A price ceiling results in a shortage of the good, and some unsatisfied consumers. Government intervention takes away the "self-correcting" nature of markets, which will always result in the attainment of equilibrium, or a situation where the quantity supplied is equal to the quantity demanded.

9.5 Mathematical models (optional)

Economics includes three ways to describe market phenomena: (1) graphs, (2) "stories," or verbal explanations, and (3) mathematical models. The previous sections used graphs and stories to describe the market for wheat. Simple algebra is another way to describe this market. The mathematical model presented below uses the same information to describe and analyze situations related to supply and demand.

The following equation represents the supply of wheat:

$$P = 5 - 0.1Q^d, \tag{9.2}$$

where P is the price of wheat in dollars per bushel, and Q^s is the quantity supplied of wheat in millions of bushels. This equation is called an **Inverse Supply Function**, since price (the independent variable) is a function of quantity supplied (the dependent variable). Mathematically, a supply function could be described as: $Q^s = f(P)$, since price is given and producers determine how much to produce given the independent variable, price. As before, price is measured along the vertical axis and quantity supplied is on the horizontal axis. Using the **Inverse Supply Function**, $P = f(Q^s)$, makes a function easier to graph.

- **Inverse Supply Function** = a supply function that is represented with price (the independent variable) as a function of quantity supplied (the dependent variable): $P = f(Q^s)$.

Similarly, define an **Inverse Demand Function** as a demand function with the dependent variable (Q^d) and the independent variable (P) reversed:

- **Inverse Demand Function** – a demand function that is represented with price (the independent variable) as a function of quantity demanded (the dependent variable). $P = f(Q^D)$.

Suppose that is the inverse demand function for wheat.

$$P = 5 - 0.1Q^D. \tag{9.3}$$

To find equilibrium, set the two equations equal to each other, since $P = P$.

$$1 + 0.1Q^S = 5 - 0.1Q^D. \tag{9.4}$$

Next, recall that in equilibrium, $Q^S = Q^D = Q^*$, so replace the quantities supplied and demanded with the equilibrium quantity.

$$1 + 0.1Q^* = 5 - 0.1Q^*. \tag{9.5}$$

Now, subtract one from each side of the equation, and add $0.1Q^*$ to each side of the equation to get.

$$0.2Q^* = 4, \text{ or } Q^* = 20 \text{ million bushels of wheat.} \tag{9.6}$$

Substituting this equilibrium quantity (Q^*) into the inverse supply function yields the equilibrium price:

$$P = 1 + 0.1Q^S = 1 + 0.1(20) = 1 + 2 = \$3/\text{bu of wheat} \tag{9.7}$$

Check this result by plugging the equilibrium quantity into the inverse demand equation:

$$P = 5 - 0.1Q^D = 5 - 0.1(20) = 5 - 2 = \$3/\text{bu of wheat.} \tag{9.8}$$

The equilibrium in the wheat market is ($P^* = \$3$ bu of wheat, $Q^* = 20$ million bushels of wheat). This same result found graphically requires graphing the supply and demand functions, and locating the equilibrium at the intersection of supply and demand (Figure 9.11).

Economists use this type of mathematical model to study agricultural markets. Price and quantity data coming from markets such as the Kansas City Board of Trade or the Chicago Mercantile Exchange enable the study of how changes in policies, weather, or any other economic variable will influence the prices and quantities of agricultural goods.

A model such as this helps an analyst determine the implications of how a change in the price of wheat will affect the wheat market. For example, suppose that the price of wheat increases to a level above the equilibrium level to $4 bu. Both the graph in Figure 9.11 and the mathematical model provide information telling that a price above the equilibrium level will increase production, decrease consumption, and result in a surplus. To calculate the levels of quantity supplied and demanded, simply plug in the price of $4 bu into the inverse supply and inverse demand equations:

$$4 = 1 + 0.1Q^S \tag{9.9a}$$

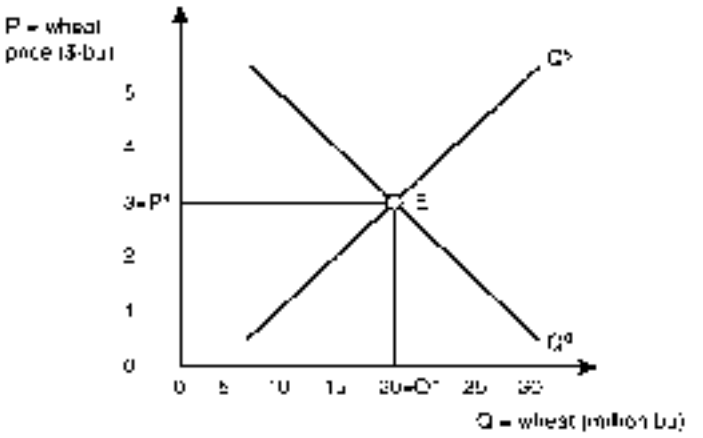

Figure 3.13 Quantitative wheat market equilibrium.

$$3 = 0.1Q^S \tag{3.9b}$$

$$Q^S = 30, \text{ so} \tag{3.9c}$$

$$Q^S = 30 \text{ million bushels of wheat.} \tag{3.9d}$$

$$1 = 0.1Q^D \tag{3.9e}$$

$$Q^D = 10 \text{ million bushels of wheat.} \tag{3.9f}$$

The surplus quantity ($Q^S - Q^D$) can also be calculated:

$$\text{Surplus} = (Q^S - Q^D) = 30 - 10 = 20 \text{ million bushels of wheat.} \tag{3.10}$$

This procedure also helps calculate a below-equilibrium price that leads to a shortage. Suppose that the price of wheat drops to $2 bu. The inverse supply and inverse demand equations yield the following estimates of quantities:

$$2 = 0.1Q^S \tag{3.11a}$$

$$1 = 0.1Q^D \tag{3.11b}$$

$$Q^D = 10 \text{ million bushels of wheat.} \tag{3.11c}$$

$$2 = 8 - 0.1Q^1 \tag{9.11d}$$

$$8 = 0.1Q^1 \tag{9.11e}$$

$$Q^1 = 80 \text{ million bushels of wheat.} \tag{9.11f}$$

The shortage quantity ($Q^1 - Q^0$) can also be calculated.

$$\text{Shortage} = (Q^1 - Q^0) = 80 - 10 = 70 \text{ million bushels of wheat.} \tag{9.12}$$

This procedure also helps calculate changes in supply or demand brought about by economic variables. The next two chapters will provide additional information related to markets. They will show how outcomes depend on the number of firms in a market, or market structure.

9.6 Summary

1. A market is an institution where buyers and sellers interact. A marketplace is a physical location where buyers and sellers meet to exchange goods.
2. The interaction between buyers and sellers determines the price of a good and the quantity of the good purchased and sold.
3. Market equilibrium is the point where the quantity supplied at a given price is equal to the quantity demanded. The equilibrium price is the price at which quantity supplied equals quantity demanded. The equilibrium quantity is the point where quantity supplied equals quantity demanded.
4. Disequilibrium is a market situation in which the market price does not equate supply and demand.
5. Economic forces will result in the price always gravitating toward the equilibrium price.
6. A surplus is a market situation where quantity supplied is greater than quantity demanded.
7. A shortage is a market situation where quantity demanded is greater than quantity supplied.
8. The inverse supply function is represented by a price as a function of quantity supplied. The inverse demand function is represented by a price as a function of quantity demanded.
9. Comparative statics is a comparison of market equilibrium points before and after a change in an economic variable.
10. A price support is a minimum price set by the government for a specified good or service.
11. A price ceiling is a maximum price set by the government for a specified good or service.

9.7 Glossary

Comparative Statics. A comparison of market equilibrium points before and after a change in an economic variable.

Disequilibrium. A market situation in which the market price does not equalize supply and demand.

Equilibrium. A point from which there is no tendency to change.

Equilibrium Price. The price at which the quantity supplied equals the quantity demanded.

Equilibrium Quantity. The point where quantity supplied is equal to quantity demanded.

Inverse Demand Function. A demand function that is represented with price (the independent variable) as a function of quantity demanded (the dependent variable): $P = f(Q^d)$.

Inverse Supply Function. A supply function that is represented with price (the independent variable) as a function of quantity supplied (the dependent variable): $P = f(Q^s)$.

Market. The interaction between buyers and sellers.

Market Equilibrium. The point where the quantity supplied by producers at a given price is equal to the quantity demanded by consumers at that same price.

Market Price. The price where quantity demanded is equal to quantity supplied.

Marketplace. A physical location where buyers and sellers meet to trade goods.

Price Ceiling. A maximum price set by the government for a specified good or service.

Price Support. A minimum price set by the government for a specified good or service.

Shortage. A market situation in which consumers are willing and able to purchase more of a good than producers are willing to supply at a given price ($Q^s < Q^d$).

Surplus. A market situation in which producers are willing to supply more of a good than consumers are willing to purchase at a given price ($Q^s > Q^d$).

9.8 Review questions

1. If the quantity supplied is greater than quantity demanded, there is:
   a. trade deficit
   b. equilibrium
   c. shortage
   d. surplus
2. If the price is higher than the equilibrium price, then:
   a. quantity demanded is greater than quantity supplied
   b. quantity supplied is greater than quantity demanded
   c. the price will increase over time
   d. cannot answer with information given
3. An inverse demand function:
   a. is incorrect
   b. has price as a function of quantity demanded
   c. has quantity demanded as a function of price
   d. must be inverted to graph the function
4. An increase in income results in:
   a. no change in demand
   b. a change in quantity demanded
   c. a shift in demand
   d. a movement along the demand curve
5. An increase in the price of fertilizer will alter the market for wheat by:
   a. a leftward shift in demand
   b. a rightward shift in demand

c. a leftward shift in supply
d. a rightward shift in supply

6. A price support results in:
   a. off-farm migration
   b. shortages
   c. surpluses
   d. lower prices
7. A price ceiling will result in:
   a. higher returns to producers
   b. higher prices
   c. surpluses
   d. shortages

Plate 10.1 The competitive firm.
Source: Dmitriy Shironosov/Shutterstock

10 The competitive firm

Synopsis

The chapter examines market structure with emphasis on four characteristics of perfect competition. The discussion centers on the efficiency found in competitive industries with special attention given to the implications that this has for perfectly competitive firms. The chapter describes strategies for perfectly competitive firms, with timely, relevant examples from agriculture and agribusiness. Since competitive firms are price takers, and have no influence over price, their best strategy is to lower production costs by being early adopters of new technologies.

10.1 Market structure

The previous chapter described how the interaction of buyers and sellers determines the market price and quantity of a good or service in a market economy. Here, attention turns to **Market Structure**, or how an industry is organized.

- ***Market Structure*** = the organization of an industry, typically defined by the number of firms in an industry.

Market structure, also referred to as "industrial organization," has a major influence on the prices and quantities of goods and services sold in a market. In general, the number of sellers in an industry is an important indicator of market structure. If there are only a few firms in an industry, their behavior and business strategies will be quite different from the behavior and strategies of firms in an industry with numerous competitors.

The number of firms in an industry varies considerably in a free market economy, especially an economy as large and complex as that of the United States. In the US, residents in a given town or city often purchase electricity from a single firm with no option to purchase power from an alternative source. Software for the nation's computers is provided primarily by Microsoft, with a few other options such as Linux. Fast food is available from numerous sources including McDonald's, Burger King, KFC, Taco Bell, Wendy's, and many others. In addition, clothing purchases come from huge chain stores (Macy's), small locally owned stores, catalogs, used clothing stores operated by churches and charities, and the Internet.

The US automobile industry is dominated by three large firms (General Motors, Ford, and Chrysler), originally called the "Big Three," but now often referred to as the "Detroit Three." This name change is due to the growth in dominance of non-US automobile producers such

as Toyota, Volkswagen, Hyundai, and many others. When the agricultural giant Archer Daniels Midland (ADM) buys soybeans to crush into oil, it can purchase beans from thousands of independent soybean growers found mainly in the Midwest and Great Plains. Together with Bunge and Cargill, ADM crushed approximately three-quarters of all US-grown soybeans in recent years. When grocery stores and restaurants seek to purchase steaks for their customers, over 80 percent of their meat purchases are from four large meatpackers: Tyson, Cargill, Swift, and National Beef Producers. Smithfield Foods dominates hog production with over 1.2 million sows in 2005, perhaps more in the years since then. The next-largest US hog producer is Triumph Foods, with 399,800 sows in 2005.

The diversity of market structures, and the frequent changes in ownership and management of processing and handling firms have attracted the attention of economists interested in the causes and consequences of the number of firms that comprise an industry. These analysts have organized the types of market structures, or industrial organizations, into several categories, as listed in Table 10.1.

The discussion of market structure begins with **Monopoly**, the extreme case of a single firm in an industry. In fact, a monopoly is an industry with only one firm.

- ***Monopoly*** = a market structure characterized by a single seller. The firm is the industry.

The firm is the industry. In many locations, the local utility company is the sole source of natural gas and electricity. Consumers cannot purchase these types of energy from any other firm. Most towns and cities use locally operated monopolies to provide such things as water, natural gas, electricity, sewage disposal, and landline phone service. These products are essential to everyone in the community. However, these firms require a huge investment in infrastructure, and they often lend themselves to some degree of government control or oversight. As a result, they are called "public utilities" and they exist in a peculiar web of regulations, typically one firm per location. At the other end of the market structure spectrum is **Perfect Competition**. In a competitive market structure, the industry has numerous firms producing an identical product.

- ***Perfect Competition*** = a market or industry with four characteristics: (1) numerous buyers and sellers, (2) ahomogeneous product, (3) freedom of entry and exit, and (4) perfect information.

Oligopoly and **Monopolistic Competition** lie between these two extremes. Oligopoly is an industry composed of a few firms, such as the automobile industry. Monopolistic Competition is a market structure that combines some features of monopoly with some

Table 10.1 Market structure (industrial organization)

Structure	*Number of Firms*	*Examples*
Monopoly	Single Seller	Electricity Company; Water Company
Oligopoly	Few Sellers	Automobiles; Beef Packing
Monopolistic Competition	Many Sellers of Branded Goods	Gasoline Stations; Grocery Stores
Perfect Competition	Numerous Sellers	Agricultural Commodities: wheat, corn

characteristics of competition. In a monopolistically competitive industry, many firms produce similar, but not identical, products. Toothpaste, soap, clothing, and many kinds of retailing are examples.

The next two chapters explain how the behavior and performance of an industry depend crucially on its market structure. Competitive firms strive to maximize profits, taking prices as fixed and given. Monopolists maximize profits by selecting and manipulating the price of the product. Firms located between the two extremes of monopoly and competition have some ability to influence price, usually within a narrow range. The ability to set the price of output is referred to as **Market Power**.

- ***Market Power*** = the ability to affect the price of output. A firm with market power faces a downward-sloping demand curve.

While individual competitive firms have no market power, monopolists have complete market power. Business firms in agriculture and agribusiness are often in competitive industries. This chapter is devoted to a discussion and analysis of firms in perfect competition.

10.2 Characteristics of perfect competition

The behavior and outcomes of competitive firms depend on four characteristics mentioned above. These are: (1) numerous buyers and sellers, (2) a homogeneous product, (3) freedom of entry and exit, and (4) perfect information. Real-world firms seldom if ever completely meet all four of these characteristics, making the concept of a perfectly competitive firm an idealized case. However, small farms and the shore-bound commercial fishery are industries that come close to the competitive model. Firms in industries that closely match the model are studied to provide analysts with a greater understanding of firm behavior in order to make useful predictions about how prices change and how competitive firms respond to price changes. The implications of each of the four characteristics of a competitive firm require special examination. This is best done by using assumptions to simplify the complex real world to reduce a situation or issue or characteristic to its most important elements.

Homogeneous product

Firms in a perfectly competitive industry all produce an identical, or **Homogeneous Product**. This means that a consumer cannot look at a product and determine which firm produced it. Thousands of dairies produce milk. A consumer cannot determine (or does not care) which of several dairies produced the gallon of milk in the dairy case of the local grocery store. In most respects, milk is milk and the dairy that produced it is not an issue.

- ***Homogeneous Product*** = a product that is the same no matter which producer produces it. The producer of a good cannot be identified by the consumer.

Most major agricultural products are homogeneous products: wheat, corn, and soybeans are identical across all producers as are walnuts, blueberries, and mushrooms. It is difficult to ascertain which beef packer processed the meat on display in the deli section of a grocery store. However, cattle can be distinguished by a brand, which gives livestock buyers the ability to identify the producer of the cattle. This information makes livestock a nonhomogeneous product, although many characteristics of the cattle industry are competitive.

Homogeneous products allow customers to be indifferent between producers. Since the products are identical, customers will purchase from the seller who is selling at the lowest price. Competitive industries do not include firms that struggle with each other to win over customers. The customers focus only on the price of the good.

Numerous firms

A perfectly competitive industry has numerous firms. The question, "How many is numerous?" has no objective answer, but the term has a special meaning. "Numerous firms" means that there are so many firms in the industry, and each individual firm is so small relative to the size of the industry, that no single firm has any influence over the prices of inputs or outputs.

Consider a wheat producer in Colorado. This individual farmer's wheat output is so tiny relative to the overall wheat market that the price of wheat would not be affected regardless of how many bushels of wheat were produced in this farmer's fields or even if he produced no wheat at all. This is true of every wheat producer in every state, no matter how large or small the individual farm. The wheat industry can be described as having "numerous" firms.

Perfect information

All firms in a perfectly competitive industry have access to complete information about prices, quantities on the market, advances in technology, and what other firms in the industry are doing. There are no secrets in a competitive industry. This characteristic means there is a level playing field for firms in a competitive industry.

- ***Perfect Information*** = a situation where all buyers and sellers in a market have complete access to technological information and all input and output prices.

All competitive firms are aware of all market-related information. This is true for most agricultural commodities. Producers have access to market information provided by the United States Department of Agriculture (USDA), and reported in major newspapers. Firms also have access to the Land Grant University Complex, and a large number of highly specialized commodity organizations and grower organizations. All producers can share in knowledge related to technology, and production techniques are typically public information.

Freedom of entry and exit

Firms in a perfectly competitive industry can enter or exit the industry at any time. Potential entrants can enter the industry without legal or economic **Barriers to Entry and Exit**.

- ***Barriers to Entry and Exit*** = legal or economic barriers that hinder or prevent a new firm from entering or exiting an industry.

A profitable industry will attract potential entrants to enter and share in the high earnings. If a profitable industry is subject to a barrier to entry, then other firms will not be able to enter. However, the economist's definition of barriers to entry is highly specific. It refers to legal barriers, rather than some circumstance that makes entry difficult. Starting a new farm

operation is challenging, expensive, and requires a significant amount of effort. While this may make it difficult to enter, or impossible for some, it is not a "barrier to entry" in the economic sense, since anyone could start the process of borrowing or acquiring money and the requisite skill to start a farm or agribusiness.

An example of an industry that is protected by barriers to entry is the electricity market in the Northwest US. Pacific Power, a division of PacificCorp, has the legal right to produce and sell electricity in many parts of California, Oregon, and Washington. In 2012, it provided electrical power to nearly one million residential and commercial customers. No other firm can lawfully enter the market and sell electricity in areas served by Pacific Power. Other firms and industries may have the technical knowledge, economic knowledge, and the generating capacity to sell electricity in Pacific Power's area. They cannot because they lack the freedom of entry requirement to become a part of a competitive industry in the region. Walmart and other big-box stores such as Target or BestBuy attempt to locate in many areas, but local governments often do not allow these stores the legal right to enter the local market. These are examples of barriers to entry into an industry. Competitive firms can enter and exit at will: think of the restaurant business in New York City, or of corn producers in Nebraska.

The four characteristics of a perfectly competitive industry form the basis for models of competitive firms and industries. This modeling helps analysts understand how firms behave, how specialized resources can or should be used, and how managers of firms in competitive industries can increase their profitability.

10.3 The perfectly competitive firm

Each competitive firm in a perfectly competitive market is a **Price Taker** that can exert no influence over output prices. The wheat seller takes whatever price the buyer offers.

- ***Price Taker*** = a firm so small relative to the industry that the price of output is fixed and given, no matter how large or how small the quantity of output it sells.

A price taker is a firm that has no market power. It must take input and output prices as given and fixed. Even though competitive firms exert no influence on product prices the prices themselves fluctuate in response to forces outside the firms' control.

Firms that have market power are **Price Makers**. These firms have at least some ability to influence the price of outputs because of the large size of the firm relative to the market. They produce and sell enough product to affect the price of the good.

- ***Price Maker*** = a firm characterized by market power, or the ability to influence the price of output. A firm facing a downward-sloping demand curve.

Restated using the language of earlier chapters, a price maker is a firm that faces a downward-sloping demand curve. These price maker firms are the subject of Chapter 11.

The demand curve facing a competitive firm

A competitive firm is small relative to the industry, so small that it cannot influence the price of the product that it sells. Consider an individual rice producer in Jackson County, Arkansas. Figure 10.1 shows the relationship between the rice market (on the left) and the individual

rice producer in Jackson County (on the right). The interaction of all (aggregated) rice producers and consumers appears in the supply and demand curves on the left. Market forces will establish an equilibrium price at the intersection of supply (Q^s) and demand (Q^d). In equilibrium, a quantity of Q* billion cwt are produced and sold at a price of P* dollars per hundredweight (cwt). The demand curve slopes downward due to the Law of Demand and the supply curve slopes upward due to the Law of Supply (Chapter 8).

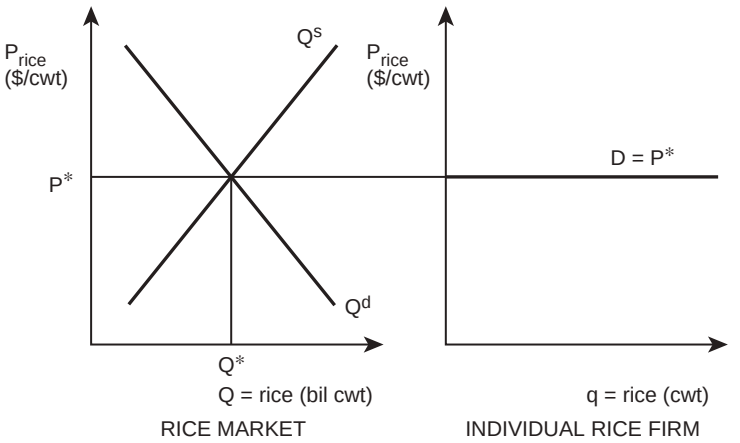

Figure 10.1 Rice market and individual producer.

Plate 10.2 Rice.

Source: FrameAngel/Shutterstock

Quick Quiz 10.1

What does the market demand curve show? How is the market demand for rice derived?

Quick Quiz 10.2

How is the market supply of rice derived?

The units shown on the graph are crucial. Farmers produce rice over most of the world, so the rice market is global in scope and is very large. The units for quantity of rice in the rice market graph are in billions of hundredweight (Q).

The graph on the right side of Figure 10.1 represents the individual firm. The individual rice producer is so small that the quantity produced on the one farm is measured by numbers of hundredweight (q). The demand curve facing the individual firm is perfectly elastic (horizontal). This means that the price elasticity of demand for one and every producer is infinite. The first hundredweight of rice sold by a producer will receive the same price as the last ($|E^d| = \infty$). The demand curves in Figure 10.2 show why this is true.

The demand curve in the left-hand panel is perfectly inelastic: the consumer purchases the same quantity, regardless of price. No substitutes exist for this good. This demand is perfectly inelastic ($|E^d| = 0$). In the next panel, the demand curve is inelastic ($|E^d| < 1$), since consumers do not make large changes in the quantity demanded in response to price changes. The third panel shows an elastic demand ($|E^d| > 1$), where consumers are responsive to price. If the price increases by even a small amount, the quantity demanded decreases significantly. Finally, the right-hand panel depicts a perfectly elastic demand curve ($|E^d| = \infty$).

When demand is perfectly elastic, the price is the same regardless of the quantity purchased. This is the defining characteristic of the perfectly competitive industry. The good is homogeneous, so consumers do not care which firm supplies the good. If the individual rice farmer in Figure 10.1 tried to raise the price of rice by one cent above the market price, P*, no buyer would purchase the farmer's rice at the higher price, since there is a large quantity of rice available at the market price, P*. At any price higher than P*, the demand facing this firm would fall to zero.

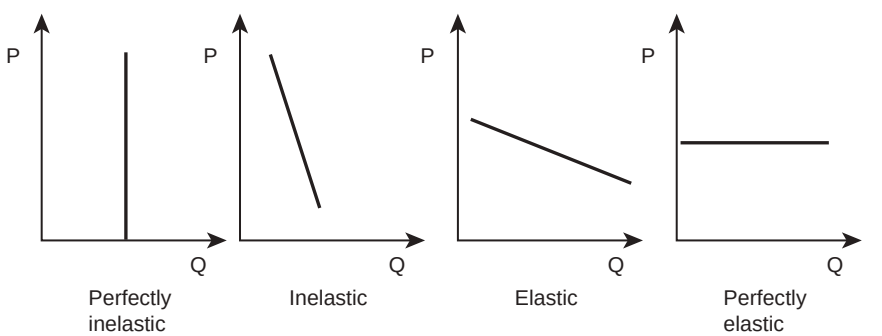

Figure 10.2 Elasticity of demand over time.

If one individual firm were to charge a price slightly lower than the equilibrium price, all of the consumers in the market would flock to the producer charging the lower price. The demand facing a competitive firm is perfectly elastic since consumers are extraordinarily responsive to price. Any rational producer would not charge less than the market price, since the firm can always receive P^* dollars per hundredweight of rice. The elastic, or horizontal, demand curve facing the individual producer reflects the ability to sell as much or as little produce as desired at the prevailing market price. The firm is so small relative to the market that the quantity it supplies does not affect the market price.

To see this, consider how large the quantity of rice is for the individual farmer relative to the world rice market. The quantity of rice in the right-hand panel of Figure 10.1 is trivial compared to the billions of hundredweight of rice traded in the world market at the equilibrium price shown in the left panel.

The demand curve (D) facing the competitive rice farmer in Figure 10.1 is identical to the price line (P^*), since the firm can sell as much or as little rice as it desires at the market price. The revenue of a competitive firm is calculated using the fixed and given market price. Total Revenue, (TR) is the market price (P) multiplied by the quantity produced (q) and sold by the firm:

$$TR = P * q. \tag{10.1}$$

Total Revenue for the rice producer is the rectangle defined by the price ($0P^*$) and the quantity sold ($0q^*$), as shown in Figure 10.3. Average Revenue (AR) is the per-unit level of revenue earned by the firm:

$$AR = TR/q = P * q/q = P. \tag{10.2}$$

The Average Revenue for the rice producer is equal to the price ($P = AR$). Lastly, the Marginal Revenue (MR) for the competitive firm is the change in TR (ΔTR) brought about by a small change in quantity sold (Δq). Price does not change, and $\Delta TR = \Delta (Pq) = P \Delta q$, so the only source of change in revenue must come from changes in the quantity sold (q):

$$MR = \Delta TR/\Delta q = \Delta (Pq)/\Delta q = P\Delta q/\Delta q = P. \tag{10.3}$$

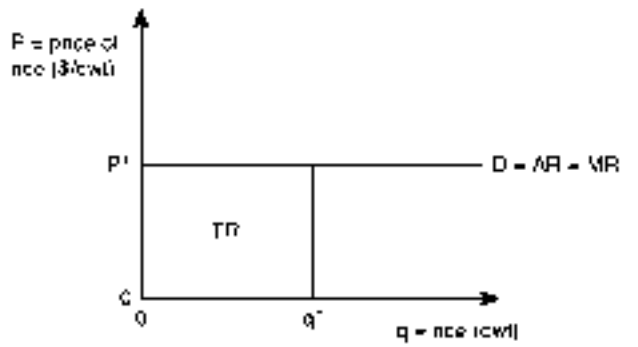

Figure 10.3 Revenues for a perfectly competitive firm.

Marginal Revenue is also equal to price for the product of the competitive firm because the additional (marginal) revenue that the firm receives from the sale of one unit of output is always equal to the constant price (P*). The demand curve for the firm is a horizontal line at the same level as average revenue, marginal revenue, and the equilibrium market price so D = AR = MR = P*.

Profit maximization for a competitive firm

A firm will maximize profits by setting marginal revenue equal to marginal cost (MR = MC). This profit-maximizing condition holds true for the competitive firm, shown in Figure 10.4.

Figure 10.4 shows the typical U-shaped cost curves, together with the market price derived from the intersection of market supply and market demand for a rice-producing firm. The rice producer in Arkansas maximizes profits by meeting the two conditions of profit maximization: (1) MR = MC, and (2) MC must cut MR from below. The profit-maximizing level of output is q*, which satisfies the two conditions. The large rectangle represents total revenue accruing to the rice producer. Total revenue is found by multiplying the equilibrium price by the equilibrium quantity (TR = P*q*). Profits are found by subtracting all costs of production from the total revenue (π = TR – TC). Total costs are found by substituting the output level (q*) into the ATC curve. This is because ATC = TC/q, so TC = ATC*q. The level of profits for the rice producer is the rectangle denoted by π in Figure 10.4. The firm in the diagram is earning positive economic profits.

Quick Quiz 10.3

What is the difference between accounting profits and economic profits? Hint: see Chapter 3.

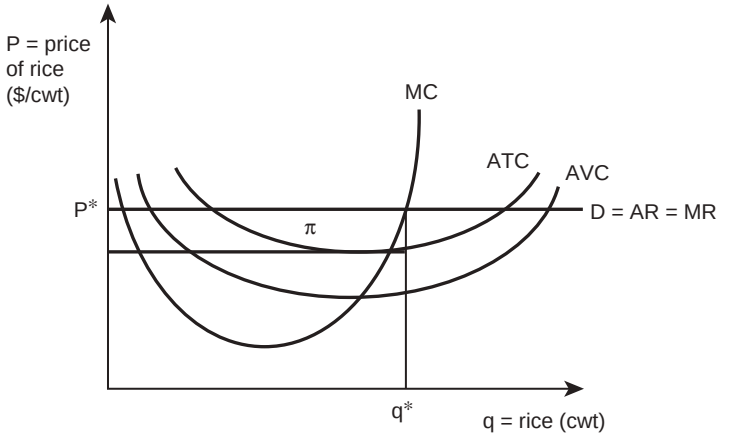

Figure 10.4 Profits for a perfectly competitive firm.

10.4 The efficiency of competitive industries

Perfectly competitive industries have many desirable features. The most important of these concerns efficiency. Competition among industries results in efficiency of resource use in the economy.

- ***Efficiency*** = a characteristic of competitive markets, indicating that goods and services are produced at the lowest possible cost and consumers pay the lowest possible prices.

Efficiency is a desirable result of competition. The industry uses scarce resources in such a way as to produce goods and services at the lowest possible cost. Prices charged by competitive firms are no higher than the cost of production (MC). The numerous firms and homogeneous product criteria guarantee this result. If a competitive firm were to try to charge a price higher than the competitive market price, customers would quickly shift to producers charging the lower market price. Consumers will never be "gouged" by producers trying to raise the price above the competitive level.

The second characteristic of perfectly competitive industries that leads to efficient market outcomes is the freedom of entry and exit. When an industry is earning high levels of profits, new firms will enter the industry to produce the profitable good or service. This eliminates the possibility of market power, or monopoly prices, in a competitive industry. When a competitive firm is unprofitable, it will drop out of the industry to find a more profitable way to use its resources. As more firms leave, the industry supply diminishes (the supply curve shifts upward and to the left) and prices to the consumer increase.

The agricultural sector of the United States has been subject to decreasing farm numbers since the mid-1930s, when the nation had 6.8 million farms. The number in 2007 stood at about 2.2 million. Why? Because the opportunities to earn a living outside of agriculture became greater than the opportunities inside of agriculture for many individuals and families. In recent years (2010–12), an economic recession in the overall economy, together with growing demand for agricultural commodities, has reversed this trend. The returns to agriculture and agribusiness have been high, relative to positions available in other sectors of the economy.

In an economy with freely operating markets, resources flow to their highest (most profitable) use. The efficiency captured by the producer allows production at the lowest possible cost per unit. Consumers enjoy this efficiency because it allows them to purchase goods at very low prices, much lower than would be the case under monopolistic conditions.

The retail fresh flower market in New York City provides an example of how this flow of resources takes place. The New York flower market depicted in Figure 10.5 shows market situations for the entire market as well as for a hypothetical individual florist, "Frank's Flowers."

The left-hand panel in Figure 10.5 represents the aggregate market for flowers in New York City. The supply curve reflects all of the florists in the market, and the demand curve represents all of the consumers. The intersection of supply and demand at P* determines the market price for flowers. All of the florists in the area charge the same price of P* per dozen flowers, or customers will shift their business to the firms that charge P*. This result is the perfectly elastic demand curve facing Frank and other individual flower shops in the area.

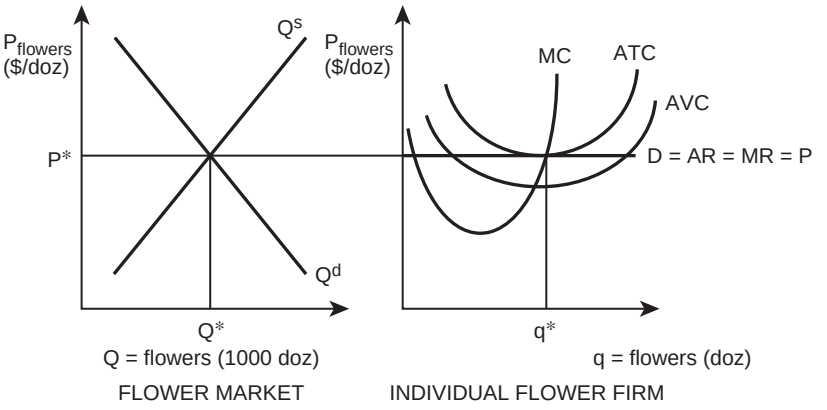

Figure 10.5 Flower market and individual flower producer.

Plate 10.3 Flower market.
Source: Cristi180884/Shutterstock

Quick Quiz 10.4

List and describe the four factors of production for Frank: K, L, A, and M.

Quick Quiz 10.5

What are opportunity costs? Why are economic profits equal to zero an acceptable outcome for Frank?

Frank sells flowers (in dozens) by setting marginal revenue (D = MR = P*) equal to marginal cost (MC) at a quantity q* dozen flowers. Economic profits are equal to zero, indicating that the resources employed by Frank (K, L, A, and M) are all earning exactly their opportunity cost.

Figure 10.5 shows a market equilibrium (left side), and a firm equilibrium (right side). The quantity supplied equals the quantity demanded in the market, the firm (which is one of many similar firms) is earning zero economic profits, and the price is equal to the marginal cost. The efficiency that results from this outcome is considered to be highly desirable because the resources employed by Frank's firm, including Frank himself, are earning at least as much as they could earn in their next-best use. Consumers are paying the exact cost of production for a dozen flowers.

Suppose there is an increase in the population of New York City. Figure 10.6 demonstrates how the New York flower market responds.

The demand for flowers increases with the increase in New York City's population. The shift in demand results in a movement along the supply curve to the new equilibrium point, showing an increase in quantity supplied. The new equilibrium price is P_1* and the new quantity is Q_1*.

The increase in price translates into increased economic profits for Frank's shop. The right panel of Figure 10.6 shows the positive economic profits in the rectangle denoted π, where π = TR – TC. The market price increased from P_0* to P_1*, while the costs of production remained the same as they were prior to the population increase.

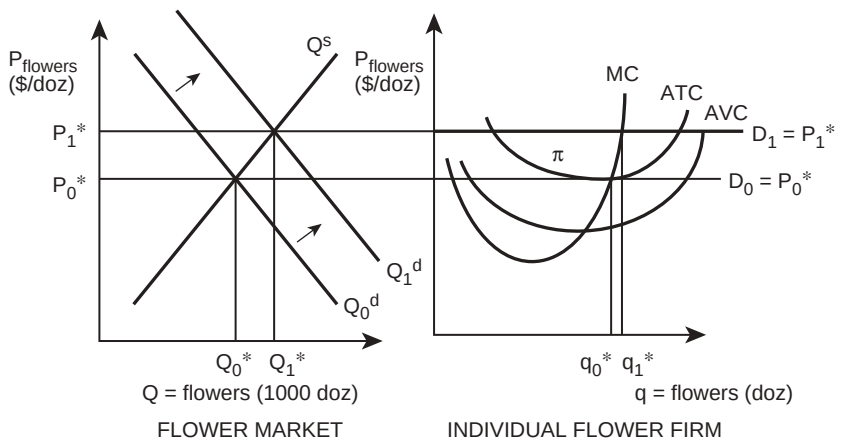

Figure 10.6 An increase in demand for flowers.

Frank's and every other florist in New York City will earn positive economic profits. The positive profits that result from population growth help explain economic behavior in other locations even where conditions may not be the same. The analysis in Figure 10.6 shows why businesses in a college town favor (1) increased enrollment at the college, (2) a good football team, (3) an active industrial park that hires graduates, (4) new golf courses, and (5) new housing developments that will attract new individuals and families. Population growth is a good thing for businesses!

The flower story, however, is not over. The high level of earnings by Frank's and the other florists will result in entry of other florists and floral-related businesses. This means that college graduates with a degree in Horticulture or Landscape Design will locate in New York City to take advantage of the profitable conditions. The entry of new firms will shift the supply curve of flowers to the right (an increase in supply) as long as positive economic profits exist. The supply of flowers will continue to shift to the right until the original price (P_0*) is reached, as shown in Figure 10.7.

The increase in supply results in an increase in the equilibrium level of output from Q_1* to Q_2*, and a decrease in the equilibrium price back to the original level, P_0*. This lowers the price line facing Frank's, since the new florists in New York City take some of Frank's original business. Frank's still maximizes profits by setting marginal revenue equal to marginal cost at the new but lower price, P_0*, and produces the original level of output, q_0*. Frank's is now back at its original equilibrium point. Frank's positive economic profits attracted new firms that attracted some of Frank's customers and reduced profits back to the equilibrium level: zero economic profits.

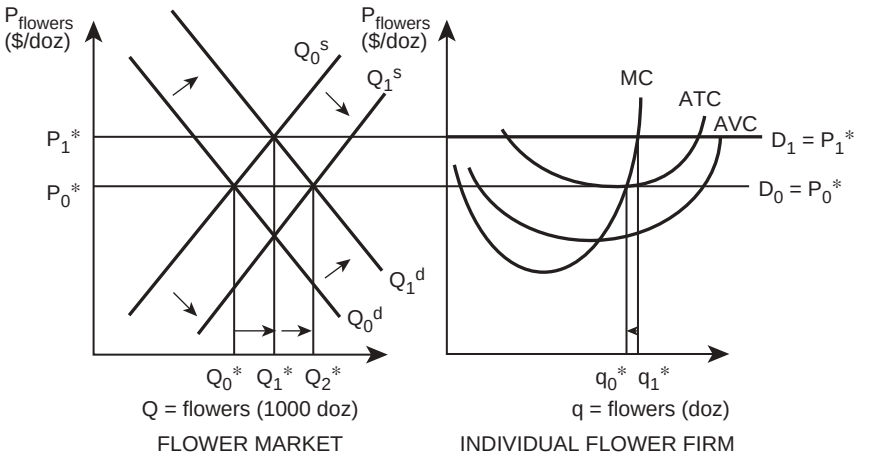

Figure 10.7 An increase in supply following an increase in demand for flowers.

Box 10.1 Cut flower production

Cut flowers are big business. In the past two decades, floriculture, the cultivation of ornamental and flowering plants, has become one of the fastest growing sectors in

US agriculture. In 2010, floriculture sales in the United States exceeded $35 billion. Slightly more than two-thirds (by dollar volume) of the fresh flowers sold in the US were produced in other countries. By value of flower sales to the United States, the top three nations that export cut flowers to the US are Colombia (65 percent), Ecuador (16 percent), and the Netherlands (6 percent). Most domestic production comes from California (76 percent), followed by Washington State (9 percent), Oregon (3 percent), and New Jersey (3 percent).

Floral crops are typically grown in greenhouses or covered areas, and are usually sold in bunches or as bouquets. The most popular cut flowers are roses, carnations, gladioli, and pompon chrysanthemums. Flower demand is highly seasonal. Sales are highest in February through May and in the fall. Cut flower sales peak on Valentine's Day and Mother's Day; and poinsettias are sold between Thanksgiving and Christmas. Since cut flowers are highly perishable, they require cool temperatures and storage conditions to prolong their quality. The increasingly automated US floral industry deals with the year-round production of high-value crops such as Easter lilies, orchids, and forest azaleas. Automation in greenhouses such as extended exposure to natural and artificial light accelerates plant production.

Flower sales are highly dependent on consumer income, and cut flowers are a luxury good (Chapter 8). Cut flower sales are higher for consumers with high incomes, and sales are highly responsive to fluctuations in consumer income. Most of the recent increase in cut flower sales in the US depends on imported stocks of flowers. About 40 percent of the imports are roses, followed by carnations (10 percent), and chrysanthemums (10 percent). Low production costs and a strong US dollar drive the import market. During the 1980s and 1990s, production of the major cut flowers shifted from US growers to Central and South America, to take advantage of year-round production, lower labor costs, and lower energy costs for heating and lighting greenhouses.

The US cut flower industry faces two major trends, the major growth in mass-market sales in big discount stores and supermarkets, and highly automated production (growing) operations resulting from the rising cost of labor. This is the substitution of capital for labor highlighted in Chapter 5. A related trend is the movement of farmers out of traditional agricultural commodities into contract floriculture: a movement along the production possibility frontier (PPF) due to change in relative prices (Chapter 6). Many former tobacco farmers in the Southeast US have contracted with large retailers such as Home Depot and Walmart. Many US companies have invested in flower farms in South America to supply the growing US demand for flowers.

Source: "Industry and Trade Summary: Cut Flowers." US International Trade Commission. February 2003. http://www.usitc.gov/publications/332/pub3580.pdf

The analysis can also show how a decrease in demand results in the exit of firms from an industry. In Frank's case, if the demand for flowers fell, the result would be a lower market price for flowers, which would lower the perfectly elastic demand curve facing the flower shop. If the price drop is small, and price remains above the shutdown point (P > min AVC), then Frank's would stay in business to minimize costs in the short run. However, if price

falls below the shutdown point, Frank's would have to shut down, and exit the industry. In this case, the resources originally employed by Frank's would move to other industries.

Quick Quiz 10.6

Use a two-panel graph of a competitive market and a firm to show the impact of an increase in the price of chicken on the beef market.

The exit of scarce resources from unprofitable industries is efficient from a societal point of view, although it can be devastating to the persons involved. In a free market economy, the consumers determine what to produce and what not to produce. If the demand for a good is not sufficient for the number of firms producing it, then some firms will close and resources will flow out of the unprofitable industry and into enterprises with higher earning opportunities.

This chapter focuses on the behavior of a competitive firm. To this point it has explained how competition brings about desirable results for society. The next section investigates strategies that competitive firms use to maximize profits in the long run.

10.5 Strategies for perfectly competitive firms

Competitive firms are price takers, so the development of an elaborate pricing strategy would be a waste of the firm's manager's resources. Since the market determines the price through the supply and demand conditions in the entire market, the price is outside the control of the individual competitive firm. Similarly, the goods produced by competitive firms are homogeneous, so competition through quality differences or branding does not matter to the competitive firm. This means that advertising and other marketing activities are not profitable for competitive firms.

These conditions and qualifications are desirable and help make life less complicated for producers and consumers. Producers do not waste money on advertising and marketing, and consumers pay only the costs of producing and distributing the good. If price and product quality are outside the firm's control, what can a competitive firm do to maximize its earnings in the long run? It can concentrate on minimizing costs.

A competitive firm's best strategy is to lower its costs of production at every opportunity. This could involve adopting new technologies, or purchasing inputs at the lowest possible price. In a competitive industry, firms must continue to keep up with the other firms to stay in business. If other firms reduce costs, the firm will have to match these cost reductions or face lower profits in the future. This helps explain why agricultural producers constantly search for new technologies in the form of new equipment, new farm management practices, and new farming methods. Indeed, the history of agriculture is one of continuous technological innovation and adoption.

Technological change allows for higher levels of output from the same level of inputs. Figure 10.8 traces the impact of a firm in the flower business adopting a new technology.

The technological change lowers the costs of production from MC_0 to MC_1. This allows the florist to go from a position of zero economic profits at the original equilibrium (q_0*) to positive economic profits at the new equilibrium (q_1*). If Frank's Flowers adopts this technology before the other florists in New York City, Frank will earn positive economic profits.

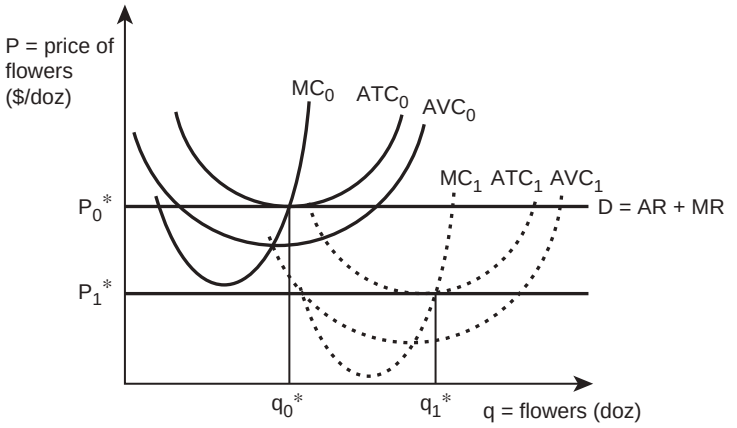

Figure 10.8 Early adoption of technology: a perfectly competitive firm.

These high earnings, however, will attract new entrants into the industry. The new entrants will increase the supply of flowers in the market until the market price drops to a new equilibrium price at the minimum point on the ATC curve. Therefore, profits are temporary in a competitive industry. Positive profits encourage entry, and entry causes supply to increase until the profits are dissipated.

The conclusion or lesson of this analysis is that the early adopters of a new technology capture the benefits of the advance. Firms not adopting the technology must leave the business, as their costs remain high while the market price drops. The best strategy recommendation for a firm in a competitive industry, such as an agricultural firm, is for it to develop and adopt technology as rapidly as possible. These businesses must continuously adopt more efficient production methods in order to remain profitable in the long run.

The nation's Land Grant Universities such as Kansas State University, Texas A&M University, the University of Wisconsin, and dozens of others conduct much of the agricultural research done in the United States. The research, often partially funded by producer groups such as the Oregon Livestock Association or the North Dakota Wheat Growers, helps find the best strategy for firms in competitive industries struggling to remain on the cutting edge. The suggested strategy often includes using the most up-to-date production technology. Not only do producers who adopt technology benefit, but the consumers of agricultural products also benefit from research and development of food and fiber, since technological change places downward pressure on the price of these goods.

Economists have a great deal of confidence in the ability of markets to allocate scarce resources efficiently. Resources move into industries where profits are high, and resources exit industries where profits are negative. The process of adjustment to new methods and new market conditions makes society better off. Producers earn the maximum profits possible by investing factors of production in the most profitable areas, and consumers pay the lowest possible prices for goods and services.

To be sure, the real world is more complicated than the stories, examples, and models presented in this chapter. Few industries exactly meet the four qualifications of perfect competition. Many real-world industries have fewer firms than the competitive ideal. Similarly, few industries include only firms that produce homogeneous products. Wheat, milk, and

soybeans may be close to homogeneous no matter where they are produced, but a bouquet of red roses from Frank's may differ from the flowers purchased down the street. The next chapter describes the performance of markets that do not qualify as perfectly competitive. The differences are large and consequential for both buyers and sellers.

10.6 Summary

1. The market structure of an industry refers to the number of sellers in the industry.
2. A monopoly has only a single firm in an industry.
3. A perfectly competitive industry has numerous firms that produce an identical product.
4. An oligopoly is composed of a "few" firms.
5. Monopolistic competition combines some factors of monopoly with some characteristics of competition. Monopolistic competitors produce similar, but not identical, products.
6. Market power is the ability of a firm to set price. Monopolists have complete market power; competitive firms have no market power.
7. A perfectly competitive firm has four characteristics: (1) numerous buyers and sellers, (2) a homogeneous product, (3) freedom of entry and exit, and (4) perfect information.
8. A homogeneous product is identical to the output of all firms in the industry, regardless of the firm that produces it.
9. A price taker is a firm so small relative to the industry that it has no influence over price. A price maker has the ability to influence price.
10. Perfect information is a situation where all buyers and sellers in a market have complete access to all technological and market information.
11. Barriers to entry and exit of a firm into an industry are legal or economic barriers to the entrance of a firm into an industry or to the exit of a firm from an industry.
12. The demand curve facing an individual competitive firm is perfectly elastic.
13. Profit-maximization conditions for a competitive firm are MR = MC and MC cuts MR from below.
14. Efficiency is a condition indicating that production of goods and services occurs at the lowest cost and consumers pay the lowest possible prices. Efficiency is consistent with all resources earning their opportunity costs.
15. A competitive firm's best strategy for maximizing profits is to minimize costs.

10.7 Glossary

Barriers to Entry and Exit. Legal or economic barriers that hinder or prevent a new firm from entering or exiting an industry.

Efficiency. A characteristic of competitive markets, indicating that goods and services are produced at the lowest possible cost and consumers pay the lowest possible prices.

Homogeneous Product. A product that is the same no matter which producer produces it. The producer of a good cannot be identified by the consumer.

Market Power. The ability to affect the price of output. A firm with market power faces a downward-sloping demand curve.

Market Structure. The organization of an industry, typically defined by the number of firms in an industry.

Monopolistic Competition. A market structure defined by: (1) many sellers, (2) a product with close, but differentiated, substitutes, (3) some freedom of entry and exit, and (4) some availability of knowledge and information.

Monopoly. A market structure characterized by a single seller. The firm is the industry.
Oligopoly. A market structure characterized by a few large firms.
Perfect Competition. A market or industry with four characteristics: (1) numerous buyers and sellers, (2) ahomogeneous product, (3) freedom of entry and exit, and (4) perfect information.
Perfect Information. A situation where all buyers and sellers in a market have complete access to technological information and all input and output prices.
Price Maker. A firm characterized by market power, or the ability to influence the price of output. A firm faces a downward-sloping demand curve.
Price Taker. A firm so small relative to the industry that the price of output is fixed and given, no matter how large or how small the quantity of output it sells.

10.8 Review questions

1. Which type of firm has complete market power?
   a. monopoly
   b. competitive firm
   c. oligopoly
   d. monopolistic competition
2. Which good is a homogeneous product?
   a. furniture
   b. automobile
   c. wheat
   d. toothpaste
3. A competitive firm is:
   a. an oligopolist
   b. price maker
   c. price taker
   d. monopolist
4. The demand curve facing an individual firm in a competitive industry is:
   a. perfectly elastic
   b. perfectly inelastic
   c. the aggregate demand curve
   d. equal to the supply curve
5. Competition results in:
   a. monopoly prices
   b. prices higher than the cost of production
   c. cut-throat price wars that leave consumers worse off
   d. efficient prices
6. A competitive firm's best strategy for maximizing profits is to:
   a. set a monopoly price for the product
   b. differentiate the product
   c. reduce output to increase price
   d. minimize costs

Plate 11.1 Market power.

Source: Tan Kian Khoon/Shutterstock

11 Market power

Synopsis

This chapter explores the causes and consequences of market power, the ability to charge prices higher than the competitive equilibrium price. Monopoly, monopolistic competition, oligopoly, and cartels are market structures characterized by market power. Examples from agriculture include the international wheat trade, beef packers, and fruit and vegetable marketing orders.

11.1 Market power

Competitive markets depend on free, voluntary trade between buyers and sellers to assure efficiency in resource use. This chapter discusses noncompetitive markets in which individual firms can influence the price charged for their products. This occurs when there are so few firms in the industry that each one can affect product prices by altering the quantity of goods they place on the market. When there are only a few firms, the rivalry among them does not necessarily result in competitive outcomes similar to those discussed in Chapter 10. Discussion now turns to situations where free markets may not, and most likely will not, yield efficient outcomes. When efficiency is absent, consumers pay more for products than manufacturers spent to make them. In more formal terms, buyers pay more than a product's cost of production in order to obtain a good. In addition, potential entrants may find it difficult or be unable to enter an industry. The discussion begins with an explanation of **Market Power**.

Market power is the ability of a firm to set the price of a good higher than the cost of production. A firm with market power can influence the price of its product, or the competitive market price.

- ***Market Power*** = the ability to affect the price of output. A firm with market power faces a downward-sloping demand curve.

When there are numerous firms in an industry, price competition forces each firm to charge the competitive market price, P = MC. If a competitive firm raises the price of the good it produces, it will sell nothing because its customers immediately shift their purchases to other firms that are selling the same product at the lower competitive price.

When there are only a few firms in an industry, individual firms may be able to charge a price higher than the competitive price, forcing consumers to pay more than the product's cost of production. Since this outcome is inefficient, the US government has legislated

against the blatant use of market power. In 1890, the United States passed the Sherman Antitrust Act (1890) to protect consumers from firms that used excessive amounts of market power. Giant firms like Standard Oil and the American Tobacco Company were among the first to be regulated by these antitrust laws. Why? Because they used their immense market power to set prices of their products at a level above the cost of production. They, and others, made huge profits from their price-setting activities. Since these practices placed a heavy burden on other sectors of the economy, the government took steps to limit the price-setting abilities of monopoly firms.

11.2 Monopoly

A **Monopoly** is easy to define and understand because the entire industry is a single firm. No other firm produces the same or similar goods.

- ***Monopoly*** **=** a market structure characterized by a single seller. The firm is the industry.

Quick Quiz 11.1

Is McDonald's a monopoly, since it is the only firm that produces and sells a Big Mac?

While it is true that McDonald's is the only firm that sells the Big Mac, McDonald's is not a monopolist, since many firms produce hamburgers, many of which are close substitutes for Big Macs. A monopoly is the only producer of a good that has no close substitutes. In a monopoly, the firm is the industry. Since the monopolist is not subject to competition, the monopolist is considered to be a **Price Maker**, instead of a **Price Taker**:

- ***Price Maker*** = a firm characterized by market power, or the ability to influence the output price. A price-making firm faces a downward-sloping demand curve.

A monopoly has characteristics that differ from those of a competitive firm. These two types of market structure are on opposite ends of a spectrum (recall Table 10.1). Table 11.1 compares the characteristics of the two types of industrial structure.

Table 11.1 shows the reasons why the monopoly's situation is different from that of a firm in a competitive industry. The monopoly firm produces a good for which there are no close

Table 11.1 Monopoly and competition

Monopoly	*Competitive Firm*
One Seller	Numerous Sellers
No Close Substitutes	Homogenous Product
Barrier to Entry and Exit	Freedom of Entry and Exit
Unavailability of Information	Perfect Information

substitutes, whereas a competitive firm produces a good that is identical in every way to the product of the numerous other firms. Competitive firms are characterized by freedom to enter and exit the industry, whereas potential entrants into the monopoly industry face a legal or financial barrier that does not allow a firm to produce and sell the same product as the existing monopolist. Lastly, the monopoly can withhold market information from others, the opposite of the perfect information situation of competitive firms. Recall that in the perfectly competitive case, all firms are assumed to know everything about technology and prices.

The profit-maximizing behavior of a monopolist is quite different from the behavior exhibited by a competitive firm. The demand curve facing the local electricity company (or perhaps the local natural gas company) provides a useful starting place. Businesses and firms in most locales must purchase electricity from the same company, since that firm has a legal monopoly on the sale of electricity in the local area. The status of the legal monopoly is not hard to understand. Electricity reaches residential and commercial areas through extensive and complex distribution networks of wires and cables. If two companies delivered electric power to the same area, a second set of wires and cables would be needed. A second delivery system would be expensive; more expensive than local consumers would like to pay or could afford to pay. The problem is avoided by the formation of a delivery area in which only one company is given the authority to deliver electric power. The firm, called a "public utility," is the industry in this area, so its market demand curve is the same as the demand curve facing the firm. For every practical purpose, this locally sanctioned power delivery firm is a monopoly that exhibits all of the characteristics shown in Figure 11.1. Electricity is sold in units of kilowatt hours (kwh).

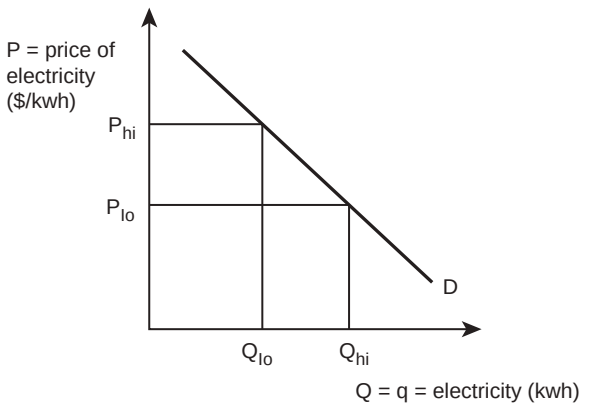

Figure 11.1 The demand curve facing an electricity company.

Quick Quiz 11.2

How is the market demand curve for electricity derived?

Quick Quiz 11.3

What does the demand curve facing a competitive firm look like?

The notation for the monopolist's demand curve is unique. Both Q (the market quantity) and q (a firm's quantity) identify the quantity of electricity demanded. The reason is that the delivery company is both the firm and the industry. Several features of a monopoly can now be made clear. The monopolist's goal, like the goal of every competitive firm, is to maximize profits. A monopolist is sometimes perceived by society as a firm that behaves differently from other firms. It may behave differently, but the underlying objective, maximizing profit, is the same.

Although the monopolist is called a "price maker," the monopoly does not have complete control over the price of the firm's product. The monopoly's price-making behavior is subject to the willingness and ability of consumers to purchase the product. These characteristics are represented by the demand curve. If the price of electricity is set higher than consumers are willing to pay, the monopolist will not sell any electricity.

Figure 11.1 shows the demand curve facing a monopolist. The monopolist can either: (1) set a price, and let consumers determine how much to purchase at that price, or (2) set a quantity, and let consumers determine the price. Restated, since the consumers control the slope and location of the demand curve, the monopolist can manipulate either price or quantity, but not both.

Figure 11.1 shows this. If the local power company sets a high price (P_{hi}), then it will sell only a small quantity of electricity (Q_{lo}). If the monopolist sets a low price (P_{lo}), then it will sell a large quantity of electricity (Q_{hi}). Contrast this with the competitive case, where any firm in the industry can sell as much or as little as it desires at a constant price. The monopolist is not a price taker, so must determine a price at which to sell the product while keeping in mind the constraints imposed by consumer demand. Note that real-world electricity firms are highly regulated, and make price and quantity decisions under government supervision. For simplicity, the example presented here is for an unregulated monopolist; examples of unregulated monopolies are difficult to find.

Plate 11.2 Electricity distribution.
Source: Wallenrock/Shutterstock

Box 11.1 Electricity

Electricity is used 24 hours a day, seven days a week, and is an important input into most economic and social activities in advanced countries. The availability of electricity is constant and reliable, so people do not usually consider how dependent they are on electrical power. In the 1820s and early 1830s, Michael Faraday, a British scientist, discovered the fundamental principles of electricity generation and management. Farraday's basic method of generating the power was based on moving a loop of wire or a disc of copper between the positive and negative poles of a magnet. This method is still used today, using a turbine. When the blades on the shaft of a turbine are rotated, the generator produces electricity through a process called magnetic induction. Commercial electricity is all produced using turbines, with the main differences being the size of the generator and the source of power used to turn the blades.

Electricity has been generated at central generating stations since 1881. The first power plants were run using water power or coal. Today, in the early twenty-first century, fossil fuels, including coal, natural gas, and petroleum, are the major sources of energy used in electricity production. These fuels are used to convert water into steam, and a steam turbine is used to produce electricity. In 2009, coal produced approximately 45 percent of all electricity produced in the US, and natural gas around 23 percent.

Coal is abundant in the US, and provides the lowest cost of producing electrical power. However, coal-fired electricity plants produce by-products of carbon dioxide, nitrous oxides, particulates, and mercury. Modern technology and "scrubbers" have reduced these emissions, but coal-generating plants still account for 40 percent of all carbon dioxide emissions. As population and incomes rise, the demand for electricity is likely to increase significantly. This need will be met mostly with coal.

Natural gas is the cleanest burning fossil fuel, but is more expensive than coal. A new technology, "hydraulic fracturing," or "fracking" involves injecting fluid into rock reserves to allow the natural gas underneath to escape. Electricity is also produced using nuclear energy. The US now (2012) has 65 nuclear power plants (104 reactors) that produce 20 percent of the nation's power. Nuclear plants have low operating costs. Hydropower provides about 6 percent of the nation's energy. Renewable forms of electricity production include geothermal, solar, and wind.

Electric utilities provide the delivery of electricity to consumers. Electricity transmission, distribution, and electrical power storage and recovery using pumped storage methods are normally carried out by the electric power industry.

Source: Wikipedia. "Electricity Generation." http://en.wikipedia.org/wiki/Electricity_generation

A monopoly firm's cost structure is the same as for any other type of firm. The cost curves are the typical "U-shaped" curves first mentioned in Chapter 3. The revenue for a monopoly, however, differs greatly from the revenue of a competitive firm. To show this, first review the revenue of a competitive firm. Recall that the demand curve facing a competitive firm such as a firm producing wheat is perfectly elastic, or horizontal, as shown by D = AR = MR = P* in Figure 11.2.

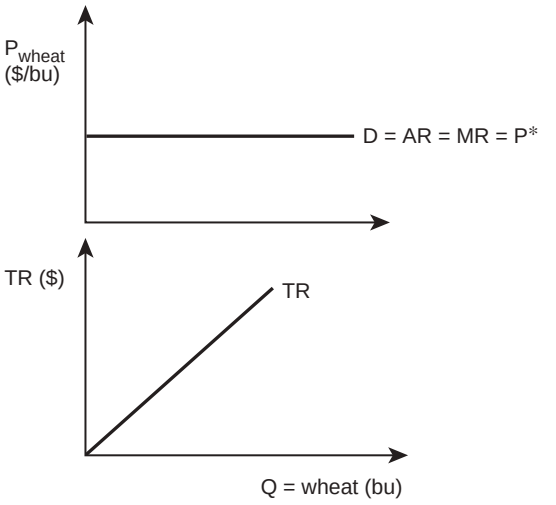

Figure 11.2 Revenues for a competitive wheat firm.

Since total revenue is the quantity sold multiplied by the price of the product (TR = P*Q), the total revenue line is upward sloping, and of constant slope (Figure 11.2). The competitive wheat firm can sell any quantity of the wheat it produces, but it must be sold at the given market price, P*. Figure 11.3 shows the demand curve of a monopolistic firm. Suppose that the inverse demand function for electricity is given by:

$$P = 10 - q, \tag{11.1}$$

where q is the quantity of electricity sold measured in kilowatt hours (kwh), and P is the price of electricity ($/kwh).

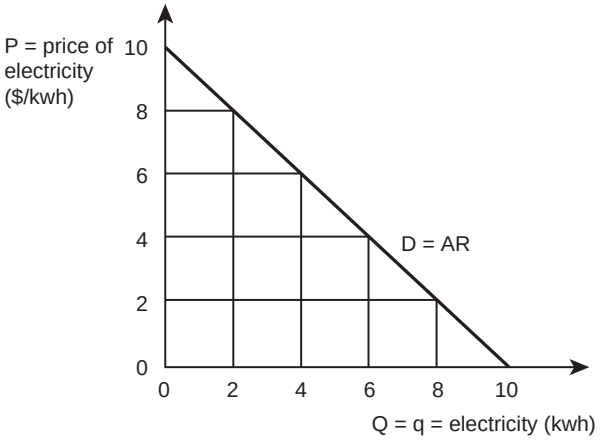

Figure 11.3 Price and quantity combinations for the electricity company.

A graph of this demand curve shows why the monopolist is unable to set the price of electricity without regard for the consumers' willingness to pay. The monopolist is constrained by the demand curve. If the electric company charged \$10/kwh, it would not sell any electricity. By lowering the price of electricity to \$8/kwh, the firm will sell 2 kilowatt hours of electricity, for total revenue (TR) equal to \$16. The Law of Demand reveals that as the price of electricity drops, consumers will purchase more. At a price of \$0/kwh (electricity is given away free), the company "sells" 10 kilowatt hours of electricity, but the total revenue is zero, since no price is being charged. Table 11.2 shows some of the possible combinations of prices, quantities, and total revenue faced by the firm selling electricity.

The revenue curves for the company are drawn in Figure 11.4. For the monopolist, average revenue can be read directly from the demand curve (D = AR), as shown in the upper graph of Figure 11.4. This result is derived from the definition of total revenue (TR = Pq). Average revenue is the revenue per unit of output, or total revenue divided by the quantity produced and sold:

$$AR = TR/q = Pq/q = P. \tag{11.2}$$

Since average revenue is equal to the price of the good, the demand curve is identical to the average revenue curve. Recall the relationship between average and marginal. The average always "chases" the marginal. Putting this idea to use, if the average revenue curve is decreasing, then the marginal revenue curve is located below the average revenue curve (Figure 11.4). The marginal revenue curve represents the rate of change, or slope, of the total revenue curve ($MR = \Delta TR/\Delta Q$).

Since marginal revenue is declining, the slope of the total revenue curve declines throughout. The marginal revenue curve crosses the x-axis at q_0 (= 5) units of output. This is the same quantity of output at which the slope of the total revenue curve becomes negative. To maximize revenue, the monopolist would sell 5 units of output, since that is the highest level of revenue (TR = 25) that the firm can earn.

The firm, however, must also consider the costs of production in deciding what level of output will maximize its profit. Depending on the firm's cost structure, it may be too costly for the firm to produce 5 units of output. Figure 11.5 shows the typical U-shaped cost curves

Table 11.2 Revenue for the electricity company

Price (\$/kwh)	*Quantity (kwh)*	*Total Revenues (\$)*	*Average Revenue (\$/kwh)*	*Marginal Revenue (\$/kwh)*
10	0	0	–	–
9	1	9	9	9
8	2	16	8	7
7	3	21	7	5
6	4	24	6	3
5	5	25	5	1
4	6	24	4	−1
3	7	21	3	−3
2	8	16	2	−5
1	9	9	1	−7
0	10	0	0	−9

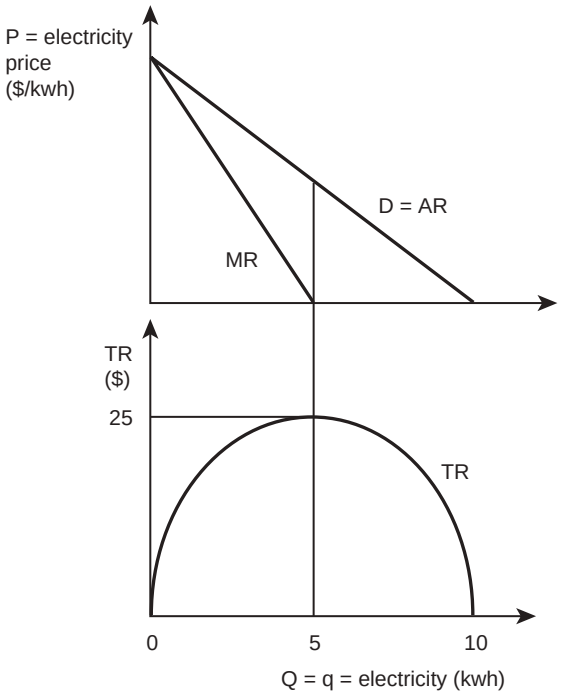

Figure 11.4 Revenues for the monopolist: an electricity company.

together with the average revenue and marginal revenue curves. The profit-maximizing strategy for the monopolist is to set MR = MC, with MC cutting MR from below.

This profit-maximizing solution is an example of incremental decision making. The firm sets MR = MC at q* kilowatt hours of electricity. The profit-maximizing price of electricity is found by taking the quantity (q*) where MR = MC, and using the demand curve to find P*.

At this quantity, the firm earns positive economic profits by selling q* kilowatt hours of electricity at P* dollars per kilowatt hour. Profits are equal to the rectangle denoted π below P* and above ATC*, to the left of q*.

Quick Quiz 11.4

What would happen if the electricity company in Figure 11.5 charged a price higher than P*? A price lower than P*?

Profits are maximized at q* kilowatt hours. If one additional unit of electricity were produced and sold, the size of the profit rectangle would decrease, since the MC curve is higher than the MR curve at all quantities greater than q*. If electricity sales dropped by one unit, profits would be lower, since MR > MC at all quantities to the left of q*.

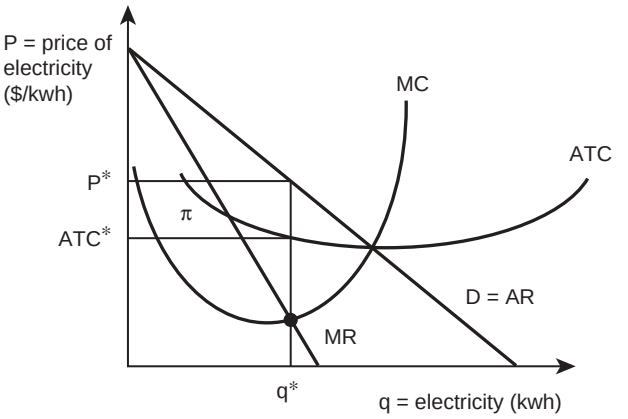

Figure 11.5 Profit maximization by an electricity company.

Monopolists search for the maximum profits by offering different prices, and discovering what the demand and total revenue are at each price. The monopolist's solution is to restrict output to a level lower than the competitive market output level to receive a price above that which would be charged by a competitive firm. By restricting output, the monopolist is making its good less available, and thus, more valuable. Notice in Figure 11.5 that the price charged by the monopolist is significantly higher than the cost of production (MC) at quantity q*. This is one major reason why economists and society favor competitive markets over monopoly. The monopoly solution is inefficient, since price is greater than the cost of production.

Monopolies exist for several reasons, including: (1) large fixed costs (public utilities), (2) locational monopolies (electricity distributors), (3) limited markets for highly specialized goods (fine jewelry, art), and (4) patents or licenses. Certain kinds of firms must incur large fixed costs prior to the sale of any product at all. These firms are called **Natural Monopolies**.

- ***Natural Monopoly*** = a situation where a single firm has large fixed costs, making it most efficient (lowest cost) for production to be concentrated in a single firm.

Think of a firm that sells and distributes electricity. Prior to selling electricity, the firm must build and operate a power generator (a huge dam or a nuclear generator), together with an expensive distribution network that includes poles, huge amounts of wire, switches, and transformers. These items are large and costly to install and maintain. The marginal cost of producing one additional kilowatt hour is quite small relative to these large fixed costs, but it does no good to produce even one kilowatt hour of electricity if the firm cannot deliver it to a purchaser. The firms that incur these huge fixed costs are poorly suited to provide electricity to only a few customers, but their vast distribution grid allows them to serve many, perhaps thousands of, customers with one generating plant. In a situation like this, only one firm is needed. A second firm producing the same product would increase the distribution costs, and, hence, the price of electricity for consumers. In more technical

terms, price competition between two or more firms would drive price down to the competitive level, where neither firm could remain in business, since costs are greater than revenue.

This is why many public utilities such as electricity, natural gas, local telephone service, mail delivery, and municipal water are either regulated monopolies or goods provided by some level of government. In these cases, huge fixed costs require firms to charge prices greater than marginal costs to recover their production costs, and the large fixed costs.

Firms that own a unique location can act like a monopoly and charge a high price for the uniqueness of the good. The golf course at Pebble Beach, California, for example, has fairways bordering the Pacific Ocean. It is a one-of-a-kind facility and it can act like a monopoly. Prime real estate locations can also charge high prices to willing customers who desire to locate homes and businesses in the areas of highest demand.

Most national governments issue patents to the inventors and originators of new machines, powerful medicines, and even new varieties of plants. The same governments issue copyrights (a kind of patent) on works of literature, music, and art. Patents and copyrights are government licenses issued to the developers of new products and techniques. Any inventor can apply for a patent that grants exclusive use of a product or technique to the inventor for a period of 17 years. This is a legal barrier to entry that gives the firm a monopoly for 17 years, if no close substitutes for the product exist. In 1996, Monsanto, a huge agricultural biotechnology firm, invented, perfected, and was licensed to sell a cotton seed called Bollgard. The seed had built-in biological protection against several weevils (insects) that had been problematic for cotton producers. Monsanto's special seed protected cotton producers from the insects. The same year, Monsanto perfected the herbicide (weed killer) RoundUp. Both Bollgard and RoundUp were extraordinarily good at doing their jobs of killing undesirable pests in agricultural fields. The patent on RoundUp gave Monsanto the exclusive right to produce and sell the product in the United States for 17 years, until the patent expired in 2003.

Patents protect firms and give them the opportunity to recover their high research and development (R&D) costs required before the product is available on the market. Patents make goods more expensive to consumers, but many argue that research and development would not occur, or be drastically reduced, in a world with no patent protection.

In the real world, few industries fit the strict definitions of monopoly or competition. Instead, real-world industries usually fall somewhere in between these two extreme forms of market structure. The next section explores a market structure that combines aspects of both monopoly and competition.

11.3 Monopolistic competition

Many real-world industries include many firms that produce similar, but not identical, goods. Economists describe the structure of firms in a similar-but-not-identical industry as **Monopolistic Competition**.

- ***Monopolistic Competition*** = a market structure defined by: (1) many sellers, (2) a product with close, but differentiated, substitutes, (3) some freedom of entry and exit, and (4) some availability of knowledge and information.

The key ingredient of monopolistic competition is product differentiation, or competition to attract customers by making a good that is different from the other goods but produced by firms in the (same) industry. Almost all consumer products fall into this form of market

structure: gasoline stations, cake mixes, toothpaste, milk, soap, soft drinks, and the like. Many, if not most, items available in big-box stores such as Walmart or Target are manufactured in a monopolistic competitive industry. Since the products are very much alike, advertising and marketing activities become key characteristics of monopolistic competition. Firms attempt to show consumers how their product differs from that of their rivals.

Since the products in a monopolistic competition industry are not homogeneous, the individual firm faces a downward-sloping demand curve. The slope, or elasticity, of demand depends upon the degree of uniqueness of the good, and the consumers' loyalty to the product. Consumers who prefer Colgate toothpaste are willing to pay more for this brand than switch to Crest. If this is true, then the demand for Colgate is relatively inelastic when compared to Crest. On the other hand, if consumers perceive Crest to be a close substitute for Colgate, then the demand curve for Colgate would be relatively elastic.

Box 11.2 Monopolistic competition in the soft drink industry: Coke and Pepsi

On May 8, 1886, a pharmacist named Dr. John Pemberton carried a jug of Coca-Cola syrup to Jacobs' Pharmacy in downtown Atlanta, Georgia, where after being mixed with carbonated water, it sold for five cents a glass. In the decades since that time, Coca-Cola has evolved from one product, Coca-Cola, to the more than 500 brands of soft drinks available in 2011. The Coca-Cola Company currently sells 1.7 billion soft drinks a day, in more than 200 nations. It is the largest beverage company in the world, with a product portfolio of over 3500 beverage products including sparkling drinks and still beverages such as bottled water, juice, juice drinks, teas, coffees, sports drinks, and energy drinks. The company is headquartered in Atlanta, Georgia, and employs roughly 140,000 workers worldwide. It manufactures concentrates, beverage bases, and syrups that are sold to bottlers, who bottle and sell the products. The company reports a 42.0 percent market share in the US, earns $35 billion in annual revenue, and had an advertising budget of $2.9 billion in 2009.

In the summer of 1898 a pharmacist named Caleb Bradham invented Pepsi-Cola in Bern, North Carolina. Pepsi-Cola and the company behind it, PepsiCo, has grown into a large marketer of beverages, juices, and snack foods. Pepsi-Cola and Frito-Lay merged in 1965. In 2001, the larger PepsiCo merged with The Quaker Oats Company. Today, PepsiCo is a $29 billion company, employing more than 150,000 people. PepsiCo sells products in nearly 200 countries, and offers more than 500 beverages, with a 29.3 percent market share in the United States, and advertising expenditures over $1 billion each year.

Coke and Pepsi have been engaged in a "marketing war" for decades, as the combined market share for the two companies is over 70 percent of the carbonated soft drink market.

Sources:
Coca-Cola. http://www.coca-cola.com/en/index.html
Pepsi-Cola. http://www.pepsi.com/

While the characteristics of goods across firms differ in monopolistic competition, the prices among similar products do not vary by much. If price differences become large, consumers will switch to the close substitutes offered by competing firms. In other words, firms do not have a great deal of control over price in monopolistic competition. Figure 11.6 shows a graph of such a firm. The demand curve is downward sloping, showing the market power of the monopolistic competitor, in this case the soft drink producer, Coca-Cola. The cost structure of the firm includes the typical "U-shaped" curves.

Figure 11.6 shows that the monopolistic competitor is in a situation similar to that of a monopolist: it sets MR = MC, produces q* units of output, and sells them at a price P*. Positive profits are shown by the rectangle between the price (P*) and average total cost (ATC*) lines, and to the left of q*. A major difference between a monopolist and a monopolistic competitor is that the monopolistic competitor has less influence over price, and must use other strategies to compete with rival firms that produce similar products.

The monopolistic competitor has two major strategies to increase profits. First, the firm could reduce costs. This is the same as in the case of a competitive firm or a monopoly: do anything possible to lower production costs, including adoption of new technology, adding a new product line, or purchasing inputs at lower prices. Second, the monopolistic competitor can attempt to influence demand through advertising and marketing efforts that strive to show how his or her product is "better" than others in this closely fought marketing battle. If consumers believe that a certain brand of toothpaste will make their teeth whiter and control cavities, then the demand for that brand of toothpaste will shift to the right (increase). This strategy is called, "**Nonprice Competition**."

- ***Nonprice Competition*** = a market situation where firms compete over good characteristics other than price, such as quality, quantity, services, color, taste, etc.

Competition to win customers over to a certain brand is often intense. The automobile manufacturers in Detroit, Michigan, for example, often hold much information privately (or secretly), for fear the other car companies will steal their new products and ideas. Coke and Pepsi do battle on prime-time television and on college campuses in their efforts to convince

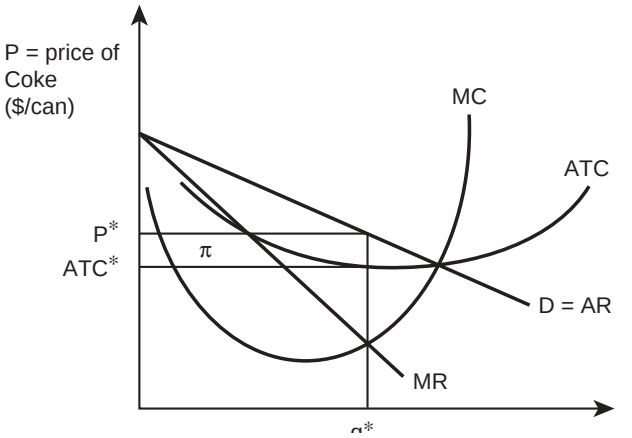

Figure 11.6 Profits for monopolistically competitive firm: Coke.

consumers that their product is better than the rival's cola. Coke and Pepsi also attempt to acquire exclusive contracts with colleges and universities, requiring the rival products to not be sold in exchange for money or profit-sharing.

Software companies and technology firms, also operating as monopolistic competitors, compete for the best workers, and to advertise as the first and best firm to sell new and powerful software applications, or "apps."

Monopolistic competition has been used as a criticism of free market capitalism. Under this type of market structure, many resources are "wasted" on advertising and marketing. Millions of dollars are paid to celebrities from the entertainment and sports industries to endorse a large number of products. Command economies, such as China in the 1950s, produced just one type of clothing, and used the resources that market economies use for advertising and marketing to produce other goods. Many individuals believe that the variety of goods offered in a free market economy is not wasteful, but rather provides consumers with information and choices regarding what they might wish to purchase. If consumers were not willing to pay for and pay attention to advertising, the advertising industry would not survive in a market system. Is advertising wasteful? This depends on your viewpoint. Since economists try to purge value judgments from their analyses, the point must be decided on an individual case basis.

Monopolistic competition is a form of market structure that lies between the two extremes of monopoly and competition. It lies close to competition because there are many firms. It is also similar to monopoly since the products of the different firms have special qualities that make them distinct and result in a downward-sloping demand curve. The next section considers a form of market structure that is closer to monopoly, since there are only a few firms in the industry.

11.4 Oligopoly

An **Oligopoly** is a market structure where production activities are conducted by a few large firms.

- ***Oligopoly*** = a market structure characterized by a few large firms.

The key characteristics of firms in an oligopoly are that the firms are rivals, even though they form an interdependent group. The behavior of one firm has an impact on the behavior of other firms in the industry. Oligopolists must take into consideration the actions of other firms. Firms in an oligopoly are considered to have market power, and their ability to set price is determined by their own actions and the actions (and reactions) of other firms in the industry.

Taken together, agricultural implement manufacturers operate as an oligopoly. There is much interdependence within the group. Both price and nonprice competition are prevalent. The John Deere farm implement manufacturer must pay close attention to its rival, Case-IH, if it wants to maximize profits, or even if it wants to stay in business. If one of these giant firms lowers the price of certain lines of implements, the other firm, also a giant, will most likely match the new low price in order to retain its customers. If the price is lowered by both firms, then both firms earn lower levels of profits. Both firms would be better off maintaining a higher price. Similarly, if one firm raises its price, it will lose some customers to the other firm, unless the price hike is matched. Profit levels and market shares are determined by all firms in an oligopoly, rather than just the one firm acting alone.

The central strategy of an oligopolist is to form an alliance with the other firms in the industry to maintain prices at a level higher than the competitive market price. Firms are said to **Collude** when they agree to make decisions as a group.

- ***Collusion*** = when the firms in an industry jointly determine the price of the good.

Collusion is a form of monopoly. If all of the firms in an oligopoly agree to act as a single firm, they would be a *de facto* monopoly and the monopoly pattern for profit maximization would be appropriate. The collusive price and quantity solution would be the monopoly solution. This form of business strategy has been illegal in the United States since passage of the Sherman Antitrust Act in 1890.

Cartels

Cartels are groups of independent firms that join together for the express intent of regulating and controlling their price and production decisions. Cartels arise when several firms in an industry attempt to band together and act like a monopoly.

- ***Cartel*** = a group of independent firms that join together to regulate price and production decisions.

While this form of market structure is illegal within the United States (the Sherman Anti-trust Act again), it is legal in some other nations. The Organization of Petroleum Exporting Countries (OPEC) is a famous international cartel that limits oil production in its member nations in an attempt to drive up the world price of oil.

Plate 11.3 Oil production.
Source: TebNad/Shutterstock

Box 11.3 The Organization of the Petroleum Exporting Countries (OPEC)

The Organization of the Petroleum Exporting Countries (OPEC) is a permanent intergovernmental organization created in 1960, to coordinate petroleum supply and price policies among member countries. OPEC includes 12 oil-producing countries as members: Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, the United Arab Emirates, and Venezuela. The OPEC headquarters are in Vienna, Austria.

OPEC is a cartel: a group of producers that restricts output in an attempt to raise prices above the competitive level. The group meets twice each year to decide overall oil output, and assign output quotas for each member nation. As a cartel, OPEC is faced with enforcement problems: overproduction and price cheating by its members. Each individual member could make itself better off by producing more than its quota, and charging a lower price for oil, since the cartel price is higher than the cost of production. In reality, cheating takes the form of credit discounts or extensions, selling higher grades of oil for a lower-grade price, transportation discounts, side-payments, and rebates.

Economists are suspicious of the ability of OPEC to increase oil prices, as the real price of oil fell from 1974 to 2003. Since then, oil prices have climbed, but much of this increase in oil prices has been due to the increased demand stemming from economic growth in Asia. OPEC's ability to control the price of oil has diminished due to discovery and development of large oil reserves in Alaska, the North Sea, Canada, and the Gulf of Mexico, the opening of Russia to trade, and market modernization. As of November 2010, OPEC members collectively controlled 79 percent of world crude oil reserves and 44 percent of the world's crude oil production, affording them considerable strength in the global market.

Source: OPEC. http://www.opec.org/

Cattle producers and the United States government pay a great deal of attention to the market structure of the beef packing industry, since there is a large concentration of market power in four firms: Tyson, Cargill, JBS, and National Beef (see Chapter 1). The fear is that these firms may form a cartel and attempt to exert detrimental levels of control over livestock producers, processors, and consumers. Figure 11.7 is a hypothetical demonstration of the supply and demand for meat for the industry (on the left), and for an individual packing plant (on the right). Assume that the packers were able to form a cartel, with the objective of reducing output in order to increase the price of beef.

The competitive solution in Figure 11.7 is shown at the intersection of beef supply and beef demand in the market graph on the left (P^*, Q_{comp}). A cartel, if successful, makes an agreement to restrict the output of meat from Q_{comp} to Q_{cartel}. Since the agreement reduces the quantity of beef, this action drives the price up to P_{cartel}. Assume that this restricted level of output is 80 percent of the original market. If the four packers collude perfectly, they charge the monopoly price, and act as if they were a single firm. If the real-world firms of Tyson, Cargill, JBS, and National Beef were to actually collude and form a cartel, this action would be illegal.

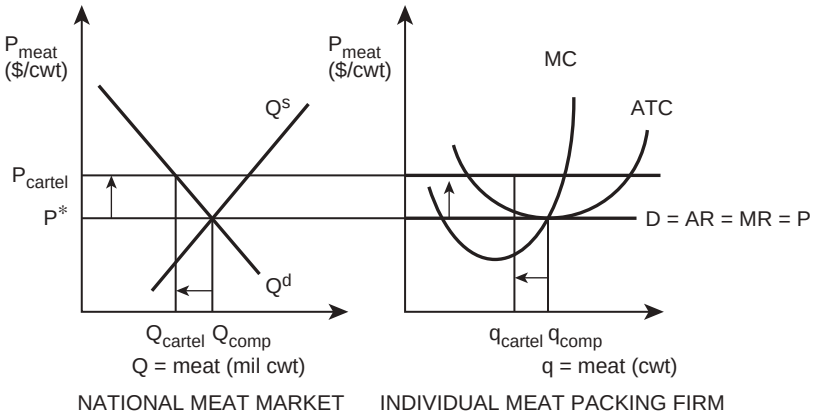

Figure 11.7 Hypothetical cartel in the meat industry.

Plate 11.4 Cattle feedlot.
Source: Thoma/Shutterstock

Box 11.4 Meat packing

The meat packing industry operates the slaughtering, processing, packaging, and distribution of meat from animals such as cattle, pigs, sheep, poultry, and other livestock. The industry is primarily focused on producing meat for human consumption, but it

also yields a variety of by-products including hides, feathers, dried blood, and, through the process of rendering, fat such as tallow and protein meals such as meat and bone meal. The meat industry is the largest agricultural sector in the United States. Meat and poultry sales are greater than $100 billion annually. The meat processing industry employed a total of 506,000 people in 2005.

The meat packing industry has changed greatly in the past 30 years, due to the movement of packing plants to the Great Plains, where large numbers of feedlots are located. New meat packing companies such as Iowa Beef Processors (IBP, now owned by Tyson) brought new technology and captured economies of scale in large plants located in areas where labor unions did not have a strong history. This, coupled with increasing worker speed and productivity, cutting labor costs, and consolidation, provided new sources of profits to large firms that operated large plants on small margins.

Over the past three decades, the number of immigrant laborers in meat packing plants, and in the Midwestern areas where they are located, has increased dramatically. The industry has been criticized for hazardous working conditions and low pay. The average earnings of production workers in 2010 was $11.27 an hour, about 30 percent less than the average wage for all manufacturing jobs in the US.

Source: Wikipedia. "Meat Packing Industry." http://en.wikipedia.org/wiki/Meat_packing_industry

If the four firms were able to agree to cut back on beef production by 20 percent each, they would earn positive economic profits, as shown in the right side of Figure 11.7. The problem with collusive agreements is the constant temptation of each firm to "cheat" once the agreement has been made. At the collusive price, if the single meat packing plant could increase its production of meat slightly, then it could take advantage of the cartel price and sell more output than the agreed to level. If the single firm could do this at the cartel price, it would set MR = MC at the intersection of those two curves in the right-hand graph.

There are only a few firms (in the case of beef packers, only four dominant firms) in an oligopoly. Therefore, one firm's cheating behavior puts downward pressure on the price of beef. This in turn erodes the cartel agreement, and leads to a breakup and the price falls back toward the competitive level, limiting the effectiveness of the cartel. The issue is that the cheating firm assumes that all other firms stick to the agreement, an assumption that is inconsistent with the firm's own behavior. If all of the firms cheat on the agreement, then the competitive output and price would result. Thus, any cartel must spend money on monitoring other firms to make sure that they don't violate the original conditions of the agreement.

Strategic behavior among oligopolists can be complicated. The rivalry between firms can lead to aggressive price competition, or effective collusion, or anything in between these two extremes. Volatility is a major feature of oligopoly. Rivalry among firms may maintain a price agreement for a short period, but it is often followed by a price war that keeps the price at a competitive level. The next section discusses the benefits and costs of highly concentrated market structures.

11.5 Is big necessarily bad?

There have been a large number of mergers and acquisitions in the agribusiness industry in the past several years. These have occurred on both the factor and the output sides of the markets. Many small firms have merged to form larger firms, which farmers and other market participants often think of as having too much power. It is true that if the large firms in concentrated industries have the ability to use market power to charge higher than competitive prices to consumers, then the consolidation of firms into larger entities would be an inefficient outcome for society. It would result in a transfer of resources from consumers to the large firms.

There are major economic advantages to the production of goods and services by very large firms, however. The primary benefit stemming from growth in firm size is **Economies of Scale**, which refers to lower production costs at larger levels of output:

- ***Economies of Scale*** = when the per-unit costs of production decrease as output increases.

There is a tradeoff between large-scale firms in agricultural production and agribusiness. If these large firms exploit their market power by charging prices above the competitive level, then consolidation could be considered a negative aspect of the agricultural economy. On the other hand, to the extent that large firms capture economies of scale, they are contributing to the efficiency of the economy by producing goods at lower cost relative to smaller firms.

Mergers and large firms are controversial. Some people are likely to emphasize the market power abuses (real or imagined) of a large firm, and others are likely to emphasize efficiency gains. Individual cases of consolidation should be considered on an individual case basis. Even then, it is likely to be very difficult to determine the exact impact on prices and output that will follow after consolidation of small into large entities. Most evidence suggests that large firms do not have a great influence on price, due to the potential competition from other firms. Also, there are huge cost savings associated with large production facilities that allow production at a low cost per unit of output. Thus, in most cases, it is likely that the benefits of bigness outweigh the costs. Just as there are gains to be made from large firms, there are also gains to be made from trading with other nations, a theme developed in the next chapter.

11.6 Summary

1. Market power is the ability to affect the price of output. A firm with market power faces a downward-sloping demand curve.
2. Monopoly is a market structure characterized by a single seller.
3. The profit-maximizing condition for a monopolist is when MR = MC, with MC cutting MR from below.
4. A natural monopoly has large fixed costs.
5. Monopolistic competition is a market structure defined by: (1) many firms, (2) a product of close, but differentiated, substitutes, (3) some freedom of entry and exit, and (4) some availability of knowledge and information.
6. Nonprice competition is when firms compete over good characteristics other than price, such as quality, quantity of services, etc.

7. An oligopoly is a market structure characterized by a few large firms.
8. Collusion occurs when the firms in an industry jointly determine the price of a good.
9. A cartel is a group of independent firms that join together to regulate price and production decisions.
10. Economies of scale exist when per-unit costs of production decrease as output increases.

11.7 Glossary

Barriers to Entry and Exit. Legal or economic barriers that hinder or prevent a new firm from entering or exiting an industry.

Cartel. A group of independent firms that join together to regulate price and production decisions.

Collusion. When the firms in an industry jointly determine the price of the good.

Economies of Scale. When the per-unit costs of production decrease as output increases.

Market Power. The ability to affect the price of output. A firm with market power faces a downward-sloping demand curve.

Market Structure. The organization of an industry, typically defined by the number of firms in an industry.

Monopolistic Competition. A market structure defined by: (1) many sellers, (2) a product of close, but differentiated, substitutes, (3) some freedom of entry and exit, and (4) some availability of knowledge and information.

Monopoly. A market structure characterized by a single seller. The firm is the industry.

Natural Monopoly. A situation where a single firm has large fixed costs, making it most efficient (lowest cost) for production to be concentrated in a single firm.

Nonprice Competition. A market situation where firms compete over good characteristics other than price, such as quality, quantity, services, color, taste, etc.

Oligopoly. A market structure characterized by a few large firms.

Price Maker. A firm characterized by market power, or the ability to influence the price of output. A firm facing a downward-sloping demand curve.

Price Taker. A firm so small relative to the industry that the price of output is fixed and given, no matter how large or how small the quantity of output it sells.

11.8 Review questions

1. Profit maximization is the goal of which type of firm?:
   a. competitive firm
   b. monopolist
   c. oligopolist
   d. all of the other three answers
2. A monopolist produces a good that:
   a. is a public utility, such as electricity
   b. has no close substitutes
   c. has numerous substitutes
   d. is inferior
3. A natural monopoly has:
   a. numerous competitors
   b. large fixed costs

c. large variable costs
d. zero fixed costs

4. The key characteristics of a monopolistic competitor is:
   a. freedom of entry and exit
   b. homogeneous product
   c. product differentiation
   d. monopolistic prices
5. A group of firms that join together to regulate price and production decisions is:
   a. the teamsters
   b. an oligopoly
   c. collusion
   d. a cartel
6. Large firms can take advantage of:
   a. natural monopoly
   b. monopoly pricing strategies
   c. economies of scale
   d. collusion

Plate 12.1 Agriculture and the global economy.
Source: TFoxFoto/Shutterstock

12 Agriculture and the global economy

Synopsis

This chapter explains why international trade and globalization occur. It also tells why most economists are enthusiastic supporters of free international trade. In simple terms, free trade carries many of the same implications as perfect competition: it is a hard-to-reach objective that can make many individuals better off. The chapter uses examples from food and agriculture to explain the motivations behind international trade. The chapter also explains the principle of comparative advantage as it applies to the globalization of trade in food and agriculture. The chapter ends with an explanation of the importance of diversity in national resources.

12.1 Globalization and agriculture

Anyone who watches television news, listens to the radio, or surfs the Internet repeatedly hears terms such as "internationalization," "globalization," and "The Global Economy." This relatively recent focus on international issues stems from the rapid reduction in economic, political, and cultural barriers between nations. Economic examples of globalization include free trade agreements such as the North American Free Trade Agreement (NAFTA), the 2011 free trade agreement between the US and South Korea, and the adoption of the Euro as the official currency of 17 European nations. Most adults in the US are familiar with current events that have international implications. However, the underlying causes and consequences of globalization are often less clearly understood.

With a few notable exceptions, politicians favor free trade between nations. Similarly, elected officials frequently join together to support free trade, while disagreeing on most other issues. Economists have even stronger feelings. They are unyielding proponents, obsessed with the idea of goods flowing freely between nations without obstructions such as **Tariffs, Import Quotas** or unnecessary searches by government officials. Free markets and free trade are the lifeblood of economists, who typically oppose government interventions in the voluntary exchange of goods and services in both domestic and international markets.

- ***Trade Barriers*** = laws and regulations to restrict the flow of goods and services across international borders, including tariffs, duties, quotas, and import and export subsidies.
- ***Tariff*** = a tax on imports of a good.
- ***Import Quota*** = a trade restriction that sets a physical limit on the quantity of a good that can be imported during a given time period.

Box 12.1 European agriculture

The European Union (EU) is an economic and political confederation of 27 member nations. The EU was first developed as the European Economic Community (EEC) beginning with six members in 1958. In 1993, the EEC became the EU, which is a single market with standardized laws and institutions to ensure the free movement of people, goods, services, and capital. The EU also maintains common policies on international trade, agriculture, fisheries, and regional development. Europe is the largest food importer in the world, and among the largest food exporters.

Agriculture within the EU is highly diverse and productive. Europe is approximately the same size as the US, four million square miles. European agriculture includes colder climates such as Sweden and Finland, where wheat, barley, oats, and timber are grown. In the south, Mediterranean nations such as Spain and Italy produce wine, olives, and tomatoes. France is the largest agricultural producer in the EU, with 35 percent of the total land area devoted to agriculture. France produces dairy, wine, beef, wheat, and corn, among many other food products. The Eastern European nations of the EU have agricultural sectors that employ large numbers of workers: in Bulgaria, 36 percent of the workforce is employed in agriculture, and 46 percent in Turkey.

After the devastation of World War II, the EU farm policy focused on providing enough food for a war-torn population. At the beginning of the European Community, the Common Agricultural Policy (CAP) had objectives of increasing agricultural production, stabilizing markets, providing certainty in food markets, and ensuring adequate incomes for farmers. The policy's high price supports and market interventions did meet these objectives, but also resulted in large and unintended overproduction and surpluses. To dispose of these food surpluses, the community often sold the excess on the world market at prices considerably below the world price. This system was criticized as unfair competition for farmers outside of the EU, especially those in low-income nations.

Since the 1990s, EU agricultural policy has evolved, and the community has implemented policy reforms. The CAP now concentrates on food quality, environmental quality, rural economic development, animal welfare, and food safety. The policy reforms have made the policies less harmful to competing nations.

Sources:
Europa Agriculture. Europa.eu/pol/agr
Stead, David (2010). "Common Agricultural Policy." EH.Net Encyclopedia. January 2. Retrieved July 23, 2012.

12.2 Interdependence and gains from trade

It does not take long to notice the advantages of buying and selling goods from other parts of the world. Consider a typical breakfast in a typical US household. It most likely includes coffee produced from beans grown in Brazil and orange juice squeezed from oranges grown in either Florida or Mexico. Similarly, China uses cotton grown in Arizona or Mississippi to make clothes worn in the United States. The Ford pickup trucks in the university parking lot required imported component parts manufactured in several different nations. The paper

used to make the printed versions of this book likely came from trees grown either in the southern United States or Canada.

People living in North America rely on goods produced all over the world, which is a good thing, because it expands the number and variety of goods available for consumption. Similarly, domestic producers acknowledge that international trade allows the US population to be more productive and efficient, since specializing in the production of a limited number of goods brings advantages in the production process.

Adam Smith, an early Scottish economist, stated this in his 1776 book, *An Inquiry into the Nature and Causes of the Wealth of Nations*. Smith's key argument advocating economic interdependence among nations focused on the advantage that comes by working full time in a specialized area, then using the earnings from this work to purchase goods and services from other specialized workers. Smith's simple insight that an individual should "do what he or she can do best" is the basis for international trade. A modern example of this concept stems from the question, "Should a professional tennis player mow her own lawn?" The tennis player may be an exceptional athlete who has earned millions of dollars playing in lucrative matches. Given her youth and athleticism, it is likely that she would be good at mowing lawns. She may be faster and more efficient at mowing than anyone else in town. In fact, she may even enjoy mowing grass as a way of unwinding from the stress of fame and fortune that stems from the United States Tennis Association (USTA) Tour.

Given her ability as a professional tennis player, she is most likely better off spending her time practicing her tennis game while someone else mows the lawn. She could make herself better off by "trading" a portion of her winnings for lawn care services, and the individual who cuts her lawn is better off by accepting payments for mowing the grass.

Suppose that the football coach at a major football-famous university is an excellent typist, and can type more words per minute than his administrative assistant. Should the coach type his own letters? No. Economic reasoning suggests that the coach should maintain focus on how to win football games, rather than type letters, even though letters are an important part of the coach's position.

The concept, "do what you can do best," appears straightforward. However, it can be difficult to apply. Should farm managers cut their own wheat or hire custom cutters? Should ranchers hire workers to work cattle, or do the work themselves? Should agribusinesses do their own record keeping or hire an accountant? These common questions require answers and explanation.

12.3 Gains from trade example: Oklahoma beef and wheat

The best way to understand the source of the gains from trade is to work through a numerical example. Suppose that the year is 1889, and two rugged individuals have made the decision to homestead in the panhandle region of Oklahoma, near the present town of Goodwell. To make things simple, assume that (1) there are only two persons living in the county: a farmer (wheat), and a rancher (beef), (2) there are only two goods available: beef and wheat, and (3) both individuals like to eat both meat and bread. If the farmer insisted on being self-sufficient, he would only be able to eat bread; if the rancher were self-reliant, she could eat all of the beef that she desired, but would be unable to enjoy bread of any type.

If each person were very good at producing one of the two goods, then it would be easy to show that they could make each other better off by specializing in the production of what they do best and trading with the other person. This is simply Adam Smith's idea of doing what you do well (you have an advantage), and trading for other goods. The concept is

Plate 12.2 Oklahoma beef.
Source: Justin S./Shutterstock

appealing, since humans are born with different abilities and interests. Specialization allows for efficient production and trade allows for a more diverse and interesting consumption package. Both individuals increase their level of satisfaction through specialization and trade: they produce what they are good at and trade for the other good.

This simple exchange becomes more interesting and more realistic when one of the individuals is better at producing both goods: a situation that is probably quite common in real life. Suppose the rancher acquires a homestead of productive, high-quality land. This allows her to be more productive at producing both beef and wheat while the farmer, whose homestead is located on poor-quality land, must continue to produce only a fair, or even poor, wheat crop. Specialization and trade can benefit both parties. Table 12.1 shows the productivity levels of both the farmer and the rancher, assuming that each can work 40 hours a week, and can raise beef, wheat, or a combination of both.

Figure 12.1 shows all possible combinations of beef and wheat that the farmer can produce, given the production possibilities shown in Table 12.1. If the farmer devotes all his effort to beef production, he ends up with two pounds of beef and no wheat. If the farmer

Table 12.1 Production possibilities of the farmer and the rancher

	Hours of Effort Needed to Make 1 Pound of:		*Amount Produced in 40 Hours (in lbs)*	
	Beef	*Wheat*	*Beef*	*Wheat*
Farmer	20	10	2	4
Rancher	1	8	40	5

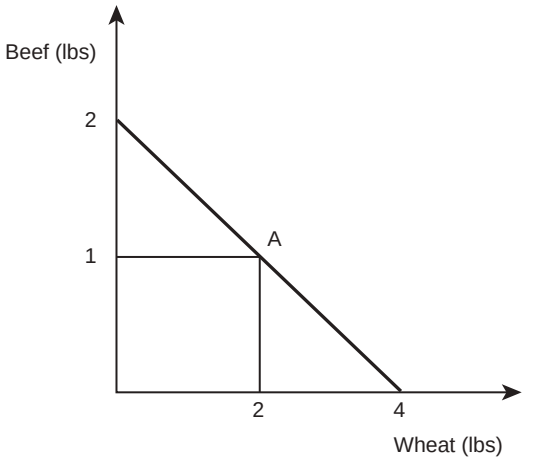

Figure 12.1 Farmer's production possibilities.

spent all available hours on wheat production, he would produce four pounds of wheat, but no beef. If the farmer allocates half his time to the production of each product, 20 hours are spent producing beef and 20 hours are devoted to wheat production. Point A in Figure 12.1 shows that in this case, the output of beef equals one pound and the output of wheat equals two pounds.

Figure 12.2 is a graph of the rancher's production possibilities. The rancher can produce more of each product, since she has resources that are more productive. If the rancher divided her time evenly between the two products, she could produce at point B: 20 pounds of meat and 2.5 pounds of wheat. These differences in productivity provide the necessary conditions for both the farmer and the rancher to become better off through specialization and trade.

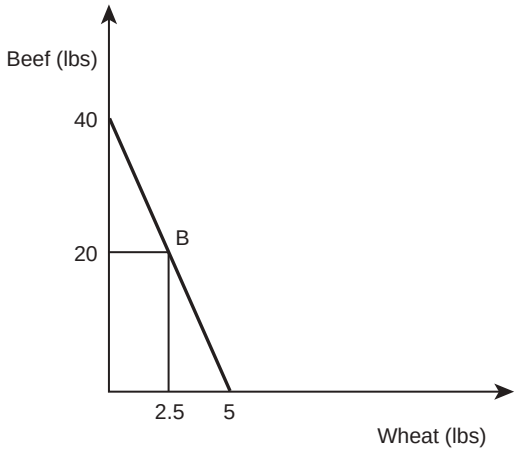

Figure 12.2 Rancher's production possibilities.

Eventually, the rancher figures out a way to increase the level of consumption of both individuals through trade, and without either person having to work any more hours. Her suggestion goes like this:

> The farmer spends 40 hours each week growing wheat (this is what he does best). Specializing in this way the farmer produces four pounds of wheat in a week. The farmer could trade one pound of wheat to the rancher for three pounds of beef in return. This would result in a higher level of consumption for both the farmer and the rancher.

Figure 12.3 shows that with no trade, the farmer is at point A, consuming one pound of beef and two pounds of wheat. If the farmer follows the advice of the rancher, he produces four pounds of wheat, trades one pound of the wheat for three pounds of meat (a trade that both parties favor), and ends at point A*, consuming three pounds of both beef and wheat. The farmer is now in a position to consume more of both goods (Figure 12.3, Table 12.2).

The rancher is also made better off through this trade. The rancher started with no trade, and consumed 20 pounds of beef and 2.5 pounds of wheat (point B in Figure 12.4). After trade, she moves her productive activities toward beef (her specialty) by allocating 24 hours a week to cattle and 16 hours per week to wheat. This allocation of her time results in 24 pounds of beef and two pounds of wheat. The rancher then trades three pounds of

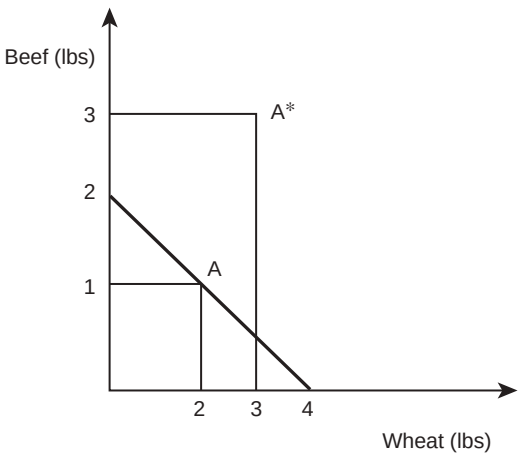

Figure 12.3 Farmer's consumption with trade.

Table 12.2 Outcomes of specialization and trade for the farmer and the rancher

	Before Trade		*After Trade*		*Net Gain*	
	Beef	*Wheat*	*Beef*	*Wheat*	*Beef*	*Wheat*
Farmer	1	2	3	3	+2	+1
Rancher	20	2.5	21	3	+1	+0.5

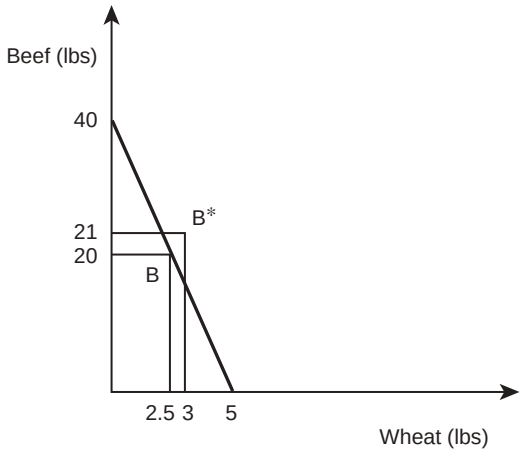

Figure 12.4 Rancher's consumption with trade.

beef for one pound of wheat (recall the rancher's proposal above). Because of the trade, the rancher consumes 21 pounds of beef and three pounds of wheat (shown at point B^* in Figure 12.4 and Table 12.2). The rancher is able to consume more of both products.

What is happening here? By each specializing in what he or she does best, the total production of goods available to the entire Oklahoma Panhandle economy grows and thrives. Although both the farmer and the rancher are better off with trade than without it, trading seems odd because the rancher is actually more productive in the production of both goods. This outcome, making all individuals better off through specialization and trade, holds true in a wide variety of situations and examples. The idea is formalized in the principle of comparative advantage.

12.4 The principle of comparative advantage

The key to understanding how interdependence between individuals in an economy, and international trade between nations, can make all trading partners better off is to understand the distinction between **Absolute Advantage** and **Comparative Advantage**. These ideas are explained by asking the question from the example in a slightly different way: "Who is better at producing wheat, the farmer or the rancher?" One possible answer is that the rancher is more efficient at producing wheat, since it takes her only eight hours of effort to produce one pound of wheat, whereas it takes the farmer 10 hours to produce the same amount. Economists use the term absolute advantage to compare the productivity of two persons, firms, or nations. Whoever is the more productive (or has the lowest cost of production) has an absolute advantage in the production of a good.

- ***Absolute Advantage*** = lower costs of production for a specific good or service.

In the farmer/rancher example, the rancher has an absolute advantage in the production of both beef and wheat. Absolute advantage was one of Adam Smith's great insights.

Quick Quiz 12.1

Define absolute advantage. Does trade require that each trading partner has a different absolute advantage? Why or why not?

Box 12.2 Adam Smith and absolute advantage

Adam Smith (1723–90), a Scottish philosopher, is considered by many to be the most important economist of all time. In his major work, *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776), Smith explained how rational self-interest in a free market economy could lead to economic well-being. The book, considered the first modern work of economics, promoted free markets, free trade, and a capitalistic form of economic organization. Smith explained, "It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own self-interest. We address ourselves, not to their humanity but to their self-love, and never talk to them of our own necessities but of their advantages."

Absolute advantage is one of the many contributions made in *The Wealth of Nations*. Smith argued that all nations would gain simultaneously if they specialized in accordance to their absolute advantage, and then traded with other nations. This was controversial at the time, since many nations were exporting goods in order to stockpile gold, a form of commercial economic policy called mercantilism. Even though there are possible economic gains stemming from absolute advantage, the gains are not always beneficial for all parties. David Ricardo (1772–1823) extended Smith's idea of absolute advantage to comparative advantage, the foundation for mutually beneficial exchanges.

The centerpiece of Smith's economic thought is the division of labor. *The Wealth of Nations* describes a pin (nail) factory where ten workers each specializes in different tasks and produce a great number of pins, whereas if each worker performed all of the tasks associated with making a pin, he would produce only a small number of pins. Smith suggested self-interest was the major motivating force that allocated resources to their highest return. This profit-seeking behavior leads to the equality of returns, since all uses of a resource will eventually yield the same rate of return; otherwise, more reallocations of resources will occur.

Smith's work is encyclopedic, but the themes related to self-interest, the division of labor, specialization and trade, and free markets continue to be seminal aspects in modern twenty-first-century economics.

Source: *The Concise Encyclopedia of Economics*. Library of Economics and Liberty. Adam Smith. http://www.econlib.org/library/Enc/bios/Smith.html

The second way to answer the question about who is better at producing wheat is to look at what must be given up to produce one pound of wheat. Using language learned in Chapter 3, what is the **Opportunity Cost** of a pound of wheat? In the example, each person

has 40 hours per week to allocate to the production of beef and wheat. There is a tradeoff between producing these two goods, since an hour spent producing beef is unavailable for the production of wheat, and vice versa. The opportunity cost to the rancher producing wheat shows the sacrifice of beef required to produce a pound of wheat. Since it takes the rancher one hour to produce one pound of wheat, and one hour to produce eight pounds of beef, every hour that the rancher spends producing wheat takes away the possibility of using that hour to produce eight pounds of beef. Put another way, the "cost" to the rancher of producing one pound of wheat is the lost opportunity (or opportunity cost) associated with giving up eight pounds of beef. Figure 12.4 shows this: the slope of the production possibilities line (rise over run) is equal to eight.

For the farmer, the opportunity cost of producing one pound of wheat is equal to how much beef must be given up to produce one pound of wheat. The farmer requires 10 hours to produce one pound of wheat. If those 10 hours were spent producing beef, he could produce 0.5 pounds of beef, since it requires the farmer 20 hours of time to produce one pound of beef (Table 12.1). The slope of the farmer's production possibilities line in Figure 12.3 shows that the farmer can use some of his resources to produce either one pound of wheat or one-half pound of beef. The slope is equal to 0.5.

The term, **Comparative Advantage** indicates that one firm has different comparative advantages from another. The firm with the smaller opportunity costs has the comparative advantage. The concept of comparative advantage works not only for individuals, but also for firms, nations, or blocs of nations such as the European Union (EU).

- ***Comparative Advantage*** = the superior productive capacity of one individual, or nation, or region, or industry, relative to all others, based on opportunity cost.

Quick Quiz 12.2

Define comparative advantage. Which is needed for trade, absolute advantage or comparative advantage?

The producer who has the smallest opportunity cost of producing a good has a comparative advantage in the production of a good. In the rancher/farmer example, even though the rancher has an absolute advantage in the production of wheat, the farmer has the comparative advantage. It is not possible for a single person to have a comparative advantage in both goods. Since the farmer has a comparative advantage in producing wheat, the rancher has the comparative advantage in producing beef.

Box 12.3 David Ricardo and comparative advantage

David Ricardo was born in London in 1772, the third of 17 children. Ricardo's father was a successful stockbroker of Portuguese origin who had recently moved to England. When Ricardo was 21, he eloped to marry Priscilla Anne Wilkinson. This elopement led to David Ricardo's rejection by his father, and his mother never spoke to him again. David, like his father, became a successful stockbroker.

Interestingly, Ricardo was exposed to economics when, at the age of 27, he read Adam Smith's *The Wealth of Nations*. Ricardo maintained his interest in economics and went on to make important contributions to the emerging discipline. He was friends with contemporary economists James Mill, Jeremy Bentham, and Thomas Malthus. Like Smith, Ricardo was a proponent of the free trade of goods between nations, without government intervention. Ricardo opposed England's tariffs on agricultural products (called the Corn Laws). Parliament repealed these tariffs in 1846.

Ricardo's major contribution was the refinement of the theory of comparative advantage, which stated simply that there is a mutual benefit from trade, even if one trading partner is more productive at every activity than the other trading partner. The theory was introduced in his book, *Principles of Political Economy*, published in 1817. The basic idea of the theory is that a nation that trades for low-cost products is better off than if the nation produced the goods at home. When each nation specializes in the goods that it can produce at lower costs than other nations, all nations can gain from trade. This simple, elegant, and powerful economic model has been used to justify and promote free trade between nations ever since.

Source: *The Concise Encyclopedia of Economics*. Library of Economics and Liberty. David Ricardo. http://www.econlib.org/library/Enc/bios/Ricardo.html

12.5 Comparative advantage and trade

Differences in comparative advantage or differences in the opportunity costs between trading partners (individuals, firms, and nations) allow for specialization and eventually lead to gains for all traders. Any time that one person has opportunity costs that are different from another person's, the total production of the two persons will increase if they each specialize in the production of the product in which they have the comparative advantage. Benefits arise because each person is doing what he or she does best, followed by trade. As a result, the total production of both products increases, making all trading parties better off.

The benefits of increasing production for two individuals also hold for groups of individuals, and nations. Nations trade in order to take advantage of other nations doing what they do best. They trade to buy goods and services from a less expensive source. A nation produces and exports the goods and services in which it has a comparative advantage. The United States exports huge tonnages of agricultural products. The Midwest, for example, sells a majority of its wheat and feed grain production overseas and its exports of beef products expands each year.

Box 12.4 Agricultural productivity growth in Brazil

Brazil is a vast nation, with huge agricultural resources and increasing productivity. Brazilian agriculture is highly diverse, and the nation is self-sufficient in food. Brazil is one of the BRIC (Brazil, Russia, India, and China) nations, characterized by high economic growth that stems partially from rapid growth in agricultural productivity.

The agricultural growth has come about by bringing new land into production, and improving the productivity of crops and livestock through scientific knowledge.

In the 1970s, Brazil was concerned about future food supplies. The nation made the decision to expand agricultural production though scientific research and free trade. Since then, Brazil has become the first tropical agricultural giant. The other large agricultural exporters are all in temperate climates: the US, Canada, Australia, the EU, and Argentina. In less than 30 years, Brazil transformed itself from a net food importer to one of the world's biggest food exporters. Between 1996 and 2006, the total value of Brazil's crops increased 365 percent, and beef exports in 2006 were ten times higher than they had been a decade earlier. Brazil has a comparative advantage in many agricultural products, and is the world's leading exporter of poultry, coffee, orange juice, sugar cane, and ethanol. It is the second largest exporter of soybeans, behind the US.

Brazil has accomplished all of this without the help of large government subsidies. State support accounted for 5.7 percent of total farm income in Brazil during 2005–07, compared to 12 percent in the US and 29 percent in the EU. The massive growth in agriculture was based on investments in agricultural research. Contemporary research has led to improvements of the soil, originally too acidic and low quality, together with advances in crop and livestock genetics. Genetically modified (GM) soybeans have led to increases in soybean production of 10.5 percent each year since 1990. Brazil produced 51 million metric tons of soybeans on 23 million hectares in 2005.

Brazilian farms are many times the size of those found in the US. Critics of the Brazilian agricultural growth have accused Brazil of destroying the Amazonian tropical rainforest to grow food. While some rainforest has been destroyed, most of the new farms are located in the cerrado, or savannah, which are grasslands located some distance from the Amazon. One limitation of Brazilian agriculture is transportation. The fields of Mato Grosso, in the center-west part of the country, are located a long distance from outdated port facilities. Improvements in both rail transport and ports will allow Brazil to become more competitive with US soybean exports, and provides an excellent example of comparative advantage.

Sources:
"Brazil's Agricultural Miracle: How to Feed the World." *The Economist*. August 26, 2010.
Cremaq, Piaui "Brazilian Agriculture: The Miracle of the Cerrado." *The Economist*. August 26, 2010.

Table 12.3 summarizes the exports and imports of five representative nations, selected to show the diversity of trade between nations. The United States (US) exports and imports a large amount of food, and imports a great deal of clothing. China has truly large exports of manufactured goods and clothing, whereas Brazil is a major net exporter of food. Switzerland imports clothing and other goods, and has a large net export of chemicals and pharmaceuticals. Niger has lower trade volumes, with imports greatly exceeding exports in all categories.

Table 12.4 shows the composition of agricultural trade for the same five nations. The US is a net exporter of grains, including wheat and rice, and meat. The US is a net importer of bananas, coffee, and sugar. Brazil has large net exports of coffee and meat, but imports

Table 12.3 Exports and imports of selected nations, 2010

	Exports (USD mil)					*Imports (USD mil)*				
	Brazil	*China*	*Niger*	*Switz*	*USA*	*Brazil*	*China*	*Niger*	*Switz*	*USA*
Food	60,836	44,168	95	7,311	112,345	8,373	59,540	402	10,212	97,347
Manufacturers	71,112	1,476,906	47	172,562	943,767	134,664	894,420	835	141,963	1,369,383
Chemicals	12,283	87,556	3	74,667	189,158	32,357	149,329	277	38,085	177,010
Machinery	33,491	781,265	15	40,867	522,001	71,996	550,004	326	47,253	728,143
Textiles	1,106	76,900	23	1,497	12,168	3,779	17,667	34	1,991	23,375
Clothing	188	129,838	1	1,366	4,694	1,356	2,513	7	5,285	81,942

Source: WTO Statistics Database. www.stat.wto.org/StatisticalProram

Table 12.4 Food exports and imports of selected nations, 2009

	Exports (USD mil)					*Imports (USD mil)*				
	Brazil	*China*	*Niger*	*Switz*	*USA*	*Brazil*	*China*	*Niger*	*Switz*	*USA*
Bananas	39	19	0	0	376	0	179	0	102	1,891
Cereals	1,636	720	11	6	17,558	1,971	2,302	64	268	2,304
Coffee	3,791	83	0	946	596	14	100	0	421	3,872
Dairy & Eggs	230	185	0	649	1,933	273	1,291	25	515	1,456
Meat	11,506	1,957	0	56	11,586	153	2,323	0	772	4,757
Rice	268	525	11	1	2,186	272	254	46	72	634
Sugar & Honey	8,634	925	8	132	1,165	42	789	29	281	3,271
Tobacco	3,046	904	8	667	1,697	67	1,354	40	368	1,614
Wheat & Flour	64	102	0	4	5,519	1,411	588	15	141	840

Source: FAOSTAT.

a large amount of wheat. China imports more cereals and dairy products than it exports. Niger has low trade volumes for all food categories. Switzerland is a net meat importer, and net tobacco exporter.

These trade volumes in all goods (Table 12.3) and in agricultural goods (Table 12.4) demonstrate that specialization and gains from trade can lead to large volumes of food and goods being produced in one place, and consumed in another location. Adam Smith argued, and now most economists agree, that this is perhaps the single most important ingredient to a high standard of living: specialization and gain from trade.

12.6 Summary

1. Absolute advantage is a situation where one nation has lower costs of production for a specific good or service.
2. Comparative advantage is the superior productive capacity of one nation or region or industry relative to others, based on opportunity cost.
3. Differences in comparative advantage or differences in the opportunity costs between individuals, firms, and nations allow for specialization and gains from trade.

12.7 Glossary

Absolute Advantage. Lower costs of production for a specific good or service.

Comparative Advantage. The superior productive capacity of one individual, or nation, or region, or industry, relative to all others, based on opportunity cost.

Import Quota. A trade restriction that sets a physical limit on the quantity of a good that can be imported during a given time period.

Opportunity Cost. The value of a resource in its next-best use. What an individual or firm must give up to do something.

Tariff. A tax on imports of a good.

Trade Barriers. Laws and regulations to restrict the flow of goods and services across international borders, including tariffs, duties, quotas, and import and export subsidies.

12.8 Review questions

1. The nation with the lowest cost of production has:
   a. a comparative advantage
   b. an absolute advantage
   c. an unfair advantage
   d. a competitive advantage
2. The nation with the lowest opportunity costs of producing a good has:
   a. a comparative advantage
   b. an absolute advantage
   c. an unfair advantage
   d. a competitive advantage
3. Trade will most likely take place between two nations that:
   a. are very different
   b. are much the same
   c. are in close proximity to each other
   d. have similar access to resources

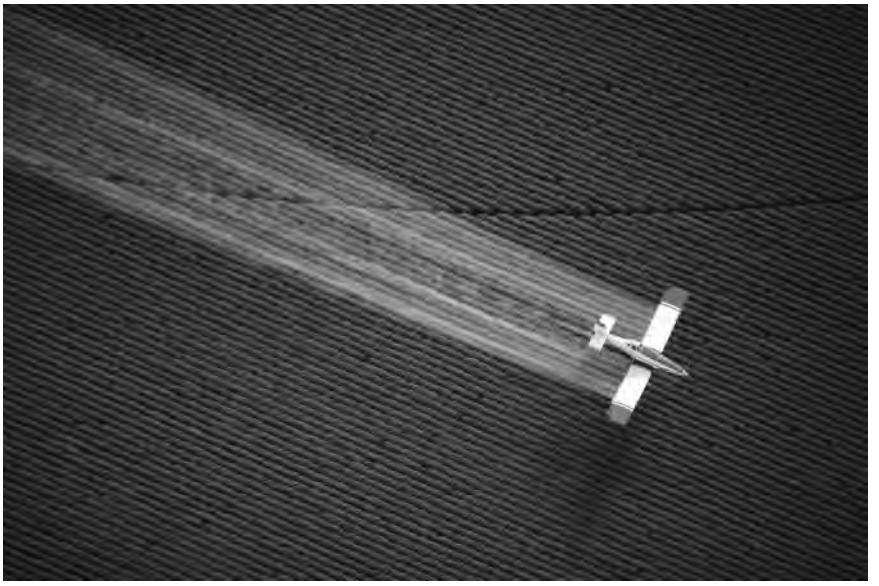

Plate 13.1 Economics, agriculture, and the environment.
Source: B Brown/Shutterstock

13 Economics, agriculture, and the environment

Synopsis

Natural resources and environmental quality are increasingly important. This is particularly true in agriculture, which is heavily dependent on land, agrochemicals, and water. This chapter explores how rational actors can overuse, or exploit, resources such as cropland, water from an underground aquifer, or grazing land. Externalities such as air and water pollution from agricultural production and processing can result in suboptimal outcomes for society. Possible solutions to the externality problem include bans, taxes, quantitative standards, and subsidies. Private bargaining can also lead to efficient outcomes, under certain circumstances.

13.0 Introduction

The impact of agricultural production and processing on the natural environment has become increasingly important over the past several decades. Modern agriculture is characterized by the increased use of inputs such as agrochemicals and fertilizer, which can influence both the environment and human health. As industrialization led to greater levels of air and water pollution, concern for the environment also grew. The desire for environmental quality is the outcome of the large increase in the level of living standards since about 1950. The populations of North America, Western Europe, Japan, Australia, and some other areas, have become wealthy enough to meet the basic needs for food, clothing, and housing. As these needs are met, additional increases in income can be used to achieve higher goals including clean air, clean water, and safe food. Given high levels of economic growth, these issues have taken on increasing importance, and a growing fraction of societal income is devoted to caring for the environment. As low-income nations grow and prosper, they too have become more interested in environmental goals. A clean environment, food safety, human health, and animal welfare are luxury goods, with Engel curves that increase at an increasing rate.

Quick Quiz 13.1

Define and explain the terms “luxury good” and “Engel curve” (Chapter 8). Explain why environmental goals are a “luxury good.”

The modern environmental movement began in 1962 with the publication of Rachel Carson's book, *Silent Spring*. Carson highlighted the potential problems associated with the use of chemical pesticides in agricultural production. The book received a large amount of attention, and was championed as well as heavily criticized. Carson notified the public of the potential dangers of DDT (dichloro-diphenyl-trichloroethane) and other chemicals used in agriculture, leading to a growing concern for the environment. This widely read book led to political action and legislation.

In 1968, Garrett Hardin, a professor of Human Ecology at the University of California–Santa Barbara, wrote, "The Tragedy of the Commons," an article published in *Science* magazine. Hardin illuminated the failure of market economies to solve a common situation of shared, or commonly owned, resources. Hardin's classic publication resulted in a greater understanding of and concern for environmental resources.

Earth Day gave impetus to the growing number of individuals and groups who supported and promoted environmental goals. Prompted by environmentalists, Senator Gaylord Nelson of Wisconsin led the effort to pass legislation for the creation of Earth Day, held on April 22, 1970. The initial efforts of Carson, Hardin, and Nelson led to the formation of the United States Environmental Protection Agency (USEPA), proposed by President Richard Nixon in 1970. Since that time the concern for the environment has grown, and the "green movement" seems likely to have an increasing impact on the agriculture and food industries.

Two major possibilities, the **Tragedy of the Commons**, and **Externalities**, lead to important and controversial issues in the area of agriculture and the environment. The "tragedy of the commons," occurs when a publicly owned resource is overused, or exploited, because no one person or institution has exclusive private rights to use the resource. An "externality" is a situation where the production or consumption of a good results in positive or negative impacts to individuals or groups external to the market.

13.1 The tragedy of the commons

In the American West, huge tracts of open land are owned by the federal government. Much of this land is dry grassland, best used for grazing sheep or cattle. Other parts of the land area throughout the West are privately owned. A Nevada rancher who owns her own grazing land will behave as a profit-maximizing firm that finds the optimal level of input, in this case land, as discussed in Chapter 4. The rancher will continue to add cattle to the land until the additional benefit (Marginal Revenue Product, MRP) is equal to the additional cost (Marginal Factor Cost, MFC).

Quick Quiz 13.2

Define the terms, "Marginal Revenue Product" and "Marginal Factor Cost." What are these two terms used for? (See Chapter 4.)

On the publicly owned land, however, a cattle rancher typically pays for a permit to graze cattle on a well-defined part of the range. To better understand the tragedy of the commons, and why the government charges these fees, consider the case when a cattle rancher does not bear any costs for grazing, at least not explicit, monetary costs. For now, assume that

grazing on public land (the "commons") is free and can be used simultaneously by many ranchers.

If all ranchers desire to use the public land for grazing, they will continue to add animals to the land until the additional benefit (MRP) is equal to the additional cost, in this case zero (MFC = 0), as seen in Figure 13.1. This can lead to the tragedy of the commons or, in this case, overgrazing, where the resource is depleted beyond beneficial use by ranching. In Figure 13.1, Q_0 acres of land would be used if there were no costs associated with land use, and Q* is the profit-maximizing, efficient rate of use. In the long run, Q_0 acres will result in depleted resource stocks, since the land would be overgrazed. Resource depletion would shift the MRP curve down and to the left over time, as overgrazed grass is not sustainable.

- ***Tragedy of the Commons*** = a situation in which a group of individuals, acting rationally and in their own self-interest, deplete a shared limited resource, resulting in destruction of the resource and a negative outcome for all parties.

The tragedy of the commons is most often described in terms of grazing and overgrazing publicly owned ranch land. However, the effect applies to all commonly owned or shared resources, including public parks and fishing streams. The outcome of the tragedy of the commons seems irrational. After all, the story of the tragedy of the commons asserts that rational, profit-maximizing individuals will use a resource beyond its optimal, sustainable use. The reason is that there are no costs (or very low costs) associated with using the land, so ranchers continue to use the land past the point of sustainability, to exploitation, or overuse. This outcome is typical of public land use for grazing animals, hunting, fishing, and camping. Use of water from an underground aquifer, and deforestation can also result in a similar kind of tragedy.

There are several possible solutions to a tragedy of this kind. The land can be privatized (sold) to individuals for private use. Use can be regulated and held at lower levels of use, or the government can charge the users (for example, cattle owners) a fee for the use of the resource (in this case, grazing land). If a permit is sold for the right to use the resource, the rate of use can be brought back in line with a sustainable rate of resource use (Q*), as in Figure 13.1. The user fee (t) could be set equal to MFC, which would result in the optimal, sustainable level of resource use, Q*. This analysis explains why the federal government uses permits and user fees for cattle grazing on public lands in the American West.

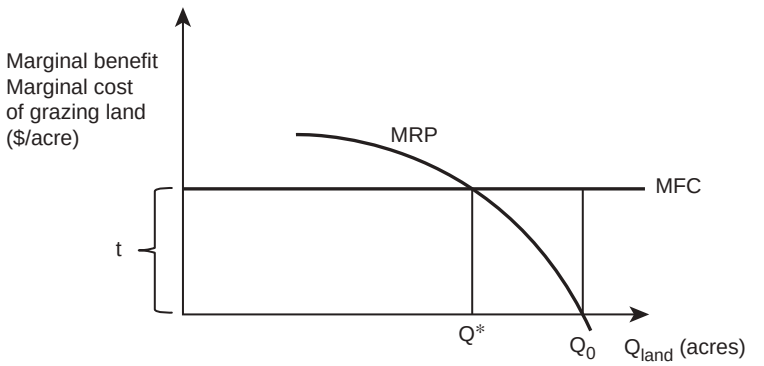

Figure 13.1 The tragedy of the commons: cattle grazing on public land.

Without these fees, the land would be overgrazed. Figure 13.1 shows this and reflects the tax placed on Atrazine in the example from Chapter 4.

13.2 Externality

Both buyer and seller benefit in a market transaction. Otherwise, the trade would not take place. The buyers consider the good to have value greater than the price, and the seller believes that the price is greater than the value of the good, resulting in a mutually beneficial exchange. Sometimes, the production and sale of a good affect a third party. A farm that uses fertilizer and chemicals to maximize crop yields may create multiple effects on many people. If the fertilizer and chemicals seep into the water supply, the chemicals could affect the health and happiness of someone living downstream. Similarly, a feedlot of cattle could result in offensive odors and a polluted water supply. When this happens, a downstream third party is said to be subject to an **Externality** or an economic loss suffered by someone who had no voice in the market transaction. Externalities can also be positive, such as the smell of chocolate from a candy store, or a view of farmland.

- ***Externality*** = a consequence of an economic activity that affects unrelated third parties. The externality can be either positive or negative. Thus, an externality is a transaction spillover that creates a cost or a benefit not transmitted through market prices.

The economic analysis of an externality is similar to that of the tragedy of the commons. The key to both situations is the costs that are not included in the market decisions or transactions. Figure 13.2 shows that producers consider their private costs of producing a good ($MC_{private}$), but not the additional, public costs of an externality like water pollution ($MC^* = MC_{private}$ + external costs). If the negative externality is not included in the production and consumption decisions, the privately produced quantity ($Q_{private}$) will result in price $P_{private}$.

This level ($Q_{private}$) is considered to be "too high" relative to society's best interests, which include both the private and external (public) costs of producing corn. When the external costs are taken into account, or "internalized," the equilibrium quantity decreases to Q*, and

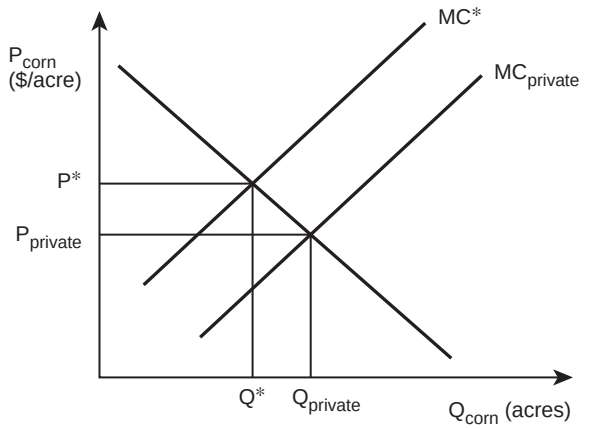

Figure 13.2 Externality: chemical runoff in corn production.

the price of corn increases to P*. The equilibrium that incorporates the externality is considered to be "optimal" for society, since it includes the costs of the negative externality (in this case water pollution). In agriculture, negative externalities occur in chemical runoff from fields, animal waste, odor, noise, soil conservation, climate change, endangered species, deforestation, and water use for irrigating crops.

- ***Negative Externality*** = a situation where the market price does not include the full cost of producing or consuming a good or service.

A negative externality occurs when a firm emits pollutants into the air or water and creates a cost not captured in the firm's costs of production. Positive externalities also occur in agriculture when tourists or travelers receive pleasure, or benefits, from viewing agricultural fields and activities. Since the travelers pay no cost for the view, private costs are larger than the societal costs and no monetary benefits include the value of the externality. The societal MC curve is to the right of the private MC curve, and the optimal equilibrium quantity would be larger than $Q_{private}$, indicating a larger level of corn production than would occur if no positive externality were present. Another classic example of a positive externality is the increased productivity of a fruit orchard that arises from a colony of bees that pollinate the fruit. The bees cost nothing but bring significant increases in production.

- ***Positive Externality*** = a situation where the market price does not include the full benefit of producing or consuming a good or service.

An example of a positive externality is how home maintenance will affect the property value of the neighboring homes. Similarly, a nation that desires high levels of food security could value higher levels of domestic food production than would occur from market forces alone. In this case, consumers and taxpayers might be willing to subsidize food production in order to provide stronger probabilities of having enough food in an emergency or war. The positive externality argument is often used to justify continued levels of government subsidies to agricultural producers in the United States.

Quick Quiz 13.3

Is living on a farm in a remote rural area a positive externality? How about living in New York City? Explain carefully.

The externality can be "internalized," or included in the market equilibrium via three mechanisms: (1) a tax, (2) government regulation such as a quantitative restriction, or (3) private bargaining between affected parties. First, consider the tax. A tax used to internalize an externality is called a **Pigouvian Tax**, named for British economist Alfred Pigou, who studied the possibility of using such taxes as early as 1932. If a tax set equal to the cost of a negative externality is levied on the person or firm that creates the externality, the socially optimal equilibrium will result. This solution justifies taxes on goods that may be considered "overconsumed" compared to socially optimal levels: agrochemicals such as pesticides and herbicides, grazing cattle, fertilizer, or water use from an aquifer.

If these goods are used at greater levels than optimal, a Pigouvian tax can lower the use back to the economically optimal level.

- ***Pigouvian Tax*** = a tax levied on firms that pollute the environment or create other negative externalities due to production of goods and services.

Imposition of a tax has limitations. It may be difficult to measure the level of externality, or to know the appropriate tax level to charge to achieve a desired outcome. Perhaps the biggest drawback to Pigouvian taxes is the measurement issue associated with externalities, including: (1) physical measurement of the externality source, such as the presence of a pollutant, which differs across time and space, (2) economic damage caused by the externality, which can be highly variable, and (3) societal preferences for nonmarket goods such as clean air, clean water, or human health. The measurement problem makes policy decisions related to resources and the environment challenging. To complicate the decision further, most environmental policies are interconnected, and have unanticipated consequences on other environmental goals and resources. However, policies are needed, even if inexact, due to the potentially large negative consequences of externalities in agricultural production: soil erosion, water quality, future water availability, and human health.

Regulation is a second option for dealing with externality problems. If the government or other authority could set a quantitative limit equal to Q* in Figure 13.2, the socially desirable level of output could be reached, and the externality effectively internalized. This strategy also faces difficulties in measurement, and can be more difficult to enforce due to measurement and enforcement issues.

13.3 Private bargaining: Coase

A third solution was suggested by Nobel-prize winning economist Ronald Coase in 1960. Coase suggested that there may be no need for government intervention to internalize the externality. Instead, Coase suggested that the affected parties could voluntarily negotiate a solution. The party that is negatively affected has an incentive to bargain with the party creating the externality. If a business firm or household downstream from a corn field is harmed by chemical runoff, the affected party could offer a payment to the corn farmer to reduce chemical use. The affected party is willing to pay up to the total cost of the externality, and the externality producer will accept a payment as long as it is greater than the economic benefit gained from chemical use.

- ***Coasian Bargaining*** = when an externality impacts a third party, the affected parties have an incentive to bargain with each other to reach an efficient outcome.

Coasian bargaining between affected parties is a popular solution among economists, since each party is allowed to voluntarily bargain until the optimal solution is reached. Suppose that a cotton producer (denoted by i) uses chemicals to control pests, including both pesticides to kill insects (boll weevils) and herbicides to control weeds. These chemicals provide increased productivity to the cotton producer in the form of increased cotton yields per acre, but their use imposes costs on a nearby horticultural nursery (j), which grows plants, shrubs, and trees for sale to suburban homeowners. The benefits to the cotton producer are the marginal revenue product (MRP_i) introduced in Chapter 4, and shown in Figure 13.3. Agrochemical use in cotton production is subject to diminishing returns: the

first gallon of chemical applied is the most productive (most effective at killing weeds), and each successive gallon of chemical applied provides lower additional revenue. At Q_0 gallons, all of the productivity (and therefore monetary) gains are exhausted. So far, the story is identical to the profit-maximizing solutions explored in Chapter 4.

Now consider the addition of the second party (j). The horticultural producer adjacent to the cotton fields makes this story an interesting and real-world resource issue. Chemical "drift" occurs when the herbicides are applied. In this case, the unintentional herbicide drift damages the flowers, shrubs, and trees that are the source of revenue to the nursery. As chemical use is increased, the damage to the horticultural crops is assumed to increase at an increasing rate: higher levels of herbicide result in larger plant damage to the nursery plants. This is captured by the MC_j curve for the horticultural producer j in Figure 13.3.

The externality occurs because the cotton producer desires to use Q_0 gallons of herbicide to maximize profits, whereas the nursery owner desires zero gallons of chemical use. The outcome will depend on who has the legal rights to use the chemical. If the cotton producer owns the right to apply chemicals, Q_0 will result, whereas if the nursery has the legal right to limit pesticides, zero chemical use will result. Coase suggested that if the costs of negotiation are low, then the optimal use of chemicals will result, regardless of which party owns the property rights. This claim is often difficult to believe, but the analysis presented below shows how private bargaining results in the optimal outcome (Q*) in either case. The optimal outcome is "best" since it considers all benefits and costs to all affected parties. The Coasian solution internalizes the externality, without the use of government intervention in the form of a tax, subsidy, or quantitative restriction.

Suppose that the cotton producer owns the right to use chemicals, and applies Q_0 gallons of herbicide. This will cost the nursery BCD dollars, since the total costs of damage are equal to the additional costs (MC_j) times the quantity used (Q), or the area under the MC curve. To reduce the quantity of chemical used to Q*, the nursery would be willing to pay any amount up to CD dollars (the total value of economic damage from using $Q_0 - Q^*$ gallons of chemical), and the cotton producer would be willing to accept any payment above C dollars (the economic gains from using $Q_0 - Q^*$ gallons of chemical). At Q*, the nursery owner's willingness to pay (MC_j) is equal to the cotton producer's willingness to accept the payment to reduce chemical use (MRP_i). Thus, the equilibrium quantity of chemical applied to the cotton is Q*.

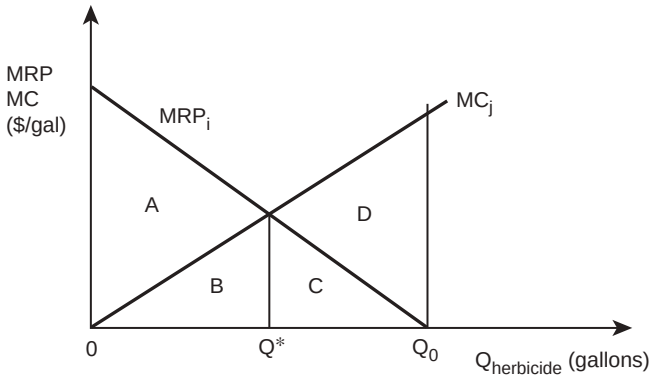

Figure 13.3 Coasian solution: herbicide drift in cotton production.

Plate 13.2 Agricultural chemical application.
Source: Federico Rostangno/Shutterstock

If the nursery owns the right to chemical use, and can legally halt all chemical use by the cotton producer, the initial value of chemical use will be zero. However, if the cotton producer can negotiate with the nursery owner, she will be willing to pay up to AB dollars (the economic benefit of chemical use for Q* gallons), and the nursery owner will accept any dollar amount above B dollars (the amount of economic damage caused by Q* gallons of chemical use). In this case, the equilibrium quantity of chemical use is also Q* gallons. This is truly an unexpected result: private bargaining will result in the optimal use of chemical (Q*), regardless of who owns the right to use or prevent the use of the chemical.

Coase's contribution suggests that in many externality cases, there is no need for government regulation or market intervention. In particular, if the costs of negotiating are low, the best solution to many externality problems may be to let the affected parties negotiate a solution. According to the analysis described here, this will result in the socially optimal level of resource use. It is important to note that the optimal level of chemical use is greater than zero, a result that many dedicated environmentalists will not accept. Some individuals and groups call for zero use of agrochemicals, fertilizer, and other agricultural inputs that can have environmental consequences. This position ignores the societal benefits from more efficient food production, resulting in lower food and fiber costs.

Negotiation is often expensive enough to eliminate the possibility of a Coasian bargaining solution. In agricultural resource issues, the costs of negotiation are often high, due to the large number of affected parties and accurate measures of benefits and costs. If many individuals are negatively affected by use of agricultural chemicals and fertilizer, they may not be able to negotiate effectively with a group of agricultural producers. Getting all of the affected parties to work together could increase the costs associated with this type of negotiation. In such cases, there may be a role for government regulation of resources used in agriculture or a government-assigned negotiator to assist in the process. In reality, agriculture is

heavily regulated by the government: input bans, quantitative restrictions, taxes, and subsidies are pervasive in agriculture. This type of regulation reflects the high costs of developing and enforcing agreements between affecting and affected parties. Similarly, it should be emphasized that government regulation is not costless, and these costs are often overlooked in policy analysis.

The agricultural sector relies more heavily on land, pesticides, and water than other sectors of the economy. As such, the application of economic principles to resource use in agriculture is timely, important, and interesting. As society develops, and the basic needs for food, clothing, and housing are met, the general population will increasingly demand higher environmental quality, higher levels of human health, and greater food safety. Although this chapter has merely introduced the economics of resources and the environment, society can expect to see an increasing fraction of its wealth devoted to higher quality food, resources, and environmental goals.

13.4 Summary

1. As nations grow wealthier, more income will be spent on the achievement of higher goals including clear air, clean water, and food safety.
2. A tragedy of the commons can result when a group of individuals, acting rationally and in their own self-interest, deplete a limited resource, resulting in a bad outcome for all parties.
3. The production and sale of a good can result in an externality that positively or negatively affects third parties. Externalities reflect a spillover of a transaction that is not incorporated into the market price.
4. If agricultural production results in external or public costs, such as air pollution, water pollution, deforestation, or global warming, then the market-based level of agricultural output could exceed the socially optimal level.
5. One solution to an externality is a Pigouvian tax, equal to the public costs of the activity. The socially optimal level of output results if the tax is set equal to the public costs.
6. Coasian bargaining provides a potential solution to an externality, when the affected party and the individual or firm creating the externality bargain until a solution is reached. This form of voluntary bargaining can result in the socially optimal level of resource use if negotiation costs are low.

13.5 Glossary

Coasian Bargaining. When an externality impacts a third party, the affected parties have an incentive to bargain with each other to reach an efficient outcome.

Externality. A consequence of an economic activity that affects unrelated third parties. The externality can be either positive or negative. Thus, an externality is a transaction spillover that creates a cost or a benefit not transmitted through market prices.

Negative Externality. A situation where the market price does not include the full cost of producing or consuming a good or service.

Pigouvian Tax. A tax levied on firms that pollute the environment or create other negative externalities due to production of goods and services.

Positive Externality. A situation where the market price does not include the full benefit of producing or consuming a good or service.

Tragedy of the Commons. A situation in which a group of individuals, acting rationally and in their own self-interest, deplete a shared limited resource, resulting in destruction of the resource and a negative outcome for all parties.

13.6 Review questions

1. As societal incomes grow, we expect that the largest increase in spending will be on:
   a. food
   b. housing
   c. health and environment
   d. clothing
2. A tragedy of the commons results when:
   a. individuals are irrational
   b. the costs of using a resource are not charged to the user
   c. transactions costs are high
   d. property rights are well specified and assigned
3. A Pigouvian tax resolves an externality if it is set equal to:
   a. the cost of enforcing a quantitative restriction
   b. marginal private costs of the activity
   c. marginal social costs of the activity
   d. transactions costs
4. Coasian bargaining does not work well when there are:
   a. high transactions costs
   b. low transactions costs
   c. property rights assigned to the affected party
   d. property rights assigned to the creator of the externality
5. Agriculture in high-income nations such as the US and EU is:
   a. mostly subject to Coasian bargaining
   b. subject to the Law of Nature, but not the Law of Government Regulation
   c. heavily regulated
   d. not a generator of externalities

Glossary

Absolute Advantage. Lower costs of production for a specific good or service.

Absolute Price. A price in isolation, without reference to other prices. Example: The price of wheat is $3/bushel (see **Relative Price**).

Accounting Costs. Explicit costs of production; costs for which payments are required.

Accounting Profits [π_A]. Total revenue minus explicit costs. $\pi_A = TR - TC_A$ (see **Economic Profits**).

Agricultural Economics. Economics applied to agriculture and rural areas.

Agriculture. The science, art, and business of cultivating the soil, producing crops, and raising livestock useful to humans. Farming.

Arc Elasticity. A formula that measures responsiveness along a specific section (arc) of a supply or demand curve, and measures the "average" price elasticity between two points on the curve.

Average Costs [AC]. Total costs per unit of output. AC = TC/Y. Note that **Average Costs** (AC) are identical to **Average Total Costs** (ATC).

Average Fixed Costs [AFC]. The average cost of the fixed costs per unit of output. AFC = TFC/Y.

Average Physical Product [APP]. The average productivity of each unit of variable input used [= Y/X].

Average Revenue [AR]. The average dollar amount received per unit of output sold. AR = TR/Y.

Average Revenue Product [ARP]. The average value of output per unit of input at each input use level. ARP = APP*P_Y.

Average Total Costs [ATC]. The average total cost per unit of output. ATC = TC/Y. Note that **Average Costs** (AC) are identical to **Average Total Costs** (ATC).

Average Variable Costs [AVC]. The average cost of the variable costs per unit of output. AVC = TVC/Y.

Barriers to Entry and Exit. Legal or economic barriers that hinder or prevent a new firm from entering or exiting an industry.

Break-Even Point. The point on a graph that shows that total revenue (TR) is equal to total cost (TC).

Budget Constraint. A limit on consumption determined by the size of the budget and the prices of goods.

Budget Line. A line indicating all possible combinations of two goods that can be purchased using the consumer's entire budget.

Capital. Physical capital: machinery, buildings, tools, and equipment.

Cardinal Utility. Assigns specific, but hypothetical, numerical values to the level of satisfaction gained from the consumption of a good. The unit of measurement is the hypothetical util (see **Ordinal Utility**).

Cartel. A group of independent firms that join together to regulate price and production decisions.

Ceteris Paribus. Latin for "holding all else constant." An assumption used to simplify the real world.

Change in Demand. When a change in the quantity of a good purchased is a result of a change in an economic variable other than the price of the good. A shift in the demand curve.

Change in Quantity Demanded. When a change in the quantity of a good purchased is a result of a change in the price of the good. A movement along the demand curve.

Change in Quantity Supplied. A change in the quantity of a good placed on the market due to a change in the price of the good. A movement along the supply curve.

Change in Supply. A change in the quantity of a good produced due to a change in one or more economic variables other than the price of the good. A shift in the supply curve.

Coasian Bargaining. When an externality impacts a third party, the affected parties have an incentive to bargain with each other to reach an efficient outcome.

Collusion. When the firms in an industry jointly determine the price of the good.

Command Economy. A form of economic organization where resources are allocated by whoever is in charge, such as a dictator or an elected group of officials (see **Market Economy** and **Mixed Economy**).

Comparative Advantage. The superior productive capacity of one individual, or nation, or region, or industry, relative to all others, based on opportunity cost.

Comparative Statics. A comparison of market equilibrium points before and after a change in an economic variable.

Complements in Consumption. Goods that are consumed together (e.g., peanut butter and jelly, see **Substitutes in Consumption**).

Complements in Production. Goods that are produced together using the same collection of inputs (e.g., beef and leather, see **Substitutes in Production**).

Constant Returns. When each additional unit of input added to the production process yields a constant level of output relative to the previous unit of input. Output increases at a constant rate.

Consumer. An individual or household that purchases a good or a service.

Costs of Production. The payments that a firm must make to purchase inputs (resources, factors).

Cross-Price Elasticity of Demand. A measure of the responsiveness of the quantity demanded of a good to changes in the price of a related good.

Cross-Price Elasticity of Supply. A measure of the responsiveness of the quantity supplied of a good to changes in the price of a related good.

Decreasing Returns. When each additional unit of input added to the production process yields less additional output relative to the previous unit of input. Output increases at a decreasing rate.

Demand. Consumer willingness and ability to pay for a good.

Demand Curve. A function connecting all combinations of prices and quantities consumed for a good, *ceteris paribus*.

Demand Schedule. Information on prices and quantities purchased.

Disequilibrium. A market situation in which the market price does not equalize supply and demand.

Economic Good. A good that is Scarce (see **Noneconomic Good**).

Economic Profits [π_E]. Total revenue minus both explicit and opportunity costs. $\pi_E = TR - TC_A$ – opportunity costs (see **Accounting Profits**).

Economics. The study of the allocation of scarce resources among competing ends.

Economies of Scale. When the per-unit costs of production decrease as output increases.

Efficiency. A characteristic of competitive markets, indicating that goods and services are produced at the lowest possible cost and consumers pay the lowest possible prices.

Elastic Demand. A change in price brings about a relatively larger change in quantity demanded.

Elastic Supply. A change in price brings about a relatively larger change in quantity supplied.

Elasticity. The percentage change in one economic variable resulting from a percentage change in another economic variable.

Elasticity of Demand. The percentage change in the quantity demanded in response to a percentage change in price.

Elasticity of Supply. The percentage change in the quantity supplied in response to a percentage increase in price.

Engel Curve. The relationship between income and quantity demanded, *ceteris paribus*.

Engel's Law. As income increases, the proportion of income spent on food declines, *ceteris paribus*.

Equilibrium. A point from which there is no tendency to change.

Equilibrium Price. The price at which the quantity supplied equals the quantity demanded.

Equilibrium Quantity. The point where quantity supplied is equal to quantity demanded.

Externality. A consequence of an economic activity that affects unrelated third parties. The externality can be either positive or negative. Thus, an externality is a transaction spillover that creates a cost or a benefit not transmitted through market prices.

Fixed Costs. Those costs that do not vary with the level of output; the costs associated with the fixed factors of production.

Fixed Input. An input whose quantity does not vary with the level of output.

Free Trade Agreement. Agreements between nations to reduce or eliminate **Trade Barriers**.

Good. An **Economic Good**.

Homogeneous Product. A product that is the same no matter which producer produces it. The producer of a good cannot be identified by the consumer.

Immediate Run [IR]. A period of time in which all inputs are fixed.

Imperfect Substitutes. Inputs that are incomplete substitutes for each other in the production process.

Import Quota. A trade restriction that sets a physical limit on the quantity of a good that can be imported during a given time period.

Income Elasticity of Demand. The percentage change in the demand for a good in response to a 1 percent change in income.

Increasing Returns. When each additional unit of input added to the production process yields an increasing level of output relative to the previous unit of input. Output increases at an increasing rate.

Indifference Curve. A line showing all possible combinations of two goods that provide the same level of utility (satisfaction).

Industry. A group of firms that all produce and sell the same product.

Inelastic Demand. A change in price brings about a relatively smaller change in quantity demanded.

Inelastic Supply. A change in price brings about a relatively smaller change in quantity supplied.

Inferior Good. A good whose consumption declines in response to an increase in income.

Inverse Demand Function. A demand function that is represented with price (the independent variable) as a function of quantity demanded (the dependent variable): $P = f(Q^d)$.

Inverse Supply Function. A supply function that is represented with price (the independent variable) as a function of quantity supplied (the dependent variable): $P = f(Q^s)$.

Isocost Line. A line indicating all combinations of two variable inputs that can be purchased for a given, or same, level of expenditure.

Isoquant. A line indicating all combinations of two variable inputs that will produce a given level of output.

Isorevenue Line. A line showing all combinations of two outputs that will generate a constant level of total revenue.

Law of Demand. The quantity of a good demanded varies inversely with the price of the good, *ceteris paribus*.

Law of Diminishing Marginal Returns. As additional units of one input are combined with a fixed amount of other inputs, a point is always reached at which the additional output produced from the last unit of added input will decline.

Law of Diminishing Marginal Utility. Marginal utility declines as more of a good or service is consumed during a given time period.

Law of Supply. The quantity of goods offered to a market varies directly with the price of the good, *ceteris paribus*.

Long Run [LR]. A time span during which no inputs are fixed; all inputs are variable.

Luxury Good. A good whose consumption increases at an increasing rate in response to an increase in income.

Macroeconomics. The study of economy-wide activities such as economic growth, business fluctuations, inflation, unemployment, recession, depression, and booms (see **Microeconomics**).

Marginal Analysis. Comparing the benefits and costs of a decision incrementally, one unit at a time.

Marginal Cost [MC]. The increase in total costs due to the production of one more unit of output. $MC = \Delta TC/\Delta Y$.

Marginal Factor Cost [MFC]. The cost of an additional (marginal) unit of input; the amount added to total cost of using one more unit of input. $MFC = \Delta TC/\Delta X$.

Marginal Physical Product [MPP]. The additional amount of total physical product obtained from using an additional, or marginal, unit of variable input [$= \Delta Y/\Delta X$].

Marginal Rate of Product Substitution [MRPS]. The rate at which one output must decrease as production of another output is increased. The slope of the production possibilities frontier (PPF) defines the MRPS. $MRPS = \Delta Y_2/\Delta Y_1$.

Marginal Rate of Substitution [MRS]. The rate of exchange of one good for another that leaves utility unchanged. The slope of an indifference curve. $MRS = \Delta Y_2/\Delta Y_1$.

Marginal Rate of Technical Substitution [MRTS]. The rate at which one input can be decreased as the use of another input increases to take its place. The slope of the isoquant. $MRTS = \Delta X_2/\Delta X_1$.

Marginal Revenue [MR]. The addition to total revenue from selling one more unit of output. $MR = \Delta TR/\Delta Y$.

Marginal Revenue Product [MRP]. The additional (marginal) value of output obtained from each additional (marginal) unit of the variable input. $MRP = MPP*P_Y$.

Marginal Utility [MU]. The change in the level of utility when consumption of a good is increased by one unit. $MU = \Delta TU/\Delta Y$.

Market. The interaction between buyers and sellers.

Market Demand Curve. The relationship between the price and quantity demanded of a good, *ceteris paribus*, derived by the horizontal summation of all individual consumer demand curves for all individuals in the market.

Market Economy. A form of economic organization in which resources are allocated by prices. Resources flow to the highest returns in a free market system (see **Command Economy** and **Mixed Economy**).

Market Equilibrium. The point where the quantity supplied by producers at a given price is equal to the quantity demanded by consumers at that same price.

Market Power. The ability to affect the price of output. A firm with market power faces a downward-sloping demand curve.

Market Price. The price where quantity demanded is equal to quantity supplied.

Market Structure. The organization of an industry, typically defined by the number of firms in an industry.

Market Supply Curve. The relationship between the price and quantity supplied of a good, *ceteris paribus*, derived by the horizontal summation of all individual supply curves for all individual producers in the market.

Marketplace. A physical location where buyers and sellers meet to trade goods.

Microeconomics. The study of the behavior of individual decision-making units such as individuals, households, and firms (see **Macroeconomics**).

Mixed Economy. A form of economic organization that has elements of both a **Market Economy** and a **Command Economy**.

Monopolistic Competition. A market structure defined by: (1) many sellers, (2) a product with close, but differentiated, substitutes, (3) some freedom of entry and exit, and (4) some availability of knowledge and information.

Monopoly. A market structure characterized by a single seller. The firm is the industry.

Natural Monopoly. A situation where a single firm has large fixed costs, making it most efficient (lowest cost) for production to be concentrated in a single firm.

Necessity Good. A good whose consumption increases at a decreasing rate in response to an increase in income.

Negative Externality. A situation where the market price does not include the full cost of producing or consuming a good or service.

Negative Returns. When each additional unit of input added to the production process results in lower total output relative to the previous unit of input. Output decreases.

Noneconomic Good. A good that is not scarce; there is as much of this good to meet any demand for it. A free good (see **Economic Good**).

Nonprice Competition. A market situation where firms compete over good characteristics other than price, such as quality, quantity, services, color, taste, etc.

Normal Good. A good whose consumption increases in response to an increase in income.

Normative Economics. Based on statements that contain opinions and/or value judgments. A normative statement contains a judgment about "what ought to be" or "what should be" (see **Positive Economics**).

Oligopoly. A market structure characterized by a few large firms.

Opportunity Costs. The value of a resource in its next-best use. What an individual or firm must give up to do something.

Opportunity Set. The collection of all combinations of goods within the budget constraint of the consumer.

Ordinal Utility. A way of considering consumer satisfaction in which goods are ranked in order of preference: first, second, third, etc. (see **Cardinal Utility**).

Own-Price Elasticity of Demand. The percentage change in the quantity demanded in response to a percentage change in price.

Own-Price Elasticity of Supply. Measures the responsiveness of the quantity supplied of a good to changes in the price of that good.

Perfect Competition. A market or industry with four characteristics: (1) a large number of buyers and sellers, (2) a homogeneous product, (3) freedom of entry and exit, and (4) perfect information.

Perfect Complements. Goods that are produced together using the same collection of resources (beef and hides) or inputs that must be used together in a fixed ratio (one tractor and one plow) (see **Complements**).

Perfect Information. A situation where all buyers and sellers in a market have complete access to technological information and all input and output prices.

Perfect Substitutes. Inputs that are completely substitutable in the production process. (see **Substitutes**).

Pigouvian Tax. A tax levied on firms that pollute the environment or create other negative externalities due to production of goods and services.

Positive Economics. Based on factual statements. Such statements contain no value judgments. Positive statements describe "what is" (see **Normative Economics**).

Positive Externality. A situation where the market price does not include the full benefit of producing or consuming a good or service.

Price Ceiling. A maximum price set by the government for a specified good or service.

Price Maker. A firm characterized by market power, or the ability to influence the price of output. A firm facing a downward-sloping demand curve.

Price Support. A minimum price set by the government for a specified good or service.

Price Taker. A firm so small relative to the industry that the price of output is fixed and given, no matter how large or how small the quantity of output it sells.

Producer. An individual or firm that produces (makes; manufactures) a good or provides a service.

Production Function. The physical relationship between inputs and outputs.

Production Possibilities Frontier [PPF]. A curve depicting all possible combinations of two outputs that can be produced using a constant level of inputs.

Profits [π]. Total revenue minus total costs: $\pi = TR - TC$. The value of production sold minus the cost of producing that output.

Rational Behavior. Individuals do the best that they can, given the constraints they face. Rational behavior is purposeful and consistent.

Relative Prices. The prices of goods relative to each other. Example: The price of wheat increased relative to the price of corn (see **Absolute Price**).

Resources. Inputs provided by nature and modified by humans who use technology to produce goods and services that satisfy human wants and desires. Also called **Inputs**, **Factors of Production**, or **Factors**. Resources include **Capital** (K), **Labor** (L), **Land** (A), and **Management** (M).

Scarcity. Because resources are limited, the goods and services produced from using those resources are also limited, which means consumers must make choices, or tradeoffs among different goods.

Service. A type of economic good that is not physical. For example, a haircut or a phone call is a service, whereas a car or a shirt is a good.

Short Run [SR]. A time span during which some factors are variable and some factors are fixed.

Shortage. A market situation in which consumers are willing and able to purchase more of a good than producers are willing to supply at a given price ($Q^s < Q^d$).

Shutdown Point. The point on a graph where marginal revenue (MR) is equal to average variable costs (AVC).

Social Science. The study of society and of individual relationships in and to society, generally regarded as including sociology, psychology, anthropology, economics, political science, and history.

Substitutes in Consumption. Goods that are consumed on an "either/or" basis (e.g., wheat bread and white bread, see **Complements in Consumption**).

Substitutes in Production. Goods that compete for the same resources in the production (wheat and barley, see **Complements in Production**), or inputs that can replace each other in the production process (land and fertilizer).

Supply. The relationship between the price of a good and the amount of a good available at a given location and at a given time.

Supply Curve for an Individual Firm. The firm's marginal cost curve above the minimum point on the average variable cost curve.

Supply Schedule. A schedule showing the relationship between the price of a good and the quantity of a good supplied.

Surplus. A market situation in which producers are willing to supply more of a good than consumers are willing to purchase at a given price ($Q^s > Q^d$).

Tariff. A tax on imports of a good.

Technological Change. Change that allows the same level of inputs to produce a greater level of output. Alternatively, technological change allows production of the same level of output with a smaller number of inputs.

Total Costs [TC]. The sum of all payments that a firm must make to purchase the factors of production. The sum of **Total Fixed Costs** and **Total Variable Costs**. TC = TFC + TVC.

Total Factor Cost [TFC]. The total cost of a factor, or input. $TFC = P_X*X$.

Total Fixed Costs [TFC]. The total costs of inputs that do not vary with the level of output.

Total Physical Product [TPP]. The relationship between output and one variable input, holding all other inputs constant.

Total Revenue [TR]. The amount of money received when the producer sells the product. $TR = P_Y*Y$.

Total Revenue Product [TRP]. The dollar value of the output produced at a given level of variable inputs. $TRP = TPP* P_Y$.

Total Utility [TU]. The total level of satisfaction derived from consuming a given bundle of goods and services.

Total Variable Costs [TVC]. The total costs of inputs that vary with the level of output.

Trade Barriers. Laws and regulations to restrict the flow of goods and services across international borders, including tariffs, duties, quotas, and import and export subsidies.

Tragedy of the Commons. A situation in which a group of individuals, acting rationally and in their own self-interest, deplete a shared limited resource, resulting in destruction of the resource and a negative outcome for all parties.

Unitary Elastic Demand. The percentage change in price brings about an equal percentage change in quantity demanded.

Unitary Elastic Supply. The percentage change in price brings about an equal percentage change in quantity supplied.

Utility. Satisfaction derived from consuming a good.

Utils. Hypothetical units of satisfaction derived from consumption of goods or services.

Variable Costs. Those costs that vary with the level of output; the costs associated with the variable factors of production.

Variable Input. A variable input is one that when changed, affects the level of output.

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